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## Enhancing immunization during second year of life by reducing missed opportunities for vaccinations in 46 countries

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## ABSTRACT

**Background:** Delivering vaccination services during the second year of life (2YL)<sup>1</sup> provides countries with an opportunity to achieve greater coverage, to provide booster doses and vaccines missed during the first year of life, as well as contribute towards disease control and elimination goals.

**Methods:** Using data from demographic health surveys (DHSs) conducted during 2010 to 2016, this paper explores the proportion of missed opportunities for vaccinations generally provided during routine immunization among children in their 2YL.

**Results:** DHS data in 46 countries surveyed 478,737 children, from which 169,259 children were 12–23 months old and had vaccination/health cards viewed by surveyors. From this group, 69,489 children aged 12–23 months had contact with health services in their 2YL. Three scenarios for a missed opportunity for vaccinations were analysed: (1) a child received one vaccine in the immunization schedule and was eligible for another vaccine, but did not receive any further vaccination, (2) a child received a vitamin A supplementation (VAS) and was due for a vaccine, but did not receive vaccines that were due, and (3) a child was taken to a health facility for a sick visit and was due (and eligible) for a vaccine, but did not receive the vaccine. A total of 16,409 (24%) children had one or more missed opportunities for vaccinations.

**Conclusion:** This analysis highlights the magnitude of the problem of missed opportunities in the 2YL. The global community needs to provide better streamlined guidance, policies and strategies to promote vaccination screenings at well-child and sick child visits in the 2YL. Where they do not exist, well-child visits in the 2YL should be established and strengthened.

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### 1. Introduction

Although estimated global immunization coverage has increased substantially since the start of the Expanded Programme on Immunization (EPI) in 1974, coverage of the third dose of diphtheria-tetanus pertussis vaccine (DTP3) has remained stagnant at around 85% since 2010 [1] and vaccine-preventable diseases remain a major cause of morbidity and mortality worldwide. In 2016, an estimated 6.6 million infants who did receive their first dose of DTP-containing vaccine did not complete the three-dose DTP series [2].

The Global Vaccine Action Plan (GVAP) provides a framework for making vaccines available to all individuals globally and calls on all countries to reach at least 90% national coverage and at least

80% district-level coverage for all vaccines in the country's national immunization schedule by 2020 [3]. One approach to achieving these goals is to provide vaccination to all eligible persons at every opportunity, including at preventive and curative health service visits. Recommendations for this approach were established by the World Health Organization (WHO) EPI Global Advisory Group in 1983 [4].

More effort is required to increase vaccination coverage. According to recent analyses of demographic health surveys (DHS), ten percent of all children aged below five years in 96 countries did not receive any vaccines and 46% were only partially vaccinated [5]. In addition, a 2014 review conducted in low- and middle-income countries concluded that missed opportunities for vaccination (MOVs) occurred in 32–46% of public health service encounters [6].

Timely vaccination is recommended, but weak immunization and public health systems play a key role in children not receiving vaccines or being incompletely vaccinated. Key factors can include

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<sup>1</sup> Abbreviations: 2YL, denotes Second Year of Life or 2nd Year of Life.

distance to vaccination sites, lack of health worker motivation/diligence, lack of resources, false contraindications and hesitance to open multi-dose vaccine vials [7–10]. Demand-related factors also play a part, including family characteristics and parental attitudes and knowledge (e.g. educational level and religious beliefs) [11].

Delivering vaccination services during the second year of life (2YL) provides countries with an opportunity to achieve greater population immunity towards reaching GVAP coverage and disease elimination goals [12–15], including a platform for the introduction of new vaccines and booster doses [13]. Well child visits during the second year of life also provides an opportunity to integrate EPI services with other health and nutrition interventions [14–15]. This paper uses recent DHSs to examine the magnitude of MOVs among children in their second year of life.

## 2. Methods

### 2.1. Demographic health surveys (DHS)

Data were selected and analysed from countries where a DHS was conducted between 2010 and 2016 and for which Vitamin A supplementation (VAS) and immunization questions were included [16]. Where countries conducted more than one DHS during this period, data from the most recent survey were analysed, which includes dates of birth for children up to 59 months (5 years) of age. Data eligibility for this study included children aged 12–23 months for which an interviewer could confirm immunization status by viewing a vaccination/health card. The child's month and year of birth and age at the time of vaccination were drawn from the vaccination/health card. Data from mothers' recall, which could not be confirmed by a vaccination/health card, were not included due to recall and information bias, and the inability to calculate exact age when a vaccine was given.

Immunization data routinely collected in DHSs were analysed in this study, which included a birth dose of Bacillus Calmette-Guérin (BCG), three doses of polio vaccine, three doses of diphtheria, pertussis and tetanus (DPT) vaccine (or other DPT-containing polyvalent vaccines), and one dose of measles-containing vaccine. In this study, a vaccination was considered 'missed' when the response to having received a vaccine was coded as 'no' or there was a missing date for one of these four antigens on the vaccination/health card.

Using the standard WHO definition, an MOV in the second year of life included any child aged 12–23 months who had access to health services and was eligible for a vaccine dose, but remained unvaccinated at the end of the encounter [17]. Three scenarios for a missed opportunity for vaccinations were identified: (1) a child received one vaccine in the immunization schedule and was eligible for another vaccine, but did not receive any further vaccination, (2) a child received a vitamin A supplementation (VAS) and was due for a vaccine, but did not receive vaccines, and (3) a child was taken to a health facility for a sick visit and was due (and eligible) for a vaccine, but did not receive the vaccine.

During the DHS surveys, mothers were asked if they had taken their child to a private or public health facility or hospital in the preceding two weeks to seek treatment for diarrhoea or a fever. For children aged 12–23 months at the time of the visit, a sick visit variable was developed if a mother responded 'yes' to having taken their child to a health facility or hospital in the preceding two weeks for diarrhoea or fever or both.

Public health facilities included public hospitals, district hospitals and clinics, maternal and child clinics, health posts and EPI outreach, or where indicated as public in the DHS. Private health facilities included private clinics and hospitals, or where indicated as private in the DHS. Other facilities included places where

vaccinations would not generally be conducted such as at pharmacies, dispensaries, markets, midwives, or traditional practitioners.

To determine whether children aged 12–23 months received VAS, the most recent or latest date of VAS receipt on the vaccination/health card, as well as the question regarding VAS in the last six months, were utilized for analysis. Data for VAS given in the last six months included only children that were 18–29 months.

### 2.2. Statistical analysis

Data from a subset of children having a vaccination/health card (confirmed by a survey interviewer) with date of birth and vaccination history for the period during which they completed 12–23 months of age were extracted from all surveyed children up to 59 months (five years) from each country's DHS data sets and were considered eligible for this study. Among these eligible children, further analyses were conducted of children that had any missed vaccine doses, had contact with a health provider for treatment of fever or diarrhoea, or had received vitamin A (see Appendix Table 1). Countries were also categorized by WHO regions and World Bank income status [18].

Pearson correlation coefficient was calculated to gain insight into the strength of the association among the card possession rates and the number of children with MOVs. Data were not weighted for this analysis and confidence intervals were calculated at 95%. SPSS software version 23 for Mac was used for data analysis.

### 2.3. Role of the funding source

The funding source had no such involvement in the study design, collection, analysis, interpretation of data, writing of the report, or in the decision to submit the paper for publication.

## 3. Results

The analysis included 31 countries from the African region, four from the Americas, four from the Eastern Mediterranean, two from Europe, three from Southeast Asia, and two from the Western Pacific. As per World Bank criteria, four countries were upper-middle income, 19 countries were lower-middle income, and 23 were low income (see Appendix Table 1).

DHS data from 46 countries identified 478,737 children under age five, of which 169,259 met the study eligibility criteria (see methods). Of these, 69,489 children had contact with health services by the end of their second year of life, including 16,409 who had MOVs in their 2YL (see Fig. 1). Of these, 15,887 were partially vaccinated and 522 had no record of receiving any eligible vaccine doses during their contact with health services. By the end of their second year of life, 7848 children had more than one contact with health services and did not receive all eligible vaccine doses.

Among children that had MOVs, 10,923 (67%) had visited the health facility for a vaccination appointment, but did not receive at least one eligible vaccine. The highest number of MOVs was for measles vaccine (5756 or 53%), followed by DPTCV (4681 or 43%), polio (4033 or 37%), and BCG (1470 or 13%) (see Appendix Table 2).

Among children with MOVs, 11,058 children (67%) visited a health facility for VAS and did not receive at least one eligible vaccine. Similarly, 5461 children (33%) visited a health facility for a sick child visit and did not receive at least one eligible vaccine doses (see Fig. 2). Among children with MOVs during a sick visit, 1770 children (32%) visited a public facility to seek treatment;

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