Fiji National Immunisation Coverage Survey - 2013

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Abstract

In 2013, the Fiji Ministry of Health conducted a national immunisation coverage survey. Using a two-stage household-based cluster design, the survey sampled 1,209 children aged between 15 and 26 months and 1,997 mothers who had given birth in the preceding 26 months from all four administrative divisions. Data on vaccinations and the date they were given were collected to determine national and divisional rates of immunisation coverage for the vaccinations on Fiji's EPI schedule. For all antigens on the childhood schedule, coverage is sufficient to meet or exceed the levels for required herd immunity. However, improvement in timeliness and coverage for some vaccinations (HBV0 and MR) is still required. Coverage of maternal tetanus toxoid vaccination is estimated at 58% nationally, indicating that improvement is needed to reach women with the required number of doses of tetanus toxoid vaccine.

Introduction

Immunisation coverage for vaccines listed on the national immunisation schedule is an important measure of the performance of Fiji's national immunisation program. In line with its EPI policy (Fiji Ministry of Health, 2013), the Fiji Ministry of Health conducts a nationwide immunisation coverage survey every 3–5 years. These surveys provide the Ministry of Health with an assessment of the national and divisional immunisation coverage rates for vaccines listed on the childhood immunisation schedule (Table 1) and for tetanus toxoid for women who have delivered a child in the preceding 26 months (Table 2). The surveys are also used to measure progress relative to prior surveys and for comparison with routine health facility reporting (administrative reports) of vaccination coverage. This article presents the findings from the immunisation coverage survey conducted in 2013, five years after the previous survey in 2008.

Table 1: Fiji national immunisation schedule for children aged less than 12 months. This schedule was superseded in late 2012 but was the applicable schedule for children aged 15–26 months being surveyed in 2013.

Child's age	Vaccine	Dose	Route of administration	Site of injection
Birth	BCG	0.05ml	Intradermal	Mid upper left arm
	HepB0	0.5ml	Intramuscular	Anterolateral thigh
	OPV0	2 drops	Oral	Mouth
6 weeks	DTPw-Hib-HepB1	0.5ml	Intramuscular	Anterolateral thigh
	OPV1	2 drops	Oral	Mouth
10 weeks	DTPw-Hib-HepB2	0.5ml	Intramuscular	Anterolateral thigh
	OPV2	2 drops	Oral	Mouth
14 weeks	DTPw-Hib-Hep3	0.5ml	Intramuscular	Anterolateral thigh
	OPV3	2 drops	Oral	Mouth

Amended from: Public Health Division, Fiji Ministry of Health (2004). Shaping Fiji's Health: Fiji Immunisation Policy 2004.

Table 2: Fiji tetanus toxoid immunisation schedule for women of childbearing age (Fiji Ministry of Health, 2013)

Vaccination history	Dose	When to give
If no previous doses in childhood or pregnancy	TT1	At first contact or as early as possible in pregnancy
	TT2	At least 4 weeks after TT1
	TT3	At least 6 months after TT2
	TT4	At least 1 year after TT3 or during subsequent pregnancy
	TT5	At least 1 year after TT4 or during subsequent pregnancy
Second or subsequent pregnancy with x3 doses given	TT4	At first contact
	TT5	One year later or during subsequent pregnancies
If x4 doses already given	TT5	At first contact
If x5 doses already given	TT6	At presentation to antenatal clinic with first pregnancy
	TT7	20 years after last dose
	Subsequent doses	Booster doses every 20 years during childbearing years
Comments	*5 dose schedule for TT began in 1997*	
	Women who had children prior to 1997 should have doses calculated according to the schedule so that no woman should have more than 5 doses	

Methods

Approvals

The Fiji Ministry of Health commissioned and approved the survey. Ethics approval was obtained from the Fiji National Research Ethics Review Committee (FNRERC). At the village level, village leaders from survey sites were notified and local permission was obtained to conduct the study within villages.

Sampling design

The survey employed a two-stage household based cluster design in each of Fiji's four administrative divisions (Central, Western, Northern and Eastern). The target sample size in each division was 300 children aged between 15 months (456 days) and 26 months (821 days) and 300 mothers who had given birth in the preceding 26 months (821 days). This sample size was designed to give a precision of 5% or better and a confidence level of 95% for coverage for all vaccines in each division, using a design effect of 2 and estimated coverage of 90%. The 90% estimated coverage was based on the results of the 2008 EPI coverage survey.

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In each of the four divisions, the 2007 National Census enumeration areas and populations were used as the clusters in the sampling. Within each division, 30 clusters and 3 contingency clusters were randomly selected with a probability proportional to their population size.

Within each of the selected clusters, enumerators surveyed ten children aged between 15 and 26 months and ten mothers who had given birth in the preceding26 months. Enumerators used a hierarchy of five methods to randomly select the first household to survey with the more robust equal probability methods (methods 1–3) being preferred.

- Method 1 - Using the Nurse's Census book
- Method 2 – Using the EA map
- Method 3 – Counting and mapping households
- Method 4 – Subdivision of large clusters followed by mapping of subdivision
- Method 5 – Random walk from centre of cluster

After selecting and surveying the starting household, the enumerators then visited the next nearest house, continuing until the required sample of children and mothers for the cluster had been reached.

Enumerators administered pre-tested questionnaires amended from the WHO EPI protocol to parents and caregivers in consenting households(World Health Organization, 2006). The questionnaires focussed on which vaccines from the national EPI schedule a child had received and when. Verification of vaccines and dates was attempted using health facility records for children who did not have an immunisation card. The questionnaires also asked about reasons for failure to immunise for children who were not fully immunised. Mothers were asked about doses of the tetanus toxoid vaccine received during the most recent pregnancy and doses received in the past.

For households where residents could not be located or did not consent to participate enumerators proceeded to the next nearest house. Local health staff were contacted in advance of the study and asked to alert villagers about the upcoming survey in an attempt to minimise the number of empty households encountered.

Enumerators worked in pairs. One enumerator entered the data on an Android smartphone (Alcatel One Touch 4030D) using Mobile Data Studio 7.2.0 (CreativityCorp Pty Ltd, 2013) which included checks to ensure the validity of the data being entered and the other enumerator recorded the data on a paper questionnaire. Smartphone data was transferred and paper questionnaires were collected at the end of each day.

Enumerators were Ministry of Health employed nursing officers, and graduates from Post Graduate Public Health from Fiji School Of Medicine. We specifically selected enumerators from a range of different linguistic backgrounds to be sure that surveyors could communicate with residents in all areas. Enumerators received two days' training in field epidemiology, research methods and the survey protocol, plus one day of practical field exercises and pilot testing. Data collection took place in August and September 2013.

Statistical analysis

The paper questionnaires were double-entered into Microsoft Excel(Microsoft Corporation, 2010) and then cleaned. Prior to analysis, the paper data was compared to the Mobile Data Studio (MDS) data set and any data missing from the MDS set was added in. This combined data set was then used for analysis. All observations that contained date data for one or more vaccine doses were classified as verified by immunisation card.

Data analysis was conducted using Microsoft Excel and STATA version 12(Statacorp, 2011). Data was analysed as a multi-stage survey in STATA and post-stratification weighting was used based on the 2007 census data.

RESULTS

In the dataset used for analysis, there were:

- 1,209 children aged 15 – 26 months who were assessed for coverage with vaccines listed on the national childhood immunisation schedule. Of these, 1,154 had a card or health facility record that was used to verify their immunisation status.
- 1,197 mothers who had given birth in the preceding 26 months were assessed for coverage of tetanus immunisation for pregnant women.

Childhood immunisations

Demographics

46% (n=561) of the sample was female and 54% was male. 73% (n=926) of children surveyed were i-Taukei, about 24% (n=240) were Fijian of Indian Descent and 2% (n=38) were Fijians of other ethnicity. The small remainder consisted of expatriates (n=1) and children whose ethnicity was not recorded (n=2).

Immunisation: full coverage

On the most conservative estimate, 91% of children nationally have received all 10 doses on the immunisation schedule and are fully immunised (Table 3). Divisionally, this coverage ranges from 87% in Eastern division to 94% in Northern. When parental reports are accepted, almost 95% of children nationally are fully immunised.

Table 3: National immunisation coverage for each vaccine on the childhood schedule

Child's Age	Vaccine	Means of Verification								
		Cardholders (N=1,152)			Card (N=1,209)			Card + Parental Report (N=1,209)		
		Proportion	95% CI	n	Proportion	95% CI	n	Proportion	95% CI	n
Birth	BCG	99.6%	99 – 99.8	1,144	95.3 %	93.4 – 96.7	1,144	98.7 %	97.8 – 99.3	1,194
	HBV0	99.6%	99 – 99.9	1,143	95.4 %	93.4 – 96.8	1,143	98.8 %	97.8 – 99.3	1,193
	OPV0	99.3%	98.3 – 99.7	1,140	95.1 %	92.9 – 96.6	1,140	98.5 %	97.3 – 99.1	1,190
6 Weeks	Pentavalent 1	99.5%	98.5 – 99.9	1,145	95.3 %	93.1 – 96.8	1,145	98.7 %	97.6 – 99.3	1,195
	OPV1	99.6%	98.5 – 99.9	1,146	95.3 %	93.2 – 96.8	1,146	98.7 %	97.6 – 99.3	1,196
10 Weeks	Pentavalent 2	99.4%	98.3 – 99.8	1,143	95.1 %	92.9 – 96.7	1,143	98.5 %	97.3 – 99.2	1,193
	OPV2	99.4%	98.3 – 99.8	1,143	95.1 %	92.9 – 96.7	1,143	98.5 %	97.3 – 99.2	1,193
14 Weeks	Pentavalent 3	99.1%	97.7 – 99.6	1,141	94.9 %	92.7 – 96.4	1,141	98.3 %	96.9 – 99	1,191
	OPV3	99.1%	97.7 – 99.7	1,142	94.9 %	92.7 – 96.5	1,142	98.3 %	96.9 – 99.1	1,192
12 Months	Measles-Rubella 1	96.4%	94.1 – 97.8	1,114	92.3 %	89.4 – 94.4	1,114	95.6 %	93.2 – 97.2	1,164
	Received all 10 vaccines	**95.5%**	**93.1 – 97.0**	**1,098**	**91.4 %**	**88.5 – 93.6**	**1,098**	**94.8 %**	**92.3 – 96.5**	**1,148**

Herd immunity

The final dose in each vaccine series was compared to the benchmarks for herd immunity. Based on verification by immunisation card alone, the estimated national and divisional coverage rates exceed the benchmark for herd immunity for polio, diphtheria and rubella (Fiji Ministry of Health, 2013; Michigan Center for Public Health Preparedness, n.d.)(Table 4). With the exception of Eastern Division, the estimated national and divisional coverage rates exceed the benchmark for herd immunity for pertussis. For measles, divisional and national coverage rates fall within, but do not exceed the benchmark. A less conservative estimate using card plus parental report results in divisional and national coverage rates that meet the benchmarks for polio, diphtheria, pertussis, measles and rubella.

Table 4: Final dose of vaccines and herd immunity benchmarks

Vaccine	National coverage (%)		Estimated coverage necessary for herd immunity (%)
	Card	Card + parental report	
OPV3	94.9 (92.7 – 96.5)	98.3 (96.9 – 99.1)	Polio: 80-86%
Penta3	94.9 (92.7 – 96.4)	98.3 (96.9 – 99.1)	Diphtheria: 85% ; Pertussis: 92-94%
MR	92.3 (89.4 – 94.4)	95.6 (93.2 – 97.2)	Measles: 83-94% ; Rubella: 83-85%

Demographic differences in coverage

Using card as the means of verification, there was a statistically significant difference (p = 0.0379) between the divisions with the highest coverage (Northern, 94.1%) and the lowest coverage (Eastern, 87%). When assessing coverage using card plus parental report (n=1,209), there was a small but statistically significant difference in coverage between male and female children and between i-Taukei and Fijian of Indian Descent children.

Immunisation providers

Almost all birth-dose vaccines are given by hospital staff: 90% of OPV0, 91% of HBV0 and 91% of BCG doses are provided at hospitals. For subsequent vaccines, health centres are the major immunisation providers for infants. This is true whether using immunisation card only or card plus parental report as the means of verification.

Features of children not vaccinated

Based on card plus parental report as the means of verification, only 61 (5.2%) of the sampled children were not fully immunised. These children were from 38 clusters spread across all four administrative divisions. 36 were female and 25 were male. Of the children not fully immunised, 64% (n=37) of these children had missed only a single vaccine. Out of these 37 children, the majority had missed the MR vaccine (89%, n = 33) and only 2% (n=21) of children missed one or more birth doses.

The dropout rates for immunisations requiring multiple doses were below 1% highlighting a continuing solid immunisation program provided, in most instances, by health centres. The total dropout rate between pentavalent 1 and pentavalent 3 and between OPV0 and OPV3 was 0.4% (n= 5). The dropout rate between HBV0 and pentavalent 3 was 0.6% (n=7).

MR vaccine coverage is 92.3%: the lowest coverage of any vaccine in the schedule. It would appear that it is more difficult to get children to return at 12 months of age than it is to provide the preceding 9 vaccines on the schedule. The first 9 vaccines in the schedule are all provided within the first 14 weeks of life.

Reasons for immunisation failure

Reasons for failure to immunise were categorised as Obstacles to accessing services, Lack of Motivation to use services, and Lack of Information about services. Obstacles (35%, n=20) and Lack of Motivation (33%, n=18) were the main categories of reasons why a child was not fully immunised. The single most common response for failure to fully immunise was "Lost card" (20.6%, n=13). 11% (n=8) of parents said that they did not know that their child needed to be immunised or were unaware that additional vaccine doses were needed. Fear of side effects was only given as a reason for two children and no responses indicated concern that vaccines are ineffective.

Timeliness of birth dose of hepatitis B vaccine (HBV0)

Nationally, at least 69% of children received their dose of HBV0 within the first 24 hours of life, based on either the recorded date and time the dose was given or, if time data was not available, based on date data indicating that the dose was given on the same date as the child's date of birth. An additional 7% received the dose between 24-48 hours based on time and date data. 9% were known to have received the dose later than 48 hours after birth, for 4% the timing was unknown and 1% did not receive the dose at all.

Timeliness of OPV1, OPV2, OPV3

Nationally, 54% of children received all four doses of OPV at the right time and with the correct spacing. Coverage of timely doses was lowest in Eastern at 44% and highest in Northern at 60%. 62% of Fijian of Indian Descent children received all doses on time compared to 52% of i-Taukei children. This difference was statistically significant (Pearson's test, p <0.05).

Pentavalent vaccine doses (DTPw-Hib-HepB1, DTPw-Hib-HepB2, DTPw-Hib-HepB3)

Nationally 57% of children received three valid doses of the pentavalent vaccine. Eastern was the division with the lowest proportion of children receiving all doses on time (45%) and Northern was the highest (64%) and there were no significant differences between coverage by ethnicity.

Measles-Rubella (MR) vaccine

Coverage of MR is 92.3% based on card confirmation and 95.6% based on card plus parental report. Nationally, 74% of children received MR within approximately one month of the scheduled time of 12 months from birth. Coverage of timely MR was lowest in Eastern division (66%) and highest in Northern (80%). More children received the vaccine too late (11%) than too early (6.5%).

Maternal tetanus toxoid immunisation

Deliveries – site and supervision

Nationally, over 97% of mothers had given birth in hospital. In the more remote and sparsely populated Eastern Division, a smaller proportion of women had given birth in a hospital (88%) and a larger proportion of women had given birth at a health centre, a nursing station, or at home. In Northern Division, hospital deliveries had increased compared with the 2008 survey and the proportion of hospital deliveries was equal to or greater than in the other three divisions. Nationally, a midwife or other health worker was present for 99.6% of deliveries.

Antenatal clinic utilisation

Nationally, 76.9% of women had made six or more visits to an antenatal clinic during their most recent pregnancy (Figure 1). Only 6.5% of women had made less than four visits to an antenatal clinic. The proportion of women making less than four visits was lowest in Eastern Division (3.7%) and highest in Western Division (9.4%), where a significant proportion of women (5.4%) made only three visits.

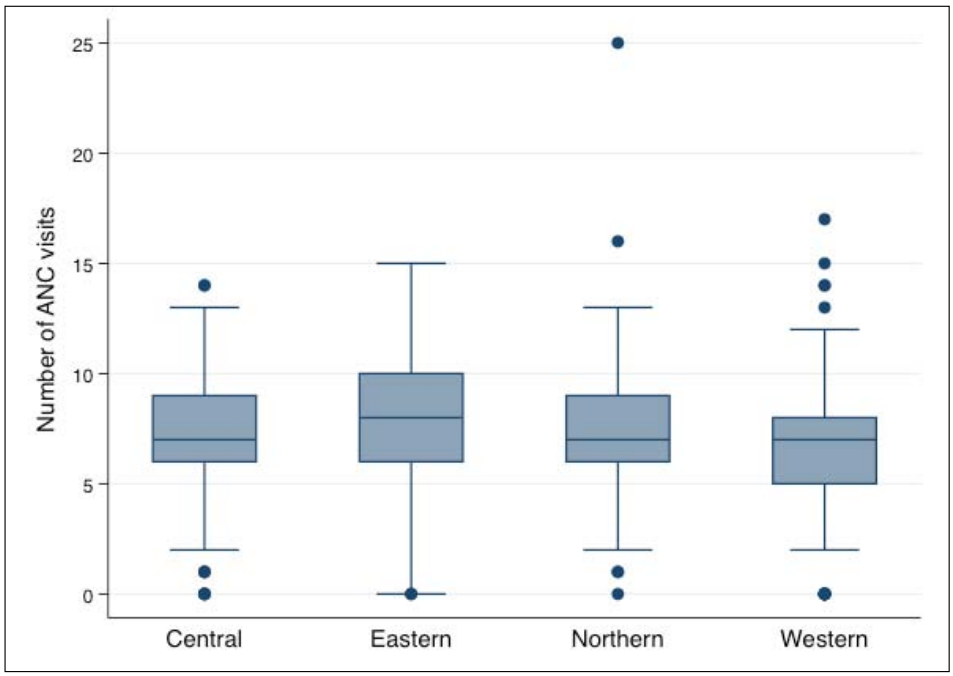

Figure 1: Number of antenatal clinic visits during most recent pregnancy, by Division

Immunisation cards for tetanus toxoid (TT)
A minority of mothers reported having received an immunisation card during their most recent pregnancy (14%) and even fewer could find their card at the time they were interviewed (1.9%)

Immunisation coverage for tetanus toxoid (TT)
58.0% of women who had given birth in the previous 26 months had been fully immunised against tetanus according to the current national immunisation schedule: either receiving 5 doses prior to first pregnancy or a fifth dose during the most recent pregnancy or two or more doses during most recent pregnancy (Table 5). Coverage was found to be lowest in Eastern Division at 45.7% and highest in Western Division at 64.6%.

Table 5: Women protected against tetanus according to WHO guidelines and previous immunisation schedule

Total doses of TT	Doses of TT received during most recent pregnancy										
	0	1	2	3	4	5	6+	TOTALS		%	2008 %
0	65	-	-	-	-	-	-	65	**356**	**26.0%** (20.8–32.0)	**33.0%** (28.4-37.6)
1	19	183	-	-	-	-	-	202			
2	32	57	94	-	-	-	-	94	89		
3	23	98	32	34	-	-	-	187	**522**	**46.0%** (39.9–52.2)	**59.2%** (54.4-63.9)
4	8	59	52	20	-	-	-	139			
5	27	44	15	11	1	2	-	102			
6+	41	189	76	8	-	1	3	319	**319**	**28.0%** (5.8-10)	**7.9%** (5.8-10)
TOTAL	**215**	**630**	**269**	**73**	**1**	**3**	**3**	**1,194**			

Key

Immune : received 2 or more doses of TT during their most recent pregnancy OR a total of 3 or more doses

Immune : but received *more* doses than necessary according to the previous national schedule

Non-immune : insufficient total doses and inadequate doses during most recent pregnancy

Immunisation providers for maternal tetanus toxoid

The majority of doses were delivered at hospitals and a sizeable minority at health centres, which mirrors the provision of antenatal care.

Missed opportunities to immunize

The current national immunisation schedule stipulates that pregnant women who have received zero lifetime doses of TT be given two or three doses of TT during their recent pregnancy, and that pregnant women who have received between one and four lifetime doses of TT be given one dose during their pregnancy.

Among women who had received zero doses of TT prior to their pregnancy, 60.2% received too few TT doses during their most recent pregnancy according to the national schedule. Among women who had received between one and four doses prior to pregnancy, between 6.2% and 23.8% received too few TT doses during their most recent pregnancy. Women who had received more doses of TT prior to their most recent pregnancy received less doses of TT during their most recent pregnancy (Pearson's test, $p < 0.03$). However, the majority of women received a single dose of TT during their most recent pregnancy.

Reasons for failure to immunise

The majority of women who were not fully immunised and for whom responses were recorded attributed their failure to be vaccinated to a lack of information, particularly a lack of awareness of the need for TT immunisation. No statistically significant association was found between women's immunisation status and whether a health worker had ever explained the reason for TT immunisation (Pearson's test, $p > 0.25$) or whether the mother knew why TT was delivered (Pearson's test, $p > 0.8$).

Discussion

Childhood immunisations

There have been significant improvements in coverage since the 2008 survey. The level of immunisation coverage with card-confirmed doses reaches requisite levels for herd immunity for all of the vaccines on the national schedule. When reports from parents are included, levels exceed those required for heard immunity for all antigens. Adherence to the age and dosing interval at which vaccines should be administered has also improved since 2008.

Timely delivery of the birth dose of hepatitis B vaccine is important for reducing maternal-child transmission of hepatitis B virus. The World Health Organization recommends that hepatitis B vaccine be given within the first 24 hours following birth(World Health Organization, 2012).

Based on the 2013 coverage survey results, coverage of timely HBV0 (69%) requires further improvement.

Similarly, coverage of MR and its timely administration are areas where the immunisation program could still improve. Early administration of MR in a single-dose schedule is a particular concern as it reduces the chances that children will develop a protective immune response (World Health Organization, 2009). Some questions about the accuracy of the recorded dates for MR were raised during analysis, such as the incorrect year being recorded for the MR date. A review of dates that would be consistent with this type of error suggests that the survey could have underestimated the proportion of children receiving a timely dose of MR by up to 4%.

Finally, underlying the national rates of coverage are differences between divisions. Timely coverage in Eastern division is lower than other divisions for some vaccination doses. In reviewing the needs for EPI programme strengthening, care should be taken to ensure that the specific challenges and issues in each division are considered.

One of the main reasons given for failure to fully immunise a child was a lost immunisation card. Qualitative investigation of this and other barriers to fully immunising children could help policy makers and health workers devise strategies to further improve immunisation coverage. In addition, health workers and their managers should focus on improving the on-time delivery of vaccines, with a focus on birth doses of OPV0, HBV0 and BCG; as well as ensuring every opportunity to deliver the remainder of the childhood schedule is well utilised.

Card retention has improved since 2008, and is expected to improve further with a new card being introduced with rotavirus and pneumococcal vaccines in late 2012. The rollout of the new cards could be assessed with a small lot quality assurance sampling (LQAS) type survey in 2014 to determine how well it is being used, especially in the area of time of birth dose.

Comparison of immunisation coverage with other data sources

The 2011 Ministry of Health Annual Report (Fiji Ministry of Health, 2011) provides national level coverage for 2011 and 2010 using data from administrative reports. Compared to the coverage levels from the 2008 and 2013 coverage surveys, it appears that administrative report data on coverage underestimates the true level of coverage and may indicate a need to strengthen recording and reporting of information at health facilities.

Table 6: Immunisation coverage by information source

Child's Age	Vaccine	Information Source					
		2008 Coverage survey*	2008 Coverage survey#	2010 Annual report	2011 Annual report	2013 Coverage survey*	2013 Coverage survey#
		Coverage	Coverage	Coverage	Coverage	Coverage (95% CI)	Coverage (95% CI)
Birth	BCG	79.9%	100%	98.7%	96.1%	95.3%	98.7%
	HBV0	79.7%	99.8%	101.9%	97.9%	95.4%	98.8%
	OPV0	79.7%	99.8%	98.6%	96.3%	95.1%	98.5%
6 Weeks	Pentavalent 1	79.7%	99.8%	80.8%	91.3%	95.3%	98.7%
	OPV1	79.7%	99.8%	80.7%	91.2%	95.3%	98.7%
10 Weeks	Pentavalent 2	79.4%	99.5%	80.5%	91.8%	95.1%	98.5%
	OPV2	79.4%	99.5%	80.3%	91.9%	95.1%	98.5%
14 Weeks	Pentavalent 3	78.9%	98.8%	77.2%	90.7%	94.9%	98.3%
	OPV3	79.2%	99.3%	76.7%	90.8%	94.9%	98.3%
12 Months	Measles-Rubella 1	75.6%	93.6%	71.8%	82.5%	92.3%	95.6%
Received all 10 vaccines		**75.2%**	**93.1**	**n/a**	**n/a**	**91.4%**	**94.8%**

* Using card as means of verification

\# Using card plus parental report as means of verification

Maternal tetanus toxoid immunisations

Card ownership and retention among women was low as was awareness of the need to protect their child against neonatal tetanus. Few women were given cards and even fewer keep them. The low proportions of card ownership and retention made it difficult to verify the number of TT doses given to women and the timeliness of those doses. The lack of a lifelong immunisation record also means that TT doses given in childhood are hard to assess. Health services providing TT are likely to face the same lack of information when determining whether a mother needs to be immunised for TT and how many doses she requires.

In this survey, the delivery of TT doses to pregnant women generally does not reflect their vaccination history, with the majority of women receiving one dose of TT in each pregnancy regardless of parity or prior vaccine history. This results in fewer doses than recommended in their first pregnancies, and unrequired doses in later pregnancies.

Approximately two-fifths (42.0%) of women were not on track to be fully immunised with the TT vaccine. The proportion of women who are non-immune to tetanus is relatively high compared to coverage for the vaccines listed on the childhood schedule. Almost all women (98.8%) could have been fully protected against tetanus if staff at antenatal clinics had immunised them according to the recommended schedule. This represents a substantial number of missed opportunities. Antenatal staff should receive refresher training on the need to review both parity and immunisation history of pregnant women, to ensure that the appropriate number of doses are given to pregnant women. Balanced against these shortcomings, there are no known cases of neonatal tetanus and few women deliver outside hospitals.

To improve quality and coverage of TT immunisation for women, tetanus toxoid information and immunisation cards should be routinely provided through antenatal clinics as part of the normal health education given to mothers during pregnancy. Other avenues of providing information to expectant mothers should also be considered.

Survey limitations

Some limitations of the survey coverage were noted:

- Selection bias – especially with exclusions in Eastern division and a small number of excluded communities in Northern division.
- Reporting bias – a problem wherever cards were not retained and a particular problem for assessment of tetanus toxoid coverage among women.
- Issues with reporting of reasons for failure to vaccinate – the pre-set quantitative tool is not ideal for assessing these reasons. Qualitative tools can provide much richer data.

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References

CreativityCorp Pty Ltd. (2013). Mobile Data Studio. West Perth, Western Australia, Australia: CreativityCorp Pty Ltd.

Fiji Ministry of Health. (2011). The Ministry of Health Annual report 2011.

Fiji Ministry of Health. (2013). Fiji National Immunisation Policy and Procedure Manual, 2013–2016.

Michigan Center for Public Health Preparedness. (n.d.). epiCentral. University of Michigan. Retrieved November 13, 2013, from https://practice.sph.umich.edu/micphp/epicentral/basic_reproduc_rate.php

Microsoft Corporation. (2010). Microsoft Excel for Mac 2011. Redmond, California, USA: Microsoft Corporation.

Statacorp. (2011). Stata 12. College Station, Texas, USA: Statacorp.

World Health Organization. (2006). Training for mid-level managers (MLM). Module 7: The EPI coverage survey. Geneva.

World Health Organization. (2009). Measles vaccines: WHO Position Paper. Weekly Epidemiological Record, (35), 349–360.

World Health Organization. (2012). Practices to improve coverage of the hepatitis B birth dose vaccine. Geneva.