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Adequacy and Quality of Immunization Data in a Comprehensive Electronic Health Record System

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Background and Purpose: Timely, simultaneous and combined vaccination is important to protect children from common infectious diseases. In a large health care delivery system in Western Kenya, we examined the adequacy and quality of data within the electronic health record (EHR) to assess the feasibility of developing a clinical decision support system to improve childhood vaccination uptake and coverage.
Methods: The study evaluated vaccination information collected and stored in an EHR between 2006 and 2012 involving 23,270 children. Encounters for 10,299 children lacked immunization information and were excluded.
Results: Documentation of vaccination coverage and timeliness is rendered in Kaplan–Meier time-to-event plots. Vaccination coverage at the end of one year ranges from 60% to 90% for all vaccines assessed individually that are part of the Kenya Expanded Program on Immunization (KEPI). Timely documentation of vaccination is low, with 52.8 weeks (95% CI: 52.1, 53.5) for measles vaccine and 29.2 weeks (95% CI: 28.5, 29.8) for the Bacillus Calmette–Guérin (BCG) vaccine. Complete vaccine observations were recorded in 16% of the encounters. Combination and simultaneous vaccine administration had high congruence and consistency.
Conclusion: A clinical decision support system that generates reminders to clinicians and caretakers of children would optimize vaccination uptake and improve overall immunization coverage. To achieve this, immunization data in the EHR must be timely, complete and consistent. Assessed vaccination timeliness is low, despite high coverage. Vaccine observations are often incomplete. There is need to improve the data collection process to achieve data quality levels that can adequately support a clinical decision support system.

Keywords: Vaccination, Electronic health records, Developing countries, Data quality

1 Introduction

Throughout the world, the use of vaccines has helped to save many lives. The Expanded Program on Immunization, created in 1974, is considered one of the world's most successful public health initiatives of the 20th century [1]. The Global Alliance for Vaccines and Immunization, which supports vaccination programs in developing countries, estimates that by 2010 its work supporting vaccination helped avert approximately 5 million pediatric deaths worldwide [2]. Vaccination programs have proven to be highly cost effective, and are important in achieving Millennium Development Goal 4, which calls for reduction by two-thirds of under-5 mortality by 2015[3]. In developing countries, vaccination programs also form a fundamental part of the healthcare systems. This is because vaccination sessions provide additional opportunities to deliver other health care services that might otherwise be missed, including treatment for malnutrition, malaria, intestinal worms, growth monitoring, breast feeding education, among others [4].

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Beyond individual benefits of vaccination, herd immunity can also be achieved when adequate numbers of children are immunized for the particular condition.

In developing countries, immunization information is often collected along with other clinical information as part of routine clinical care for the child. In these cases, the immunization information becomes part of the child's longitudinal record. Well-functioning immunization programs need reliable record systems to assist providers in offering timely and high quality immunization care. These records should include details about a child's prior vaccinations, immunizations administered on a particular visit, and the administration dates for all vaccinations [5]. The same individual immunization data can be aggregated and used by administrators and Ministries of Health in health services planning and to inform healthcare policies. With increasing adoption of Electronic Health Records (EHRs) in developing countries, immunization data is increasingly being stored in an electronic format as part of a longitudinal electronic record [6]. When available electronically, immunization information can potentially be leveraged to deliver automatic reminders and alerts for upcoming or missed immunizations. The immunization information stored can also be aggregated in various ways to best serve the needs of decision-makers at multiple levels.

To best serve the clinical purpose, immunization records need to be part and parcel of the patient's comprehensive record and available to clinicians when needed. As such, cases of isolated immunization databases, often seen as part of some immunization campaigns, rarely reflect the reality of the child's comprehensive clinical record.

EHRs are oftentimes touted as leading to more accurate, timely and readily available data than traditional paper systems [7]. However, almost no research exists to inform on the adequacy with which immunization information collected as part of routine care within EHRs in developing countries actually meet the needs for high quality immunization care [8]. In this study, we critically evaluate the quality and usefulness of child immunization data collected as part of routine clinical visits in a large comprehensive care program in Western Kenya. We particularly focus on how well this data reflects the real picture of immunization services provided, and whether the data passes 'fitness for use' test to inform decisions at individual and systemic levels.

2 Methods

2.1 Study setting

This study was conducted in a large care program formed by the partnership between United States Agency for International Development (USAID) and the Academic Model Providing Access to Healthcare (AMPATH) in Western Kenya [9]. Established in 2001, the AMPATH program is one of the largest comprehensive care programs in sub-Saharan Africa, serving a catchment area of over 2 million individuals through 30 parent and 49 satellite clinical sites. The program offers a broad range of services from antenatal care, pediatric and adult primary care services, HIV care and chronic disease management programs.

At AMPATH clinics, childhood immunizations are offered as per the Kenya Expanded Programme on Immunization (KEPI) schedule, with each child completing routine immunizations in five encounters [10]. The immunizations administered as part of the KEPI schedule are as follows: At Birth - Bacillus Calmette-Guerin (BCG) and Oral Polio (Polio 0); At 6, 10 and 14 weeks of age the children receive Oral Polio, Pentavalent, and Pneumococcal Conjugate vaccines at each of these visits. Measles vaccine is administered last at the age of 9 months. Pentavalent vaccine is a combination vaccine comprised of Diptheria, Pertusis,Tetanus (DPT), Hemophilus influenza Type B (HIB) and Hepatitis B (Hep B) vaccines.

2.2 Immunization Records

Since 2004, AMPATH clinics have used the AMPATH Medical Record System (AMRS) to store comprehensive, longitudinal electronic patient records for all enrolled patients [11]. AMRS is the original implementation of OpenMRS, an open-source electronic health record system deployed widely in the developing world [12]. Clinicians caring for AMPATH patients do not enter data directly into AMRS but rather complete paper encounter forms that contain clinical parameters and categorical observations

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previously defined and encoded into the AMRS concept dictionary (see Appendix A for pediatric encounter form). Where necessary, clinicians can write down diagnoses, test results, and other observations as free-text if these are not included in checklists on the encounter form. Clerks with basic computer skills and minimal medical knowledge enter data from the encounter forms into the AMRS. The encounter forms are then placed in the patient's paper clinic chart, which is available to the clinician during patient care.

At AMPATH, immunization information is collected within pediatric encounter forms by clinicians at every visit (Appendix A & **Fig. 1**). Immunization information collected include all previous immunizations (**Fig. 1** – Item 32a), whether the child is on schedule with immunizations or not (**Fig. 1** – Item 32b), and the exact immunizations administered during the visit (**Fig. 1** – Item 51e).

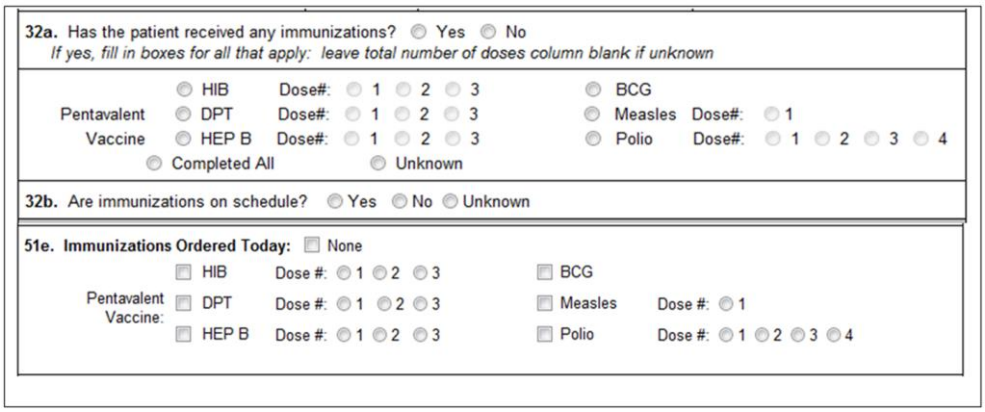

Fig. 1. Sections of routine clinical encounter form that capture immunization information for a child

2.3 Study Population

This study involved evaluation of immunization data collected for all children enrolled in the AMPATH program clinics and born between January 2006 and December 2010 as represented on **Fig. 2**.

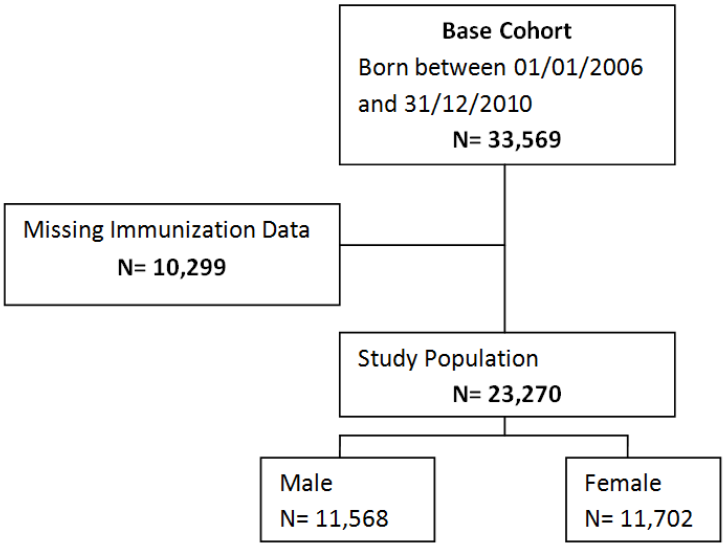

Fig. 2. Study population

2.4 Data Collection

All immunization information for the cohort of children in the study was collected in the paper encounter forms, and the data entered into the AMRS EHR. We used data in the EHR from January 1, 2006 to 31

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March 2012. These dates were chosen because the oldest children in the cohort were born in January 2006, whereas the youngest were born in December 2010. By looking at data until March 2012, we felt comfortable that the youngest children in the study cohort would be expected to have completed the required immunization as per the schedule. For each of the study participants, we extracted demographic information and for each clinical encounter, we extracted historical immunization information, and the vaccine types and value of dose administered.

IRB approval was obtained from the Institutional Research and Ethics Committee at Moi University School of Medicine, Eldoret, Kenya, and Indiana University's Institutional Review Board in Indianapolis, Indiana. All data was de-identified before analysis.

2.5 Outcome measures

The goal of this study was to assess the data quality and adequacy of immunization data collected within the EHR to satisfy the needs of a clinical decision support system aimed at improving immunization in the relevant population. Data quality dimensions that are generally accepted as depicting the real world scenarios are accuracy, timeliness, completeness, precision and consistency [13]-[17]. As pertains to immunization data quality, these dimensions have been refined in the General Recommendation on Immunization [18]. Since these redefined dimensions are better at ascertaining the accuracy and adequacy of immunization data, we chose to apply these in our analysis. These are:

1. Timeliness. Age appropriate administration of vaccines as recommended based on demonstrated efficacy and safety for specific age groups at risk of experiencing the disease. Timely vaccinations induce adequate immunity.
2. Spacing of the multiple sources of the same antigen. Optimal immune response is achieved when doses of the same vaccine are administered at recommended intervals.
3. Simultaneous administration. Administering more than one vaccine on the same clinic day, at different anatomic sites, and not combined in the same syringe. There is adequate scientific basis for simultaneously administering all vaccines for which a child is eligible at the time of a visit and this increases the probability of age appropriate compliance.
4. Combination vaccines. Combination vaccines merge equivalent component vaccines into single products to prevent more than one disease or to protect against multiple strains of infectious agents causing the same disease. This also reduces the number of injections patients receive and alleviates concerns associated with the number of injections.

2.6 Data analysis

MYSQL was used to extract the data from AMRS and analysis was done in SPSS version 19.The analyses were confined to 23,270 children aged 15 – 75 months (born between 1 January 2006 and 31 December 2010) excluding 10,299 children due to missing vaccination information. A reference date of 31 March 2012 was set for age calculations and vaccination observations made after this date were excluded.

Age appropriate vaccination uptake (timeliness) was estimated by the Kaplan-Meier method with age in weeks as the timescale [19][20]. Vaccination coverage at age t was estimated by 1 - SKM (t), the Kaplan-Meier survival function; 1 - SKM (t) is the cumulative probability of being vaccinated by age t. Comparison of survival distribution from cohort to cohort was carried out using Log Rank and Tarone-Ware techniques [21].

3 Results

A total of 23,270 eligible children (49.3% male, 50.7% female), aged 15 - 75 months in a total of 272,926 encounters and 1,258,348 immunization observations comprising 5 birth cohorts were included in the study period from 1 January 2006 to 31 March 2012. 10,299 children did not have any immunization data collected during this period. The mean age for the study subjects was 42 months (SD 17.4). The distribution of children in the cohorts is 3,125 in 2006; 3,848 in 2007; 4,095 in 2008; 5,359 in 2009 and 6,843 in 2010 cohorts.

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Kaplan-Meier estimates show an overall systematic reduction in the mean time of recording of the first immunization observation over time towards the recommended age of vaccine administration. This trend is best demonstrated by measles observations with a mean time of 38.240 (95% CI: 37.728, 38.751) weeks against the recommended age of 36 weeks in the last cohort (2010), however the overall mean time throughout the 5 cohorts is slightly higher, 52.804 (95% CI: 52.147,53.462). The first vaccine in the schedule, BCG, takes longer to be administered or recorded in the system with a mean overall time of 29.162 (95% CI: 28.482, 29.841) weeks, but this interval reduces over time through the cohorts (**Fig. 3** and **Fig. 4**).

The time course of completion of BCG and DPT series vaccinations is described graphically in **Fig. 3**.It is evident that for both BCG and DPT the series completion of primary vaccination is achieved by only about 10% of the children by the recommended time of 14 weeks at most, and it takes another 300 weeks for all children to have the vaccine observations recorded.

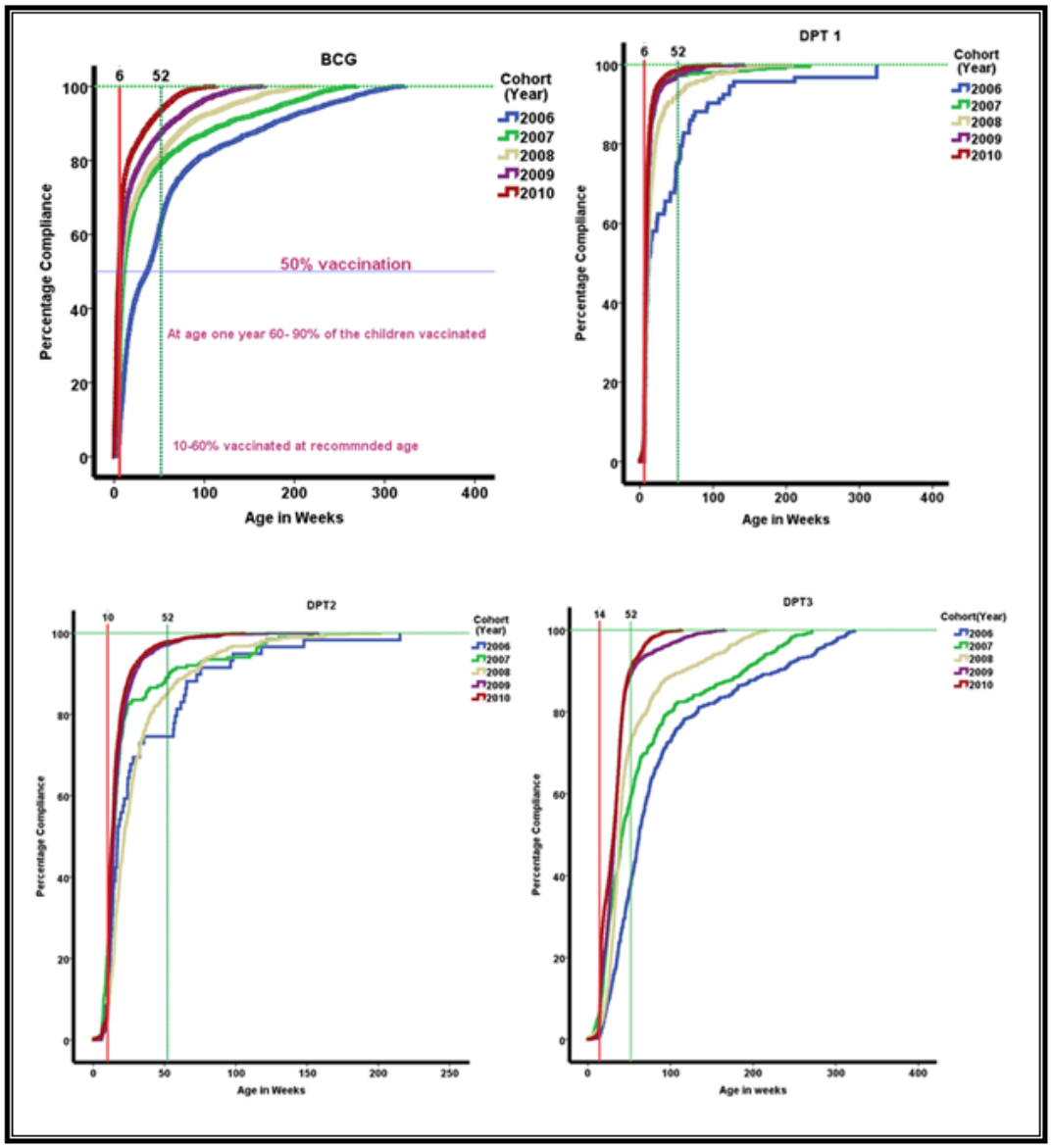

Fig. 3. Age at recording of vaccine observations presented in Kaplan–Meier plots (inverse and cumulative) for BCG and DPT. The X-axis is the age in weeks (used in KEPI schedule) and the Y-axis is the proportion of vaccine observations at each time point. The red vertical lines indicate the recommended age for vaccination. Age of one year is indicated as a scaling (green vertical dotted line), and is the age when all the vaccines are required to have been completed.

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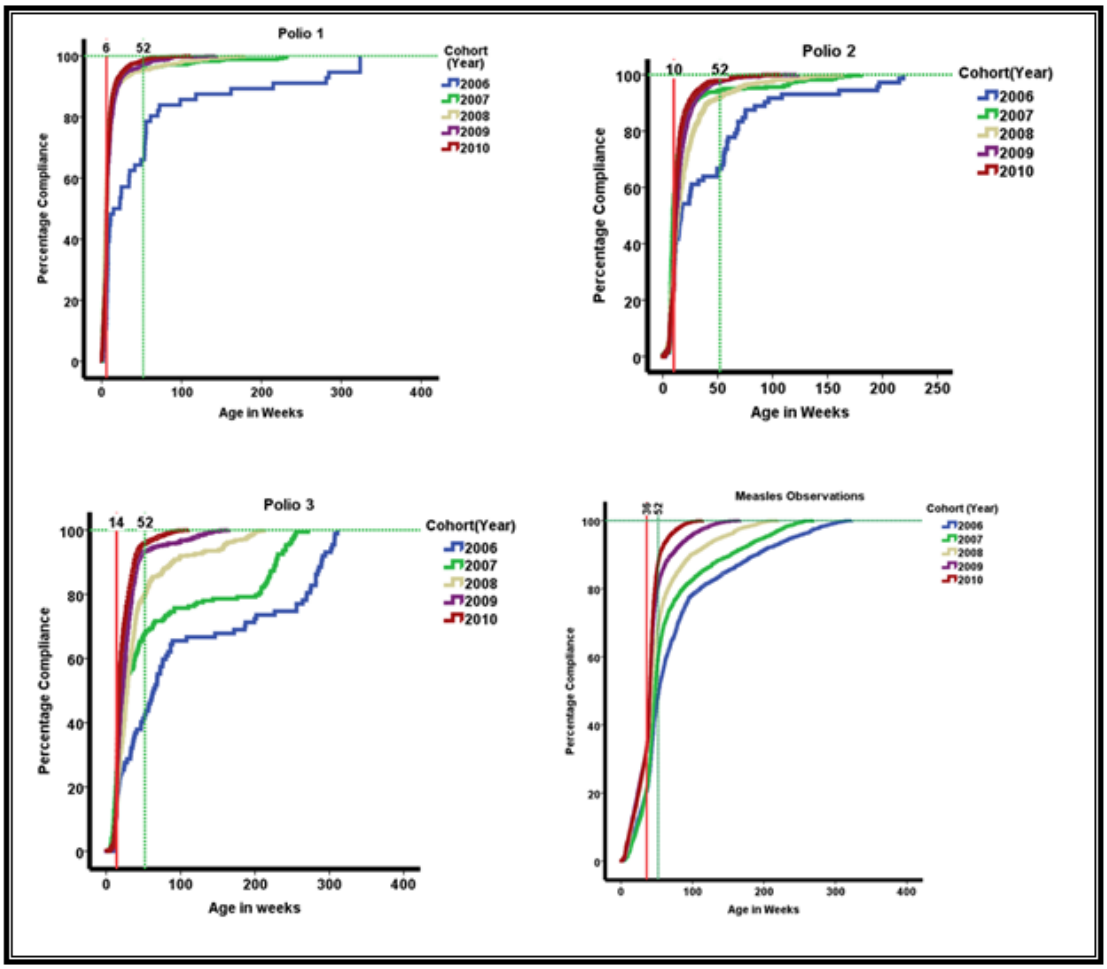

Fig. 4. Age at recording of vaccine observations presented in Kaplan–Meier plots (inverse and cumulative) for Oral Polio and Measles

Up to 80% of all children have their observations recorded by their first birthdays, demonstrated by steeper survival curves. After the first year, the curves generally plateau off and it takes much longer for the remaining children to have their vaccine observations administered or recorded. This also explains why most vaccine coverage estimations in the region are found to be about 80%; since age one year is usually taken as the benchmark for a fully immunized child, against a global recommendation of 90% [22]. This commonly used approach is disadvantageous since vaccination coverage can only be determined for the preset age groups and it is not possible to establish the age at which the defined coverage levels are achieved [20]. The multiple dose vaccines such as DPT and Polio reach the 80% mark within the recommended age of 6 weeks for the first doses in both vaccines. The subsequent doses show less steep curves and reach 80 % after longer time intervals.

Test of equality of survival distributions for the different vaccine and different birth cohorts using Log Rank (Mantel-Cox) and Breslow (Generalized Wilcoxon) methods found significant differences between cohort pairs and overall comparisons. This means that the timeliness of vaccine administration and observation changes over the years; with a systematic improvement from 2006 to 2010 as demonstrated by differences in gradients of the graphs.

In the year 2011, the total number of pentavalent component vaccine observations (DPT,Hep B and HIB) were the highest throughout the study period. During this time, this combination vaccine had a concurrence of 97.4% for the 3 vaccine components. This is expected since these vaccines are administered from the same vial. There was no significant difference between the individual vaccine observations (**Fig. 5**).

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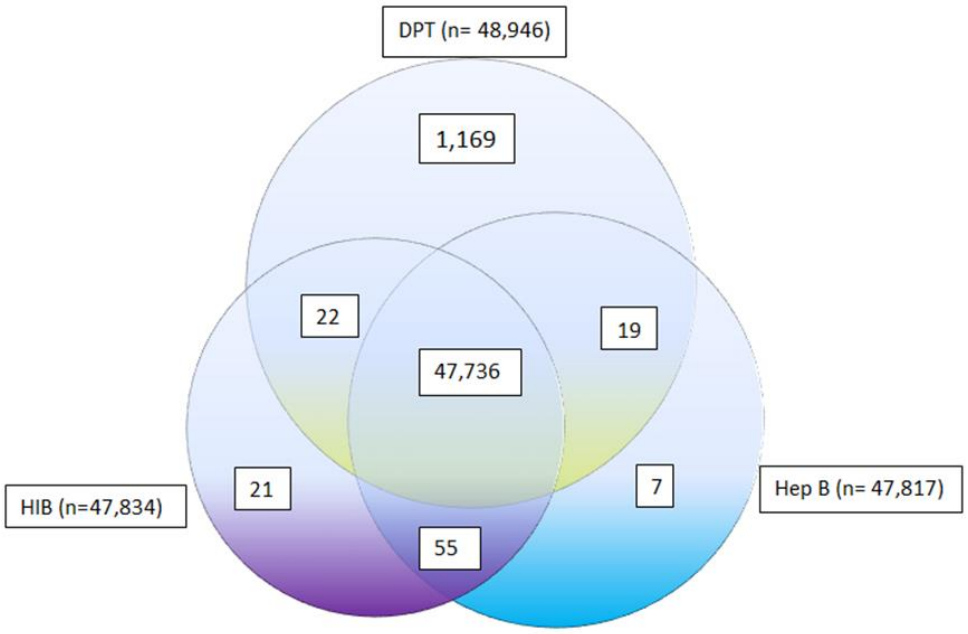

Fig. 5. Relationship of combination vaccine components for immunization observations in 2011.

Based on the recommendation that all age-appropriate doses of vaccines be administered simultaneously to children for whom no specific contraindications exist at the time of the visit, **Fig. 6** depicts the relationship between Polio and DPT observations through the 5 cohorts [18]. The proportions of DPT observations range from 48.1% to 50.0% while Polio observations range from 50.0% to 51.9% through the 5 cohorts. There are no significant differences between these proportions at alpha 0.05 levels as demonstrated by the overlapping 95% CI bars in the first two cohorts. Polio 0, administered at birth for children born in health facilities, estimated at 40% of all deliveries, contributes to the slightly higher polio observations in the last 3 cohorts, since DPT is not administered at this time [23]. In these 3 cohorts, the 95% CI do not overlap and thus the differences are significant.

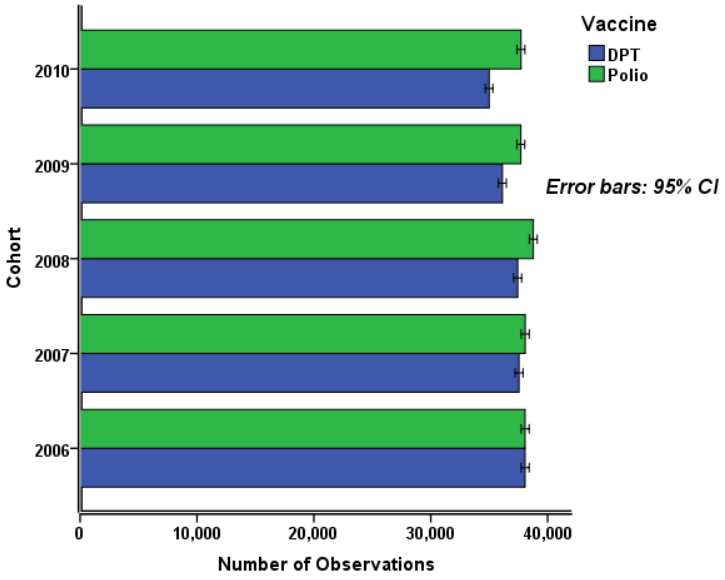

Fig. 6. DPT/Polio Observations showing simultaneous administration

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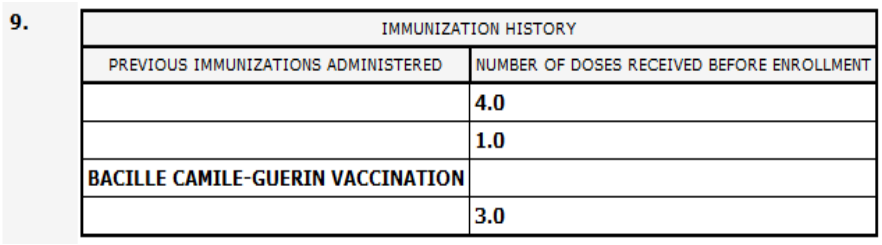
Fig. 7 shows an output from the EHR. Each vaccine represented is incomplete and it is not possible to know how far the child is in the vaccination schedule. This is a direct consequence of having 2 checkboxes for each vaccine as clinicians often tick one of the two required places. When they tick only the checkbox with the vaccine type, the system will store that vaccine type without the dosage, and when they only tick the checkbox with dosage, the system stores a value without a corresponding vaccine type. This is a very common phenomenon and

Table 1 shows exactly how this applies to other vaccines for the study duration. Most vaccines have doses 1-3 and polio has 0-4.



9.

IMMUNIZATION HISTORY	
PREVIOUS IMMUNIZATIONS ADMINISTERED	NUMBER OF DOSES RECEIVED BEFORE ENROLLMENT
	4.0
	1.0
BACILLE CAMILE-GUERIN VACCINATION	
	3.0

Fig. 7. Sample output from AMPATH Medical Record System.

Table 1. Completeness of immunization data for multiple dose vaccines

			VACCINE TYPE								
			DPT	*Hep B*	*Polio*	*HIB*	*Pneumovax*	*Penta*	*PCV 10*	*Missing*	*Total*
Dose value	*0*	*Count*	*N/A*	*N/A*	*798*	*N/A*	*N/A*	*N/A*	*N/A*	*935*	*1,794*
		%			*0.4%*					*2.7%*	*0.2%*
	1	*Count*	*5,391*	*3,593*	*5,534*	*3,623*	*10*	*1*	*19*	*8,318*	*26,428*
		%	*2.9%*	*2.0%*	*2.9%*	*2.0%*	*3.8%*	*0.5%*	*9.7%*	*24.3%*	*3.5%*
	2	*Count*	*5,252*	*3,445*	*5,556*	*3,445*	*9*	*4*	*41*	*5,407*	*23,159*
		%	*2.9%*	*1.9%*	*2.9%*	*1.9%*	*3.4%*	*2.1%*	*20.9%*	*15.8%*	*3.0%*
	3	*Count*	*13,111*	*11,087*	*5,850*	*11,099*	*211*	*171*	*128*	*17,060*	*58,717*
		%	*7.1%*	*6.2%*	*3.1%*	*6.2%*	*79.6%*	*90.0%*	*65.3%*	*49.9%*	*7.7%*
	4	*Count*	*N/A*	*N/A*	*8,975*	*N/A*	*N/A*	*N/A*	*N/A*	*2,495*	*11,470*
		%			*4.7%*					*7.3%*	*1.5%*
	Missing	*Count*	*160,422*	*159,609*	*163,630*	*159,761*	*35*	*14*	*8*		*643,479*
		%	*87.1%*	*89.8%*	*86.0%*	*89.8%*	*13.2%*	*7.4%*	*4.1%*		*84.1%*
Total		*Count*	*184,176*	*177,734*	*190,343*	*177,928*	*265*	*190*	*196*	*34,215*	*765,047*

4 Discussion

A fully immunized child is one who has received all the recommended immunizations within the first one year of life as per the KEPI schedule. This commonly used measure of the proportion of children with specific immunization types at defined ages (`up-to-date') lacks the flexibility of measuring immunization compliance over time and often gives lower compliance figures. EHRs allow visualization of

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immunization compliance over time. Kaplan-Meier survival plots enable graphic visualization of vaccination at any chosen time interval [20].

Measuring immunization compliance at specific ages recommended for particular vaccine administration and at the age of 1 year showed significantly low rates compared to the overall rates achieved at the end of the study period. This could be explained in two ways; delays in vaccine administration and information system time lag between vaccine administration and recording [24]. Actual delays in vaccine administration are common in the setting where this study was carried out and there are many shortfalls in the healthcare system and personal factors that result in this. Identified characteristics of a well-functioning vaccination systems that promote timely vaccination include availability of health services at all times, short distances and waiting times, media promotion and campaigns [24]. The time intervals between vaccine administration and recording into the EHR vary, and could affect calculation of compliance rates when these intervals are large because vaccine observations are recorded on the date of encounter and not the date of administration.

In the 5 cohorts, there is a general trend of improvement in compliance rates at the age appropriate intervals as time progresses. Whereas the compliance rate of BCG in 2006 is about 60% at the age of one year, it is over 90% in 2010 at the same age. The EHR was relatively new in 2006 and clinicians and other users were still getting used to use it. This phase of learning involves not only getting used to the new encounter forms and workflows, but also disrupts routine tasks and interrupts existing workflows in the healthcare processes with record keeping and data quality falling behind the previous schedules [25]. By 2010, extensive use of the encounter forms and full integration into the workflows resulted in marked improvements in timeliness and therefore, compliance rates. This is important because timely vaccination aside from good coverage, offers better protection from diseases such as Pertussis, Measles and Haemophilus Influenzae type B [26]-[28]. However, we do not know for sure whether the changes in timeliness are due to changes in the recording process or healthcare administrative processes because the system records vaccine observations as per encounter dates and not administration dates. To adequately address this phenomenon, we will carry out another analysis after redesigning the encounter form to take into consideration human and system factors that affect vaccine data quality.

Other studies have found similar differences between up-to date and age-appropriate vaccination [20] [29]. However, in this study care must be taken when evaluating compliance across time because data delay and ongoing processes yield incomplete data and comparison at face value may not be fully valid. In addition, there are logistical challenges such as failure to store sufficient vaccine stocks at all times, poor cold chain system maintenance, and inadequate staffing at health facilities that further reduce compliance rates [30].

Simultaneous and combined vaccine administrations were found to have high consistencies and concurrence among the various affected vaccine observations. This is associated not only with reduced number of injections, but also improves the main target of vaccination programs: timely and complete protection [31].

Findings from this study are mostly consistent with other reports on analysis of EHRs. While EHRs provide a versatile means of information storage and access, there are associated deficiencies in clinical and managerial applications [25]. There are many reasons for this, ranging from people dynamics to electronic tools. In relatively new systems, like the AMRS, the learning process is still taking place. The data collection forms and processes are initially still being refined and the personnel are getting used to the new system. Completeness was found to have the lowest data quality across all data variables (

Table 1). We found that providers often did not complete the immunization fields as required in the forms. They would check the vaccine type and leave out the dose and vice versa. This made it difficult to calculate the spacing between different doses of the same antigen, as this requires vaccine type and dosage values to be present.

Decision support tools are important in promoting structured data entry and other determinants of data quality [16]. Since data entry is a tedious process and consumes a considerable amount of clinicians' and data entry clerks' time, it would be efficient to collect only new and relevant data during every encounter. The design of the encounter forms plays a significant role in data quality. 10,299 (30.1%) of the children had missing immunization observations attributable to the encounter type used in this group. The Rural Health Centre Encounter form does not have the section on 'previous immunizations' and only collects 'ordered' (given today) immunization observations (See appendix 2), which directly contributes to significant missing data.

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As a result of this evaluation, the encounter form has been significantly improved to take into consideration human factors that affect data quality and effective data collection processes. The immunization sections on the redesigned encounter forms are depicted on **Fig. 8**. In this design, the separation of vaccines and dosages has been eliminated and these now appear as one combined tickable checkbox for each vaccine given. Combined vaccine Pentavalent is now represented as one vaccine instead of individual components. The arrangement also corresponds to the KEPI schedule and it is convenient for clinicians to check all vaccines in a row that are given at the same time.

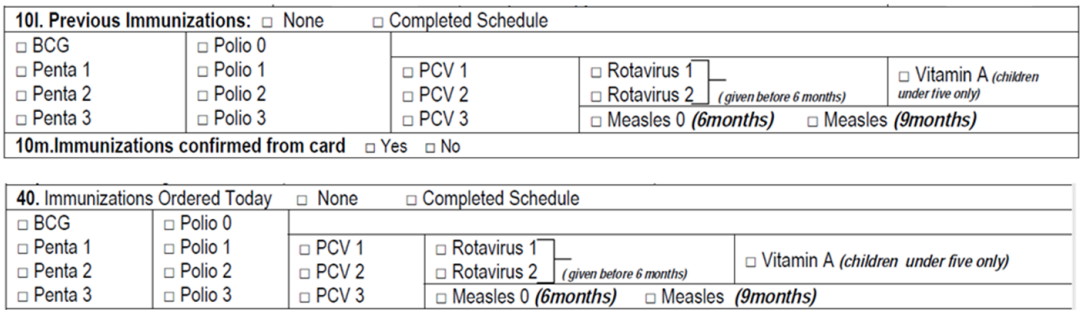

Fig. 8. Immunization section on redesigned AMPATH pediatric encounter form

4.1 Limitations

Generalizability of these findings is limited to settings with similar characteristics. The study uses vaccine observation times rather than administration times.

In some cases, it may be justified to postpone vaccination temporarily when children are moderately or severely ill. Vaccination is then recommended to be given soon after recovery. This was not assessed nor analyzed.

5 Conclusion

Data quality is affected by many factors involving data collection, storage and retrieval. Development of a clinical decision support system that generates reminders directed at clinicians and parents with immunization eligible children would optimize vaccination uptake and improve overall immunization coverage. This study found low age-appropriate vaccination status and high overall vaccination coverage which implies that vaccine administration and recording into the EHR are not timely. Many children were unprotected by vaccination for several months despite being vaccinated at the end of follow-up. The data collection through ticking of checkboxes on paper encounter forms contributes to incomplete data when clinicians fail to tick all the required checkboxes. To achieve data quality levels adequate for a clinical decision support, data collection processes need to be improved through form redesign and clinician sensitization.

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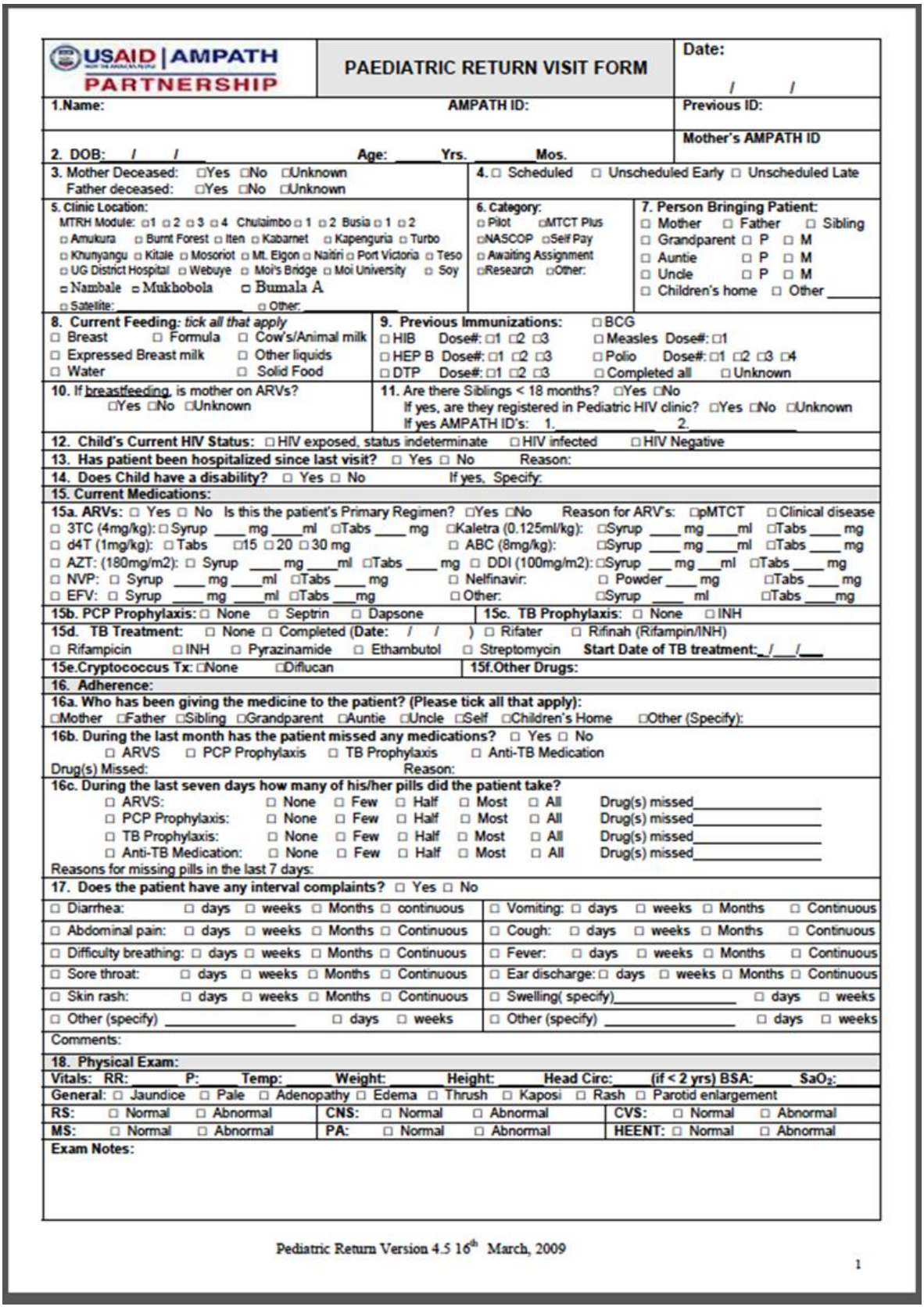
Appendix A: AMPATH Pediatric Clinical Encounter Form



USAID | AMPATH PARTNERSHIP

PAEDIATRIC RETURN VISIT FORM

Date: / /

1.Name: AMPATH ID: Previous ID:

Mother's AMPATH ID

2. DOB: / / Age: Yrs. Mos.

3. Mother Deceased: ☐Yes ☐No ☐Unknown
Father deceased: ☐Yes ☐No ☐Unknown

4. ☐ Scheduled ☐ Unscheduled Early ☐ Unscheduled Late

5. Clinic Location:
MTRH Module: ☐1 ☐2 ☐3 ☐4 Chulaimbo ☐1 ☐2 Busia ☐1 ☐2
☐ Amukura ☐ Burnt Forest ☐ Iten ☐ Kabarnet ☐ Kapenguria ☐ Turbo
☐ Khunyangu ☐ Kitale ☐ Mosoriot ☐ Mt. Elgon ☐ Naitiri ☐ Port Victoria ☐ Teso
☐ UG District Hospital ☐ Webuye ☐ Moi's Bridge ☐ Moi University ☐ Soy
☐ Nambale ☐ Mukhobola ☐ Bumala A
☐ Satelite: ☐ Other:

6. Category:
☐ Pilot ☐MTCT Plus
☐NASCOP ☐Self Pay
☐ Awaiting Assignment
☐Research ☐Other:

7. Person Bringing Patient:
☐ Mother ☐ Father ☐ Sibling
☐ Grandparent ☐ P ☐ M
☐ Auntie ☐ P ☐ M
☐ Uncle ☐ P ☐ M
☐ Children's home ☐ Other

8. Current Feeding: *tick all that apply*
☐ Breast ☐ Formula ☐ Cow's/Animal milk
☐ Expressed Breast milk ☐ Other liquids
☐ Water ☐ Solid Food

9. Previous Immunizations: ☐BCG
☐ HIB Dose#: ☐1 ☐2 ☐3 ☐ Measles Dose#: ☐1
☐ HEP B Dose#: ☐1 ☐2 ☐3 ☐ Polio Dose#: ☐1 ☐2 ☐3 ☐4
☐ DTP Dose#: ☐1 ☐2 ☐3 ☐ Completed all ☐ Unknown

10. If breastfeeding, is mother on ARVs?
☐Yes ☐No ☐Unknown

11. Are there Siblings < 18 months? ☐Yes ☐No
If yes, are they registered in Pediatric HIV clinic? ☐Yes ☐No ☐Unknown
If yes AMPATH ID's: 1. 2.

12. Child's Current HIV Status: ☐ HIV exposed, status indeterminate ☐ HIV infected ☐ HIV Negative

13. Has patient been hospitalized since last visit? ☐ Yes ☐ No Reason:

14. Does Child have a disability? ☐ Yes ☐ No If yes, Specify:

15. Current Medications:

15a. ARVs: ☐ Yes ☐ No Is this the patient's Primary Regimen? ☐Yes ☐No Reason for ARV's: ☐pMTCT ☐ Clinical disease
☐ 3TC (4mg/kg): ☐ Syrup ____ mg ____ml ☐Tabs ____ mg ☐Kaletra (0.125ml/kg): ☐Syrup ____ mg ____ml ☐Tabs ____ mg
☐ d4T (1mg/kg): ☐ Tabs ☐15 ☐20 ☐30 mg ☐ ABC (8mg/kg): ☐Syrup ____ mg ____ml ☐Tabs ____ mg
☐ AZT: (180mg/m2): ☐ Syrup ____ mg ____ml ☐Tabs ____ mg ☐ DDI (100mg/m2): ☐Syrup ____ mg ____ml ☐Tabs ____ mg
☐ NVP: ☐ Syrup ____ mg ____ml ☐Tabs ____ mg ☐ Nelfinavir: ☐ Powder ____ mg ☐Tabs ____ mg
☐ EFV: ☐ Syrup ____ mg ____ml ☐Tabs ____mg ☐ Other: ☐Syrup ____ ml ☐Tabs ____mg

15b. PCP Prophylaxis: ☐ None ☐ Septrin ☐ Dapsone

15c. TB Prophylaxis: ☐ None ☐ INH

15d. TB Treatment: ☐ None ☐ Completed (Date: / /) ☐ Rifater ☐ Rifinah (Rifampin/INH)
☐ Rifampicin ☐ INH ☐ Pyrazinamide ☐ Ethambutol ☐ Streptomycin Start Date of TB treatment: _/___/___

15e.Cryptococcus Tx: ☐None ☐Diflucan

15f.Other Drugs:

16. Adherence:

16a. Who has been giving the medicine to the patient? (Please tick all that apply):
☐Mother ☐Father ☐Sibling ☐Grandparent ☐Auntie ☐Uncle ☐Self ☐Children's Home ☐Other (Specify):

16b. During the last month has the patient missed any medications? ☐ Yes ☐ No
☐ ARVS ☐ PCP Prophylaxis ☐ TB Prophylaxis ☐ Anti-TB Medication
Drug(s) Missed: Reason:

16c. During the last seven days how many of his/her pills did the patient take?
☐ ARVS: ☐ None ☐ Few ☐ Half ☐ Most ☐ All Drug(s) missed
☐ PCP Prophylaxis: ☐ None ☐ Few ☐ Half ☐ Most ☐ All Drug(s) missed
☐ TB Prophylaxis: ☐ None ☐ Few ☐ Half ☐ Most ☐ All Drug(s) missed
☐ Anti-TB Medication: ☐ None ☐ Few ☐ Half ☐ Most ☐ All Drug(s) missed
Reasons for missing pills in the last 7 days:

17. Does the patient have any interval complaints? ☐ Yes ☐ No

☐ Diarrhea: ☐ days ☐ weeks ☐ Months ☐ continuous	☐ Vomiting: ☐ days ☐ weeks ☐ Months ☐ Continuous
☐ Abdominal pain: ☐ days ☐ weeks ☐ Months ☐ Continuous	☐ Cough: ☐ days ☐ weeks ☐ Months ☐ Continuous
☐ Difficulty breathing: ☐ days ☐ weeks ☐ Months ☐ Continuous	☐ Fever: ☐ days ☐ weeks ☐ Months ☐ Continuous
☐ Sore throat: ☐ days ☐ weeks ☐ Months ☐ Continuous	☐ Ear discharge: ☐ days ☐ weeks ☐ Months ☐ Continuous
☐ Skin rash: ☐ days ☐ weeks ☐ Months ☐ Continuous	☐ Swelling(specify) ☐ days ☐ weeks
☐ Other (specify) ☐ days ☐ weeks	☐ Other (specify) ☐ days ☐ weeks

Comments:

18. Physical Exam:

Vitals: RR: P: Temp: Weight: Height: Head Circ: (if < 2 yrs) BSA: SaO_2:

General: ☐ Jaundice ☐ Pale ☐ Adenopathy ☐ Edema ☐ Thrush ☐ Kaposi ☐ Rash ☐ Parotid enlargement

RS: ☐ Normal ☐ Abnormal	CNS: ☐ Normal ☐ Abnormal	CVS: ☐ Normal ☐ Abnormal
MS: ☐ Normal ☐ Abnormal	PA: ☐ Normal ☐ Abnormal	HEENT: ☐ Normal ☐ Abnormal

Exam Notes:

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19. Test Results: (Please record date test was drawn, rather than date test was run)

Test	Result	Test Date	Test	Result	Test Date
WBC/mm³			CD4		
Hgb g/dL			CD8		
MCV			CD4%		
Platelets/ mm³			HIV Long Elisa		
ALC/ mm³			HIV DNA PCR		
SGPT			Viral Load		
Creat mmol/L			Other:		
CXR: Code:			Codes: 0=normal 1=Pl Effusion 2=Infiltrate 3=Miliary 4=Diffuse abn/non-miliary 5=Cavity 6=Cardiomegaly 7=Other abnormality		

20. Current Pediatric Staging:

CDC Class: □ N □ A □ B □ C Criteria _____ New Stage □Yes □ No

WHO Stage: □ 1 □ 2 □ 3 □ 4 Criteria _____ New Stage □Yes □ No

Not-applicable: □ HIV negative □ HIV Exposed, status indeterminate

Tuberculosis:

21a. Household member diagnosed with TB? □ Yes □ No

21b. Has the patient been diagnosed with TB since the last visit □ Yes □ No

21c. Have you diagnosed this child with TB today? □ Yes □ No □ Already on anti-TB

21d. If diagnosed, TB Diagnosis was done on basis of:
□ Household contact □ Chronic cough (> 2 weeks)
□ FTT/weight loss □ Persistent fever
□ Suggestive CXR □ AAFB positive
□ TST positive *□ Keith Jones score_____ □Other (specify):_____
*□ Edward Keith score_____ *□ (Refer to the manual)

22. ARV Side-effects/Toxicity: Any side-effects attributable to ARV since the last visit? □ Yes □ No
If yes, tick all that apply: □ Rash □ Anemia □ Lipo-dystrophy □ Hepatitis □ Neuropathy □ IRIS □ Steven-Johnson syndrome □ Lactic Acidosis □ Diarrhoea □ Persistent Vomiting □Other (specify):

23. Diagnosis: New Diagnosis (* *Tick "Add" to add to summary sheet. Tick "Remove" to delete to from summary sheet*)

Diagnosis	New	Ongoing	Resolved	Diagnosis	New	Ongoing	Resolved
1.	□	□	□	3.	□	□	□
2.	□	□	□	4.	□	□	□

24. Plan:

24a. ARVs: □None □Start ARVs □Continue Regimen □Change Formulation □Change Regimen □Re-dose □Stop All
Reason for stop/change/re-dose: □Failure □Toxicity (Specify) _____ □Weight Change □Other_____
If start or change or re-dose, tick new regimen:
□ 3TC (4mg/kg): □Syrup ____ mg ____ml □Tabs ____ mg □ Kaletra (0.125ml/kg): □Syrup ____ mg ____ml □Tabs ____ mg
□ d4T (1mg/kg): : □ Tabs □15 □20 □30 mg □ ABC (8mg/kg): □Syrup ____ mg ____ml □Tabs ____ mg
□ AZT: (180mg/m2): □ Syrup ____ mg ____ml □Tabs ____ mg □ DDI (100mg/m2): □Syrup ____ mg ____ml □Tabs ____ mg
□ NVP: □ Syrup ____ mg ____ml □Tabs ____ mg □ Nelfinavir: □ Powder ____ mg □Tabs ____ mg
□ EFV: □ Syrup ____ mg ____ml □Tabs ____mg □ Other:

24b. PCP Prophylaxis: □ None □ Start □ Continue Regimen □ Change Regimen □ Re-dose □ Stop
Reason for stop/change/re-dose: □Toxicity (Specify) _____ □ Weight Change □ Other_____
New Drugs: □ Septrin _____tabs/day or _____ml/day □ Dapsone _____mg/day

24c. TB Prophylaxis: □ None □ Start INH □ Continue INH □ Re-dose □ Stop INH
Reason for stop/change/re-dose: □ Completed □ Toxicity(Specify) _____ □ Active TB
□ Weight Change □ Other_____Drug Dose: □ INH _____mg/day

24d. TB Treatment: □ None □ Start Induction □ Change to Continuation □ Continue Regimen □ Re-dose □ Stop
Reason for stop/change/re-dose: □ Completed □ Toxicity (Specify) _____ □ Weight Change □ Other_____
New Drugs: □ Rifater_____tabs/day □ Rifinah_____tabs/day □ Rifafour_____tabs/day □ Ethambutol_____mg/day
□ Streptomycin_____mg □ Rifampicin_____mg □ INH_____mg □ Pyrazinamide _____mg

24e. Immunizations Ordered Today: □ None

Pentavalent Vaccine	□ HIB	Dose#: □ 1 □ 2 □ 3	□ BCG		
	□ DPT	Dose#: □ 1 □ 2 □ 3	□ Measles	Dose#: □ 1	
	□ HEP B	Dose#: □ 1 □ 2 □ 3	□ Polio	Dose#: □ 1 □ 2 □ 3 □ 4	

24f. Feeding plan: □ Breast □ Expressed Breast milk □ Formula □ Cow's/Animal milk □Other liquids (Uji, tea, soup, juice) □ Solid food (ugali, potatoes, bananas)
If this is a change, reason for change: □ Age □ Affordability □ Intolerance □ Other(Specify):

24g. Other Drugs Started or Re-dosed at this Visit:

Drug	Dose	Freq & Duration	New	Dose∆
1.			□	□
2.			□	□
3.			□	□

25. Tests Ordered:

□ Full Haemogram □ Hgb □ SGPT □ CD4 Panel □ Viral Load
□ HIV Elisa □ HIV DNA PCR □ Creatinine □ CXR □ Other (Specify):

26. Referrals:

□ None □ TB treatment/DOT program □ Adherence Counseling □ Nutritional support □ Mental Health Services
□ Psychosocial counseling □Social Support Services □ Disclosure Counseling □ OVC □ Express care
□ Inpatient care/Hospitalization: (□ MTRH □ Health Center □Other _____) □ Other referral (specify):

Additional Comments:_____
Return to Clinic: Weeks_____ Months_____ Date_____ CO/Physician:_____Provider #: _____

□ HIV Negative, Discontinue from Clinic
□ Transfer care to other centre:
□ AMPATH □ non-AMPATH TO: _____

Nurse:_____Provider #:_____

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Appendix B: AMPATH Rural Health Centre Pediatric Clinical Encounter Form

Mosoriot Health Centre Primary Care Encounter Form — Today's Date: / / (dd/m m/yyyy)

1. Name (3 names – given, middle, family): | 2. AMRS ID: | 3. Old MMRS ID: | 4. HCT ID:

5. Age: Yrs _____ Mo_____ Days _____ | 6. Sex: ☐ M ☐ F | 7. Marital Status: ☐S ☐M ☐D ☐W ☐Se

8. Next of Kin: | 9. Phone #: | 10. Occupation:

11. Clinic	Child< 5	Child 5+	Adult	FamPlan	STI	Chest/TB	Dental	ENT	Eye	PhysT	Occ T	Plaster	Psych	Other
New														
Return														

12. Main Problem (today): _____ Duration of illness (days)_____
☐ None (preventive care, follow-up, etc.)

Prior Care for this Problem: ☐None ☐Self-medicated ☐Traditional healer ☐Private Pharmacy ☐CHW

13. Vital Signs:
BP:_____/_____ Pulse:_____ Weight:_____kg Height:_____cm Temp:_____°C Head circ _____cm

Visual Acuity: R____/_____ L: ___/_____

Notes:

14. Counseled on HIV today?: ☐ Yes ☐ No ☐N/A | 15. Tested for HIV today?: ☐ Yes ☐ No ☐N/A (If Yes, record Test result in test section)

Family Planning Clinic Data FP #: _____

16. Contraception (check all that apply):☐ condoms ☐ IUD ☐ sterilization ☐ natural FP ☐ diaphragm ☐ DepoProvera ☐ pills ☐ Other:_____ Notes:

Paediatric Clinic Data

17. Underweight? ☐ Yes ☐ No | 18. Issued with ITN today? ☐ Yes ☐ No

19. Danger Signs this visit? ☐ Yes ☐ No
If Yes: ☐ Unable to drink or breastfeed ☐ Vomiting everything ☐ Has had convulsions ☐ Lethargic ☐ Unconscious
☐ Other urgent sign demanding immediate attention: ☐ Cough or difficulty breathing ☐ Diarrhoea ☐ Fever
☐ Ear Problem ☐ Other:_____

Additional Comments:

20. Immunizations Given Today:

Pentavalent (DTP-HepB-Hib)		1	2	3	BCG	0	Revacc
Polio	0	1	2	3	Measles	1	2
Yellow Fever		1			Hepatitis A	1	2

Other:_____
Immunizations Complete? ☐ Yes ☐ No | BCG Scar Present? ☐ Yes ☐ No

21. Vitamin A:	6-11 mo	12-17 mo	18-23 mo	24-29 mo	30-35 mo	36-41 mo	42-47 mo	48-53 mo	54-59 mo	60+ mo

22. Ancillary Services

☐ Medical Exam ☐Medical Report ☐Plaster of Paris ☐ Dressing ☐ Other:

23. Dental Clinic

☐ tooth filling (# filled:____) ☐ tooth extraction (# extracted:____) ☐ other procedures (list):

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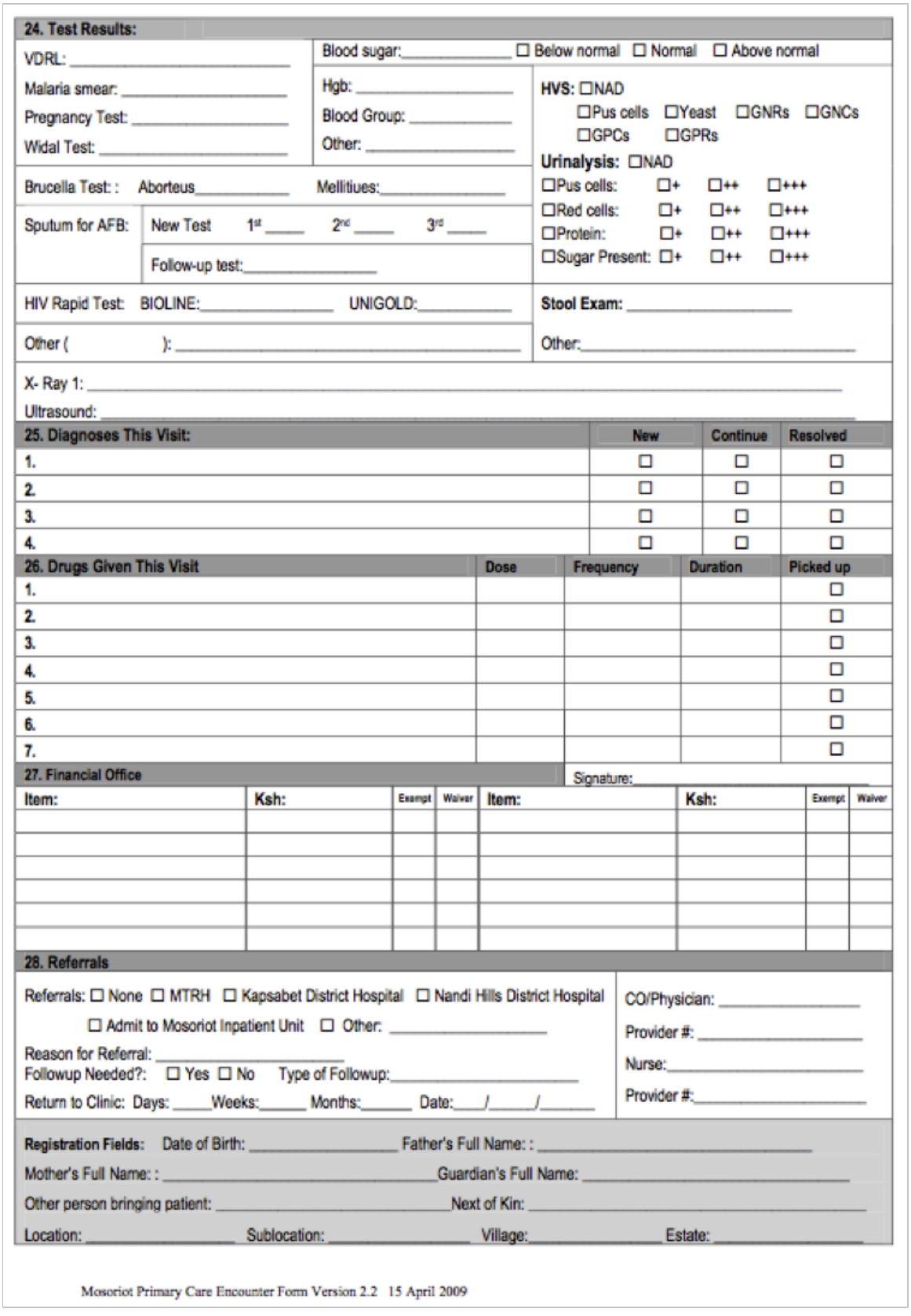

24. Test Results:

VDRL: _____
Malaria smear: _____
Pregnancy Test: _____
Widal Test: _____

Blood sugar: _____ ☐ Below normal ☐ Normal ☐ Above normal
Hgb: _____
Blood Group: _____
Other: _____

HVS: ☐NAD
☐Pus cells ☐Yeast ☐GNRs ☐GNCs
☐GPCs ☐GPRs

Urinalysis: ☐NAD
☐Pus cells: ☐+ ☐++ ☐+++
☐Red cells: ☐+ ☐++ ☐+++
☐Protein: ☐+ ☐++ ☐+++
☐Sugar Present: ☐+ ☐++ ☐+++

Brucella Test: : Aborteus_____ Mellitiues:_____

Sputum for AFB: New Test 1st____ 2nd____ 3rd____
Follow-up test:_____

HIV Rapid Test: BIOLINE:_____ UNIGOLD:_____

Other ( ): _____

Stool Exam: _____

Other:_____

X- Ray 1: _____

Ultrasound: _____

25. Diagnoses This Visit:	New	Continue	Resolved
1.	☐	☐	☐
2.	☐	☐	☐
3.	☐	☐	☐
4.	☐	☐	☐

26. Drugs Given This Visit	Dose	Frequency	Duration	Picked up
1.				☐
2.				☐
3.				☐
4.				☐
5.				☐
6.				☐
7.				☐

27. Financial Office Signature:_____

Item:	Ksh:	Exempt	Waiver	Item:	Ksh:	Exempt	Waiver

28. Referrals

Referrals: ☐ None ☐ MTRH ☐ Kapsabet District Hospital ☐ Nandi Hills District Hospital
☐ Admit to Mosoriot Inpatient Unit ☐ Other: _____
Reason for Referral: _____
Followup Needed?: ☐ Yes ☐ No Type of Followup:_____
Return to Clinic: Days:_____Weeks:_____ Months:_____ Date:____/_____/_____

CO/Physician: _____
Provider #: _____
Nurse:_____
Provider #:_____

Registration Fields: Date of Birth: _____ Father's Full Name: : _____
Mother's Full Name: : _____Guardian's Full Name: _____
Other person bringing patient: _____Next of Kin: _____
Location: _____ Sublocation: _____ Village:_____ Estate: _____

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