Implementing WHO guidance on conducting and analysing vaccination coverage cluster surveys: Two examples from Nigeria
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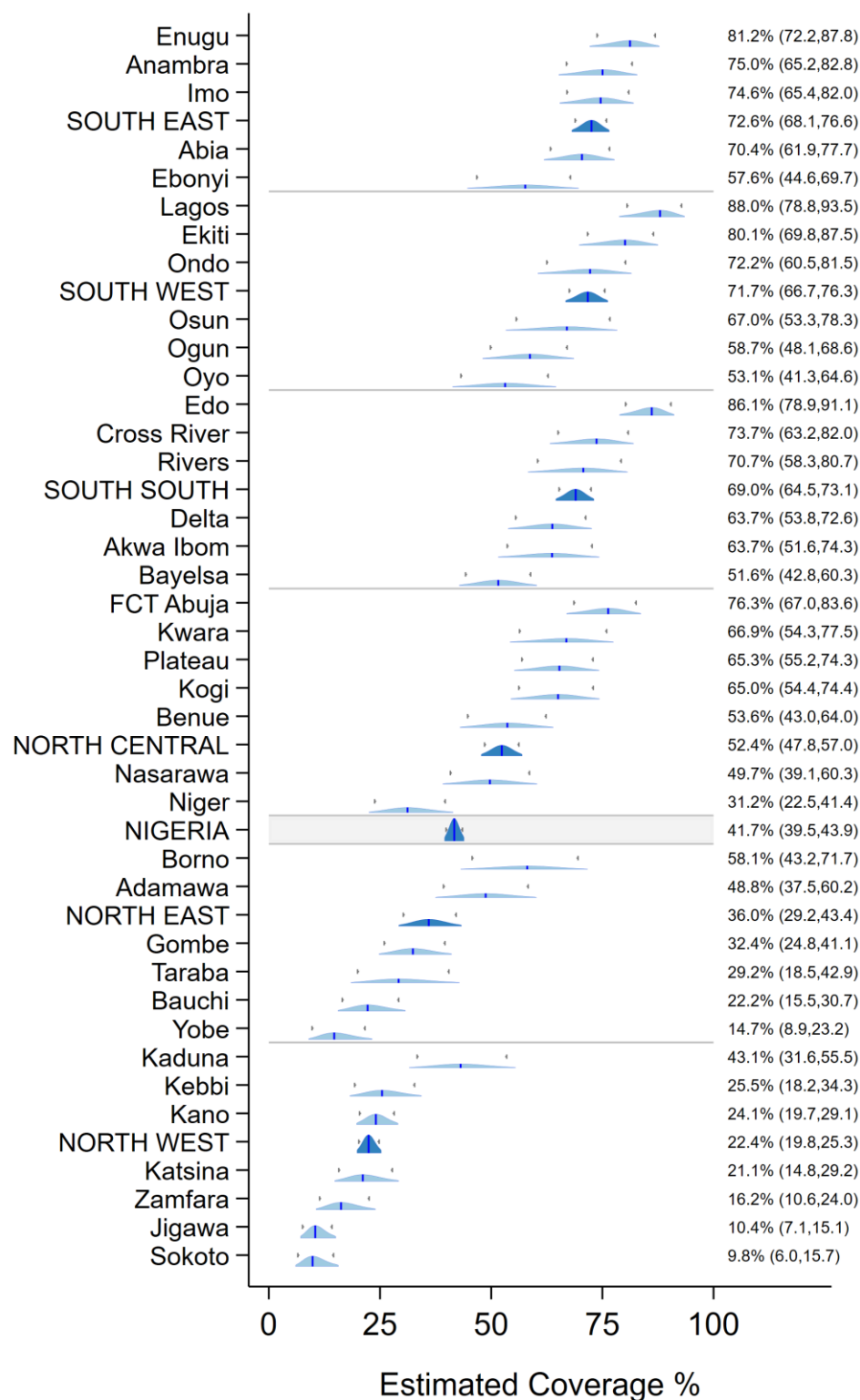4. MICS/NICS data cleaning details

Supplementary Figures

S1 Fig: Map of Nigeria, showing zones (coloured) and states
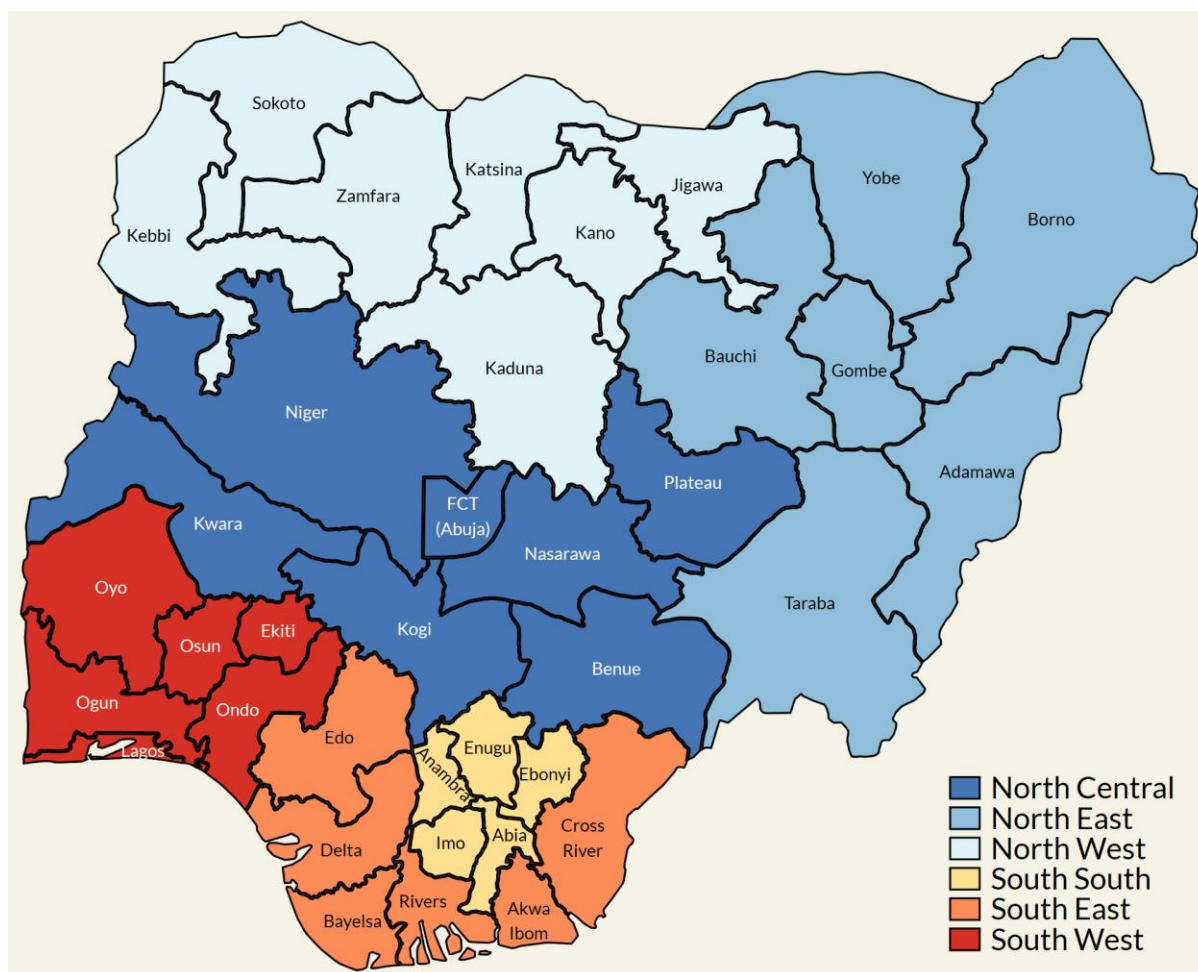
Note: The map was plotted by the authors in Stata (StataCorp. 2019. Stata Statistical Software: Release 16. College Station, TX: StataCorp LLC.). No copyrighted materials were used. The boundaries and names shown and the designations used on this map do not imply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city or area nor of its authorities, or concerning the delimitation of its frontiers or boundaries.

S2 Fig: Crude coverage with one dose of measles-containing vaccine (MCV1), children aged 12-23 months, Nigeria MICS/NICS 2016-17, by state and zone

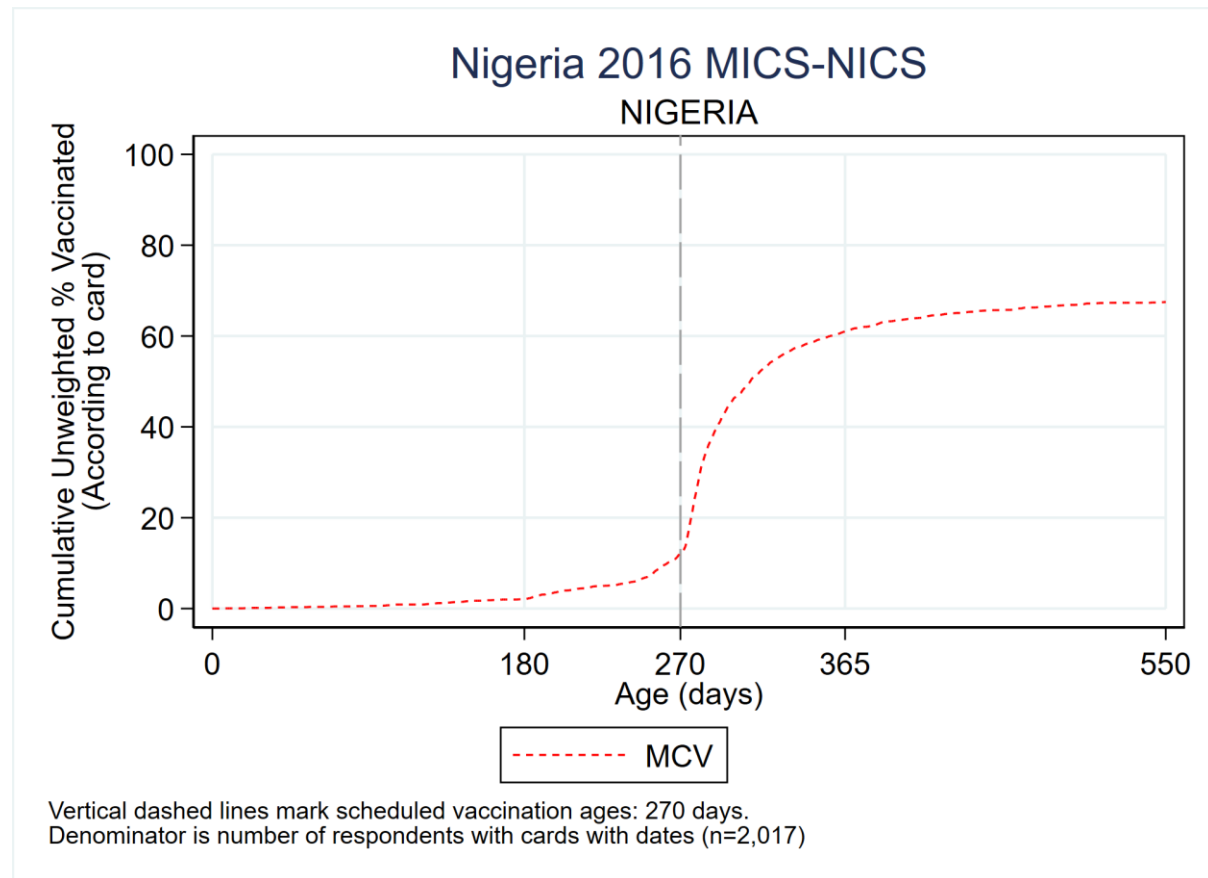| State / Zone	Point Estimate (95% CI)
Enugu	81.2% (72.2,87.8)
Anambra	75.0% (65.2,82.8)
Imo	74.6% (65.4,82.0)
SOUTH EAST	72.6% (68.1,76.6)
Abia	70.4% (61.9,77.7)
Ebonyi	57.6% (44.6,69.7)
Lagos	88.0% (78.8,93.5)
Ekiti	80.1% (69.8,87.5)
Ondo	72.2% (60.5,81.5)
SOUTH WEST	71.7% (66.7,76.3)
Osun	67.0% (53.3,78.3)
Ogun	58.7% (48.1,68.6)
Oyo	53.1% (41.3,64.6)
Edo	86.1% (78.9,91.1)
Cross River	73.7% (63.2,82.0)
Rivers	70.7% (58.3,80.7)
SOUTH SOUTH	69.0% (64.5,73.1)
Delta	63.7% (53.8,72.6)
Akwa Ibom	63.7% (51.6,74.3)
Bayelsa	51.6% (42.8,60.3)
FCT Abuja	76.3% (67.0,83.6)
Kwara	66.9% (54.3,77.5)
Plateau	65.3% (55.2,74.3)
Kogi	65.0% (54.4,74.4)
Benue	53.6% (43.0,64.0)
NORTH CENTRAL	52.4% (47.8,57.0)
Nasarawa	49.7% (39.1,60.3)
Niger	31.2% (22.5,41.4)
NIGERIA	41.7% (39.5,43.9)
Borno	58.1% (43.2,71.7)
Adamawa	48.8% (37.5,60.2)
NORTH EAST	36.0% (29.2,43.4)
Gombe	32.4% (24.8,41.1)
Taraba	29.2% (18.5,42.9)
Bauchi	22.2% (15.5,30.7)
Yobe	14.7% (8.9,23.2)
Kaduna	43.1% (31.6,55.5)
Kebbi	25.5% (18.2,34.3)
Kano	24.1% (19.7,29.1)
NORTH WEST	22.4% (19.8,25.3)
Katsina	21.1% (14.8,29.2)
Zamfara	16.2% (10.6,24.0)
Jigawa	10.4% (7.1,15.1)
Sokoto	9.8% (6.0,15.7)

Estimated Coverage %

Text at right: Point Estimate (2-sided 95% Confidence Interval)

Note: Strata are sorted bottom-to-top by zone-level coverage and within each zone, sorted by state-level coverage. National coverage appears near the centre with grey shading. Zone names are listed in capital letters and horizontal grey lines demarcate zones.
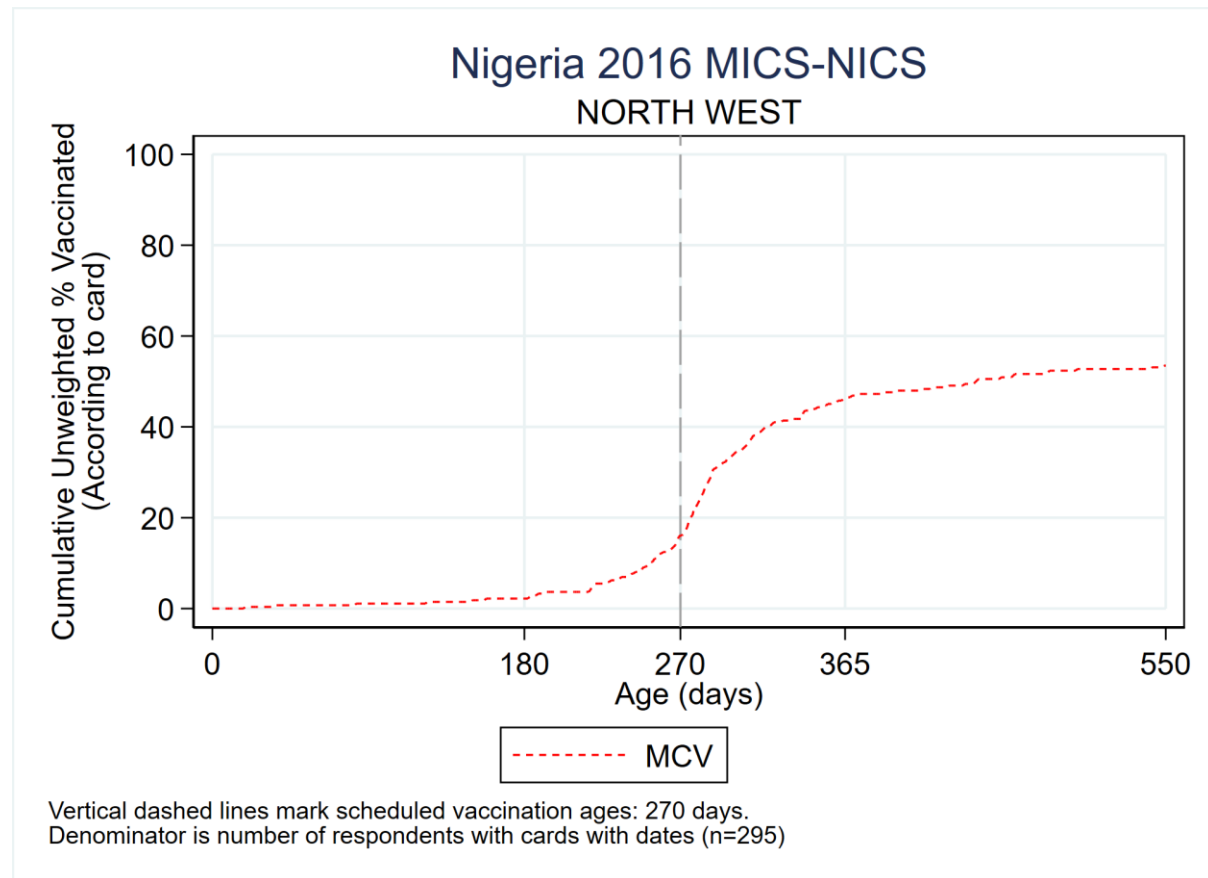
S3 Fig: Post-measles campaign coverage survey (PMCCS) "organ pipe plots" of percentage of children in each survey cluster who had received a measles vaccine SIA dose (by card or history) for four states, Nigeria PMCCS 2018.
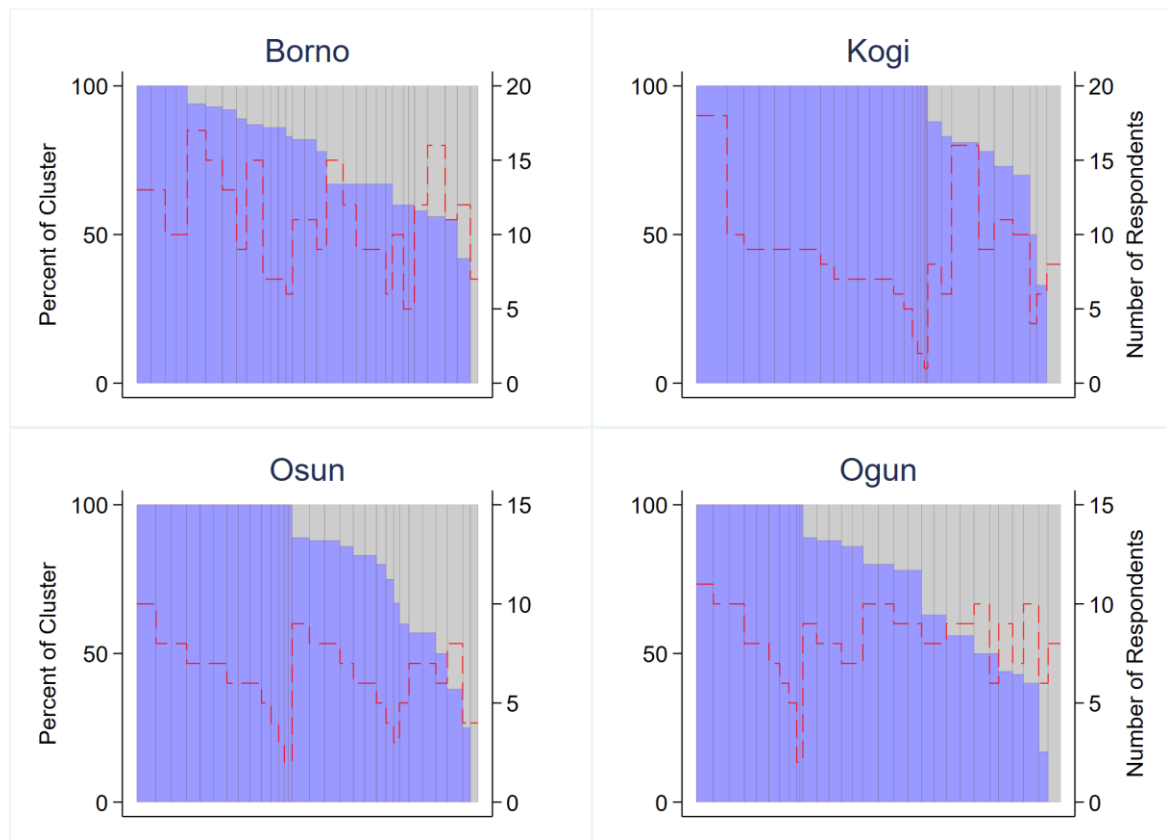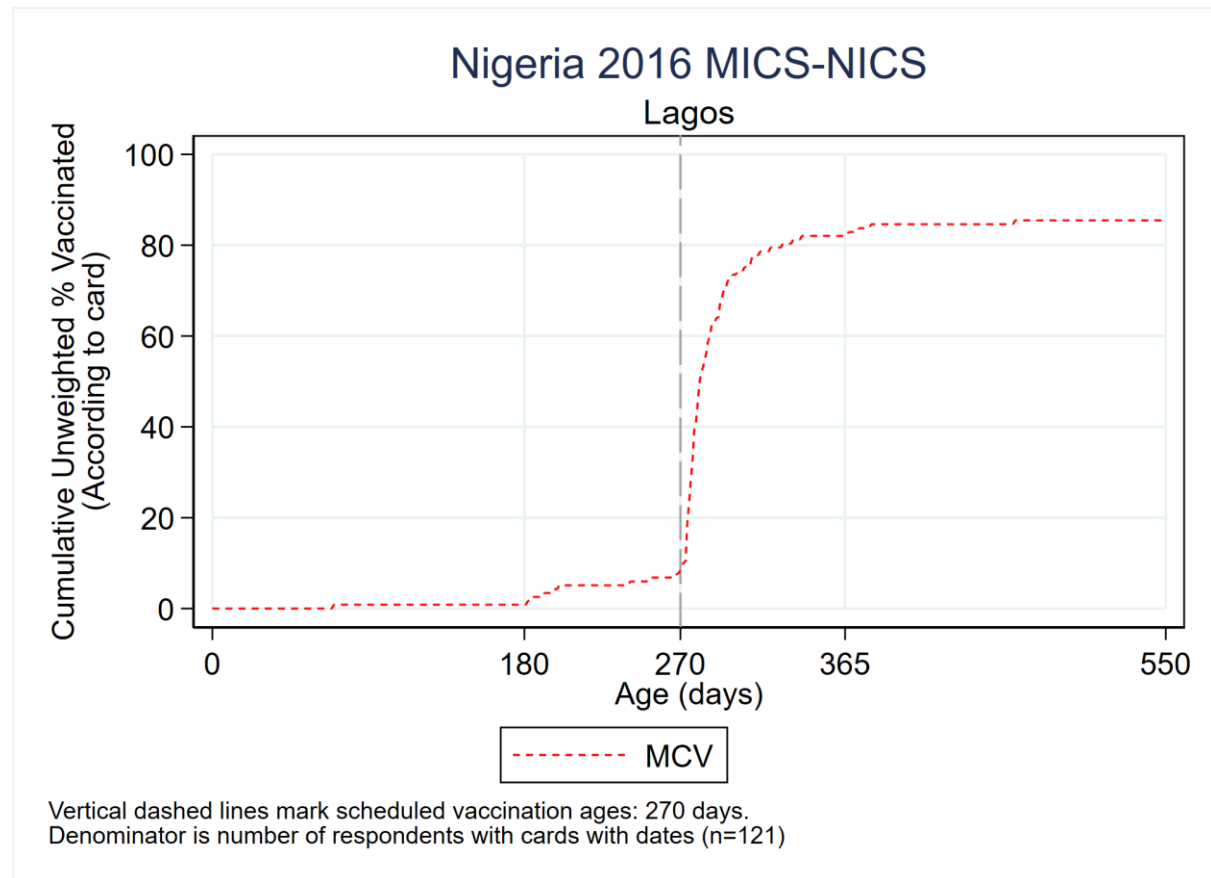
S4 Fig: Cumulative measles-containing vaccine (MCV) coverage plot by age of child (days) in Nigeria among children aged 12-23 months who showed a home-based record or card, MICS/NICS 2016-17

Nigeria 2016 MICS-NICS

NIGERIA

Vertical dashed lines mark scheduled vaccination ages: 270 days.
Denominator is number of respondents with cards with dates (n=2,017)

S5 Fig: Cumulative measles-containing vaccine (MCV) coverage plot by age of child (days) in North West zone, among children aged 12-23 months who showed a home-based record or card, Nigeria MICS/NICS 2016-17

Nigeria 2016 MICS-NICS
NORTH WEST

Vertical dashed lines mark scheduled vaccination ages: 270 days.
Denominator is number of respondents with cards with dates (n=295)

S6 Fig: Cumulative measles-containing vaccine (MCV) coverage plot by age of child (days) in Lagos state, among children aged 12-23 months who showed a home-based record or card, Nigeria MICS/NICS 2016-17

Nigeria 2016 MICS-NICS

Lagos

Vertical dashed lines mark scheduled vaccination ages: 270 days.
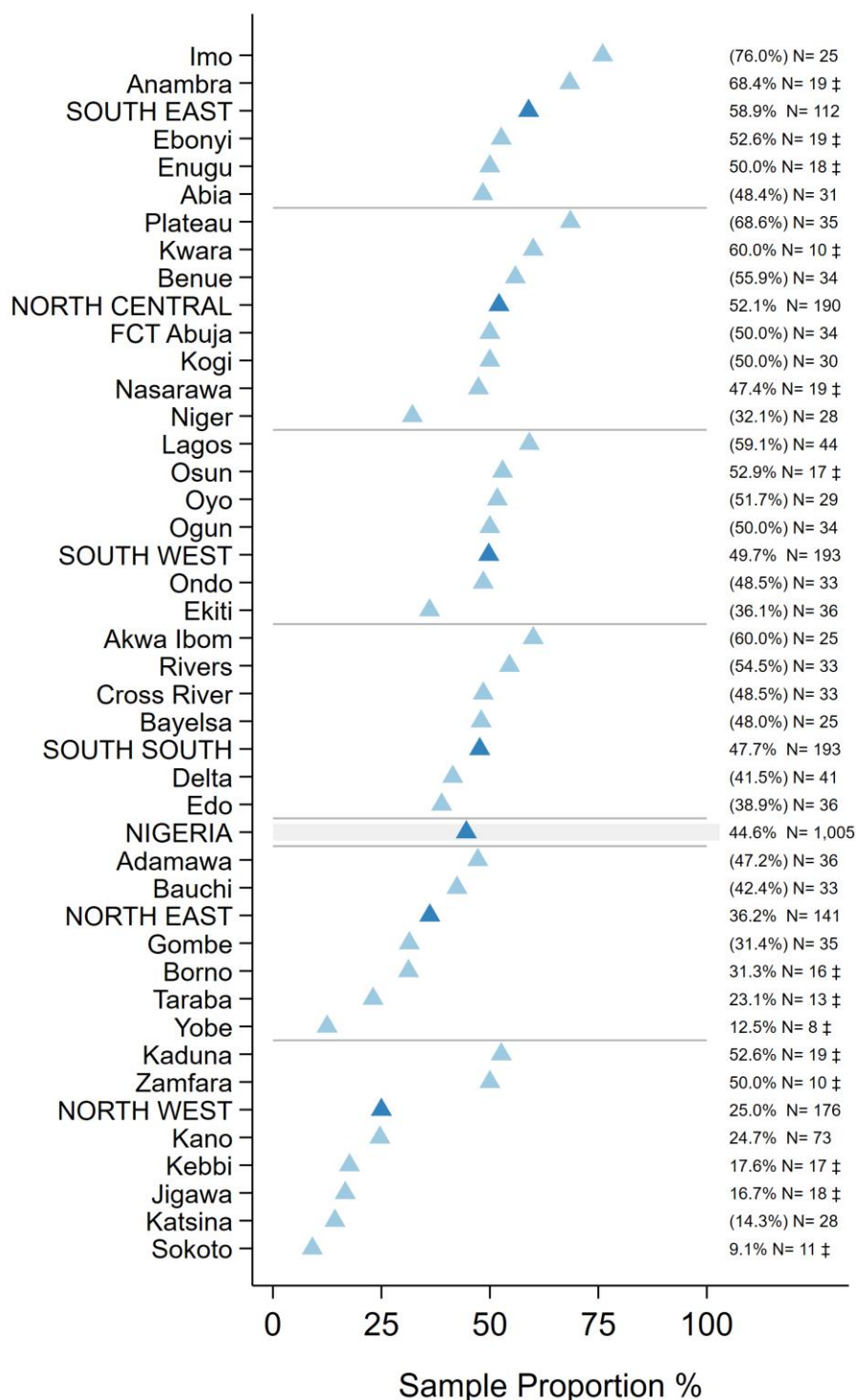Denominator is number of respondents with cards with dates (n=121)

S7 Fig: Cumulative pentavalent dose 1, 2 and 3 vaccine coverage plot by age of child (days) among children aged 12-23 months who showed a home-based record or card, Lagos state, Nigeria MICS/NICS 2016-17
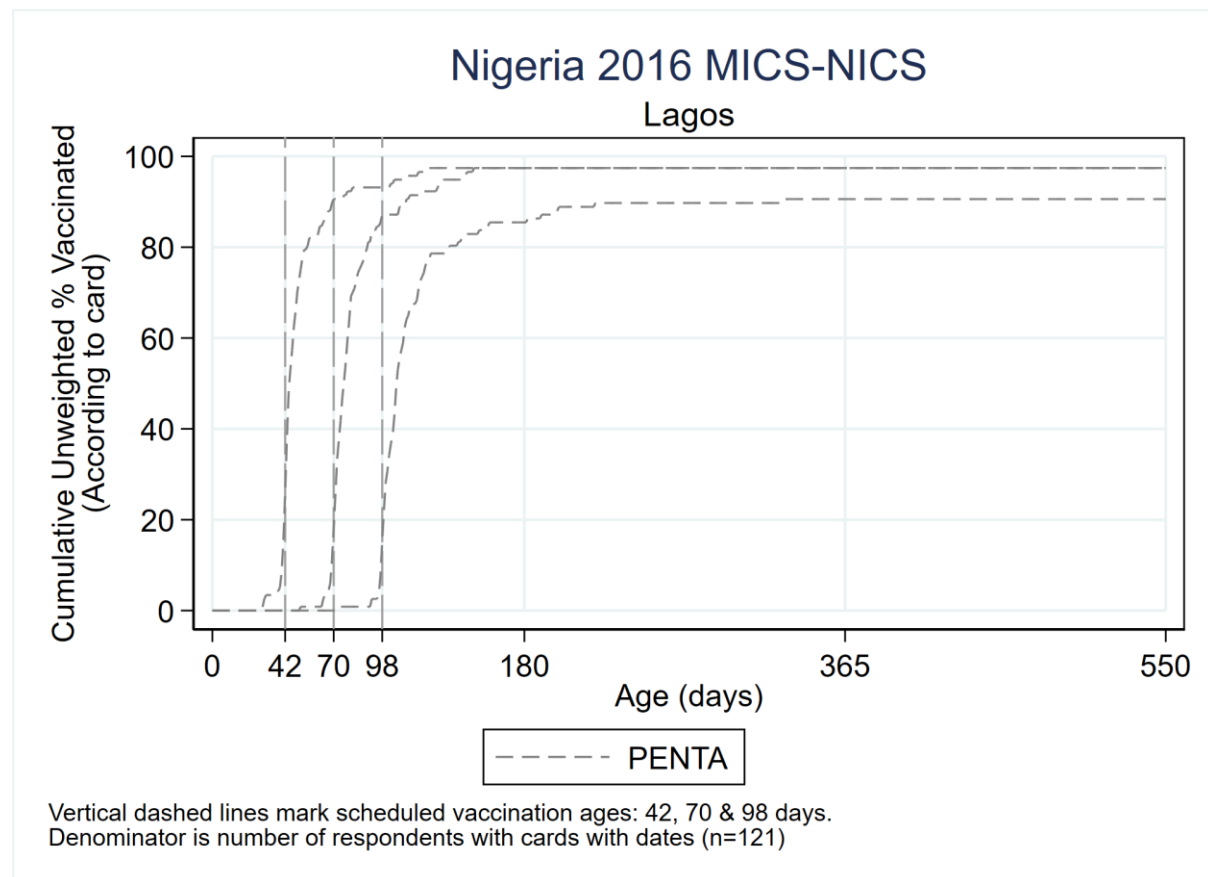
S8 Fig: Unweighted percentage of children aged 12-23 months with a home-based record (HBR) and at least one missed opportunity for vaccination (MOV) for BCG, HBV0, OPV0-3, Penta1-3, MCV or YF who later received all the vaccines that had been missed ("corrected" MOVs), by state and zone, Nigeria MICS/NICS 2016-17

State/Zone	Value
Imo	(76.0%) N= 25
Anambra	68.4% N= 19 ‡
SOUTH EAST	58.9% N= 112
Ebonyi	52.6% N= 19 ‡
Enugu	50.0% N= 18 ‡
Abia	(48.4%) N= 31
Plateau	(68.6%) N= 35
Kwara	60.0% N= 10 ‡
Benue	(55.9%) N= 34
NORTH CENTRAL	52.1% N= 190
FCT Abuja	(50.0%) N= 34
Kogi	(50.0%) N= 30
Nasarawa	47.4% N= 19 ‡
Niger	(32.1%) N= 28
Lagos	(59.1%) N= 44
Osun	52.9% N= 17 ‡
Oyo	(51.7%) N= 29
Ogun	(50.0%) N= 34
SOUTH WEST	49.7% N= 193
Ondo	(48.5%) N= 33
Ekiti	(36.1%) N= 36
Akwa Ibom	(60.0%) N= 25
Rivers	(54.5%) N= 33
Cross River	(48.5%) N= 33
Bayelsa	(48.0%) N= 25
SOUTH SOUTH	47.7% N= 193
Delta	(41.5%) N= 41
Edo	(38.9%) N= 36
NIGERIA	44.6% N= 1,005
Adamawa	(47.2%) N= 36
Bauchi	(42.4%) N= 33
NORTH EAST	36.2% N= 141
Gombe	(31.4%) N= 35
Borno	31.3% N= 16 ‡
Taraba	23.1% N= 13 ‡
Yobe	12.5% N= 8 ‡
Kaduna	52.6% N= 19 ‡
Zamfara	50.0% N= 10 ‡
NORTH WEST	25.0% N= 176
Kano	24.7% N= 73
Kebbi	17.6% N= 17 ‡
Jigawa	16.7% N= 18 ‡
Katsina	(14.3%) N= 28
Sokoto	9.1% N= 11 ‡

Sample Proportion %

Text at right: Unweighted sample proportion (%) and N
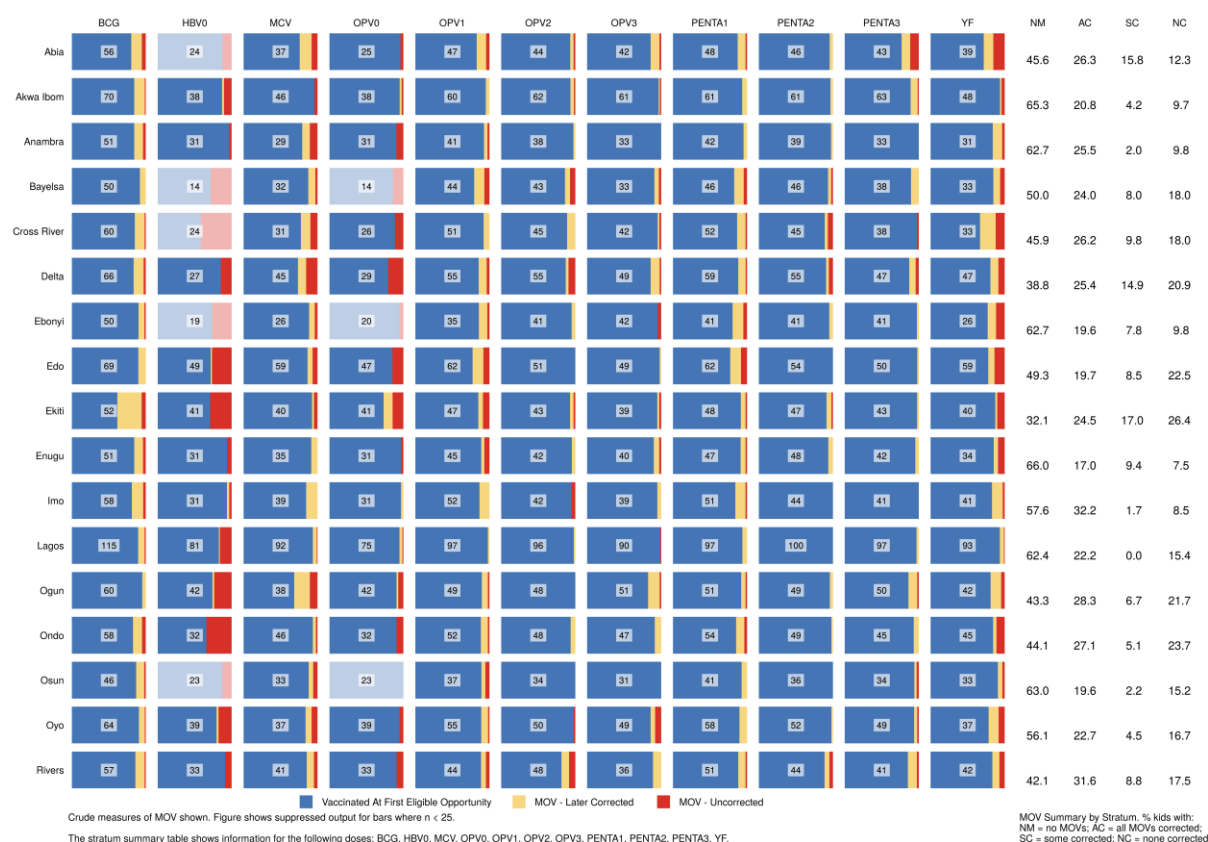Parentheses () mean 25 ≤ N < 50 and ‡ means N < 25.

Note: Zone names are listed in capital letters; horizontal grey lines demarcate zones; national Nigeria average shown in grey shading

S9 Fig: Proportion of children with a home-based record (HBR) who were vaccinated at the first eligible opportunity, and proportion who experienced one or more missed opportunity for vaccination (MOV), whether later corrected or not, by state for Northern states, Nigeria MICS/NICS 2016-17.
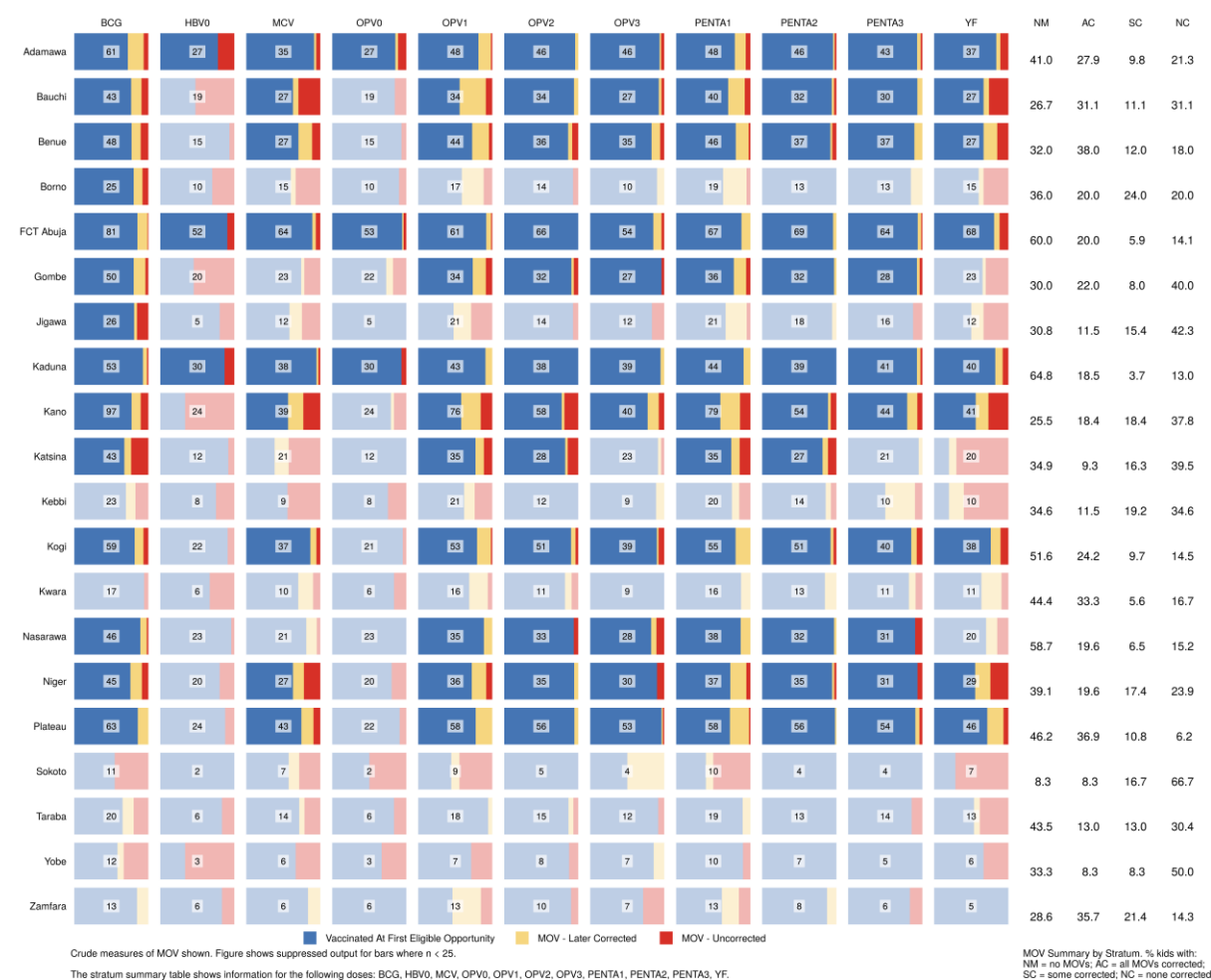
Note: The numbers in the centre of each cell portray the number of children in that state (row) who had at least one vaccination visit when age eligible to receive that dose (column).

S10 Fig: Proportion of children with a home-based record (HBR) who were vaccinated at the first eligible opportunity, and proportion who experienced one or more missed-opportunity for vaccination (MOV), whether later corrected or not, by state for Southern states, Nigeria MICS/NICS 2016-17.

State	BCG	HBV0	MCV	OPV0	OPV1	OPV2	OPV3	PENTA1	PENTA2	PENTA3	YF	NM	AC	SC	NC
Abia	56	24	37	25	47	44	42	48	46	43	39	45.6	26.3	15.8	12.3
Akwa Ibom	70	38	46	38	60	62	61	61	61	63	48	65.3	20.8	4.2	9.7
Anambra	51	31	29	31	41	38	33	42	39	33	31	62.7	25.5	2.0	9.8
Bayelsa	50	14	32	14	44	43	33	46	46	38	33	50.0	24.0	8.0	18.0
Cross River	60	24	31	26	51	45	42	52	45	38	33	45.9	26.2	9.8	18.0
Delta	66	27	45	29	55	55	49	59	55	47	47	38.8	25.4	14.9	20.9
Ebonyi	50	19	26	20	35	41	42	41	41	41	26	62.7	19.6	7.8	9.8
Edo	69	49	59	47	62	51	49	62	54	50	59	49.3	19.7	8.5	22.5
Ekiti	52	41	40	41	47	43	39	48	47	43	40	32.1	24.5	17.0	26.4
Enugu	51	31	35	31	45	42	40	47	48	42	34	66.0	17.0	9.4	7.5
Imo	58	31	39	31	52	42	39	51	44	41	41	57.6	32.2	1.7	8.5
Lagos	115	81	92	75	97	96	90	97	100	97	93	62.4	22.2	0.0	15.4
Ogun	60	42	38	42	49	48	51	51	49	50	42	43.3	28.3	6.7	21.7
Ondo	58	32	46	32	52	48	47	54	49	45	45	44.1	27.1	5.1	23.7
Osun	46	23	33	23	37	34	31	41	36	34	33	63.0	19.6	2.2	15.2
Oyo	64	39	37	39	55	50	49	58	52	49	37	56.1	22.7	4.5	16.7
Rivers	57	33	41	33	44	48	36	51	44	41	42	42.1	31.6	8.8	17.5

Legend: ■ Vaccinated At First Eligible Opportunity ■ MOV - Later Corrected ■ MOV - Uncorrected

Crude measures of MOV shown. Figure shows suppressed output for bars where n < 25.

The stratum summary table shows information for the following doses: BCG, HBV0, MCV, OPV0, OPV1, OPV2, OPV3, PENTA1, PENTA2, PENTA3, YF.

MOV Summary by Stratum. % kids with:
NM = no MOVs; AC = all MOVs corrected;
SC = some corrected; NC = none corrected

Note: The numbers in the centre of each cell portray the number of children in that state (row) who had at least one vaccination visit when age eligible to receive that dose (column).

Supplementary Tables

S1 Table: Selected definitions used in the Vaccination Coverage Quality Indicators (VCQI) tool for indicators calculated using weighted analyses

Indicator	Definition	Numerator	Denominator
Home-based record (HBR) ever ownership	Percentage of children age 12-23 months whose mother or caretaker says have ever received a HBR, even if the record is not seen on the day of the interview (e.g. because it is locked away and the person with the key is absent, or it was lost)	Sum of weights of children said to have had a vaccination record even if not seen on day of interview	Sum of weights of all children in the sample in the defined target population (12-23 months)
HBR current ownership	Percentage of children age 12-23 months whose home-based record is seen and contains usable information	Sum of weights of children whose vaccination record is seen and has at least one date of vaccination on it	Sum of weights of all children aged 12-23 months in the sample
Crude Coverage of {vaccine-dose} *	Percentage of children age 12-23 months who received {vaccine-dose} at any age by time of survey (sub-categories: according to documentation (HBR) and according to maternal recall)	Sum of weights of all children identified in the denominator who received the specified vaccine dose(s) (by sub-categories: by documented evidence or by recall) by any date prior to the survey	Sum of weights of all children in the sample in the defined target population (12-23 months)
Crude Coverage of fully vaccinated** children	Percentage of children age 12-23 months who received all vaccine-doses recommended in the national schedule by time of survey (sub-categories: according to documentation (HBR) and according to maternal recall)	Sum of weights of all children identified in the denominator who received all vaccine-doses included in the fully vaccinated definition	Sum of weights of all children in the sample in the defined target population (12-23 months)
Valid Coverage of {vaccine-dose} * based on documented evidence	Percentage of children age 12-23 months who received {vaccine-dose} respecting the minimum age for each dose and the minimum interval between doses as recommended in the national schedule by time of survey. Because documented dates of each vaccine-dose are needed in order to determine if the schedule was followed appropriately, this can only be calculated among children with documented evidence.	Sum of the sample weights for children 12-23 months who are vaccinated where the doses followed the earliest recommended age and minimum interval between doses	Sum of the sample weights for children 12-23 months with documented evidence of their vaccination status (unless otherwise specified – can have a second related indicator that includes all children in denominator)

Indicator	Definition	Numerator	Denominator
Never vaccinated (with any of the basic antigens) coverage	Percentage of children aged 12-23 months who received none of the basic vaccines included in the country schedule	Sum of the sample weights for those of children who received none of recommended vaccine doses for the basic six antigens, by the time of the survey, based on the combination of recall and documented evidence	Sum of weights of all children aged 12-23 months in the sample
Supplementary Immunization Activity (SIA) coverage {in this case with measles-containing vaccine (MCV)}	Percentage of children aged 9 months to 59 months {or age group targeted in the SIA} who received a dose of MCV during the SIA	Sum of weights of children said to have received MCV during the SIA	Sum of weights of all children aged 9-59 months in the sample
Percentage of children not vaccinated against measles before SIA ("zero-dose" children)	Percentage of children aged 9 months to 59 months who had not received a dose of MCV before the SIA	Sum of weights of children with no history or record of receiving MCV before the SIA	Sum of weights of all children aged 9-59 months in the sample
Percentage of children already vaccinated against measles before SIA	Percentage of children aged 9 months to 59 months who had received a dose of MCV before the SIA	Sum of weights of children with a history or record of having received MCV before the SIA	Sum of weights of all children aged 9-59 months in the sample
SIA coverage among measles zero-dose children	Percentage of children aged 9-59 months at the time of the SIA with NO history of receipt of MCV before the SIA who received a dose of MCV during the SIA (by card, finger-mark or parental recall)	Sum of weights of children with no history or record of receiving MCV before the SIA who received a dose of MCV during the SIA	Sum of weights of children with no history or record of receiving MCV before the SIA
SIA coverage among children vaccinated previously	Percentage of children aged 9-59 months at the time of the SIA with a history of receipt of MCV before the SIA who received a dose of MCV during the SIA (by card, finger-mark or parental recall)	Sum of weights of children with a history or record of having received MCV before the SIA who received a dose of MCV during the SIA	Sum of weights of children with a history or record of having received MCV before the SIA

* {vaccine-dose} is specified in each row, e.g. BCG, pentavalent 1, pentavalent 2, etc.

** May have 2 definitions for fully vaccinated, one focusing only on the original 6 vaccines and another including all vaccines in the schedule – see results table.

S2 Table: Selected definitions used in VCQI for indicators calculated using unweighted analyses which represent a subset of the total target population

Indicator	Definition	Numerator	Denominator
Percentage of {vaccine-doses} that were invalid	The percentage of children who had received the relevant {vaccine-dose} while they were either at too young or with too short an interval since the previous dose in the series. E.g. DTP1<42 days; DTP2<70 days or <28 days after DTP1; DTP3<98 days or <28 days since DTP2; MCV1<273 days.	Number of respondents whose {vaccine-dose} was invalid	e.g. Number of respondents who had date of birth data within specified ranges and received {vaccine-dose} with a date
Dropout between vaccine-doses (e.g. Penta1 to Penta3; Penta1 to MCV etc.	The estimated percentage of children 12-23 months who received the specified vaccine-dose given earliest in the schedule but failed to receive the specified subsequent vaccine-dose in the schedule. For example, Penta1 to Penta3 dropout is shown here: dropout = (Penta1-Penta3)/Penta1 This indicator can be sub-categorized according to source of evidence (HBR/recall/either)	Number of respondents who received the first dose but did <u>not</u> receive the later dose (e.g. received Penta1 but did not receive Penta3)	Number of respondents who received the first dose (e.g. Penta1)
Percent of children with missed opportunity for simultaneous vaccination (MOV)	Percent of children who on at least on occasion, did not receive all the vaccines for which they were eligible*. E.g. those with different dates for Penta1 and OPV1. Can sub-categorise according to whether the MOV was later corrected or not (i.e., was the missed vaccine-dose received later at a valid age?) Calculate for each vaccine and dose Calculate over all vaccines and doses	Number of children who experienced 1+ missed opportunities to be vaccinated for the dose in question	Number of children with date of birth data within specified ranges and date of vaccination data indicating that they had 1+ visits for vaccination on days when they were eligible to receive the dose in question
Percent of *visits* with missed opportunity for simultaneous vaccination (MOV)	Percent of visits (i.e. considering all visits by all children with documentation) where at least one vaccine-dose was not administered despite the child being eligible* Calculate for each vaccine and dose Calculate over all vaccines and doses	Number of vaccination visit dates where a respondent did not receive all vaccinations for which they were eligible	Number of vaccination visit dates where a respondent was eligible to receive 1+ vaccinations

*Eligibility is based on age of child and, where relevant, interval since the previous dose in the sequence. Information on any potential contraindications on the visit is not available hence all children are assumed to have no contraindications.

S3 Table: Dropout rates between different vaccine-dose combinations in the vaccination series, by source of information, Nigeria MICS/NICS 2016-17.

		Source of Information					
		Children with HBR having received at least Penta1		Children without HBR having received at least Penta1 by recall		All children with any evidence of having received Penta1	
		Penta1 to Penta3	Penta1 to measles	Penta1 to Penta3	Penta1 to measles	Penta1 to Penta3	Penta1 to measles
		% (weighted N)	% (weighted N)	% (weighted N)	% (weighted N)	% (weighted N)	% (weighted N)
	National	16.9 (1737)	26.9 (1737)	51.6 (1326)	14.8 (1326)	31.7 (3055)	21.1 (3055)
	Urban	12.2 (797)	18.7 (797)	48.3 (571)	9.3 (571)	26.9 (1366)	14.0 (1366)
	Rural	20.9 (940)	33.9 (940)	54.2 (755)	18.9 (755)	35.6 (1689)	26.9 (1689)
Zone	North West	28.8 (356)	36.7 (356)	69.5 (271)	17.4 (271)	46.1 (625)	28.2 (625)
	North East	24.2 (288)	36.7 (288)	51.9 (343)	17.4 (343)	39.6 (629)	26.3 (629)
	North Central	16.8 (276)	26.9 (276)	52.0 (253)	10.4 (253)	33.4 (528)	18.2 (528)
	South West	7.2 (394)	16.7 (394)	45.6 (177)	14.3 (177)	18.7 (570)	15.1 (570)
	South East	11.0 (164)	23.1 (164)	39.0 (138)	15.6 (138)	23.3 (301)	19.1 (301)
	South South	11.1 (259)	20.8 (259)	36.4 (144)	11.4 (144)	19.3 (401)	16.1 (401)
Caregiver's education	Non-formal	36.1 (114)	56.6 (114)	66.0 (150)	11.4 (150)	53.7 (260)	31.3 (260)
	Primary	16.2 (283)	33.0 (283)	49.4 (211)	15.8 (211)	30.1 (493)	24.5 (493)
	Secondary / Secondary-technical	13.3 (803)	22.6 (803)	46.2 (520)	13.8 (520)	25.5 (1322)	18.3 (1322)
	Higher	3.3 (260)	7.1 (260)	42.8 (193)	4.8 (193)	20.1 (452)	5.7 (452)
	Missing	33.2 (276)	39.8 (276)	63.0 (252)	25.6 (252)	47.8 (527)	33.4 (527)
Wealth index	Poorest	31.6 (157)	47.4 (157)	67.5 (129)	24.5 (129)	47.7 (285)	36.8 (285)
	Second	24.4 (243)	39.0 (243)	59.0 (231)	22.0 (231)	41.6 (470)	30.7 (470)
	Middle	23.2 (348)	32.7 (348)	50.4 (244)	11.6 (244)	33.6 (591)	23.3 (591)
	Fourth	14.1 (423)	26.2 (423)	44.2 (392)	11.9 (392)	28.4 (813)	18.8 (813)
	Richest	7.8 (565)	13.0 (565)	50.1 (331)	11.8 (331)	23.1 (896)	11.8 (896)
	Median (range) by state*	14.7 (3.0,45.5)	26.9 (8.8,59.9)	53.1 (19.6,94.4)	11.8 (0,55.9)	31.8 (13.4,69.0)	20.6 (7.2,57.1)

*The median, min. & max. percentages of the 37 states are provided, not the mean or weighted N.

S4 Table: Data cleaning details for Nigeria MICS/NICS 2016-17 and PMCCS 2018

Issue	Resolution
Eligible population and indicator definitions	Vaccination coverage for the MICS/NICS focused on children aged 12-23m. The denominator for crude and valid coverage and fully-immunised and proportion showing cards is all eligible children in the survey. The denominator for indicators concerning timeliness and missed opportunities for vaccination (MOVs) is all eligible children whose date of birth was known, within specified ranges and showed a card with vaccination dates on it. The eligible population for the PMCCS is all children aged 9-59m and the denominator for coverage indicators is all eligible children in the PMCCS.
Steps to differentiate RI from SIA doses	The MICS/NICS asked not only about doses delivered through routine immunization but also, for children with a HBR that does not show a date of MCV, whether additional vaccines had been received in a campaign. For children without a HBR, mothers are asked if the child ever received each vaccine but without specifying if it was in RI or a campaign. For analysis purposes, if the HBR is blank for measles but the caretaker says the child participated in an SIA, the child could be given coverage credit based on the caretaker's recall. This requires careful coding of the input data and tracking of provenance if the analysis plan calls for tables that document the sources of vaccination.
How valid doses are defined	A dose is *valid* if the child has reached the minimum age to receive the antigen and, for multi-dose antigens, if the appropriate interval has passed since the most recent dose. To assess age and interval duration, the software requires dates of birth and vaccination, so children who do not furnish HBRs and for whom FBRs are not found must be excluded from calculations about valid doses. There is a tradition in WHO EPI surveys to include all eligible children in the denominator of valid coverage, even though the numerator can only include children who show cards with dates. For example, if 40% of children showed an HBR and 90% of children with HBRs showed evidence of receiving a valid dose of measles, the valid coverage estimate would be 36% (or 90% of 40%). Including all children in the denominator puts the valid coverage estimate on the same scale as crude coverage, but if HBR availability is low, it suppresses the maximum possible value for valid coverage. If only a small portion of children have or show HBRs, then we can only confirm the validity of doses for a small portion of respondents. The White Paper recommends that valid coverage include all eligible children in the denominator but that it only be presented when at least 80% of children have an HBR.
Evidence from tick marks	In the best case, doses are documented on HBRs and FBRs with a legible date of vaccination. In some cases, the date is missing and the HBR includes only a check mark or a signature from the vaccinator. In other case the date is present, but incomplete or impossible to read. These children receive credit for a crude dose of the vaccine, but because we cannot know the age at which they received it, they are excluded from indicators that assess age or eligibility at the time of vaccination.

Issue	Resolution
Imperfect date values	In some cases, the dates of birth or vaccination may be incorrect on the source document, the survey questionnaire or the survey dataset. One important step during data cleaning is to identify impossible or unlikely dates of birth or vaccination dates and, if paper forms were used, send them back to the data entry team to confirm or correct. The MICS/NICS and PMCCS interviewers entered responses directly into tablets via computer-assisted personal interviewing (CAPI) so there was no possibility of correcting nonsensical dates. In VCQI analyses of RI surveys, imperfect dates are handled thus: − The analyst provides input parameters listing the earliest and latest possible dates of vaccination for a child in the dataset − Any date of birth that falls outside the appropriate calendar range for the target age group is set to missing (.); those children will not contribute meaningfully to analyses that rely on calculating age at vaccination − Any vaccination date that falls a) before the child's date of birth, or b) outside the earliest-to-latest window is analysed as if it were a tick mark instead of a date; that is, the child is given credit for crude coverage but is not included in date-based analyses for that dose − Any vaccination dates in a dose series that is out-of-chronological order is also analysed as if it were a tick mark − If the HBR or FBR includes dates for later doses in a series (e.g., OPV2) but is missing evidence for the earlier dose (OPV1) then VCQI analyses the earlier dose as if it had been recorded with a tick mark − Finally, any date that is partially recorded (i.e., includes month and year but missing day) or illegibly recorded, and any date that is legible but nonsensical, like February 30 or September 31 is analysed as if it had been recorded with a tick mark
Missing values, 'unsure', and 'do not know' responses	The VCQI Results Quick Interpretation Guide lists how missing/unsure/do not know responses are handled for each indicator [27]. For coverage outcomes, the child is assumed to be unvaccinated if the caretaker is not sure. In cases where the caretaker is confident that the child received the antigen but are unsure how many doses they received, VCQI gives credit for only a single dose, which is a conservative approach.

Issue	Resolution
Confidence interval calculations	Symmetric Wald-type confidence intervals can yield absurd lower or upper bounds that fall outside the 0-100% range when the estimated coverage is very low or very high. Several alternative formulae have nice properties: – Their bounds always fall between 0-100% (inclusive) – If the survey is unbiased, the confidence intervals contain the true population proportion nearly 95% of the time – The intervals are narrow (precise) when compared to alternatives A coverage survey report should document which formula was used. VCQI can calculate logit, Wilson, Jeffreys, or Clopper-Pearson intervals, and it adjusts the degrees of freedom to account for the complex sample design. The analyses reported here used Wilson confidence intervals when coverage was between 0 and 100% and Clopper-Pearson intervals when coverage was exactly 0% or 100%.
How many decimal places to report	It is common to report coverage percentages with a single digit after the decimal place (e.g., 53.4%). But to keep tables from being too wide to fit on a standard page, some reports omit that final digit, rounding to the nearest percent, reasoning that the decimal digit is usually not critical for policymakers. The MICS report and PMCCS reports included the final digit and the NICS report omitted it.