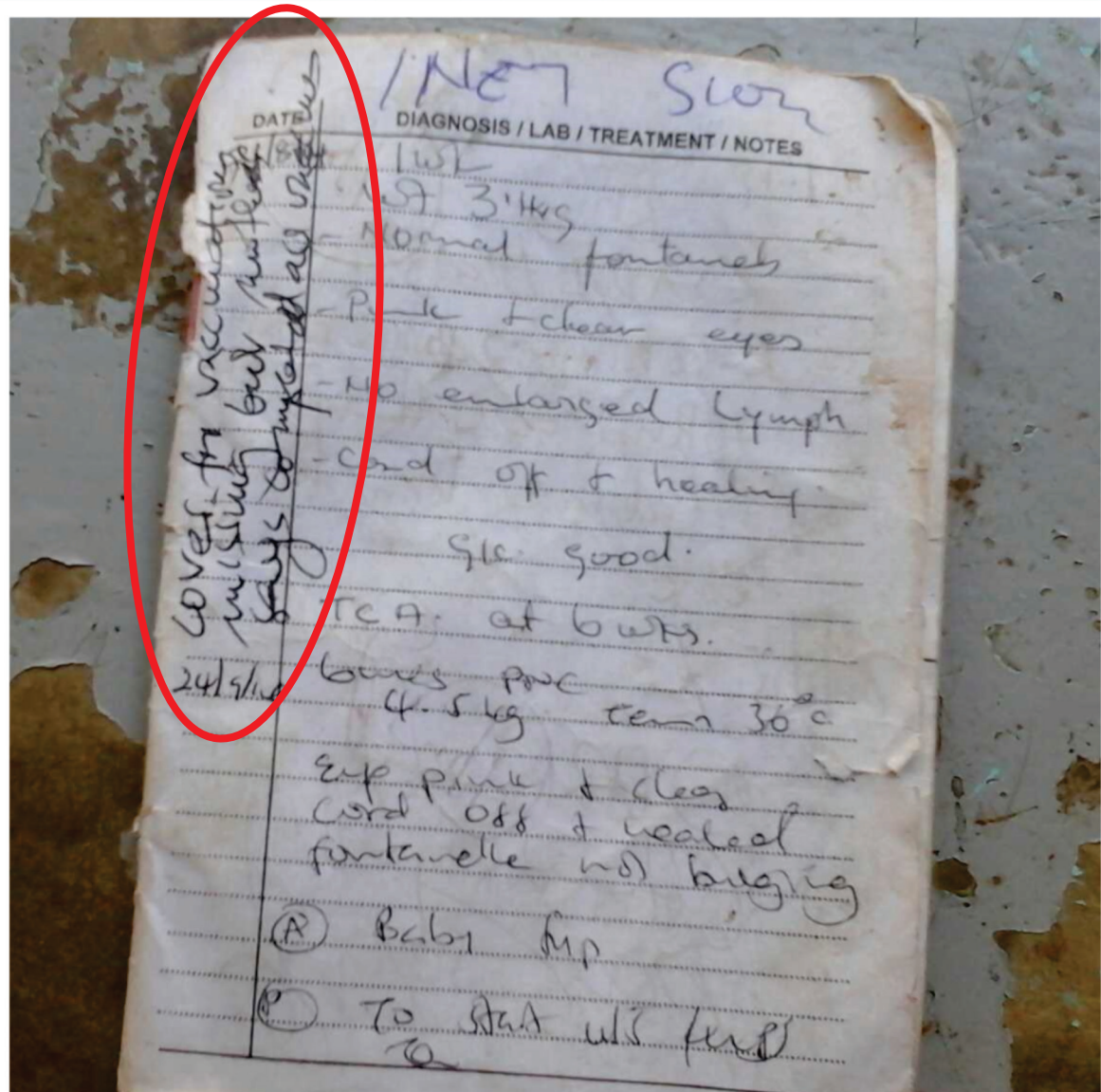


Results of a digital image review and assessment of home-based record durability and recording practices



Valuable information lost, perhaps to never be recovered. Image of a home-based record taken in Malawi at a time when the vaccination history recording page was located on the back of the front cover. As indicated in the health worker notes circled in red, the cover page and vaccination history is missing. The health worker has written, “mother says completed all vaccines.”. Current research calls into question the reliability of caregiver recall of vaccination history.

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Background

Home-based records represent a simple, cost-effective recording tool and information resource *i)* to enhance health professionals' ability to make appropriate clinical decisions (e.g., which vaccinations have been received already and which vaccinations remain outstanding) and improve continuity of care across providers in the absence of other health records, *ii)* to empower individuals or their caregivers as a vehicle for health education about which primary healthcare services have been received and those which remain outstanding as well as *iii)* to support public health monitoring efforts. In contrast to a facility-based record, the HBR is maintained in the household by an individual or their caregiver (e.g., mother, father, grandparent, etc) in order to encourage a partnership in the care of the child between the healthcare worker and the caregiver.

To fulfil its functional purpose as a critical reference source for an individual's vaccination history, it is important that the home-based record be durable in form and design to withstand the harsh day-to-day environments to which it is exposed. Documents which are not durable ultimately may result in lost information that is unable to be recovered due to absent or poorly organized facility-based recording systems.

In addition, in order for the home-based record to serve as a tool supportive of maintaining continuity of care across healthcare providers, the information recorded in the document must be complete and legible. Illegible handwriting is an important source of error in clinical decision making. Information recorded using poor or illegible handwriting is often worse than having absent information if the reader tries to make judgements and inferences that are incorrect based on what they think they see on the page.

For example, consider a healthcare worker visited by a mother and her 10-month old child with a home-based record suggesting the child has been vaccinated with one dose of measles containing vaccine. The healthcare worker sees that a date is written next to the measles vaccine field but she cannot read the date. She decides that the child has received a dose of measles containing vaccine and sends the mother and child along without administering any vaccines. Unfortunately, the child had been vaccinated quite early, well before 9 months of age, and was in fact not immunized against measles. Had the healthcare worker been able to read the recorded date of vaccination, she might have decided to administer a dose of measles vaccine.

Objective

To qualitatively assess the current physical state of a sample of home-based records as well as characterize recording practices and assess issues of legibility of handwriting based on a review of electronic images of home-based records obtained during field implementation of WHO's new methodology for assessing and reducing Missed Opportunities for Vaccination project.

The reviewed images of home-based records originated from a WHO strategy to assess missed opportunities for vaccination based on a 2016 revision of the original 1988 and 2013 methods to do the same. The images reviewed here originate from missed opportunities for vaccination assessments conducted in Chad, Malawi and Timor-Leste during 2015-16.

Per the 2016 revision of the protocol, in each site, the target population for the assessment is mothers or caregivers of children between the ages of 0-23 months who attend a health facility in the selected districts on the day of the assessment. All mothers or caregivers of children aged 0-23 months exiting the health facility on the day of the assessment were eligible, regardless of the reason for the visit to the facility, the mother or caregiver's place of residence or relationship to the child. In each assessment, the study team(s) aims to conduct a minimum of 500 caregiver exit interviews. (Healthcare workers are also interviewed but are not the focus of this discussion here because they do not hold the home-based record.)

As mothers aged at least 15 years with children aged 0-23 months exit health facilities, they are approached and asked to participate. Age-eligible mothers of age-eligible children are selected sequentially as opposed to a sampling process. Prior to each interview, the mother is made aware that her participation is voluntary and she is asked to provide verbal consent. Questions are asked of all consenting mothers or caregivers and images are taken of the home-based record, if available, on which a child's vaccination history is recorded. For a detailed description, refer to the WHO's *Methodology for the Assessment of Missed Opportunities for Vaccination* (available [online](#)).

Field staff include interviewers and supervisors centrally trained over a 2-3 day period in each assessment. The number of field teams is chosen to try and complete field work data collection during 3-5 days with each team expected to complete at least 20 interviews of mothers or caregivers and at least 10 interviews of healthcare workers per day. All data collection is completed using smartphones or tablets programmed with a standardized questionnaire. Field team training includes informal instruction on how to take images of home-based records using the smartphone or tablet to be used during the field work.

Field staff are asked to conduct 10 interviews of caregivers of children aged 0-11 months and 10 interviews of caregivers of children aged 12-23 months exiting each selected facility if possible. Field teams are asked to conduct interviews at health facilities on days (and during hours) when immunization services are being held at each health facility.

The image review was completed by two individuals who were not involved in the field data collection. Each reviewer received and reviewed a package of the same 707 unique records to review. Each reviewer received a randomly sorted image listing order to follow and direct their progress through the 707 records. For each record, both reviewers completed a standardized image criteria questionnaire. The image criteria questionnaire (see Annex) captured information on image quality, whether the images included both background demographic information (e.g., name, date of birth, unique identifiers, etc) and vaccination history information, presence of physical damage to the record and a general characterization of observed recording practices including fit of recorded information in provided space, legibility of handwriting, vaccination date recording practices. An orientation of the image criteria questionnaire was provided to both reviewers though there was no formal training given.

The questionnaire was transferred to a web-based survey form for reviewers to interact with. Data were then downloaded on completion of the image review and transferred to MS Excel (Redmond, Washington, USA). After all images were reviewed, the results from each reviewer were pooled. Items with discrepancies were adjudicated by the author of this report and a final determination made. Data were cleaned and analysed using Stata v14 (College Station, Texas, USA).

Results

A total of 987 images were reviewed for 707 unique records. Of the 707 unique records, 56 were identified by reviewers as facility-based records and are not described further. Of the remaining 651 home-based records, eleven records were so severely blurred or distorted due to poor photographic imaging, it was not possible to read the document; therefore, no assessments were made for these eleven records, leaving 640 home-based records for characterization.

Country	No. Unique records	Not able to review due to poor imaging
Malawi	467	5
Timor-Leste	169	5
Chad	15	1
Total	651	11

A complete set of images—meaning that at least one image was available for the cover page (or its equivalent) with information on child name, date-of-birth and in some instances unique identification number and one image was available with the vaccination history recording page—was available for 182 (28%) home-based records. For the remaining 458 records, either the cover page or the vaccination history recording page was available, but not both.

Among the 640 reviewed and readable home-based records, 95% (n=617) were officially issued records, meaning they were pre-printed, of standardized form and appeared to be issued by an official government agency. Twenty-three documents were substitute, handwritten records on loose leaf or notebook paper.

Observed HBR physical damage

Overall, 53% (n=345) of the home-based records were identified with some sort of physical damage to the document. Physical damage included tearing or creasing (84%, n=293), fading (50%, n=172), water or liquid exposure (39%, n=134), mold or mildew damage (28%, n=97), edgeworn or chipped (e.g., where pieces are missing from edges such as might occur due to rodent eaten paper) (5%, n=18) as well as from fire (3%, n=10).

Among the 345 home-based records with damage, information was lost as a result of the damage for 27% (n=95) of records. Information lost included date of vaccination (n=60 records, 64% of 95 damaged records with information lost), child name (n=24, 25%) and child date of birth (n=23 records, 24%).

The vaccination history recording page was separated from the home-based record in 5% (n=30) of records. Nearly all (29 of 30) of the records with the vaccination history page separated from the rest of the home-based record had evidence of other damage (tearing or creasing, n=29/30; fading, n=15; water or liquid exposure, n=11; mold or mildew damage, n=10). We were unable to assess whether the vaccination history recording page was separated in one-third (n=219) of the images most often as a result of imaging angles that prohibited a definitive determination whether the recording page remained or not (e.g., preceding pages perfectly folded under the back of the recording page out of view).

Figure 1. Example of physical damage to a home-based record from Malawi

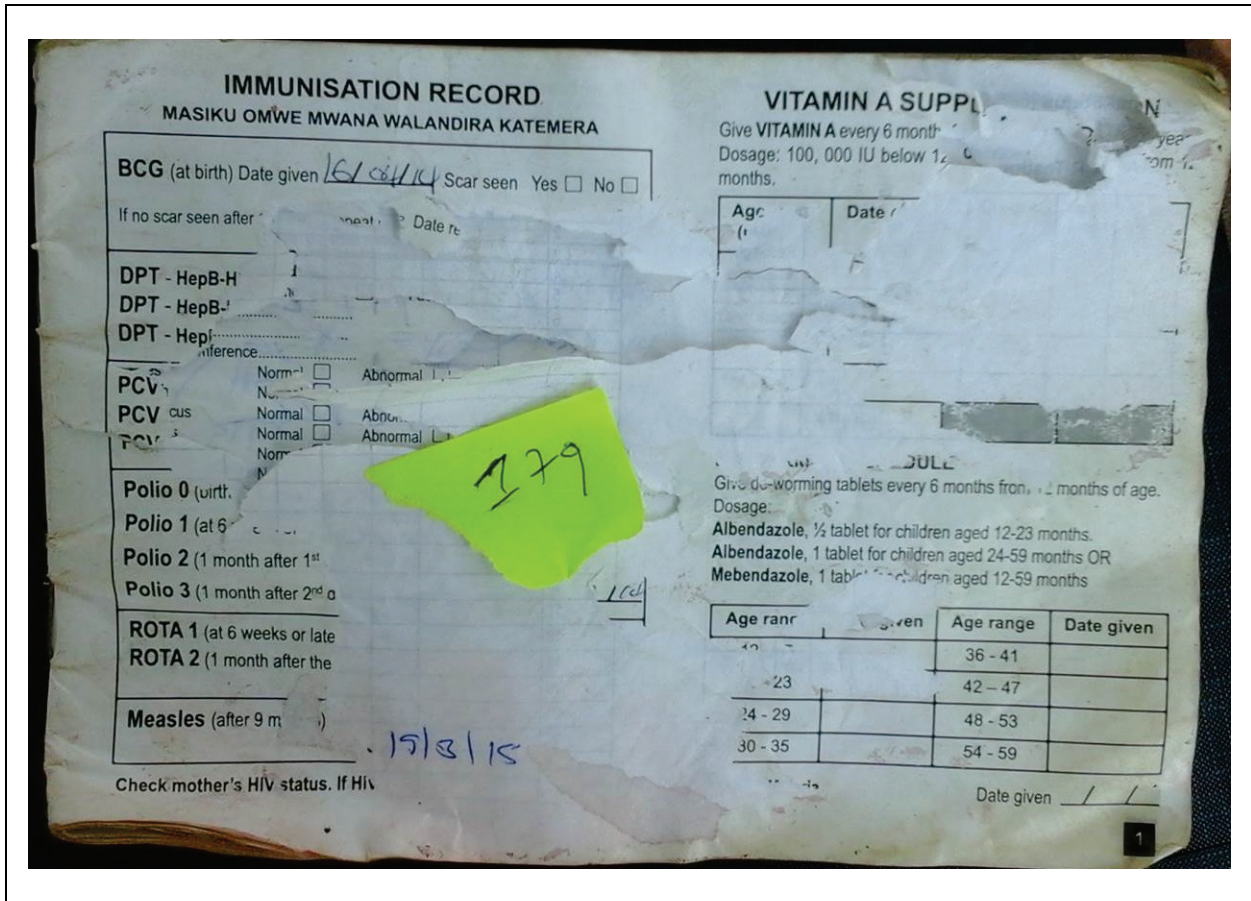


Figure 2. Example of mold / mildew damage on a home-based record from Malawi



Observed HBR recording practices

The review and assessment revealed:

- Reviewer's assessed the legibility of handwriting as fair or poor in 11% (n=69) of records and as good or excellent in 64% (n=417) records. Assessments were not made by both reviewers for 19 records due to image quality, field obstruction or blank recording areas (overall agreement was 76%; kappa 0.31). Reviewer assessments of handwriting legibility disagreed for 154 (24%) records. Reassessment for a random sample of these 154 records failed to result in common resolution of legibility. If all 154 records were assessed as having good or excellent legible handwriting, then 88% of records (n=562) would be so classified, leaving 11% of records assessed as having fair or poorly legible handwriting. Similarly, if all 154 records were assessed as having fair or poorly legible handwriting, then one-third (n=214) of records would be so classified.
- For 35% (n=223) of records, the handwritten information did not appropriately fit in provided recording areas. Assessment of whether recording did not fit in provided spaces was not possible in 15 records. In the 223 instances where recorded information did not fit in provided recording areas, information was most often recorded in the margins (66%, n=148), infringed on other recording areas (18%, n=41) or a combination of both infringement on other recording fields and in the margins (15%, n=33). Only one instance of recording in an attachment was observed when information did not fit in provided spaces.

There was one observed instance where problems with recording fit resulted in loss of name, and no instances in loss of date of birth information or unique identification numbers. Nearly one-third (30%, n=68) of the 223 records had evidence of lost information on the date of at least one vaccination as a result of recorded information that did not fit appropriately in the provided recording area.

- For 87% (n=559) of reviewed records, there was no evidence of corrections on the vaccination history page or the cover identification fields. Among the remaining 81 records, 50 (62%) had evidence of a correction or edit that was marked and legible value written in but without neighbouring initials; 29 (36%) records were marked with a correction or edit that was not legible; and two records were marked with a correction or edit that was not only legible but also initialled.
- Widespread use of abbreviations on the vaccination recording areas beyond use those used to identify vaccines was not observed in the reviewed HBR images.
- Health workers in Timor-Leste often recorded a single date across all vaccine recording fields for vaccines, presumably vaccines delivered at the same health encounter on the same date (see Figure). This recording practice is particularly problematic if the process includes recording dates of vaccination prior to the delivery of the vaccine, in which case the health worker might record that vaccine has been received when in fact it has not because of a mid-session vaccine shortage.

Figure 3. Recorded vaccination date does not fit into the recording area

In the example below, the vaccination date recording for the polio vaccine birth dose infringes on the recording area for the polio vaccine dose recommended at 6 weeks. As noted elsewhere, the recording practice in Timor-Leste allows for health workers to record a single date across vaccines that are recommended for delivery during the same visit. In the example below, it is unclear whether the child did or did not receive a polio vaccine dose during the 6 week visit along with DTP containing vaccine and hepatitis B. The example below also highlights the practice of writing the new vaccine (IPV in this case) in the margin of visit column. Here it is unclear whether the child received a dose of IPV during the 14 week visit on 18 April 2016.

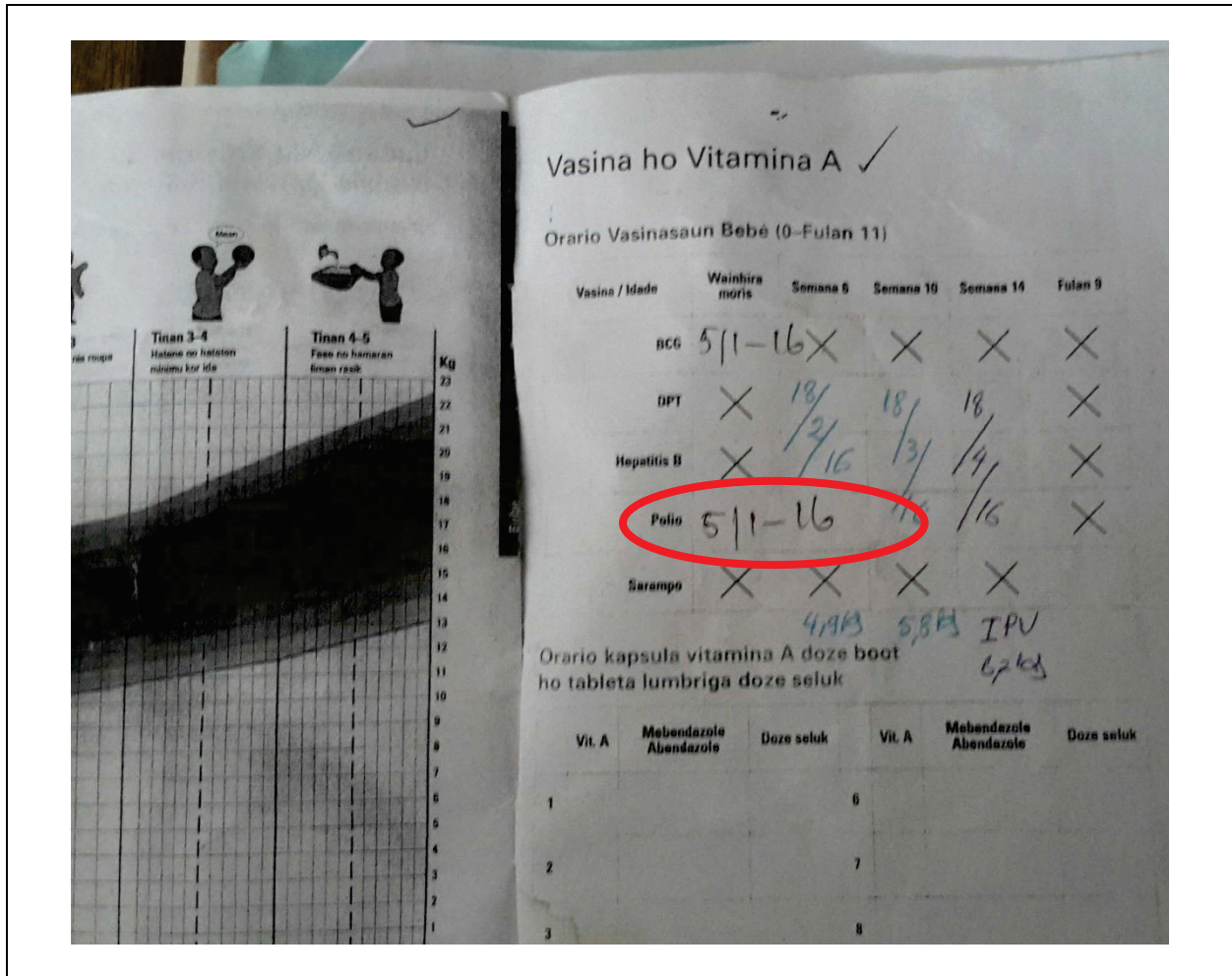


Figure 4. Recording practice used for a new vaccine added to the vaccination schedule, Timor-Leste.

Below, as a result of an absent recording area for new vaccines, in this case inactivated polio vaccine (IPV), the healthcare worker has written in “IPV” near the recorded date for vaccines recommended at 14 weeks of age. It remains unclear whether IPV was in fact delivered on 18 April 2016 as recorded across the recording areas for vaccines recommended at 14 weeks. Assumptions must be made to come to such a conclusion. The example below also demonstrates the poor practice of recording a single date across the recording areas for the three vaccines recommended at 14 weeks of age. The example also provides three different date recording forms.

Vasina / Idade	Wainhira moris	Semana 6	Semana 10	Semana 14	Fulan 9
BCG	29/15	X	X	X	X
DPT	X	12/16	18/16	18/16 ✓	X
Hepatitis B	X	2/16	3/16	9/16	X
Polio	28/15	16/16	16/16	18/16	X
Sarampo	X	X	X	X	X

ario kapsula vitamina A doze boot
tableta lumbriga doze seluk

Figure 5. Recording practice used for a new vaccine added to the vaccination schedule, Timor-Leste

In the absence of a space for recording vaccination dates for new vaccines, health workers often get creative and record dates in the margins. In this example, the recording style used appears to reflect the delivery of IPV at the same visit at which the first dose of measles containing vaccine was delivered. The absence of a recorded date of vaccination requires the reader of this record to make an assumption that the IPV was delivered on the date that measles vaccine was delivered.

Vasina / Idade	Wainhira moris	Semana 6	Semana 10	Semana 14	Fulan 9
BCG	06/15	X	X	X	X
DPT	X	17/	14/	13/	X
Hepatitis B	X	8	9/	015	X
Polio	06/15 17	15	15	10	X
Sarampo	X	X	X	X	9/4/15 + IPV

5,1 kg

kapsula vitamina A doze boot
leta lumbriga doze seluk

Figure 7. Example of a date marked through by health worker without initialization

IMMUNISATION RECORD
MASIKU OMWE MWANA WALANDIRA KATEMERA

BCG (at birth) Date given 2 / 07 / 2015 Scar seen Yes <input type="checkbox"/> No <input type="checkbox"/>	
If no scar seen after 12 weeks, repeat dose Date repeat dose given / /	
DPT - HepB-Hib 1 (at 6 weeks or later) Date given / /	
DPT - HepB-Hib 2 (1 month after 1 st dose) Date given / /	
DPT - HepB-Hib 3 (1 month after 2 nd dose) Date given 2 / 09 / 15	
PCV 1 (at 6 weeks or later) Date given / /	
PCV 2 (1 month after 1 st dose) Date given / /	
PCV 3 (1 month after 2 nd dose) Date given / /	
Polio 0 (birth up to 2 weeks) Date given 2 / 07 / 15	
Polio 1 (at 6 weeks or later) Date given / /	
Polio 2 (1 month after 1 st dose) Date given / /	
Polio 3 (1 month after 2 nd dose) Date given / /	
ROTA 1 (at 6 weeks or later) Date given / /	
ROTA 2 (1 month after 1 st dose) Date given / /	

VITAMIN
Give VITAMIN
Dosage: 100,
months.

Age range (months)
6 - 11
12 - 17
18 - 23
24 - 29
30 - 35

DE-WORM
Give de-worm
Dosage:
Albendazole
Albendazole
Mebendazole

Age rang
12 - 17

154

Figure 8. Ambiguous, un-initialled mark in a vaccination date recording area

Below a health worker has placed an X mark in the polio birth dose recording area. It is unclear whether the X mark indicates that a polio birth dose was or was not delivered to this child. Such ambiguity may create problems for survey interviewers abstracting information from HBRs. In this case, the surveyor would likely record that a mark was present for the polio birth dose indicating that the child received such. This may not be correct.

18/16/14

BCG

DPT 18

Hepatitis B 5/16

Polio X

Sarampo

Figure 9. Example of different date recording formats used to record the date of vaccination, Timor-Leste

In the example below, three different recording styles are used by health workers in the same home-based record when recording vaccination dates.

Vasina / Idade	Wainhira monis	Semana 6	Semana 10	Semana 14	Fulan 9
BCG	29/02-16	X	X	X	X
DPT	X	19/16	19/5		X
Hepatitis B	X	16	15/16		X
Polio	29/02-16	0	15/16		X
Sarampa	X	X	X	X	

Orario kapsula vitamina A doze boot

Figure 10. Example of common recording practice for date of vaccination observed in Timor-Leste

a. Common cross-field date recording practice used by healthcare workers

Vasina ho Vitamina A 11/8/15

Orario Vasinasaun Bebé (0-Fulan 11)

Vasina / Idade	Wainhira moris	Semana 6	Semana 10	Semana 14	Fulan 9
BCG	4/8/15	X	X	X	X
DPT	X	8/	7/	10/	X
Hepatitis B	X	9/	10/	11/	X
Polio	4/8/15	15	015	15	X
Sarampo	X	X	X	X	16/05-016

Orario kapsula vitamina A doze boot

IPU 16/5-016

b. Recommended practice for date of vaccination recording in each field; however, corrected date entries for BCG and polio vaccine birth dose are not clear nor are corrections initialled

Vasina ho Vitamina A

Orario Vasinasaun Bebé (0-Fulan 11)

Vasina / Idade	Wainhira moris	Semana 6	Semana 10	Semana 14	Fulan 9
BCG	21/07/15	X	X	X	X
DPT	X	2/09/15	2/10/15	5/11/15	X
Hepatitis B	X	2/09/15	2/10/15	5/11/15	X
Polio	21/07/15	2/09/15	2/10/15	5/11/15	X
Sarampo	X	X	X	X	22/4/16

Orario kapsula vitamina A doze boot
ho tableta lumbriga doze seluk

- We identified 177 (28%) records where the child’s name was recorded; 168 (92%) of the 182 complete records reviewed had a recorded name. We identified 165 records where the child’s date-of-birth was recorded (one additional recorded included a partial date-of-birth); 162 of the 182 complete records reviewed had a recorded date-of-birth. We identified 45 records, all of which were complete records, with a recorded unique identification number.
- Among the 597 (90%) records with recorded vaccination dates, the recorded date was complete—meaning the date includes year, month and day—for 579 (97%) records. Seven records included a mark that vaccination took place but not a recorded date. An assessment was not possible for 54 (8%) records, either because the vaccination history recording page was blank or exclusion due to severe image blur.
- There were no examples observed where the facility was indicated in the vaccination recording area.
- The review identified few (6%) records where healthcare workers initialled all (14 records) or some (24 records) of the recorded dates of vaccination. An assessment was not possible for 14 (2%) records.

Figure 11. Healthcare worker initialization of medical services administered

The home-based record issued by the Government of Tonga and imaged in the Timor-Leste highlights a design that includes healthcare worker initialization next to recorded dates of vaccination. When provided a dedicated field for placing their initials, healthcare workers are perhaps more likely to do so.

Vaccine	Schedule	Date	Sign
Hep B Birth Dose	At birth (within 24 hrs)	24/11/15	
BCG	Within first 4 weeks	23/11/15	
OPV 1	6 weeks	11/01/16	T. F. F. F.
OPV 2	10 weeks	29/3/16	S. P. J. L.
OPV 3	14 weeks	17/5/16	L. A.
DPT/Hib/Hep B 1	6 weeks	11/01/16	K. L. O. L.
DPT/Hib/Hep B 2	10 weeks	29/3/16	S. P. J. L.
DPT/Hib/Hep B 3	14 weeks	17/5/16	L. A.
DTP 4	18 months		
DTP 5	School entry 5-6 yrs		
MR 1	12 months		
MR 2	18 months		

- In 90% (n=577) of records, blue or black ink was used to record information in the record. In 6% (n=39) of records, either pencil or red pen was used in addition to blue or black ink for recording information. Two records were identified wherein the record was completed entirely in red ink, and an assessment was not possible in 22 (3%) records.

Figure 12. Use of pencil to document date of next visit on the home-based record, Chad

Digital photographic image quality

- Overall, 56% (n=362) of the 647 records were without blur or distortion and in clear focus, while 28% (n=183) were readable with mild blur or distortion and 15% (n=95) were moderately blurred or distorted and only partially readable. Eleven records were classified as severely blurred or distorted to the point that the image was unreadable.
- Overall, 54% (n=349) records had images that were cropped or obscured such that text within the image was unreadable. Information was lost in 326 (93%) of the 349 records because images were not centred (239, 69%), an object was obstructing the image (e.g., post-it note) (130, 37%) and/or because of a shadow or overexposure (23, 7%). A total of 54 records had information lost because of other image clarity issues such as poor angle of the camera to the document being photographed, poor lighting for photographs of photocopied documents, and documents that were not placed flat prior to taking the photograph.

Figure 13. Poor lighting of a damaged home-based record, Malawi

The image below highlights the importance of good lighting when photographing damaged documents. In this instance, the combination of the shadow and the tear at the top of the backside of the cover page, which at the time served as the vaccination history recording page, has made the recorded day of vaccination with BCG unreadable. If this were an image to be used in a coverage survey for verification of an unclear date recording on a survey questionnaire, information for this vaccine would be lost.

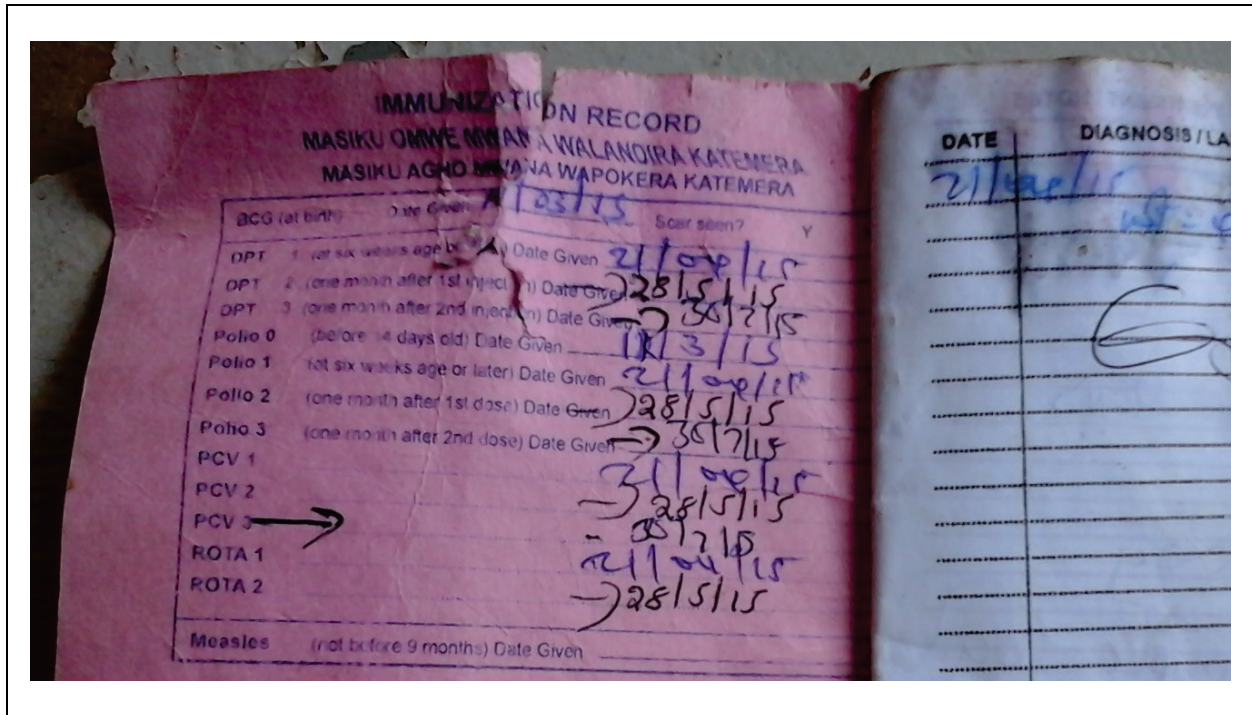
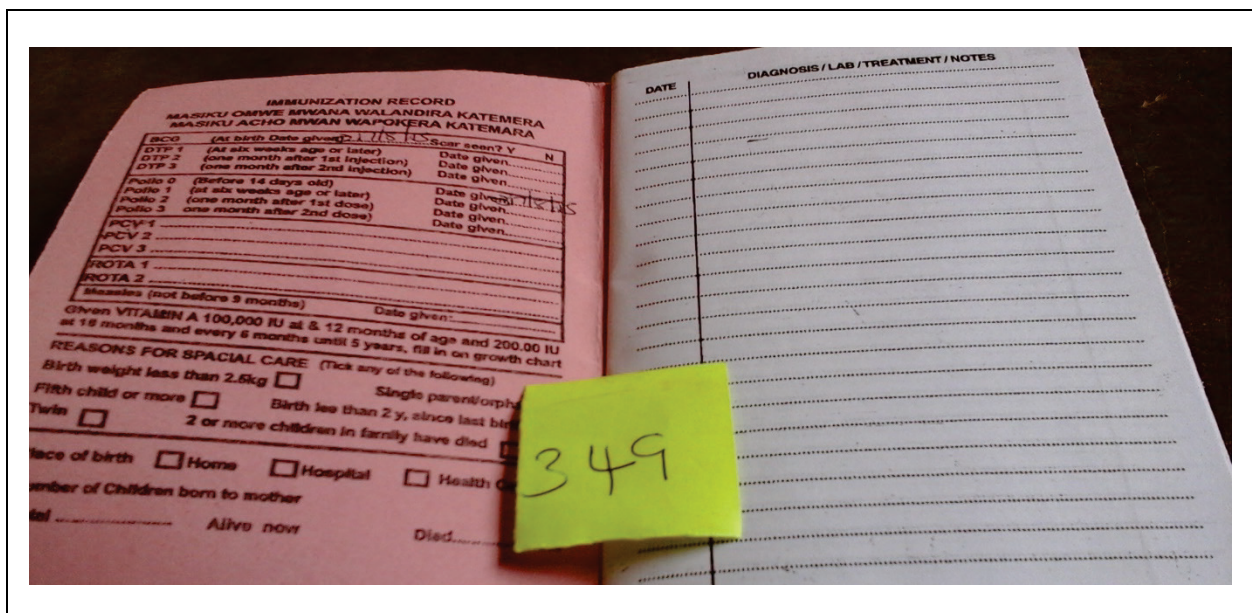


Figure 14. Poor camera to document angle, Malawi

The image below is an example of how a poor angle of the camera to the document can obscure information in the document. In this image, while the reader can strain to read the month and year of the vaccination date for BCG and birth dose of polio vaccine, it is not possible to read the day of vaccination.



Assessment of image utility for indicating what vaccines a child received

- Reviewers were asked to provide an overall indication of whether the HBR image was sufficient (based on ability to read information in the image [clarity], availability of information, legibility of handwritten vaccination dates) to indicate what vaccines a child had received and when those vaccines were received. Overall, the HBR images were consistent with an assessment of *definite* in 13% (n=84) of records, of *probable* in 55% (n=355) of records, *possible* in 20% (n=127) records and *unintelligible* in 11% (n=74) of records.
- Inter-rater agreement on the four level qualitative assessment scale (agreement, 36%; kappa, 0.11) was poor but improved (agreement, 80%; kappa, 0.40) when scale categories *definite* and *probable* were combined. Follow-up discussion with reviewers highlighted that one reviewer was fairly consistent in requiring the presence of date-of-birth information alongside vaccination history dates when making a determination of *definite* while the second reviewer did not. As such, for two-thirds of the determinations of *definite* by reviewer 1, the second reviewer had resolved the record as *probable*.

Comments and Considerations

- Given the intended purpose of the home-based record as a historical record of primary care services received, particularly vaccination history, concerns of the document's durability are warranted.
 - More than half of reviewed records had one or more forms of physical damage.
 - 45% of all reviewed home-based records had evidence of tearing or creasing
 - 5% of reviewed records included a full separation of the vaccination history recording page from the full document which might suggest the need for further consideration of ideal location of the vaccination history recording area. In nearly all situations, the separated vaccination history recording page was on a cover page.
 - The records observed in Malawi appeared to be exposed to much different environments than those in Timor-Leste where it appears that the records may be maintained by healthcare workers at facilities rather than in the home.
 - Damage from liquid exposure and mold or mildew damage, particularly among records in Malawi, highlight the need for further consideration of paper products that are water resistant and not susceptible to damage from mold or mildew.
 - Of particular concern are the one-quarter of documents on which information was lost as a result of the physical damage.
- Date of vaccination recording practices differ across countries and within countries across healthcare workers. Overall, most records included a complete vaccination date (day, month and year). Some observed recording practices for dates of vaccination were deemed potentially problematic for readers of the document including healthcare workers making decisions based on dates of vaccination as well as field survey staff charged with abstracting vaccination history data from home-based records.

- Handwriting legibility was assessed as poor in about 10% of home-based records suggesting some attention to this issue in pre-service or in-service healthcare worker training may be warranted.

HBR design

- Recording area size matters. When recording fields on a form are ill-sized to facilitate good recording practice, the form's user must make a decision: she must either take additional time to legibly record in the available space, or she will record beyond the available space. Evidence of recorded information that did not fit in the provided recording area was observed in one-third of reviewed records. When information is recorded beyond provided space, there is the risk that information will be lost. During this review, information loss was observed in one quarter of records with information that did not fit the provided space.
- Additional recording spaces for new vaccines is important. Evidence of recording information on receipt of new vaccines varied. In some instances, new vaccines and the corresponding date of vaccination were recorded in the margins of the vaccination history recording areas. In other instances, the new vaccine and corresponding date of vaccination was recorded on a neighbouring structured page that was not part of the vaccination history recording area. Such a practice is less than ideal because it forces readers to search through the document for information, a practice that may not take place thereby leading to an inefficiency. For survey teams that may review a home-based record to abstract vaccination history information, the interviewer may only refer to information recorded on the vaccination history recording area. Thus, for many purposes, vaccinations recorded beyond the vaccination history recording page are by all means lost information in many settings.

HBR imaging

- Appropriate consideration should be given to develop one or more different methods for uniquely identifying an imaged HBR for the purpose of linking the image with the interviewed individual while protecting privacy of the individual. In most situations, it would likely be deemed inappropriate to include an individual's personal identifying information (e.g., name, residence address) within an image.
- It may be important to consider development of specific verbal or written consent language/forms to deal with photographing a personal health record with a description of how the image will be used. In some settings, consent to participate in an interview may be sufficient to cover the unique situation around photographs while in other settings it may be important for the individual owner of the HBR to explicitly consent to the imaging of the document.
- Once a decision has been made to digitally image home-based records during field study, it is important to get the best image possible. The observed challenges observed in the quality of digital images reviewed here highlight expected gaps in the ability of generalist field survey staff to take appropriate quality photographs of HBRs. Similar to damaged home-based records wherein information may be lost, poorly imaged home-based records are equally problematic and entirely preventable with good training, practice and field supervision.

While we are aware of a guide that was developed as part of the Bolivia Immunization Coverage Survey, it seems apparent that a practical field guide or protocol needs to be developed based on professional expertise in the field of digital imaging and archiving of documents to help guide field-based imaging of home-based records. Such a guide would

establish the ideal situation with a recognition of the minimal training that would be available to field staff and the need to photograph under suboptimal conditions (i.e., no tripod, damaged documents, etc). The guide or protocol would establish clear parameters based on best practice while remaining practical to help guide field staff training and evaluation during field work.

For example, if possible, photographs should be taken in daylight which often may require the document to be taken outside. Similarly, it is often important to avoid placing the document on reflective surfaces which can produce a wash out of the detail (overexposure) and the handwritten information may become less visible on the photograph. The guide would perhaps discuss issues of equipment selection and identify the top five or ten most important considerations for field staff when taking a photograph of a HBR (e.g., lighting, where to focus in order to get a clear image, angle of camera to document, distance of digital camera/smartphone/tablet to document, shooting against a white rather than dark background, turning flash off when photographing a document printed on glossy paper, etc). The guide may also provide trouble shooting advice for those who have to take photographs in poor conditions (e.g., when using the flash in poor lighting conditions, be sure to take photos from a distance of approximately 50 cm).

- Careful consideration should be given in home-based record imaging protocols to capture as much information in the record as possible when photographing a home-based record. The greatest cost to coverage surveys and field work is the time getting to the field site. So, even if the immediate study may not be relevant to the recording of vitamin A receipt, serious consideration should be given to capturing the information while the home-based record is available to the team.
- Although most instances that involve home-based record imaging may occur during vaccination coverage surveys that utilize smartphones or tablets for data collection, it remains unclear whether the camera included with the smartphone or tablet is sufficient or whether there are alternative approaches that provide superior quality images that meet the needs of a given situation. It is possible that the image quality of smartphone pictures may not be sufficient depending on necessary purposes. Also, as the mobile phone lens often has a wide angle, the images can be distorted on the sides which might require careful attention during training to ensure appropriate distance control during imaging.

There may still be some interest in field testing whether scanning or photography is the best approach for obtaining images of HBRs. By all accounts, scanning is a preferred method for creating a digital copy of many types of documents. It is recognized, however, that scanning may or may not be practical in some field settings and with severely damaged HBRs. In fact, with some documents, trying to scan might result in further damage.

Annex

Results of a digital image review and assessment of homebased record durability and recording practices

Malawi

Background

Home-based records (HBRs) represent a simple, cost-effective recording tool and information resource to:

- i. enhance health professionals' ability to make appropriate clinical decisions (e.g., which vaccinations have been received already and which vaccinations remain outstanding) and improve continuity of care across providers in the absence of other health records;
- ii. empower individuals or their caregivers as a vehicle for health education about which primary healthcare services have been received and those which remain outstanding; as well as
- iii. support public health monitoring efforts.

In contrast to a facility-based record, the HBR is maintained in the household by an individual or their caregiver (e.g., mother, father, grandparent, etc) in order to encourage a partnership in the care of the child between the healthcare worker and the caregiver.

To fulfil its functional purpose as a critical reference source for an individual's vaccination history, it is important that the HBR be durable in form and design to withstand the harsh day-to-day environments to which it is exposed. Documents which are not durable ultimately may result in lost information that is unable to be recovered due to absent or poorly organized facility-based recording systems.

It is also important for the information recorded in HBRs to be complete and legible. Illegible handwriting is an important source of error in clinical decision making. Information recorded using poor or illegible handwriting is often worse than having absent information if the reader tries makes judgements and inferences that are incorrect based on what they think they see on the page.

Objective

To qualitatively assess the current physical state of a sample of home-based records as well as characterize recording practices and assess issues of legibility of handwriting based on a review of electronic images of home-based records obtained during field implementation of WHO's new methodology for assessing and reducing Missed Opportunities for Vaccination project.

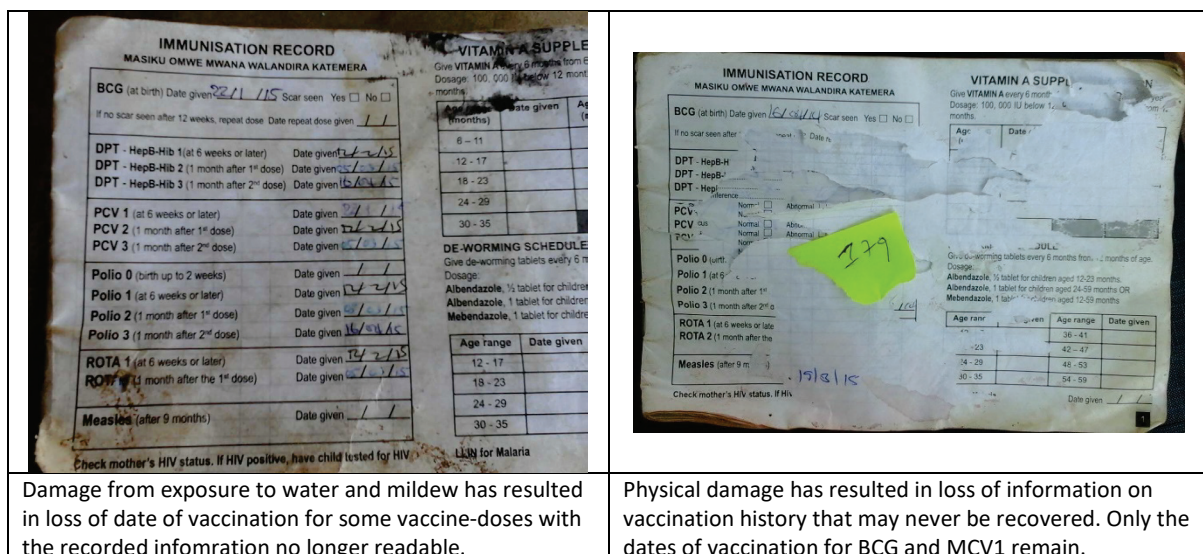
Methods

- Images of home-based records (HBRs) were collected as part of a WHO strategy to assess missed opportunities for vaccination conducted in Malawi during 2015.

- **Target population for the assessment:** mothers or caregivers of children between the ages of 0-23 months who attend a health facility, regardless of the reason for the visit, in the selected districts on the day of the assessment.
 - As mothers aged ≥ 15 years with children aged 0-23 months exit health facilities, they are asked to participate.
 - Prior to each interview, the mother is asked to provide verbal consent.
 - Questions are asked of all consenting mothers or caregivers and images are taken of the HBR, if available, on which a child's vaccination history is recorded.
 - For a detailed description, refer to the WHO's *Methodology for the Assessment of Missed Opportunities for Vaccination* (available [online](#)).
- HBR images were reviewed by two persons who were not involved in the field data collection. For each record, reviewers completed a standardized image criteria questionnaire that collected information on image quality, whether the images included both background demographic information (e.g., name, date of birth, unique identifiers, etc) and vaccination history information, presence of physical damage to the record and a general characterization of observed recording practices including fit of recorded information in provided space, legibility of handwriting, vaccination date recording practices.

Results

- A total of 708 images were reviewed for 467 unique records from Malawi. Five records were so severely blurred or distorted due to poor photographic imaging, it was not possible to read the document; therefore, no assessments were made for these five records, leaving 462 HBRs for characterization.
- A complete set of images—meaning that at least one image was available for the cover page (or its equivalent) with information on child name, date-of-birth and in some instances unique identification number and one image was available with the vaccination history recording page—was available for 138 (30%) home-based records. For the remaining 324 records, either the cover page or the vaccination history recording page was available, but not both.



Damage from exposure to water and mildew has resulted in loss of date of vaccination for some vaccine-doses with the recorded information no longer readable.

Physical damage has resulted in loss of information on vaccination history that may never be recovered. Only the dates of vaccination for BCG and MCV1 remain.

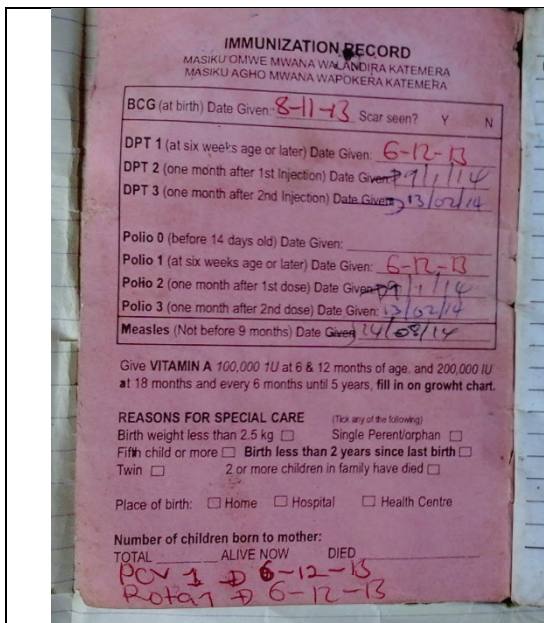
Observed HBR physical damage

- Overall, 66% (n=307) of the home-based records were identified with some sort of physical damage to the document. Physical damage included tearing or creasing (84%, n=258), fading (52%, n=160), water or liquid exposure (41%, n=126), mold or mildew damage (31%, n=96), as well as edgeworn or chipped (e.g., where pieces are missing from edges such as might occur due to rodent eaten paper) (5%, n=17).
- Among the 307 home-based records with damage, information was lost as a result of the damage for 29% (n=89) of records. Information lost included date of vaccination (n=56 records, 59% of 95 damaged records with information lost), child name (n=24, 27%) and child date of birth (n=23 records, 26%).

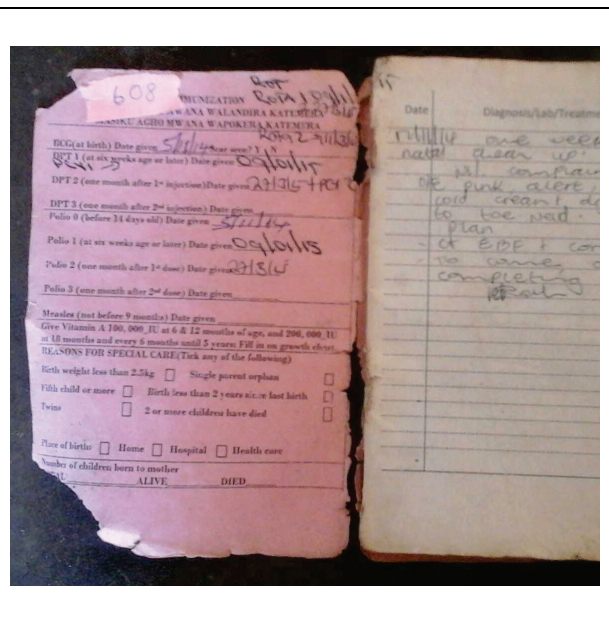
Observed HBR recording practices

The review and assessment revealed:

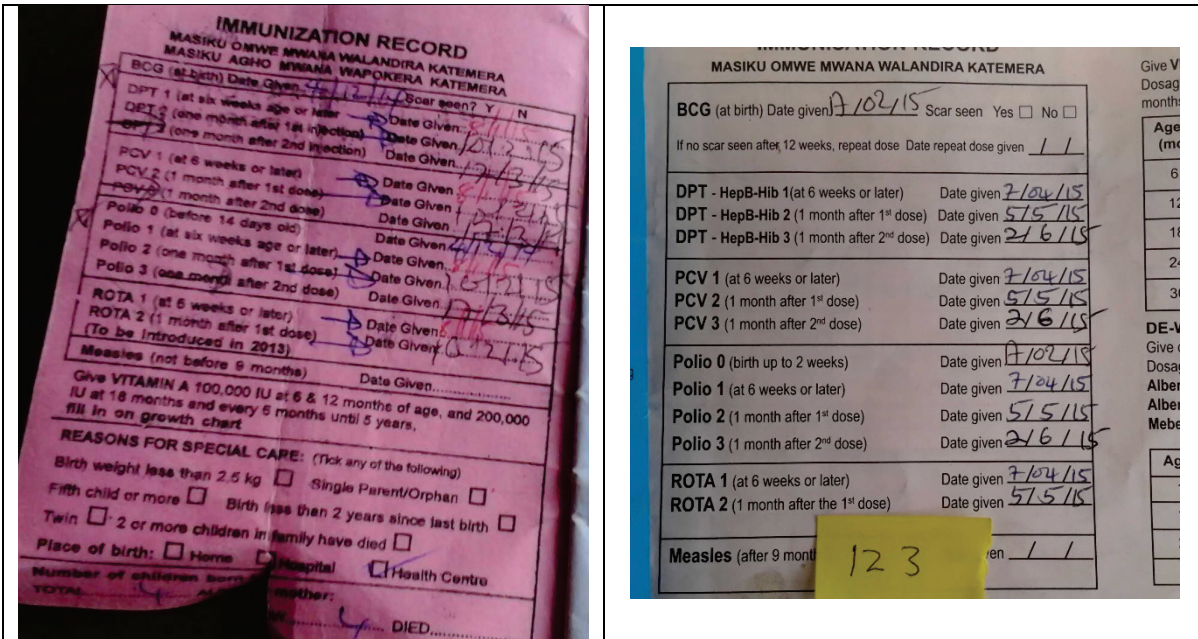
- For 31% (n=144) of records, the handwritten information did not appropriately fit in provided recording areas. Assessment of whether recording did not fit in provided spaces was not possible in 8 records. In the 144 instances where recorded information did not fit in provided recording areas, information was most often recorded in the margins (55%, n=80), infringed on other recording areas (23%, n=33) or a combination of both infringement on other recording fields and in the margins (21%, n=30).
- In most records, blue or black ink was used to record information in the HBR. This is preferred to use of pencil or red pen, which was observed occasionally.



Absent recording area for new vaccines results in written information in the margins at the bottom of the page.



The damage to the vaccination recording page has resulted in partial loss of information on date of vaccination for rotavirus vaccine written in the top margin. The entire vaccination recording page is a risk of being lost altogether.



Compare and contrast the handwriting used to record the date of vaccination information in the images above. The healthcare workers reading the information in the HBR shown on the right are much less likely to make an error in reading the date of vaccination than healthcare workers reading the information in the HBR shown in the image on the left. The recorded information on the HBR at right is clear and legible with markings in blue or black ink.

Comments and Considerations

- Given the intended purpose of the home-based record as a historical record of primary care services received, particularly vaccination history, concerns about the HBR's durability are warranted with more than half of records missing either the cover page or the vaccination history recording page and half of reviewed records in Malawi having one or more forms of physical damage (tearing, fading, damage due to liquid exposure, etc).
- Damage from liquid exposure and mold or mildew damage highlight the need for further consideration of paper products that are water resistant and not susceptible to mold or mildew damage.
- Handwriting legibility assessments suggest some attention to this issue in pre-service or in-service healthcare worker training may be warranted.
- Recording area size matters. When recording fields on a form are ill-sized to facilitate good recording practice, the form's user must make a decision: she must either take additional time to legibly record in the available space, or she will record beyond the available space. When information is recorded beyond provided space, there is the risk that information will be lost.
- Including additional recording spaces for new vaccines is important. In some instances, new vaccines and the corresponding date of vaccination were recorded in the margins of the vaccination history recording areas. In other instances, the new vaccine and corresponding date of vaccination was recorded on a neighbouring structured page that was not part of the vaccination history recording area. Such a practice is less than ideal because it forces readers to search through the document for information, a practice that may not take place thereby leading to an inefficiency.

Results of a digital image review and assessment of homebased record durability and recording practices

Timor-Leste

Background

Home-based records (HBRs) represent a simple, cost-effective recording tool and information resource to:

- i. enhance health professionals' ability to make appropriate clinical decisions (e.g., which vaccinations have been received already and which vaccinations remain outstanding) and improve continuity of care across providers in the absence of other health records;
- ii. empower individuals or their caregivers as a vehicle for health education about which primary healthcare services have been received and those which remain outstanding; as well as
- iii. support public health monitoring efforts.

In contrast to a facility-based record, the HBR is maintained in the household by an individual or their caregiver (e.g., mother, father, grandparent, etc) in order to encourage a partnership in the care of the child between the healthcare worker and the caregiver.

To fulfil its functional purpose as a critical reference source for an individual's vaccination history, it is important that the HBR be durable in form and design to withstand the harsh day-to-day environments to which it is exposed. Documents which are not durable ultimately may result in lost information that is unable to be recovered due to absent or poorly organized facility-based recording systems.

It is also important for the information recorded in HBRs to be complete and legible. Illegible handwriting is an important source of error in clinical decision making. Information recorded using poor or illegible handwriting is often worse than having absent information if the reader tries makes judgements and inferences that are incorrect based on what they think they see on the page.

Objective

To qualitatively assess the current physical state of a sample of home-based records as well as characterize recording practices and assess issues of legibility of handwriting based on a review of electronic images of home-based records obtained during field implementation of WHO's new methodology for assessing and reducing Missed Opportunities for Vaccination project.

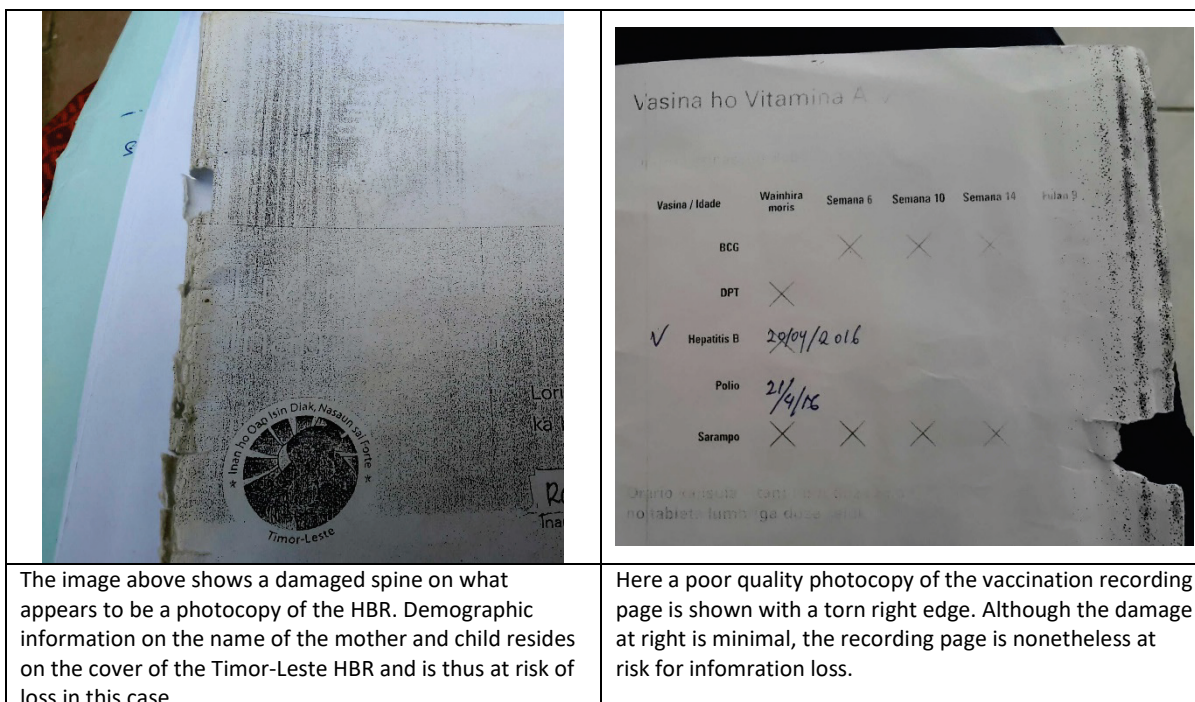
Methods

- Images of home-based records (HBRs) were collected as part of a WHO strategy to assess missed opportunities for vaccination conducted in Timor-Leste during 2016.
- Target population for the assessment: mothers or caregivers of children between the ages of 0-23 months who attend a health facility, regardless of the reason for the visit, in the selected districts on the day of the assessment.

- As mothers aged ≥ 15 years with children aged 0-23 months exit health facilities, they are asked to participate.
 - Prior to each interview, the mother is asked to provide verbal consent.
 - Questions are asked of all consenting mothers or caregivers and images are taken of the HBR, if available, on which a child's vaccination history is recorded.
 - For a detailed description, refer to the WHO's *Methodology for the Assessment of Missed Opportunities for Vaccination* (available [online](#)).
- HBR images were reviewed by two persons who were not involved in the field data collection. For each record, reviewers completed a standardized image criteria questionnaire that collected information on image quality, whether the images included both background demographic information (e.g., name, date of birth, unique identifiers, etc) and vaccination history information, presence of physical damage to the record and a general characterization of observed recording practices including fit of recorded information in provided space, legibility of handwriting, vaccination date recording practices.

Results

- A total of 259 images were reviewed for 169 unique records from Timor-Leste. Five records were so severely blurred or distorted due to poor photographic imaging, it was not possible to read the document; therefore, no assessments were made for these five records, leaving 164 HBRs for characterization.
- A complete set of images—meaning that at least one image was available for the cover page (or its equivalent) with information on child name, date-of-birth and in some instances unique identification number and one image was available with the vaccination history recording page—was available for 35 (21%) home-based records. For the remaining 129 records, either the cover page or the vaccination history recording page was available, but not both.



Observed HBR physical damage

- Overall, 21% (n=34) of the home-based records were identified with some sort of physical damage to the document. Physical damage included tearing or creasing (91%, n=31), fading (32%, n=11), water or liquid exposure (21%, n=7). There was no evidence of mold or mildew damage nor edgeworn or chipped pages.
- Among the 34 home-based records with damage, information was lost as a result of the damage for 15% (n=5) of records, including lost date of vaccination in 3 records.

Observed HBR recording practices

The review and assessment revealed:

- For 46% (n=75) of records, the handwritten information did not appropriately fit in provided recording areas. Assessment of whether recording did not fit in provided spaces was not possible in 6 records. In the 75 instances where recorded information did not fit in provided recording areas, information was most often recorded in the margins (91%, n=68), infringed on other recording areas (8%, n=6) or a combination of both infringement on other recording fields and in the margins (n=1).
- In most records, blue or black ink was used to record information in the HBR. This is preferred to use of pencil or red pen, which was observed occasionally.

Vasina / Idade	Wainhira moris	Semana 6	Semana 10	Semana 14	Fulan 9
BCG	06/15	X	X	X	X
DPT	X	17	14	13	X
Hepatitis B	X	8	9	015	X
Polio	06/15	15	15	10	X
Sarampo	X	X	X	X	5/4/16 + IPV

5,1 kg

kapsula vitamina A doze boot
leta lumbriga doze seluk

In the absence of a space for recording vaccination dates for new vaccines, health workers often get creative and record dates in the margins. In this example, the recording style used appears to reflect the delivery of IPV at the same visit at which the first dose of measles containing vaccine was delivered. The absence of a recorded date of vaccination requires the reader of this record to make an assumption that the IPV was delivered on the date that measles vaccine was delivered.

Vasina / Idade	Wainhira moris	Semana 6	Semana 10	Semana 14	Fulan 9
BCG	29/15	X	X	X	X
DPT	X	12/	18/	18/	X
Hepatitis B	X	2/	3/	9/	X
Polio	25/15	2/16	3/16	10/16	X
Sarampo	X	X	X	X	X

Vasina / Idade	Wainhira moris	Semana 6	Semana 10	Semana 14	Fulan 9
BCG	21/07/15	X	X	X	X
DPT	X	2/09/15	2/10/15	5/11/15	X
Hepatitis B	X	2/09/15	2/10/15	5/11/15	X
Polio	21/07/15	2/09/15	2/10/15	5/11/15	X
Sarampo	X	X	X	X	22/4/16

Compare and contrast the two vaccination recording practices in the HBRs at left and right above. On the left side, as a result of an absent recording area for new vaccines, in this case inactivated polio vaccine (IPV), the healthcare worker has written in "IPV" near the recorded date for vaccines recommended at 14 weeks of age. It remains unclear whether IPV was in fact delivered on 18 April 2016 as recorded across the recording areas for vaccines recommended at 14 weeks. Assumptions must be made to come to such a conclusion. The example on the left side also demonstrates the poor practice of recording a single date across the recording areas for the three vaccines recommended at 14 weeks of age. The example on the right side shows the preferred practice of recording a date for each vaccine delivered.

Comments and Considerations

- Home-based records are most effective when maintained by the parent or caregiver in the home rather than retained by healthcare workers.
- Overall, home-based records in Timor-Leste appeared in good physical condition. Given the intended purpose of the home-based record as a historical record of primary care services received, particularly vaccination history, the document's durability should always be reviewed. The review of records in Timor-Leste identified one-in-five reviewed records with one or more forms of physical damage, most often some form of tearing.
- Overall, handwriting legibility assessments of records from Timor-Leste were quite good. Continued attention to the legibility of healthcare worker recording practices during pre-service or in-service training is encouraged.
- Health workers in Timor-Leste often recorded a single date across all vaccine recording fields for vaccines, presumably vaccines delivered at the same health encounter on the same date. This recording practice is particularly problematic if the process includes recording dates of vaccination prior to the delivery of the vaccine, in which case the health worker might record that vaccine has been received when in fact it has not because of a mid-session vaccine shortage.
- Recording area size matters. When recording fields on a form are ill-sized to facilitate good recording practice, the form's user must make a decision: she must either take additional time to legibly record in the available space, or she will record beyond the available space. When information is recorded beyond provided space, there is the risk that information will be lost.
- Including additional recording spaces for new vaccines is important. In some instances, new vaccines and the corresponding date of vaccination were recorded in the margins of the vaccination history recording areas. In other instances, the new vaccine and corresponding date of vaccination was recorded on a neighbouring structured page that was not part of the vaccination history recording area. Such a practice is less than ideal because it forces readers to search through the document for information, a practice that may not take place thereby leading to an inefficiency.