

# Computerised vaccination register for the Murcia region, Spain, 1991 to 2011

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We describe the Murcia regional vaccination register in Spain, which was set up in 1991, detailing its main features, advantages and limitations. We also report on some recent special actions carried out that led to an improvement in vaccination coverage against measles, rubella and mumps (MMR): by using the vaccination register, we were able to identify and vaccinate persons aged under 20 years in a measles outbreak in 2010 in the town of Jumilla who were not adequately vaccinated for their age with MMR vaccine. From spring 2012, use of our register will enable us to identify susceptible individuals in our region under 40 years of age who have received fewer than two doses of MMR vaccine and call them for the appropriate vaccination. We also set out our experience in the use of barcodes to identify individuals and collect vaccine data: our data show that the barcodes help to improve data quality and completeness. Finally, we identify certain challenges in search of greater standardisation for systems and encoding that is necessary to enable an easy exchange of data between different registers.

## Introduction

Vaccine information systems or registers are a major tool that allows public health personnel to measure, maintain and increase vaccine coverage levels and also to gather information automatically about an individual's vaccine needs. Among other things, such registers allow relatives or the person concerned to be given reminders about the doses still to be received in order to complete a primary or booster series – helping healthcare personnel to vaccinate a person at the most appropriate time – or for them to be asked to provide missing vaccine-related data. The registers can also provide official certificates of a person's vaccination status and detect unvaccinated groups and areas or local population groups with low coverage in which outbreaks of vaccine-preventable diseases are likely to occur [1,2]. They can also help to improve data quality and monitor the implementation of new vaccination recommendations [3]. In addition, they also enable the registration of side effects and the monitoring of vaccine effectiveness. All these advantages have been demonstrated in countries with extensive experience

of computerised vaccination registers such as Australia [4] and the United Kingdom [5].

In this article, we describe the centralised, computerised vaccination register of the region of Murcia in Spain, showing how it has been used, as well as its limitations and the resources needed. Murcia region – one of the 17 in the country – has a population of 1,471,406 inhabitants, of whom almost 18% are under the age of 14 years [6]. Over the last 10 years, the mean number of births per year was about 17,000, having risen from 13,000 in 1999 to about 18,300 in 2010 [6]. The region has received devolved powers from central government covering public health and healthcare provision, although in some matters, such as the vaccination calendar, it coordinates its activities with those of the other regions and with the national health ministry.

There are similar centralised regional registers in the Spanish regions of Galicia, Valencia, La Rioja and Andalusia, as well as in some cities such as Barcelona and Salamanca: these registers are not connected to each other. Elsewhere in Spain, vaccines administered are recorded on an individual's case report in primary healthcare: there is no centralisation of data at the country level. Work is currently under way to develop a single format for recording a person's case history at the national level that would also incorporate the person's vaccine data.

Most of the regions use official population figures for calculating coverage, except for La Rioja and Murcia which have their own population databases.

Public and private health providers, mostly in primary healthcare, carry out the vaccinations. In the primary healthcare centres, data are entered by the health professional who administers the vaccine. In the management centres of the vaccination register, clerical staff enter the data.

The vaccines included in the vaccination calendar are paid for by the regional government: those not included in the calendar are paid for by parents or guardians.

## Description of the vaccination register of Murcia region

The computerised vaccinations register was set up in the Murcia region in 1991. It was founded on an earlier register for infants that recorded only the primary vaccination series (i.e. vaccines received in the first two years of life). The computerised register has evolved over time, so that it currently records all vaccines administered in the region, whether in the private or the public sector, during childhood or adulthood, and also includes vaccines that are not part of the official vaccination calendar. All primary healthcare centres in the region participate in the register.

### Inclusion of individuals in the register

Murcia's vaccination register is part of the regional public health information system. The register uses a single population database (PER\_SAN), which is fed with real-time updates from the regional population database of the healthcare system. These are classified as new entries, deletions, deaths, change of address, change of paediatrician or family physician, etc.

Various processes are used to include individuals in the register's population database, PER\_SAN (Figure 1).

- When a child is born in hospital, the public health information system assigns them a personal regional identification code (a barcode), which is given to the parents on labels. This is part of the documentation parents receive after childbirth, which also includes notification cards that they take with them to accredited vaccination centres, be they public or private. The barcode is recorded in the PER\_SAN database through the results of screening for neonatal hearing loss.
- The same barcode is also used in a programme to detect congenital errors of metabolism. Blood and urine samples are taken on the third day of life and sent to a laboratory together with a card containing the newborn's personal details. Attached to this card is one of the barcoded labels given to the parents at the hospital. This barcode is recorded in the PER\_SAN database when the laboratory results have been obtained.
- When parents or guardians apply for a health insurance card for their child, the child's details are manually included in the PER\_SAN database. This applies too if the child was not born in hospital.
- If a person (child or adult) comes to live in the region, when they visit a primary healthcare centre, a form containing their details (identification card) is sent to the vaccination register. These details are added to the PER\_SAN database manually.

Data duplication is prevented by a double check, one automatic and the other manual.

i. Automatic check: an identification code assigned by PER\_SAN to each person included in the database and the regional personal identification code (the code

issued by the public health information system) enable the duplication of individuals to be avoided, through searches that are automatically carried out when the codes are entered. In addition, whenever a person is entered into PER\_SAN manually, internal search processes are run automatically to identify whether that person is already present on the database and thus prevent a duplicate entry.

ii. Manual check: two technicians work on the PER\_SAN database to identify duplicates and correct any database errors.

### Inclusion of vaccination data in the register

Our register can import vaccine-related information from primary healthcare case reports, but the primary healthcare information system is not currently ready to import data from our register. However, our register is available through the Internet, so any authorised healthcare professional can consult a patient's immunisation status regardless of where the person was vaccinated.

At primary healthcare centres that participate in the register, a person's vaccination details are entered into a computerised case report, using the same codes as in our register. Thus whenever we incorporate data from these computerised case reports, the system detects whether the vaccination has already been recorded for that person and, if so, does not include it in the register.

### Data input

The register records the date the vaccine was administered, the vaccination post at which it was administered, the product administered, dose order number (whether this was the first or second dose, for example) and the manufacturer and batch of the vaccine. The indications for the vaccine are also recorded, either using the official vaccination calendar or any special indication due to the individual's medical circumstances, such as being in a risk group for a particular disease, having a chronic illness, etc. Whenever a vaccine-related adverse effect occurs, this can also be recorded. In addition, the reasons for not administering a vaccine, such as contraindication or refusal to receive it, are also included.

At all the primary healthcare centres in the region, around 25,000 vaccine doses administered are recorded every month, except in the influenza vaccination season, when as many as 140,000 monthly doses can be recorded. Our register imports these data, but approximately 10% of the doses recorded on the primary healthcare computerised case reports each month cannot be imported into our system due to encoding errors that arise due to the manual input of all the data (vaccine code, manufacturer and batch). In order to ensure that this information is not lost, we still use the same dose notification system we started with in 1991: the notification cards given to parents after childbirth. These cards include adhesive labels with the barcode

identifying each child. The product administered, the dose order number, batch number, date of administration and name of the vaccination centre are recorded on the card. These cards are then sent by post to one of the register's four management centres, where a check is made to see whether that dose is already recorded in the register.

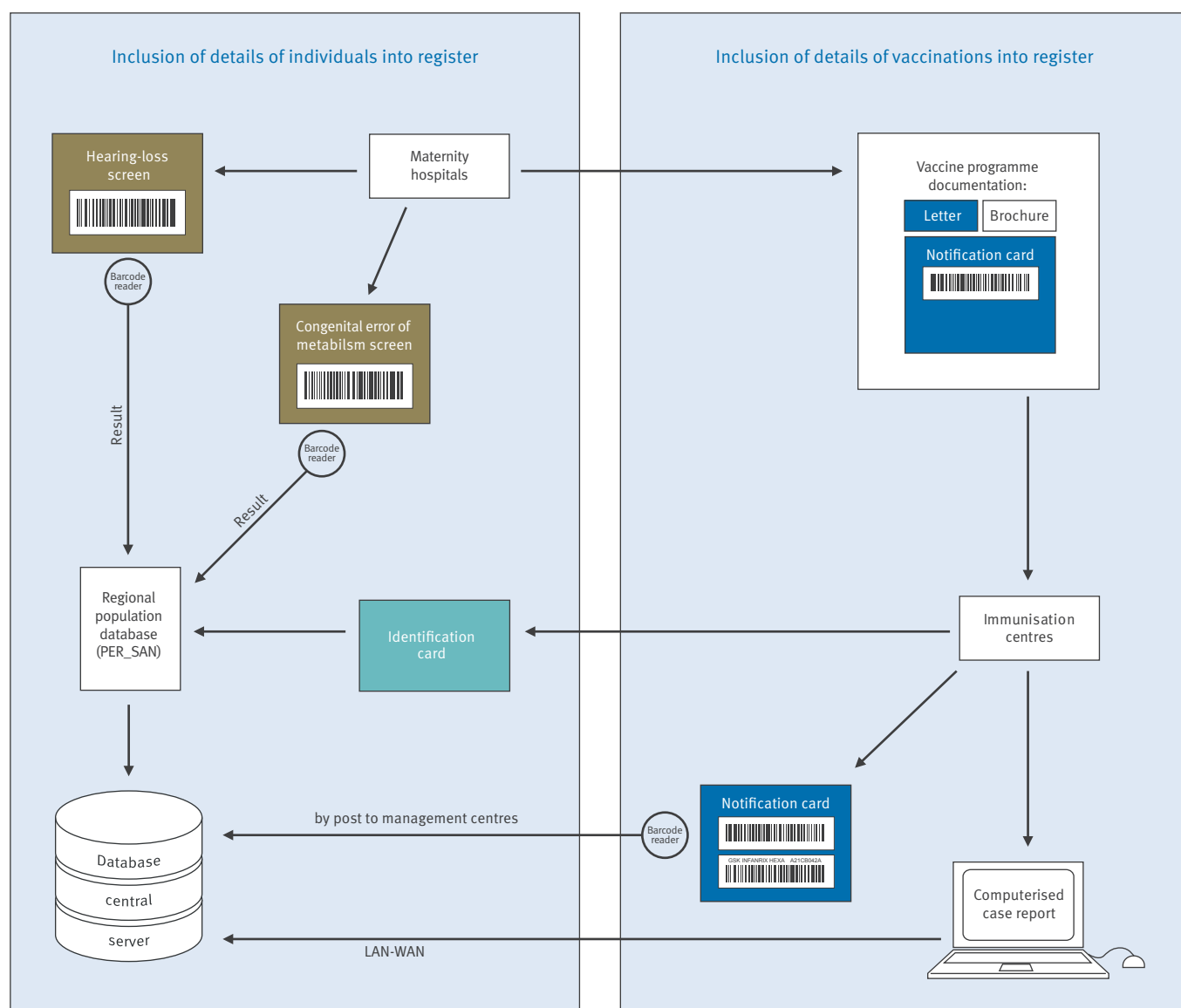
One aspect of importing dosage information is the use of a barcode scanner that reads the details of the vaccine (commercial name, manufacturer, production site and batch number). The scanner software breaks down the information from the barcode (Figure 2). Currently, four of the six manufacturers supplying the region with vaccines (GlaxoSmithKline, Baxter, Pfizer and Sanofi Pasteur MSD) include two barcode labels with each dose of vaccine: one of these is placed on

the notification card and the other on the child's own vaccine administration record.

In the Spanish regions, the use of these labels is voluntary, but the Ministry of Health has established a standard label format for manufacturers who decide to use barcodes. In order to promote the supply of such barcoded labels by manufacturers, a technical criterion for their design is included in the competitive tender procedure used for the acquisition of vaccines. Reading such labels with a barcode scanner means that only the administration date, the dose order number and the vaccination centre need to be recorded manually.

Primary healthcare centres are not equipped to scan the barcode labels. In order to assess the advantage afforded by recording doses using a barcode scanner, we analysed the details of doses recorded in the primary healthcare system for vaccines supplied with

**FIGURE 1**  
Data flow in the computerised vaccination register for Murcia region, Spain



LAN: local area network; WAN: wide area network.

**FIGURE 2**

Composition of a vaccine barcode, Murcia region, Spain



barcode labels. During 2010, the region's primary healthcare teams recorded the administration of a total of 200,352 doses of six different vaccines that have these labels. Of the total number of doses, 17,511 (8.74%) did not have their batch number correctly recorded, 1,162 (0.58%) had no batch number recorded and 16,349 (8.16%) had an incorrect batch number. Regarding the name of the manufacturer, 38,247 (19.09%) of the doses did not have this information correctly recorded: 11,059 (5.52%) had no manufacturer recorded and 27,188 (13.57%) showed the wrong manufacturer. In contrast, 100% of the doses obtained through the barcode scanner had all their details correctly recorded.

### Access to an individual's vaccination data

As mentioned earlier, one important advantage of a vaccination register is that by incorporating in a centralised system all the doses administered, any authorised healthcare professional can access an individual's vaccination history from their work station (data security is regulated by national legislation).

There are several levels of data access, depending on the healthcare professional's role. The access level ranges from full, for example, for coordinators of the vaccination register, to minimal, for those who can access only minimal personal and vaccination details (Table). The coordinator authorises the access and the person requesting access is given an appropriate password that safeguards the confidentiality of the data.

The case report information system used for public healthcare services in the region does not allow professionals at one health centre to consult the vaccine information recorded in the case reports at another. In order to facilitate access to this information for healthcare professionals, a web-based system has been created for the regional vaccination register so that, if granted the appropriate access, it is possible to view

vaccination details and the outcome of the neonatal hearing-loss screen.

### Features of the regional register

The large amount of data collected allows us to define a number of special features of the register.

#### Routine interventions

- Reminders sent out for vaccine doses at the age of six years (diphtheria-tetanus-acellular pertussis vaccine, mumps-measles-rubella (MMR) vaccine), at age 11 years (varicella vaccine, only for susceptible children) and at 14 years (diphtheria and tetanus for boys and girls, human papillomavirus for girls).
- Reminders sent out for influenza vaccination for adults aged 60 years.
- Regular reminders sent out to those insufficiently immunised.

#### Special interventions

The register allows us to carry out special actions from time to time to help increase coverage levels and identify poorly immunised population groups – a very useful option when facing an outbreak of diseases that can be prevented through vaccination. For example, during 2010, there was an outbreak of measles in the town of Jumilla, with a total of 90 confirmed cases. By using the vaccination register, we were able to identify those persons under 20 years of age who were not adequately vaccinated for their age with MMR vaccine. A total of 3,195 letters were sent out to individuals between 6 months and 20 years of age (or their parents or guardians) and 1,667 doses were administered during the month after the letters were sent out (the mean monthly number of vaccine doses in that town is 68). Simultaneously, we were able to update the

**TABLE**

Levels of data access, regional vaccination register, Murcia region, Spain

Healthcare professional's role in the vaccination register	Level of access
Consulting vaccination records	Can view data on vaccines administered to an individual. Has access to minimal personal information.
Operational	Can consult and input information on vaccine doses. Has full access to personal information.
Management	Can consult, input and evaluate information on vaccine doses. Has full access to personal information.
Coordination	Has access to all the register's functions, including the management of software, and the allocation and authorisation of access levels.

information about the doses administered that we did not have on record in our vaccination register.

From spring 2012, use of our register will enable us to identify susceptible individuals in our region under 40 years of age who have received fewer than two doses of MMR vaccine and call them for the appropriate vaccination.

Having people's mobile telephone numbers (part of the information recorded in the vaccination register) allowed short message service (SMS) text messages to be sent to teenage girls who had not completed the vaccination regime against human papilloma virus, thus increasing coverage by 5.1% in the cohort of girls born in 1994 [7].

Regarding data management, our system allows vaccination coverage to be calculated at different levels of data disaggregation, making it easier for healthcare professionals to carry out actions at the level of the individual.

### **Resources needed for the maintenance of the register**

The features of the register allow actions to be taken that would be impossible or very complicated without them. Some of these actions would probably require additional human resources and so such actions would be hard for a region such as ours to undertake. Even so, maintenance of the register requires a considerable involvement in terms of human resources. A total of 19 people – at various professional levels (medical doctors, nurses and clerical staff) – at the four management centres work on maintaining the register. In addition, two people are devoted exclusively to maintaining the PER\_SAN database, which is shared by almost all public health programmes in Murcia.

To ensure that everything works correctly, we have the support of highly qualified informatics staff who, in addition to having developed the software application, enable us to incorporate improvements as and when required without having to resort to external resources.

### **Limitations of computerised vaccination registers**

Although there are a large number of advantages associated with computerised vaccination registers, there are also some drawbacks. Vaccination coverage levels determined from such a register are always underestimated and the number of doses administered (used as the numerator) is always lower than the actual number of doses administered as there are always notification failures [8]. On the other hand, despite the maintenance efforts and the quality assurance checks, the denominator may be overestimated as insufficient information may be received about deaths or changes of address: the latter may have an impact given the extent of migration flow in and out of the region associated with seasonal agricultural activities in the Murcia region.

### **Challenges of vaccination registers**

The first challenge is the systematic use in all countries of vaccination registers with certain minimum functional standards in order to make them compatible [9]. Standardisation in the methods for calculating coverage would make it easier to obtain and compare the levels between countries or even between areas within a single country [10 15].

Another equally important challenge is the standardisation of vaccine- and batch-encoding methods. The batch-encoding system we use – based on what was supplied by a manufacturer we were developing the project with – would help to ensure that the information provided about a batch is homogeneous in all countries using the system. It would be desirable for this or another encoding method to be agreed upon by consensus among the European regulatory agencies, as this would enable the automated inclusion of a larger number of data elements into the vaccination registers, which would be a great improvement in the quality of the information system [16,17].

### **Conclusions**

Vaccination registers are a valuable tool for the management of vaccination programmes. Our regional register has enabled us, among other things, to improve vaccination coverage against measles, rubella and mumps, and against the human papillomavirus in adolescent girls. We believe that at global level we are still at an early stage in terms of developing and using such registers and we therefore still have the chance to take decisions that will enable improvements to be made that will facilitate widespread use of registers in those areas or countries where they are not yet present. Additionally, it is desirable that there should be a high degree of compatibility between the registers used. These are challenges facing those involved in running vaccination programmes, regulatory agencies and health authorities.

## References

1. Bernal González PJ, Navarro Alonso JA, Luna T. Registro nominal de vacunación de la Región de Murcia [Computerised vaccination register for the Murcia region]. *Vacunas. Investigación y Práctica*. 2000;1:137-40. Spanish. Available from: <http://www.elsevier.es/es/revistas/vacunas-investigacion-practica-72/registro-nominal-vacunaciones-region-murcia-10021509-estrategias-vacunales-2000> (restricted access).
2. Vyse AJ, Gay NJ, White JM, Ramsay ME, Brown DW, Cohen BJ, et al. Evolution of surveillance of measles, mumps, and rubella in England and Wales: providing the platform for evidence-based vaccination policy. *Epidemiol Rev*. 2002;24(2):125-36.
3. Writing team for the Public Health Agency of Canada/Canadian Institutes of Health Research Influenza Research Network Vaccine Coverage Theme Group. Why collect individual-level vaccination data? *CMAJ*. 2010;182(2):273-5.
4. Hull BP, Deeks SL, McIntyre PB. The Australian Childhood Immunisation Register – a model for universal immunisation registers? *Vaccine*. 2009;27(37):5054-60.
5. Health Protection Agency (HPA). Vaccination coverage and COVER (cover of vaccination evaluated rapidly). London: HPA. [Accessed 29 Aug 2011]. Available from: <http://www.hpa.org.uk/Topics/InfectiousDiseases/InfectionsAZ/VaccineCoverageAndCOVER>
6. Regional Centre for Statistics of Murcia (CREM). Murcia: CREM. [Accessed 29 Aug 2011]. Spanish. Available from: <http://www.carm.es/chac/dgep/econet/>
7. Pérez-Martín JJ, Bernal-González PJ, Jiménez-Guillén P, Fernández-Sáez L, Navarro-Alonso JA. Resultados de dos estrategias de captación en la vacunación frente al Virus del Papiloma Humano (VPH) en la Región de Murcia. [Results of two recruitment strategies for vaccination against human papillomavirus (HPV) in the Region of Murcia]. *Boletín Epidemiológico de Murcia*. 2010;30:133-6. Spanish. Available from: [http://www.murciasalud.es/recursos/ficheros/200385-boletin\\_Diciembre\\_2010-5.pdf](http://www.murciasalud.es/recursos/ficheros/200385-boletin_Diciembre_2010-5.pdf)
8. Khare M, Piccinino L, Barker LE, Linkins RW. Assessment of immunization registry databases as supplemental sources of data to improve ascertainment of vaccination coverage estimates in the national immunization survey. *Arch Pediatr Adolesc Med*. 2006;160(8):838-42.
9. Centers for Disease Control and Prevention (CDC). IIS: minimum functional standards for registries. Updated 31 Jan 2011. Atlanta: CDC. [Accessed 29 Aug 2011]. Available from: <http://www.cdc.gov/vaccines/programs/iis/stds/min-funct-std-2001.htm>
10. VENICE. Vaccine European New Integrated Collaboration Effort. [Accessed 30 Aug 2011]. Available from: <http://venice.cineca.org/>
11. Report on vaccination coverage assessment in Europe. VENICE. December 2007. Work Package No. 3. Vaccine European New Integrated Collaboration Effort (VENICE). [Accessed 30 Aug 2011]. Available from: [http://venice.cineca.org/Final\\_Report\\_I\\_WP3.pdf](http://venice.cineca.org/Final_Report_I_WP3.pdf)
12. Burton A, Monasch R, Lautenbach B, Gacic-Dobo M, Neill M, Karimov R, et al. WHO and UNICEF estimates of national infant immunization coverage: methods and processes. *Bull World Health Organ*. 2009;87(7):535-41.
13. Kalies H, Redel R, Varga R, Tauscher M, von Kries R. Vaccination coverage data can be estimated from health insurance data. *BMC Public Health*. 2008;8:82.
14. O'Flanagan D, Cotter S, Mereckiene J. Survey on functional standards for computerised immunisation registries in Europe 2008. VENICE. November 2008 – June 2009. Work Package No.3. Vaccine European New Integrated Collaboration Effort (VENICE). [Accessed 30 Aug 2011]. Available from: [http://venice.cineca.org/Final\\_Report\\_Functional\\_Standards\\_v1.0\\_.pdf](http://venice.cineca.org/Final_Report_Functional_Standards_v1.0_.pdf)
15. Haverkate M, D'Ancona F, Johansen K, van der Velden K, Giesecke J, Lopalco PL. Assessing vaccination coverage in the European Union: is it still a challenge? *Exp Rev Vaccines*. 2011;10(8):1195-205.
16. Heijbel H, Jefferson T. Vaccine safety – improving monitoring. *Vaccine*. 2001;19 19(17-19):2457-60.
17. Heijbel H. Improving vaccine safety through the use of immunisation registers and bar code labelled vaccines. *Vaccine*. 2002;20(Suppl 1):S75-7.