Mission *Indradhanush*

Universal Access to Vaccination?

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Overview

Motivation

- Vaccination is well established as a cost-effective and efficacious intervention that saves lives and raises long-term economic productivity (Bloom et. al. 2017; Piot et al. 2019).
- Vaccine-preventable diseases continue to account for more than 13% of all under-5 mortality in the world; 99% of these deaths take place in LMIC (Frenkel 2021).
- National and sub-national hot spots with incomplete vaccine coverage are present globally. India's Mission Indradhanush arose in the context of 200 districts collectively accounting for 50% of all children without vaccination.

Question:

Can policy-driven vaccination strategies play a role in expanding vaccination coverage?

Background: MI

- Piot et al. (2019) document that it took 180 years for vaccination-related science to become public policy through the 1974 Expanded Program on Immunization through the WHO focused on 6 diseases.
- National vaccination programs are a common feature of the health system in most LMICs; many struggle to achieve vaccination for all.
- MI sought to provide 90% coverage when prevailing coverage rates are near 65% using periodic intensification of routine immunization.
- Summan et al. (2021) report that the rate of full immunization of 2-year-olds is 27% higher in districts covered by MI than those without. Can we learn more?

Data Context

Table: MI Phase-wise Roll-out, April 2015 - July 2017

Phase	Period	# of Districts	Repeated Districts?
Phase - 1	April - July 2015	201	
Phase - 2	October 2015 - January 2016	352	73 Phase 1 districts
Phase - 3	April - July 2016	216	199 Phase 1 or 2 districts
Phase - 4 A	February - May 2017	68	60 Phases 1, 2, or 3 districts
Phase - 4 B	April - July 2017	186	163 Phases 1, 2, or 3 districts

- Data: DHS India (2015-16) (NFHS-4) - 29 states + 6 UT - 640 districts and Census 2011 data.
- 95,558 child vaccination records with date of interview are mapped to administrative roll-out data to identify MI exposure
- Outcomes: Full Immunization, Partial Immunization, Count of Vaccines received.

Identifying Impacts

We estimate the following equation to evaluate the causal impact of MI on child immunization:

$$Immunization_{ihds} = \alpha + \beta Treated_{hds} + \sum_{p} \gamma_p Phase^{p}_{ds} + \sum_{m} \delta_m Month^{m}_{hds} + X'_{ihds}\theta + W'_{hds}\lambda + Z'_{ds}\zeta + \phi_s + \varepsilon_{ihds} \quad (1)$$

- β, the coefficient of interest, captures the intent-to-treat (ITT) estimate of MI
- Non-random roll-out; causal inference is driven by the expgeneity of $Treated_{hds}$, conditional on the control variables - driven by phase-wise MI roll-out and timing of DLS
- Phase fixed effects to account for district heterogeneity
- Month of interview fixed effects to capture calendar/season effects.

Summary Stats

Table: Summary Statistics

Variable	Mean	Std. Dev	Min.	Max.
Immunization Full	0.37	0.48	0.00	1.00
Immunization Partial	0.91	0.28	0.00	1.00
Immunization Count	5.63	2.76	0.00	8.00
MI Treated	0.48	0.50	0.00	1.00
MI Currently Treated	0.22	0.42	0.00	1.00
Exposure Months	2.58	3.39	0.00	12.00
Received BCG	0.89	0.32	0.00	1.00
Received DPT1	0.80	0.40	0.00	1.00
Received DPT2	0.72	0.45	0.00	1.00
Received DPT3	0.61	0.49	0.00	1.00
Received Polio1	0.82	0.38	0.00	1.00
Received Polio2	0.72	0.45	0.00	1.00
Received Polio3	0.58	0.49	0.00	1.00
Received Measles	0.49	0.50	0.00	1.00
Girl child	0.48	0.50	0.00	1.00
Age of child in months	11.66	6.70	0.00	23.00

Note: Number of observations is 95558. Data sources are NFHS-4, Census 2011, and DLHS-3.

Main Results

Table: Main results: Effect of MI on immunization

VARIABLES	(1) Full	(2) Partial	(3) Count
Treated	0.030***	0.025***	0.233***
	(0.010)	(0.008)	(0.069)
Girl Child	0.001	-0.001	-0.013
	(0.003)	(0.002)	(0.014)
Age in months	0.061***	0.027***	0.692***
	(0.001)	(0.001)	(0.006)
Female household head	0.005	0.009***	0.048**
	(0.004)	(0.003)	(0.023)
Age of household head	-0.0001	0.00006	0.0005
	(0.0001)	(0.00007)	(0.0005)
Rural household	0.023***	0.007**	0.157***
	(0.004)	(0.003)	(0.026)
District literacy rate	0.052	0.081**	0.775***
	(0.037)	(0.035)	(0.296)
District past immunization rate	0.128***	0.102***	1.070***
	(0.032)	(0.031)	(0.242)
Observations	95,558	95,558	95,558
R-squared	0.295	0.094	0.398
Treatment Phase FE	YES	YES	YES
State FE	YES	YES	YES
Month of Interview FE	YES	YES	YES
Mean of Dependent Variable	0.374	0.912	5.629

Note: Robust standard errors clustered at district level are in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

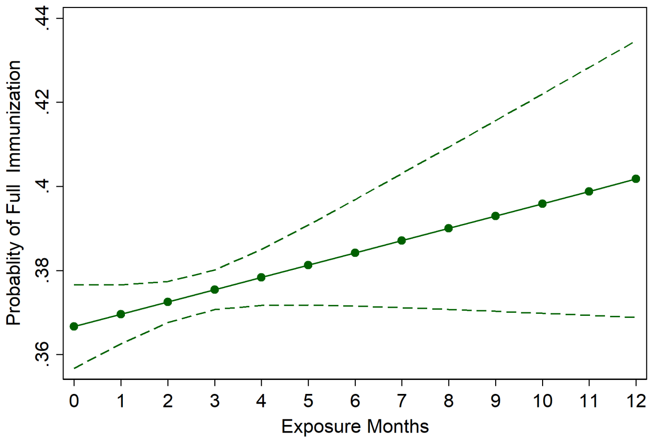
Main Results

Table: Effect of MI on immunization - each vaccine as a separate outcome

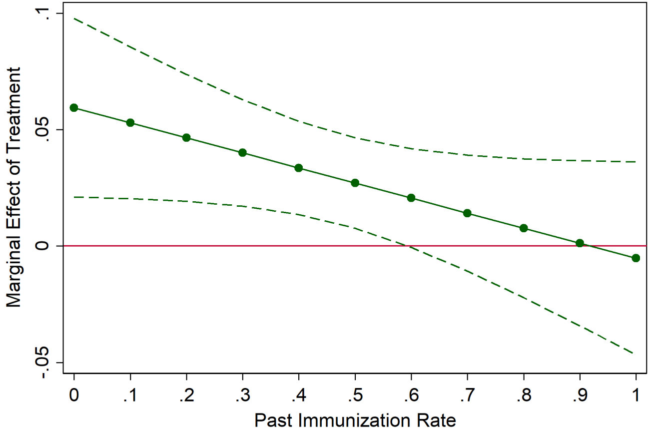
VARIABLES	(1) bcg	(2) dpt1	(3) dpt2	(4) dpt3	(5) pol1	(6) pol2	(7) pol3	(8) msls
Treated	0.029***	0.033***	0.034***	0.039***	0.022**	0.026***	0.028**	0.022**
	(0.009)	(0.010)	(0.010)	(0.011)	(0.009)	(0.010)	(0.011)	(0.009)
Observations	95,558	95,558	95,558	95,558	95,558	95,558	95,558	95,558
R-squared	0.101	0.221	0.307	0.317	0.209	0.288	0.258	0.422
Treatment Phase FE	YES	YES	YES	YES	YES	YES	YES	YES
State FE	YES	YES	YES	YES	YES	YES	YES	YES
Month of Interview FE	YES	YES	YES	YES	YES	YES	YES	YES
Mean of Dependent Variable	0.888	0.801	0.715	0.610	0.820	0.721	0.579	0.493

Note: Additional controls include sex and age (in months) of the child, age squared, age of the mother (in years), sex and age of the household head, place of residence (rural/urban), district-level literacy rate, immunization rate, religion, caste, and wealth quartiles. Robust standard errors clustered at district level are in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

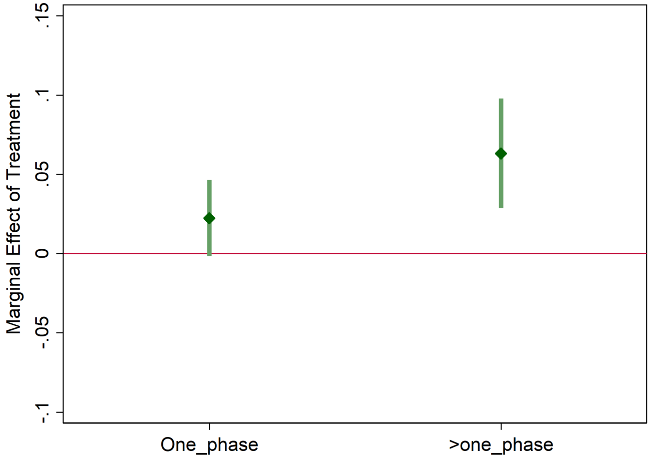
Exposure Gradient for MI



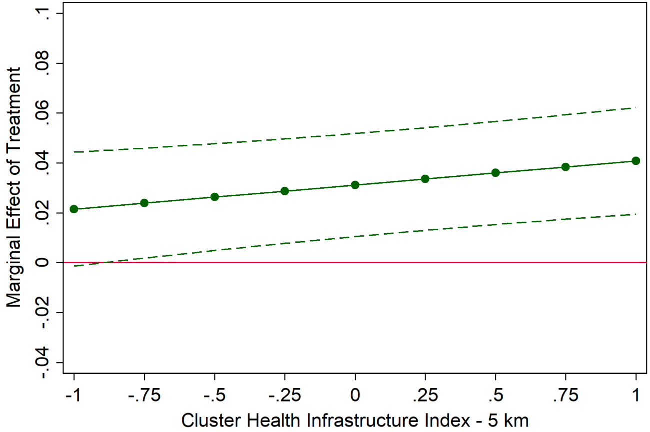
Past Immunization Rate Gradient for MI



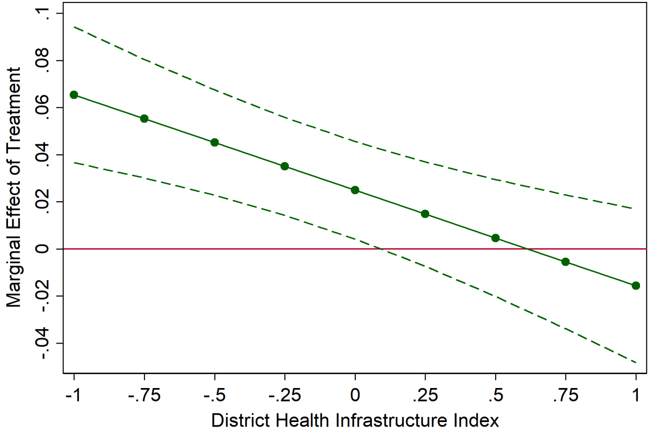
Effect of repeated drives for MI



Effect of Cluster Level Health Infrastructure for MI



Effect of District Level Health Infrastructure for MI



Takeaways

- MI has a significant and positive impact; MI raises a child's probability of full (partial) immunization rose by 3 (2.5) percentage points, while the number of vaccines rise by 0.23
- Disaggregating by each vaccine shows that each vaccine shows these kinds of impacts.
- Greater exposure and more frequent drives increase the likelihood of full immunization.
- Clusters with better local health infrastructure are more likely to be fully immunized.
- Better Targeting: districts with low prior levels of immunization and those with poorer district infrastructure have a higher likelihood of full immunization.
- Policy-driven vaccination strategies can play a role in expanding vaccination coverage and MI's experience shows that effects are widespread across vaccines and targeted to places that need it most.

The End

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