



Results from a survey of national immunization programmes on home-based vaccination record practices in 2013

Stacy L. Young^a, Marta Gacic-Dobo^b and David W. Brown^{c,*}

^aConsultant to the World Health Organization, Geneva, Switzerland; ^bWorld Health Organization, Geneva, Switzerland; ^cUnited Nations Children's Fund, UNICEF House, 3 UN Plaza, New York, USA

*Corresponding author: Tel: +1 212 303 7988; E-mail: dbrown@unicef.org

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Background: Data on home-based records (HBRs) practices within national immunization programmes are non-existent, making it difficult to determine whether current efforts of immunization programmes related to basic recording of immunization services are appropriately focused.

Methods: During January 2014, WHO and the United Nations Children's Fund sent a one-page questionnaire to 195 countries to obtain information on HBRs including type of record used, number of records printed, whether records were provided free-of-charge or required by schools, whether there was a stock-out and the duration of any stock-outs that occurred, as well as the total expenditure for printing HBRs during 2013.

Results: A total of 140 countries returned a completed HBR questionnaire. Two countries were excluded from analysis because they did not use a HBR during 2013. HBR types varied across countries (vaccination only cards, 32/138 [23.1%]; vaccination plus growth monitoring records, 31/138 [22.4%]; child health books, 48/138 [34.7%]; combination of these, 27/138 [19.5%] countries). HBRs were provided free-of-charge in 124/138 (89.8%) respondent countries. HBRs were required for school entry in 62/138 (44.9%) countries. Nearly a quarter of countries reported HBR stock-outs during 2013. Computed printing cost per record was <US\$0.50 in 53/77 (69%) of countries providing information.

Conclusions: These results provide a basis for national immunization programmes to develop, implement and monitor corrective activities to improve the availability and utilization of HBRs. Much work remains to improve forecasting where appropriate, to prevent HBR stock-outs, to identify and improve sustainable financing options and to explore viable market shaping opportunities.

Keywords: Health records, Immunization, Immunization systems, Medical records, Vaccination, Vaccination card

Introduction

Home-based records play an important role in documenting immunization services received by individuals.¹ A home-based vaccination record is a document (more often physical than electronic) issued to an individual person by an official authority such as a national, provincial or district health department and retained by the individual or their caregiver, on which vaccinations received by that individual through routine immunization services and supplementary immunization activities from all health care providers are recorded. Home-based records foster coordination and continuity of immunization service delivery between service providers, facilitate communication between health workers and caregivers and support public health monitoring.¹⁻¹⁰ In the area

of monitoring, coverage evaluation survey results may be compromised when home-base records are not routinely employed, namely as a result of reporting errors that occur when caregivers misclassify a child's vaccination history during recall in lieu of documentation.^{11,12} When properly used,¹³ home-based records provide a relatively inexpensive and effective instrument for stimulating demand for childhood immunization, being associated with improved up-to-date vaccination status,^{14,15} particularly among children who visit multiple health care providers,¹⁵ and educating caregivers about their child's immunization status.

Beyond evidence indicating that home-based records are often underutilized,¹ very little information is available about factors that may impact the availability and utilization of home-based records in national immunization programmes. Moreover, we

are unaware of any published information on expenditures by national immunization programmes for printing home-based records. As part of a series of activities conducted by WHO and United Nations Children's Fund (UNICEF) to further understand the availability and utilization of home-based records in national immunization programmes, WHO and UNICEF sent a brief questionnaire to national immunization programmes to gather information on the use of home-based records during 2013. We summarize the results here.

Methods

Each year WHO and UNICEF jointly collect national-level data on the incidence of selected vaccine-preventable diseases, immunization coverage, recommended immunization schedules, vaccine supply and other information on the structure, policies and performance of national immunization systems through the WHO/UNICEF Joint Reporting Form on Immunization (JRF). During January 2014, WHO and UNICEF sent a one-page Excel-based questionnaire to 195 countries or territories in conjunction with the WHO/UNICEF JRF to obtain information on home-based records (see [Supplementary materials](#)). English questionnaires were translated into French, Spanish and Russian.

Immunization programmes were asked if they used a home-based record during 2013, the type of record used (i.e., vaccination only card, vaccination plus growth monitoring record, child health book, other),¹⁶ the number of records printed, whether the record was provided free-of-charge and required by schools, whether there was a stock-out of home-based records at national or district level and the duration of any stock-outs that occurred, as well as information on the institution(s) responsible for printing and financing records. As noted elsewhere¹⁶ the types of home-based record referred to include documents designed exclusively to record basic identifying information and immunization services received (i.e., vaccination only card); more inclusive, though concise documents to record child growth and development (e.g., child growth charts) and a broad range of health services received, as well as providing a limited set of basic information related to child survival (e.g., infant and young child feeding) (i.e., vaccination plus card); and more comprehensive child health books that often include a record of birth characteristics, health services received beyond vaccination, growth and feeding practices, as well as detailed guidance to parents in the areas of infant and young child feeding, developmental milestones, prevention of diarrhoea and malaria, family planning among other child survival interventions. Questionnaires were returned to WHO and UNICEF by the end of June 2014. Data were compiled and reviewed for completeness and response consistency. Prior to analysis, data queries were sent to countries to confirm responses and resolve missing values or inconsistencies.

The number of records printed was compared to the estimated annual birth cohort for each country based on estimates produced by the United Nations Population Division (UNPD).¹⁷ We computed the percent (relative) difference between the reported number of home-based records printed and the estimated total number of births for 2013. As a sensitivity analysis, we also abstracted the total number of births for 2013 reported by national immunization programmes on the JRF and computed the percent difference between the reported number of home-based records and the reported number of births. Countries were also

asked to provide the total expenditure for printing home-based records during 2013. Expenditure per record was computed by converting the total expenditure of printing in local currency to US dollars using exchange rates obtained from a web-based currency converter (<http://www.xe.com/currencyconverter/>) prior to dividing the total expenditure by the reported total number of records printed.

Results are presented by geographic region, based on WHO operational region with the exception of State of Palestine, which maintains observer status in the World Health Assembly but is not one of the 194 member states and that was grouped with other countries in the Eastern Mediterranean region; by World Bank national income status categories for 2013 and by eligibility for funding support from the GAVI Alliance (i.e., 73 countries eligible for Phase 2 new vaccine introduction support; www.gavi.org). Data were reviewed and managed using Epi-Info software v.3.5.4 (Centers for Disease Control and Prevention, Atlanta, GA, USA) and analysis was completed using Stata v12 (Stata Corp, College Station, TX, USA).

Results

A total of 139 member states of the World Health Assembly and one observer (State of Palestine) returned a completed home-based records questionnaire (Table 1). Response rates were highest in Southeast Asia (10/11; 91%), followed by Africa (35/47; 76%), Western Pacific (20/27; 74%) and the Americas (25/35; 71%). The response rate was 70% in Europe (37/53) and 55% in the Eastern Mediterranean (13/22 including the State of Palestine). Fifty-four of the respondent countries were GAVI Alliance eligible; three-quarters (107/140) of respondent countries are classified as low- (n=28) or middle-income (n=79) according

Table 1. Number of respondent countries by geographical region, GAVI Alliance eligibility and income classification group

| | Respondent (n=140) | Non-respondent (n=55) |
|---|-----------------------|--------------------------|
| Geographical region | | |
| Africa | 35 | 12 |
| Americas | 25 | 10 |
| Eastern Mediterranean | 13 | 9 |
| Europe | 37 | 16 |
| Southeast Asia | 10 | 1 |
| Western Pacific | 20 | 7 |
| GAVI Alliance eligible | 54 | 19 |
| World Bank income classification ^a | | |
| Low-income | 28 | 8 |
| Middle-income | 79 | 23 |
| High-income | 32 | 22 |

^a Niue (respondent), Cook Islands (non-respondent) and Nauru (non-respondent) are not classified as low-, middle- or high-income by the World Bank.

to World Bank classification for 2013. Two countries (Belarus, Norway) reported that they did not use a home-based record during 2013 and were excluded from further analysis.

Home-based record type

Original country responses included use of a vaccination only card by 18 countries, a vaccination plus growth monitoring record by 19 countries, a child health book by 25 countries and multiple record types by 76 countries. In an effort to further clarify the number of countries reporting multiple record types, we supplemented the information on reported record type with a review of physical or electronic record copies submitted by countries and residing in a repository maintained by UNICEF and WHO (see www.immunizationcards.org). Supplementary information from the home-based record repository was available for 99 of the 138 respondent countries. Home-based record type was re-classified based on the physical/electronic record review for 56 countries, of which 49 instances resulted in the reclassification from reported 'multiple record types' (i.e., the respondent selected more than one type of home-based record on the survey form) to either vaccination only (n=15), vaccination plus growth monitoring record (n=14) or child health book (n=20). The remaining seven reclassifications were from reported vaccination only to vaccination plus growth monitoring (n=1), reported vaccination only to child health book (n=1), reported vaccination plus growth monitoring to child health book (n=4) and child health book to vaccination plus growth monitoring (n=1).

After reclassification, home-based record types included vaccination only cards in 32 (23.1%) countries, vaccination plus growth monitoring records in 31 (22.4%) countries, child health books in 48 (35%) countries and a combination of these in 27 (19.5%) countries (Table 2). By World Bank income group

classification, vaccination only cards were utilized by 26% (8/31), 22% (17/78) and 25% (7/28) of high-, middle- and low-income countries, respectively. Vaccination plus growth monitoring records were utilized by 3% (1/31), 21% (16/78) and 50% (14/28) of high-, middle- and low-income countries, respectively. Child health books were utilized by 39% (12/31), 37% (29/78) and 25% (7/28) of high-, middle- and low-income countries, respectively (Table 2).

Gratis records and school requirements

Home-based records were provided free-of-charge in 124 of 138 (89.8%) respondent countries (Table 2). All respondent countries in the Americas and Southeast Asia reported providing home-based records to caregivers free-of-charge. Gratis home-based records were reported by 28 of 35 (80%) countries in Africa, 10 of 13 (77%) countries in the Eastern Mediterranean, 33 of 35 (94%) countries in Europe and 18 of 20 (90%) countries in the Western Pacific. By World Bank income group classification, home-based records were provided free-of-charge in 29 of 31 (93%) high-, 70 of 78 (90%) middle- and 24 of 28 (86%) low-income countries; among 54 respondent GAVI Alliance-eligible countries, 45 (83%) countries provided home-based records free-of-charge.

During 2013, 68 countries reported a school-based approach to delivering immunization in the JRF (data not shown but available from http://www.who.int/immunization/monitoring_surveillance/data/en/). Sixty-two of 138 (44.9%) respondent countries reported that home-based records were required for school entry. Of the 68 countries reporting a school-based approach, 31 countries did not require home-based records for school entry. Of the 62 countries requiring home-based records for school entry, 25 countries did not report a school-based approach. Seventeen of 25 (68%) countries from the Americas, 8 of 13 (61%) countries from the Eastern

Table 2. Home-based record type and characteristics by geographic region, GAVI eligibility status and income classification

| | Home-based record type | | | | Provided gratis | School requirement |
|--------------------------------------|------------------------|------------------------------------|-------------------|----------------|-----------------|--------------------|
| | Vaccination-only card | Vaccination plus growth monitoring | Child health book | Multiple types | | |
| Geographic region | | | | | | |
| Africa (n=35) | 3 (9%) | 19 (54%) | 13 (37%) | 0 | 28 (80%) | 12 (34%) |
| Americas (n=25) | 6 (24%) | 3 (12%) | 9 (36%) | 7 (28%) | 25 (100%) | 17 (68%) |
| Eastern Mediterranean (n=13) | 6 (46%) | 3 (23%) | 3 (23%) | 1 (8%) | 10 (77%) | 8 (61%) |
| Europe (n=35) | 14 (40%) | 0 | 11 (31%) | 10 (29%) | 33 (94%) | 17 (49%) |
| Southeast Asia (n=10) | 2 (20%) | 2 (20%) | 6 (60%) | 0 | 10 (100%) | 3 (30%) |
| Western Pacific (n=20) | 1 (5%) | 4 (20%) | 6 (30%) | 9 (45%) | 18 (90%) | 5 (25%) |
| GAVI Alliance eligible (n=54) | 12 (22%) | 24 (44%) | 16 (30%) | 2 (4%) | 45 (83%) | 13 (24%) |
| World Bank income group ^a | | | | | | |
| Low-income (n=28) | 7 (25%) | 14 (50%) | 7 (25%) | 0 | 24 (86%) | 4 (14%) |
| Middle-income (n=78) | 17 (22%) | 16 (21%) | 29 (37%) | 16 (21%) | 70 (90%) | 46 (59%) |
| High-income (n=31) | 8 (26%) | 1 (3%) | 12 (39%) | 10 (32%) | 29 (93%) | 12 (39%) |
| Overall (n=138) | 32 (23.1%) | 31 (22.4%) | 48 (34.7%) | 27 (19.5%) | 124 (89.8%) | 62 (44.9%) |

^a Niue, a survey respondent country, is not classified by the World Bank.

Mediterranean and 17 of 35 (49%) countries from the Europe noted a home-based record school requirement (Table 2). Home-based record requirements for school were reported by one-third or fewer countries in the other regions. In addition to the 62 countries reporting a school requirement, four countries reported that home-based records were conditionally required in some geographic areas or by select schools (e.g., private, preschool, day-care) and six countries reported that while records are not mandatory for school entry, immunization records are requested or recommended for school entry.

Financing of home-based records

Results highlight the shared nature of financing of home-based records between government and external partners (Figure 1). The national immunization programme and Ministry of Health (MoH) were cited as solely responsible for financing home-based records in 20 of 135 (14.8%) countries (3 of 138 countries did not respond to the question). Development partners were cited as the sole organization responsible for financing in 12 of 135 (8.8%) countries and shared responsibility with the national programmes or MoH in 31 of 135 (22.9%) countries. Among the remaining 72 respondent countries providing information on financing, other partnership combinations involving the national

immunization programme or MoH without development partner involvement were noted in 53 countries. Development partners shared responsibility with the national immunization programme or MoH for financing home-based records in 43% (23/54) of GAVI Alliance-eligible respondent countries (vs 10% [8/84] of non-GAVI Alliance-eligible respondent countries) and in 23% (18/78) of middle- and 43% (12/28) of low-income respondent countries.

Forecasting home-based record needs

Of the 138 countries that reported using home-based records during 2013, 102 (73.9%) provided information on the number of records printed in 2013; this includes 2012 printing values reported by four countries where no 2013 values were available. Twenty-three of 138 (16.6%) countries reported no knowledge of how many home-based records were printed for distribution during 2013, 3 of 138 (2.1%) countries reported that no records were printed during 2013 due to sufficient supply levels following surplus print runs pre-2013 and 10 of 138 (7.2%) countries did not respond to the question.

The percent difference in reported number of home-based records printed for 2013 and the UNPD estimated number of births for 2013 was <10% in 24 countries and $\geq 50\%$ in 43 countries (Figure 2). In Africa, the quantity of home-based records

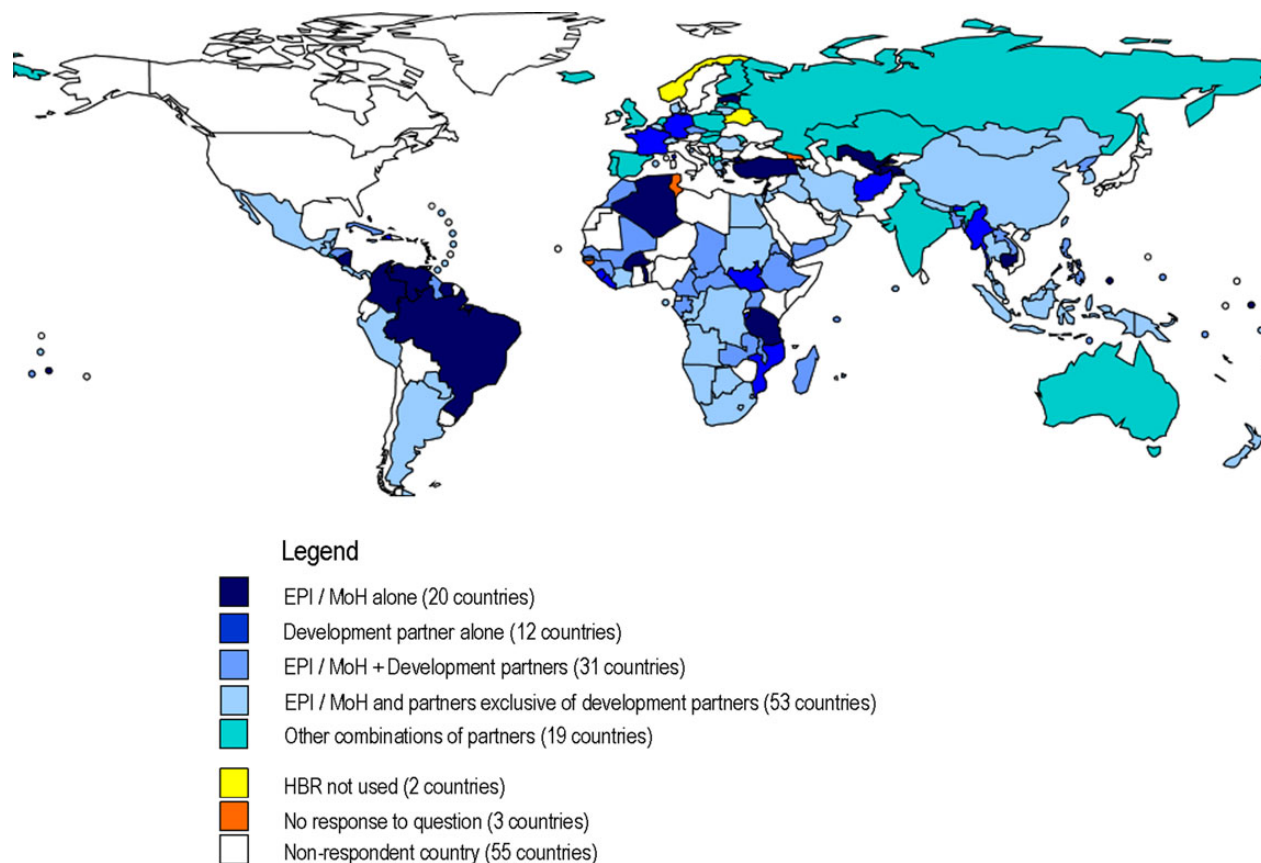


Figure 1. Responsibility for financing of home-based vaccination records across partners during 2013.

Map Disclaimer: The boundaries and names shown and the designations used on this map do not imply the expression of any opinion whatsoever on the part of WHO or UNICEF concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted lines on maps represent approximate border lines for which there may not yet be full agreement.

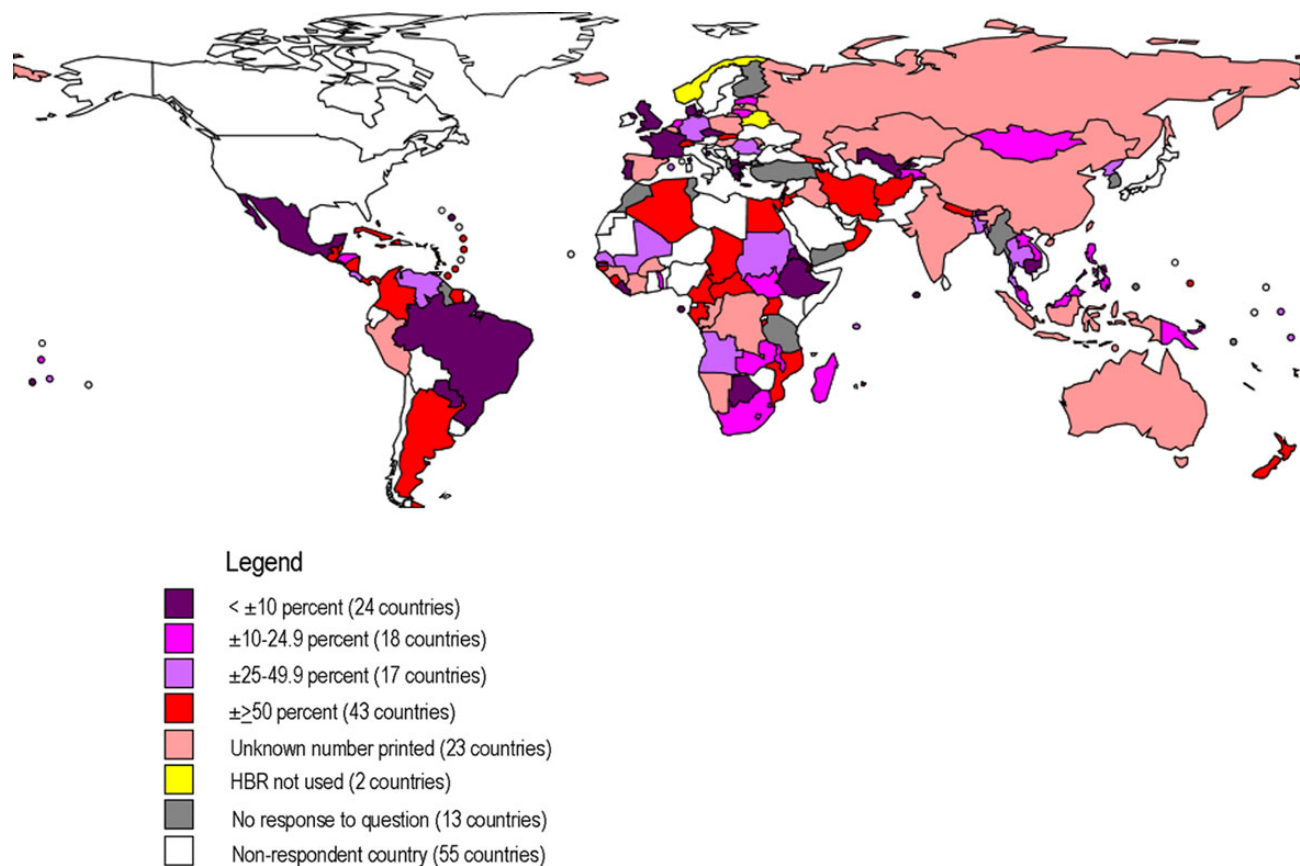


Figure 2. Computed percent difference in reported number of home-based records printed for 2013 and the estimated number of births from the United Nations Population Division.

Map Disclaimer: The boundaries and names shown and the designations used on this map do not imply the expression of any opinion whatsoever on the part of WHO or UNICEF concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted lines on maps represent approximate border lines for which there may not yet be full agreement.

printed for 2013 differed from the UNPD estimated birth cohort size for each country in relative terms by more than 50% in 12 of 28 countries (–difference: 5 countries; +difference: 7 countries). Similarly in the Americas, 15 of 23 countries reported home-based record print quantities that differed by 50% or more from the estimated birth cohort size (–difference: 6; +difference: 9). In contrast, 13 of 21 countries in the European region reported home-based record print quantities that differed by <25% from the estimated birth cohort size.

In an attempt to disentangle whether the observed difference between the reported number of home-based records and birth cohort size was a reflection of differences between estimated birth cohort sizes maintained by the national immunization programme and the UNPD or difficulties in home-based record forecasting, we repeated the relative difference computation using the national immunization programme reported birth cohort size when available. Among the 102 countries that provided information on the number of records printed in 2013, reported birth cohort size data was available for 83 of 102 (81.3%) respondent countries. The percent difference in reported number of home-based records printed and the programmes' reported number of births for 2013 was <10% in 20 countries, 10–24.9% in 15 countries, 25–49.9% in 18 countries and ≥50% in 30 countries. In Africa, the quantity of home-based records printed for 2013

differed from the nationally reported birth cohort size in relative terms by more than 50% in 11 countries, and in the Americas the quantity of home-based records differed by more than 50% in 12 countries.

Stock-outs of home-based records during 2013

Approximately one-in-four respondent countries reported national- (22%; 27/124; n=14 countries did not respond) or district-level (24.7%; 29/117; n=21 countries did not respond) stock-outs of home-based records during 2013 (Figure 3). Of the 117 countries that responded to questions about both national- and district-level stock-outs, 22 (18.8%) countries reported stock-outs during 2013 at both levels, 7 (5.9%) countries reported stock-outs at the district-level but not at the national-level, and 2 (1.7%) countries reported a national-level stock-out and no district stock-out. An additional three countries reported a national stock-out but did not respond to the district-level question. Among the 34 countries that reported national- and/or district-level stock-outs, nine countries reported financing partnership combinations involving the national immunization programme or MoH without development partner involvement, four reported the national immunization programme and MoH were solely responsible for financing home-based records, five reported development partners were solely

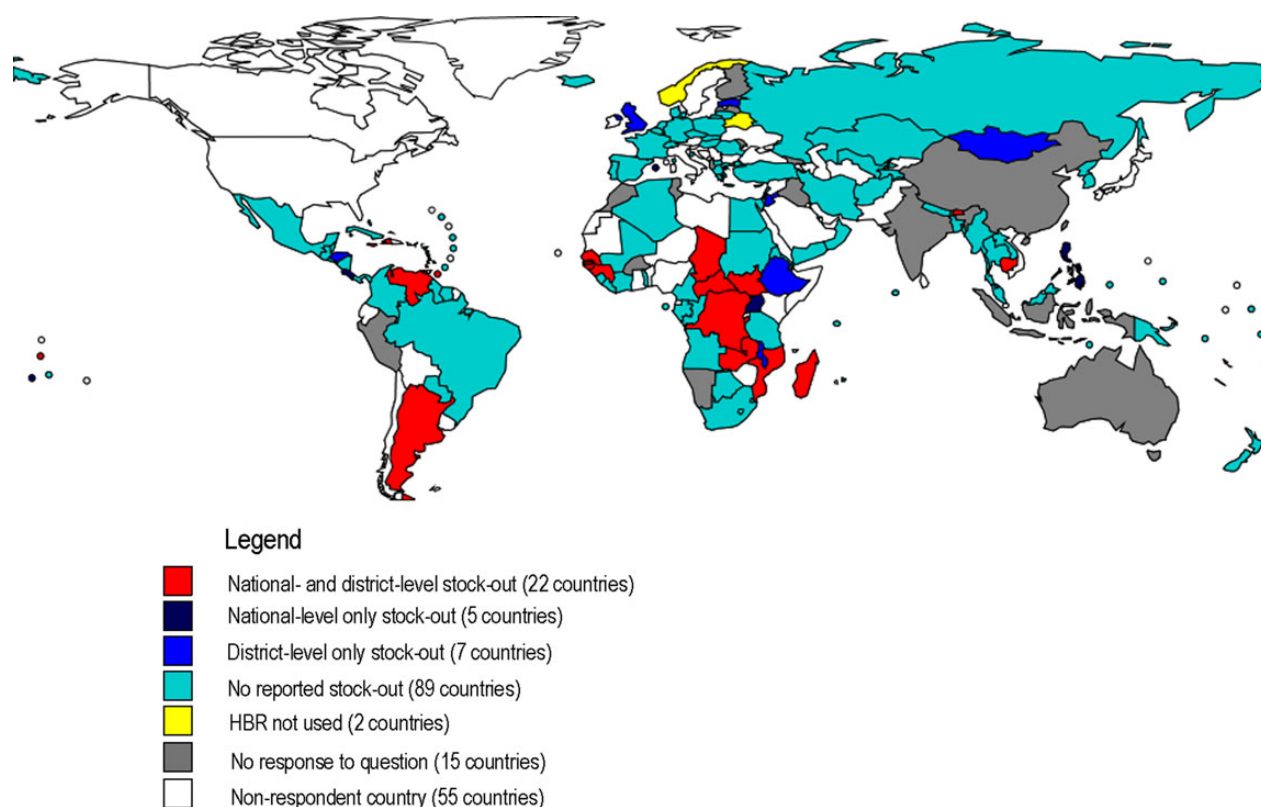


Figure 3. Reported stock-outs of home-based vaccination records at national- and/or district-level during 2013 among 195 national immunization programmes.

Map Disclaimer: The boundaries and names shown and the designations used on this map do not imply the expression of any opinion whatsoever on the part of WHO or UNICEF concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted lines on maps represent approximate border lines for which there may not yet be full agreement.

responsible for financing, 14 reported shared responsibility between government and development partners and two countries reported other financing partnership combinations.

A response of 'no stock-outs' was more frequently observed among countries reporting home-based financing arrangements that did not involve development partners (15 of 20 countries where immunization and MoH were solely responsible; 39 of 53 countries where immunization or MoH were responsible without development partner involvement) compared to countries where development partners maintained a primary or shared responsibility (7 of 12 countries where development partners were solely responsible; 16 of 31 where there was a shared responsibility between development partners and national programmes).

In Africa, 41% (14/34; one country did not respond to the question) of respondent countries reported national-level stock-outs of home-based records and 47% (15/32; three countries did not respond to the question) of respondent countries reported district-level stock-outs. National-level stock-outs were reported by 28% (5/18; two countries did not respond) of countries in the Western Pacific, by 25% (6/24; one country did not respond) countries in the Americas, while 4 of 16 (25%) respondent countries (four countries did not respond) in the Western Pacific and 6 of 23 (26%) respondent countries (two countries did not respond) in the Americas reported district-level stock-outs. One country in Europe and one country in Southeast Asia reported a national-level stock-out, while two countries in Europe and one country

in both the Eastern Mediterranean and Southeast Asia regions reported district-level stock-outs. National-level stock-outs of home-based records were more often reported in low-income (48%; 13/27, one country did not respond) respondent countries than middle- (19%; 13/68, 10 countries did not respond) or high-income (4%; 1/25, 6 countries did not respond) respondent countries; district-level stock-outs were reported by 14 (56%) low-income countries, 13 (20%) middle-income countries and 2 (7%) high-income countries.

National stock-outs lasted an average of 7 months (SD 8) (median 3.5; min 0.5; max 36; IQR 5; n=22) while district-level stock-outs lasted an average of 6 months (SD 8) (median 3; min 1; max 36; n=21).

Expenditure per home-based record

Information on the number of home-based records and total expenditures for printing home-based records for 2013 was provided by 77 of 138 (55.7%) countries. The computed printing expenditure per record ranged from US\$0.01–3.36 with expenditures per record <US\$0.50 in 69% (53/77) of countries with available information. Among 21 countries reporting information and who reported using a vaccination card only, the expenditure per record was <US \$0.10 in seven countries, US\$0.10–0.24 in eight countries and US \$0.25–0.99 in the remaining six countries. Among 21 countries reporting information and use of a vaccination plus growth

monitoring record, the expenditure per record was <US\$0.10 in five countries, US\$0.10–0.24 in five countries, US\$0.25–0.99 in eight countries and was US\$1.00 or more in three countries. Among 23 countries reporting expenditure information and use of a child health book only, expenditure per record was <US\$0.10 in one country, US\$0.10–0.24 in three countries, US\$0.25–0.99 in 14 countries and was US\$1.00 or more in five countries.

Among countries with available information, the computed printing expenditure per record was <US\$0.10 in 39% (7/18) of low-income, 18% (8/44) of middle-income and 7% (1/15) of high-income countries. The expenditure per record was US\$0.10–0.24 in 22% (4/18) of low-income, 25% (11/44) of middle-income and 20% (3/15) of high-income countries. The expenditure per record was ≥US\$1.00 in 17% (3/18) of low-income, 9% (4/44) of middle-income and 20% (3/15) of high-income countries.

Discussion

Although immunization status is recorded in facility-based registries (electronic or, more often, paper-based) in many countries, the home-based record remains an important tool for documenting immunization services received by much of the world's annual birth cohort. The availability of electronic immunization registries^{18,19} will increase as the global immunization community further engages with the growing momentum of technology innovation and integration in public health to improve child immunization recording and monitoring of immunization status, but parallel paper-based health record systems are likely to remain for the foreseeable future in many countries as the transitions to registries will be incremental and take time to be fully implemented. Even when fully implemented electronic immunization registries are in place, a role may remain for home-based records as a durable resource for caregivers in those instances where different national systems are not able to communicate with each other.

The results described here further inform our understanding of several factors impacting the availability and utilization of home-based records across countries. The variation in types of home-based records is consistent with prior reviews that WHO and UNICEF have completed.¹⁶ However, respondent classification of home-based record type appears to have included home-based maternal records (e.g., TT/Td cards) and facility records as well as the targeted home-based child records in at least a few instances based on comparison with records in the physical or electronic repository. Consideration of records other than the home-based child records may have resulted from unclear terminology. Recognizing the need for a common vocabulary, we have begun to develop a thesaurus to facilitate referencing home-based records for children when working across countries. We reclassified record type for 56 of 99 countries where supplemental information existed, and most of the reclassification of record type shifted respondent reports of 'multiple record types' (n=76) to one of three specific home-based record types (after reclassification, multiple record types occurred in 27 countries). The reclassification of home-based record type using the supplemental record review assumes that a country's latest version of the home-based record resides in the UNICEF/WHO home-based record repository (www.immunizatoincards.org). This may not uniformly be true.

While the results suggest home-based records are provided free-of-charge in many countries, differences between policy

and practice in the field (where anecdotal stories of health workers charging caregivers for access to a home-based record exist in spite of a national gratis policy) remain unknown. For example, respondents to the JRF survey indicated that in the Democratic Republic of the Congo, the home-based record is free according to national policy, but is sold by private institutions. In Mongolia, the home-based record is free to certain income groups, and in Cameroon, the document is free to certain age groups. Similarly, though 45% of respondent countries reported a home-based record requirement for school entry, whether this policy is fully implemented in these countries is unclear, particularly given the frequency of reported stock-outs. Further work is needed to better understand if a school entry requirement increases retention of the document by caregivers and is associated with increased likelihood of completing the recommended childhood immunization schedule.

Results also indicate absent or suboptimal systems at the national level to monitor the availability of home-based records including supply levels and stock-outs (i.e., physically having no stock of the home-based record as issued by national or local authorities). Twenty-three (17%) countries explicitly reported no available data on the number of home-based records printed during 2013, perhaps explained in part by decentralized health care systems noted by some of the respondent countries (e.g., Argentina, Australia, Belgium, China, Finland, Iceland, India, Indonesia, Spain and Switzerland noted information on the number of records printed may be maintained at local levels). In addition, institutions other than the national immunization programme or Ministry of Health may be responsible for printing the documents as in the case of the Philippines, where the Department of Education is involved, or in The Netherlands, where the National Institute of Public Health and the Environment is the responsible agent.

Observed relative differences between reported print quantities and estimated annual total birth cohort size in the Americas were somewhat surprising given a perception of better data on target population in the region. In contrast, differences observed in African countries were not a surprise given rapidly changing regional demographic patterns including rapid changes in fertility and infant mortality.^{20,21} For similar reasons, the observed results around reported home-based record stock-outs during 2013 in Africa were not surprising in light of a recent review of immunization target populations for the region.²² Nonetheless, it is possible that large discrepancies may reflect factors beyond imprecise target population estimates, such as inclusion of home-based records printed for age groups other than children in the reported total print quantity.

Nonetheless, stock-outs of home-based records should not occur. Just as with vaccines and injection supplies, it is important to monitor the quantity of home-based records available at the operational, district, provincial and national levels and to accurately forecast needs for home-based records to prevent stock-outs as well as unnecessary over-stocks. Frequent changes in the national immunization schedule in countries that are introducing new vaccines provide a good reason for not overstocking home-based records. Forecasting the needed quantity of home-based records is based on consideration of the target population size and expected loss or damage to home-based records that will need replacement as well as target coverage.²³ In those instances where stock-outs do occur, a coordinated plan of action is encouraged whereby health workers maintain a supply of photocopies or

similar temporary documents on which to record the vaccines delivered to an individual, as reportedly done in Swaziland during 2013. Because the durability of a photocopy form is poor, it is critical that the health worker encourage the caregiver to keep the document safe and damage free, particularly from moisture. It is also important to encourage health workers to transcribe information from such temporary documents to the home-based vaccination record once available to better ensure that the vaccination history is maintained in a single location.

Our results also highlight the need for further understanding the potentially complex financing relationships for home-based records that exist between a national immunization programme, Ministry of Health and development partners. One hypothesis to be further explored in more detail is whether stock-outs are indeed more likely to occur when the national immunization programme lacks control of the financing of the home-based records, such as the case when multiple departments within a Ministry of Health share or rotate responsibility for procuring home-based records. Further research is needed to understand the viability and potential (dis-)advantages of bundling home-based records with other commodities in the vaccination delivery system that the immunization programme may have greater financial control over.

Although these results suggest expenditures for printing home-based records are low in many countries (<US\$0.50 in two-thirds of respondent countries), cost issues related to printing home-based records are anecdotally cited as a barrier. Moving forward it may be useful for countries within a region or sub-region to explore opportunities for market shaping around the production of home-based records. Movements toward the use of more robust physical materials that resist moisture, flame, bacteria and are not easily torn (e.g., Tyvek paper) may provide a prime opportunity to establish regional or sub-regional markets for the material itself or the printing services for the document itself. Future discussions are needed to explore market-shaping opportunities around home-based records similar to other commodities keeping a public health focus to avoid gaps in what is and is not available to low- and middle-income countries.

The results described here are constrained by the following limitations. The home-based record questionnaire was targeted to national immunization programmes, which may or may not have had ready access to information requested in the form. This may have been a particular issue where home-based records are the result of a coordinated effort across multiple departments in a Ministry of Health. In addition to the noted limitation above around the reclassification of home-based records that allowed improved categorization from 'multiple card types' to a single category essentially by narrowing to the child record from respondent consideration of both child and maternal records (as we know with certainty for some countries that the latest version is maintained in the repository), it is unclear whether respondents considered only home-based records provided by the national immunization programme (i.e., public sector) or included those provided through the private sector, which may also explain reported combinations of home-based records. Information on home-based record stock-out occurrence may be underestimated either due to lacking awareness or reluctance to report the system failure. Question non-response is always a concern that may bias results; follow-up queries were sent to countries to minimize non-response. Speculation on direction of bias for results is difficult. Although the per

record print expenditures were <US\$0.50 in two-thirds of respondent countries, actual expenditures are not known nor are component costs (e.g., labour, material, shipping) and there was no effort to validate reported values through a request of invoices or other supporting documentation.

In summary, although a great deal remains unknown about the dynamic systems that control supply and use of home-based records in national immunization programmes, these results provide the first quantitative impression of home-based record practice in national immunization programmes and provide a basis for agenda setting and developing strategies, in collaboration with these programmes and development partners, to improve the supply, use and retention of home-based records. Several areas that have been identified for targeted action include working to better understand current home-based record financing and forecasting practices. Given a scarcity of resources for recording and monitoring in immunization systems, motivating action around home-based records may necessitate the development of an investment or business case for home-based records.²⁴ Moving forward, work remains to improve forecasting where appropriate, to prevent home-based record stock-outs, to identify and improve sustainable financing options and to explore viable market shaping opportunities. It may also be important to explore opportunities for devising new technologies or adapt existing ones to impact the recording of immunization services at the point of delivery, especially in resource constrained settings.

Home-based records offer a simple, appropriate and relatively inexpensive means to foster coordination and continuity of immunization service delivery while facilitating communication, promoting childhood immunization, educating caregivers about their child's immunization status and stimulating demand for services that complement facility-based recording practices. As such, on-going discussions of sustainable health system strengthening, immunization system performance improvement and data quality improvement are encouraged to incorporate home-based records as a part of their strategic efforts.

Supplementary data

Supplementary data are available at International Health Online (<http://inthealth.oxfordjournals.org/>).

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Authors' contributions: MGD and DWB conceived the study; MGD and DWB designed the questionnaire; SLY carried out the data reconciliation and analysis; SLY, MGD and DWB were involved in the interpretation of these data; SLY and DWB drafted the manuscript; SLY, MGD and DWB critically revised the manuscript for intellectual content. All authors read and approved the final manuscript. MGD and DWB are guarantors of the paper.

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