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Mobile Nudges and Financial Incentives to Improve Coverage of Timely Neonatal Vaccination in Rural Areas (GEVaP trial): A 3-armed Cluster Randomized Controlled Trial in Northern Ghana

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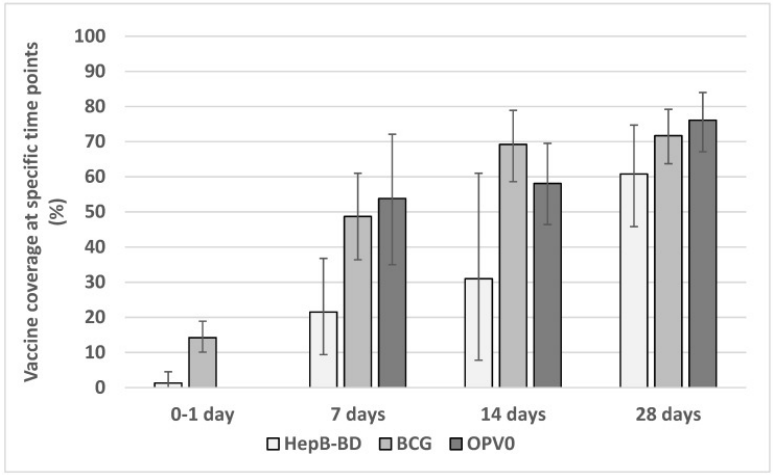
Early childhood vaccinations often delayed



Error bars represent 95% confidence intervals.

Pooled estimates of birth vaccines in sub-Saharan Africa
Bassoum et al., *Vaccines*, 2020

Coverage in sub-Saharan Africa

Bacillus Calmette-Guérin vaccine (BCG)

- 80% within first year (2019)
- 72% within first month

Polio vaccine:

- 74% 3 doses within first year (2018)
- 76% first dose within first month
- 58% first dose within 14 days

Bassoum O, Kimura M, Tal Dia A, Lemoine M, Shimakawa Y. Coverage and Timeliness of Birth Dose Vaccination in Sub-Saharan Africa: A Systematic Review and Meta-Analysis. *Vaccines (Basel)*. 2020;8(2):301.

World Health Organization, Global and regional immunization profile: Africa Regions. 30 June, 2020. https://www.who.int/immunization/monitoring_surveillance/data/gs_afrprofile.pdf?ua=1

Karaga district, Northern Ghana

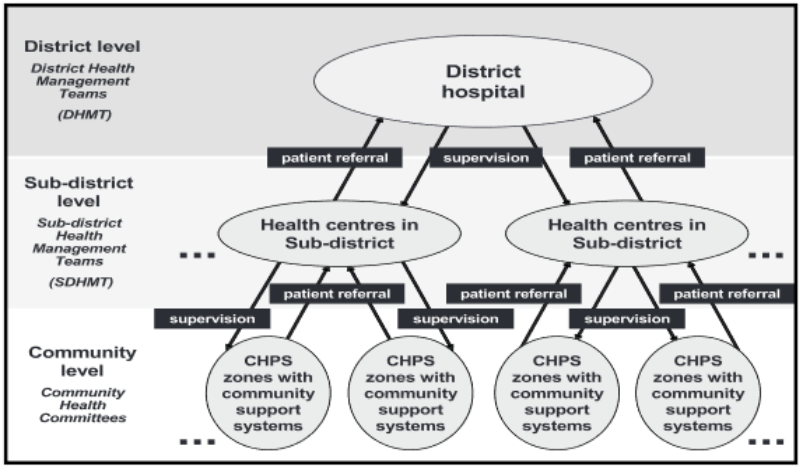
- 59% Childbirth outside of health facility
- <40% children receive Polio vaccine birth dose
- <50% of infants receive BCG vaccine within first month of life

Ghana Demographic and Health Survey 2014. Rockville, Maryland, USA: GSS, GHS, and ICF International; 2015.
Ghana Demographic and Health Survey 2017. Rockville, Maryland, USA: GSS, GHS, and ICF International; 2018.

Opportunities to improve coverage in underserved areas

- Growth of community health systems and vaccine delivery infrastructures
- Increasing coverage of mobile technologies and systems

Ghana Primary Health Care System



Aim

To assess if community-based interventions including mobile phone-based reminders and small financial incentives to community health volunteers (CHV) and caregivers could increase timely neonatal vaccination in a rural, low-resource setting

Approach

- Ghana Early Vaccination Program (GEVaP)
- Pilot 3-arm, cluster-randomized controlled trial in 15 communities (2 x 5 intervention; 1 control)

GEVaP Program Implementation

- 6-month intervention phase in 10 communities
- Local CHWs hired and trained to identify and report births to central study center

Arm A: Voice call reminders only
Study coordinators contact caregivers by phone to promote early vaccination and connect caregiver to available vaccination services in communities

Arm B: Community health workers and incentives
CHW promote early vaccination in communities; connect caregivers to available vaccination services in communication. CHW and caregivers receive small incentives for timely vaccination via 'mobile money'
- 1 Ghana cedis per vaccination (~ 0.25 USD)

Population: Consenting primary caregivers of young infants born in previous week residing in intervention communities

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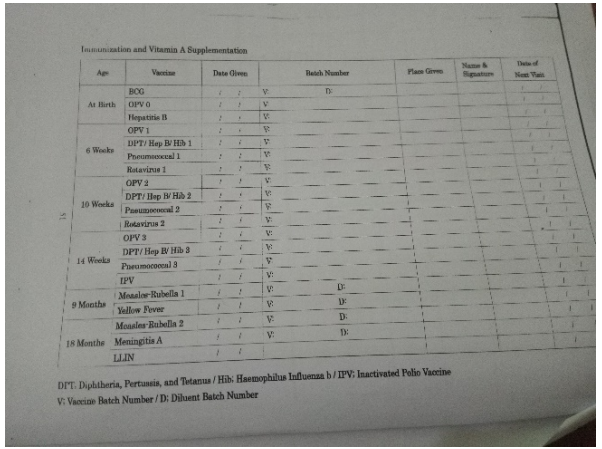
Ghana Early Vaccination Program (GEVaP)

	Intervention Arm A *Voice call reminders only*	Intervention Arm B *CHW and incentives*	Control
• Routine vaccination services available per Ghana Health Service	X	X	X
• Community Health Workers (CHW) report births - 1 Ghana cedis incentive per birth	X	X	
• Voice call "nudges" from study staff to inform caregivers of vaccination service points/times and encourage vaccination	X		
• CHW encourage vaccination with caregivers and inform them of service delivery points/times		X	
• CHW and caregivers rewarded for on-time vaccination via 'mobile money' - 1 Ghana cedis per vaccination (~ 0.25 USD)		X	

Evaluation

- Endline population-based household survey in intervention and control communities, to evaluate vaccination coverage in pre-intervention and intervention periods
- All live-births/children < 1 year in pre-intervention and intervention periods residing in communities enumerated
- Primary endpoint: ≥ 1 dose Polio vaccine within 14 days of life **and** BCG vaccination within 28 days of life

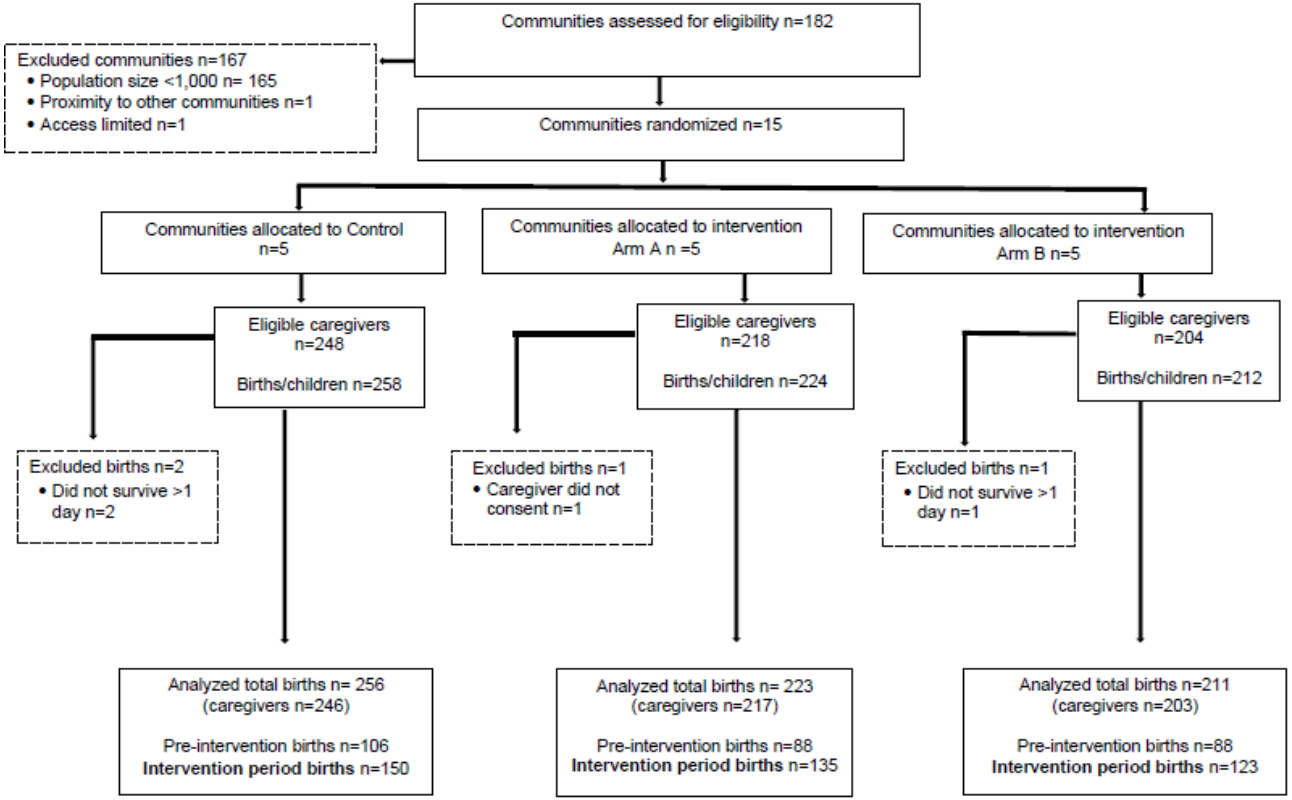


Immunization and Vitamin A Supplementation

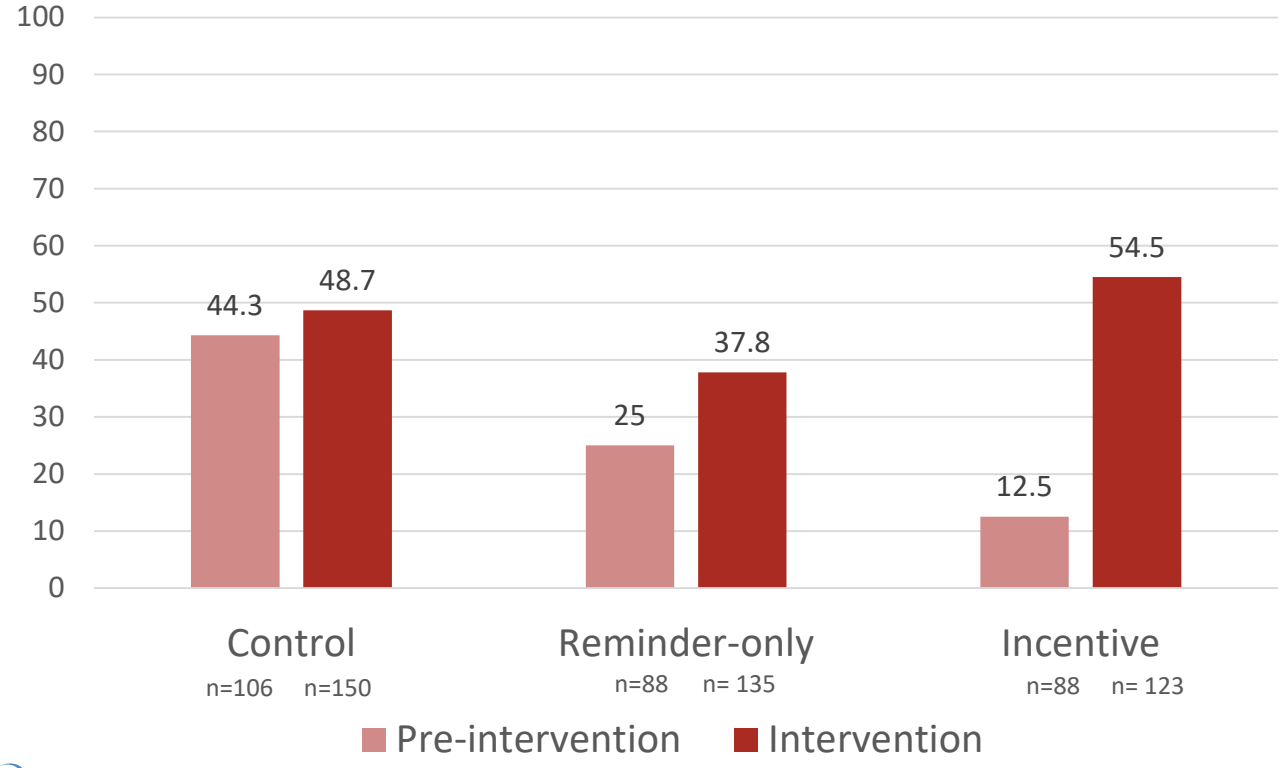
Age	Vaccine	Date Given	Batch Number	Place Given	Name & Signature	Date of Next Visit
At Birth	BCG	/ /	V: D:			
	OPV 0	/ /	V:			
	Hepatitis B	/ /	V:			
6 Weeks	OPV 1	/ /	V:			
	DPT/ Hep B/ Hib 1	/ /	V:			
	Pneumococcal 1	/ /	V:			
	Rotavirus 1	/ /	V:			
10 Weeks	OPV 2	/ /	V:			
	DPT/ Hep B/ Hib 2	/ /	V:			
	Pneumococcal 2	/ /	V:			
	Rotavirus 2	/ /	V:			
14 Weeks	OPV 3	/ /	V:			
	DPT/ Hep B/ Hib 3	/ /	V:			
	Pneumococcal 3	/ /	V:			
	IPV	/ /	V:			
9 Months	Measles-Rubella 1	/ /	V: D:			
	Yellow Fever	/ /	V: D:			
18 Months	Measles-Rubella 2	/ /	V: D:			
	Meningitis A	/ /	V: D:			
	LLIN	/ /				

DPT: Diphtheria, Pertussis, and Tetanus / Hib: Haemophilus Influenza b / IPV: Inactivated Polio Vaccine
V: Vaccine Batch Number / D: Diluent Batch Number

GEVaP Study Population

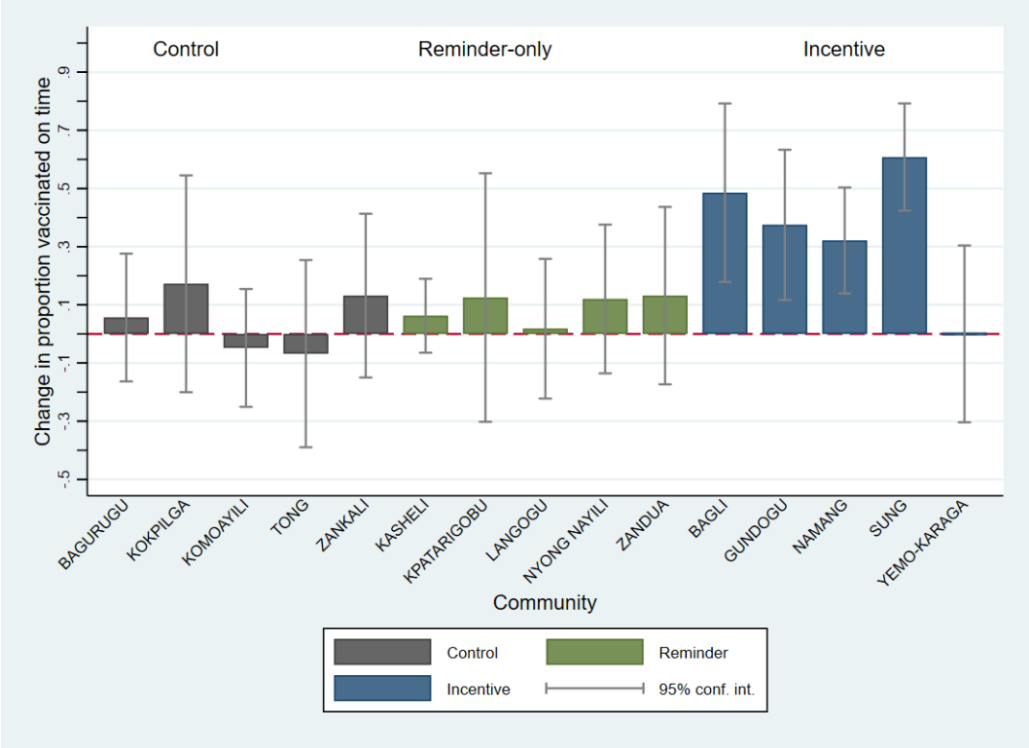


Complete timely early vaccination coverage* (OPV0 & BCG) (%)



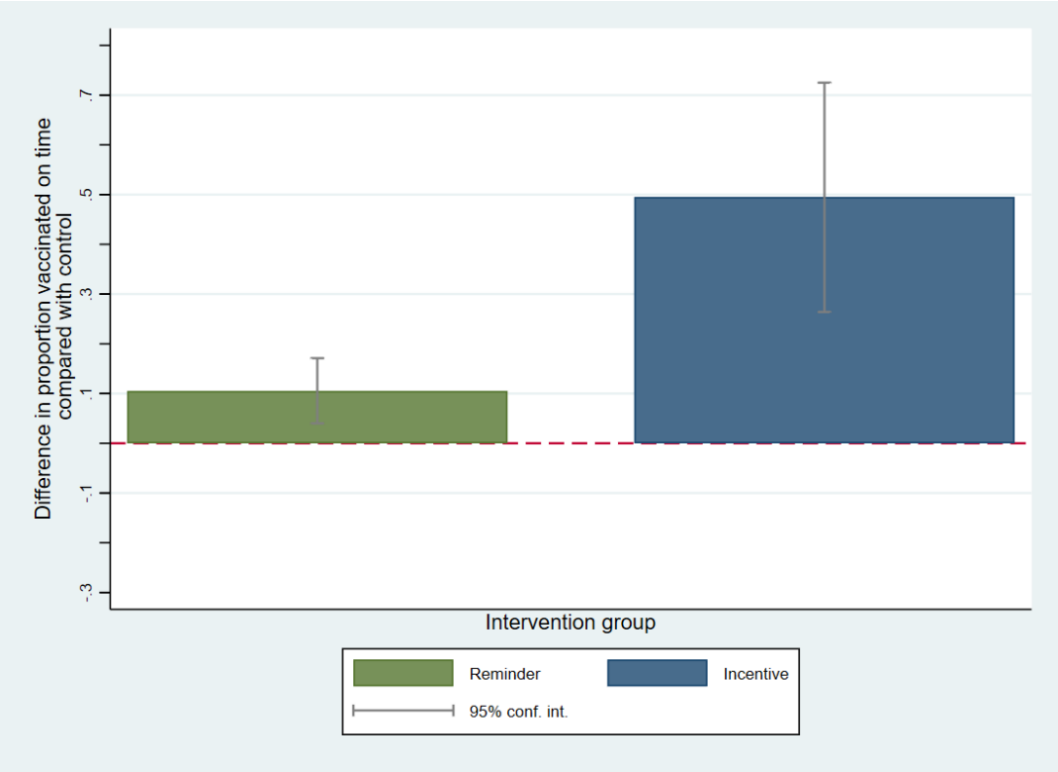
* Timely vaccination defined as ≥1 dose Polio vaccine within 14 days and BCG within 28 days of life

Change in timely early-infant vaccination coverage (OPV0 & BCG) * pre-intervention and GEVaP intervention periods– crude differences



*Timely vaccination defined as receipt of at least 1 dose Polio vaccine by 14 days of life and BCG vaccine by 28 days of life

Impact of GEVaP intervention on timely early-infant vaccination coverage (OPV0 and BCG)* –intention-to-treat (adjusted[1])



Voice reminders only: 10.5 percentage point (95% CI: 4.0, 17.1) difference in coverage

CHW and incentives: 49.5 percentage point (95% CI: 26.4, 72.5) difference in coverage

[1] Estimates from linear regression models adjusted for vaccination coverage in pre-intervention period in community; community; maternal education; electricity; tv ownership; ANC attendance; childbirth location; distance to childbirth facility. Robust variance estimates accounting for clustering by community.

*Timely vaccination defined as receipt of at least 1 dose Polio vaccine by 14 days of life and BCG vaccine by 28 days of life

Observations

- Large variation in coverage across communities at baseline
- Mobile phone coverage poor in some regions
- Literacy and numeracy limited

Considerations for scale and sustainability

- Demand-side focus requires available service delivery structure/supplies
- Addressing motivation and sustained engagement
- Ideal incentive level/type/timing
- Supervision and monitoring structure
- Other vaccinations and public health interventions?
- Funding mechanisms

Conclusion

- Impact of vaccination “nudges” via voice calls may be constrained in settings where network coverage and phone ownership are limited
- Community-based interventions with mobile phone technologies and small incentives to community workers and to caregivers improved timely early vaccination coverage

Acknowledgments

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Funding: Bill & Melinda Gates Foundation Grand Challenges Exploration Grant ID OPP1190674
Trial registration: NCT03797950

Levine G, Salifu A, Mohammed I, Fink G (2021) Mobile nudges and financial incentives to improve coverage of timely neonatal vaccination in rural areas (GEVaP trial): A 3-armed cluster randomized controlled trial in Northern Ghana. PLOS ONE 16(5): e0247485.

Strengths

- Pragmatic approach embedded in local health service delivery structure
- Engaged local health workers
- Limited resource requirements
- Acceptable

Limitations

- Baseline vaccination coverage differed across arms
- Small number communities

	Control Arm % (n)		Reminder-only Arm % (n)		Incentive Arm % (n)	
	Pre-intervention (n=106)	Intervention (n=150)	Pre-intervention (n=88)	Intervention (n=135)	Pre-intervention (n=88)	Intervention (n=123)
Mother and household						
Age of mother (mean, (SD))	27.9 (6.9)	28.5 (6.0)	27.1 (85)	28.4 (5.7)	28.6 (6.9)	29.8 (7.1)
Mother attended no formal education	78.3 (83)	80.7 (121)	80.7 (71)	79.3 (107)	77.3 (68)	84.6 (104)
Household has electricity	77.4 (82)	80.7 (121)	68.2 (60)	78.5 (106)	56.8 (50)	53.7 (66)
Household has television	41.5 (44)	48.7 (73)	37.5 (33)	36.3 (49)	30.7 (27)	28.5 (35)
Mobile phone ownership (mother)	41.5 (44)	37.3 (56)	46.6 (41)	47.4 (64)	38.6 (34)	46.3 (57)
Access to shared phone (mother)	49.0 (52)	59.3 (89)	45.5 (40)	43.7 (59)	54.6 (48)	45.5 (56)
Network strength[1]						
Very good/good	23.2 (23)	25.0 (37)	65.4 (53)	66.9 (87)	39.0 (32)	49.1 (57)
Fair	33.3 (33)	40.5 (60)	25.9 (21)	22.3 (29)	41.5 (34)	39.7 (46)
Poor or very poor	43.4 (43)	34.5 (51)	8.6 (7)	10.8 (14)	19.5 (16)	11.2 (13)
Infant						
Any antenatal care received	98.1 (104)	98.0 (147)	96.6 (85)	98.5 (133)	98.9 (87)	97.6 (120)
Female	43.4 (46)	44.7 (67)	51.1 (45)	46.7 (63)	47.7 (42)	41.5 (51)
Birth location[2]						
Home/ community	15.2 (16)	15.4 (23)	42.1 (37)	35.1 (47)	29.6 (26)	30.9 (38)
Hospital, Clinic or Health Center	28.6 930)	27.5 (41)	21.6 (19)	19.4 (26)	25.0(22)	28.5 (35)
Health Post or CHPS compound	56.2 (59)	57.1 (85)	36.4 (32)	45.5 (61)	45.5 (40)	40.7 (50)
Vaccination paper or child health booklet available	97.2 (103)	96.7 (145)	95.5 (84)	98.5 (133)	95.5 (84)	97.6 (120)

Birth dose vaccination coverage in GEVaP study [descriptive] (N= 690)

Outcome	Control Arm % (n)		Reminder-only Arm % (n)		Incentive Arm % (n)	
Period	Pre-intervention	Intervention	Pre-intervention	Intervention	Pre-intervention	Intervention
Complete on-time vaccination[1]	44.3 (47)	48.7 (73)	25.0 (22)	37.8 (51)	12.5 (11)	54.5 (67)
On-time first dose Polio[2]	50.9 (54)	52.7 (79)	28.4 (25)	41.5 (56)	12.5 (11)	56.1 (69)
Any first dose Polio	63.2 (67)	60.7 (91)	36.4 (32)	45.2 (61)	31.8 (28)	69.9 (86)
Age at first dose Polio (days) median (IQR) [3]	4 (1, 12)	4 (1, 10)	8 (4.5, 14)	5 (2, 10)	20 (6, 39)	6 (3, 12)
On-time BCG[4]	70.8 (75)	78.0 (117)	62.5 (55)	73.3 (99)	53.4 (47)	82.1 (101)
Any BCG	89.6 (95)	91.3 (137)	96.6 (85)	94.8 (128)	94.3 (83)	97.6 (120)
Age at BCG (days) median (IQR)[3]	12 (6, 26)	10 (3, 19)	20 (7, 36)	15 (5, 26)	26 (13, 46)	11 (5, 20)

1 Complete on-time vaccination defined as receipt of at least 1 dose Polio vaccine by 14 days of life and BCG vaccine by 28 days of life