Estat immunitari enfront de les malaties immunoprevenibles dels treballadors sanitaris a Catalunya

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UNIVERSITAT DE BARCELONA

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Tesi presentada per

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Per obtenir el títol de doctor per la Universitat de Barcelona

Dirigida per:

Àngela Domínguez García

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A Susi

Índex

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Aquesta tesi doctoral és fruit del projecte d'investigació "Estudi sobre la situació immunitària dels treballadors sanitaris a Catalunya", treball que va ser promogut per la Direcció General de Salut Pública del Departament de Salut (Generalitat de Catalunya), amb el suport del CIBER d'Epidemiologia i Salut Pública (CIBERESP) i AGAUR (expedient número 2009 SGR 42).

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En primer lloc el meu agraïment és per a la meva directora de tesi, Àngela Domínguez, perquè la seva motivació va fer possible que em decidís a fer-la malgrat trobar-me al tram final de la meva carrera professional. També per tot el que he après treballant amb ella, juntament amb els altres investigadors del projecte: José María Bayas, Eva Borràs, Sonia Broner, Magda Campins, Josep Costa i María Esteve, amb els quals vàrem constituir el grup de redacció per transformar en articles científics les tasques i els resultats de l'Estudi sobre la situació immunitària dels treballadors sanitaris a Catalunya, i als quals agreixo la seva inestimable col·laboració.

A la resta del Grup de treball de l'estudi de l'estat immunitari del treballadors sanitaris de Catalunya, ja que sense la seva participació no hagués estat possible desenvolupar l'estudi.

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Moltes gràcies a tots!

Glossari

Anticossos antiHBs: Anticossos específics contra l'antigen de superfície del virus de l'hepatitis B

ASPCat: Agència de Salut Pública de Catalunya

CDC: "Centers for Disease Control and Prevention" dels Estats Units

DTP: Vacuna contra la diftèria, el tètanus i la tos ferina de cèl·lules completes

dTpa: Vacuna contra la diftèria, el tètanus i la tos ferina de component acel·lular i baixa càrrega antigènica

eCAP: Història clínica electrònica d'atenció primària de l'ICS

ICS: Institut Català de la Salut

HC3: Història clínica compartida a Catalunya

Preven: Història clínica laboral electrònica dels serveis dels prevenció de riscos laborals de l'ICS

Td: Toxoides tetànic i diftèric de baixa càrrega antigènica

TV: Vacuna triple vírica contra el xarampió, la rubèola i la parotiditis

VHB: Virus de l'hepatitis B

VVZ: Virus de la varicel·la zòster

1. Introducció

Els treballadors sanitaris estan més exposats a agents infecciosos que la població general. Els microorganismes poden infectar els sanitaris mitjançant diferents mecanismes. La transmissió es produeix des dels pacients infectats cap al personal sanitari, però també dels professionals infectats als pacients i companys del lloc de treball. Per això, el risc de les infeccions en els treballadors sanitaris no es limita a que es pugui afectar la seva salut, sinó que també poden actuar com a font d'infecció per als pacients amb els que tenen contacte, per als altres treballadors sanitaris i per als seus familiars.[1-3]

El risc que els treballadors sanitaris contreguin infeccions es pot minimitzar amb mesures de prevenció com la higiene de mans, el seguiment de les precaucions d'aïllament i la vacunació apropiada.[4]

Les malalties que es poden evitar amb vacunacions inclouen les que es transmeten per via respiratòria (grip, varicel·la, xarampió, tos ferina, rubèola i parotiditis) o per contacte de mucoses amb sang o fluids corporals (hepatitis B).

És important garantir que les persones que treballen en centres sanitaris siguin immunes enfront de les malalties que es poden prevenir amb vacunacions, ja sigui perquè han patit la malaltia prèviament i han desenvolupat anticossos o bé perquè han estat vacunats. D'aquesta manera s'evitarà que puguin ser font d'infecció per als malalts que atenen.

Per tots aquests motius és molt important conèixer quina és la situació immunitària dels treballadors sanitaris,[5] ja que a partir d'aquesta situació es podran realitzar les recomanacions de vacunació més adequades.

A Catalunya s'han fet diverses enquestes de seroprevalença amb mostres representatives de la població general,[6,7] però no s'ha fet mai un estudi dirigit especialment a conèixer la situació dels treballadors sanitaris.

1.1. Vacunacions recomanades als treballadors sanitaris

Dins el marc de la vacunació i de la prevenció de malalties transmissibles al medi sanitari, el concepte de treballadors sanitaris ha de ser ampli i incloure totes les persones que desenvolupen la seva activitat professional en els entorns d'atenció de salut i que poden estar exposats a pacients o materials potencialment infecciosos (substàncies biològiques, equipament sanitari, superfícies o aire contaminat), inclou metges, infermeres, altres treballadors clínics (auxiliars d'infermeria, terapeutes, tècnics, personal de serveis d'emergències mèdiques, farmacèutics i personal de laboratori) i els treballadors no clínics (personal administratiu, bugaderia, seguretat, manteniment i altres treballadors no clínics). Les recomanacions de vacunació dels treballadors sanitaris també s'han de fer extensives al personal no remunerat (estudiants, voluntaris, etc.) que hi ha en els centres sanitaris.[2,4]

Tots els treballadors sanitaris haurien de ser immunes al xarampió, la parotiditis, la rubèola, la varicel·la i l'hepatitis B. A més, a tots els treballadors se'ls hauria d'oferir la vacunació anual contra la grip. En l'actualitat, per tal d'augmentar la immunitat enfront de la tos ferina, es considera convenient que tots els treballadors sanitaris rebin una dosi de la vacuna contra la diftèria, el tètanus i la tos ferina (dTpa).[8-12]

Igualment, a tots els treballadors sanitaris se'ls ha d'oferir les vacunes que es recomanen de forma rutinària per als adults, com el tètanus i la diftèria, o les indicades per condicions de salut o edat, com per exemple la vacuna contra el pneumococ. Per als treballador sanitaris en determinades condicions de risc o personal de laboratori, s'ha de considerar també la vacunació contra la poliomielitis, la malaltia meningocòccica, la ràbia, la febre tifoide, l'hepatitis A i la tuberculosi.[2] Els treballadors sanitaris immunodeprimits requereixen consideracions especials. Per tot això, cal oferir un consell de vacunació personalitzat a cada treballador que tingui en compte les seves característiques personals i les del seu lloc de treball.[5,13]

Tots els proveïdors sanitaris han de preveure la vacunació dels treballadors sanitaris com una part important del programa de prevenció de riscos laborals, i

es recomana formular i posar en pràctica una política d'immunització integral per a tots els treballadors de la salut.[5,14] La vacunació no s'ha de limitar als treballadors amb professions clíniques, sinó que s'han d'incloure també les professions no clíniques així com els estudiants de ciències de la salut o els voluntaris que pugui haver als centres.[2,4] Cal revisar l'estat vacunal dels nous empleats abans de què comencin a atendre pacients i, a més, la revisió anual de tots els treballadors per assegurar que les vacunacions es mantenen al dia.[4,15]

Quan l'administració prèvia d'una vacuna no es pugui documentar es recomana la vacunació, llevat que el professional sanitari tingui una contraindicació per a l'administració de la vacuna. El cribratge serològic de la immunitat generalment no es considera rendible per decidir si cal vacunar. Tampoc és necessari verificar la resposta a totes les vacunacions, però és important en malalties com l'hepatitis B en les que la profilaxi postexposició és diferent segons hagi constància d'immunitat o no. Tota la informació relacionada amb la vacunació ha de ser documentada en la història clínica del treballador de la salut i ha d'estar disponible en registres electrònics fàcilment accessibles. Els serveis de prevenció han de tenir registres que continguin els detalls de la història de les malalties que es poden prevenir per vacunació dels treballadors sanitaris, les vacunacions, els resultats de les serologies, el registre de consentiments o negatives a les vacunacions, la marca i el lot de les vacunes. Els registres han de ser actualitzats quan es produeixen nous esdeveniments (vacunació, proves serològiques, malalties) i han de mantenir la confidencialitat dels treballadors sanitaris, però han de poder ser consultats pel personal autoritzat quan sigui necessari.[14,15]

Amb la finalitat d'investigar l'estat immunitari dels treballadors sanitaris de Catalunya enfront de les malalties per a les quals està indicada la vacunació, i en especial per aquelles en les que els anticossos específics són importants per determinar la susceptibilitat, en aquest treball s'ha analitzat la presència d'anticossos contra el xarampió, la parotiditis, la rubèola, la varicel·la, el tètanus, la diftèria i la tos ferina.

Encara que la infecció pel virus de l'hepatitis B (VHB) és un risc ocupacional àmpliament reconegut,[16,17] i la vacunació contra aquesta infecció està recomanada en els treballadors sanitaris,[18] en aquest estudi no s'ha inclòs l'anàlisi dels resultats dels anticossos específics contra l'antigen de superfície del virus de l'hepatitis B (anticossos antiHBs), que són els induïts per la vacunació. El motiu és que amb el pas del temps el títol d' anticossos antiHBs va disminuint, arribant fins i tot a fer-se negatiu (<10UI/l) en un alt percentatge de vacunats. Entre un 30% i un 60% dels adults tenen <10UI/l un cop transcorreguts de 9 a 11 després de la vacunació.[19] Tanmateix, aquesta davallada del títol dels anticossos antiHBs no significa pèrdua de la protecció enfront la malaltia, ja que en els vacunats immunocompetents la protecció queda garantida per la memòria immunitària encara que els anticossos antiHBs desapareguin.[19,20]

1.1.1. Xarampió

La transmissibilitat del xarampió és tan elevada que sense vacunació gairebé tota la població contrau la malaltia durant la infància. Això és el que passava a Catalunya fins l'any 1981, en el qual es va iniciar la vacunació sistemàtica amb vacuna triple vírica (TV). El xarampió reuneix les condicions que ha de tenir una malaltia per ser eliminada d'una comunitat o un país, i fins i tot eradicada del món. El reservori del virus és exclusivament humà; no hi ha formes clíniques inaparents i es disposa d'una vacuna suficientment eficaç perquè, si l'estratègia de vacunació és l'adequada i es vacuna la majoria de la població, es pugui arribar a interrompre la cadena epidemiològica i cessi la transmissió en una comunitat o país. Amb la vacunació, la incidència de la malaltia va baixar ràpidament, de manera que l'any 1988 el Departament de Sanitat i Seguretat Social va posar en marxa en Programa d'Eliminació del Xarampió a Catalunya i a l'any 2000 es va aconseguir interrompre la transmissió autòctona de xarampió a Catalunya. Des de llavors es van presentar casos esporàdics procedents de fora de Catalunya i petits brots que no es van difondre a la comunitat general fins l'any 2006, any en que es va produir un brot important

amb 381 casos; posteriorment hi ha hagut dos brots més en els que han estat afectats nombrosos treballadors sanitaris.[21,22]

Els treballadors sanitaris tenen més risc de contraure el xarampió que la població general.[23-25] Tant a nivell hospitalari com ambulatori, els pacients susceptibles que pateixen altres malalties, especialment els ancians, els pacients greument malalts i els ingressats en les unitats de cures intensives, es troben en alt risc de malaltia greu o de mort si adquireixen el xarampió, per la qual cosa s'ha d'evitar que els treballadors sanitaris siguin font d'infecció per als pacients.[9,26-29]

A Catalunya la majoria dels treballadors sanitaris són immunes al xarampió,[30] però molts no poden proporcionar evidència de la immunitat de manera suficientment documentada, ja que no disposen de carnet de vacunacions i no hi ha informació a la seva història clínica laboral. Quan es produeix un brot en un centre sanitari els treballadors sanitaris que no poden assegurar immunitat s'han d'absentar temporalment del treball, la qual cosa pot provocar problemes logístics i financers greus.[31-33]

1.1.2. Rubèola

Tot i que la rubèola es considera una malaltia benigna, s'observa freqüentment artràlgia i artritis transitòria en adults infectats, sobretot entre les dones post-púbers. Altres complicacions que es presenten, encara que amb poca freqüència, són la trombocitopènia i l'encefalitis. La infecció és asimptomàtica en el 25-50% dels casos. La principal preocupació són els efectes que pot tenir la rubèola quan una dona embarassada s'infecta, especialment durant el primer trimestre, fet que pot donar lloc a avortaments, i a la síndrome de la rubèola congènita, una constel·lació de defectes de naixement que sovint inclou ceguesa, sordesa, endarreriment mental i defectes congènits del cor.[34,35]

A Catalunya tots el treballadors sanitaris haurien de ser immunes a la rubèola, però, a causa de la naturalesa de la malaltia és primordial vacunar enfront de la rubèola en determinats serveis com són els d'obstetrícia i pediatria, on les infeccions poden tenir les repercussions més greus.[35,36]

1.1.3. Parotiditis

La prevenció de la parotiditis mitjançant la vacunació s'ha de considerar com una estratègia integrada amb la prevenció del xarampió i la rubèola, ja que es realitza amb la vacuna triple vírica.[37, 38]

La transmissió en establiments de salut no és comú, però quan es produeixen brots en la comunitat, l'exposició i la transmissió en els treballadors de salut és freqüent. Segons els resultats d'estudis de seroprevalença, els Centers for Disease Control and Prevention (CDC) estimen que les persones nascudes abans de l'any 1957 als Estats Units són immunes. Malgrat això, alguns informes han trobat que un 4-5% de les persones nascudes abans de 1957 són susceptibles.[2,39]

A Catalunya, com a la resta de l'estat espanyol, la proporció de persones susceptibles a la parotiditis és major que la de susceptibles al xarampió i a la rubèola.[40,41] Aquest fet s'observa tant en les cohorts de les persones que són majoritàriament immunes per haver nascut abans de que la vacunació fos sistemàtica (a l'any 1981) i haver patit la infecció de forma natural, com en les nascudes amb posterioritat que tenen bàsicament immunitat produïda per vacunació. A l'enquesta seroepidemiològica de Catalunya de l'any 2002 eren susceptibles el 8,9 % del total de les persones estudiades.[7] Aquests fets es reflecteixen en la epidemiologia de la malaltia, ja que malgrat la davallada de la incidència de parotiditis produïda per la vacunació, la seva incidència s'ha mantingut per sobra de la del xarampió i de la rubèola.[7,42,**43**]

1.1.4. Varicel·la

La infecció pel virus de la varicel·la zòster (VVZ) en el medi sanitari és poc freqüent però potencialment greu, ja que pot afectar els nadons prematurs, dones embarassades, adults majors i pacients que estan immunodeprimits a causa de malalties subjacents o determinades teràpies. La vacunació dels treballadors sanitaris contra les infeccions transmissibles és una part important

dels programes de control d'infeccions del centre de salut. A Catalunya, la vacunació contra la varicel·la s'inclou en les mesures recomanades universalment per a tots el treballadors de salut susceptibles. L'Organització Mundial de la Salut (OMS) considera adient la vacunació dels treballadors sanitaris potencialment susceptibles (sense antecedents de malaltia o vacunació), en els llocs on la població en contacte amb els treballadors sanitaris tingui un risc elevat de patir varicel·la greu, encara que la vacuna no estigui inclosa en el calendari de vacunacions sistemàtiques.[44]

A Catalunya, l'any 2002, el 89,7% del grup de edat entre 5 i 14 anys i el 98% dels majors de 15 anys de la població general eren immunes a la varicel.la.[45] Els resultats de l'any 2000 a nivell de la població general d'Espanya son similars, ja que a la nostra àrea geogràfica, abans que es disposés de vacuna, la majoria de les persones adquirien la malaltia en els primers anys de vida.[41] La informació disponible sobre la prevalença d'immunitat contra la varicel·la en treballadors sanitaris a Espanya és escassa. Un estudi realitzat en cinc hospitals de Catalunya va trobar una prevalença de 96,2%.[46] Estudis en diversos països mostren que la immunitat natural dels treballadors sanitaris oscil·la entre 90 i 98%.[46]

1.1.5. Tètanus, diftèria i tos ferina

Hi ha poca informació sobre la prevalença de susceptibilitat al tètanus i la diftèria en treballadors sanitaris. Això probablement és deu all fet que la diftèria està pràcticament eliminada en molts territoris i que el tètanus no es transmet de persona a persona. De tota manera, és important que els treballadors sanitaris siguin immunes, en el cas del tètanus, com qualsevol altra persona donada la gravetat de la malaltia, i en el cas de la diftèria també per les greus repercussions que pot tenir aquesta malaltia en el medi sanitari davant la possibilitat d'un brot, encara que sigui remota.[8,47]

Pel que fa a la tos ferina, es tracta d'una infecció que en els darrers anys s'està comportant com una malaltia re-emergent en molts països en els que hi ha una elevada cobertura de vacunació infantil. A Catalunya també s'ha produït aquest

fenomen, i s'ha observat un increment de la incidència de tos ferina que va assolir el màxim a l'any 2011, amb una taxa de 20,9 casos per cent mil habitants, més de quatre vegades la incidència màxima observada des que la tos ferina es va declarar malaltia de declaració individualitzada a l'any 1997. Es recomana la vacunació dels treballadors de la salut d'àrees pediàtriques i obstètriques, ja que estan exposats i poden transmetre la infecció als pacients especialment vulnerables.[48]

2. Hipòtesis

Hipòtesis

A Catalunya hi ha un nombre important de treballadors sanitaris que són susceptibles a malalties que es poden prevenir amb vacunacions, la qual cosa implica un risc per a aquests treballadors i per als pacients que atenen, especialment els més vulnerables i també per a la resta de treballadors sanitaris.

La cobertura de vacunació en els treballadors sanitaris enfront les malalties que es poden evitar amb vacunacions i que es poden transmetre en els centres sanitaris és baixa o insuficient contra algunes d'aquestes malalties. Els antecedents de malaltia o la confirmació serològica d'immunitat, tampoc són suficientment coneguts. Per tal de poder adoptar les mesures adequades que evitin que els treballadors sanitaris siguin font d'infecció, cal investigar els factors que estan associats a un nivell de protecció insuficient.

Els sistemes d'informació utilitzats per enregistrar les dades de l'estat immunitari dels treballadors sanitaris enfront de les malalties evitables amb vacunacions que poden ser transmeses en el medi laboral no estan estandarditzats, tenen carències importants d'informació, estan fragmentats en diferents registres i no permeten l'intercanvi àgil d'informació entre diferents estaments. Aquests sistemes d' informació no són prou versàtils per conèixer de manera adequada si els treballadors sanitaris són susceptibles o no, ni per facilitar aquesta informació amb la celeritat necessària per respondre a les situacions urgents o brots. El coneixement de les limitacions presents en els diferents nivells del sistema sanitari pot ajudar a millorar l'estructura i les estratègies per accedir i compartir aquest tipus d' informació.

3. Objectius

Objectiu general

Investigar la situació immunitària dels treballadors sanitaris enfront de les malalties que es poden prevenir amb vacunacions i que es poden transmetre als centres sanitaris de Catalunya així com els sistemes d'enregistrament de la vacunació utilitzats.

Objectius específics

- Investigar la prevalença de sanitaris amb anticossos protectors enfront del xarampió, la rubèola, la parotiditis, el tètanus, la diftèria, la tos ferina i la varicel·la en una mostra dels treballadors sanitaris de Catalunya.

- Investigar la relació entre la presència d'immunitat contra el xarampió, la rubèola, la parotiditis, el tètanus, la diftèria, la tos ferina i la varicel·la i les característiques sociodemogràfiques i laborals dels treballadors sanitaris.

- Conèixer el procediment utilitzat per enregistrar la situació immunitària enfront les malalties que es poden prevenir amb vacunacions en els diferents centres sanitaris de Catalunya, així com les recomanacions que es donen en aquests centres en relació a les vacunacions i les intervencions que realitzen per garantir la protecció dels treballadors i els pacients.

4. Resultats

4.1. Resultats de l’estudi de seroprevalença

4.1.1. Prevalence of measles antibodies among health care workers in Catalonia (Spain) in the elimination era. Luis Urbiztondo, Eva Borràs, Josep Costa, Sonia Broner, Magda Campins, José María Bayas, María Esteve, Àngela Domínguez and the Working Group for the Study of the Immune Status in Healthcare Workers in Catalonia. BMC Infectious Diseases 2013;13:391

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Prevalence of measles antibodies among health care workers in Catalonia (Spain) in the elimination era

Luis Urbiztondo[1*], Eva Borràs[1,2], Josep Costa[3], Sonia Broner[2], Magda Campins[4], José María Bayas[3], María Esteve[5], Angela Domínguez[2,6] and the Working Group for the Study of the Immune Status in Healthcare Workers in Catalonia

Abstract

Background: Interruption of measles transmission was achieved in Catalonia (Spain) in 2000. Six years later, a measles outbreak occurred between August 2006 and June 2007 with 381 cases, 11 of whom were health care workers (HCW).
The objective was to estimate susceptibility to measles in HCW and related demographic and occupational characteristics.

Methods: A measles seroprevalence study was carried out in 639 HCW from six public tertiary hospitals and five primary healthcare areas. Antibodies were tested using the Vircell Measles ELISA IgG Kit. Data were analyzed according to age, sex, type of HCW, type of centre and vaccination history.
The odds ratios (OR) and their 95% CI were calculated to determine the variables associated with antibody prevalence. OR were adjusted using logistic regression.
Positive predictive values (PPV) and the 95% confidence intervals (CI) of having two documented doses of a measles containing vaccine (MCV) for the presence of measles antibodies and of reporting a history of measles infection were calculated.

Results: The prevalence of measles antibodies in HCW was 98% (95% CI 96.6-98.9), and was lower in HCW born in 1981 or later, after the introduction of systematic paediatric vaccination (94.4%; 95% CI 86.4-98.5) and higher in HCW born between 1965 and 1980 (99.0%; 95% CI 97.0-99.8). Significant differences were found for HCW born in 1965–1980 with respect to those born in 1981 and after (adjusted OR of 5.67; 95% CI: 1.24-25.91).
A total of 187 HCW reported being vaccinated: the proportion of vaccinated HCW decreased with age. Of HCW who reported being vaccinated, vaccination was confirmed by the vaccination card in 49%. Vaccination with 2 doses was documented in only 50 HCW, of whom 48 had measles antibodies. 311 HCW reported a history of measles.
The PPV of having received two documented doses of MCV was 96% (95% CI 86.3-99.5) and the PPV of reporting a history of measles was 98.7% (95% CI 96.7-99.6).

Conclusions: Screening to detect HCW who lack presumptive evidence of immunity and vaccination with two doses of vaccine should be reinforced, especially in young workers, to minimize the risk of contracting measles and infecting the susceptible patients they care for.

Keywords: Measles, Seroprevalence, Health care workers, MCV vaccination

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Background

Health care workers (HCW) are at greater risk of acquiring measles than the general public [1,2]. Transmission occurs from infected patients to staff and from infected staff to patients and colleagues. In both inpatient and outpatient settings, susceptible patients suffering other conditions, especially the elderly and severely ill patients in intensive care units, are at high risk of severe disease or death if infected with measles by a HCW [3,4]. The most effective preventive measure against measles is vaccination with two doses of measles-containing vaccine (MCV).

In Catalonia, a region in the northeast of Spain with 7.5 million inhabitants, MCV vaccination at 12 months was included in the immunization schedule in 1981. In 1988, the recommended age of MCV1 vaccination was raised to 15 months to improve effectiveness and MCV2 vaccination at 11 years of age was introduced to replace the monovalent rubella dose, in accordance with recommended measles elimination strategies. To reduce the number of cohorts vaccinated with a single dose, in 1998 MCV2 was advanced to 4 years [5]. Therefore, subjects born after 1981 should have received two doses of MCV, one at 12 or 15 months and another later in life.

The incidence of measles in Catalonia declined from 470 per 100000 inhabitants in 1983 to 1.01/100000 in 1997 and 0.5/100000 inhabitants in 1999. Elimination of endemic measles transmission was achieved in 2000 [6]. During the period 2000–2005, the incidence of measles in Catalonia was very low (51 cases in 6 years), and outbreaks were related to imported cases and affected few people [7].

A measles outbreak occurred in Catalonia between August 2006 and June 2007 with 381 cases (Incidence rate = 6.6/100000), mainly in children aged < 15 months. Transmission occurred in health care settings in 20% of the cases in which the location was identified. Among affected adults, 11 were HCW, of whom only one had received one dose of MCV, while the rest were not vaccinated [8]. In 2008, after the outbreak, the recommended age of MCV1 vaccination was changed back to 12 months, because protection of infants due to passively-acquired maternal antibodies is less long-lasting in vaccinated mothers not exposed to wild measles virus [9].

In 2008 and 2009, the incidence of measles was very low, with only 14 cases in small outbreaks linked to imported cases. Between November 2010 and September 2011, there was another outbreak with transmission among the native population that affected 305 people, mostly unvaccinated adults aged > 25 years, including 11 HCW, of whom one had received two doses of MCV [10]. Currently there is no continuous transmission of measles in Catalonia.

The objective of this seroprevalence study was to determine the level of protection against measles in HCW in Catalonia and the factors associated with evidence of measles immunity, in order to implement appropriate strategies to detect susceptible HCW and minimize their risk of contracting measles and infecting the susceptible patients they care for.

Methods

The study was carried out using a convenience sample. Occupational Risk Prevention (ORP) services from the 10 primary healthcare areas and from 9 of the leading tertiary hospitals in Catalonia were asked to recruit patients. We considered HCW all persons, paid and unpaid, working in healthcare settings who had the potential for exposure to patients and/or to infectious materials. HCW included physicians, nurses, other clinical workers (nursing assistants, therapists, technicians, emergency medical service personnel, pharmacists, laboratory personnel, students and trainees) and non-clinical workers (clerical, house-keeping, laundry, security, maintenance, administrative staff and billing). HCW attending voluntary periodic health examinations between June 2008 and December 2010 were informed of the study and were recruited after written informed consent was obtained. The study was approved by the Ethics Committee of the University of Barcelona. Blood samples were obtained and demographic and epidemiological variables were collected using a questionnaire (age, sex, type of HCW, type of centre, history of having had measles disease and vaccination history) and completed by ORP physicians and nurses. If available, the vaccination card was also reviewed.

To determine long-lasting immunity to measles, IgG antibodies were studied using the Vircell Measles ELISA IgG Kit (Vircell SL. Granada. Spain). According to the manufacturer, the sensitivity and specificity of the method are 99% and 92%, respectively.

The prevalence of antibodies and the 95% confidence intervals (CI) were calculated using the exact binomial method.

The relationship between the dependent variable, measles antibodies, and the independent variables, age, sex, professional category and type of centre, was assessed using odds ratios (OR) and 95% CI. Odds ratios were adjusted using multiple logistic regression with two additional strategies: full model (i.e. with all candidate variables) and a backward selection procedure. The inclusion and exclusion criteria used were; $p < 0.05$ for model entry and $p > 0.10$ for output, according to Wald statistics. Statistical significance was established assuming an alpha error of 0.05.

The positive predictive value (PPV) and their 95% CI were calculated using a binomial distribution. The PPV of documented previous MCV vaccination was calculated as the number of HCW with both positive antibodies and documented MCV vaccination (2 doses) divided by the total of HCW with documented MCV vaccination (2 doses). The PPV of a reported history of measles infection

was calculated as the number of HCW with both positive antibodies and a reported history of measles divided by the total of HCW with a reported history of measles. The 95% CI of the PPV were calculated using a binomial distribution.

Data processing and analysis were carried out using the SPSS v19.0 for Windows and R 2.13.0 (R Development Core Team 2011) programs.

Results

Five of the 10 primary healthcare ORP and 6 of the 9 hospital ORP invited to participate accepted. The participating centres were located in 5 of the 7 Catalan health regions, representing 87.6% of the population.

A total of 639 HCW participated in the study, of whom 149 (23.3%) were male and 490 (76.7%) female. The median age of HCW was 41 years (Range 21 – 66). The distribution according to professional category showed a predominance of nurses (249; 29.6%) and physicians (189; 39.0%) followed by other clinical workers (86; 13.5%) and non-clinical workers (115; 18.0%). According to type of centre, 341 workers (53.4%) came from hospitals and 298 (46, 6%) from primary healthcare centres. Very few workers refused to take part in the study (> 5% in participating ORP). No HCW participating in the study was affected by the measles outbreak that began at the end of 2010.

The overall prevalence of measles antibodies was 98.0%, (95% CI 96.6-98.9) and was lower in HCW born in 1981 and after (94.4; 95% CI 86.4-98.4) than in those born between 1965 and 1980 (99%; 95% CI 97.0-99.8).

In the multivariate analyses, significant differences were found only for HCW born in 1965–1980 with respect to those born in 1981 and after, with an adjusted OR of 5.67 (95% CI: 1.24-25.91) (Table 1).

A total of 187 HCW reported being vaccinated, and the proportion of vaccinated decreased with age: 81.9% in HCW born in or after 1981, 39.0% in those born between 1965–1980, 6.1% in those born between 1955–1964 and 3.6% in those born in 1954 or before. In HCW who reported being vaccinated, vaccination was confirmed with the vaccination card only in 49%. Vaccination with 2 doses was documented in only 50 HCW, of whom 48 had antibodies against measles. A history of measles was reported by 311 HCW (48.7% of the total) and increased with age: 12.5% in HCW born in or after 1981, 43.5% in those born between 1965–1980, 59.8% in those born between 1955–1964 and 69.4% in those born in or before.

The PPV of documented measles vaccination with 2 doses with respect to positive serology was 96.0 (95% CI 86.3-99.5). The lowest PPV was found in HCW born in or after 1981 (95.5; 95% CI 77.2-99.9). No significant differences were found between HCW born after 1981 and the other birth cohorts (Table 2). The PPV of a history of measles with respect to positive serology was 98.7 (95% CI 96.7-99.6) (Table 3).

Discussion

The results of this study show that the prevalence of measles antibodies in HCW in Catalonia is higher than that found in other countries [11,12]. A study in a New York

Table 1 Results of the bivariate and multivariate analyses of measles antibodies in healthcare workers

Variable	n	Prevalence (95% CI)	Crude OR (95% CI)	p	Adjusted OR (95% CI)	p
Year of birth						
1981 and after	72	94.4 (86.4 – 98.5)	Reference		Reference	
1965 – 1980	292	99.0 (97.0 – 99.8)	5.67 (1.24 – 25.91)	0.02	5.67 (1.24 – 25.91)	0.02
1955 – 1964	164	97.0 (93.0 – 99.0)	1.87 (0.49 – 7.18)	0.36	1.87 (0.49 – 7.18)	0.36
1954 and before	111	99.1 (95.1 – 100)	6.47 (0.71 – 59.11)	0.09	6.47 (0.71 – 59.11)	0.09
All	639	98.0 (96.5 – 98.9)	-		-	
Sex						
Male	149	98.0 (94.3 – 99.6)	1.01 (0.28 – 3.73)	0.98		
Female	490	98.0 (96.3 – 99.0)	Reference			
Professional group						
Physician	189	98.9 (96.2 – 99.9)	2.5 (0.41 – 15.22)	0.32		
Nurse	249	97.6 (94.8 – 99.1)	1.08 (0.27 – 4.42)	0.91		
Other clinical workers	86	97.7 (91.9 – 99.7)	1.12 (0.18 – 6.88)	0.90		
Non-clinical workers	115	97.4 (92.6 – 99.5)	Reference			
Type of centre						
Primary health	298	98.7 (96.6 – 99.6)	1.99 (0.61 – 6.54)	0.25		
Hospital	341	97.4 (95.1 – 98.8)	Reference			

Table 2 PPV of having 2 documented doses of MCV for presence of measles antibodies

Variable	Measles vaccination Antibodies +/n	PPV (95% CI)
Year of birth		
1981 and after	21/22	95.5 (77.2–99.9)
1965 – 1980	25/26	96.2 (80.4–99.9)
1964 – 1955	1/1	100 (2.5–100)
1954 and before	1/1	100 (2.5–100)
All	48/50	96 (86.3–99.5)
Sex		
Male	13/14	92.9 (66.1–99.8)
Female	35/36	97.2 (85.5–99.9)
Professional category		
Physician	22/22	100 (84.6–100)
Nurse	16/18	88.9 (65.3–98.6)
Other clinical workers	8/8	100 (63.1–100)
Non-clinical workers	2/2	100 (15.8–100)
Type of centre		
Primary health	10/11	90.9 (58.7–99.8)
Hospital	38/39	97.4 (86.5–99.9)

Table 3 PPV of a reported history of measles for the presence of measles antibodies

Variable	History of measles Antibodies +/n	PPV (95% CI)
Year of birth		
1981 and after	9/9	100 (66.4–100)
1965 - 1980	127/127	100 (97.1–100)
1964 - 1955	95/98	96.9 (91.3–99.4)
1954 and before	76/77	98.7 (93.0–100)
All	307/311	98.7 (96.7–99.6)
Sex		
Male	60/60	100 (94.0–100)
Female	247/251	98.4 (96.0–99.6)
Professional category		
Physician	94/94	100 (96.2–100)
Nurse	120/123	97.6 (93.0–99.5)
Other clinical workers	34/35	97.1 (85.1–99.9)
Non-clinical workers	59/59	100 (93.9–100)
Type of centre		
Primary health	157/157	100 (97.7–100)
Hospital	150/154	97.4 (93.5–99.3)

tertiary hospital [11] found a prevalence of 91%, and a Japanese study in which the majority of participants were tertiary hospital physicians found a prevalence of 92.6% [12]. The specific characteristics of hospitals do not seem to be the main explanation for the differences between these studies and ours (which also included primary healthcare workers) because we found no significant differences in the prevalence between hospital and primary healthcare workers. Likewise, we found no differences between professional categories.

In Catalonia, as in other countries, vaccination of all subjects without documented evidence of measles immunity is recommended. Sufficient evidence is considered as birth after 1965 with a documented history of physician-diagnosed measles, serologic evidence of immunity or written confirmation of receipt of two doses of MCV [5,13]. Adults born before 1966 are considered immune to measles, because the lack of vaccination and greater circulation of the virus resulted in near-universal exposure and the development of natural immunity [14].

Susceptible individuals may be found in population cohorts born between 1965 and 1980, as some persons may have avoided measles infection due to the reduction in the incidence and because they were not vaccinated [15]. However, this was not confirmed by the results of our study, as HCW from this age group had the highest prevalence of measles antibodies. Our results showed that the most susceptible group was HCW born after 1980, who should have received two doses of MCV. These findings are similar to those of Botelho-Nevers et al. [16], and Seo et al., who suggested that, in younger subjects, vaccination coverage remained low [11].

Although the objective of measles elimination in the European Region by 2010 was established, 120 outbreaks were reported throughout the region during the period 2005–2008, of which 17 had more than 250 cases, with 25 deaths [17]. Currently, the goal of elimination has been renewed as 2015 [18]. Therefore, improvements in vaccination coverage targeting all pockets of susceptible individuals and the early identification of and response to outbreaks are critical to achieving this target date for elimination in Europe [4].

In some developed countries, due to the low incidence of measles in the last twenty years, exposure and the risk of infection of non-vaccinated subjects, including HCW, has been minimal. As vaccination coverages increase and the incidence of measles declines, nosocomial transmission is likely to become an increasingly important source of measles virus in the population [19-23]. In these circumstances, physicians are less familiar with diagnosing measles, and delays occur in the diagnosis and laboratory confirmation of measles [24-26], increasing the risk of nosocomial transmission. HCW have been affected by many outbreaks and their role in measles transmission is

key on many occasions [15,27,28]. Given the potential severity of measles and the ease of transmission in healthcare centres, vaccination of susceptible HCW is essential to control nosocomial infection and achieve progress in the elimination strategy [4,21].

Because HCW are at extremely high risk of acquiring measles from patients or transmitting measles to patients and co-workers in medical settings, in addition to the universal vaccination of children, the vaccination of susceptible individuals working in healthcare facilities with two doses of vaccine separated by an interval of at least 28 days is currently recommended [5,12,29].

Most HCW are immune to measles, but many cannot provide sufficient accessible evidence of documented immunity. If outbreaks occur, these HCW should be temporarily taken off health care work, which may cause severe logistic and financial problems [24,26]. In circumstances in which HCW state they know their history [30,31], undocumented information is clearly not sufficient to justify overriding these problems. This is true even for situations in which the PPV for immunity of having had measles or being vaccinated are high, as in the present study.

In the era of measles elimination, the goal is 100% immunity in populations at high risk of acquiring measles, such as HCW. The risk of acquiring measles is estimated to be 13 to 19 times higher for susceptible HCW than for the general population [4]. The criteria accepted as sufficient evidence of immunity in the general population may be insufficient in HCW, especially in younger age groups. These criteria should be reviewed, replacing the required documentation of physician-diagnosed disease as a evidence of measles immunity by laboratory confirmation of measles [13,21,24,32]. Those HCW who cannot provide proof of laboratory-confirmed measles or receipt of 2 doses of MCV should receive a full course of vaccination [4].

In Catalonia, the priority should be the availability of information on HCW measles immunity. Measles serology should be required in all HCW born after 1966 without documented evidence of vaccination with two doses of MCV or laboratory confirmation of the disease. The data should be stored and easily accessible, in computerized occupational records [4,24]. The vaccination card demonstrated limited usefulness in confirming vaccination in our study, suggesting that the undocumented histories reported by HCW have little validity. Another preoccupation is the possible limitation of the vaccination history of two doses as a criterion to ensure immunity. Although this information was only obtained in 50 HCW, serologies were negative in 4%. In addition, in the 2010 outbreak in Catalonia, one of the 11 HCW affected was an emergency room physician who had 2 documented doses of MCV [10].

A lesser priority should be routine review of the situation of unvaccinated HCW born before 1966 who lack laboratory evidence of measles immunity or laboratory confirmation of measles, in whom the recommendation of two doses of MCV should be strongly considered.

One limitation of this study is that, as we used a convenience sample, the results may not be generalizable to all HCW in Catalonia. Likewise, the serological study was made in HCW who voluntarily attended ORP health examinations: therefore, the prevalence of measles immunity in the study subjects may differ from that of HCW who did not attend these health examinations. However, the large sample size, which included hospital and primary healthcare centre workers from 5 of the 7 Catalan health regions, added to the fact that less than 5% of HCW invited to participate refused, suggest that our results may reflect the true situation in many Catalan health centres.

Conclusion

Although most HCW have immunity against measles, everybody working in medical facilities should have evidence of this immunity [33]. Optimal preparedness for measles exposure includes ensuring that all HCW have documented and easily retrievable measles immunity records to guide case management and outbreak response [24]. Vaccination of susceptible subjects with two doses of MCV should be reinforced, especially in young workers, to minimize the risk of contracting measles and infecting the susceptible patients they care for.

Competing interests

All authors declare that they have no conflicts of interest.

Authors' contributions

All the authors participated in the design, implementation, analysis and interpretation of the results of the study. AD was the principal investigator and secured funding. LU and AD drafted the report. JC performed the laboratory analysis. EB, MC, JMB, and ME supervised the study and reviewed the draft article. SB conducted the statistical analysis. The other members of the Working Group contributed to recruitment of subjects, data collection and interpretation of the results. All authors read and approved the final manuscript.

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Are healthcare workers immune to rubella?

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Abbreviations: CI, confidence interval; CRS, congenital rubella syndrome; HCW, healthcare worker; IgG, immunoglobulin G; MMR, measles mumps rubella; OR, odds ratio; WHO, World Health Organization

Healthcare workers (HCW) have high exposure to infectious diseases, some of which, such as rubella, are vaccine-preventable. The aim of this study was to determine the immunity of HCW against rubella. We performed a seroprevalence study using a self-administered survey and obtained blood samples to determine rubella Immunoglobulin G (IgG) antibody levels in HCW during preventive examinations by five Primary Care Basic Prevention Units and six tertiary hospitals in Catalonia. Informed consent was obtained. IgG was determined using an antibody capture microparticle direct chemiluminometric technique. The odss ratio (OR) and 95% confidence intervals (CI) were calculated. Logistic regression was made to calculate adjusted OR.

Of 642 HCW who participated (29.9% physician, 38.8% nurses, 13.3% other health workers and 18% non-health workers), 46.6% were primary care workers and 53.4% hospital workers. Of total, 97.2% had rubella antibodies. HCW aged 30–44 years had a higher prevalence of antibodies (98.4%) compared with HCW aged <30 years (adjusted OR 3.92; 95% CI 1.04–14.85). The prevalence was higher in nurses than in other HCW (adjusted OR: 5.57, 95% CI 1.21–25.59).

Antibody prevalence did not differ between females and males (97.4% vs. 97.1%, *P* 0.89), type of center (97.7% vs. 96.8%, *P* 0.51) or according to history of vaccination (97.3% vs. 96.8%, *P* 0.82). Seroprevalence of rubella antibodies is high in HCW, but workers aged <30 years have a higher susceptibility (5.5%). Vaccination should be reinforced in HCW in this age group, due to the risk of nosocomial transmission and congenital rubella.

Introduction

Rubella is an exanthematic disease caused by the rubella virus of the genus *Rubivirus*. Although 20–50% of infected people are asymptomatic, newborns are the group with the most serious complications (malformations). Congenital rubella syndrome (CRS) can affect all fetal organs causing birth defects, stillbirth, spontaneous abortion or premature birth, with deafness being one of the most common manifestations.[1] The extent of involvement depends on the time of pregnancy at which infection occurs, but in a susceptible woman infected during the first trimester, the fetus is affected in between 80% and 100% of cases.[2,3] More than 20% of maternal infections occur within the first 8 wk of gestation, causing miscarriage.[1] Because rubella, as measles, is a vaccine-preventable disease with an exclusively human reservoir, the virus cannot survive in the environment and there are specific and sensitive techniques to diagnose cases, in 1998 the WHO European Region approved the aims of eliminating indigenous measles and rubella and controlling congenital rubella.[4] In 2003, a plan focused on achieving these objectives by 2010 was approved and in 2005, a strategic plan for 2005–2010 was approved with the aims of eliminating endemic rubella and preventing CRS (<1 case per 100 000 live births). Finally, in September 2010, the aims of the WHO European Region were postponed to 2015.[5,6] However, the incidence of rubella remains substantial: 121 378 cases of rubella and 162 cases of CRS were reported worldwide in 2009, and 94 030 and 300, respectively, in 2012.[7]

Rubella vaccination of all girls aged 11 y was introduced into the routine immunization schedule in Catalonia in 1978. In 1980, the MMR vaccine (measles and mumps rubella) was introduced in children aged 12 mo. In 1987, the MMR was changed from 12 to 15 mo, and in 1988 the MMR replaced the rubella vaccine at 11 y. In 1999, the age of administration of the second MMR dose was advanced from 11 to 4 y. Finally, in 2008, the age of administration of the first dose of MMR was advanced from 15 to 12 mo. The global prevalence of rubella antibodies in a seroprevalence study performed in 2002 in a representative sample of the population aged ≥15 y in Catalonia[8,9] was 95.7% and the distribution of rubella antibodies according to age groups showed no statistical differences. However, there are no prevalence data in health care workers (HCW).

Recent outbreaks in Spain[10–12] and Europe[13] have affected pregnant women.[12-14] There are also reports of rubella outbreaks

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Table 1. Sociodemographic and epidemiological characteristics of study subjects (n = 642)

Characteristics	n	%
Age group		
<30 y	128	19.9
30 - 44 y	254	39.6
45 - 54 y	169	26.3
≥55 y	91	14.2
Sex		
Male	151	23.5
Female	491	76.5
Professional category		
Physicians	191	29.9
Nurses	248	38.8
Other clinical workers	85	13.3
Non-clinical workers	115	18.0
Type of center		
Primary health	299	46.6
Hospital	343	53.4
History of vaccination		
Yes	95	14.8
No	547	85.2

that affected between 15 and 47 hospital HCW.[15-17] In 1980, in the United States, a hospital with 2983 workers reported a nosocomial outbreak that affected 47 people, one of whom was a pregnant woman,[15] and 5 y later, another hospital with 3900 HCW reported an outbreak that affected 19 HCW, whose contacts included five pregnant women.[16] In Japan, in 2003, a local outbreak affected 15 HCW.[17]

The aim of this study was to determine the immune status of HCW against rubella and factors associated to this status.

Results

A total of 642 HCW participated in the study (46.6% primary care and 53.4% hospital). The sociodemographic and epidemiological characteristics of the participants are shown in **Table 1**.

Of the 642 participants, 97.2% (95% CI 95.6–98.3) had titers of IgG antibodies ≥10 IU/mL, which according to Skendel[18] is indicative of seroprotection. There was a higher percentage of immune HCW in the ≥55 y age group with respect to the <30 y age group (the reference group), although the differences were not statistically significant. In both the bivariate and multivariate analyses, significant differences were found in the prevalence of immunity in HCW aged 30–44 y compared with those aged <30 y (adjusted OR 3.92; 95% CI 1.04–14.85). No significant differences were found between males and females (97.4%, 95% CI 93.4–99.3 vs. 97.1%, 95% CI 95.3–98.4) (**Table 2**).

Physicians and nurses had the highest prevalence of immunity. Both the bivariate and multivariate analyses showed that nurses had significantly higher levels of immunity than other HCW (adjusted OR 5.57, 95% CI 1.21–25.59) (**Table 2**). Primary care HCW had a slightly higher, not-significant prevalence of immunity than hospital workers (97.7% [95% CI 95.2–99.1] vs. 96.8% [95% CI 94.3–98.4]). The prevalence of immunity in HCW who reported being vaccinated showed no significant differences (97.3% [95% CI 95.5–98.5] vs. 96.8% [95% CI 91.0–99.3]). The prevalence of rubella antibodies did not differ significantly in HCW with and without a recorded history of vaccination by age group or according to the other study variables (**Table 3**).

Discussion

The prevalence of HCW with protective rubella antibodies in Catalonian health centers included in this study (97.2%) is higher than that found in other studies,[19-23] probably due to the vaccination programs performed in Catalonia since 1978. A Saudi Arabian study[19] found a prevalence of antibodies of 90%. In Madurai (India), 84.85% of HCW in a university hospital had antibodies.[24] A study in a Brazilian university hospital found that the prevalence of one dose of MMR or a history of disease confirmed by serology was 62.5% in residents in the final year of pediatrics.[20] In Japan, in a study performed in 2001,[21] 95.9% of physicians and nurses had rubella antibodies, but in a more recent study[25] the prevalence was 89.5%. In Australia, antibodies to measles, mumps, and rubella were found in 89–94% of participating HCW.[26] Campagna et al.[22] found a wide range of seroprevalence (47%–96.8%) in HCW from 9 hospitals in northern Italy. Turkish studies by Alp et al.,[27] Aypak et al.,[25] and Celikbas et al.,[28] found a prevalence of antibodies in HCW of 97%, 97.5%, and 98.3%, respectively. Alp et al.[27] suggested that working in a high risk-department is associated with immunity (OR: 2.7, 95% CI 1.4–5.2).

As in the study by Aypak et al.,[25] we found fewer immune subjects among young HCW (94.5% in HCW aged <30 y vs. 97.2% for all participants). The prevalence of rubella antibodies was lower in HCW aged <30 y than those aged 30–44 y (adjusted OR 3.92). A possible explanation may be that rubella incidence has been low in Catalonia in recent years, with small, very-limited outbreaks in specific population groups[11,29] and therefore booster effects due to contact with the wild virus are scarce for younger HCW. In contrast, in HCW aged 30–44 y, the prevalence of rubella antibodies may reflect not only the vaccination status but previous infection or a booster effect by the wild virus. In any case, the lower prevalence of antibodies in HCW aged <30 y suggests that vaccination should be reinforced in this age group.

No differences were observed in the prevalence of antibodies in HCW with and without a recorded history of vaccination. The fact that the prevalence of rubella antibodies was similar in HCW aged <30 y with and without a history of vaccination suggests that, at least in our study, a history of vaccination is not a good predictor of the rubella immune status. In fact, the vast majority of HCW aged <30 y without a recorded history of

Table 2. Prevalence of rubella antibodies in healthcare workers by study variables

Variable	Number	Prevalence	Crude OR	*P*	Adjusted OR	*P*
		(95% CI)	(95% CI)		(95% CI)	
Age						
<30 y	128	94.5(89.1–97.8)	reference		reference	
30–44 y	254	98.4(96.0–99.6)	3.62 (1.04–12.59)	0.043	3.92 (1.04–14.85)	0.044
45–54 y	169	96.4 (92.4–98.7)	1.57 (0.52–4.80)	0.427	1.31 (0.36–4.78)	0.684
≥55 y	91	98.9 (94.0–100)	5.21 (0.63–43.07)	0.126	4.02 (0.44–36.91)	0.219
All	642	97.2 (95.6–98.3)				
Sex						
Male	151	97.4 (93.4–99.3)	1.08 (0.35–3.33)	0.895	1.34 (0.41–4.39)	0.627
Female	491	97.1(95.3–98.4)	reference		reference	
Professional group						
Physician	191	97.9 (94.7–99.4)	2.92 (0.76–11.17)	0.117	2.89 (0.73–11.51)	0.138
Nurse	248	98.8 (96.5–99.7)	5.1(1.19–21.83)	0.028	5.57(1.21–25.59)	0.027
Other clinical workers	85	94.1(86.8–98.1)	reference		reference	
Non-clinical workers	115	94.8 (89.0–98.1)	1.14 (0.33–3.85)	0.839	1.08 (0.30–3.90)	0.904
Type of center						
Primary health	299	97.7 (95.2–99.1)	1.38 (0.53–3.61)	0.509	1.27 (0.45–3.52)	0.651
Hospital	343	96.8 (94.3–98.4)	reference		reference	
History of vaccination						
Yes	95	96.8 (91.0–99.3)	reference		reference	
No	547	97.3 (95.5–98.5)	1.15 (0.33–4.07)	0.821	0.90 (0.22–3.75)	0.890

vaccination but with rubella antibodies (94.7%) very likely had been vaccinated, even if the vaccination was not recorded.

The risk perception of HCW to vaccine-preventable diseases is 78% with respect to hepatitis according to Dinelli et al.[30] but there are no estimates for rubella. However, the lack of vaccination in HCW may be of importance, as shown by a recent outbreak of rubella in India that affected 23 workers.[31] HCW should be vaccinated against preventable diseases because they have a greater risk than the general population and because infectious diseases can spread to the patients they care for, other HCW, and their families. Due to the nature of the disease, rubella vaccination is essential in some services, such as obstetrics and pediatrics, where infections can have serious repercussions.

Another important factor in favor of rubella vaccination is that the cost of vaccination is lower than the cost of the disease[32] since the appearance of the disease implies precautionary measures that have higher health care costs. The mean cost of a hospital stay varies with the severity of the case, but ranges between €2082 and 4832.[33] Therefore, it is important to emphasize prevention strategies and infection control in the workplace, either through strict measures such as obliging new workers to be vaccinated[34,35] or through specific seroprevalence surveys to determine the situation and develop strategies to improve the immune status of HCW. It would also be desirable to facilitate maximum access to occupational health services and make catch-up campaigns.

The main strengths of this study are the large sample size and the inclusion of both hospital and primary health workers from various Catalan regions, which allowed a true picture of rubella infection in Catalan HCW. A main shortcomings of the study is that data on vaccination were collected retrospectively from the vaccination cards of participants and not all vaccinated HCW have the vaccinations received well recorded. However, because the main objective of the study was to determine the immune status of HCW against rubella, and IgG antibodies can demonstrate this, we believe our conclusions about immunity may be valid. Another limitation is that we used a convenience sample, which may not be representative of all HCW in Catalonia. However, as noted before, the large sample size, which included hospital and primary health workers from 5 of the 7 Catalan regions, and the fact that less than 5% of HCW invited to participate refused, suggest that our results may reflect the true situation in many healthcare centers.

In conclusion, our results show that the prevalence of immunity to rubella in HCW in Catalonia is high, but is lower in younger HCW, which could cause outbreaks in susceptible people and make the aims of eliminating endemic rubella and preventing CRS more difficult. Rubella vaccination should be reinforced in HCW aged <30 y to prevent nosocomial cases and cases of CRS. If vaccination coverage increases, the proportion of protected HCW in this age group will increase and consequently,

Table 3. Distribution of prevalence of rubella antibodies according to recorded history of vaccination in the variables studied

Variable	Recorded history of vaccination		No recorded history of vaccination			
	Number	Prevalence	Number	Prevalence	OR	*P*
		(95% CI)		(95% CI)	(95% CI)	
Age						
<30 y	53	94.3 (84.3–98.8)	75	94.7 (86.9–98.5)	0.94 (0.20–4.38)	1
30 – 44 y	38	100 (90.7–100)	216	98.1 (95.3–99.5)	NC	1
45 – 54 y	4	100 (39.8–100)	165	96.4 (92.3–98.7)	NC	1
≥55 y	0		91	98.9 (94.0–100)	NC	1
All	95	96.8 (91.0–99.3)	547	97.3 (95.5–98.5)	0.86 (0.25–3.05)	0.739
Sex						
Male	20	90.0 (68.3–98.8)	131	98.5 (94.6–99.8)	0.14 (0.02–1.05)	0.085
Female	75	98.7 (92.8–100)	416	96.9 (94.7–98.3)	2.39 (0.31–18.52)	0.706
Professional group						
Physician	37	94.6 (81.8–99.3)	154	98.7 (95.4–99.8)	0.23 (0.03–1.69)	0.170
Nurse	38	100 (90.7–100)	210	98.6 (95.9–99.7)	NC	1
Other clinical workers	12	91.7 (61.5–99.8)	73	94.5 (86.6–98.5)	0.64 (0.07–6.25)	0.542
Non-clinical workers	8	100 (63.1–100)	107	94.4 (88.2–97.9)	NC	1
Type of center						
Primary health	31	100 (88.8–100)	268	97.4 (94.7–98.9)	NC	1
Hospital	64	95.3 (86.9–99)	279	97.1 (94.4–98.8)	0.60 (0.15–2.33)	0.437

NC, Not calculable.

the risk of being infected and spreading the infection to the patients they take care of will decrease.

Materials and Methods

We performed a seroprevalence study of rubella antibodies in HCW in Catalonia using a convenience sample. Six public tertiary hospitals and five Primary Care Basic Prevention Units from different provinces of Catalonia (a region in the northeast of Spain with 7.5 million inhabitants) participated in the study.

In 2009, HCW of the participating centers were asked to complete a self-administered questionnaire during the routine health examination performed by the corresponding Occupational Health Unit, and to provide a blood sample. All subjects were informed of the nature of the study and gave written informed consent. The questionnaire collected the following variables: date of birth, sex, professional category (physician, nurse, other clinical workers, and non-clinical workers), type of center (hospital or primary care), history of having had rubella disease and vaccination history.

Blood samples were obtained by venipuncture. Sera were separated by centrifugation at 3000 rpm for 10 min and stored frozen at –40 °C until analysis.

Levels of rubella IgG antibodies were determined using the ADVIA® Centaur G™ Rubella Assay (Siemens Healthcare Diagnostics Inc.) IgG antibody capture microparticle direct chemiluminometric assay according to the manufacturer's instructions. Samples with values ≥10 IU/mL were considered positive[18] and those <5.0 IU/mL, negative. Samples with values between 5.0 and 9.9 IU/mL were considered indeterminate and repeated. Replicated results which were <10 IU/mL were considered negative. According to the manufacturer, the sensitivity and specificity of the method are 97.2% and 99.5% respectively. The intra-assay and interassay coefficients are less than 5% and 6.1%, respectively.

We calculated the prevalence, odds ratios (OR) and 95% confidence intervals (CI). To determine which variables were independently associated with antibody prevalence, crude odds ratios were calculated for different variables. For each variable studied, we took the group with the lowest prevalence of rubella antibodies as the reference group. Odds ratios were adjusted using multiple logistic regression analysis. Statistical significance was established assuming an α error of 0.05.

The data and statistical analyses were processed using the Statistical Package for Social Sciences (SPSS 19.0 for Windows) and R 2.13.0 (R Development Core Team 2011).

All data collected were treated as a confidential, in strict observance of legislation on observational studies. The study was approved by the Ethic Committee of the University of Barcelona. Written information consent was obtained from all subjects included in the study.

Disclosure of Potential Conflict of Interest

No potential conflicts of interest were disclosed .

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4.1.3. Serological survey of mumps immunity among health care workers in the Catalonia region of Spain. Magda Campins, Luis Urbiztondo, Josep Costa, Sonia Broner, María Esteve, José María Bayas, Eva Borras, Angela Domínguez and the Working Group for the Study of the Immune Status in Healthcare Workers of Catalonia. American Journal of Infection Control 2013; 41:378-380

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Brief report

Serological survey of mumps immunity among health care workers in the Catalonia region of Spain

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Susceptible health care workers are at risk of acquiring and transmitting mumps to or from patients. A survey was carried out in 639 health care workers from tertiary public hospitals and primary care centers in the Catalonia region of Spain during 2009 to determine the prevalence of immunity to mumps among this group. The prevalence of immune health care workers was 87.5% (95% confidence interval, 84.7-89.9). Vaccination with 2 doses of vaccine should be reinforced in health care workers to minimize the risk of mumps transmission in health care settings.

Mumps is a highly contagious infection caused by a *Paramyxovirus* and transmitted by droplets of respiratory secretions or by direct contact with the saliva of infected people.[1]

Following the introduction of the mumps vaccine, the incidence of the disease has decreased significantly. However, outbreaks still occur in populations with high vaccination coverage and typically affect young adults.[2] Transmission in health facilities is not common, but when community outbreaks occur, exposure and transmission in health care workers is frequent.[3] In the 2 most-recent large outbreaks in the United States—in 2006 and 2009-2010—between 0.2% and 8.5% of patients were health care workers who acquired mumps through contact with patients.[4]

The aim of this study was to determine the degree of protection against mumps in health care workers in the Catalonia region of Spain.

METHODS

Six hospitals and 5 primary health care centers were chosen from the different provinces of Catalonia in Spain. The study period was June 2008 to December 2010. All health care workers were informed of the study during routine health examinations at the occupational risk prevention units. Blood samples were collected from health care workers who agreed to participate. The following variables were collected by an autoadministered questionnaire: age, sex, professional category, type of center, and history of mumps infection or mumps vaccination.

Mumps antibodies were determined by Mumps ELISA IgG Kit (Vircell Microbiologists, Granada, Spain), using the Genesis RMP 150 autoanalyzer (Tecan, Männedorf, Switzerland) according to the manufacturer's instructions. The sensitivity and specificity of the method is 98% and 95%, respectively.

Pearson's χ^2 test was used to compare proportions. The odds ratios (OR) and their 95% confidence intervals (CI) were calculated to determine the variables associated with the prevalence of protective antibodies. A multivariate logistic regression analysis was performed to adjust the study variables. A P value $<.05$ was considered statistically significant. The statistical analysis was performed using the SPSS version 18.0 statistical package (2009, IBM, Armonk, NY).

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Table 1
Prevalence of immunity to mumps according to study variables

Variable	n	Prevalence of immunity (95% CI)	Crude OR (95% CI)	Adjusted OR (95% CI)
Birth cohort				
≥1981	72	76.4 (64.9-85.6)	Reference	Reference
1965-1980	292	89.4 (85.3-92.7)	2.6 (1.35-5.03)	2.71 (1.36-5.40)
1957-1964	138	87.7 (81-92.7)	2.2 (1.05-4.63)	2.32 (1.04-5.18)
<1957	137	89.1 (82.6-93.7)	2.51 (1.17-5.4)	2.66 (1.17-6.02)
Sex				
Male	150	86.7 (80.2-91.7)	Reference	Reference
Female	489	87.7 (84.5-90.5)	1.10 (0.64-1.89)	1.14 (0.63-2.05)
Professional category				
Physicians	186	87.6 (82-92)	1.26 (0.61-2.63)	1.20 (0.56-2.54)
Registered nurses	249	88 (83.2-91.7)	1.30 (0.64-2.62)	1.15 (0.55-2.40)
Other health workers	86	84.9 (75.5-91.7)	Reference	Reference
Nonhealth workers	115	87.8 (80.4-93.2)	1.28 (0.57-2.90)	1.31 (0.49-2.59)
Workplace				
Primary care	299	87.6 (83.3-91.1)	1.03 (0.64-1.64)	1.18 (0.71-1.98)
Hospital	340	87.4 (83.3-90.7)	Reference	Reference

OR, odds ratio; *CI*, confidence interval.

RESULTS

A total of 639 health care workers (299 from primary care and 340 from hospital settings) participated in the study. One hundred seventy-six health care workers (27.5%) reported mumps infection in the past, and 170 (26.6%) mumps vaccination, but only in 81 (12.7%) it could be documented by vaccination card. Vaccination with 2 doses was documented in only 38 health care workers, of whom 32 were aged <27 years.

The overall prevalence of immunity to mumps was 87.5% (95% CI, 84.7-89.9). Table 1 shows the percentages of immune health care workers according to birth cohort, sex, professional category, and type of center. The highest proportion of susceptible subjects (23.6%) was found in health care workers aged <27 years. There were no statistically significant differences in the prevalence of susceptibility by sex, professional category, or type of center. Prevalence of immunity in vaccinated health care workers who documented it by vaccination card (85.2%) did not differ from the prevalence in subjects with unverified history of vaccination (86.5%) ($P = 0.93$).

The only variable associated with the prevalence of immunity was the birth cohort: subjects born before 1981 had a higher prevalence than those born after 1980. The highest OR was observed in the cohort born between 1965 and 1980 (OR, 2.71; 95% CI, 1.36-5.4) (Table 1). Neither the history of vaccination or the antecedent of mumps infection was significantly associated with serological immunity (OR, 0.83; 95% CI, 0.39-1.76 and OR, 1.82; 95% CI, 0.97-3.39, respectively).

DISCUSSION

The prevalence of susceptibility to mumps in health care workers from Catalonia (12.5%) is higher than that found in the general population in our setting (8.9%; 95% CI, 7.8-10)[5] and similar to that found in other studies performed in health care workers.[6-11] Two studies carried out in the United States in 2006-2007 found that 8%-13% of health care workers were susceptible.[6,7] According studies including health care workers from Japan and Australia, the percentages of susceptibility ranges between 14.2%[8] and up to 17%,[9] respectively. Studies in Italy and France show similar figures, which are higher than those observed for other vaccine-preventable diseases such as measles or rubella.[10,11]

Age was the most important predictor of susceptibility. According to results from seroprevalence studies, Centers for Disease Control and Prevention guidelines consider that people born before 1957 are immune.[4] However, some reports have found that 4%-5% of people born before 1957 are susceptible,[10] a figure that reaches 10% in our study. The highest prevalence of susceptible subjects was found in the younger cohorts, as observed in our study, with 23% of health care workers seronegative in those aged <27 years. In Catalonia, routine pediatric vaccination against mumps (ie, the MMR vaccine) was introduced in 1980. It would be logical to expect that only health care workers born after 1980 were correctly vaccinated with 2 doses of vaccine and that susceptibility to mumps would be minimal in these subjects. However, the results of this study do not corroborate this supposition.

In contradiction to the Centers for Disease Control and Prevention guidelines,[4] Fedeli et al[10] recommended serological screening of all health care workers working in high-risk units, regardless of age and the history of mumps infection, unless immunization with 2 doses of vaccine was documented.

A 2007 update of the Advisory Committee on Immunization Practices of the Centers for Disease Control and Prevention recommended the incorporation of a second dose of MMR vaccine for all adults without serological evidence of immunity or medical evidence of mumps infection, and also for some high-risk groups, including health care workers.[12] The resurgence of mumps in recent years in many countries with high vaccination coverage, and the occurrence of major outbreaks, justifies this recommendation. The effectiveness of a single dose of vaccine is around 65%-80% and ranges between 88%-95% for 2 doses.[4]

Among the limitations of this study we must consider the lack of external validity. Because this was an opportunistic sample, the results cannot be generalized to all health care workers in Catalonia. In addition, there was no serological study of all employees of the selected centers, but only those who voluntarily attended health screenings. However, we studied a large sample, including both hospital and primary care workers and various age groups.

The high transmissibility of mumps and the risk of nosocomial outbreaks make it necessary to strengthen preventive strategies. Our results suggest that efforts should be made in Catalonia to increase the mumps vaccination coverage in health care workers.

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J. Amores, T. Catalán, A. Company, M. Cortés, C. Diez, E. Domenech, X. Esteva, J. Funes, R. Llobet, A. Marinetto, M. Plana, J. Sol, A. Tarragó, M. Vendrell (Unitats Bàsiques de Prevenció de Riscos Laborals d'Atenció Primària del Institut Català de la Salut); E. Barbé,

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4.1.4. Prevalence of susceptibility to tetanus and diphtheria in health care workers in Catalonia. María Esteve, Angela Domínguez, Luis Urbiztondo, Eva Borrás, Josep Costa, Sonia, Magda, José María Bayas and the Working Group for the Study of the Immune Status in Healthcare Workers in Catalonia. American Journal of Infection Control 2012; 40:896-8

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Brief report

Prevalence of susceptibility to tetanus and diphtheria in health care workers in Catalonia

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Key Words:
Vaccination coverage
Health-care personnel
Seroprevalence
Occupational health program

A seroprevalence study of tetanus and diphtheria was carried out in a sample of 537 health care workers in Catalonia. The prevalence of protective antibodies against tetanus was 93.9% (95% confidence interval: 91.5-95.7). The prevalence of protective antibodies against diphtheria was 46.4% (95% confidence interval: 42.1-50.7). Tetanus protection should be improved in health care workers born before 1975. The immune status against diphtheria was poor, with less than half of people born before 1975 correctly immunized.

Studies evaluating vaccination in health care workers (HCW) show that coverage against measles, rubella, mumps, varicella, and hepatitis B are usually above 85% and that HCW can acquire immunity by vaccination or natural immunity.[1-3] However, there are little data on data on vaccination coverage of tetanus and diphtheria, which although not specifically indicated in HCW, are indicated in all adults. Therefore, HCW may play an educational, exemplary role by keeping their vaccination card up to date.[4] The aim of this study was to determine levels of protection against diphtheria and tetanus in HCW in Catalonia.

PATIENTS AND METHODS

HCW from public health centers in Catalonia were informed of the study and recruited after obtaining written informed consent. Blood samples were obtained and demographic and clinical variables collected using a questionnaire (age, sex, occupational category, type of health center, and vaccination history).

Anti-tetanus toxoid antibody and anti-diphtheria toxoid antibody levels were determined by Tetanus ELISA IgG Testkit and Diphtheria ELISA IgG Testkit, respectively (Virotech; Genzyme Virotech GmbH, Löwenplatz 5, D-65428 Rüsselsheim, Germany). Tetanus or diphtheria levels antibodies $\geq$ 0.1 IU/mL were considered protective.

The odds ratios (OR) and their 95% confidence intervals (CI) were calculated to determine variables associated with the prevalence of protective antibodies. ORs were adjusted using multiple logistic regression. The statistical analysis was performed using SPSS v19.0 (SPSS Inc, Chicago, IL) for Windows and R 2.13.0 (R Development Core Team 2011).

RESULTS

Between June 2008 and December 2010, 537 HCW were recruited. The mean age was 42.3 years (standard deviation, 10.9), and 76.5% were female. By occupational category, 29% were physicians, 39.8% registered nurses, 12.2% other HCW (laboratory technicians, orderlies), and 18.2% non-health care professionals (maintenance, and cleaning and kitchen workers).

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Table 1
Prevalence of antibodies to tetanus in health care workers

Characteristics	No, n	Yes, n	Prevalence, % (95% CI)*	Crude OR (95% CI)	*P* value	Adjusted OR (95% CI)	*P* value
Age group, yr							
<25	16	16	100 (79.4-100)		.20		.20
25-34	154	154	100 (97.4-100)		<.001		<.001
35-44	134	130	97 (92.5-99.2)	4.90 (1.51-15.93)	.01	4.90 (1.5-15.9)	.01
45-54	149	131	87.9 (81.6-92.7)	1.10 (0.49-2.45)	.84	1.10 (0.49-2.45)	.84
≥55	84	73	86.9 (77.8-93.3)	Reference		Reference	
All	537	504	93.9 (91.5-95.7)				
Sex							
Male	126	121	96 (91-98.7)	Reference			
Female	411	383	93.2 (90.3-95.4)	0.57 (0.21-1.5)	.25		
Total	537	504					
Type of center							
Primary care	299	278	93 (89.5-95.6)	Reference			
Hospital	238	226	95 (91.4-97.4)	1.42 (0.69-2.95)	.34		
Total	537	504					
Occupational category							
Physician	156	144	92.3 (86.9-96)	Reference			
Nurse	214	200	93.5 (89.3-96.4)	1.19 (0.53-2.65)	.68		
Other (health care)	66	65	98.5 (91.8-100)	5.42 (0.69-42.54)	.11		
Other (non-health care)	98	92	93.9 (87.1-97.7)	1.28 (0.46-3.52)	.80		
Total	537	504					

*People with antibodies ≥ 0.1 IU/mL.

Table 2
Prevalence of antibodies to diphtheria in health care workers

Characteristics	No, n	Yes, n	Prevalence, % (95% CI)*	Crude OR (95% CI)	*P* value	Adjusted OR (95% CI)	*P* value
Age group, yr							
<25	16	14	87.5 (61.7-98.4)	11.96 (2.62-54.62)	<.001	11.96 (2.62-54.62)	<.001
25-34	154	89	57.8 (49.6-65.7)	2.34 (1.48-3.71)	<.001	2.34 (1.48-3.71)	<.001
35-44	134	59	44 (35.5-52.9)	1.34 (0.83-2.17)	.22	1.34 (0.83-2.17)	.22
45-54	149	55	36.9 (29.2-45.2)	Reference		Reference	
≥55	84	32	38.1 (27.7-49.3)	1.05 (0.61-1.83)	.86	1.05 (0.61-1.83)	.86
All	537	249	46.4 (42.1-50.7)				
Sex							
Male	126	60	47.6 (38.7-56.7)	1.07 (0.72-1.59)	.75		
Woman	411	189	46 (41.1-50.9)	Reference			
Total	537	249					
Type of center							
Primary	299	135	45.2 (39.4-51)	Reference			
Hospital	238	114	47.9 (41.4-54.4)	1.12 (0.79-1.57)	.53		
Total	537	249					
Occupational category							
Physician	156	72	46.2 (38.2-54.3)	1.16 (0.76-1.76)	.49		
Nurse	214	91	42.5 (35.8-49.4)	Reference			
Other (health care)	66	36	54.5 (41.8-66.9)	1.62 (0.93-2.83)	.09		
Other (non-health care)	98	49	50 (39.7-60.3)	1.35 (0.84-2.18)	.22		
Total	537	249					

*People with antibodies ≥0.1 IU/mL.

The overall prevalence of protective antibodies against tetanus was 93.9% (Table 1), which decreased significantly with age, from 100% in people aged < 35 years to 87% in people aged > 55 years. HCW aged < 45 years were almost 5-fold more likely to be protected than people aged > 55 years (OR, 4.90; 95% CI: 1.51-15.93).

Geometric mean titers of tetanus antibodies in HCW aged < 40 years were significantly higher than those for all other ages (2.78 ± 0.52 and 2.08 ± 0.57 IU/mL, respectively) ($P < .0001$). A history of tetanus vaccination was a good predictor of immunity: 98% of people who stated they were vaccinated were immune and most susceptible people were unvaccinated.

The overall prevalence of protective antibodies against diphtheria was 46.4% (95% CI: 42.1-50.7) (Table 2). HCW aged < 25 years were almost 12-fold more likely to be protected than people aged > 55 years (OR, 11.96; 95% CI: 2.6-54.6).

A history of diphtheria vaccination was not a good predictor of immunity to diphtheria. No differences were detected in the tetanus and diphtheria immune status according to sex, occupational category, or type of center (hospital or primary care).

DISCUSSION

Our results show that 93.9% of Catalan HCW are adequately immunized against tetanus, a much-higher prevalence than the 70.4% recently reported by Lu et al,[3] who obtained information on HCW vaccination status by telephone interview (National Adult Immunization Survey; Centers for Disease Control and Prevention).[3]

HCW immune status against tetanus has improved in recent years as shown by the results of a 1999 Spanish study that found an overall prevalence of tetanus antibodies of 76.5%[5] and that the prevalence of tetanus antibodies in HCW decreased, although not significantly, with age, and was significantly higher in males (84% vs 72.4%, respectively).

Compared with studies in the general population, there are few reports on the prevalence of tetanus antibodies in HCW.[6,7] A recent seroepidemiologic study in the Catalan general population found a prevalence of tetanus antibodies of 99.4% in people aged 5 to 14 years and 68.3% in people aged >15 years.[8] In our study, 100% of people aged <35 years had protective antibodies compared with 87% of people aged >55 years. The widely reported association between lower levels of tetanus immunity and increasing age[9,10] is related to inadequate revaccination. Likewise, the prevalence of tetanus antibodies is significantly higher in males in both US HCW[3] and the Spanish population.[8] However, we found no between-sex differences in the prevalence of antibodies, possibly due to the efforts of the health system to ensure high vaccination coverages and occupational health programs in HCW.

We found that tetanus toxin geometric mean titers were significantly higher in people aged < 40 years. Recent studies have reported prevalences of tetanus immunization of > 94% and shown the impact of revaccination programs every 10 years, leading to recommendations to extend the interval between booster doses of tetanus and diphtheria toxoid vaccine (Td).[6,7,10]

Only 46.4% of HCW had protective levels of antibodies against diphtheria. Immunity fell significantly with age, from 87.5% in people aged < 25 years to 38.1% in people aged > 55 years. Adults born before approximately 1965 not receiving diphtheria, tetanus, and pertussis primary vaccination in childhood may not have received primary diphtheria vaccination, with some receiving only 1 dose in the last 15 years.

When diphtheria was common, immunity was acquired naturally but is now acquired by vaccination. Without revaccination and natural contact with the bacillus, vaccine immunity is lost, and most adults become susceptible. Introducing systematic adult Td revaccination in many countries in the 1980s has increased diphtheria vaccination coverage. Recent studies show that >70% of people aged >50 years are protected against diphtheria.[6,7,11]

Although tetanus and diphtheria are very infrequent in Catalonia, it is important that HCW—as well as providing an example to the general public—should guard against accidental transmission and possible transmission through contact with patients by correct vaccination.

In conclusion, tetanus antibody levels were adequate in HCW born after 1975 but should be improved in those born before this date. However, less than half of HCW born before 1975 were correctly immunized against diphtheria. Efforts should be made to ensure adequate levels of immunization against tetanus and diphtheria, especially in people revaccinated with tetanus and diphtheria toxoid vaccine (Td or Tdpa) at ≤ 40 years of age without evidence of correct primary vaccination.

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Seroprevalence study of *B. pertussis* infection in health care workers in Catalonia, Spain

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Keywords: Pertussis, whooping cough, pertussis antibodies, anti-pertussis toxin antibodies, health care workers, nosocomial pertussis outbreaks.

Abbreviations: Anti-FHA, Anti-filamentous hemagglutinin antibodies; Anti-pertussis ab, Pertussis antibodies; Anti-PT ab, Anti-pertussis toxin antibodies; Tdap, Adult type diphtheria-tetanus acellular pertussis (vaccine); DTaP, Diphtheria-tetanus acellular pertussis (vaccine); DTwP, Diphtheria-tetanus whole-cell pertussis (vaccine) ELISA, Enzyme-linked immunosorbent assay; FHA, Filamentous hemagglutinin; HCW, Health care workers; ORP, Occupational Risk Prevention; PT, Pertussis toxin

Pertussis is a re-emerging infection in countries with high infant immunization coverage. Healthcare workers (HCW) are exposed and can transmit the infection to especially-vulnerable patients. Therefore, pertussis vaccination of HCW is recommended.

Between June 2008 and December 2010, 460 HCW from hospital and primary healthcare centers were recruited to determine susceptibility to pertussis. IgG antibodies against pertussis (anti-pertussis ab) were measured, using a routine technique that detects antibodies against pertussis including pertussis toxin (PT) and filamentous hemagglutinin (FHA). Positive results were confirmed with a more-specific technique that only assesses anti-PT IgG antibodies.

The median age was 42 years (range, 21–65), 77.3% were female. 172 were nurses, 133 physicians, 60 other clinical workers and 95 non-clinical workers. None had received pertussis vaccination since childhood. The overall prevalence of anti-pertussis antibodies was 51.7%, (95% CI 47.1–56.4).

Anti-PT antibodies were determined in the 220 HCW with positive anti-pertussis antibodies: 4 (1.8%) were negative and 33 (15%) had a high titer (≥ 45 IU/mL).

No significant differences between the prevalence of anti-pertussis antibodies or anti-TP antibodies were found according to age, type of occupation or type of center.

Our study confirms the need for vaccination of HCW because at least half are susceptible to pertussis. High anti-PT titers found in 15% of seropositive HCW showed that they had had recent contact with *B. pertussis*.

Introduction

Pertussis, or whooping cough, is a bacterial infection caused by *Bordetella pertussis,* an exclusively-human pathogen that can affect individuals of all ages. Infants younger than 4 mo are the most vulnerable group, with high rates of complications and mortality.[1] Neither infection nor vaccination induce life-long immunity and reinfections are frequent and occur throughout life. Pertussis is a worldwide disease, including countries with high vaccination coverage.[2]

In Catalonia, pertussis vaccination in children began in 1965. Initially, whole-cell vaccine (DTwP) was used but was replaced by acellular pertussis vaccine (DTaP) in 2002. The incidence of pertussis decreased with vaccination, reaching the lowest level in the early 1990s. As observed in other countries with high vaccination coverages,[3] in recent years the incidence of pertussis has increased in Catalonia, with major outbreaks occurring.[4,5] Infants aged <1 y are the most affected age group, with most cases occurring in children aged <6 mo who have not initiated vaccination or have not completed primary vaccination.

Nosocomial outbreaks of pertussis are not uncommon and healthcare workers (HCW) may be a source of infection in infants whose poor health status (prematurity, etc) makes them particularly vulnerable.[1,6,7] Numerous nosocomial outbreaks of pertussis

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with a large number of exposed HCW have been reported.[8–13] This highlights the importance of vaccination of HCW, especially in maternity and pediatric units, a strategy recommended in various countries.

In order to reduce pertussis transmission in children in whom the disease may be associated with serious complications, since 2004 in Spain vaccination against pertussis is recommended for HCW who care for preterm children requiring hospitalization[14] and since 2011 for HCW working in pediatrics and obstetrics.[15]

However, pertussis vaccination coverages in HCW are still very low and it is assumed that many HCW are susceptible. The objective of this study was to determine the seroprevalence of antibodies against pertussis in Catalan HCW.

Results

Five of the 10 primary healthcare Occupational Risk Prevention (ORP) services and 6 of the 9 hospital ORP invited to participate in the study accepted. The participating centers were located in 5 of the 7 Catalan health regions, representing 87.6% of the population.

Between June 2008 and December 2010, 460 HCW were recruited 172 nurses, 133 physicians, 60 other clinical workers and 95 non-clinical workers. The median age was 42 y (range, 21–65) and 77.3% were female (**Table 1**).

A total of 238 HCW had positive anti-pertussis antibodies. Overall prevalence was 51.7%, (95% CI 47.1–56.4).

Anti-PT antibodies were determined in 220 of the HCW with positive anti-pertussis antibodies (in 18 subjects no sample was available), of whom 4 (1.8%) were negative and 33 (15%) had a titer ≥ 45 IU/mL (**Table 2**).

No significant differences between the prevalence of anti-pertussis ab or anti-PT antibodies were found according to age, type of occupation or type of center. No HCW studied had been vaccinated with the adult type pertussis vaccine (Tdap)

Table 1. Results of the bivariate analyses of pertussis antibodies in healthcare workers

Variable	Positive anti-pertussis ab	n	Prevalence (95%CI)	OR (95%CI)	p
Year of birth					
1981 and after	20	44	45.5 (30.4–61.2)	1	
1965–1980	102	208	49.0 (42.1–56.0)	1.16 (0.60–2.22)	0.666
1964–1955	66	123	53.7 (44.4–62.7)	1.40 (0.70–2.77)	0.351
1954 and before	50	85	58.8 (47.6–69.4)	1.71 (0.82–3.57)	0.150
All	238	460	51.7 (47.1–56.4)		
Sex					
Male	57	104	54.8 (44.7–64.6)	1.17 (0.76–1.82)	0.477
Female	181	356	50.8 (45.5–56.2)	1	
Professional group					
Physician	73	133	54.9 (46.0–63.5)	1.22 (0.66–2.24)	0.529
Nurse	87	172	50.6 (42.9–58.3)	1.02 (0.57–1.84)	0.938
Other clinical workers	30	60	50.0 (36.8–63.2)	1	
Non-clinical workers	48	95	50.5 (40.1–60.9)	1.02 (0.54–1.95)	0.949
Type of care					
Pediatric care	54	95	56.8 (46.3–70.0)	1	
No pediatric care	184	365	50.4 (45.2–55.7)	1.30 (0.82–2.04)	0.265
Type of center					
Primary healthcare	140	277	50.5 (44.5–56.6)	1	
Hospital	98	183	53.6 (46.0–60.9)	1.13 (0.78–1.64)	0.527

Anti-pertussis ab, pertussis antibodies; OR, odds ratio; CI, confidence interval.

Discussion

Our results show that around half the HCW studied had no antibodies against pertussis, similar to the finding of studies in HCW conducted in Spain and other countries.[16-18] De Juanes et al.[16] found a seroprevalence of pertussis antibodies in 51.7% of HCW tested in routine health exams at a university hospital in Madrid (Spain), with no significant differences according to age or type of occupation, Higa et al.[17] found 43.8% of IgG-PT in medical staff at a Japanese university hospital, and Hashemi et al.[18] found a prevalence of IgG-PT antibodies of 47.6% in Iranian medical students.

Of HCW in whom antibodies were measured, 15% (7.8% of all participants) had a titer ≥45 IU/mL, which is an indicator of recent *B. pertussis* infection,[19] highlighting the persistence of circulation among HCW. This may be due to a higher risk of infection in the healthcare environment or simply a result of the circulation of *B. pertussis* in the general population. A Dutch study found that 9% of people aged > 9 y had high anti-PT titles, indicating recent infection.[20] In a Chinese study of seroprevalence in the general population, 8.9% of subjects studied had

anti-PT titers > 30 IU/ml, showing a high incidence of infection in adolescents and adults, which supports the appropriateness of revaccinating adolescents and adults.[21] In Europe, recent infection was significantly more likely in adolescents aged 10–19 y and adults in high-coverage countries (Finland, the Netherlands, France, East Germany), whereas infection was more likely in children aged 3–9 y than adolescents in low-coverage (<90%; Italy, West Germany, United Kingdom) countries.[22]

Whether or not pertussis circulation is similar in healthcare environments and the general population, infection in the healthcare setting is particularly serious because it may affect especially vulnerable subjects, as newborns or premature infants. Nosocomial pertussis outbreaks have been well documented, being a health-care worker with pertussis the source of infection many times.[8-13,23] Our results also suggest the importance of complying Tdap vaccination recommendations for HCW in order to prevent transmission of pertussis to patients.[2,24-26]

Moreover, this strategy for the control of nosocomial outbreaks of pertussis may also have a better cost-effectiveness ratio, since nosocomial outbreaks are difficult to manage and result in significant associated expenditure.[27-29] Begget el al.[27] in an outbreak in a general hospital in Washington State estimated that the cost of a case of pertussis was 43,893 US$ and Yasmin et a.l[29] in an outbreak affecting a neonatal intensive care unit estimated the cost per case as 6,500 US$.

Exposure of HCW to pertussis during contact with children who have the disease is largely unavoidable, and management of this exposure results in substantial costs to hospitals, even when the number of pertussis cases is low. Universal pre-exposure pertussis vaccination of HCW is a better utilization of resources than a case-based post-exposure strategy.[30]

One limitation of this study is that, as a convenience sample was used, the results may not be generalizable to all Catalan HCW. Likewise, the serological study was made in HCW who voluntarily attended ORP health examinations. Therefore, the prevalence of pertussis antibodies in the study subjects may differ from that of HCW who did not attend these health examinations. However, the large sample size, including hospital and primary healthcare workers from 5 of the 7 Catalan health regions, and the fact that less than 5% of HCW invited to participate refused, suggest that our results may reflect the true situation in many Catalan healthcare centers.

In conclusion, HCW with high titer of anti-PT antibodies show evidence of the circulation of *B. pertussis* in Catalonia, nevertheless a high percentage of susceptible HCW were detected. Taking into account the risk for patients attended by these HCW, Catalan HCW should receive Tdap vaccination, especially in HCW working in pediatric and obstetric settings.

Materials and Methods

The study was performed using a convenience sample. ORP services from the 10 primary healthcare areas and 9 of the leading tertiary hospitals in Catalonia were asked to recruit subjects participating in the study. We considered as HCW all persons working in healthcare settings who had the potential for exposure to patients and/or to infectious materials. HCW included physicians, nurses, other clinical workers (nursing assistants, therapists, technicians, emergency medical service personnel, pharmacists, laboratory personnel, students and trainees) and non-clinical workers (house-keeping, laundry, security, maintenance, administrative staff and billing).

Table 2. Anti-PT antibodies level in HCW with positive anti-pertussis antibodies

Anti-PT ab	Meaning	n	%
<5 UI/mL	N	4	1.8
5–35 UI/mL	NCR	161	73.2
36–44 UI/mL	I	22	10.0
45–99 UI/mL	P	23	10.5
^{3}100 UI/mL	PI	10	4.5
All		220	100

Anti-PT ab, anti- pertussis toxin antibodies; N, Negative or antibodies not detected; NRC, No recent contact, positive titer with low antibodies; I, Positive indeterminate, possible infection or recent vaccination but not sure; P, Positive, recent infection or vaccination; PI, Positive infection, current infection or vaccination in last 12 mo.

HCW attending voluntary periodic health examinations between June 2008 and December 2010 were informed of the study and were recruited after written informed consent was obtained. The study was approved by the Ethics Committee of the University of Barcelona. Blood samples were obtained and were centrifuged (10 min at 2500 rpm) and sera were stored at –20 °C until analysis. Demographic and epidemiological variables were collected using a questionnaire (age, sex, type of HCW, type of center, and vaccination history) that was completed under the supervision of ORP physicians and nurses. If available, the vaccination card was also reviewed.

The seroprevalence of anti-pertussis IgG antibodies (anti-pertussis ab), which includes the anti-pertussis toxin (anti-PT) and anti-filamentous hemagglutinin (anti-FHA) antibodies, was determined using a screening test (*Bordetella pertussis* ELISA test. Sekisui Virotech GmbH. Germany), which has a sensitivity of >99.8% and a specificity of 78.1% for IgG antibodies against PT and FHA. Results were considered positive if anti-pertussis antibodies were detected and negative if they were not.

Filamentous hemagglutinin is an antigen group also found in other agents of the species *Bordetella* (e.g., *Bordetella parapertussis, Bordetella bronchiseptica*) and cross reactivity is therefore to be expected. For this reason, in people with a positive result, IgG anti-PT antibodies were determined by a quantitative ELISA test (Pertussis Toxin ELISA test. Sekisui Virotech GmbH. Germany) that can detect acute or recent infection. Titers >40 IU / mL indicate recent contact with *B. pertussis*, with a sensitivity of 80% and a specificity of 95%.[19]

The results were grouped into the following categories: N (anti-PT < 5 IU / mL) Negative or antibodies not detected; NRC (anti-PT = 5–35 IU / mL) No recent contact, positive titer with low antibodies; I (anti-PT = 36–44 IU / mL) Positive indeterminate, possible infection or recent vaccination but not sure; P

(anti-PT = 45–99 IU / mL) Positive, recent infection or vaccination; and PI (anti-PT ≥ 100 IU / mL) Positive infection, current infection or vaccination in last 12 mo.

All determinations were performed following the manufacturer's recommended instructions.

Antibody prevalence and their 95% confidence intervals (CI) were calculated. To determine which variables were independently associated with antibody prevalence, odds ratios (OR) and 95% CI were calculated for different variables. Statistical significance was established assuming an α error of 0.05. The data and statistical analyses were processed using the Statistical Package for Social Sciences (SPSS 19.0 for Windows) and R 2.13.0 (R Development Core Team 2011).

Disclosure of Potential Conflicts of Interest

No potential conflicts of interest were disclosed.

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4.1.6. Varicella-zoster virus immunity among health care workers in Catalonia.

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Varicella-zoster virus immunity among health care workers in Catalonia

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ABSTRACT

Objective: To determine varicella-zoster virus (VZV) immunity among healthcare workers (HCWs). Cross-sectional study. Participants: HCWs attending voluntary periodic health examinations between June 2008 and December 2010. Setting: Six public hospitals and five primary care areas in Catalonia, Spain.
Methods: A self-administered questionnaire was given to eligible HCWs. Variables including age, sex, professional category, type of centre, history of varicella infection, and VZV vaccination were collected. The study was carried out using a convenience sample. The prevalence of antibodies and positive and negative predictive values (PPV and NPV) of the history of clinical VZV infection or vaccination were calculated. Crude and adjusted odds ratios (OR and ORa) and their 95% confidence intervals (CI) were calculated to determine the variables associated with antibody prevalence.
Results: Of 705 HCWs who agreed to participate, 644 were finally included. The overall prevalence of antibodies to varicella was 94.9% (95% CI: 92.9–96.4). Of the variables studied, only age was associated with serological susceptibility to VZV. HCWs aged 25–35 years had the highest serological susceptibility (8.1%, 95% CI: 4.6–13.0). The prevalence of antibodies was 96% in subjects reporting previous VZV infection or vaccination, compared with 93% in subjects who did not report these states or did not know.
Conclusions: The high proportion of serologically-susceptible HCWs found in this study indicates the need to develop for screening and vaccination strategies in Catalonia. Due to the high capacity of propagation of the VZV in health settings and its consequences, VZV vaccination programmes in HCWs should be reinforced.

1. Introduction

Varicella-zoster virus (VZV) is highly contagious, with high secondary attack rates in susceptible people [1]. Varicella is generally benign and self-limiting in immunocompetent children, but is often more severe in adults. Control of varicella is especially important in health care settings because VZV infection is infrequent but potentially serious, as it may affect premature babies, pregnant women, adults and patients who are immunocompromised due to underlying disease or some therapies [2–4]. In these patients, varicella is more severe and has a worse prognosis than in the rest of the population [5–10]. VZV vaccination is included in the measures recommended for all susceptible healthcare workers (HCWs) [11], even when it is not included in the routine immunization schedule [12].

Since 2005, the official immunization schedule of Catalonia, as in most Spanish regions, indicates VZV vaccination (two doses) of susceptible adolescents with no clinical history of VZV infection or previous vaccination (reported by parent or guardian) at 12 years of age [13]. At this age, 90% of subjects have VZV antibodies [14]. An undefined proportion of children of this age are already vaccinated

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by private clinics. Selective vaccination is recommended in people with negative serology belonging to some groups, including HCWs [13].

Both wild-type VZV infection and vaccination induce a humoral and cellular immune response that provides long term protection against varicella in the majority of subjects, although subclinical reinfection is common [12]. Cellular immunity plays a crucial role in defending the infected person from spreading the virus during acute illness and protects persons with latent VZV from developing zoster [15]. It is unclear whether the VZV-specific antibody plays a direct role in protection or if it is simply a surrogate marker of vaccine-elicited T cell responses that accompany seroconversion [16]. Nevertheless, traditionally, immunity to VZV after infection or immunization is assessed by measuring antibody titres [15]. In general, persons with a positive titre in a commercial glycoprotein-based immunoenzyme (gp-ELISA) assay, are thought to be protected from varicella [15]. This is the rationale for serological screening.

Available information on the prevalence of VZV antibodies in Spanish HCWs is scarce. A study carried out in HCW from five hospitals in Catalonia found a prevalence of 96.2% [17].

The aim of this study was to determine the prevalence of VZV antibodies among HCWs from different health care areas in Catalonia.

2. Methods

2.1. Study design and study participants

A cross-sectional study was carried out using a convenience sample. Occupational Risk Prevention (ORP) services from 10 primary healthcare areas and 9 of the leading tertiary hospitals in Catalonia were asked to recruit patients between June 2008 and December 2010. There are an estimated 104,000 HCW in Catalonia, of which 45% belong to the ORP services invited to participate in the study.

HCWs attending voluntary periodic health examinations were informed of the study and were recruited after written informed consent was obtained. ORP services must offer a health examination in order to prevent the specific risks related to HCW at the beginning of the professional relationship and at least every three years thereafter.

The study was approved by the Ethics Committee of the University of Barcelona.

Blood samples were obtained and demographic and epidemiological variables were collected using a self-administered questionnaire (age, sex, type of HCW, type of centre, history of having had varicella infection and vaccination history). If available, the vaccination card was also reviewed.

The presence of VZV IgG antibodies was studied by a gp-ELISA, (Vircell Varicella-Zoster ELISA IgG Kit. Vircell SL. Granada, Spain) using the Tecan Genesis RMP 150 autoanalyser according to the manufacturer's instructions. According to the manufacturer, both the sensitivity and specificity of the method are 96%.

2.2. Statistical analysis

The prevalence of antibodies and their 95% confidence intervals (CI) were calculated by the exact binomial method. Positive and negative predictive values (PPV and NPV) and their 95% CI were calculated using binomial distribution. To determine which variables were associated with antibody prevalence, the odds ratios (OR) and their 95% CI were calculated. Odds ratios were adjusted (ORa) using multiple logistic regression with two additional strategies: full model (i.e. with all candidate variables) and a backward selection procedure. The inclusion and exclusion criteria used were; $p < 0.05$ for model entry and $p > 0.10$ for output, according to Wald statistics. Statistical significance was established assuming an alpha error of 0.05. Data processing and analysis was carried out using the IBM SPSS Statistics for Windows, version 19.0 and R 2.13.0 (R Development Core Team 2011) programs.

3. Results

Five of the 10 primary healthcare ORP and 6 of the 9 hospital ORP invited to participate accepted. The participating centres were located in 5 of the 7 Catalan health regions, representing 87.6% of the population. Very few workers refused to take part in the study (<5% in participating ORP). Of 705 HCWs who agreed to participate, 644 (299 primary and 345 hospital workers) were finally included in the study, of whom 76.5% were female. The distribution by professional category was: 191 (29.8%) physicians, 249 (38.8%) nursing graduates, 86 (13.5%) other health professionals and 115 (17.9%) non-clinical workers. In three workers, the professional category was not recorded.

The overall prevalence of VZV antibodies was 94.9% (95% CI: 92.9–96.4). Table 1 shows the percentages of HCWs seropositive for VZV antibodies according to age, sex, professional category and type of centre. HCWs aged 25–35 years had the highest prevalence of subjects without VZV antibodies (8.1%, 95% CI: 4.6–13.0) and the 36–44 year age group had the lowest frequency of serologically-susceptible HCW (3.0%, 95% CI: 1.0–6.8). There were no statistically significant differences in the prevalence of serological-susceptibility by sex, professional category or type of centre.

Of the study participants, 425 (66%) had a vaccination card. This allowed VZV vaccination to be confirmed in 19 (3%) HCWs, while 445 (69.1%) HCWs reported a clinical history of VZV infection. The prevalence of VZV antibodies in these two groups was 94.7% (95% CI: 74.0–99.9) and 96% (95% CI: 93.7–97.6), respectively.

Neither a history of VZV infection nor VZV vaccination was significantly associated with serological immunity (OR: 1.67, 95% CI: 0.6–4. 64 and OR: 1.00, 95% CI: 0.13–7.92, respectively). Of the 451 HCWs who reported previous VZV infection or VZV vaccination, 432 were seropositive, representing a PPV of 95.8% (95% CI: 93.5–97.4). Of the 193 HCWs who stated they had not suffered VZV infection or received VZV vaccination, or did not know, 14 were seronegative, representing a NPV of 7.3% (95% CI: 4.0–11.9) (Table 2).

4. Discussion

Our results show a high prevalence of VZV antibodies in Catalan HCWs, which helps explain the low frequency of transmission of the VZV virus in healthcare settings in Catalonia. The percentage of HCWs without detectable varicella antibodies observed (5.1%) is slightly higher than the 3.8% found in a previous investigation in Catalonia, which used a similar method of participant selection, but was limited to hospitals [17]. A recently-published study carried out in a hospital in Catalonia found a prevalence of 7.4% [18]. Thus, our results fall between those found by these studies. The multicentre nature of our study, which was carried out in six hospitals and five primary care areas, suggests that our results may be more representative of the reality in our geographical and health setting. This is supported by the fact that the prevalence by age group was almost identical to that observed in a seroepidemiological survey carried out in the general population of Catalonia [14].

The results of seroprevalence studies in HCW in other countries show a wide range of results. In temperate countries, the prevalence of negative results is quite low [19–27]: 9–2.1% in Italy, 5.6–1.5% in Israel, 4.3% in Ireland, 2% in the USA and 1.5% in Belgium. In contrast in warmer or tropical countries, the prevalence of

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Table 1
Results of the bivariate and multivariate analyses of varicella-zoster IgG antibodies in healthcare workers.

Variable	*n*	Prevalence (95% CI)	OR (95% CI)	*p*	ORa (95% CI)	*p*
Age						
≤25	30	93.3 (77.9–99.2)	1.23 (0.27–5.66)	0.792	1.23 (0.27–5.66)	0.792
25–35	186	91.9 (87.0–95.4)	Reference		Reference	
36–44	167	97.0 (93.2–99.0)	2.84 (1.01–8.00)	0.040	2.84 (1.01–8.00)	0.040
45–54	170	95.3 (90.9–97.9)	1.78 (0.73–4.30)	0.198	1.78 (0.73–4.30)	0.198
≥55	91	96.7 (90.7–99.3)	2.57 (0.73–9.13)	0.194	2.57 (0.73–9.13)	0.194
Sex						
Male	151	93.4 (88.2–96.8)	Reference			
Female	493	95.3 (93.1–97.0)	1.45 (0.67–3.12)	0.340		
Professional category						
Physician	191	96.3 (92.6–98.5)	1.97 (0.69–5.57)	0.196		
Nursing graduate	249	96.0 (82.7–98.1)	1.79 (0.69–4.65)	0.229		
Other health worker	86	94.2 (87.0–98.1)	1.21 (0.38–3.84)	0.744		
Non-clinical workers	115	93.0 (86.8–96.9)	Reference			
Type of centre						
Primary health care	299	96.3 (93.5–98.1)	1.78 (0.85–3.74)	0.121		
Hospital	345	93.6 (90.5–96.0)	Reference			
All	644	94.9 (92.9–96.4)				

negative results is much higher [12]: 19% in Saudi Arabia, 26% in India and approximately 50% in Sri Lanka. The results are consistent with the epidemiology of VZV and the seroprevalence observed in the general population. In temperate countries, varicella is normally acquired at an early age and most young adults have VZV antibodies.

Age was the only variable associated with the prevalence of antibodies in our study. The slightly-higher prevalence of susceptibility found in younger HCWs has been observed in some, but not all, other studies [24]. This was expected because younger workers have a lower chance of infection, due to the lower cumulative time of exposure. However, most infections occur before reaching working age, as shown by a study of the immune status of 223 medical students in the University Hospital of Frankfurt which found that 96.9% were immune to varicella [28]. However, as the VZV immune status of HCWs is expected to mirror the immune status of adults in the respective country, HCWs from the tropics may be at high risk for varicella [29].

As expected, there was no difference in the prevalence of susceptibility to VZV according to sex, confirming the results of other studies [25,27]. Our study included three times more women than men, reflecting the distribution of sexes in our health setting. Neither was an association found with the professional category, reflecting the results of most other studies [24,23,30].

Our results show that a history of VZV infection is a good predictor of VZV antibody positivity. Almost 96% of HCWs reporting having had VZV infection or receiving VZV vaccination were seropositive. High PPV have also been observed in other studies [17,22,27,28,31]. However, almost 93% of HCWs who stated that they had not had VZV infection or had not been vaccinated or did not know were also seropositive for VZV antibodies. The very poor NPV found for the history of clinical infection or vaccination and the lack of documentation in adult HCWs for prior vaccination question the validity of the history of varicella infection and vaccination reported by HCWs, and are an argument for better adult vaccine databases, especially in HCWs.

Thus, a history of varicella infection or vaccination did not ensure the presence of VZV antibodies and their absence did not imply serological susceptibility [22,32]. Therefore, given the potentially-serious consequences for both patients and HCWs, the VZV IgG status should be documented for all HCWs without proof of prior vaccination, and serologically-susceptible workers should be vaccinated to prevent nosocomial infection [32]. In the USA, the Centers for Disease Control and Prevention only accepts the

Table 2
Positive predictive value (PPV) and negative predictive value (NPV) of reporting a history of VZV infection or VZV vaccination and VZV antibodies according to study variables.

Variable	History of VZV infection or vaccination Positive VZV antibodies/*n*	No history of VZV infection or vaccination Positive VZV antibodies/*n*	PPV (95% CI)	NPP (95% CI)
Age				
≤25 y	24/25	4/5	96.0 (79.6–99.9)	20.0 (0.5–71.6)
25 to 34 y	138/149	33/37	92.6 (87.2–96.3)	10.8 (3.0–25.4)
35 to 44 y	122/125	40/42	97.6 (93.1–99.5)	4.8 (0.6–16.2)
45 to 54 y	102/105	60/65	97.1 (91.9–99.4)	7.7 (2.5–17.0)
≥55 y	46/47	42/44	97.9 (88.7–99.9)	4.5 (0.6–15.5)
All	432/451	179/193	95.8 (93.5–97.4)	7.3 (4.0–11.9)
Sex				
Male	100/105	41/46	95.2 (89.2–98.4)	10.9 (3.6–23.6)
Female	332/346	138/147	96.0 (93.3–97.8)	6.1 (2.8–11.3)
Professional category				
Physician	145/150	39/41	96.7 (92.4–98.9)	4.9 (0.6–16.5)
Nurse	156/162	83/87	96.3 (92.1–98.6)	4.6 (1.3–11.4)
Other clinical workers	54/58	27/28	93.1 (83.3–98.1)	3.6 (0.1–18.3)
Non-clinical workers	77/80	30/35	96.2 (89.4–99.2)	14.3 (4.8–30.3)
Type of centre				
Primary health	191/197	97/102	97.0 (93.5–98.9)	4.9 (1.6–11.1)
Hospital	241/254	82/91	94.9 (91.4–97.2)	9.9 (4.6–17.9)

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following as evidence of immunity [33]: (a) Documented vaccination with two doses of vaccine; (b) Laboratory-confirmed seropositivity; (c) Previous history of VZV infection documented by the health provider; and (d) Previous history of herpes zoster infection documented by the health provider. They recommend the vaccination of susceptible subjects with two doses of VZV vaccine separated by at least four weeks [34].

This study has some limitations. As a convenience sample was used, the results may not be generalizable to all HCWs in Catalonia. In addition, there was no serological study of all employees of the selected centres, but only those who attended health screenings, and therefore the prevalence of susceptibility may differ between HCWs studied and those who did not attend health checks. However, the sample was quite large and covered a wide age range, including both hospital and primary care workers and thus, although it was a convenience sample, it provides an approximation of the immune status of HCWs in Catalonia.

In conclusion, the large proportion of HCWs susceptible to VZV infection found in this study indicates the need to develop screening and vaccination strategies for this group in Catalonia. Due to the high capacity of propagation of the varicella-zoster virus in health settings, vaccination and screening programs in HCWs should be reinforced.

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Conflict of interest statement

All authors report no conflicts of interest relevant to this article.

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4.2. Resultats de l'enquesta adreçada als responsables del centres sanitaris

4.2.1. Antecedents

La vacunació dels treballadors sanitaris és una prioritat del Departament de Salut de Catalunya, per la qual cosa l'any 2007 es va plantejar la realització d'un estudi per conèixer la seva situació immunitària que va constar de dues fases amb diferents tipus d'activitats.

En una primera fase es va investigar el procediment utilitzat per enregistrar la situació immunitària dels treballadors sanitaris enfront les malalties que es poden prevenir amb vacunacions, mitjançant un qüestionari (annex 1) adreçat als gerents i als responsables dels serveis de prevenció de riscos laborals de tots els centres sanitaris públics de Catalunya.

En la segona fase es va realitzar un estudi de marcadors serològics en una mostra dels treballadors sanitaris de Catalunya. Es va comprovar, en aquesta mateixa mostra, el sistema de registre de les vacunacions rebudes mitjançant un qüestionari individual dels antecedents (annex 2).

Els resultats d'aquest estudi es van considerar suficientment rellevants per redactar la sèrie d'articles científics que formen part d'aquesta tesi, que es presenta com a compendi d'articles. Malgrat això, com que el treball desenvolupat ha estat més ampli que el què recullen les publicacions presentades, en aquest apartat s'inclou un breu resum dels resultats obtinguts en la primera fase de l'estudi.

Durant el mes de desembre de 2007 es van enviar els qüestionaris als 754 centres sanitaris de la xarxa d'utilització pública de Catalunya, adreçats als responsables dels serveis de prevenció de riscos laborals i amb l'objectiu de conèixer els procediments utilitzats per a la prevenció de les malalties que es poden prevenir amb vacunacions en els treballadors sanitaris dels diferents proveïdors de la sanitat pública de Catalunya. Es va recollir informació sobre el tipus de centre, població i regió sanitària, nombre i categoria laboral dels

treballadors, tipus de servei de prevenció de riscos laborals responsable del treballadors, existència, tipus i cobertura del registre de vacunacions i/o proves serològiques respecte a cada una de les malalties, la manera d'obtenir aquesta informació i el programari utilitzat.

Es van recollir 195 qüestionaris vàlids. Aquesta xifra va ser inferior a la de centres participants a causa de que els responsables de prevenció que van respondre podien presentar dades agrupades dels centres que tenien al seu càrrec. Entre tots els centres que van respondre sumaven 55.203 treballadors sanitaris d'un cens estimat de103.000 treballadors sanitaris.

4.2.2. Característiques dels treballadors sanitaris, dels tipus de centres i dels procediments utilitzats per a la valoració de la situació immunitària als diferents centres.

Dels 55.203 treballadors sanitaris pertanyents als centres que van respondre, 11.678 (21.2%) eren metges, farmacèutics i altres facultatius, 25.724 (46,6%) infermeres i auxiliars d'infermeria i 14.092 (25,5%) administratius, personal de manteniment i altres treballadors sanitaris no clínics. El nombre de treballadors sanitaris del conjunt de centres que van participar representava més del 50% del total de treballadors del sector sanitari públic de Catalunya.

Els 195 serveis de prevenció participants cobrien totes les regions sanitàries, el 60% eren serveis de titularitat pròpia i el 37% serveis aliens contractats; la resta no va facilitar aquesta informació. El 53% de centres al seu càrrec eren d'atenció primària, el 27% d'atenció hospitalària, el 10% sociosanitaris i el 10% de salut mental.

Van afirmar tenir registres sobre l'estat immunitari dels treballadors respecte les malalties que es poden prevenir amb vacunacions en 80 serveis de prevenció. D'aquest registres, 79 tenien dades relacionades amb l'hepatitis B, 75 amb el tètanus i la diftèria, 73 amb la grip, 37 amb la varicel·la, 35 amb el xarampió, 34 amb la rubèola i 27 amb la parotiditis (taula 1). La majoria (95%) de registres estaven informatitzats, encara que una part (18%) dels registres de vacunació d'hepatitis B i tètanus-diftèria estaven en arxius antics en suport paper. El tipus

de programari utilitzat va ser molt divers (taula 2) i el 59% utilitzaven programes d'ofimàtica (Microsoft Office Excel i Access).

Malalties amb informació enregistrada	Serveis de prevenció amb registre	Nombre de treballadors enregistrats (%)
Hepatitis B	79	35373 (64,1%)
Tètanus-diftèria	75	32327 (58,6%)
Grip	73	12537 (22,7%)
Varicel·la	37	11460 (20,8%)
Xarampió	35	9826 (17,8%)
Rubèola	34	10026 (18,2%)
Parotiditis	27	4105 (7,4%)

Taula 1. Nombre de serveis de prevenció que disposaven de registres amb informació sobre l'estat immunitari dels treballadors segons el tipus de malaltia i nombre de treballadors amb informació enregistrada.

Programa informàtic	Nombre de serveis de prevenció que l'utilitzen (%)
Access	18 (22,5%)
Clas	1 (1,3%)
e-CAP	3 (3,8%)
Excel	29 (36,3%)
Gesdhoc	2 (2,5%)
Imasis	1 (1,3%)
Omi	5 (6,3%
Preven	4 (5%)
SET prevenció	2 (2,5%)
SIAP	1 (1,3%)
SINAPSIS	1 (1,3%)
Tecno preven	1 (1,3%)
Word	1 (1,3%)
Medtra	1 (1,3%)
Sense especificar	10 (12,5%)
Total	**80 (100%)**

Taula 2. Tipus de programari utilitzat pels serveis de prevenció per enregistrar les dades relacionades amb l'estat immunitari dels treballadors sanitaris.

5. Discussió

Els resultats de l'enquesta als serveis de prevenció mostren que els registres de vacunació dels treballadors sanitaris no estaven ben implantats i que hi havia una gran heterogeneïtat en els sistemes de registre utilitzats per recollir les dades sobre l'estat immunitari dels treballadors sanitaris. Mancava una sistemàtica estandarditzada que permetés recollir una informació homogènia sobre la situació dels treballadors sanitaris. La majoria de registres estaven informatitzats, però en una part important es feia servir un programari d'ofimàtica estàndard i els registres no estaven integrats amb els sistemes d'informació institucionals, per la qual cosa la informació no es compartia i només era accessible per al servei de prevenció posseïdor del registre. Fins i tot els registres institucionals, com el Preven (història clínica laboral electrònica dels serveis de prevenció de l'ICS) i l'eCAP (història clínica electrònica d'atenció primària) no comparteixen la informació entre ells.

En la majoria dels centres amb registres de vacunacions hi havia informació de la vacunació dels treballadors contra l'hepatitis B, el tètanus i la diftèria, i la grip, però menys de la meitat tenien dades sobre el xarampió, la rubèola, la parotiditis i la varicel·la. D'altra banda, la informació relacionada amb l'hepatitis B, el tètanus i la diftèria era molt superior que la informació referent a la grip, la varicel·la, el xarampió, la rubèola i la parotiditis.

Una possible limitació de l'enquesta és que només es van recollir 195 qüestionaris, malgrat que es van enviar a tots el centres sanitaris públics de Catalunya. Aquesta xifra és inferior a la de centres representats als qüestionaris a causa de que els responsables de prevenció que van respondre tenien al seu càrrec diversos centres. De tota manera, els serveis de prevenció que van respondre tenien al seu càrrec un total de 55.203 treballadors sanitaris d'un cens estimat de 103.000 treballadors sanitaris de la xarxa pública en el conjunt de Catalunya, per la qual cosa les enquestes rebudes es poden considerar força representatives de com està recollida la informació relacionada

amb les malalties que es poden prevenir amb vacunacions per part dels serveis de prevenció de riscos laborals dels centres sanitaris de Catalunya.

Altres estudis també han trobat diferències en les cobertures vacunals en els treballadors sanitaris segons les vacunes.[49,50] Aquestes diferències entre vacunes confirmen la necessitat de millorar els registres de vacunacions,[2] però també que cal millorar els coneixements dels treballadors sanitaris,[51,52] ja que la percepció dels treballadors sanitaris respecte de la importància i el risc de les malalties que es poden prevenir amb vacunacions no és homogènia[49] i pot influir en les cobertures. A Itàlia, Taddei et a.l[49] van observar que menys de la meitat dels treballadors potencialment susceptibles (sense antecedents de malaltia, ni vacunació, ni confirmació serològica) tenien percepció de risc de les malalties en qüestió i menys de la tercera part estaven vacunats. Per això els autors consideren que hauria d'estar disponible més informació sobre els beneficis de la vacunació i que cal implementar programes educatius per incrementar la percepció de risc de les malalties infeccioses en els treballadors sanitaris. També destaquen la necessitat de formació dels treballadors sanitaris Stewart et al.[51] i Murray i Skull[52] en observar en un hospital de tercer nivell a Austràlia que el 76% del treballadors sanitaris no coneixien les directrius de vacunació, mentre que només el 39% guardaven registres vacunals escrits. Únicament el 24% estaven correctament vacunats, encara que el 96% manifestaven la voluntat de mantenir actualitzades les seves vacunacions i que tots els treballadors que van acudir a les cites per vacunar-se van rebre les vacunes.[53]

L'assoliment d'altes cobertures de vacunació entre els treballadors sanitaris és un desafiament permanent i per aquest motiu s'ha proposat la vacunació obligatòria del treballadors sanitaris.[54] Quan l'imperatiu moral dels treballadors sanitaris i de les institucions per garantir la vacunació del personal no és suficient per aconseguir voluntàriament nivells de cobertura òptims, en particular per a aquells que treballen en entorns amb pacients d'alt risc, la vacunació obligatòria es considera acceptable des d'un punt de vista ètic,[55] ja que el benestar dels pacients, la salut pública i també la salut dels propis treballadors sanitaris han d'estar per sobre de l'autonomia individual. Tan mateix, cal tenir en compte que una política de vacunació obligatòria justa ha

de ser curosa a l'hora de valorar les diferents malalties, les vacunes, els grups de pacients i les característiques del lloc de treball dels treballadors sanitaris. En aquesta línia, el 2007, l'estat de Nova Gal·les del Sud a Austràlia va promulgar una directiva sobre l'obligatorietat de vacunació dels treballadors sanitaris. En un estudi realitzat per a identificar la consciència i les actituds del personal en la fase inicial d'aplicació d'aquesta directiva es va comprovar que el 78% va recolzar la política de vacunació, el 13% es va mostrar indiferent i només el 4% es va oposar.[56] Maltezou et al. troben que la vacunació obligatòria es més acceptada pels metges i les infermeres que per la resta del personal (72.1%, 61.9% i 54.2%, respectivament).[50] En qualsevol cas, encara que la vacunació obligatòria és una manera de millorar la cobertura de vacunació entre els treballadors sanitaris, hi ha obstacles per poder aplicar-la amb èxit.[57-59] A Catalunya no hi ha normativa legal específica que sustenti la vacunació obligatòria dels treballadors sanitaris. Tan maeix, hi ha una Guia de Bona Praxi sobre Vigilància de la Salut envers Agents Biològics[60] que protocol·litza les vacunacions i les determinacions serològiques que han d'enregistrar els serveis de prevenció de riscos laborals. Malgrat això, els resultats obtinguts a l'enquesta adreçada als serveis de prevenció demostren que cal millorar la quantitat i qualitat de la informació disponible en aquests serveis, què està limitada, entre d'altres factors, per la dificultat d'aconseguir que tots els treballadors sanitaris realitzin l'examen de salut, ja que els exàmens de salut són en general voluntaris i no obligatoris per al treballador, malgrat que la llei de protecció de riscos laborals a l'article 22.1 diu que "Els reconeixements són obligatoris quan siguin imprescindibles per verificar si l'estat de salut del treballador pot constituir un perill per als altres treballadors o per a altres persones relacionades amb l'empresa".[61] Molts treballadors no es realitzen els exàmens de salut, encara que la Guia de Bona Praxi abans esmentada especifica que a tots els treballadors se'ls ha de realitzar l'examen bàsic de salut a l'inici de la seva activitat laboral i després de canvis en les condicions de treball o personals, i que com a mínim, cal oferir a cada treballador una exploració mèdica cada 3 anys.[62,63] A més, la manca d'informació pot actuar com un factor de confusió sobre els resultats a l'hora d'analitzar la informació enregistrada.[64] És necessari que les dades relacionades amb la immunitat dels treballadors sanitaris respecte a les

malalties que es poden prevenir amb vacunacions disponibles a la història clínica de l'atenció primària i la història clínica compartida a Catalunya (HC3) pugui ser compartida a la història clínica laboral, garantint el compliment de la privacitat i la legislació de protecció de dades, la qual cosa permetria poder consultar l'estat immunitari del treballadors sanitaris per part dels serveis de prevenció quan fos necessari. La intercanviabilitat d'informació entre els registres clínics i laborals és objecte de reflexió en l'actualitat.[65]

Els registres de salut electrònics estan totalment establerts en la realitat assistencial, però és necessari que tinguin una perspectiva que vagi més enllà de la de la salut individual. També és necessari millorar les funcionalitats, incloent modificacions de la història clínica electrònica que permetin l'accés dels pacients i una perfecta integració amb altres aplicacions,[66] entre les quals cal incloure les relacionades amb la salut ocupacional.[67]

La immunitat dels treballadors sanitaris és molt important per al Departament de Salut i una prioritari per a l'Agència de Salut Pública de Catalunya, que és responsable de la promoció i la protecció de la salut, la prevenció i la gestió de les alertes epidemiològiques i alimentàries, la salut laboral, i també del Programa de Vacunacions de Catalunya. Per això, en el Pla de Salut de Catalunya 2011-2015 es contempla la vacunació dels treballadors sanitaris dins al projecte 2.2 que tracta sobre com potenciar els programes de protecció i promoció de la salut i prevenció de les malalties.[68] Per aprofundir en el coneixement sobre l'estat immunitari dels treballadors sanitaris i del registre de la informació relacionada, actualment s'està desenvolupant un projecte demostratiu d'un dels objectius del Pla de Salut de Catalunya.

Als articles que formen part d'aquesta tesi es mostren els resultats de l'estudi de seroprevalença en els treballadors sanitaris de Catalunya d'anticossos enfront de sis malalties que es poden prevenir per vacunació (tètanus, diftèria, tos ferina, xarampió, rubèola i parotiditis). Als participants en aquest estudi també se'ls va fer una enquesta (annex 2) on es recollien els antecedents de vacunació, referits o documentats si disposaven de carnet de vacunacions. La primera observació que cal fer és que el percentatge de vacunacions documentades mitjançant carnet que es va poder recollir va ser relativament

baix (66%), per la qual cosa l'estudi es va centrar en els resultats serològics, que son dades objectives. Les evidencies serològiques es consideren fonamentals per estudiar l'estat immunitari dels treballadors sanitaris, ja que la manca de documentació, així com les limitacions de la informació proporcionada pels propis treballadors sobre els seus antecedents de vacunació i malaltia, fan que una enquesta de seroprevalença, seguida d'un programa de vacunació adequat adreçat als subjectes susceptibles, sigui crucial per prevenir i controlar les infeccions en els centres sanitaris.[69-73]

El nivell de protecció dels treballadors sanitaris respecte a les malalties que es poden evitar amb vacunació varia segons la malaltia i l'edat. D'altra banda, la disponibilitat de vacunes i la seva introducció en els calendaris s'ha fet de forma progressiva al llarg del temps, la qual cosa ha fet variar l'epidemiologia de les malalties.[30] Per aquest motiu, en el cas de malalties que temps enrere eren molt freqüents, com per exemple el xarampió, les persones de més edat van estar exposades en la seva infantesa i van adquirir immunitat de forma natural. De forma contraria, els més joves que van néixer quan aquestes malalties ja estaven controlades tenen la immunitat proporcionada per la vacunació, ja que el risc de contagi i desenvolupament d'immunitat natural ha estat baix. Per a altres malalties com la diftèria, pel fet d'estar eliminada des de fa anys a Catalunya,[74] o el tètanus, que no produeix immunitat natural, la immunitat únicament és d'origen vacunal i la proporció de persones immunes es relaciona clarament amb la introducció de les vacunes.[75,76]

En estudis que avaluen la immunitat en els sanitaris s'han trobat nivells de protecció elevats, generalment superiors al 85%, contra xarampió, rubèola, parotiditis i varicel·la,[11,77-81] amb immunitat adquirida per vacunació o de forma natural.

Hi ha menys dades sobre la vacunació contra el tètanus i la diftèria que, encara que no estan específicament indicades en els treballadors sanitaris, també són molt importants, per la qual cosa es recomanen a tota la població. A més de la protecció contra aquestes malalties, mantenir al dia les vacunacions en els treballadors sanitaris té un valor afegit, atès el rol exemplar que tenen aquestes persones per a la resta de la població.[4]

La recomanació de vacunació contra la tos ferina en els treballadors sanitaris és recent i les dades de cobertura són escasses. A l'any 2004 a Espanya es va recomanar la vacunació contra la tos ferina dels treballadors sanitaris que atenien infants prematurs hospitalitzats i des de l'any 2011 es recomana a tots els que treballen en àrees obstètriques i pediàtriques.[48,82]

En aquest estudi, el grau de protecció contra el xarampió i la rubèola és molt alt, mentre que el nivell protecció contra la parotiditis és una mica més baix. Encara que el coneixement dels antecedents de malaltia i/o vacunació no és òptim i el nivell de registre de la informació és baix, aquests resultats són coherents amb les característiques de la resposta immune contra aquests virus, tant si la resposta ha estat induïda per la infecció natural com si ha estat induïda per la vacunació.[23,34,38]

La immunitat contra el xarampió en els participants en aquest estudi és elevada, del 98% (IC 95% 96,6-98,8). Encara que en totes les edats el percentatge d'immunes és elevat, hi ha una acumulació de susceptibles entre els més joves, persones nascudes a partir de 1981, just després de la introducció de la vacunació sistemàtica.[83] A conseqüència de la vacunació, l'epidemiologia de la malaltia a Catalunya es va modificar de forma radical, la incidència de xarampió va disminuir dràsticament i fins i tot es va arribar a aconseguir la interrupció de la transmissió i l'eliminació de la malaltia l'any 2000, que es va mantenir fins a l'any 2006, amb un nombre de casos molt baix associats a casos importats de fora de Catalunya.[84] L' eliminació és una situació reversible i es pot reintroduir el virus i ocasionar un brot si es produeixen cadenes de transmissió en població susceptible, la qual cosa pot succeir també en poblacions amb altes cobertures de vacunació si l'agregació del individus no vacunats és heterogènia.[85-87]

A Catalunya s'han produït tres brots importants en els darrers anys, en els que han estat implicats nombrosos treballadors sanitaris. En el brot dels anys 2006 i 2007, dels 381 casos que es van produir, 11 van ser treballadors sanitaris. El brot dels anys 2010 i 2011 va afectar 305 persones, de les quals 11 eren treballadors sanitaris i un d'ells va ser un metge d'urgències que tenia 2 dosis documentades de TV. Al gener de 2014 va començar un tercer brot que va

finalitzar el 17 de juny, amb 131 casos confirmats, un 23 % dels quals van ser sanitaris.[21,22]

En l'era de l'eliminació del xarampió, la transmissió nosocomial s'ha convertit en una font d'infecció per a la població cada vegada més important i la implicació dels treballadors sanitaris queda palesa amb la creixent proporció d'aquest col·lectiu entre els casos que s'han produit en els brots comentats.

Aquestes dades confirmen la necessitat de conèixer l'estat immunitari enfront del xarampió en els treballadors sanitaris,[88,89] especialment en els més joves que quasi exclusivament tenen immunitat vacunal, ja que malgrat les generacions més joves de treballadors sanitaris haurien d'haver rebut dues dosis de TV en la infància, com que les cobertures vacunals no són mai del 100%, els no vacunats tenen un gran risc d'infectar-se en contacte amb un cas de la malaltia i han de ser apartats de la feina en cas de brot. Aquestes troballes són similars a les descrites per Botelho-Nevers et al. i Seo et al. que suggereixen insuficient cobertura en els més joves.[28,29]

A Catalunya és una prioritat la disponibilitat d'informació sobre la immunitat contra el xarampió dels treballadors sanitaris. Cal disposar de serologia en tots els treballadors sanitaris nascuts després de l'any 1966 sense evidència documentada de vacunació amb dues dosis o sense diagnòstic de la malaltia confirmat pel laboratori.[90,91] Aquesta informació ha de estar enregistrada en els sistemes d'informació clínics (història clínica electrònica) i també als registres de les unitats de salut laboral, i ha de ser fàcilment accessible en situació de brot, per poder separar els treballadors susceptibles del lloc de treball mentre hi hagi risc de contagi. És menys prioritari conèixer la situació dels nascuts abans de l'any 1966, però en els treballadors sanitaris que pensen que no han patit la malaltia cal considerar la confirmació serològica o la vacunació amb dues dosis.

La prevalença de treballadors sanitaris amb immunitat contra la rubèola en aquest estudi és molt elevada (97%), superior a la trobada en altres estudis fets a països com Aràbia Saudí (90%), l'Índia (85%) o Brasil (62%). En estudis fets a altres països les dades són més similars a les obtingudes en el present

estudi. Així, al Japó ha estat entre 89.5% i 95.9%, a Itàlia entre 47% i 96.8% i a Turquia entre 97% i 98.3%.[79,92-98] Els treballadors sanitaris de menys de 30 anys d'edat presenten el percentatge més baix d'immunitat (94,5%). Com en el cas del xarampió, la incidència de rubèola a Catalunya en els darrers anys ha estat molt baixa i les cohorts més joves han tingut poca probabilitat de contactar amb el virus salvatge, de manera diferent del que ha ocorregut en les persones de edat més avançada, en les quals gairebé tothom té immunitat per haver patit la malaltia durant la infància.

La prevalença d'anticossos anti-parotiditis en els treballadors sanitaris estudiats (87.5%) és similar a la trobada en altres estudis en treballadors sanitaris i inferior a la que s'ha observat tant per al xarampió com per a la rubèola.[99-101] Els treballadors sanitaris més joves, nascuts a partir de l'any 1981, tenen el percentatge de susceptibles més elevat. A la població general la prevalença d'immunitat enfront del xarampió i la rubèola també es major que la de la parotiditis [7,40,43,102]. L'explicació més probable és la menor immunogenicitat del component de la parotiditis, respecte als del xarampió i de la rubèola que formen part conjuntament de la vacuna triple vírica.[103-106] De fet, des de la introducció de la vacuna la incidència de la parotiditis ha baixat molt, però menys que la del xarampió i la rubèola, i hi ha brots de parotiditis amb més freqüència.[7]

El 93,9% dels sanitaris de Catalunya estan correctament immunitzats contra el tètanus, prevalença força més alta que el 76,5 % trobat per Ortega et al. l'any 1999 en un treball realitzat a Madrid.[47] Com que la immunitat antitetànica únicament es pot aconseguir mitjançant vacunació, els resultats són reflex directe de les cobertures. En aquest estudi són immunes el 100% dels menors de 35 anys mentre que dels majors de 55 anys només ho són el 87%. És coneguda l'associació entre els nivells més baixos de la immunitat contra el tètanus i l'augment de l'edat.[107,108,109] Contrariament, mentre que a la població general s'ha observat un nivell de protecció significativament major en els homes, atribuïble als antecedents de servei militar,[110] no s'ha trobat diferència entre sexes entre els sanitaris catalans en la prevalença d'anticossos, possiblement a causa dels esforços del sistema de salut i els serveis de

prevenció de riscos laborals per aconseguir altes cobertures de vacunació en els treballadors sanitaris.[111]

Només en el 46,4% dels sanitaris estudiats s'han trobat nivells protectors d'anticossos contra la diftèria. La proporció de persones immunes ha disminuit significativament amb l'edat, des d'un 87,5% en persones menors de 25 anys fins arribar al 38,1% en les persones de més de 55 anys. Les persones nascudes abans de l'any 1965 no van rebre la vacunació contra la diftèria, el tètanus i tos ferina (DTP) a la infància,[112,113] i en alguns casos únicament han estat vacunats amb dosis aïllades en l'edat adulta sense haver rebut una pauta completa de vacunació primària. A més, fins als anys noranta, per vacunar els adults no es va fer servir la vacuna de toxoide antitetànic i antidiftèric (Td), sinó que es va utilitzar la vacuna antitetánica monovalent,[114] per la qual cosa en molts casos, les persones de més edat no han estat immunitzats contra la diftèria encara que si ho han estat contra el tètanus. Malgrat que la diftèria a Catalunya està eliminada, és important la vacunació dels treballadors sanitaris per protegir-se ells mateixos i evitar la transmissió nosocomial en cas d'un eventual contacte amb la malaltia.[115]

La re-emergència de la tos ferina en els darrers anys[116,117] ha fet que es prestés més atenció a la situació immunitària dels treballadors sanitaris contra aquesta malaltia.[118-119] En aquest estudi aproximadament la meitat dels treballadors sanitaris no presenten anticossos contra la tos ferina, resultat similar al trobat en altres estudis fets a Espanya i altres països.[120,121] D'altra banda, entre les persones positives, el 15% (7,8% del total) tenien títols elevats d'anticossos que indiquen infecció recent per *Bordetella pertussis*. Això confirma que al menys una part de treballadors sanitaris està exposada a la infecció, encara que no es pot assegurar que el contacte hagi estat en el medi sanitari, ja que en estudis fets en població general també s'han trobat percentatges similars de persones amb títols elevats,[122-125] Tan mateix, hi ha consens que la infecció dels treballadors sanitaris revesteix molta importància per la possibilitat de que origini brots nosocomials que poden afectar persones especialment susceptibles com els nadons i els prematurs.

6. Conclusions

1. Els treballadors sanitaris tenen un coneixement limitat de la seva immunitat o susceptibilitat en relació a les malalties que es poden prevenir per vacunació. La informació referida pels treballadors sanitaris sobre el seu estat vacunal és inconsistent, ja que no s'han observat diferències en la seroprevalença respecte als antecedents de vacunació.

2. Els sistemes d'enregistrament de l'estat immunitari (vacunació i/o resultat de proves serològiques) dels treballadors sanitaris utilitzats pels serveis de prevenció són insuficients i estan poc integrats amb la resta dels sistemes d'informació institucionals. La informació és incompleta i no està estructurada de forma estàndard, la qual cosa dificulta que sigui compartida entre els diferents sistemes d'informació sanitària.

3. La informació disponible en relació a la situació immunitària dels treballadors sanitaris de Catalunya no proporciona evidencies d'immunitat en situacions en les que es requereix disposar d'aquest tipus d'informació amb rapidesa (per exemple en situacions de brots de xarampió) per evitar que es produeixi transmissió nosocomial. Cal implementar la connexió dels sistemes de informació existents per poder tenir l'evidència d'immunitat de manera ràpida.

4. El 98,7% dels treballadors sanitaris nascuts després de l'any 1965, que van ser vacunats amb DTP a la infància, tenen uns nivells d'anticossos contra el tètanus adequats, però el 12,4% dels nascuts abans d'aquesta data són susceptibles. Només el 53,3% de treballadors sanitaris nascuts després de l'any 1965, i el 37,3% dels nascut abans, tenen immunitat contra la diftèria. Cal fer un esforç per assegurar que els nivells d'immunització contra el tètanus i la diftèria, especialment en persones sense evidència de vacunació primària correcta, són els adequats.

5. Pràcticament la meitat dels treballadors sanitaris no mostren immunitat contra la tos ferina, mentre que hi ha evidència d'infecció recent en el 8%. Aquest fet destaca la importància de la vacunació dels treballadors sanitaris amb vacuna antitetànica, antidiftèrica i antipertússica de baixa carrega

antigènica (dTpa), especialment dels que treballen en àrees pediàtriques i obstètriques.

6. El 98% dels treballadors sanitaris són immunes al xarampió, però molts no poden aportar evidència d'immunitat. Això és especialment important en el nascuts després de l'any 1980, el 6,6% dels quals són susceptibles. Els treballadors sanitaris més joves, nascuts a l'època en que la vacunació ja era sistemàtica, han tingut poques possibilitats de contacte amb el virus al llarg de la seva vida i tenen un risc molt alt de contraure la malaltia si s'exposen en situació de brot.

7. La prevalença d'immunitat contra la rubèola en els treballadors sanitaris de Catalunya és alta (97,2%), però és inferior en els treballadors sanitaris més joves (94,5% en <30 anys). Aquesta situació permet que s'ocasionin brots en les persones susceptibles i fa més difícil de mantenir l'objectiu d'eliminació de la rubèola i la síndrome de rubèola congènita. Per aquesta raó cal reforçar la identificació i la vacunació dels treballadors sanitaris susceptibles menors de 30 anys d'edat.

8. La prevalença d'immunitat contra la parotiditis, del 87,5%, és inferior a la trobada enfront de la rubèola i el xarampió, però similar a la trobada en treballadors sanitaris en altres estudis. La diferència respecte a la situació immunitària enfront la rubèola i el xarampió pot ser atribuïda a la menor efectivitatdel component parotidític de la vacuna triple vírica.

9. La vacunació dels susceptibles amb dues dosis de vacuna triple vírica s'hauria de reforçar, especialment en els treballadors sanitaris joves, per minimitzar el risc de contraure el xarampió, la rubèola i la parotiditis, i per evitar la transmissió nosocomial d'aquestes malalties als pacients susceptibles que atenen.

10. La prevalença de la immunitat a la varicel·la en els treballadors sanitaris va ser de 94,9%. El grup d'entre 25 i 35 anys va presentar major proporció de susceptibles (8,1%). L'estudi serològic dels treballadors sanitaris és necessari per detectar i vacunar els susceptibles.

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Annex 1. Enquesta per als centres sobre els registres de l'estat immunitari dels treballadors sanitaris

Generalitat de Catalunya
Departament de Salut

ENQUESTA DE CENTRES SOBRE REGISTRES DE L'ESTAT IMMUNITARI DEL PERSONAL SANITARI

Nom del centre_____
Persona que emplena l'enquesta (telèfon i a/e de contacte):_____
Telèfon:_____a/e:_____

1. Centre/hospital

- ☐ Atenció primària
- ☐ Hospital

2. Regió sanitària

- ☐ Barcelona
- ☐ Lleida
- ☐ Camp de Tarragona
- ☐ Terres de l'Ebre
- ☐ Girona
- ☐ Catalunya Central
- ☐ Alt Pirineu

3. Nombre de treballadors del centre

Nombre total ____

Personal mèdic ____
DUE, aux. infermeria ____
Altres professionals ____

4. Servei responsable de la salut dels treballadors:

- ☐ Servei de prevenció de riscos laborals propi
- ☐ Servei de prevenció de riscos laborals aliè
- ☐ Servei de medicina preventiva
- ☐ Altres (especifiqueu-los): _____

5. Es disposa de registres sobre l'estat immunitari dels treballadors sanitaris del centre? ☐ Sí ☐ No

En cas afirmatiu, especifiqueu per a quines de les malalties següents i per a quin nombre de treballadors en actiu es disposa d'aquesta informació:

- ☐ Hepatitis B..... Nombre de treballadors ____

Roc Boronat, 81-95
08005 Barcelona
Tel. 93 551 39 00
Fax 93 551 75 06
http://www.gencat.cat/salut

- ☐ Xarampió..... Nombre de treballadors |_|_|_|
- ☐ Rubèola..... Nombre de treballadors |_|_|_|
- ☐ Parotiditis..... Nombre de treballadors |_|_|_|
- ☐ Varicel·la..... Nombre de treballadors |_|_|_|
- ☐ Grip..... Nombre de treballadors |_|_|_|
- ☐ Tètanus-diftèria... Nombre de treballadors |_|_|_|

6. Aquests registres estan informatitzats?

Hepatitis B	☐ Sí	☐ No_____	Nom del programa informàtic_____
Xarampió	☐ Sí	☐ No_____	Nom del programa informàtic_____
Rubèola	☐ Sí	☐ No_____	Nom del programa informàtic_____
Parotiditis	☐ Sí	☐ No_____	Nom del programa informàtic_____
Varicel·la	☐ Sí	☐ No_____	Nom del programa informàtic_____
Grip	☐ Sí	☐ No_____	Nom del programa informàtic_____
Tètanus-diftèria	☐ Sí	☐ No_____	Nom del programa informàtic_____

7. Aquesta informació per quins mecanismes s'obté (se'n pot marcar més d'un):

- ☐ Exàmens de salut periòdics del personal / consulta de salut
- ☐ Estudis de seroprevalença específics per a aquestes malalties, en determinats serveis del centre
- ☐ Revisió dels carnets vacunals, a l'inici de l'activitat laboral
- ☐ No es disposa d'aquesta informació

8. Quin nombre de treballadors d'aquest centre s'ha vacunat contra la grip en l'últim any:

Personal mèdic |_|_|_|
DUE, aux. infermeria |_|_|_|
Altres professionals |_|_|_|

Roc Boronat, 81-95
08005 Barcelona
Tel. 93 551 39 00
Fax 93 551 75 06
http://www.gencat.cat/salut

Annex 2. Enquesta per als treballadors sobre l'estat immunitari dels treballadors sanitaris

Generalitat de Catalunya
Departament de Salut
Direcció General de Salut Pública

CatSalut Servei Català de la Salut

Institut Català de la Salut

Nom del centre_____

Codi del centre |_|_|_|_|_|_|_|

ENQUESTA SOBRE L'ESTAT IMMUNITARI DEL PERSONAL SANITARI

DADES PERSONALS

Nom i cognoms:_____

Data de naixement |_|_|-|_|_|-|_|_|_|_| Sexe: ☐ Home ☐ Dona

☐ Personal mèdic ☐ DUE, aux. infermeria

☐ Altres (especifiqueu-los):_____

Presta atenció pediàtrica habitualment? ☐ Sí ☐ No

Presta serveis quirúrgics habitualment? ☐ Sí ☐ No

1. HEPATITIS B

S'ha vacunat d'HB? ☐ Sí ☐ No ☐ NS/NC

Indiqueu el nombre de dosis rebudes: ☐ 1 ☐ 2 ☐ 3 o més

Indiqueu l'any aproximat de la vacunació |_|_|_|_|

Aquesta informació consta al carnet de vacunacions?[1] ☐ Sí ☐ No ☐ NS/NC

2. GRIP

En les últimes 3 temporades, quantes vegades s'ha vacunat contra la grip?

☐ 1 ☐ 2 ☐ 3 vegades

Aquesta informació consta al carnet de vacunacions? ☐ Sí ☐ No ☐ NS/NC

3. TÈTANUS / TÈTANUS-DIFTÈRIA

Quantes vegades ha rebut la vacuna antitetànica (inclosa qualsevol que estigui combinada amb component T) al llarg de la seva vida?

☐ Menys de 3 ☐ 3 o més ☐ cap vegada

Indiqueu l'any d'administració de l'última dosi |_|_|_|_|

Aquesta informació consta al carnet de vacunacions? ☐ Sí ☐ No ☐ NS/NC

[1] Cal adjuntar una fotocòpia del carnet vacunal, si se'n disposa

4. XARAMPIÓ

Ha patit la malaltia? ☐ Sí ☐ No ☐ NS/NC
S'hi ha vacunat? ☐ Sí ☐ No ☐ NS/NC
Indiqueu el nombre de dosis rebudes: ☐ 1 ☐ 2 dosis o més
Aquesta informació consta al carnet de vacunacions? ☐ Sí ☐ No ☐ NS/NC

5. RUBÈOLA

Ha patit la malaltia? ☐ Sí ☐ No ☐ NS/NC
S'hi ha vacunat? ☐ Sí ☐ No ☐ NS/NC
Indiqueu el nombre de dosis rebudes: ☐ 1 ☐ 2 dosis o més
Aquesta informació consta al carnet de vacunacions? ☐ Sí ☐ No ☐ NS/NC

6. PAROTIDITIS

Ha patit la malaltia? ☐ Sí ☐ No ☐ NS/NC
S'hi ha vacunat? ☐ Sí ☐ No ☐ NS/NC
Indiqueu el nombre de dosis rebudes: ☐ 1 ☐ 2 dosis o més
Aquesta informació consta al carnet de vacunacions? ☐ Sí ☐ No ☐ NS/NC

7. VARICEL·LA

Ha patit la malaltia? ☐ Sí ☐ No ☐ NS/NC
S'hi ha vacunat? ☐ Sí ☐ No ☐ NS/NC
Indiqueu el nombre de dosis rebudes: ☐ 1 ☐ 2 dosis o més
Aquesta informació consta al carnet de vacunacions? ☐ Sí ☐ No ☐ NS/NC

Aquest apartat l'ha d'emplenar el servei de prevenció de riscos laborals

Les vacunacions abans assenyalades consten al registre?

Hepatitis B	☐ Sí	☐ No
Xarampió	☐ Sí	☐ No
Rubèola	☐ Sí	☐ No
Parotiditis	☐ Sí	☐ No
Varicel·la	☐ Sí	☐ No
Grip	☐ Sí	☐ No
Tètanus-diftèria	☐ Sí	☐ No