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# Actual immunization coverage throughout Europe: are existing data sufficient?

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## Abstract

Assessing vaccine coverage is an essential component of vaccine programme monitoring and evaluation. Vaccine coverage data are available in EU/EEA countries at both national and subnational levels and are used for programmatic purposes at any level. European-wide data collection is performed by WHO through the Centralized Information System for Infectious Diseases, as part of the global data collection jointly conducted with UNICEF. Data quality and comparability are still challenging at an international level. According to available information, vaccination registries are available in 11 countries in the EU/EEA, but only in five countries do they have national coverage. In 2012 ECDC, through the VENICE II network, started the European Vaccination Coverage Collection System (EVACO project), with the final aim of improving the quality of vaccine coverage data at EU level, by defining and implementing standards.

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## What Is Vaccination Coverage?

Vaccination coverage can be defined as the number of persons belonging to a certain population (i.e. one birth cohort, a group targeted by vaccination campaigns, etc.) vaccinated against a specific disease, divided by the total number of individuals belonging to the same population. Such an apparently easy parameter is actually very tricky both to define and to assess adequately.

Several methods have been developed to assess vaccination coverage.

1. Administrative methods that are based on routine estimates of administered vaccine doses divided by the total estimated number of people in the target population. Administrative method estimates can be severely affected by inaccurate numerators or denominators.
2. Surveys: different survey designs have been developed to estimate the levels of immunization coverage at either national or subnational level, or even in selected population groups. Those are usually intended to provide coverage estimates that can be used to verify data collected by administrative methods and eventually to provide additional information that is not available with administrative systems. Several different methodologies have been developed to conduct such surveys [1].
3. Seroprevalence surveys are designed to assess the actual level of immunity against a specific infectious disease. Serological surveys cannot distinguish between protection due to vaccination and naturally acquired immunity, and cannot estimate or verify vaccination coverage. In addition, they can be useful only when a clear correlate of protection from the disease is available after serology testing.
4. Immunization registries (immunization information systems): population-based, computerized registries, including individual records about all the residents within a certain area, can be used for assessing vaccination coverage. Immunization information systems are very useful tools to implement vaccination programmes and sustain high vaccination coverage; on the other hand, they are not extensively used for assessing vaccination coverage. Strengths and weaknesses of each methodology are summarized in Table 1.

## Potential Issues That May Affect Vaccine Coverage Assessment

Methods used for defining vaccination coverage can affect the outcome. As an example, measles vaccination coverage can be defined as 'the percentage of 1-year-olds who have received at least one dose of measles containing vaccine in a given year' [2]. According to this definition, the statement '95% measles coverage in 2012 in country X' suggests that 95% of children living in country X in 2012 received one dose of measles vaccine before their 1st birthday. This looks apparently simple; nevertheless there are different options for assessing vaccination coverage using the definition above. The denominator should include children between 1 and 12 months of age living in country X in 2012; the numerator should account for those children among the population included in the denominator who received one dose of measles vaccine. If a one-point survey is used to assess vaccine coverage, then the numerator will report on the number of vaccinated children living in country X in 2012. In contrast, if an administrative method is used, very likely only those children vaccinated in 2012 will be counted (or even measles vaccine doses distributed in 2012), and children who were still 12 months old in 2012 but who received their measles vaccination in 2011 will not be included in the numerator. This is not a trivial issue and represents only one of the potential problems related to the way vaccination coverage is defined. A correct definition of both numerator and denominator is essential for allowing comparison and interpretation of coverage data, as well as methodology used for the assessment.

**TABLE 1. Strengths and weaknesses of different methodologies for assessing vaccination coverage**

| Method | Strengths | Weaknesses |
|---|---|---|
| Administrative methods | Based on routine collection, provide robust series of data.<br>Integrated in the vaccination programme, do not require *ad hoc* implementation.<br>Not expensive. | Can be severely affected by inaccurate numerator and/or denominator.<br>Do not provide individual data if only number of administered doses is reported. |
| Surveys | Useful to assess data collected through administrative methods.<br>Are the only source of information if administrative systems are not in place.<br>Can provide additional information, i.e. on reasons for missed vaccination.<br>Can be integrated into surveys with broader scope (nutrition, child health, education, etc.). | Require *ad hoc* implementation.<br>Require *ad hoc* resources. |
| Seroprevalence surveys | Can provide information on the actual level of immunity in the target population.<br>Extremely useful in population subgroups that are likely to be missed by administrative methods (hard-to-reach). | Impossible to distinguish between vaccination-acquired and naturally acquired immunity.<br>Are suitable only when a clear serological correlate of protection is available.<br>Expensive. |
| Immunization registries | Can provide very precise, individual information on immunization status.<br>Can be linked to other health data sources for assessing other aspects of vaccination programme (safety, effectiveness, impact, etc.). | Are designed for improving service delivery (reminder systems, schedule compliance, etc.) more than providing vaccine coverage data.<br>Estimates are strongly affected by the coverage of the registry.<br>Are implemented at national level in few countries so far. |

Unfortunately, not only methodological issues can affect vaccination coverage assessment. In fact both numerator and denominator ascertainment could be severely biased. In the absence of a good information system, the denominator (i.e. the target population) can be underestimated because of the presence of uncensored population groups. This can be the case of illegal immigrants or travelling communities not captured by the system. On the other hand, the denominator can be overestimated because of the presence of emigration flows that are not promptly communicated and registered; for this reason, people no longer residing in the area may be still counted in the denominator and will dilute the coverage estimate. Similarly, ascertainment of vaccination status (numerator) could represent a challenge; lack of documentation of past vaccinations is one of the most frequent issues. Moreover, vaccine coverage assessment can be particularly challenging after supplementary immunization activities; in this specific case it is common to observe vaccination coverage levels >100%, because the number of distributed doses is often higher than the targeted population (i.e. children out of the targeted age groups are vaccinated).

## Why Vaccination Coverage Assessment Is Important

Vaccination, more than any other public health intervention, has not only an intrinsic value for the individual but also a great value for society. Beneficial externalities linked to vaccination programmes are related not only to the indirect protection effect, which non-immune people could benefit from, but also to broader societal benefits in the form of higher productivity (fewer working days lost), better education (lower school absenteeism) and economic gain (in the case of a positive cost–benefit ratio).

Traditionally, vaccines are used in the framework of a broad programme including planning, implementation and evaluation. Vaccine coverage is one of the primary output indicators of vaccination programmes: programme goals are usually expressed in terms of vaccine coverage levels (i.e. >90%, >95%, etc.) and a drop in vaccination coverage should lead to an urgent reaction by public health. More than the number of vaccinated individuals, what counts is the proportion of the