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Original article

# Vaccination trends in people with HIV infection participanting in the hospital-based survey of patients infected with HIV, 2006–2021☆

Victoria Hernando[a,b,*], Lucia Suárez[c], Gonzalo Gutiérrez[d], Juan Carlos López[b,e], Roser Navarro-Soler[f], Alfonso Cabello[g], Jesús Sanz[h], Inés Suarez-García[b,i], Maria Teresa Fernández[j], Juan Emilio Losa[k], Jose Luis Pérez[l], Luis Ramos-Ruperto[m], Maria Jesús Pérez-Elías[n], Wafa Ben Cheikh El Aayuni[o], Mar Cuesta[p], Gustavo González[q], Ana Izquierdo[r], Luis Viloria[s], Irene López[t], Eva Martínez[u], Daniel Castrillejo[v], Maria Glòria Jaume Amengual[w], Maria Antonia Belmonte[x], Antonio Arraiza[y], Javier de la Torre[z], Estrella Miqueleiz[aa], Henar Marcos[ab], Marta Ruiz-Algueró[a,b], Teresa Villegas[a], Lorena Simón[a], Asuncion Diaz[a,b], on behalf of the Hospital Survey Working Group[◊]

[a] *Unidad de Vigilancia de VIH, ITS y Hepatitis B y C. Centro Nacional de Epidemiología, Instituto de Salud Carlos III, Madrid, Spain*
[b] *CIBER de Enfermedades Infecciosas (CIBERINFEC), Instituto de Salud Carlos III, Madrid, Spain*
[c] *Servicio de Medicina Preventiva y Salud Pública, Complejo Hospitalario Universitario de Albacete, Albacete, Spain*
[d] *Servicio de Epidemiología, DG de Salud Pública, Consejería de Sanidad, Toledo, Spain*
[e] *Servicio de Enfermedades Infecciosas, Hospital Universitario Gregorio Marañón, Madrid, Spain*
[f] *Unidad VIH, Hospital Universitario 12 de Octubre, IMAS12.UCM, Madrid, Spain*
[g] *Unidad de Enfermedades Infecciosas y VIH, Fundación Jimenez Díaz, Madrid, Spain*
[h] *Unidad de Enfermedades Infecciosas, Hospital Universitario de la Princesa, Madrid, Spain*
[i] *Grupo de Enfermedades Infecciosas, Servicio de Medicina Interna, Hospital Universitario Infanta Sofía, San Sebastián de los Reyes, Madrid, Spain*
[j] *Servicio de Medicina Interna, Hospital del Sureste, Arganda del Rey, Madrid, Spain*
[k] *Unidad de Enfermedades Infecciosas, Hospital Universitario Fundación Alcorcón, Alcorcón, Madrid, Spain*
[l] *Servicio de Medicina Interna, Hospital Universitario Infanta Cristina, Parla, Madrid, Spain*
[m] *Servicio de Medicina Interna, Hospital Universitario La Paz/IdiPAZ, Madrid, Spain*
[n] *Servicio de Medicina Interna, Hospital Universitario Ramón y Cajal, Madrid, Spain*
[o] *Coordinación de VIH/sida, Servicio de Promoción de la Salud y Prevención de la Enfermedad, Dirección General de Salud Pública, Zaragoza, Spain*
[p] *Servicio de Salud Poblacional, Dirección General de Salud Pública, Consejería de Salud, Oviedo, Asturias, Spain*
[q] *Oficina de Coordinación VIH en Extremadura, Dirección General de Salud Pública, Servicio Extremeño de Salud, Mérida, Badajoz, Spain*
[r] *Servicio de Epidemiología y Promoción de la Salud, Dirección General de Salud Pública, Servicio Canario de la Salud, Santa Cruz de Tenerife, Canary Islands, Spain*
[s] *Servicio de Vigilancia Epidemiológica, Dirección General de Salud Pública, Santander, Cantabria, Spain*
[t] *Servicio de Prevención y Epidemiología del Plan Sobre Sida, Consejería de Sanidad y Consumo, Ceuta, Spain*
[u] *Sección de Vigilancia Epidemiológica y Control de Enfermedades Transmisibles, Dirección General de Salud Pública y Consumo, Logroño, La Rioja, Spain*
[v] *Servicio de Epidemiología, Dirección General de Sanidad y Consumo, Consejería de Bienestar Social y Sanidad, Melilla, Spain*
[w] *Coordinación Autonómica de Drogas y de la Estrategia de Sida, Dirección General de Salut Pública i Consum, Conselleria de Salut, Família i Bienestar Social, Palma de Mallorca, Balearic Islands, Spain*
[x] *Servicio de Promoción y Educación para la Salud, Dirección General de Salud Pública y Adicciones, Consejería de Salud, Murcia, Spain*
[y] *Programas de Salud, Dirección General, Osakidetza, San Sebastián, Guipúzcoa, Spain*
[z] *Coordinación del Plan Andaluz frente al VIH/SIDA y otras ITS, Dirección General de Salud Pública y Ordenación Farmacéutica, Consejería de Salud y Familias, Sevilla, Spain*
[aa] *Coordinación del Programa VIH/sida, Sección de Promoción de la Salud, Instituto de Salud Pública y Laboral, Pamplona, Navarra, Spain*
[ab] *Servicio de Vigilancia Epidemiológica y Enfermedades Transmisibles, Dirección General de Salud Pública, Consejería de Sanidad, Valladolid, Spain*

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ABSTRACT

*Objective:* To assess the trend in hepatitis A, hepatitis B, pneumococcal, tetanus and seasonal influenza vaccination in people with HIV infection and to analyse associated factors.
*Methods:* The Hospital Survey of Patients with HIV, an annual cross-sectional study conducted on a fixed day (2006–2021), was used. Inpatients and outpatients were included. Trends in vaccination and associated factors were analysed using logistic regression.
*Results:* A total of 8643 participants were included. Vaccination rates increased to 65.3% for hepatitis A, 83.7% for hepatitis B, 49.3% for tetanus, 68.9% for pneumococcal and 74.5% for seasonal influenza

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* Corresponding author.
*E-mail address:* vhernando@isciii.es (V. Hernando).
◊ The names of the members of the Hospital Survey Working Group are listed in Appendix A.

Hepatitis A
Hepatitis B
Tetanus
Pneumococcal
Seasonal influenza

in 2021. Factors positively associated with vaccination were older age for pneumococcal and influenza vaccination; higher educational level for hepatitis A and tetanus; living in a closed institutions or prison for tetanus, pneumococcal and influenza; and having acquired HIV through sex between men for hepatitis A, B and pneumococcal. In addition, being on antiretroviral treatment and having a high CD4 count were positively associated with vaccination for all these diseases. Factors inversely associated with vaccination were being older (hepatitis A, B and tetanus), being an immigrant (tetanus and seasonal influenza) and being an injection drug user/ex-user for hepatitis A and B.
*Conclusions:* Vaccination in people with HIV has increased in the study period. The results are in line with the recommendations in this population, although there is still room to reach the established vaccination indicators.


## Tendencia en la vacunación en personas con infección por VIH participantes en la Encuesta Hospitalaria de pacientes con VIH, 2006-2021

*Palabras clave:*
Vacunación
VIH
Hepatitis A
Hepatitis B
Tétanos
Neumococo
Gripe estacional

R E S U M E N

*Objetivo:* Evaluar la tendencia en la vacunación de hepatitis A, hepatitis B, neumococo, tétanos y gripe estacional en personas con infección por VIH y analizar sus factores asociados.
*Métodos:* Como fuente se utilizó la Encuesta Hospitalaria de pacientes con VIH, estudio transversal anual realizado un día prefijado (2006-2021). Se incluyeron pacientes hospitalizados o atendidos ambulatoriamente. Se analizaron las tendencias en vacunación y los factores asociados mediante regresión logística.
*Resultados:* Se incluyeron 8.643 participantes. Los porcentajes de vacunación aumentaron hasta el 65,3% para hepatitis A, 83,7% para hepatitis B, 49,3% frente a tétanos, 68,9% frente a neumococo y 74,5% para la gripe estacional en 2021. Los factores asociados positivamente con la vacunación fueron tener mayor edad para la vacuna de neumococo y gripe; mayor nivel de estudios para hepatitis A y tétanos; residir en un establecimiento colectivo o en prisión para tétanos, neumococo y gripe; y haber adquirido el VIH mediante relaciones sexuales entre hombres para hepatitis A, B y neumococo. Además, estar recibiendo tratamiento antirretroviral y tener un alto recuento de CD4 se asoció positivamente con la vacunación de todas estas enfermedades. Los factores asociados inversamente con la vacunación fueron tener mayor edad (hepatitis A, B y tétanos), ser inmigrante (tétanos y gripe estacional) y ser usuario/ex usuario de drogas inyectadas para hepatitis A y B.
*Conclusiones:* La vacunación en personas con VIH ha aumentado en el periodo de estudio. Los resultados se ajustan a las recomendaciones en esta población, aunque queda margen para alcanzar los indicadores de vacunación establecidos.


## Introduction

Vaccines are one of the most important preventive strategies against a growing number of infectious diseases in people with human immunodeficiency virus (HIV) infection.[1,2] The immunosuppression associated with HIV infection puts these people at risk of contracting other infectious diseases that, in some cases, share the same routes of transmission and may be vaccine-preventable.[3]

The vaccination guidelines for at-risk groups published by the Spanish Ministry of Health in 2018 recommend vaccination for people with immunodeficiency, including people living with HIV infection. These guidelines recommend the administration of pneumococcal, influenza, hepatitis B, hepatitis A, human papillomavirus (HPV), meningococcal, tetanus, herpes zoster, varicella and MMR vaccines for the adult HIV-infected population.[4]

However, uncertainty in people living with HIV infection about the safety and efficacy of vaccines[5] and about the optimal timing of vaccination in relation to antiretroviral therapy may hinder the attainment of high vaccination coverage, making vaccination in this population a challenge.[3,6]

The aim of this study was to assess the trend in hepatitis A, hepatitis B, pneumococcal, tetanus and influenza vaccination, and to analyse factors associated with vaccination in participants of the Hospital Survey (HS) living with HIV infection between 2006 and 2021.

## Methods

Data were sourced from the HS, a cross-sectional observational study carried out annually on a fixed day. National Health System hospitals participate in the HS, and all HIV-infected individuals who were treated on an outpatient basis, seen at outpatient clinics or day hospitals, or who were inpatients on the day of the study were included. People admitted to or seen at departments other than HIV units on the day of the survey were excluded.[7] This study was first conducted in 1996 and has been continuously adapting to changes in the evolution of the HIV epidemic in Spain. The study period of this analysis spans from 2006 to 2021; however, it was not conducted in 2020 due to the COVID-19 pandemic.

Participation in the HS is voluntary for both hospitals and people living with HIV. An average of 66 hospitals from 14 autonomous communities participated each year in the study period. Information is mostly collected from medical records, with the exception of behavioural variables (condom use at last sexual encounter, active intravenous drug use and recent methadone treatment), which the patient participating in the consultation is asked about directly.

The HS collects information on: a) epidemiological variables: gender (male, female), age (under 34 years, 35–44 years, 45–54 years and 55 years and over), educational level (no education or primary education, secondary and university education), country of birth (Spain, another country), living situation (lives alone, lives

with family and/or friends, lives in a collective dwelling, is in prison, or is homeless), employment status (employed/temporary incapacity to work, unemployed, pensioner, student or homemaker, any other status), mode of HIV transmission (men who have sex with men [MSM], current or former intravenous drug user [IVDU], heterosexual and other or unknown); and b) clinical variables: time since diagnosis (less than five years, between five and 15 years, between 16 and 20 years and more than 20 years), CD4 count at last blood test (less than 200 cells/mm$^3$, 200–349 cells/mm$^3$, 350–499 cells/mm$^3$ and more than 500 cells/mm$^3$), receiving antiretroviral therapy (yes, no) and CDC stage of infection (asymptomatic, symptomatic and AIDS).

Regarding the vaccination variables, data are collected on vaccination history for: *hepatitis A* and *hepatitis B*, both categorised as: Yes – person who has received the vaccine, No – person who has not received the vaccine, and Not applicable – person who is already immunised due to having had the disease; *tetanus, pneumococcus and seasonal influenza*, categorised as: Yes – person who has received the vaccine and No – person who has not received the vaccine.

In 2011, seasonal influenza vaccination was incorporated and the information collected on vaccination for hepatitis A and hepatitis B was modified, so there is no information available for these two diseases in that year.

An assessment of vaccination trends for the five diseases in the period 2006–2021 (for seasonal influenza 2012–2021) was conducted. Vaccination rates were calculated for all HS participants with information on each of the vaccines. For hepatitis A and hepatitis B, those who were previously immunised because they had had the disease were excluded. A descriptive analysis and a bivariate and multivariate analysis were performed to identify factors associated with vaccination for each of the diseases. Associations were expressed as odds ratio (OR) and the 95% confidence interval (95% CI).

### *Ethical considerations*

The HS is part of the second-generation epidemiological surveillance of HIV, so it is exempt from the need for informed consent as stated in Law 33/2011, of 4 October, Art. 41 of the General Law on Public Health BOE [Official Gazette]-A2011-15623), and was approved by the Hospital Puerta de Hierro Independent Ethics Committee in 2014 (Minutes No. 301).

## Results

### *Description of the sample*

Between 2006 and 2021, information was collected from 8643 people living with HIV infection. In total, 73.2% were male, 83.5% were Spanish, 36.5% were or had been IVDU and 90.4% were receiving antiretroviral therapy. The socio-demographic and clinical characteristics of the sample are summarised in Table 1.

### *Vaccination rates and trends*

The highest vaccination rates were observed for pneumococcal (64.0%) and seasonal influenza (62.9%) vaccinations followed by tetanus (55.7%). In contrast, vaccination rates were lower for hepatitis A (18.6%) and hepatitis B (38.3%), although it should be noted that 46.5% for hepatitis A and 37.6% for hepatitis B were immunised due to having had the disease before (Table 2).

Over the study period, the percentage of vaccinated participants increased from 9.4% in 2006 to 65.3% in 2021 ($p < 0.001$) for hepatitis A, from 30.8% in 2006 to 83.7% in 2021 ($p < 0.001$) for hepatitis B, from 45.5% in 2006 to 74.5% in 2021 ($p < 0.001$) for pneumococcus,

**Table 1**
Socio-demographic and clinical characteristics of the 8643 Hospital Survey participants, 2006–2021.

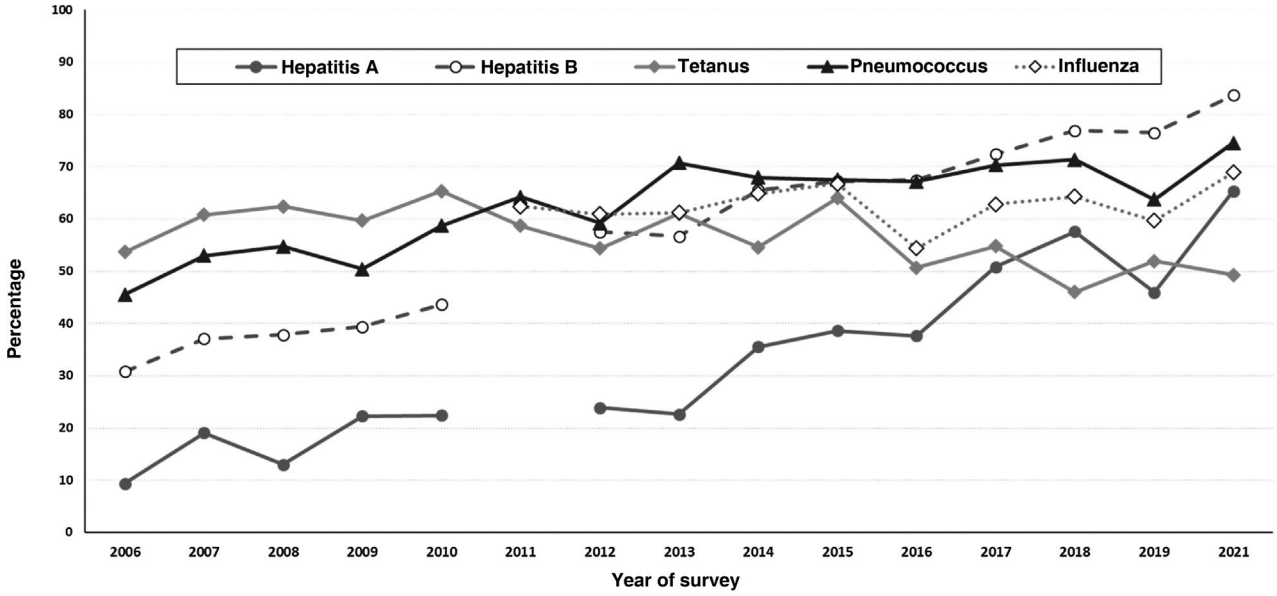
| | Hospital Survey participants, 2006–2021 | |
|---|---|---|
| | Number | Percentage |
| *Gender* | | |
| Male | 6331 | 73.2 |
| Female | 2312 | 26.7 |
| *Age group* | | |
| Under 34 years | 1170 | 13.5 |
| 35–44 years | 2592 | 30.0 |
| 45–54 years | 3103 | 35.9 |
| Over 55 years | 1693 | 19.6 |
| Unknown | 85 | 1.0 |
| *Region of origin* | | |
| Spain | 7217 | 83.5 |
| Immigrant | 1320 | 15.3 |
| Unknown | 106 | 1.2 |
| *Level of education* | | |
| None/primary education | 4056 | 46.9 |
| Secondary | 2815 | 32.6 |
| University | 1466 | 17.0 |
| Unknown/not stated | 306 | 3.5 |
| *Living situation* | | |
| Lives alone/family/friends | 7856 | 90.9 |
| Collective dwelling | 350 | 4.1 |
| Prison | 167 | 1.9 |
| No fixed abode/unknown | 270 | 3.1 |
| *Employment status* | | |
| Active or incapacity for work | 4116 | 47.6 |
| Unemployed/student | 2048 | 23.7 |
| Retired | 2077 | 24.0 |
| Other/unknown | 402 | 4.7 |
| *Time since diagnosis* | | |
| Less than 5 years | 2111 | 24.4 |
| 5 to 15 years | 2904 | 33.6 |
| 16–20 years | 1438 | 16.6 |
| Over 20 years | 1993 | 23.1 |
| Unknown | 197 | 2.3 |
| *Mode of transmission* | | |
| Heterosexual | 2535 | 29.3 |
| Homosexual/bisexual | 2363 | 27.3 |
| IVDU | 3152 | 36.5 |
| Other/unknown | 593 | 6.9 |
| *CD4 values (most recent test)* | | |
| Less than 200 | 1253 | 14.5 |
| 200–349 | 1222 | 14.1 |
| 350–499 | 1500 | 17.4 |
| More than 500 | 4425 | 51.2 |
| Unknown | 243 | 2.8 |
| *Antiretroviral therapy* | | |
| Yes | 7812 | 90.4 |
| No | 780 | 9.0 |
| Not stated | 51 | 0.6 |
| *CDC stage of infection* | | |
| Stage A (asymptomatic) | 3917 | 45.3 |
| Stage B (symptomatic) | 1481 | 17.1 |
| Stage C (AIDS) | 3039 | 35.2 |
| Not stated | 206 | 2.4 |
| *Year of the survey* | | |
| 2006 | 532 | 6.2 |
| 2007 | 434 | 5.0 |
| 2008 | 412 | 4.8 |
| 2009 | 467 | 5.4 |
| 2010 | 441 | 5.1 |
| 2011 | 525 | 6.1 |
| 2012 | 504 | 5.8 |
| 2013 | 583 | 6.8 |
| 2014 | 621 | 7.2 |
| 2015 | 556 | 6.4 |
| 2016 | 543 | 6.3 |
| 2017 | 627 | 7.2 |
| 2018 | 638 | 7.4 |
| 2019 | 826 | 9.6 |
| 2021 | 934 | 10.8 |

IVDU: intravenous drug use.

**Table 2**
Hepatitis A, hepatitis B, tetanus, pneumococcus and influenza vaccination status among Hospital Survey participants, 2006–2021.

| | Total HS participants[a] | Vaccinated | | Unvaccinated | | Immune | |
|---|---|---|---|---|---|---|---|
| | Number | Number | Percentage | Number | Percentage | Number | Percentage |
| Hepatitis A[b] | 6122 | 1140 | 18.6 | 2133 | 34.8 | 2849 | 46.5 |
| Hepatitis B[b] | 6876 | 2632 | 38.3 | 1661 | 24.1 | 2583 | 37.6 |
| Tetanus | 5711 | 3182 | 55.7 | 2529 | 44.3 | – | |
| Pneumococcus | 7418 | 4751 | 64.0 | 2667 | 36.0 | – | |
| Influenza[c] | 5428 | 3414 | 62.9 | 2014 | 37.1 | – | |

HS: Hospital Survey.
[a] Total number of participants with information on each of the vaccines.
[b] Data for 2011 are not included.
[c] In HS since 2011.




| | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2021 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hepatitis A | 9.4 | 19.1 | 13 | 22.3 | 22.4 | | 23.9 | 22.6 | 35.5 | 38.6 | 37.6 | 50.8 | 57.6 | 45.9 | 65.3 |
| Hepatitis B | 30.8 | 37.1 | 37.8 | 39.4 | 43.6 | | 57.5 | 56.7 | 65.5 | 67.2 | 67.4 | 72.4 | 76.9 | 76.5 | 83.7 |
| Tetanus | 53.7 | 60.8 | 62.4 | 59.7 | 65.3 | 58.7 | 54.4 | 61 | 54.6 | 64 | 50.7 | 54.8 | 46 | 51.9 | 49.3 |
| Pneumococcus | 45.5 | 53 | 54.7 | 50.4 | 58.7 | 64.2 | 59.2 | 70.7 | 67.9 | 67.5 | 67.1 | 70.3 | 71.3 | 63.7 | 74.5 |
| Influenza | | | | | | 62.4 | 60.9 | 61.2 | 64.8 | 66.7 | 54.4 | 62.8 | 64.3 | 59.7 | 68.9 |

**Figure 1.** Changes over time of the percentage of HS participants vaccinated against hepatitis A, hepatitis B, tetanus, pneumococcus and seasonal influenza, 2006–2021.
Note: The trend p-value was <0.001 for the hepatitis A, hepatitis B, tetanus and pneumococcal vaccines, and 0.052 for the seasonal influenza vaccine.

and from 62.4% in 2011 to 68.9% in 2021 ($p = 0.021$) for seasonal influenza, while the percentage of participants vaccinated against tetanus decreased from 53.7% in 2006 to 49.3% in 2021 ($p = 0.178$) (Fig. 1).

*Factors associated with vaccination*

The vaccination rates for each vaccine according to the socio-demographic and clinical characteristics of the participants, as well as the results of the univariate logistic regression analysis, are shown in Appendix B Table A1 of the Supplementary material.

The factors associated with vaccination are shown in Table 3. For hepatitis A, the following were associated with a higher likelihood of being vaccinated: having secondary education (adjusted OR [ORa]: 1.23; 95% CI: 1.01–1.50) or higher (1.28 [1.00–1.63]); longer time since diagnosis (five to 15 years: 1.24 [0.99–1.55], 16–20 years: 1.54 [1.15–2.07] and more than 20 years: 1.68 [1.25–2.24]) compared to those diagnosed less than five years ago; men having acquired the infection through having sex with men (1.57 [1.26–1.95]) compared to heterosexual sexual relations; and having higher CD4 counts (200–349 cells/mm$^3$: 1.82 [1.28–2.59], 350–499 cells/mm$^3$: 1.50 [1.05–2.12] and more than 500 cells/mm$^3$: 1.78 [1.31–2.43] compared to less than 200 cells/mm$^3$). Conversely, not receiving antiretroviral therapy (0.71 [0.51–0.97]), having AIDS stage disease (0.66 [0.54–0.81]), being or having been an IVDU (0.76 [0.60–0.97]) and being older at the time of the survey (aged 45–54 years: 0.71 [0.54–0.92] and for those aged 55+: 0.47 [0.34–0.65] compared to those aged under 34 years), were associated with a lower likelihood of having had hepatitis A vaccination.

For hepatitis B, factors associated with a higher likelihood of vaccination were: diagnosis five to 15 years ago (ORa: 1.35, 95% CI: 1.12–1.62), 16–20 years ago (1.87 [1.46–2.38]) and over 20 years ago (1.58 [1.23–2.03]); being MSM (1.59 [1.33–1.90]); and higher CD4 count (200–349 cells/mm$^3$: 1.71 [1.32–2.23], 350–499 cells/mm$^3$: 2.14 [1.66–2.75], more than 500 cells/mm$^3$: 2.75 [2.20–3.44]) compared to less than 200 cells/mm$^3$). Age 35–44 years old (0.72 [0.58–0.89]), 45–54 years old (0.68 [0.54–0.86]) and 55+ (0.57 [0.44–074]) was associated with a lower likelihood of vaccination compared to those aged under 34 years old; as were being or having been an IVDU (0.66 [0.54–0.80]), not being on antiretroviral therapy (0.72 [0.56–0.91]) and having an AIDS diagnosis (0.82 [0.69–0.97]).

**Table 3**
Factors associated with hepatitis A, hepatitis B, tetanus, pneumococcal and influenza vaccination among Hospital Survey participants, 2006–2021.

| Variables | Hepatitis A | | Hepatitis B | | Tetanus | | Pneumococcus | | Seasonal influenza | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Adjusted OR | p-value | Adjusted OR | p-value | Adjusted OR | p-value | Adjusted OR | p-value | Adjusted OR | p-value |
| *Gender* | | | | | | | | | | |
| Male | | | | | 1 | | | | | |
| Female | | | | | **0.84 (0.74–0.95)** | 0.006 | | | | |
| *Age group* | | | | | | | | | | |
| Under 34 years | 1 | | 1 | | 1 | | 1 | | 1 | |
| 35–44 years | 0.99 (0.77–1.20) | 0.951 | **0.72 (0.58–0.89)** | 0.003 | **0.82 (0.69–0.98)** | 0.035 | 1.00 (0.85–1.19) | 0.908 | 1.17 (0.96–1.43) | 0.105 |
| 45–54 years | **0.71 (0.54–0.92)** | 0.011 | **0.68 (0.54–0.86)** | 0.001 | **0.82 (0.69–0.99)** | 0.045 | 1.14 (0.96–1.35) | 0.123 | **1.52 (1.25–1.86)** | <0.001 |
| Over 55 years | **0.47 (0.34–0.65)** | <0.001 | **0.57 (0.44–0.74)** | <0.001 | **0.68 (0.55–0.83)** | <0.001 | **1.44 (1.19–1.75)** | <0.001 | **2.62 (2.10–3.26)** | <0.001 |
| Unknown | 0.64 (0.21–1.94) | 0.438 | 0.93 (0.43–2.03) | 0.871 | 1.33 (0.74–2.41) | 0.332 | 1.78 (1.02–3.08) | 0.040 | 1.55 (0.82–2.91) | 0.171 |
| *Region of origin* | | | | | | | | | | |
| Spain | | | | | 1 | | | | 1 | |
| Immigrant | | | | | **0.77 (0.65–0.90)** | 0.001 | | | **0.76 (0.64–0.89)** | 0.001 |
| Other/unknown | | | | | 0.87 (0.55–1.38) | 0.573 | | | 0.71 (0.45–1.12) | 0.145 |
| *Level of education* | | | | | | | | | | |
| None/primary education | 1 | | | | 1 | | | | | |
| Secondary | **1.23 (1.01–1.50)** | **0.031** | | | 1.09 (0.97–1.24) | 0.129 | | | | |
| University | **1.28 (1.00–1.63)** | **0.043** | | | **1.22 (1.04–1.43)** | 0.011 | | | | |
| Unknown/not stated | 0.93 (0.54–1.59) | 0.806 | | | 0.66 (0.44–0.98) | 0.039 | | | | |
| *Living situation* | | | | | | | | | | |
| Lives alone/family/friends | | | | | 1 | | 1 | | 1 | |
| Collective dwelling | | | | | 1.29 (0.97–1.71) | 0.074 | **1.47 (1.12–1.93)** | 0.005 | **1.61 (1.13–2.30)** | 0.008 |
| Prison | | | | | **2.54 (1.59–4.04)** | <0.001 | 0.91 (0.61–1.36) | 0.662 | 1.17 (0.69–1.97) | 0.546 |
| No fixed abode/unknown | | | | | 0.81 (0.54–1.21) | 0.323 | 0.76 (0.55–1.05) | 0.100 | 0.58 (0.39–0.86) | 0.007 |
| *Time since diagnosis* | | | | | | | | | | |
| Less than 5 years | 1 | | 1 | | 1 | | 1 | | 1 | |
| 5 to 15 years | **1.24 (0.99–1.55)** | **0.050** | **1.35 (1.12–1.62)** | **0.001** | **1.27 (1.09–1.47)** | **0.001** | **1.74 (1.52–2.00)** | **<0.001** | **1.53 (1.30–1.80)** | **<0.001** |
| 16–20 years | **1.54 (1.15–2.07)** | **0.003** | **1.87 (1.46–2.38)** | **<0.001** | **1.50 (1.25–1.80)** | **<0.001** | **2.04 (1.71–2.44)** | **<0.001** | **1.57 (1.28–1.92)** | **<0.001** |
| Over 20 years | **1.68 (1.25–2.24)** | **<0.001** | **1.58 (1.23–2.03)** | **<0.001** | **1.40 (1.17–1.66)** | **<0.001** | **2.24 (1.87–2.69)** | **<0.001** | **1.67 (1.39–2.01)** | **<0.001** |
| Unknown | 1.13 (0.60–2.11) | 0.69 | 1.51 (0.90–2.53) | 0.112 | 1.00 (0.66–1.51) | 0.978 | 1.02 (0.70–1.47) | 0.907 | 1.57 (1.01–2.44) | 0.044 |
| *Mode of transmission* | | | | | | | | | | |
| Heterosexual | 1 | | 1 | | | | 1 | | | |
| Homosexual/bisexual | **1.57 (1.26–1.95)** | **<0.001** | **1.59 (1.33–1.90)** | **<0.001** | | | **1.31 (1.14–1.50)** | **<0.001** | | |
| IVDU | **0.76 (0.60–0.97)** | **0.030** | **0.66 (0.54–0.80)** | **<0.001** | | | 0.93 (0.81–1.07) | 0.368 | | |
| Unknown | 0.91 (0.64–1.28) | 0.590 | 1.14 (0.85–1.52) | 0.368 | | | 1.11 (0.89–1.38) | 0.341 | | |
| *CD4 values (most recent test)* | | | | | | | | | | |
| Less than 200 | 1 | | 1 | | 1 | | 1 | | 1 | |
| 200–349 | **1.82 (1.28–2.59)** | **0.001** | **1.71 (1.32–2.23)** | **<0.001** | **1.28 (1.04–1.57)** | **0.017** | **1.93 (1.60–2.32)** | **<0.001** | **2.26 (1.78–2.85)** | **<0.001** |
| 350–499 | **1.50 (1.05–2.12)** | **0.022** | **2.14 (1.66–2.75)** | **<0.001** | **1.45 (1.19–1.76)** | **<0.001** | **2.23 (1.87–2.66)** | **<0.001** | **2.29 (1.84–2.86)** | **<0.001** |
| More than 500 | **1.78 (1.31–2.43)** | **<0.001** | **2.75 (2.20–3.44)** | **<0.001** | **1.64 (1.38–1.94)** | **<0.001** | **2.71 (2.33–3.16)** | **<0.001** | **2.59 (2.15–3.12)** | **<0.001** |
| Unknown | 1.31 (0.69–2.46) | 0.398 | 1.24 (0.77–2.01) | 0.363 | 1.27 (0.88–1.84) | 0.199 | 1.05 (0.75–1.49) | 0.747 | 1.46 (0.94–2.29) | 0.091 |
| *Antiretroviral therapy* | | | | | | | | | | |
| Yes | 1 | | 1 | | | | 1 | | 1 | |
| No | **0.71 (0.51–0.97)** | **0.038** | **0.72 (0.56–0.91)** | **0.007** | | | **0.56 (0.46–0.67)** | **<0.001** | **0.33 (0.25–0.44)** | **<0.001** |
| Not stated | 1.64 (0.18–14.29) | 0.652 | 0.65 (0.08–5.14) | 0.689 | | | 1.08 (0.23–5.07) | | 3.08 (0.30–31.42) | 0.342 |
| *CDC stage of infection* | | | | | | | | | | |
| Stage A (asymptomatic) | 1 | | 1 | | | | | | | |
| Stage B (symptomatic) | 0.83 (0.65–1.04) | 0.12 | 0.92 (0.76–1.13) | 0.479 | | | | | | |
| Stage C (AIDS) | **0.66 (0.54–0.81)** | **<0.001** | **0.82 (0.69–0.97)** | **0.028** | | | | | | |
| Not stated | 0.96 (0.53–1.73) | 0.909 | 0.99 (0.60–1.62) | 0.969 | | | | | | |
| *Year of survey* | | | | | | | | | | |
| Year of survey (reference year: 2006) | | | **1.14 (1.12–1.16)** | **<0.001** | **0.96 (0.95–0.97)** | **<0.001** | **1.03 (1.02–1.04)** | **<0.001** | | |

IVDU: intravenous drug use.
In bold, statistically significant OR ($p < 0.005$).

For tetanus vaccination, women were less likely to have been vaccinated (ORa: 0.84; 95% CI 0.74–0.95) than men; and other factors inversely related to vaccination were age 35–44 years old (0.82 [0.69–0.98]), 45–54 years old (0.82 [0.69–0.99]) and over 55 years old (0.68 [0.55–0.83]) compared to those under 34 years; and immigrant status (0.77 [0.65–0.90]). Those with a university education were more likely to have been vaccinated (1.22 [1.04–1.43]) compared to those with no education; as were those in prison (2.54 [1.59–4.04]); and those who had been diagnosed 5–15 years ago (1.27 [1.09–1.47]), 16–20 years ago (1.50 [1.25–1.80]) and over 20 years ago (1.40 [1.14–1.66]) compared to less than five years ago. People with higher CD4 counts (200–349 cells/mm$^3$: 1.28 [1.04–1.57], 350–499 cells/mm$^3$: 1.45 [1.19–1.76] and more than 500 cells/mm$^3$: 1.64: [1.38–1.94]) were also more likely to have been vaccinated compared to individuals with less than 200 cells/mm$^3$.

For pneumococcus, the factors associated with higher likelihood of having been vaccinated were: being over 55 years old (ORa: 1.44, 95% CI: 1.19–1.75) compared to those under 34 years old; living in a collective dwelling (1.47 [1.12–1.93]) compared to those living alone/with family or friends; longer time since diagnosis (between five and 15 years ago: 1.74 [1.52–2.00], between 16 and 20 years ago: 2.04 [1.71–2.44] and over 20 years ago: 2.24 [1.87–2.69]) compared to those diagnosed less than five years ago; MSM (1.31 [1.14–1.50]) compared to heterosexuals; and higher CD4 count (200–349 cells/mm$^3$ (1.93 [1.60–2.32]), 350–499 cells/mm$^3$ (2.23 [1.87–2.66]), more than 500 cells/mm$^3$ (2.71 [2.33–3.16]) compared to less than 200 cells/mm$^3$). Not being on antiretroviral therapy was associated with a lower likelihood of having been vaccinated (0.56 [0.46–0.67]).

Finally in the case of seasonal influenza, older age (45–55 years old: 1.52 [1.25–1.86], and over 55 years old: 2.62 [2.10–3.26] compared to under 34 years old), living in a collective dwelling (1.61 [1.13–2.30]), longer time since diagnosis (5–15 years: 1.53 [1.30–1.80], 16–20 years: 1.57 [1.28–1.92] and more than 20 years: 1.67 [1.39–2.01] compared to less than five years since diagnosis); and higher CD4 count (200–349 cells/mm$^3$: 2.26 [1.78–2.85], 350–499 cells/mm$^3$: 2.29 [1.84–2.86] more than 500 cells/mm$^3$: 2.59 [2.15–3.12] compared to less than 200 cells/mm$^3$) were associated with an increased likelihood of vaccination. Not being on antiretroviral therapy (0.33 [0.25–0.44]) and immigrant status (0.76 [0.64–0.89]) were associated with a lower likelihood of vaccination.

## Discussion

Overall, there is an upward annual trend for the vaccines reviewed, except for tetanus and seasonal influenza vaccines.

This study analysed data from the HS, which has been carried out every year since 1996 and allows us to understand the clinical and socio-demographic characteristics of people living with HIV treated at hospital departments and how they change over time.[8] The majority of participants are male with an average age of 46 years. Regarding the mechanism of transmission, 36.5% were IVDUs and 27.3% MSM, in contrast to new HIV diagnoses in Spain, where IVDUs represent 2.4% and MSM 55.2%.[9] These differences are due to the fact that the HS represents the profile of individuals who have been living with HIV for longer.

The complexity of treating and managing people living with HIV infection, coupled with the fact that it has become a chronic disease, has led to the need for greater standardisation of care. GESIDA's [AIDS Study Group] "Quality of Care Guidelines for the Care of People Living with HIV"[10] include the need for an assessment of patients' vaccination status at baseline and during their clinical follow-up, consistent with the European EACS guidelines.[11] Both sets of guidelines cover the main indications for vaccination. Vaccination coverage against hepatitis A, hepatitis B and pneumococcus should be 85% according to the guidelines established by GESIDA.[10]

The vaccination rate is similar to that estimated in neighbouring countries. For hepatitis A and hepatitis B, vaccination coverage was around 70–75 %[12,13] and in our study it was 65.3% and 83.7% in 2021, respectively. Tetanus vaccination coverage was 84.6%[13], a high figure compared to our findings (49.3% in 2021), although it should be noted that if somebody has already received the full schedule, there would be no need for a booster vaccination in adulthood. In order to better understand these results, it should be taken into account that in Spain the probability of having had hepatitis A or hepatitis B increases significantly with age, and thus these patients would not require vaccination; and in the case of tetanus vaccination it should be taken into account that if somebody has already received the full schedule, there would be no need for a booster vaccination in adulthood.[14]

In contrast, pneumococcal vaccination was around 65%,[13,15] lower than estimated in our analysis (74.5% in 2021). We found seasonal influenza vaccination to be 68.9% in 2021, higher than that shown by other studies in the USA (35%)[16] and Greece (39%).[12]

Among the factors found to be associated with vaccination, we observed that likelihood of vaccination decreased with age for hepatitis A, hepatitis B and tetanus, while likelihood increased with age for pneumococcal and influenza vaccination. These differences are explained by the fact that 35% of the participants had had hepatitis A and 32% had had hepatitis B, making vaccination unnecessary. For tetanus vaccination, the general recommendation is a booster dose every 10 years to a maximum of five doses,[17] so as age increases it is more likely that a person has had the full vaccination schedule. For pneumococcal and seasonal influenza vaccination, the recommendation would be to administer it to the at-risk population regardless of age,[18] although it is recommended for the over 65 s in the general population.[17] Higher educational attainment was associated with a higher likelihood of having been vaccinated against hepatitis A and tetanus. This may be because less educated individuals may have acquired HIV infection to a greater extent through intravenous drug use, and therefore acquired immunity to it by having had the disease.

A lower likelihood of having been vaccinated against tetanus and influenza was found among immigrants compared to Spaniards, similar to the findings of other studies.[12,19] The precarious legal and occupational status of many immigrants is an obstacle to accessing health services, especially visits related to prevention and health promotion, along with low vaccination coverage in their countries of origin.[20,21]

The association we found with vaccination for the five diseases reviewed in terms of CD4 lymphocyte count, antiretroviral therapy or stage of infection could be related to the recommended vaccination schedules for this population; vaccinating when immune reconstitution is achieved after starting antiretroviral therapy and avoiding vaccinating people with counts below 200 CD4 lymphocytes/mm.[11,22]

Regarding the mode of transmission, we observed a higher probability of vaccination against hepatitis A, hepatitis B and pneumococcus in homosexual/bisexual men and a lower probability of vaccination in IVDUs. Vaccination against hepatitis A is especially recommended in MSM following an outbreak of hepatitis A in 17 EU countries, with more than 4000 cases, where 84% of the men were MSM.[23] IVDUs are a group at high risk of acquiring hepatitis,[24–26] so many may already be immunised and therefore not vaccinated.

In our study we found that HS participants living in collective dwellings are more likely to have been vaccinated against pneumococcus and seasonal influenza. Vaccination against these diseases in institutionalised individuals is included in the vaccination proto-

cols for at-risk groups,[4,27] but it is also related to the fact that people living in residential care may be older or have other comorbidities that make them more vulnerable to these diseases and more likely to present with more severe clinical signs and symptoms. On the other hand, participants who were in prison were more likely to have been vaccinated against tetanus. In penitentiary institutions, upon arrival of a new inmate, vaccination status is assessed and updated,[28] as the prison setting may promote the transmission of some vaccine-preventable infections. In a study conducted in Spanish prisons, 71.9% of inmates were immunised against tetanus and 52.3% against hepatitis B.[29]

In terms of the limitations of this study, the voluntary participation of hospitals in the HS may influence the representativeness of the results obtained nationwide. However, given that coverage over the time this survey has been conducted is very high, and the fact that antiretroviral therapy in Spain is provided free of charge in hospital, it is possible to collect information from people living with HIV who are newly diagnosed and those who have been living with HIV for longer, so this possible bias would be minimised. Moreover, the information collected by healthcare staff in hospitals on vaccination status corresponds not only to vaccinations administered in the hospital itself but also to vaccinations that the patient may have received at other healthcare centres, such as primary care and self-reported to their medical specialist, which could be influenced by the patient's memory bias. For a better follow-up of the patient, vaccination status should be assessed and the vaccination response should be monitored.[22]

In conclusion, our results show that vaccination against these diseases in people living with HIV has increased over the study period. Overall, the results are in line with the recommendations on vaccination in people living with HIV in Spain, but there is room for improvement to attain the established vaccination targets in this population.

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## Conflicts of interest

The authors declare that they have no conflicts of interest.

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## Appendix A. Hospital Survey Working Group

*Andalusia:* A. Collado (H.U. Torrecárdenas, Almería), G. Garcia (H. La Línea, La Línea de la Concepción), J.A. Girón (H.U. Puerta del Mar, Cádiz), A. Romero (H.U. Puerto Real, Puerto Real), A. Rivero (H.U. Reina Sofía, Córdoba), J. Hernández (H.U. San Cecilio, Granada), J.A. Terrón (H.U. Jerez de la Frontera, Jerez de la Frontera), J. de la Torre, J. Olalla Sierra (H. Costa del Sol, Málaga), R. Palacios (H.U. Virgen de la Victoria, Málaga), M.J. Ríos (H.U. Virgen de la Macarena, Seville), M. Santos, E. García (H.U. Virgen de Valme, Seville), L. Fernández (H.U. Virgen del Rocio, Seville), M. Omar Mohamed-Balghata (H.U. de Jaén, Jaén) and D. Merino (H. Juan Ramón Jiménez, Huelva).

*Aragón:* S. Letona (H.C.U. Lozano Blesa, Zaragoza), P. Arazo (H.U. Miguel Servet, Zaragoza), M. Díaz (H. Royo Villanova, Zaragoza) and M. Egido (H. San Jorge, Huesca).

*Asturias:* V. Asensi (H.U. Central de Asturias, Oviedo), B. de la Fuente (H. Cabueñes, Gijón), J. Lobo (H. Valle del Nalón, Langreo), M.A. Meana (H. Álvarez Buylla, Mieres) and M. de Zárraga (H. San Agustí, Avilés).

*Balearic Islands:*A. Rey (F.H. Comarcal de Inca, Inca), A. Payeras (H. Son Llatzer, Palma de Mallorca), M. Riera, M. Leyes (H. Son Espases, Palma de Mallorca), J. Martínez (H. Manacor, Manacor) and E. Rodríguez de Castro (H. Mateu Orfila, Mahón).

*Canary Islands:* M.E. Colino (H. Materno-Infantil, Las Palmas de Gran Canaria), J.L. Gómez (H.U. de Canarias, San Cristóbal de la Laguna), J. Gómez (H. Nuestra Señora de la Candelaria-Ped., Santa Cruz de Tenerife) and J.F. Lluch (H. Dr. José Molina Orosa, Arrecife).

*Cantabria:* M.C. Fariñas (H.U. Marqués de Valdecilla, Santander).

*Castile-La Mancha:* E. Martínez (C.H.U. de Albacete, Albacete), I. Marañes (H. de Hellín, Hellín), M.I. García (H. General de Almansa, Almansa), M.L. Porras (H. General de Ciudad Real, Ciudad Real), J.R. Barbera (H. General La Mancha-Centro, Alcázar de San Juan), A. López de la Osa (H. Virgen de Altagracia, Manzanares), C. Muñoz, C. Pereda (H. Santa Bárbara, Puertollano), M.P. Geijo (H. Virgen de la Luz, Cuenca), F. Cuadra (H. Virgen de la Salud, Toledo), M. Torralba (H.G.U. de Guadalajara, Guadalajara) and J.M. Yzusqui (H. Nuestra Señora del Prado, Talavera de la Reina).

*Castile and León:* M.A. Garcinuño (C.A. de Ávila-Nuestra Señora Sonsoles, Ávila), M. J. Sánchez (H. Santiago Apóstol, Miranda de Ebro), C. Navarro (C.A.U. de Burgos, Burgos), C. de la Higuera, S.S Mendoza (H. Santos Reyes, Aranda de Duero), J.A. Carro, R. Perez (C.A. de León, León), A. Bahamonde (H. del Bierzo, Ponferrada), A.Y. Morán, J. Sánchez (C.A.U. de Palencia, Palencia), A. Iglesias (H. Universitario de Salamanca), E.M. Ferreira (C.H. de Segovia, Segovia), M. del Valle (C.A. de Soria-Santa Bárbara, Soria), C. Hinojosa, C. Dueñas (H. Clínico Universitario, Valladolid), P. Bachiller, J. Abadía (H. Universitario Río Hortega) and A. Chocarro and C. Martín (C.A. Zamora-Virgen de la Concha, Zamora).

*Ceuta:* D. Navarro (H.U. de Ceuta, Ceuta).

*Extremadura:* M.N. Nogales (H.U. de Badajoz, Badajoz), J.L. Moreiras (H. Campo Arañuelo, Navalmoral de la Mata), C. García (H. Virgen del Puerto, Plasencia), M. Medina (H. de Mérida, Mérida), J.L. Chicón (H. Llerena-Zafra, Llerena), C. Martín (H.U. de Cáceres, Cáceres), M. Galán (H. Don Benito-Villanueva, Don Benito) and I. Montes (H. Ciudad de Coria, Coria).

*La Rioja:* J.A. Oteo (H. San Millán y San Pedro, Logroño).

*Madrid:* F. Pulido (H. Doce de Octubre, Madrid), J.E. Losa (F. Hospital Alcorcón, Alcorcón), M. Górgolas, A. Cabello (F. Jiménez Díaz, Madrid), J.C. López (H.G.U. Gregorio Marañón, Madrid), J. Sanz (H. de la Princesa, Madrid), M.J. Pérez-Elías (H. Ramón y Cajal, Madrid), L. Ramos, A. Delgado (H. U. La Paz/IdiPAZ, Madrid), I. Suárez (H. Infanta Sofía, San Sebastián de los Reyes), M.T. Fernández (H. del Sureste, Arganda del Rey) and J.L. Pérez (H.U. Infanta Cristina, Parla).

*Melilla:* A. Fernández (H. Comarcal de Melilla, Melilla).

*Murcia:* C. Galera, H. Albendin (H.U. Virgen de la Arrixaca, El Palmar), D.P. Piñar (H. Los Arcos del Mar Menor, San Javier), A.J. Sánchez, O.J. Martínez (H.G.U. Santa Lucía, Cartagena), J. Sánchez (H. Comarcal del Noreste, Caravaca de la Cruz) and J. Bravo (H. Morales Meseguer, Murcia).

*Navarre:* C. Ibero (C.H. de Navarra, Pamplona-Iruña) and M.T. Rubio Obanos (H. Reina Sofía, Tudela).

*Basque Country:* X. Kortajarena and J.A. Iribarren (H.U. Donostia, San Sebastián-Donostia).

*Coordinators in the autonomous communities:* Javier de la Torre (Andalusia), Maria Oliva Ladrero/Wafa Ben Cheikh El Aayuni (Aragón), José María Blanco/Mar Cuesta (Asturias), Rosa Aranguren/Maria Glòria Jaume Amengual (Balearic Islands), Ana Izquierdo (Canary Islands), Luis Viloria (Cantabria), Gonzalo Gutiérrez (Castile-La Mancha), Henar Marcos (Castile and León), Irene López (Ceuta), Gustavo González (Extremadura), Eva Martínez (La Rioja), Daniel Castrillejo (Melilla), M. Antonia Belmonte (Murcia), Estrella Miqueleiz (Navarre) and Antonio Arraiza (Basque Country).

## Appendix B. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.eimce.2023.07.006.

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