



Review

Validity of vaccination cards and parental recall to estimate vaccination coverage: A systematic review of the literature

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ABSTRACT

Immunization programs frequently rely on household vaccination cards, parental recall, or both to calculate vaccination coverage. This information is used at both the global and national level for planning and allocating performance-based funds. However, the validity of household-derived coverage sources has not yet been widely assessed or discussed. To advance knowledge on the validity of different sources of immunization coverage, we undertook a global review of literature. We assessed concordance, sensitivity, specificity, positive and negative predictive value, and coverage percentage point difference when subtracting household vaccination source from a medical provider source. Median coverage difference per paper ranged from –61 to +1 percentage points between *card versus provider sources* and –58 to +45 percentage points between *recall versus provider source*. When card and recall sources were combined, median coverage difference ranged from –40 to +56 percentage points. Overall, concordance, sensitivity, specificity, positive and negative predictive value showed poor agreement, providing evidence that household vaccination information may not be reliable, and should be interpreted with care. While only 5 papers (11%) included in this review were from low-middle income countries, low-middle income countries often rely more heavily on household vaccination information for decision making. Recommended actions include strengthening quality of child-level data and increasing investments to improve vaccination card availability and card marking. There is also an urgent need for additional validation studies of vaccine coverage in low and middle income countries.

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1. Background

In order to achieve the Millennium Development Goal of reducing mortality among children under age five years, countries need

strong vaccination programs that can effectively deliver lifesaving immunizations [1]. The World Health Organization (WHO) and United Nations Children's Fund (UNICEF) Global Immunization Vision and Strategy includes the global goal of achieving and sustaining 90% vaccination coverage in each country and at least 80% in all districts by 2015 [2]. To measure progress toward these goals, timely and accurate assessments of vaccination coverage are needed. At the global level vaccination coverage estimates are

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used not only to measure progress, but also to prioritize activities and advocate for donor funding. For example, beginning in 2000 the GAVI Alliance provided performance-based funding dependent upon improvements in national coverage with 3 doses of diphtheria–tetanus–pertussis vaccine (DTP3) [3]. At national and sub-national levels, vaccination coverage is used for internal program monitoring, modifying services to achieve the greatest impact, allocating funds, and developing plans [4].

The two main methods used to obtain vaccination coverage data are service delivery administrative tallies and community-based household surveys [5]. While administrative tallies are routinely collected, they are often compromised by constraints in staffing, supply of vaccine cards or registers, consistency of supervision, and capacity to transmit data to higher levels, and are subject to both numerator bias (e.g., inaccurate counting, incomplete reporting, including doses given to children >12 months of age) as well as denominator bias (e.g., poor population estimates, out-dated census data, imprecise population growth correction, population movement) [6–10]. Lim et al. compared administrative data from 193 countries to household surveys conducted during the same time period and found administrative figures grossly over estimate coverage compared to survey estimates [11]. As a result, household surveys are thought to provide more valid coverage estimates [5,12–14].

Household surveys typically assess vaccination status based on vaccination dates documented on vaccination cards, parental recall, or a combination of the two (typically using parental recall for children without cards). Although sampling error from these surveys can be accounted for statistically, non-sampling error, such as misclassification or measurement error, is often overlooked [15–17]. Vaccination cards may not always be supplied and cards may be incomplete or inaccurate if providers fail to record doses administered or caregivers forget to bring them to a vaccination session. Brown, et al. report that of 101 Demographic and Health Surveys and Multiple Indicator Cluster Surveys conducted from 1990 to 2000, vaccination data were obtained from recall for approximately one third of children [18] due to lack of vaccination cards. Parental recall may be inaccurate if parents forget the number and type of vaccinations given, provide socially desirable responses, are not the person who brought the child to the vaccination session, or receive incorrect information on vaccine schedules from providers.

Acknowledging problems with household vaccination cards and parental recall, child and adolescent vaccination coverage estimates in the United States derived from the National Immunization Survey are based on vaccination histories validated by medical providers. In addition, some countries also maintain registry systems that can be further used to validate survey-based coverage estimates [19]. Such provider-based sources of information are not widely utilized in low and middle income country vaccination coverage surveys, and thus most estimates are reliant on the accuracy of vaccination cards and parental recall. We conducted a systematic review of the published literature to summarize available evidence regarding the validity of household sources of vaccination information.

2. Methods

2.1. Search strategy

OVID Medline was searched to review all published, in-process, and non-indexed citations from January 1, 1975 through February 4, 2011. Three categories of keywords were used: terms related to immunization (e.g., “immunization”, “vaccination”), terms related to bias (e.g., “valid”) and terms related to source of vaccination information (e.g., “hospital record”, “recall”, “card”). To be included in the initial review at least one keyword from each of the three categories was required (e.g., “immunization” and “validity” and

Table 1
OVID Medline keyword search terms used to retrieve articles for review.

Immunization terms: immunization\$, immunisation\$, vaccination\$, shot\$,
Bias terms: accuracy, bias, valid\$, reliability, misclassification, error, overestimate\$, underestimate\$, concordance, higher, lower
Vaccination source terms: recall, remember, medical record\$, provider record\$, hospital record\$, immunization record\$, administrative, card\$, maternal report, parental report, mothers report, registry, registries, register\$, household record\$, vaccination record\$ vaccination status, immunization status, immunization status, immunization coverage, immunization coverage, vaccination coverage

“recall”) (Table 1). All languages were included. References were manually reviewed and subject matter experts known to authors were queried via email and/or phone to identify additional relevant papers.

To be included in the final analysis, the paper’s author must have identified vaccination coverage estimates from at least 2 child-level sources: a household source (i.e., vaccination card [card], parental recall [recall]) and a medical provider source (i.e., medical or hospital records, registries, direct clinic observation of vaccination). All medical provider sources were considered equivalent. Bacillus Calmette–Guérin (BCG) scars and serology results were excluded as sources of vaccination history. Household source information (card and/or recall) could be collected either at the household itself or at another location. Papers were excluded if the study population did not include children ≤18 years of age. Relevant papers were identified by initial screening of titles and abstracts to determine eligibility, and a full text review to abstract key information. The full text review was conducted independently by a primary (el) and secondary reviewer (tr, vd, or mm) and any discrepancies were resolved by consensus among reviewers prior to analysis.

2.2. Outcome measurements and analysis

We assessed the validity of household sources of vaccine dose administration based on the following comparisons: 1) *card versus medical provider source*, 2) *recall versus medical provider source*, 3) *card and recall combined versus medical provider source*. For all analyses, medical provider source served as the ‘gold standard’ to assess systematic error in the household source based on measures of agreement, as described in the following two-by-two table:

Agreement of sources		Children vaccinated based on medical provider source	
		Yes	No
Children vaccinated based on household source (i.e., card and recall)	Yes	True positives (TP)	False Positives (FP)
	No	False negatives (FN)	True negatives (TN)

Concordance was defined as the percentage of children for whom the household source accurately indicated the vaccination status $([TP + TN]/total)$. *Sensitivity* was defined as the percentage of vaccinated children who were found vaccinated based on the household source $(TP/[TP + FN])$. *Specificity* was defined as the percentage of under-vaccinated children who were found to be under-vaccinated based on the household source $(TN/[FP + TN])$. *Positive predictive value* (PPV) was defined as the percentage of children found to be vaccinated based on the household source who were actually vaccinated $(TP/[TP + FP])$, and *negative predictive value* (NPV) as the percentage of children found to be under-vaccinated based on the household source who were actually under-vaccinated

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