Nigeria Vaccine Wastage Study

Preliminary Report

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United Nations Children's Fund - UNICEF

World Health Organization - WHO

US Centers for Disease Control - CDC

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Table of Contents

Executive Summary

Introduction: A need exists for understanding vaccine wastage rates and related knowledge and practices as Nigeria embarks upon strategies for increasing routine immunization coverage rates and readies for introduction of newer, expensive vaccines. The objectives of this study were to document wastage rates across routine vaccines and assess wastage related knowledge, attitudes and practices at the service delivery level and above.

Methods: Eleven LGAs and 55 health facilities were randomly sampled nationwide during August 2011. Health facility and LGA staff involved in managing and conducting routine immunization services were interviewed about immunization policy, vaccination and vaccine wastage knowledge, attitudes and practices. Health facility and LGA stock and session records from January to June 2011 were reviewed to abstract data to calculate wastage rates and document reported wastage, coverage and related indicators.

Results: A large number (36%-53%) of health facility records were either missing or incomplete to be able to calculate wastage rates. Of the complete records, median calculated monthly wastage rates at the health facility level were highest for TT vaccine (23%) and lowest for HepB vaccine (10%). Most rates were between 10-15%. At the LGA (storage-only) level, calculated

wastage rates were 0% for the 4 of 11 LGAs which reported sufficient data. BCG vaccine was opened in only 25% of the reviewed sessions and Measles vaccine in only 62% of sessions, compared to 90% for DPT vaccine. Health workers reported they usually wait until 6-7 children are present prior to opening a Measles vaccine vial.

The majority of health facility and LGA staff reported that wastage is an important topic and believed their wastage rates were too high, should be lowered and were a major cause of vaccines stockouts. However, knowledge about wastage-related policies and practices is low across both health facility and LGA levels. For instance, at both levels, the majority of respondents largely attribute wastage to poor patient flow at immunization sessions and discarding of any opened vials within 6 hours of opening. The multi-dose vial policy (MDVP) was largely unknown and usually did not appear to be implemented at the health facility level. Rather, health workers were reportedly using a 6 hour window for keeping any opened vaccine, rather than a 4 week window for MDVP-applicable vaccines. Target wastage rates were not given to 82% of health facilities and of those who had target rates, the most frequently reported wastage target rate was 10%. Of the 263 mothers interviewed, 30% reported being turned away from a health facility to get their child vaccinated in the previous 2 years and half of these mothers reported that their infant never ended up receiving the vaccine. Health facility and LGA staff reported that improved stock management and better community mobilization were the best strategies for improving wastage rates.

Health facility-level knowledge of other wastage-related policies was also low as only 55% reported knowing that unvaccinated children up to 5 years of age were eligible for routine vaccines. Only 2% of health facilities reported opening a measles vial as soon as an eligible child came to the clinic per the national policy and at the LGA level, only 59% knew that a vial should be opened for any eligible infant, per the national policy.

Conclusions and recommendations: Considering the strong level of concern over high wastage rates, LGA and health facility staff should be made aware that calculated wastage rates are well under acceptable levels and, in some instances, may be bordering on being too low such that eligible children may be getting missed due to overriding concerns about wastage. Nationally-

developed Stock management forms (e.g. the VM1, VM2, VM3 forms) should be distributed, along with written instructions on their use, to all health facilities as soon as possible. Follow-up should be made with health facility staff on how to accurately calculate wastage rates, information on appropriate wastage targets and importance of appropriately balancing wastage rates with missed opportunities to vaccinate a child. In future health worker and LGA staff trainings, immunization policies need to be reinforced, particularly on the MDVP, when to open a vial and ages of eligibility for routine vaccinations. Nigeria should consider how to adequately budget for the policy of opening a Measles or BCG vial for every eligible infant which comes to a facility on any immunization session day so as to reduce missed opportunities and increase vaccination coverage, which may currently be hampered by a potentially all-overriding emphasis on reducing vaccine wastage due to stockout concerns. In relation to strengthening other aspects of the immunization program, health facilities which reportedly do not believe or do not know if they have hard to reach populations in their catchment area should undertake an exercise to identify any of these special populations. Once identified, outreach sessions should be planned in appropriate locations and this information compiled with fixed session dates and targets into a health facility-level immunization microplan.

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Introduction

Nigeria has one of the largest routine immunization programs worldwide. The program, which started in the early 1980s, currently provides Polio vaccine, BCG vaccine, Diphtheria-Tetanus-Pertussis (DTP) vaccine, Hepatitis B vaccine (HepB), Measles vaccine, Yellow Fever (YF) vaccine to infants and Tetanus Toxoid (TT) vaccine to women of child bearing age. Nigeria is on the verge of introducing newer vaccines, including pneumococcal (PCV), meningitis and rotavirus vaccines in the coming years. As these newer vaccines are much more expensive than the currently used vaccines, an increased interest exists with better understanding current vaccine wastage rates and the wastage-related knowledge, attitudes and practices of program staff.

Vaccination wastage rates are an important part of monitoring immunization program performance as they are an indicator of program health including financial efficiency. In 2003, the World Health Organization (WHO) estimated that more than half of all vaccines produced are wasted each year [1]. Countries are facing increasing pressure to improve vaccine management and reduce wastage, particularly in light of the introduction of expensive new and underutilized vaccines [2]. As routine vaccination programs introduce additional new vaccines with higher costs, there is renewed interest and importance in reviewing vaccine wastage. In GAVI eligible countries, GAVI recommends a maximum wastage rate of 25% during the first year of funding with a plan to reduce wastage to 15% by the third year [3]. Reasons for wastage are categorized into those which are acceptable and those that are unacceptable as some

wastage is an inevitable part of any vaccination program. Specific sources of unacceptable wastage include poor stock management (e.g., expired vaccine), cold chain problems, loss and theft [1]. Acceptable wastage factors include vials without the expected number of doses or discarding doses at the end of an immunization sessions because there were fewer children than doses in the vaccine vial [4].

WHO policy clearly states that a vaccine vial should be opened anytime a child is present for vaccinations irrespective of the total number of children expected during vaccination session [1]; however, in practice this policy is not always applied. In a literature review of missed opportunities across all countries, Hutchins et al. found that negative health worker attitudes, including fear of wasting vaccines and not screening for immunizations when a child came for a non-immunization visit collectively accounted for a median of 16% (range: 1%-26%) of all missed opportunities. Reconstituted vaccines (measles, BCG, yellow fever and some Hib) have particular wastage issues as they must be discarded at the end of each immunization session or after six hours, whichever comes first [5]. As such, vaccinators often either wait until an "adequate" number of children have arrived, request mothers to return to a future session, or provide these antigens less frequently (e.g., weekly, monthly) [6]. Vaccine vial size plays an important role in wastage, as with fewer eligible children present at a vaccination session, greater amounts of vaccine must be discarded. In a recent study in Bangladesh, the mean open vial vaccine wastage rate for measles was 68% while unopened wastage rate was <1% [7].

Increasing the availability and utilization of smaller dose or single dose vaccines is an approach to aid in reducing missed opportunities associated with health worker attitudes towards vaccine wastage [8]. As attention to vaccine wastage increases and integration of varying vial sizes are incorporated, it is important to note the implication on cold chain systems. Drain et al. found that when 50% of multi-dose vial vaccine is wasted, half of the cold chain resources are being used on immunizations that will never be administered to children. Yet, the introduction of single-dose vials with a wastage rate of 5% would create a threefold increase in cold chain volume.

As Nigeria moves toward the introduction of new vaccines, there is a need to understand wastage rates for each vaccine and identify how to optimize coverage while keeping wastage rates reasonable.

Study Objectives

The general aim of this study was to assess the wastage rates and practicesinNigeria's immunization programme.

The specific objectives were:

1. Measure vaccine wastage rates for all routine immunization vaccines in Nigeria (i.e., BCG, DTP, HepB, Polio, Measles, Yellow Fever and TT)
2. Describe and quantify the measles vaccine vial practices that create missed opportunities to vaccinate children
3. Identify areas of the immunization program related to wastage which may need strengthening either through policy guidelines or improved programming

Methodology

Data collection included 1) a retrospective study of records to calculate wastage and 2) a knowledge, attitudes and practice (KAP) survey of health workers in a sample of public health facilities and LGA immunization offices [7].

Definitions

A missed opportunity was defined as an infant not receiving a vaccine when the infant attends a health facility, is considered eligible for the vaccine based on the infant's age and the country's vaccination schedule and has not received the vaccine in question. Wastage policies

were the policies which were been set in the Nigeria's EPI regulations and usually define the wastage rate for each vaccine as well as the acceptable and unacceptable forms of wastage.

Calculated wastage rate was defined as the rate which was calculated based on the use of health facility or LGA stock data or health facility session data i.e. the number of doses received, starting balance of doses, ending balance of doses and number of children vaccinated. Three calculated wastage rates were produced: calculated wastage rate for the health facility based on health facility stock records, calculated wastage rates for the health facility based on individual session records at the facility and calculated wastage rates for the LGA based on LGA-level stock records.

Reported wastage rate was defined as the wastage rate figure which was written in a health facility or LGA's monthly summary form. *Reported coverage rate* was defined as the coverage rate figure which was written in a health facility or LGA's monthly summary form.

Sampling

A 2-stage random sample was conducted of LGAs and health facilities. TwoLGAs from each of the 6 Nigerian regions were randomly selected using population proportional to size (PPS) sampling. Additionally 1 LGA in the Federal Capital Territory (FCT) was randomly selected using PPS sampling, for a total of 13 LGAs originally selected. Within each LGA,5 health facilities were randomly selected using simple random sampling. In total, 65 health facilitieswere originally selected.

Table 1: LGAs selected for vaccine wastage survey

Zone	**State**	**LGA**
NC	Benue	Apa
	FCT	Gwagwalada
	Benue	Gboko

SW	Lagos	Alimosho
	Ekiti	Ekiti South-West
NW	Kaduna	Soba
	Katsina	Rimi
NE	Taraba	Karim-Lamido
	Adamawa	Ganye
SS	Delta	Udu
	Rivers	Abua/Odual
SE	Abia	Ikwuano
	Anambra	Ogbaru

Data collection process, questionnaires and forms

Data collection tools were developed and pilot tested at 3 health facilities in Amak LGA within FCT by UNICEF and CDC staff in May 2011. Data collection took place from 10-20 August, 2011. Data collectors were national or regional vaccine logistics officers of NPHCDA and UNICEF. In total 12 data collectors were identified from the 2 institutions. Each of the 12 data collectors received a 1-day training, followed by 1 day practicing data collection from selected health facilities in FCT. Following the data collection activity in FCT, the data collection tools were further modified based and then finalized. Each data collector was assigned a single LGA within which they collected data from 5 health facilities and the LGA level over the course of 1 week. If data collectors were regional officers, they were assigned to a different region from the one where they normally worked.

LGA level data collection

At the LGA a structured interview questionnaire was used to collect knowledge, attitudes and practices (KAP) data at the LGA level. The LGA immunization officer and cold chain officer were interviewed for this KAP data. Additionally at the LGA level,vaccine stock data were

retrospectively collected using excel-based forms. Data was abstracted for a retrospective 6 month period (January – June 2011) from the LGA records on monthly starting vaccine stock balances, doses received, doses distributed, monthly ending balances and doses discarded unopened for various reasons. The reasons included breakage, expiration, VVM status, freezing and other. This data was collected for HepB, DPT, BCG, Measles, TT, and Yellow Fever vaccines.

Health facility level data collection

At the health facility level, a structured interview questionnaire was used to collect KAP data from service providers involved in immunization and child health. Topics included understanding and application of relevant immunization policies and guidelines.Mothers of recently vaccinated children werealso asked about their experiences it terms of getting vaccines, being asked to return at another time etc.Up to 5 mothers per health facility were interviewed. These mothers were conveniently selected from villages around the health facility.

At the health facility, collection of retrospective stock and session data was done using 2 excel-based forms. Data was abstracted for a retrospective 6 month period (January – June 2011) fromhealth facility records on the quantity of vaccine vials provided, distributed, used and returned unopened at service delivery levels (Stock level form). Additionally, session data was collected (e.g., number of sessions by type, doses administered) for the previous 1 month (June 2011) or 12 sessions, whichever was greater.Stock and session data was collected for all vaccines provided through the routine immunization system (i.e., BCG, DTP, HepB, Polio, Measles, Yellow Fever).

Data entry and analysis

Abstracted data were entered into excel-based forms by each data collector. Data were cleaned and formatted for analysis by CDC staff. All analysis was completed in SAS 9.2. Weighted analyses, and correspondingly appropriate SAS procedures, were used due to the survey design. All data is presented as weighted proportions, with the unweighted frequencies given.

Stock data: Calculated vaccine wastage

Vaccine wastage was calculated separately for the health facility level (first level service delivery) and the LGA level (storage level i.e. no service delivery occurred at this level). At the health facility level, a wastage rate was calculated for sessions using only session records and a wastage rate was calculated for the health facility using monthly stock records. A common formula was used for calculating vaccine wastage rates at the health facility level. This formula was:

Health facility wastage rate (based on monthly stock data or individual session data)

$$= \frac{\textit{(opening balance + number of doses received) – closing balance – number of doses administered}}{\textit{(opening balance + number of doses received) – closing balance}}$$

A common formula was used for calculating the vaccine wastage rate at the LGA level. As this was a vaccine storage-only level, the formula used was for calculating unopened vial vaccine wastage:

LGA(storage)-level unopened vial vaccine wastage rate

$$= \frac{\textit{(number of doses discarded unused for any reason)}}{\textit{(opening balance + number of doses received) – closing balance}}$$

As immunization stock data was collected across a period of 6 months (January-June, 2011), a median monthly wastage rate was calculated for both levels. An interquartile range of 25% to 75% was also calculated to provide an estimate of the ranges of rates among facilities or LGAs.

Stock and session data analysis

Other stock and session data (i.e. cold chain temperature data, reported wastage rate, reported coverage rate) were processed to be presented as median monthly values.

KAP data analysis

KAP variables which were categorical were analyzed to calculate weighted proportions and the taylor series method was used for calculating standard errors. KAP variables which were numerical were analyzed to calculated weighted means and standard errors (taylor series method) or weighted medians and an interquartile range of 25% to 75%. To compare the significance of the relationship between variables, chi-squared tests were performed and the relationship was considered statistically significant if p-values were less than 0.05.

Results

Facilities visited

Of the 65 health facilities which were originally to be included in the survey, five health facilities (in Ogbaru LGA) were eliminated because of a prolonged strike in Anambra state. In another 5 health facilities (Adamawa LGA in Ganye state), the data could not be retrieved from the data collector due to communication issues. An X LGA, only 4 health facilities had health workers which were available for interviews; however the stock and sessions records could be reviewed

at all 5 facilities. A total of 54 health facilities were thus included for the KAP survey and 55 facilities included for the stock and session record review. Ninety percent of health facilities were classified as rural and 10% as urban.

Availability and quality of vaccine stock data

At the health facility level, data was missing for a number of stock indicators across the 55 health facilities. Missing data for calculating the median monthly wastage rate was highest for BCG (50%), compared to DTP (39%), TT (39%), Polio (37%), HepB (35%) and Measles (33%). Of the 55 health facilities, 43 (78%) did not report routine monthly wastage rates. Missing data was high for reported monthly coverage rates, including Polio coverage (79% missing) and DTP coverage (72%). Fifty health facilities (91%) were missing cold chain data (maximum and minimum temperatures recorded and number of times temperatures were under 2 degrees or over 8 degrees Celsius). None (0%) of the 55 health facilities had reported data on any doses discarded for specific reasons (i.e. expiration, breakage, freezing etc). Due to this limitation, unopened vaccine wastage rates could not be calculated at the service delivery level.

At the LGA level, 2 of 11 LGAs were missing reported monthly wastage rates across all antigens; 1 LGA was also missing monthly cold chain data. Two of 11 LGAs were also missing stock management data across all months. Four of the 11 LGAs reported data on doses discarded, however only 1 LGA reported 1 month where unopened doses were discarded for a single antigen. Otherwise, the number of unopened doses discarded was reported as "0" by these 4 LGAs.

Availability of immunization session data

A total dataset of 588 immunization sessions were available out of an expected 660 sessions of data (target=12 sessions per health facility x 55 health facilities). These analyzed sessions all had occurred between January and June, 2011.

Missing session data needed forcalculating median session wastage rates (*doses received, doses opened, doses returned unopened and population vaccinated*) was greatest for BCG (55% of health facilities missing needed data), followed by TT (52%), YF(48%), Measles(46%), HepB(46%), DTP(44%) and Polio (44%). The specific data variables which were most commonly missed were number of vaccine doses received (23-34% of sessions without data), number of vaccine doses opened (37-39%) and number of vaccine doses returned unopened (41-43%).

At 14 health facilities, lack of proper vaccine stock reporting forms (e.g. VM1 form) were anecdotally reported to be a factor in low availability of vaccine stock management data. In Ekiti SW LGA, a smaller than expected number of immunization sessions was conducted as health worker strikesoccurred for part or all of the January-June 2011 period in these health facilities.

Calculated wastage rates at health facility level

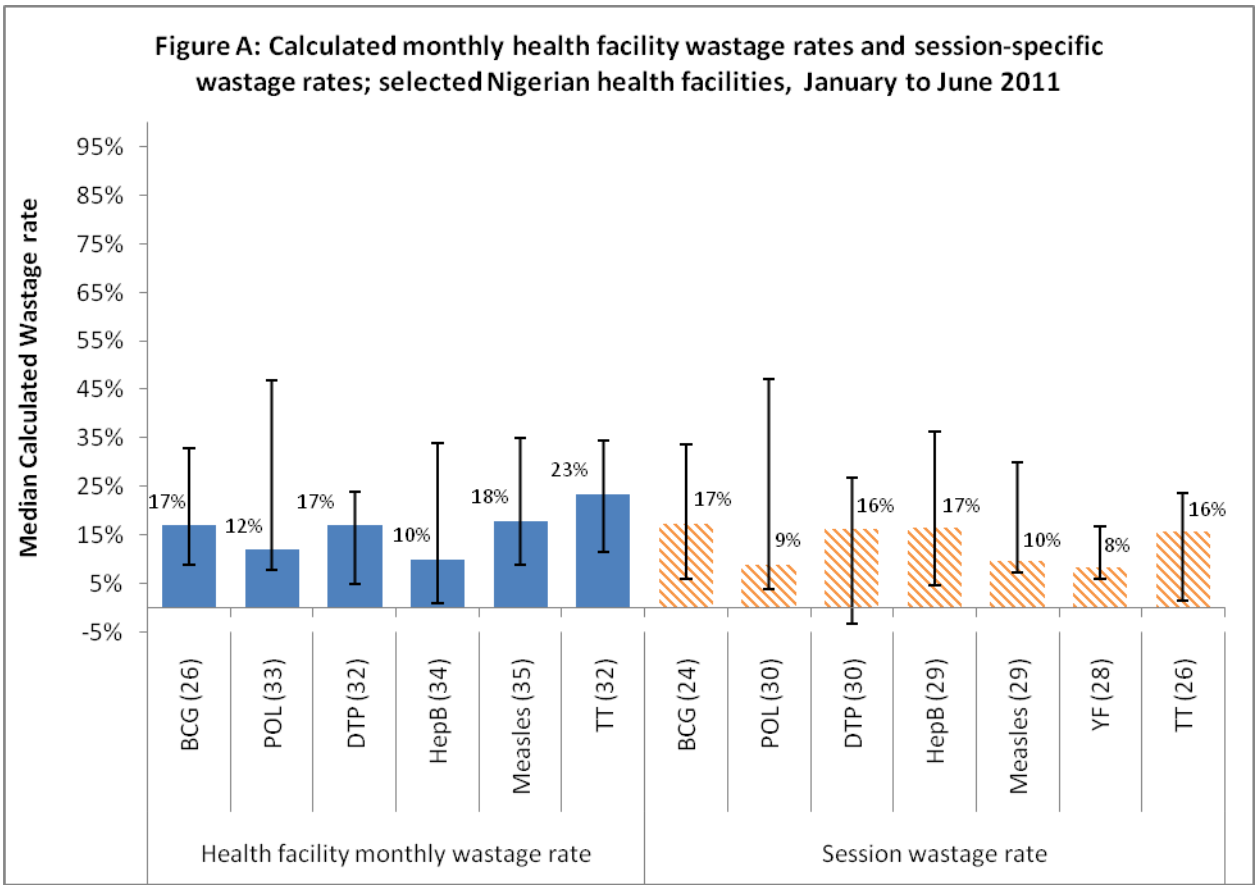
Calculated wastage rates based on health facility stock data

Sufficient stock management data for calculating wastage rates was available from 26 to 35 health facilities, varying by antigen. Calculated median monthly vaccine wastage rates using data from health facility stock records indicate that HepB median monthly vaccine wastage rate was lowest (10%) and TT vaccine wastage rate was highest (23%). HepB rate had the widest interquartile range (1% - 34%) and DTP rate had the lowest(5% - 24%) (Figure A).

Calculated wastage rates based on health facility session data

Sufficient immunization session data for calculating wastage rates was available from 24 to 30 health facilities, varying by antigen. Calculated monthly median vaccine wastage rates using data from immunization session recordsindicate that YF rate was lowest (8%) and BCG and HepB rate was highest (17%). The Polio rate had the widest interquartile range (4% - 47%) and the YF rate had the lowest (6% - 17%).

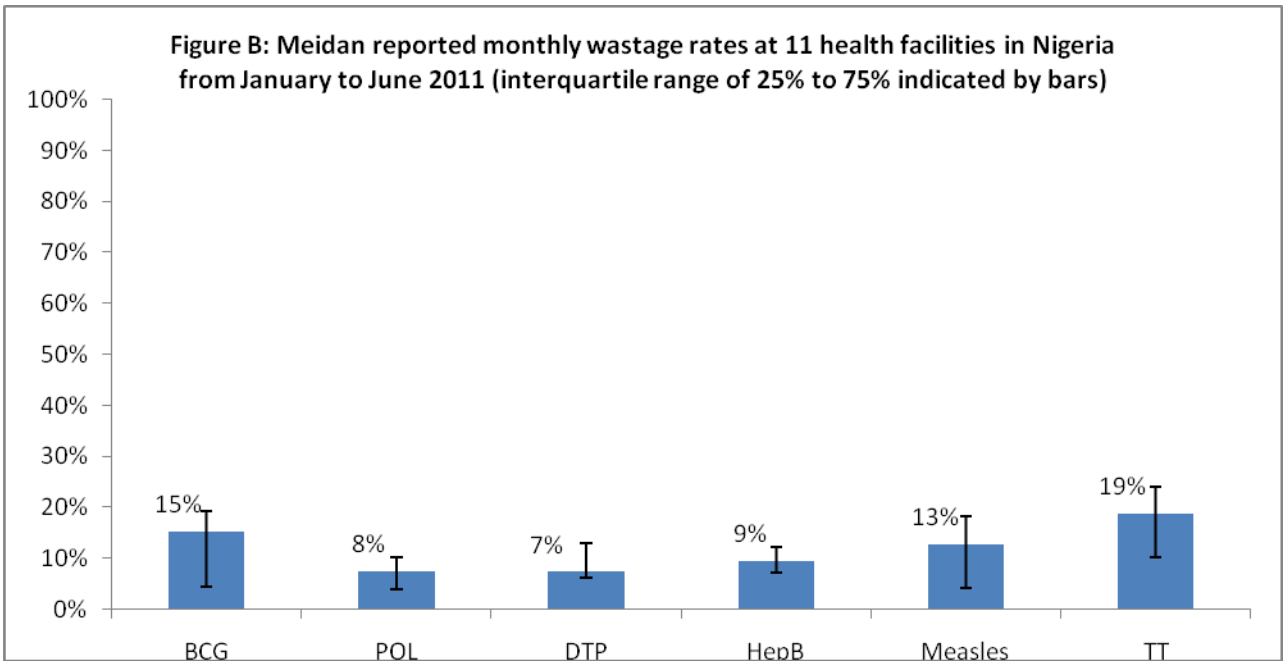
In comparing the calculated median monthly wastage rates derived from health facility stock management records compared to immunization session records, the largest differences were observed for Measles and TT (8% difference) and smallest for DTP and BCG (1% and 0% respectively).



Note: Number of health facilities used in calculation given in parentheses. Bars indicate the interquartile range of 25% to 75%

Reported wastage rates at the health facility

Of the 54 health facilities surveyed, 11 had administrative self-reports of monthly wastage rates for each antigen. Reported median monthly wastage rates from these 11 health facilities varied from a high of 19% for TT vaccine to a low of 7% for DTP vaccine (Figure B). The widest interquartile ranges were observed for BCG (4% - 19%), Measles (4% - 18%) and TT (10% - 24%).



In comparison to calculated median wastage rates sourced from health facility stock management records, the greatest difference was observed for DTP (10 percentage point difference) and smallest differences were observed for HepB (1 point) and BCG (2 points).

Reported wastage rates based on LGA records

Nine LGAs had data on reported wastage rates of the health facilities within their catchment area for the January-June 2011 period. The highest median reported wastage rate was for BCG (13.5%; IQR [3.9-18.1]), followed by Measles (8.7%; IQR[7.9-9.1]), HepB (8.6%[5.3-8.8]), Polio (8.1%[5.8-8.7]), TT (7.3%[6.5-9.3]) and DPT (6.6%[5.1-6.8]) vaccines.

Calculated monthly wastage rates at the LGA storage level

Four to five LGAs (antigen-dependent) reported stock management data to allow for calculation of median monthly wastage rates at the LGA cold store level (i.e. unopened wastage rate at the storage level). The median monthly wastage rate across these LGAs was 0% for all antigens and months, except for BCG during the month of April 2011. In that month, a single LGA had a calculated wastage rate of 14% (20 of 140 doses were discarded due to breakage), otherwise, all other LGAs which had stock data on doses discarded during the January-June 2011 period reported zero doses discarded for any reason, resulting in calculated median wastage rates at the LGA storage level of 0%.

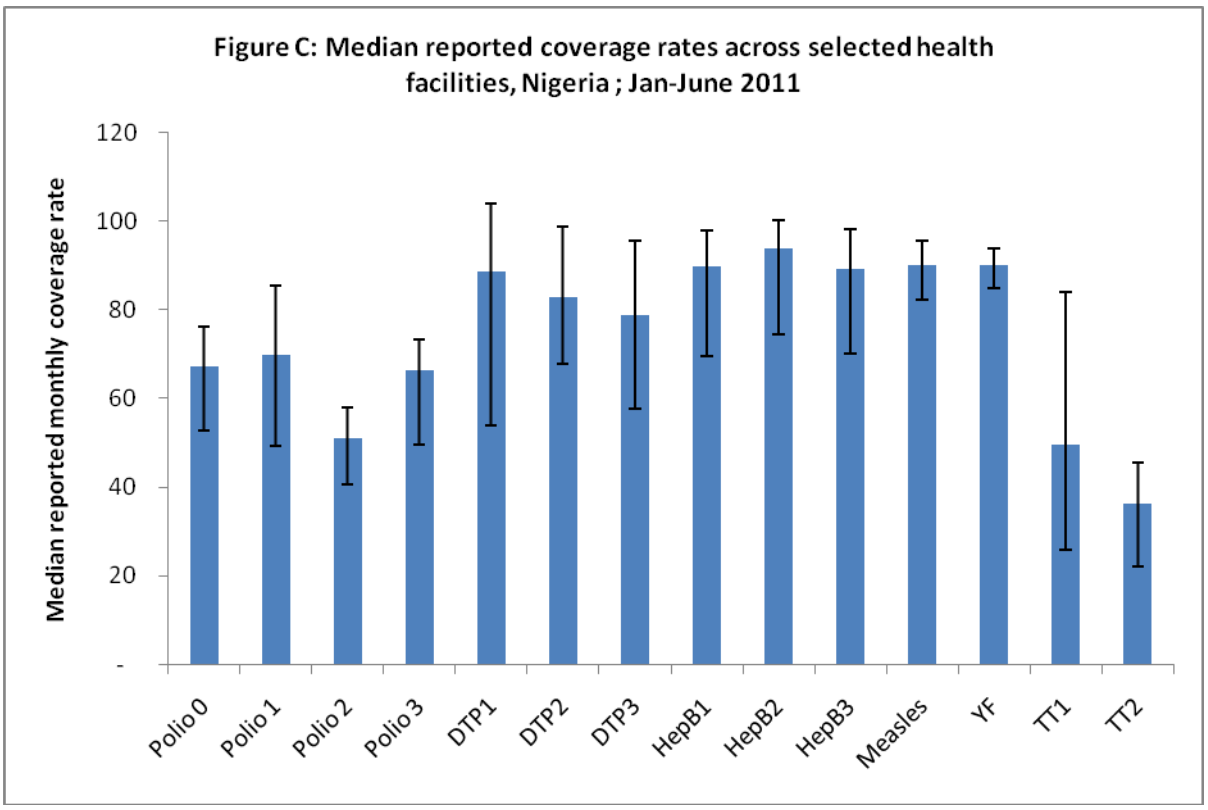
In comparison to median reported monthly wastage rates sourced from health facility stock management records, the greatest differences compared to LGA records was observed for TT (12 percentage points). The difference for all other antigens was 4 points or less.

Availability of vaccines at immunization sessions

Of the 588 analyzed immunization sessions, DPT was most frequently given at the session (90%), followed by HepB (87%), TT (69%), Measles (62%) and BCG (25%). Vials of all vaccines were opened in 10% of the sessions and vials of all vaccines, except BCG, were opened in 33% of the sessions. In 84% of sessions, both DPT and HepB vaccines were given and in 60% of sessions, both DPT and Measles vaccines were given.

Reported monthly coverage rates at the health facility

10-15 health facilities (antigen –dependent) reported monthly coverage values. Median monthly coverage ranged from a high of 94% (IQR: 74-100; n=10) for HepB2 to a low of 51% (IQR:51-58; n=10) for Polio2 (Figure C).



Error bars represent 25%-75% interquartile range

General immunization-related knowledge and practices of health workers

Vaccine availability and vaccine age eligibility practices

All vaccines except TT vaccine were reportedly available in all surveyed health facilities. TT vaccine was available in 94% (SE=6%) of health facilities. When asked up to what age of child they will vaccinate, 58% (SE=12%) of respondents said they vaccinate up to 59 months of age, followed by 12 months (14%), 24 months (12%), don't know (9%) and other ages (7%)(Table 2).

Planning

The majority (54%; SE=7%) of health facilities reported they did not have special or hard-to-reach populations in their catchment area. However, 22% (SE=14%) were uncertain if they had these special populations. The most frequently reported hard to reach populations were geographical (37% of health facilities reported), followed by seasonal (26%), nomadic (17%) and vaccine refusers (6%). Few (15%; SE=8%) health facilities reported having a routine microplan for immunization activities.

Outreach

Outreach sessions were reportedly held during the May-July 2011 period in 57% (SE=18%) of health facilities. In 36% of health facilities, immunization data reports were disaggregated by outreach and fixed sessions, however in 32% of health facilities, staff were uncertain if data were disaggregated. On average, 1.38 (95%CL: 0.95,1.82) outreach sessions were reportedly conducted per month at a health facility and an average of 13.2 (95% CI: 5.9,20.5) children were vaccinated at an outreach session.

Table 2: Summary of major system indicators from selected health facilities, Nigeria 2011

Key health facility immunization system indicators	Percentage of respondents reporting "Yes" (standard error)
Hard to reach populations are in catchment area	26% (8%)
Outreach session conducted in the last 3 months	57% (18%)
A microplan is available	15% (8%)
A supervisory visit has been received in the last 3 months	6% (6%)
Attended a vaccine management training	2% (1%)
Vaccine stockouts / inadequate supplies occurred in last 6 months	63% (24%)
Cold chain temperature records monitored twice daily	17% (4%)

Wastage-related knowledge and attitudes of health workers

Multi-dose vial policyknowledge

Over half (62%) of health facilities were unfamiliar with the open multi-dose vial policy (MDVP) which states that multi-dose vials of OPV, DTP, TT and HepB from which 1 or more doses of vaccine have been removed during an immunization session may be used in subsequent sessions for up to a maximum of 4 weeks provided key storage and vaccine quality conditions are met. Of the 38%who were familiar with the policy, nearly all (90-100%) knew that the policy applied to only the listed vaccines above. About 1/3 of those familiar with MDVP, incorrectly believed it applied to Measles, BCG and Yellow Fever vaccines.

The majority of those surveyed were not familiar with the appropriate conditions which need to be met before a vaccine could be reused per the MDVP; the most frequently mentioned condition was VVM status (mentioned by 43%), followed by expiry date not passed (32%),

appropriate storage conditions (32%), aseptic techniques used (10%) and vial not submerged in water (14%). Only 10% of health facility staff accurately knew that these opened vials could be used up to 4 weeks; 82% were uncertain of the length.

Wastage targets and reporting knowledge

Most respondents were not aware of which data are needed to calculate wastage rates; 37% knew they needed the number of children immunized and 16% knew they needed the doses used. Although respondents reported being told it was important to reduce wastage (79% report being told), only 12% reported being given wastage rate targets to use at their health facility; however 30% were able to give a wastage target. Wastage targets reportedly used by facilities are given below:

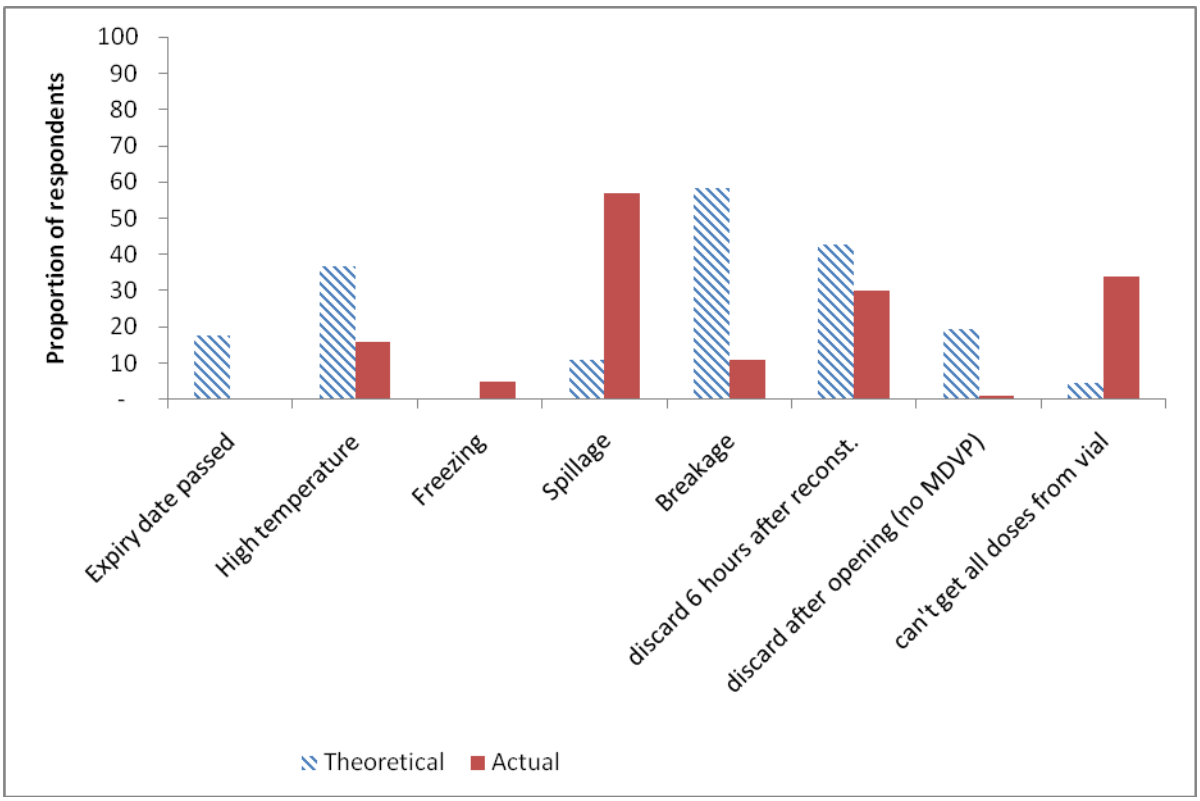
Table 3: Wastage targets reportedly used by selected health facilities and LGAs, Nigeria 2011

Vaccine	**Mean wastage target reported by health facilities (standard error) (n=15)**	**Mean wastage target reported by LGAs (standard error) (n=9)**
BCG	21.1% (13.4%)	41% (4.1%)
Polio	12.9% (8.4%)	17.4% (3.5%)
DPT	11.4% (7.2%)	17.1% (3.4%)
HepB	11.4% (7.2%)	17.1% (3.4%)
Measles	11.4% (7.0%)	30.9% (4.0%)
Yellow Fever	11.4% (7.0%)	31.3% (4.0%)
TT	11.4% (7.2)	17.2% (3.3)

Knowledge on reasons for wastage

A majority of respondents were unaware of the theoretical reasons for vaccine wastage. The most frequently cited theoretical reason for wastage was vial breakage (58%), followed by discarding 6 hours after reconstitution (43%) and exposure to high temperature (37%). When asked which reasons for wastage occurred at their own health facility, the most frequently cited reasons were spillage (57%) and unable to retrieve all doses from vial (34%) (Figure D).

FigureD: Respondent-reported theoretical reasons for wastage and reasons for wastage which occurred at their health facilities in the previous six months



Wastage-related practices of health workers

Immunization sessions and vaccine availability

Immunization sessions were reportedly conducted once per month in 55% (SE=19%) of health facilities, followed by once per week in 20% (SE=11%), twice per month in 14% (SE=11%) four times per month in 7% (SE=6%) and 2-5 times per week in 2% (SE=1%) of health facilities. Health facilities reported conducting an average of 1.4 (95%CI: 0.7, 2.1) immunization sessions per week. Ninety percent of health facilities reported they offer all vaccines every immunization session.

Vial usage practices

Nearly half (47%) of health facilities reported they do not re-use an opened vial of Polio vaccine as recommended in the MDVP. When health workers were asked how they decide to open a

vial when conducting an immunization session, 54% (SE=25%) responded they only open vials on certain days of month i.e. sessions are only held on specific days of the month. An additional 24% (SE=22%) state they open a vial whenever a child comes to the health facility, followed by 13% who wait for a few children to show at the health facility and 8% who wait for a pre-determined minimum of number of children before they decide to open a vial. In conducting reviews of the cold chain system at health facilities, it was observed that 17% of health facilities' cold chains contained vaccine which had been returned to the cold chain per the MDVP. However, only 23% of these vialshad a written date of when it was originally opened.

Measles-specific vial usage practices

Efforts to use measles vaccine on only specific days were common. 47% of respondents reported they open a measles vial only on certain days of the month, followed by 43% who wait for a pre-determined minimum of number of children before they decide to open a vial, 8% who wait for a few children and 2% who open a vial as soon as an eligible child comes to the health facility for measles vaccination. Additionally, when asked whether they grouped, or batched, children (i.e. waited for a large group of children to show at the session or told mothers to get other mothers to come to the session for measles vaccine) before they a measles vial, 60% (SE=15%) said they commonly do so (Table 4).

Table 4: Major vial usage practices reported by respondents at surveyed health facilities

Indicator	**Proportion of respondents saying "Yes"**	**Mean (95% CI)**	**Standard Error**
Open measles vial on only certain days	43%	NA	5%
Open measles vial as soon as an eligible child	2%	NA	1%

comes to the facility			
Wait for a minimum number of children before opening a measles vials	43%	NA	28%
Batch children for measles vaccination	60%	NA	
Number of children present before staff will open a measles vaccine vial	NA	6.19 (5.37, 7.01)	0.32
length of time to keep a re-constituted measles vaccine is 6 hours	85%	NA	9%
Length of time to keep an opened vial which falls under the MDVP is 4 weeks under appropriate conditions	10%	NA	2%

Vaccine management practices

As few health facilities had microplans, only 13% reported receiving vaccines based on figures in a microplan. Vaccine was usually received monthly (56%), weekly (19%) or at every session (13%). Although stock registers were not used to record or report lost/damaged quantities of vaccine, 38% of health facilities reported they had loss/damage of vaccine in the last six months and nearly all health facilities were uncertain how to manage lost/damaged vials. Measles and DPT vaccine were the most frequently mentioned (6% for each) which were lost or damaged.

When determining the number of vials to request, 53% of health facilities reported using the number of vaccines which were used in previous immunization sessions; 33% used the target population, 8% used the anticipated target population and 3% did not know.

Upon review of stock management registers, health facilities had variable completeness of stock register fields usually required for complete and adequate management of vaccine stock. These proportion of health facilities which were recording various stock data variables is listed in the table below:

Table 5: Observed condition of vaccine stock registers at selected facilities; Nigeria 2011

Stock register field/information	**% of health facilities with stock registers including information**
Date of receipt of vaccine	55% (30%)
Information on where vaccine received from	20% (8%)
Vaccine name	55% (30%)
Quantity received in doses	44% (20%)
Quantity used	40% (23%)
Batch number	42% (28%)
Expiry date	39% (28%)
Balance in stock	40% (23%)
Quantity damaged	14% (7%)
Reasons for damage	20% (12%)
VVM status	29% (22%)

Vial returned unused	16% (11%)
Signature of health worker	27% (17%)
Remarks by health worker	14% (7%)

Adequate recording of cold chain temperatures was also uncommon as 17% (SE=4%) of health facilities had monitored the temperatures twice daily over the previous month.

Wastage calculation practices

Most (92%) health facilities reported they do not calculate wastage, which corresponds with the observations of the stock management records.

Wastage and vaccine supply practices

At surveyed facilities, 82% reported that vaccine supplies were affected by vaccine wastage during the January-June 2011 period. About 63% of facilities had experienced a vaccine stockout during that period. Stockouts were most frequently reported for BCG (63% of health facilities reported stockout) , followed by TT and HepB (30% for both) and DPT, HepB and Measles (16% for all). When asked if any stockouts were due to high vaccine wastage rates, 98% of health facilities said yes; 79% also reported they make an effort to reduce vaccine wastage.

Table 6: Summary of vaccine wastage indicators from selected health facilities; Nigeria 2011

Key selected health facility wastage indicators	**Percentage of respondents**

	reporting "Yes" (standard error)
High wastage rates are a reason for vaccine stockout	98% (2%)
An effort is made to reduce wastage	79% (7%)
Vaccines were wasted due to cold chain failure	35% (18%)
Familiar with the multi-dose vial policy	55% (23%)
Vaccine vials lost/damaged in the last six months	38% (6%)
Wastage is calculated for each vaccine	8% (4%)
Staff were given vaccine wastage targets	12% (6%)
Vaccine supply was affected by wastage in the last six months	82% (17%)
Vaccine wastage due to cold chain supply constraints	0% (0%)
Vaccine needs are based on target population	33% (13%)
Vaccine needs are based on previous number of vaccines used	53% (18%)

Reported reasons for vaccine wastage

Over a third (35%) of health facilities reported wasting vaccine due to cold chain failures in the previous six months. When asked which reasons for wastage occurred at their own health facility, the most frequently cited reasons were spillage (57%) and unable to retrieve all doses from vial (34%) (Figure D).

Methods for changing wastage rates

Although few health facilities (6%) reported receiving a recent supervisory visit, 78% of health facilities reported that supervisors discussed the need to reduce vaccine wastage. Multiple strategies were mentioned by respondents for changing (reducing) wastage rates. The most frequently cited was improving stock management (42%), followed by improving community mobilization (38%), batching children (25%), implementing the MDVP (19%) and better organizing outreach sessions (13%).

Table 7: Methods cited by health facility staff for changing wastage rates; Nigeria, 2011

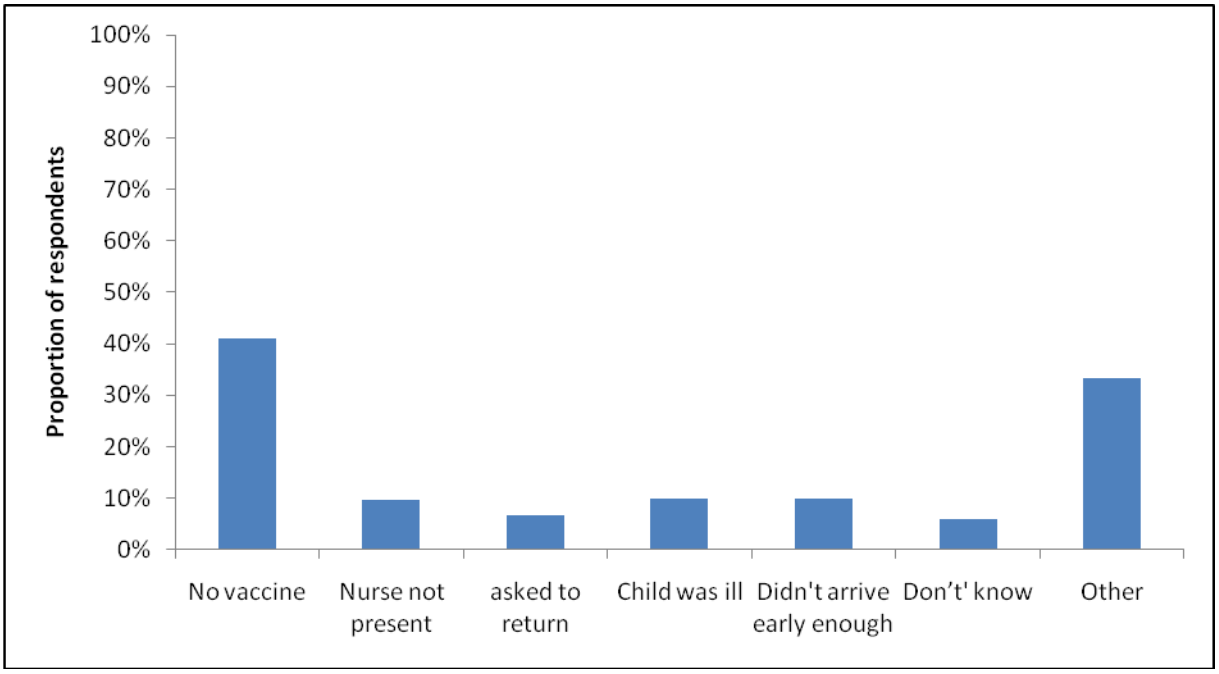
Cited methods for changing wastage	**Percentage of respondents reporting "Yes" (standard error)**
improve stock management	42% (18%)
improve community mobilization	38% (8%)
batch children	25% (12%)
implement MDVP	19% (5%)
better organize outreach sessions	13% (7%)
implement EEFO	7% (5%)
Change vial size	2% (2%)
change number of vaccination sessions	0% (0%)

Community-based observations of immunization practices

A total of 263 mothers of infants under 24 months of age were interviewed about their perspectives on immunization services. 90% of all mothers reported their infants had received vaccinations and of these mothers of vaccinated infants, 52% reported the child received the vaccines on time, 40% reported the vaccines were not received on time and 8% did not know.

The most frequently mentioned reason for child not receiving the vaccination on time was lack of vaccine (mentioned by 41% of respondents of children who did not receive vaccines on time), followed by "other reasons" (33%) (Figure E).

Figure E: Proportion of mothers of children who did not receive vaccinations on time and reasons given for why they believed their child did not receive the vaccination on time



Seventy-one percent of mothers reported that their child was not vaccinated on the day of the survey. The reasons given by the mothers for why their children were not vaccinated on the day of the survey included: infant already fully vaccinated (32%), infant was not due for vaccine (21%), don't know (13%), no session occurred (11%), no vaccine available (8%), child too old (5%) and child ill (2%).

A minority of mothers (30%) reported they had come for immunization services and been turned away or asked to come back at some point during the life of their infant. An additional 10% were uncertain if they had been turned away or asked to come back for immunization services. Of the 30% of mothers who were turned away, 33% reported they were turned away for BCG vaccine, followed by Measles vaccine (26%), HepB vaccine (19%), DPT vaccine (12%),

OPV vaccine (9%) and Yellow Fever vaccine (6%). Only 47% of these mothers turned away reported that their child received the vaccine they had missed.

LGA-levelwastage-related knowledge, attitudes and practices

Vial usage knowledge and practice

When asked the national policy on opening a vial, 59% of LGAs reported a vial should be opened as soon as required, 17% reported that vials are to only be opened on certain days, 18% stated that vials are only to be opened if a certain minimum number of children show up at the facility and 6% did not know. When asked if the practice in the LGA differed from the national policy, 64% of LGAs agreed.

The most common practice for when vials are opened for vaccination was to only vaccinate on days planned for giving the vaccine (47% of LGA reported), followed by opening a vial only if a certain minimum number of children show up at the facility (33%), waiting for a few children to show up before opening a vial (14%) and opening a vial as soon as required (6%). 51% of LGAs reported that that this vial usage policy does differ by vaccine. The majority of LGAs (62%) described how any vaccines which need to be reconstituted, including BCG, Yellow Fever and Measles vaccines, will not be opened until a number of children have gathered at the facility. Other vaccines, particularly vaccines in liquid formulation, are given immediately when a child comes to the facility.

Nearly all (97%) of LGAs reported that vaccine stockouts were a problem and 62% felt that stockouts were related to vaccine wastage. Additionally, 57% of LGAs believed that wastage was related to vaccine coverage.

Opened vial re-use knowledge and practice

When asked about the national policy on reuse of opened vials (i.e. MDVP), all LGAs reported knowing that opened vials of vaccines in liquid formulation could be returned to the cold chain for later use; 100% knew they should open a vial as soon as required, 64% knew that opened vials must meet certain conditions for reuse and 35% knew these opened vials could be reused for up to 4 weeks. When asked if the practice in the LGA differed from the national policy, 7% of LGAs agreed.

Age-based vaccination knowledge and practices

When asked the national policy on vaccinating children over the age of 12 months, 40% of LGAs accurately stated the policy, 42% of LGAs inaccurately stated that the policy was not to vaccinate these children and 15% did not know (Table 8).

Table 8: LGA level knowledge of national immunization policies and application to their LGA

National Policy	Correctly know the policy	Incorrectly know policy	Don't know any policy	Policy differs from practice in LGA
All children under the age of 5 years are eligible for vaccination	40%	45%	15%	6%
A vial is to be opened for any	59%	35%	6%	64%

eligible infant				
Certain opened vials may be returned to cold chain	100%	0%	0%	7%
Certain opened vials may be reused for up to 4 weeks	35%	65%	0%	7%
Vaccines which expire first should be used first	91%	0%	9%	NA

Vaccination contraindication practices

Twelve percent of LGAs did not mention any contraindications, 7% mentioned 1 contraindication and the majority (77%) mentioned 2 to 3 contraindications. For example, 54% of LGAs mentioned that BCG vaccine is not given to HIV+ infants, 52% mentioned that a sick child is not vaccinated, and 47% mentioned an infant will not be vaccinated if any previous vaccine reaction has occurred. Twelve percent of LGAs did not mention any contraindications, 7% mentioned 1 contraindication and the majority (77%) mentioned 2 to 3 contraindications.

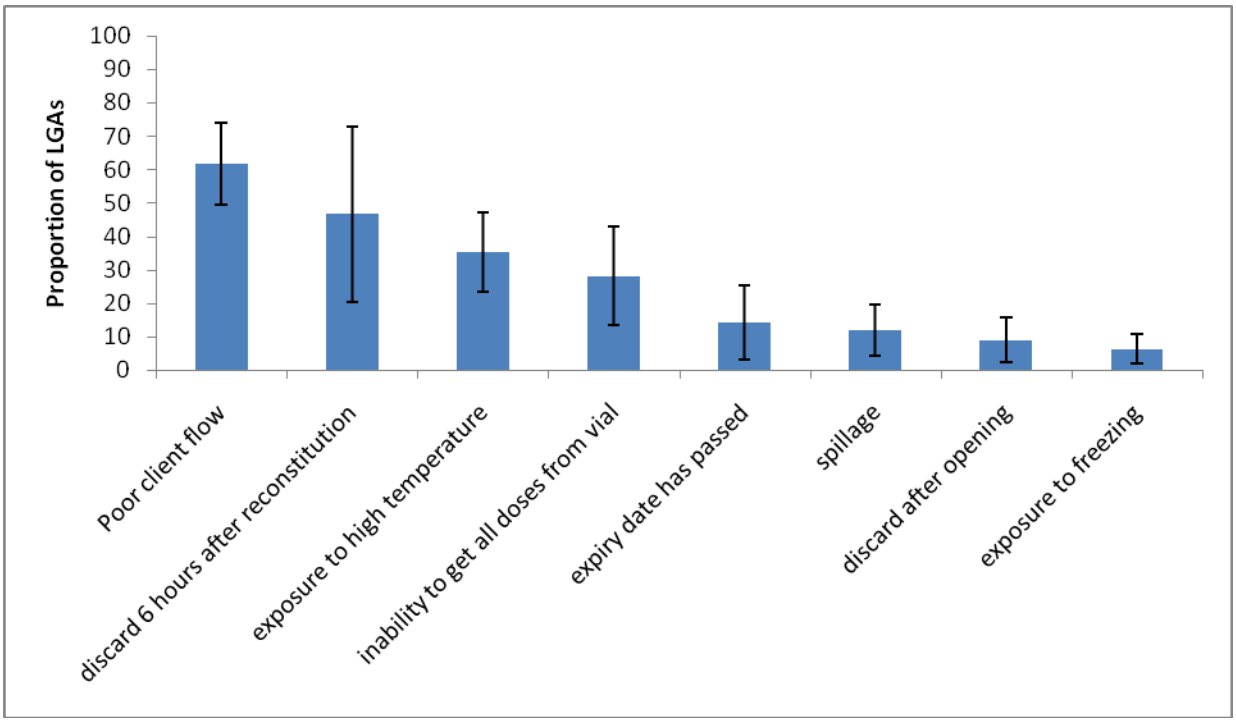
Wastage knowledge, attitudes and practices

Wastage was considered an important topic by all LGAs (100%). However, only 25% of LGAs collected vaccine wastage data from health facilities within the LGA. If a health facility

appeared to have high wastage, the majority (65%) said they would conduct a supervisory visit to the health facility; the rest did not report any specific actions taken or not taken.

The majority of LGAs believed the biggest reason for wastage was due to poor client flow at sessions (65%), followed by discarding vials 6 hours after reconstitution (reported by 47%), exposure of vaccine to high temperatures (35%) and inability to get all doses from vial because of syringe type (28%) (Figure F).

Figure F: Reported reasons for vaccine wastage in selected Nigerian LGAs, August 2011



Wastage targets were reported by 9 of the 11 LGAs. These targets ranged from a high of 41% (BCG) to a low of 17.2% (TT vaccine) (Table F).

Wastage calculation knowledge and practices

A reported 83% of LGAs say they calculate wastage at the LGA level. When asked about the data required to calculate wastage rates, 38% of LGAs accurately reported that target population was needed, 39% reported that number of doses was needed and 38% believed that coverage data was needed.

Methods for changing wastage rates

The majority (79%) of LGAs believed their wastage rates needed to decrease, compared to 20% who believed it should increase and 1% who believed it should remain the same. In mentioning strategies for how they could change their wastage rates, improving stock management was mentioned by 53% of LGAs, followed by improving organization of outreach sessions (46%), batching children for vaccination (41%), improving community mobilization (38%) and implementing EEFO or MDVP (9% for each).

Conclusions

A number of conclusions can be drawn from the results of this study. These conclusions include:

- A majority of health facilities and LGAs stock management records are inadequately documented and insufficient for calculating both unopened and opened vaccine wastage rates. Reasons for unopened vial wastage are not currently documented. Nearly all health facilities are not using the nationally-developed vaccine management forms.Most health facility and LGA staff also confirmed they do not usually calculate or keep track of wastage.
- Calculated wastage rates at the storage level (LGA level) are zero for nearly all LGAs and months, however, this rate is limited by inadequate record-keeping.

- Calculated wastage rates at the service delivery level vary by vaccine, however most are within a range of 10-15% for the 2/3 of facilities where stock data was adequately available to calculate the rates.
- Vials of all vaccines are not opened every immunization session, particularly BCG which was only opened in a quarter of analyzed sessions, and Measles in 2/3 of analyzed sessions. However, 90% of facilities report they offer all vaccines every session. Health workers, though, confirmed they usually wait for 6-7 children before opening a Measles vial and only open these vials on certain days. 2/3 of LGA staff confirmed that the reality of opening vials differs from the national policy that a vial should be opened whenever eligible infants are present.
- Half of facilities report they do not have hard to reach populations in their catchment area and thus about half report they did not conduct outreach sessions in the last six months. Only a few facilities have REW microplans, have received a recent supervision visit.
- A majority of facilities have reported vaccine stockouts in the last 6 months. Most health workers believe they have high wastage rates at that these are a major factor leading to these stockouts.Most LGAs also believe that wastage rates needs to decrease; improved stock management was the most frequently mentioned strategy by both LGAs and health facilities to alter wastage rates.
- Wastage is reported to be an important topic. However, health worker knowledge of immunization policies (MDVP, eligible ages for vaccination etc), target wastage rates, wastage rate calculation, and causes of wastage is very low. At the LGA level, only about half of LGAs accurately understood the major immunization policies (MDVP, eligible age and when to open a vial).
- Among the few health facilities which said they were given wastage rate targets, the usually target rate used is around 10% for each vaccine.
- Reported and observed re-use of opened vials per the MDVP is low as the majority of facilities report they discard any vials within 6 hours of opening. Most health workers were aware that measles vaccine should be discarded within 6 hours of reconstitution.

- Over a third of facilities report losing or damaging vials, however these are not usually reported in records as staff members are uncertain how to report these situations.
- About a third of mothers reported being turned away for vaccines at some point in the last 2 years; the majority said it was for either BCG or Measles vaccine and half of these mothers said their child never ended up receiving the missed vaccine.

Recommendations

Considering the strong level of concern over high wastage rates, LGA and health facility staff should be made aware that calculated wastage rates are well under acceptable levels and, in some instances, may be bordering on being too low such that eligible children may be getting missed due to overriding concerns about wastage. Stock management forms (VM1, VM2, VM3) should be distributed, along with written instructions on their use, to all health facilities as soon as possible. Follow-up should be made with health facility staff on how to accurately calculate wastage rates, information on appropriate wastage targets and importance of appropriately balancing wastage rates with missed opportunities to vaccinate a child.

In future health worker and LGA staff trainings, immunization policies need to be reinforced, particularly on the MDVP, when to open a vial and ages of eligibility for routine vaccinations. Nigeria should consider how to adequately budget for the policy of opening a Measles or BCG vial for every eligible infant which comes to a facility on any immunization session day so as to reduce missed opportunities and increase vaccination coverage, which may currently be hampered by a potentially all-overriding emphasis on reducing vaccine wastage due to stockout concerns.

In relation to strengthening other aspects of the immunization program, health facilities which reportedly do not believe or do not know if they have hard to reach populations in their catchment area should undertake an exercise to identify any of these special populations. Once identified, outreach sessions should be planned in appropriate locations and this information

compiled with fixed session dates and targets into a health facility-level immunization microplan.

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Annex: Complete Health facility KAP questionnaire results

Annex Table 1: Results for categorical variables

Q #	Question	Sub-question	Answer value	Weighted Percent	Standard Error
7	Urban or rural location		Urban	10	4
			Rural	90	4
8	qualification of person being interviewed		JCHEW	12	7
			CHEW	46	12
			CHO	12	2
			Nurse	11	6
			Midwife	12	11
			Other	6	3
10	Please verify that the following vaccine presentations are utilized in this facility	BCG	Checked	100	-
			Not checked	-	
		OPV	Checked	100	-
			Not checked	-	
		DTP	Checked	100	-
			Not checked	-	
		HepB	Checked	100	-
			Not checked	-	
		Measles	Checked	100	-
			Not checked	-	
		Yellow Fever	Checked	100	-
			Not checked	-	
		TT	Checked	94	6
			Not checked	6	6
		Other	Checked	11	7
			Not checked	89	7
11	In your catchment area, are		Yes	26	8

	there any hard-to-reach or special populations?		No	52	7
			Don't' Know	22	14
12	What kind of hard-to-reach or special populations are in the area?	nomadic	Checked	17	12
			Not checked	83	12
		semi-nomadic	Checked	-	
			Not checked	100	-
		migrants	Checked	-	
			Not checked	100	-
		minority groups	Checked	1	0
			Not checked	99	0
		non-compliance / vaccine refusal groups	Checked	6	6
			Not checked	94	6
		geographically hard-to-reach	Checked	37	7
			Not checked	63	7
		seasonally hard-to-reach	Checked	26	6
			Not checked	74	6
		Other	Checked	-	
			Not checked	100	-
13	How frequently are routine immunization services provided at this health facility? (please mark either day(s) per week or day(s) per month)		1 per month	55	19
			1 per week	20	11
			2 per month	14	11
			2 per week	1	1
			3 per month	1	1
			3 per week	0	0
			4 per month	7	6
			5 per week	1	1
14	Are all vaccine offered during		Yes	90	5

	every session?		No	9	5
			Don't' Know	-	
			Missing	1	1
15	How frequently is the following vaccine offered?	BCG	Missing	85	7
			1 per month	7	5
			1 per week	7	4
			2 per week	-	0
		DPT	Missing	88	7
			1 per month	5	5
			1 per week	6	4
			2 per week	-	0
			5 per week	1	1
		HepB	Missing	88	7
			1 per month	9	6
			1 per week	1	1
			2 per week	-	0
			5 per week	1	1
		MCV	Missing	86	7
			1 per month	7	5
			1 per week	7	4
			2 per week	-	0
		YF	.	88	7
			1 per month	5	5
			1 per week	7	4
			2 per week	-	0
		TT	Missing	88	7
			1 per month	5	5
			1 per week	7	4
			2 per week	-	0
16	How do you determine the	Vaccine availability	Checked	14	7

	number of immunization sessions you hold per month?		Not checked	86	7
		Number of beneficiaries	Checked	79	3
			Not checked	21	3
		DK	Checked	3	2
			Not checked	97	2
		Number of nurses	Checked	10	7
			Not checked	90	7
		Other	Checked	14	12
			Not checked	86	12
17	Have you done outreach in the past 3 months?		Yes	57	18
			No	43	18
18	Don't know about number of outreach days		Yes	-	
			No	100	-
			Other	-	
			Missing	79	3
19	Are data collected by fixed and outreach delivery separately (disaggregated)?		Yes	36	22
			No	32	5
			Don’t' Know	32	23
20	Are data collected by fixed and outreach delivery separately (don't know)		Checked		
			Not checked	100	-
			Yes		
21	At this facility, if a vial of OPV is not finished during an immunization session, do you use it at another session?		Yes	47	18
			No	53	18
			Don’t' Know	1	1
22	Are you familiar with the “open multi-dose vial policy” (MDVP)?		Yes	55	23
			No	34	23
			Don’t' Know	10	6
23	For which vaccines does the	BCG	Checked	11	11

	"open multi-dose vial policy" apply?		Not checked	89	11
		OPV	Checked	27	12
			Not checked	73	12
		DPT	Checked	38	13
			Not checked	62	13
		HepB	Checked	38	13
			Not checked	62	13
		Measles	Checked	12	11
			Not checked	88	11
		Yellow Fever	Checked	12	11
			Not checked	88	11
		TT	Checked	38	13
			Not checked	62	13
		99 DK	Checked	7	5
			Not checked	93	5
24	What conditions must be met before you reuse a vaccine per the open multi-dose vial policy?	expiry date has not passed	Checked	32	22
			Not checked	68	22
		vaccines are stored under appropriate cold chain conditions	Checked	32	12
			Not checked	68	12
		vaccine vial septum has not been submerged in water	Checked	14	7
			Not checked	86	7
		Aseptic technique has been used to withdraw all doses	Checked	10	7
			Not checked	90	7

		Vaccine vial monitor (VVM) in stage 1 or 2	Checked	43	18
			Not checked	8	6
		99 DK	Yes	12	7
			No	15	7
25	If previously discussed conditions are met, for how long can an open vaccine vial (e.g., DPT) be used for future sessions?		No	-	0
			6 hours	1	1
			1 day	1	1
			1 week	4	2
			2 weeks	-	0
			4 weeks	10	7
			Don't Know	82	7
25	Don't know how long you can keep a vaccine open	99 DK	Yes	17	12
			No	83	12
26	When conducting an immunization session, with regard to opening a vial, what do you do the majority of the time?		open as soon as required	24	22
			wait for a few children	13	8
			minimum children	8	3
			only certain days	54	25
			Don't know	1	1
27	Specifically for measles vaccine, when conducting an immunization session, with regard to opening a vial, what do you do the majority of the time? (please read all the answer choices and select one)		open as soon as required	2	1
			wait for a few children	8	5
			minimum children	43	28
			only certain days	47	29
			Don't know	1	1
28	Don't know for how long can		Yes	2	1

	you use an open measles vaccine		No	98	1
29	Do you make an effort to batch (put together or group) children for measles vaccines?		Yes	60	15
			No	40	15
30	Once reconstituted, for how long can you use an open measles vaccine?		2 hours	2	2
			24 hours	3	2
			3 hours	2	2
			6 hours	85	9
30	Don't know how long to keep measles vaccine		Yes	4	4
			No	96	4
31	Up to what age will you give vaccines to a child not yet fully vaccinated?		12 months	14	5
			18 months	1	1
			24 months	12	5
			59 months	58	12
			no max	-	
			other	6	6
			dk	9	6
32	Do you have a routine immunization (REW) micro-plan?		Yes	15	8
			No	84	8
			Don't Know	1	1
33	Do you receive vaccines based on the micro-plan?		Yes	13	7
			No	11	7
			Don't Know	76	10
34	How frequently do you receive vaccines?		for each session	13	7
			daily	-	
			weekly	19	9
			every 2 weeks	11	11
			monthly	56	20
			irregular	-	

			dk	-	
			other	-	
			Missing	2	2
35	During the last 6 months, was there any loss or damage of vaccine vials in the routine program?		Yes	38	6
			No	59	5
			Don't Know	2	2
36	If loss or damage, please mark for which vaccine.	BCG	Yes	1	1
			No	99	1
		OPV	Yes	1	1
			No	99	1
		DPT	Yes	6	6
			No	94	6
		HepB	Yes	-	0
			No	6	5
		Measles	Yes	6	6
			No	94	6
		Yellow Fever	Yes	-	
			No	100	-
		TT	Yes	-	
			No	100	-
		DK	Yes	-	
			No	100	-
37	How did you manage the lost/damaged quantity of vaccine?		Reorder	1	1
			other	-	0
			DK	99	15
38	How do you record or report the lost/damaged quantity of vaccine		Record in stock register		
			Notify LGA level	8	6
			Don't record or	1	1

			report		
			dk		
			other		
			Missing	91	6
39	Do you calculate wastage for each vaccine?		Yes	8	4
			No	92	17
40	How frequently do you calculate wastage?		monthly	25	13
			quarterly		
			annually		
			dk	-	-
			other	1	1
			MISSING	74	13
41	What data are needed to calculate wastage?	doses used	Checked	16	7
			Not checked	84	7
		children immunized	Checked	37	7
			Not checked	63	7
		DK	Checked	39	12
			Not checked	61	12
		Other	Checked	13	11
			Not checked	87	11
42	Do you have or were you given fixed targets or goals for vaccine wastage rates?		Yes	12	6
			No	83	6
			DK	5	2
43	What are your wastage targets?	BCG	numeric between 0 and 100	53	27
				6	7
				41	20
		OPV	numeric between 0 and 100	53	27
				8	8

				29	14
				11	5
		DPT	numeric between 0 and 100	53	27
				8	8
				29	14
				11	5
		HepB	numeric between 0 and 100	53	27
				8	8
				29	14
				11	5
		MCV	numeric between 0 and 100	53	27
				6	7
				34	17
				2	1
				5	3
		YF	numeric between 0 and 100	53	27
				6	7
				34	17
				2	1
				5	3
		TT	numeric between 0 and 100	53	27
				8	8
				29	14
				11	5
44	In theory, what are reasons	expiry date has	Checked	18	7

	for vaccine wastage?	passed			
			Not checked	82	7
		exposure to high temperature (VVM)	Checked	37	4
			Not checked	63	4
		exposure to freezing	Checked	-	
			Not checked	100	-
		spillage	Checked	11	7
			Not checked	89	7
		breakage	Checked	58	7
			Not checked	42	7
		discard 6 hours after reconstitution	Checked	43	6
			Not checked	57	6
		discard after opening and not adopting MDVP	Checked	20	4
			Not checked	80	4
		inability to get all doses from vial because of syringe type	Checked	5	4
			Not checked	95	4
44	In theory, what are reasons for vaccine wastage?	Don't Know	Yes	1	1
			No	99	1
		Other	Yes	43	6
			No	57	6
45	Which of the previously discussed reasons for vaccine wastage apply to your health	wastage is not a problem at this facility	Yes	7	5
			No	93	5

	facility?	expiry date has passed	Checked	0	0
			Not checked	100	0
		exposure to high temperature (VVM)	Checked	16	8
			Not checked	84	8
		exposure to freezing	Checked	5	5
			Not checked	95	5
		spillage	Checked	57	12
			Not checked	43	12
		breakage	Checked	11	6
			Not checked	89	6
		discard 6 hours after reconstitution	Checked	30	8
			Not checked	70	8
		discard after opening and not adopting MDVP	Checked	1	1
			Not checked	99	1
		inability to get all doses from vial because of syringe type	Checked	34	12
			Not checked	66	12
		Don't Know	Checked	3	1
			Not checked	97	1
		Other	Checked	33	17
			Not checked	67	17
46	During the past 6 months, was the vaccine supply ever		Yes	82	17
			No	17	16

	affected by vaccine wastage?		Don't Know	1	1
47	During the past 6 months have you experienced vaccine stockouts or inadequate supplies?		Yes	33	8
			No	63	7
			Don't Know	4	2
48	For which vaccines did you experience stockouts or inadequate supplies?	BCG	Checked	63	24
			Not checked	37	24
		OPV	Checked	16	5
			Not checked	84	5
		DPT	Checked	16	8
			Not checked	84	8
		HepB	Checked	30	13
			Not checked	70	13
		Measles	Checked	16	10
			Not checked	84	10
		Yellow Fever	Checked	12	6
			Not checked	88	6
		TT	Checked	30	3
			Not checked	70	3
		Don't Know	Checked	1	1
			Not checked	99	1
49	Do you think that high wastage rates were a reason for any of the vaccine stockouts?		Yes	98	2
			No	2	2
			Don't Know		
50	Do you make an effort to reduce wastage?		Yes	79	7
			No	21	7
			Don't Know		
51	What strategies would you use to change your wastage	improve stock management	Checked	42	18

	rate? (please do not read answer choices and select all that apply)		Not checked	58	18
		batch children	Checked	25	12
			Not checked	75	12
		better organize outreach sessions	Checked	13	7
			Not checked	87	7
		improve community mobilization	Checked	38	8
			Not checked	62	8
		implement EEFO	Checked	7	5
			Not checked	93	5
		implement MDVP	Checked	19	5
			Not checked	81	5
		change number of vaccination sessions	Checked	-	
			Not checked	100	-
		vial size	Checked	2	2
			Not checked	98	2
		Don't Know	Checked	2	2
			Not checked	98	2
		Other	Checked	28	8
			Not checked	72	8
52	Do your supervisors talk to you about the need to reduce vaccine wastage?		Yes	78	5
			No	21	4
			Don't Know	1	1
53	Have you received a supervisory visit in the previous 3 months?		Yes	6	6
			No	94	6
			Don't Know		
54	Do you request your vaccine needs or does the higher level		request vaccine	97	2
			higher level	3	2

	give you vaccine based on what they think you need?		DK	-	-
			other	-	-
			missing	100	-
55	How do you determine your vaccine needs?		vaccines used	53	18
			target	33	13
			anticipated target	8	6
			DK	3	3
			other	1	1
			MISSING	2	2
56	Was there any routine immunization vaccine wastage due to constraints of storage space in the previous 6 months?		Yes	0	0
			No	100	0
			Don't Know		
57	Were any routine immunization vaccines wasted due to cold chain failure in the previous 6 months?		Yes	35	18
			No	65	18
			Don't Know	-	-
58	Have you attended a training that included vaccine management?		Yes	2	1
			No	39	22
			Don't Know	-	-
			Missing	59	22
59	Check if the following are present within the cold chain / vaccine stock:	Date of receipt	Yes	55	30
			No	45	30
60	Check if the following are present within the cold chain / vaccine stock:	Received from	Yes	20	8
			No	80	8
61	Check if the following are	Vaccine name	Yes	55	30

	present within the cold chain / vaccine stock:		No	45	30
62	Check if the following are present within the cold chain / vaccine stock:	Quantity received in doses	Yes	44	20
			No	56	20
63	Check if the following are present within the cold chain / vaccine stock:	Quantity used	Yes	40	23
			No	60	23
64	Check if the following are present within the cold chain / vaccine stock:	Batch Number	Yes	42	28
			No	58	28
65	Check if the following are present within the cold chain / vaccine stock:	Expiry date	Yes	39	28
			No	61	28
66	Check if the following are present within the cold chain / vaccine stock:	Balance in stock	Yes	40	23
			No	60	23
67	Check if the following are present within the cold chain / vaccine stock:	Quantity damaged	Yes	14	7
			No	86	7
68	Check if the following are present within the cold chain / vaccine stock:	Reasons for damage	Yes	20	12
			No	80	12
69	Check if the following are present within the cold chain / vaccine stock:	VVM status	Yes	29	22
			No	71	22
70	Check if the following are present within the cold chain / vaccine stock:	Returned un-used	Yes	16	11
			No	84	11
71	Check if the following are	Signature	Yes	27	17

	present within the cold chain / vaccine stock:		No	73	17
72	Check if the following are present within the cold chain / vaccine stock:	Remarks	Yes	14	7
			No	86	7
73	Please review temperature monitoring chart, during the past month, was temperature monitoring done at least twice daily?		Yes	17	4
			No	83	4
74	Are there vaccines that have been returned to the cold chain per the open multi-dose vial policy (MDVP)?		Yes		
			No		
			Don't Know		
75	If there are vaccines which have been returned to the cold chain per MDVP, please indicate (all that are applicable) if the vaccine is:	Not expired	Yes	17	4
			No	83	4
		VVM has not yet passed	Yes	17	4
			No	83	4
		Date vial open is written on vial	Yes	4	4
			No	96	4
		Other	Yes	6	6
			No	94	6

Annex Table 2: Results for categorical variables

Q ID	Question	sub-question	Answer Values	Weighted Percent	Standard Error

77	Has your child ever been vaccinated		Yes	90.0	3.2
			No	10.0	3.2
78	Did your child receive all vaccines on time (of those children who were vaccinated)		Yes	52.2	16.3
			No	39.9	14.3
			Don't Know	7.9	5.0
79	Why did child not receive vaccine on time? (of those children who reported not receiving vaccines on time)	No vaccine	Checked	16.4	9.1
		Nurse not present	Checked	3.9	4.2
		asked to return	Checked	2.7	2.1
		Child was ill	Checked	4.0	2.3
		Didn't arrive early enough	Checked	4.0	1.5
		Don't' know	Checked	2.4	1.6
		Other	Checked	13.3	4.4
80	Was child vaccinated today?		Yes	20.3	11.5
			No	71.0	11.3
			Missing	8.7	2.4
81	Why was your child not vaccinated today? (of those who were not vaccinated today)		Was not due	21.4	6.9
			No vaccine	7.8	5.1
			Child is ill	2.4	1.3
			Child too old	4.6	1.9
			Fully vaccinated already	32.2	18.9
			No session	11.4	7.8
			Refused vaccine	0.3	0.2
			Other	7.1	7.3
			Don't' know	12.7	5.1
82	Come for services and		Yes	30.0	10.4

	turned away?		No	59.2	12.3
			Don't Know	9.9	8.3
			Missing	0.9	0.7
83	Did you come for services and were you turned away? (of those turned away, i.e. where Q82=Yes)	For BCG	Yes	33.7	10.2
			No	23.6	10.3
			Don't Know	42.0	14.0
		For OPV	Yes	8.5	5.5
			No	32.8	17.7
			Don't Know	58.5	16.0
		For DPT	Yes	11.6	4.8
			No	28.3	14.2
			Don't Know	60.0	16.6
		For HepB	Yes	19.1	9.8
			No	26.5	16.5
			Don't Know	54.4	15.5
		For Measles	Yes	26.4	8.5
			No	18.1	8.3
			Don't Know	55.4	17.4
		For YF	Yes	5.6	5.2
			No	34.1	17.6
			Don't Know	60.3	19.8
		Don't know	Yes	9.7	7.4
			No	90.3	20.2
85	Did you child ever get vaccine that they missed? (of those who were turned away i.e. where Q82=Yes)		Yes	47.4	14.8
			No	31.0	18.4
			Don't Know	21.7	7.3

Annex Table 3: Results for numerical (continuous) variables

Question	N	Mean	Standard Error	Min	Max
Number of staff who assist with vaccine delivery	54	3.34	1.21	-	24.00
Frequency of RI days at health facility (per week)	54	1.43	0.29	1.00	5.00
Number of outreach sessions conducted each month	45	1.38	0.18	1.00	4.00
Number of children vaccinated in an average outreach session	35	13.18	2.97	2.00	80.00
Number of children present before you will open a measles vaccine vial	34	6.19	0.32	1.00	19.00
Wastage target for BCG	15	21.1	13.4	1.00	4.00
Wastage target for POL	15	12.9	8.4	-	50.00
Wastage target for DPT	15	11.4	7.2	-	33.00
Wastage target for HEPB	15	11.4	7.2	-	33.00
Wastage target for MCV	15	11.4	7.0	-	33.00
Wastage target for YF	15	11.4	7.0	-	33.00
Wastage target for TT	15	11.4	7.2	-	33.00
How long to keep a re-constituted measles vaccine (hours)	48	6.43	0.32	2.00	24.00

Annex: Complete LGA KAP questionnaire results

Annex Table 4: LGA KAP questions results for categorical variables

Q ID	Question	Sub-question	Answer value	Weighted Percent	Standard Error
8	Please verify that the following vaccine presentations are utilized in this LGA	BCG	Yes	100	0
		OPV	Yes	100	0
		DPT	Yes	100	0
		HEPB	Yes	100	0
		MCV	Yes	100	0
		YF	Yes	100	0
		TT	Yes	100	0
		OTHER	No	100	0
9	What is the practice around opening a vaccine vial?		only open on days planned for giving that particular vaccine	47	26
			wait for a few children to show up before opening the vial	14	12
			you open a vial as soon as it is required	6	6
			you will open the vial only if certain minimum number of children show up	33	25
10	Does the policy around opening a vaccine vial vary by vaccine? If yes, please		No	49	27
			Yes	51	27

	describe.				
11	In this LGA, do health facilities return open vials with remaining doses of DPT, OPV, TT, and HepB to their own cold chain for future use?		No	6	6
			Yes	94	6
12	In this LGA, what do health facilities do if a child >12 months of age appears for vaccination?		Don't know	9	10
			Other	3	3
			don't vaccinate	41	26
			vaccinate children irrespective of age	47	24
13	In this LGA, what vaccine contraindications do the health facilities apply?	no BCG for HIV+	No	46	27
			Yes	54	27
		no additional DPT doses if previous reaction	No	100	0
		reaction to any vaccine	No	53	27
			Yes	47	27
		sick child	No	48	27
			Yes	52	27
		hospitalized child	No	59	25
			Yes	41	25
		Don't know	No	97	3
			Yes	3	3
		Other	No	71	25
			Yes	29	25
14	Do you have an alternative cold chain at the LGA level?		No	50	24
			Yes	50	24

15	What is the national policy on opening a vaccine vial?		Don't Know	6	6
			minimum children	1	1
			only certain days	17	12
			open as soon as required	59	12
			wait for a few children	17	13
16	Is the practice in this LGA different than the national policy?		No	36	13
			Yes	64	13
		vials of OPV, DPT, TT, HepB can be returned to cold chain for later use	No	0	0
17	What is the national policy on reuse of open multi-dose vials (i.e., open multi-dose vial policy)?		Yes	100	0
		vials can be used for up to 28 days	No	65	25
			Yes	35	25
		vials must meet certain conditions	No	36	25
			Yes	64	25
		open vial as required (don't batch)	No	100	0
			Yes	0	0
		Don't know	No	100	0
			Yes	0	0
		Other	No	71	25
			Yes	29	25
18	Is the practice in this LGA different than the national policy in regard to the open multi-dose vial policy?		No	93	6
			Yes	7	6
19	What is the national policy		Don't know	15	12

	on vaccinating children >12 months of age? (please do not read answer choices and select only 1)		Other	3	1
			don't vaccinate	42	27
			vaccinate children irrespective of age	40	25
20	Is the practice in this LGA different than the national policy in regard to vaccinating children >12 months of age?		No	94	6
			Yes	6	6
21	What are contraindications per the national policy?	no BCG for HIV+	No	20	13
			Yes	80	13
		no additional DPT doses if previous reaction	No	91	7
			Yes	9	7
		reaction to any vaccine	No	56	27
			Yes	44	27
		sick child	No	51	27
			Yes	49	27
		hospitalized child	No	36	11
			Yes	64	11
		Don't know	No	87	11
			Yes	13	11
		Other	No	100	0
			Yes	0	0
22	Is the practice in this LGA different than the national policy in regard to contraindications?		Dont know	12	10
			No	82	13
			Yes	6	6
23	What is the EEFO policy?		Don't know	9	10
			Early expiry first out	91	10

24	Do you have copies of the national polices and guidelines?		No	18	8
			yes not observed	35	26
			yes observed	47	27
25	How are these policies taught to health workers?		No	29	25
			Yes	71	25
			No	53	25
			Yes	47	25
			No	100	0
			Yes	0	0
			No	89	8
			Yes	11	8
			No	100	0
			Yes	0	0
			No	71	25
			Yes	29	25
26	Is wastage considered an important topic?		No	0	0
			Yes	100	0
27	Does this level collect vaccine wastage data from the next lower level?		No	75	14
			Yes	25	14
28	If yes, how frequently?		at least monthly	100	0
29	Do you have or were you given acceptable rates for vaccine wastage rates?		No	9	10
			Yes	91	10
30	What is considered highest acceptable wastage for each vaccine?	BCG	2	12	4
			7	7	7
			10	1	1
			50	80	9
		OPV	5	7	8
			10	35	30

			20	36	31
			25	7	8
			30	7	7
			33	7	3
		DPT	5	7	8
			10	35	30
			20	36	31
			25	14	10
			33	7	3
		HEPB	5	7	8
			10	35	30
			20	36	31
			25	14	10
			33	7	3
		MCV	5	7	8
			10	2	2
			25	10	8
			30	40	31
			33	4	4
			40	36	31
		YF	5	7	8
			10	2	2
			25	7	7
			30	40	31
			33	4	4
			35	4	4
			40	36	31
		TT	7	7	8
			10	35	30
			20	36	31

			25	14	10
			33	7	3
31	If a health facility has high wastage rates, what does the LGA do? (do not read answer choices and select all that apply)	conduct supervisory visit	Checked	65	26
			Not checked	35	26
		punish / indictment	Checked	0	0
			Not checked	100	0
		no action taken	Checked	0	0
			Not checked	100	0
		Don't know	Checked	0	0
			Not checked	100	0
		Other	Checked	32	25
			Not checked	68	25
32	Do you calculate wastage at the LGA?		No	17	13
			Yes	83	13
33	What do you believe are the biggest reasons for vaccine wastage? (please do not read the answer choices and mark all that apply)	expiry date has passed	No	86	11
			Yes	14	11
		exposure to high temperature (VVM)	No	65	12
			Yes	35	12
		exposure to freezing	No	94	4
			Yes	6	4
		spillage	No	88	8
			Yes	12	8
		discard 6 hours after reconstitution	No	53	26
			Yes	47	26
		discard after opening and not adopting MDVP	No	91	7
			Yes	9	7
		inability to get	No	72	15

		all doses from vial because of syringe type	Yes	28	15
		Don't know	No	100	0
			Yes	0	0
		Other	No	38	12
			Yes	62	12
34	Do you think your wastage rates should decrease, stay the same or increase?		decrease	79	17
			increase	20	17
			stay the same	1	2
35	What strategies would you use to change your wastage rate?	improve stock management	No	47	27
			Yes	53	27
		batch children	No	59	25
			Yes	41	25
		better organize outreach sessions	No	54	26
			Yes	46	26
		improve community mobilization	No	62	25
			Yes	38	25
		implement EEFO	No	91	6
			Yes	9	6
		implement MDVP	No	91	6
			Yes	9	6
		change number of vaccination sessions	No	94	6
			Yes	6	6
		vial size	No	94	6
			Yes	6	6
		Don't know	No	100	0
			Yes	0	0

		Other	No	56	26
			Yes	44	26
36	What are the data you need to calculate your vaccine wastage?	target population	No	62	24
			Yes	38	24
		health facility needs	No	100	0
			Yes	0	0
		wastage factor	No	100	0
			Yes		
		buffer	No	100	0
			Yes	0	0
		coverage	No	62	25
			Yes	38	25
		current stock	No	94	6
			Yes	6	6
		number of doses in schedule	No	61	25
			Yes	39	25
		Don't know	No	100	0
			Yes	0	0
		Other	No	50	24
			Yes	50	24
37	Are stockouts or inadequate quantities of vaccines a problem in this LGA?		No	3	3
			Yes	97	3
38	Do you think there is any association between stockouts and vaccine wastage?		No	38	13
			Yes	62	13
39	Does vaccine wastage relate to vaccine coverage?		No	43	26
			Yes	57	26

Annex Table 5: LGA KAP questions results for numerical - continuous variables

Description	N	Weighted Mean	Standard Error	Minimum	Maximum
Wastage target for BCG	10	41.0	4.1	-	24.0
Wastage target for POL	9	17.4	3.5	1.0	5.0
Wastage target for DPT	9	17.1	3.4	1.0	4.0
Wastage target for HepB	9	17.1	3.4	2.0	80.0
Wastage target for MCV	9	30.9	4.0	2.0	99.0
Wastage target for YF	9	31.3	4.0	1.0	19.0
Wastage target for TT	9	17.2	3.3	2.0	24.0

Annex: Complete Health facility stock data results

Table 1: Median of calculated monthly wastage over six month period (Jan to June 2011)

Formula: (# of doses,start + # of doses received - # of doses,end - # of children vax)/ (# of doses,start + # of doses received - # of doses,end)

Variable name	Description	N	Minimum	Maximum	Mean	Std Error of Mean	Median	Quartile 1 (25%)	Quartile 3 (75%)
median_clwsb	BCG vaccine wastage rate	26	0%	38%	20%	1%	17%	9%	33%
median_clwsp	Polio vaccine wastage rate	33	-87%	64%	26%	4%	12%	8%	47%
median_clwsd	DTP vaccine wastage rate	32	-32%	52%	18%	6%	17%	5%	24%
median_clwsh	HepB vaccine wastage rate	34	-63%	50%	16%	10%	10%	1%	34%
median_clwsm	Measles vaccine wastage rate	35	-90%	60%	21%	4%	18%	9%	35%
median_clwst	TT vaccine wastage rate	32	-20%	55%	22%	2%	23%	12%	35%

Table 2: Median of reported monthly wastage over six month period (Jan to June 2011)

Formula: reported wastage from monthly reporting form

Variable name	Description	N	Minimum	Maximum	Mean	Std Error of Mean	Median	Quartile 1 (25%)	Quartile 3 (75%)
median_wsb	BCG vaccine wastage rate	11	4%	33%	15%	4%	15%	4%	19%
median_wsp	Polio vaccine wastage rate	11	3%	16%	8%	1%	8%	4%	10%
median_wsd	DTP vaccine wastage rate	11	3%	15%	9%	1%	7%	6%	13%

median_wsh	HepB vaccine wastage rate	11	3%	15%	10%	1%	9%	7%	12%
median_wst	Measles vaccine wastage rate	11	4%	24%	13%	3%	13%	4%	18%
median_wsm	TT vaccine wastage rate	11	6%	48%	21%	5%	19%	10%	24%

Table 3: Median of reported monthly coverage over six month period (Jan to June 2011)

Formula: reported coverage from monthly reporting form

Variable name	Description	N	Minimum	Maximum	Mean	Std Error of Mean	Median	Quartile 1 (25%)	Quartile 3 (75%)
median_cvp0	Polio 0 coverage	10	16	137	68	2	67	53	76
median_cvp1	Polio 1 coverage	10	25	107	73	6	70	49	85
median_cvp2	Polio 2 coverage	10	27	93	56	4	51	41	58
median_cvp3	Polio 3 coverage	10	27	89	67	5	66	50	73
median_cvd1	DTP1 coverage	15	27	120	84	10	89	54	104
median_cvd2	DTP2 coverage	10	32	104	84	8	83	68	99
median_cvd3	DTP3 coverage	15	26	121	78	7	79	58	96
median_cvh1	HepB1 coverage	10	32	130	88		90	70	98

						4			
median_cvh2	HepB2 coverage	10	35	112	89	9	94	74	100
median_cvh3	HepB3 coverage	10	33	112	88	6	89	70	98
median_cvm1	Measles coverage	10	38	124	89	7	90	82	96
median_cvy1	YF coverage	10	38	124	91	4	90	85	94
median_cvt1	TT1 coverage	12	3	117	60	20	50	26	84
median_cvt2	TT2 coverage	15	-	101	41	11	36	22	46

Table 3: Median of reported cold chain information over six month period (Jan to June 2011)

Formula: reported from cold chain maintenance register

Variable name	Description	N	Minimum	Maximum	Mean	Std Error of Mean	Median	Quartile 1 (25%)	Quartile 3 (75%)
median_ccmin	Minimum cold chain temperature recorded	4	-6	2	-1.1	.	-1.6499	-5.40493	0.607183
median_ccmax	Maximum cold chain temperature record	4	2	8	5.554	.	4.52012	2	6.357183

median_ccu2m	# of times under 2 degrees	4	0	0	0	.	0	0	0
median_cco8m	# of times over 8 degrees	4	0	0	0	.	0	0	0

Table 4: Median of opened vial wastage over six month period (Jan to June 2011)

Formula: Number of children vaccinated / Number of doses opened ; Note: indicator is incomplete as no data available on opened vial wastage

Variable name	Description		Minimum	Maximum	Mean	Std Error of Mean	Median	Quartile 1 (25%)	Quartile 3 (75%)
median_opwsb	BCG opened vial wastage		0%	38%	19%	5%	15%	9%	31%
median_opwsp	Polio opened vial wastage		-53%	64%	15%	7%	9%	5%	44%
median_opwsd	DTP opened vial wastage		-32%	63%	19%	3%	13%	7%	23%
median_opwsh	HepB opened vial wastage		-63%	50%	16%	2%	10%	4%	32%
median_opwsm	Measles opened vial wastage		-90%	60%	19%	3%	10%	8%	33%
median_opwst	TT opened vial wastage		-20%	57%	23%	3%	24%	10%	31%