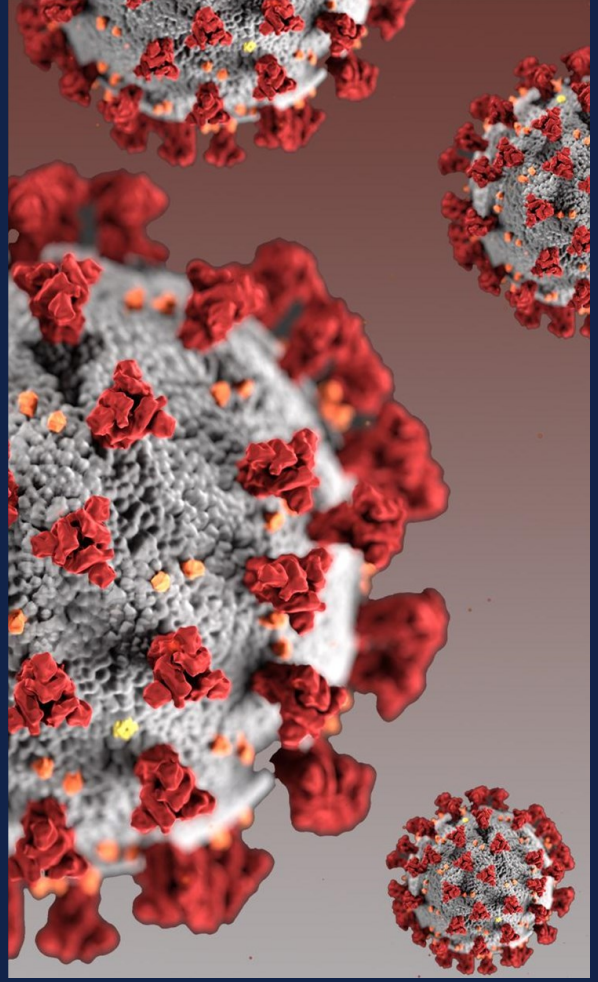

WORLD BANK GROUP

VACCINATING SOUTH ASIA:
SAEF SPECIAL CHAPTER

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SOUTH ASIA VACCINATES AGAINST COVID-19

The COVID-19 pandemic has been an unprecedented shock to the global economy, has exacerbated inequalities and has been a dramatic setback towards eradicating poverty;

Therefore, vaccination is a key development priority; unlike other policy measures, such as lockdowns, vaccines save lives and livelihoods.

However, vaccinating at the scale and speed required to end the pandemic is a daunting task never attempted before. This presentation highlights:

- Vaccination has a high benefit/cost ratios;
- Having features of a public good, herd immunity by vaccination requires government intervention and its financing, while high, seems 'feasible';
- However, financing is one of the challenges; allocation of the vaccine, at least in the short run, presents trade-offs between equity and efficiency;
- And delivering the vaccines – given the current preparedness of the health systems and potential vaccine hesitancy – is an additional key obstacle;
- It is especially important to ensure that vaccines are reaching all those eligible, not just those with the privilege and resources to obtain them.

1 INTRODUCTION: THE COVID-19 PANDEMIC IN SOUTH ASIA

2 ECONOMICS OF COVID-19 VACCINE DEVELOPMENT AND PRODUCTION

3 BENEFIT-COST ANALYSIS

4 HEALTH SYSTEMS AND VACCINE DISTRIBUTION

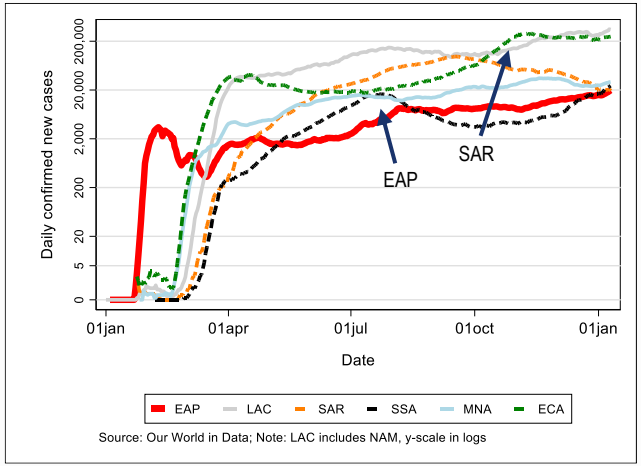
5 VACCINE ALLOCATION IN THEORY AND IN PRACTICE

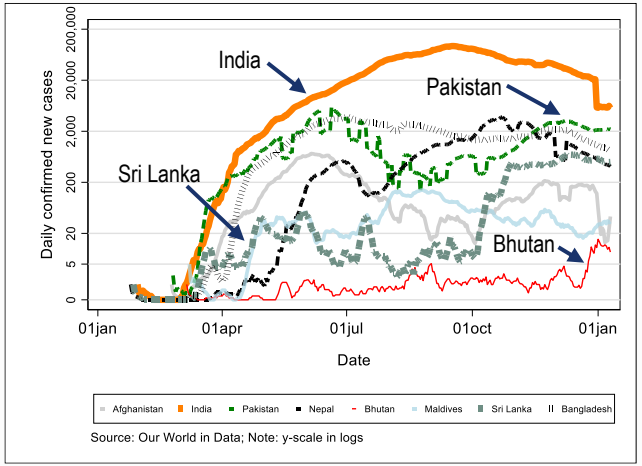
6 PREPAREDNESS OF THE HEALTH SYSTEMS AND EQUITY ISSUES

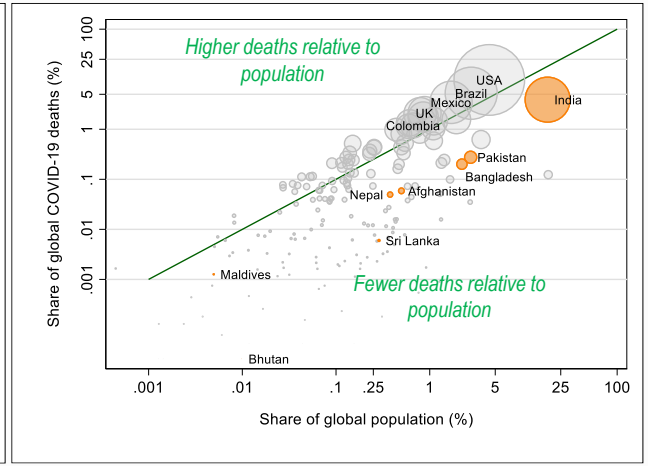
01. INTRODUCTION: THE PANDEMIC IN SOUTH ASIA

COVID-19 IN SAR: A REGION HEAVILY AFFECTED

Cases peaked in many countries in Jun-Sep and then fell sharply; some trying to contain widespread outbreaks (Bhutan, Sri Lanka); death rates relatively low, likely due to young population

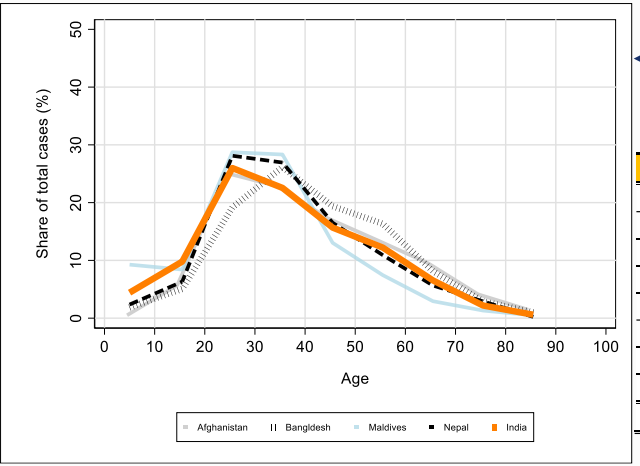






...most COVID-19 deaths (>50%) are concentrated in just four countries: USA, Brazil, India, and Mexico

MOST CASES AMONG YOUNG, MOST DEATHS AMONG ELDERLY

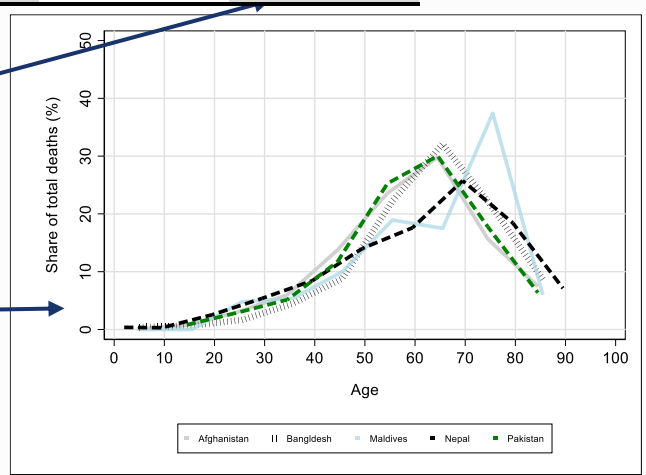


Incidence of cases highest among those 20-40 years of age; this is largely driven by population structure

Country	Total cases	Cases per million	Total deaths	Deaths per million	Case fatality rate
Afghanistan	53,489	1,374	2,277	58	4.3%
Bangladesh	522,453	3,172	7,781	47	1.5%
Bhutan	813	1,054	1	1	0.1%
India	10,466,595	7,584	151,160	110	1.4%
Maldives	14,109	26,102	49	91	0.3%
Nepal	264,780	9,087	1,917	66	0.7%
Pakistan	504,293	2,283	10,676	48	2.1%
Sri Lanka	48,380	2,259	232	11	0.5%
SAR	*11,874,912*	*6,614*	*174,093*	*54*	*1.5%*

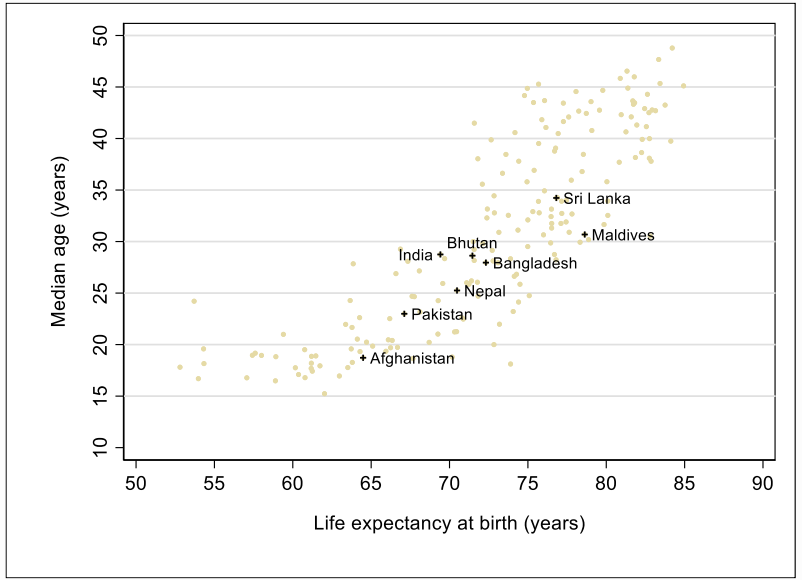
Case fatality rates vary widely in part due to reporting issues; hard to discern true infection fatality rate

Incidence of deaths highest among those 60+ years of age, as seen elsewhere in the world



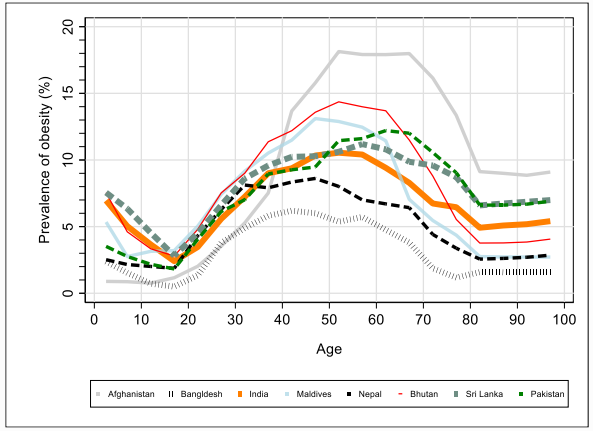
DEMOGRAPHIC & HEALTH RISKS

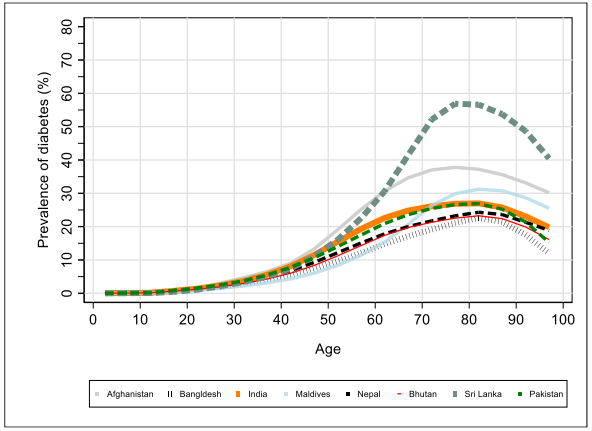
Country	Population	Life expectancy	Median age	Share 40+	Share 50+	Share 65+
Afghanistan	38.9	64	19	16.8%	9.1%	2.7%
Bangladesh	170.1	72	28	30.3%	17.5%	5.3%
Bhutan	0.8	71	29	28.9%	16.9%	6.3%
India	1,395.6	69	29	32.2%	19.7%	6.8%
Maldives	0.4	79	31	25.8%	13.0%	3.8%
Nepal	29.2	70	25	27.4%	16.9%	5.9%
Pakistan	212.5	67	23	23.5%	13.7%	4.4%
Sri Lanka	22.1	77	34	42.4%	28.8%	11.6%
SAR	*1,869.5*	*71*	*27*	*28.4%*	*17.0%*	*5.9%*
LMICs	*6,481.6*	*69*	*26*	*28.7%*	*17.9%*	*6.4%*

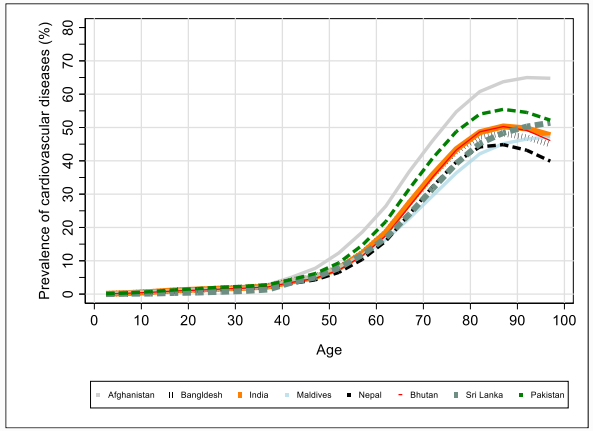


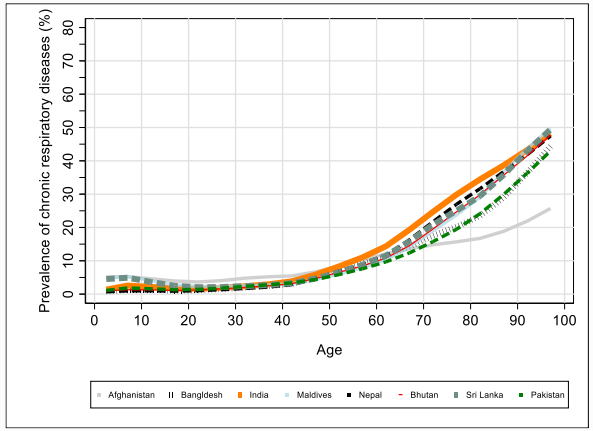
SAR countries are relatively young; Afghanistan has the lowest and Sri Lanka has the highest share of population over age 50

PREVALENCE OF MOST RISK FACTORS CORRELATED WITH AGE









… meaning that vaccine prioritization by age will also largely mirror prioritization by health risk factors

02.
ECONOMICS OF VACCINE DEVELOPMENT AND PRODUCTION

DEVELOPING VACCINES QUICKLY WAS AN EXTRAORDINARY ACHIEVEMENT

TYPICAL VACCINE TIMELINE IS **3-4 YEARS**

Why so extraordinary? Market failures

- In the absence of intervention, market failures will delay broad availability of a COVID-19 vaccine
- Vaccines typically take 5-15 years to develop (Plotkin et al. 2017)
- The timeline to vaccine access is often even longer for developing countries
- For example, in the case of the Rotavirus vaccine, it took 11 years for vaccination rates in Gavi-eligible countries to catch up to the global average

MARKET FAILURES CONT.

Social value >> private value

- **First**, vaccination has significant health and economic externalities, so market prices and firm profits are unlikely to reflect vaccines' full social value. For this reason, governments rather than individuals purchase vaccines.
- **Second**, political and/or public pressures may limit vaccine prices, reducing the incentives for firms to make investments in expanding manufacturing capacity.
- **Third**, firms lack incentives to install capacity early enough or at large enough scale--which could result in significant delays in the development, production, and delivery of successful COVID-19 vaccines. Since firms do not recover the full social value of faster or larger capacity installation, it is optimal for governments to make these investments, but as noted, governments may also introduce pressures that constrain prices.
- Installing large capacity may put downward pressure on prices in high-income countries.

POTENTIAL MARKET-BASED POLICIES TO ADDRESS MARKET FAILURES

- **Advance Market Commitments**

  AMCs incentivize development and distribution of vaccines by providing a market-based incentive to produce a vaccine. The agreements promise a relatively high price per dose for a limited number of doses once the vaccine is developed, creating a market return comparable to that of blockbuster drugs for developing a vaccine. AMCs have previously been successfully used in the case of pneumococcal disease to advance development and availability of vaccines.

- **Patent buyouts or patent pools**

  Another option is to purchase patents at their market value from companies once the vaccine is developed. However, some limitations of this include that companies may be reluctant to share intellectual property that cuts across classes of vaccines, and also that there could be limited transferability of technology across firms due to know-how embodied in firms' production lines that is difficult to transfer.

- **Prizes**

MULTILATERAL EFFORTS TO SOLVE MARKET FAILURES

Gavi's COVAX AMC and facility

- Gavi's COVAX AMC and facility is intended to ensure faster delivery and equitable access to COVID vaccines.
- All South Asian countries are anticipated to participate in COVAX
- For so-called AMC 92 countries, vaccines will be subsidized by ODA and free up to the point of delivery at national airports.
- For so-called self-pay countries, prices will be as negotiated by the COVAX facility (anticipated to be less than $10 per dose on average).
- In both cases, distribution costs are to be covered by countries.

World Bank's Additional Financing for vaccines

- Bangladesh ($500 million), Afghanistan ($110 million) and Nepal ($75 million) IDA heading to Board in March 2021

CURRENT STATUS OF VACCINE DEVELOPMENT AND APPROVAL

Globally, several vaccines have received at least emergency use authorization for use in various countries (Pfizer, Moderna, AstraZeneca, Bharat Biotech, Sinovac, Sputnik)

- India has approved AstraZeneca/Serum Institute vaccine and Bharat Biotech vaccine, notably without results of phase 3 trials for the latter
- Bangladesh, Pakistan, Sri Lanka have approved AstraZeneca vaccine
- Bhutan, Maldives have received doses of Covishield (AstraZeneca vaccine produced by India's Serum Institute) – presumably approved for emergency use
- Pakistan reportedly close to approving Sputnik vaccine

LOCAL PRODUCTION CAPACITY FOR COVID-19 VACCINES

Currently two Indian companies with approved vaccine production

- Serum Institute (Covishield, AstraZeneca vaccine)
- Bharat Biotech (Covaxin)

Early concerns about nationalization of production, but new commitment to vaccine diplomacy and supply the region/world

- Serum Institute's CEO had tweeted that exports would be banned
- However, India has started exports to Brazil/Morocco as well as sending shipments to regional neighbors such as Bhutan, Maldives, Sri Lanka

03.
BENEFIT-COST ANALYSIS

Vaccines are a cost-effective investment for South Asia

- Benefit-cost analysis for if vaccines had been available immediately
- Benefit-cost analysis for current scenario

Table 1: $3 per dose vaccine cost scenario (beyond COVAX initial coverage) – if vaccines had been available at the beginning of the pandemic

								Covax (up to 20 percent)			20% -> 50% Vaccination			50% -> 70% Vaccination		
	Population (m)	GDP ($ bn)	2020 % loss	2021 % loss	Total % loss	Total loss ($ bn)	Monthly loss ($ bn)	20% vaccination benefits	Cost of vaccinating 20% ($ bn)	B/C Ratio	Benefit difference 20% -> 50%	Cost of vaccinating 30% ($ bn)	B/C Ratio	Benefit difference 50% -> 70%	Cost of vaccinating 20% ($ bn)	B/C Ratio
Afghanistan	38.04	19.29	8.50%	1.00%	18.00%	3.4724	0.1447	0.78	0.044	17.75	0.63	0.14	4.49	0.33	0.09	3.55
Bangladesh	163.05	302.57	5.20%	5.70%	16.10%	48.7139	2.0297	10.96	0.189	58.09	8.77	0.60	14.68	4.63	0.40	11.62
Bhutan	0.76	2.53	4.90%	8.30%	18.10%	0.4580	0.0191	0.10	0.001	116.71	0.08	0.00	29.50	0.04	0.00	23.35
India	1,366.42	2,868.93	15.40%	0.70%	31.50%	903.7130	37.6547	203.34	1.581	128.59	162.67	5.01	32.50	85.85	3.34	25.73
Maldives	0.53	5.64	27.00%	-3.90%	50.10%	2.8267	0.1178	0.64	0.001	1035.15	0.51	0.00	261.62	0.27	0.00	207.11
Nepal	28.61	30.64	6.20%	5.90%	18.30%	5.6074	0.2336	1.26	0.033	38.11	1.01	0.10	9.63	0.53	0.07	7.62
Pakistan	216.57	278.22	3.90%	2.50%	10.30%	28.6569	1.1940	6.45	0.251	25.73	5.16	0.79	6.50	2.72	0.53	5.15
Sri Lanka	21.80	84.01	10.00%	0.40%	20.40%	17.1378	0.7141	3.86	0.025	152.83	3.08	0.08	38.63	1.63	0.05	30.58

Table 2: $7 per dose vaccine cost scenario (beyond COVAX initial coverage) – if vaccines had been available at the beginning of the pandemic

								Covax (up to 20 percent)			20% -> 50% Vaccination			50% -> 70% Vaccination		
	Population (m)	GDP ($ bn)	2020 % loss	2021 % loss	Total % loss	Total loss ($ bn)	Monthly loss ($ bn)	20% vaccination benefits	Cost of vaccinating 20% ($ bn)	B/C Ratio	Benefit difference 20% -> 50%	Cost of vaccinating 30% ($ bn)	B/C Ratio	Benefit difference 50% -> 70%	Cost of vaccinating 20% ($ bn)	B/C Ratio
Afghanistan	38.04	19.29	8.50%	1.00%	18.00%	3.4724	0.1447	0.78	0.044	17.75	0.63	0.24	2.61	0.33	0.16	2.06
Bangladesh	163.05	302.57	5.20%	5.70%	16.10%	48.7139	2.0297	10.96	0.189	58.09	8.77	1.03	8.53	4.63	0.69	6.75
Bhutan	0.76	2.53	4.90%	8.30%	18.10%	0.4580	0.0191	0.10	0.001	116.71	0.08	0.00	17.14	0.04	0.00	13.57
India	1,366.42	2,868.93	15.40%	0.70%	31.50%	903.7130	37.6547	203.34	1.581	128.59	162.67	8.61	18.89	85.85	5.74	14.95
Maldives	0.53	5.64	27.00%	-3.90%	50.10%	2.8267	0.1178	0.64	0.001	1035.15	0.51	0.00	152.04	0.27	0.00	120.36
Nepal	28.61	30.64	6.20%	5.90%	18.30%	5.6074	0.2336	1.26	0.033	38.11	1.01	0.18	5.60	0.53	0.12	4.43
Pakistan	216.57	278.22	3.90%	2.50%	10.30%	28.6569	1.1940	6.45	0.251	25.73	5.16	1.37	3.78	2.72	0.91	2.99
Sri Lanka	21.80	84.01	10.00%	0.40%	20.40%	17.1378	0.7141	3.86	0.025	152.83	3.08	0.14	22.45	1.63	0.09	17.77

Table 3: $3 per dose vaccine cost scenario (beyond COVAX initial coverage) – current scenario

									Covax (up to 20 percent)			20% -> 50% Vaccination			50% -> 70% Vaccination		
	Population (m)	GDP ($ bn)	2020 % loss	2021 % loss	2022 % loss	Total % loss 2022	Total loss ($ bn)	Monthly loss ($ bn)	20% vaccination benefits	Cost of vaccinating 20% ($ bn)	B/C Ratio	Benefit difference 20% -> 50%	Cost of vaccinating 30% ($ bn)	B/C Ratio	Benefit difference 50% -> 70%	Cost of vaccinating 20% ($ bn)	B/C Ratio
Afghanistan	38.04	19.29	8.50%	1.00%	-1.10%	8.40%	1.6205	0.06752	0.36	0.044	8.28	0.29	0.14	2.06	0.15	0.09	1.63
Bangladesh	163.05	302.57	5.20%	5.70%	-2.00%	8.90%	26.9288	1.12203	6.06	0.189	32.11	4.85	0.61	8.00	2.56	0.40	6.33
Bhutan	0.76	2.53	4.90%	8.30%	-1.60%	11.60%	0.2935	0.01223	0.07	0.001	74.79	0.05	0.00	18.63	0.03	0.00	14.75
India	1,366.42	2,868.93	15.40%	0.70%	-2.70%	13.40%	384.4366	16.0182	86.50	1.581	54.70	69.20	5.08	13.63	36.52	3.38	10.79
Maldives	0.53	5.64	27.00%	-3.90%	-1.90%	21.20%	1.1961	0.04984	0.27	0.001	438.03	0.22	0.00	109.13	0.11	0.00	86.40
Nepal	28.61	30.64	6.20%	5.90%	0.20%	12.30%	3.7689	0.15704	0.85	0.033	25.61	0.68	0.11	6.38	0.36	0.07	5.05
Pakistan	216.57	278.22	3.90%	2.50%	0.40%	6.80%	18.9191	0.7883	4.26	0.251	16.99	3.41	0.80	4.23	1.80	0.54	3.35
Sri Lanka	21.80	84.01	10.00%	0.40%	1.60%	12.00%	10.0811	0.42004	2.27	0.025	89.90	1.81	0.08	22.40	0.96	0.05	17.73

Table 4: $7 per dose vaccine cost scenario (beyond COVAX initial coverage) – current scenario

									Covax (up to 20 percent)			20% -> 50% Vaccination			50% -> 70% Vaccination		
	Population (m)	GDP ($ bn)	2020 % loss	2021 % loss	2022 % loss	Total % loss 2022	Total loss ($ bn)	Monthly loss ($ bn)	20% vaccination benefits	Cost of vaccinating 20% ($ bn)	B/C Ratio	Benefit difference 20% -> 50%	Cost of vaccinating 30% ($ bn)	B/C Ratio	Benefit difference 50% -> 70%	Cost of vaccinating 20% ($ bn)	B/C Ratio
Afghanistan	38.04	19.29	8.50%	1.00%	-1.10%	8.40%	1.6205	0.06752	0.36	0.044	8.28	0.29	0.24	1.22	0.15	0.16	0.96
Bangladesh	163.05	302.57	5.20%	5.70%	-2.00%	8.90%	26.9288	1.12203	6.06	0.189	32.11	4.85	1.03	4.72	2.56	0.69	3.73
Bhutan	0.76	2.53	4.90%	8.30%	-1.60%	11.60%	0.2935	0.01223	0.07	0.001	74.79	0.05	0.00	10.99	0.03	0.00	8.70
India	1,366.42	2,868.93	15.40%	0.70%	-2.70%	13.40%	384.4366	16.0182	86.50	1.581	54.70	69.20	8.61	8.03	36.52	5.74	6.36
Maldives	0.53	5.64	27.00%	-3.90%	-1.90%	21.20%	1.1961	0.04984	0.27	0.001	438.03	0.22	0.00	64.34	0.11	0.00	50.93
Nepal	28.61	30.64	6.20%	5.90%	0.20%	12.30%	3.7689	0.15704	0.85	0.033	25.61	0.68	0.18	3.76	0.36	0.12	2.98
Pakistan	216.57	278.22	3.90%	2.50%	0.40%	6.80%	18.9191	0.7883	4.26	0.251	16.99	3.41	1.37	2.49	1.80	0.91	1.98
Sri Lanka	21.80	84.01	10.00%	0.40%	1.60%	12.00%	10.0811	0.42004	2.27	0.025	89.90	1.81	0.14	13.20	0.96	0.09	10.45

04.
HEALTH FINANCING &HEALTH SYSTEMS CONSIDERATIONS

COVID-19 VACCINE: COVERAGE AND FINANCING SCENARIOS

SCENARIO 1: PESSIMISTIC SCENARIO

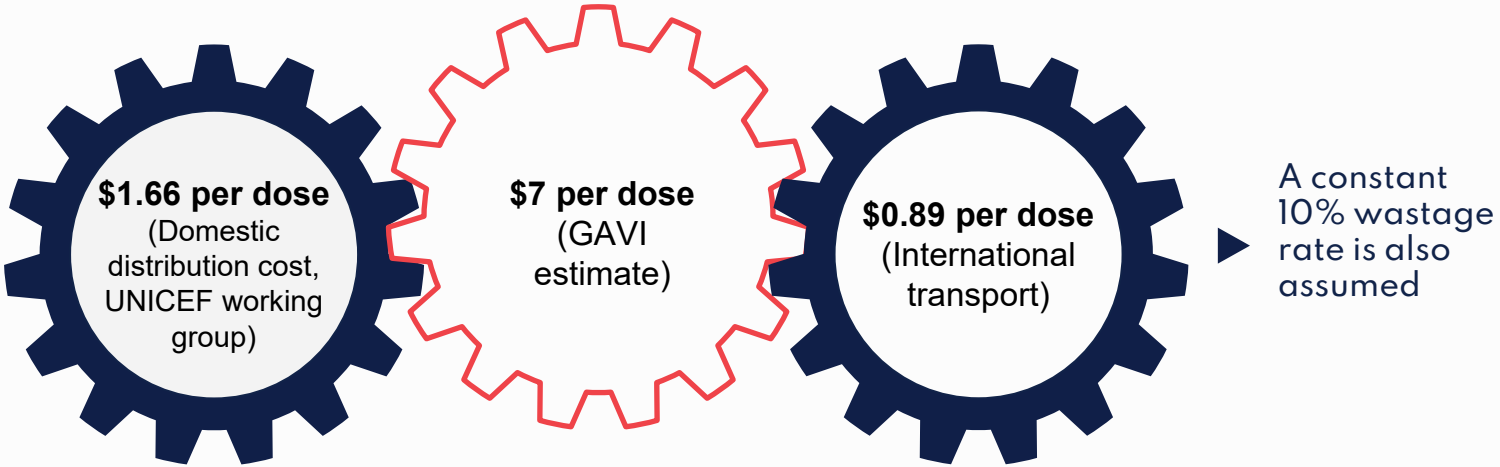
SCENARIO 2: REALISTIC SCENARIO

SCENARIO 3: OPTIMISTIC SCENARIO

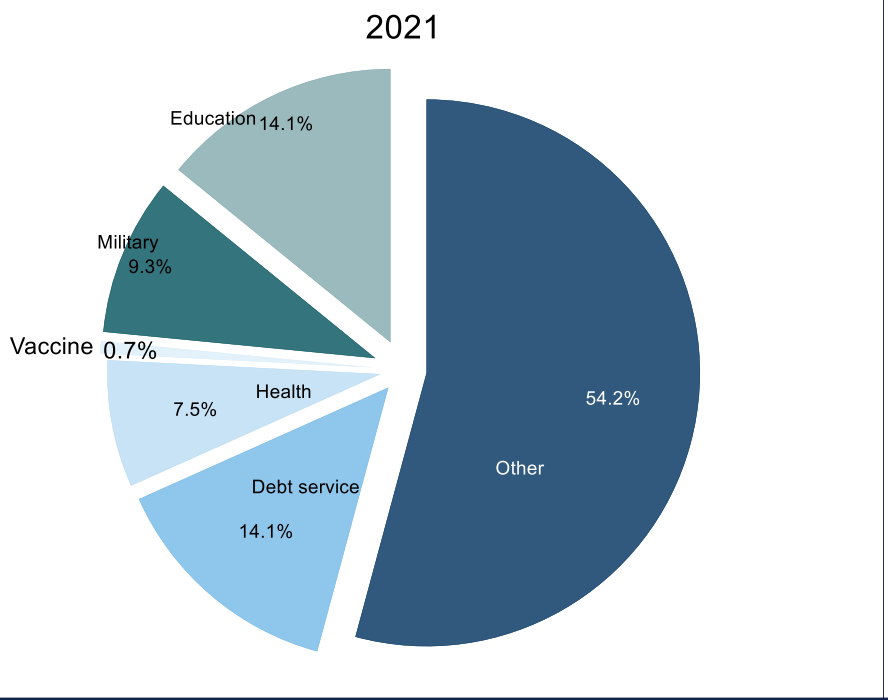
SCENARIOS

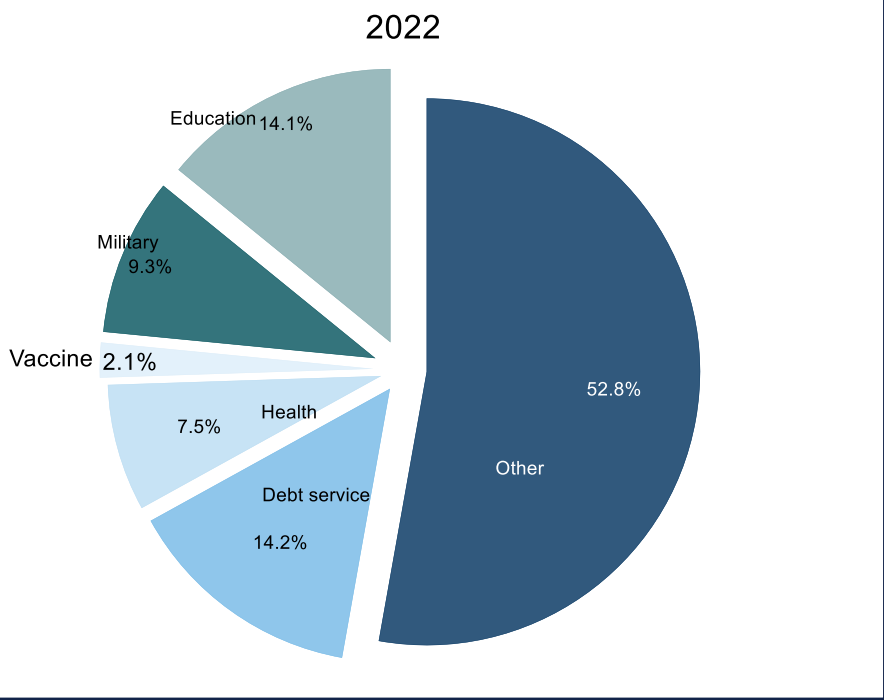
Scenario 1: "Pessimistic" costs and coverage in 2021 | Scenario 2 | Scenario 3

Assumes cost of vaccine per person is US$19.27 across all countries:



Assumes 20% coverage from COVAX in 2021 and 50% self-financed by countries (10% in 2021 and 40% in 2022) to reach the target 70% herd immunity.





Scenario 1:
Percent of government spending on vaccines in contrast to other sectors, associated with 20% coverage from COVAX and 50% self-financing by countries (10% in 2021, 40% in 2022), assuming $19.27 per vaccinated person for all countries in SAR

SCENARIO 1: COUNTRY-SPECIFIC

Coverage, costs, budget share, and GDP share associated with 20% coverage from COVAX and 50% self-financing by countries (10% in 2021, 40% in 2022), assuming $19.27 per vaccinated person, by SAR country

	Coverage (millions)		Vaccine cost ($millions)		Share health (%)		Share budget (%)		Share GDP (%)	
Country	2021	2022	2021	2022	2021	2022	2021	2022	2021	2022
Afghanistan	11.7	15.9	110.2	334.7	43.8	124.8	2.0	5.7	0.56	1.61
Bangladesh	51.0	68.7	481.5	1,444.0	28.3	75.2	1.0	2.5	0.14	0.39
Bhutan	0.2	0.3	2.2	6.5	3.0	9.5	0.2	0.8	0.08	0.23
India	418.7	563.8	3,951.4	11,845.9	13.6	37.9	0.5	1.3	0.14	0.38
Maldives	0.1	0.2	1.1	3.3	0.3	0.7	0.1	0.2	0.02	0.05
Nepal	8.8	11.8	82.7	248.6	15.1	43.8	0.8	2.2	0.24	0.67
Pakistan	63.7	86.6	601.6	1,819.2	18.0	52.0	0.9	2.7	0.22	0.61
Sri Lanka	6.6	8.9	62.5	186.6	4.4	11.9	0.4	1.0	0.07	0.20
SAR ave.					**15.8**	**44.5**	**0.7**	**2.1**	**0.18**	**0.52**

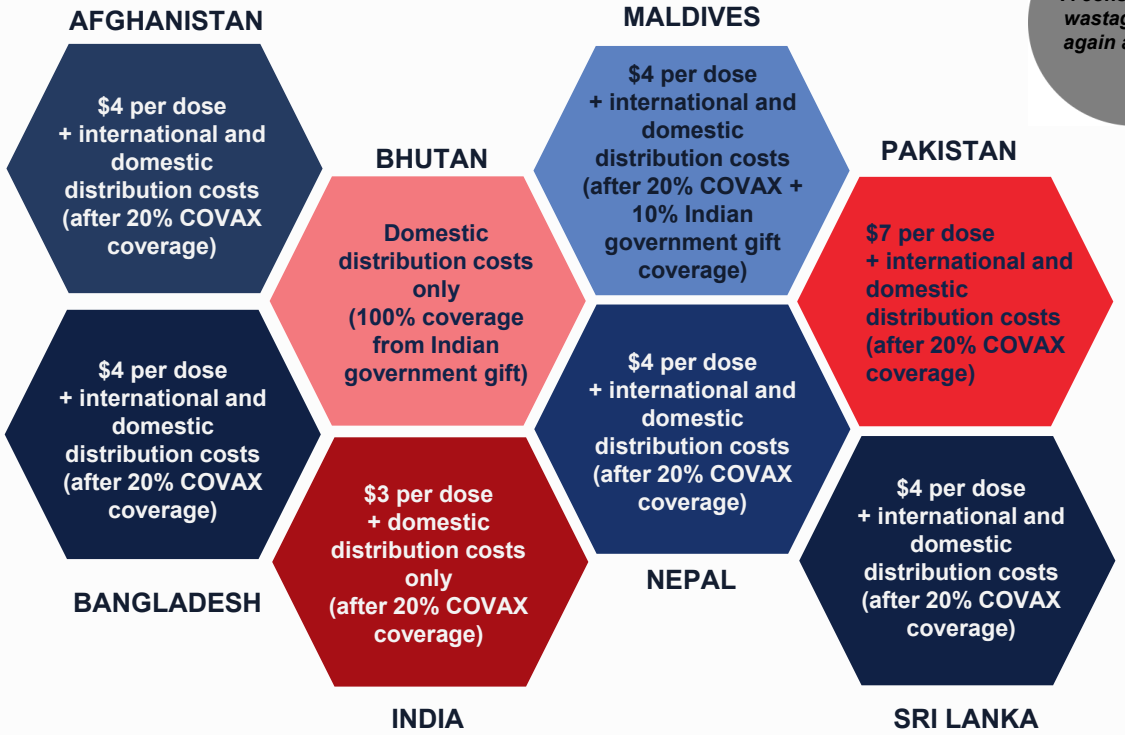
- Vaccine-related costs relatively low in 2021, averaging only 0.7% of government budgets across the region (0.18% of GDP), since only delivery-related costs would need to be financed for two-thirds of the total coverage in 2021.
- Estimated costs in 2022 exceed 2% of government budget in Afghanistan (5.7%), Pakistan (2.7%), Bangladesh (2.5%), and Nepal (2.2%), which is likely to be difficult for governments to cover.

SCENARIOS

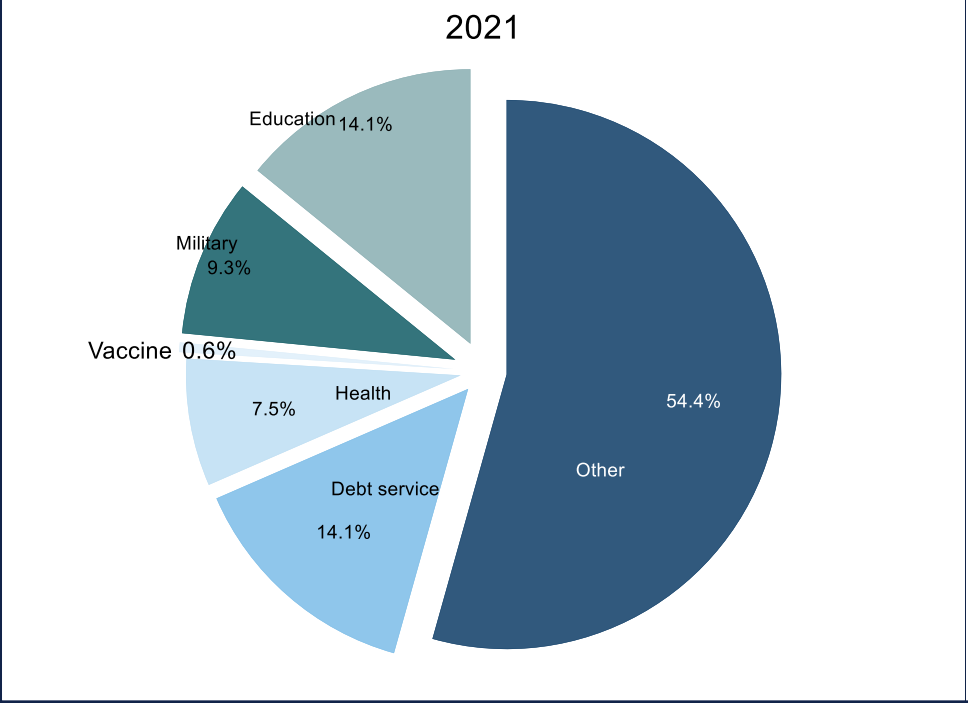
Scenario 1 | **Scenario 2: "Realistic" costs and coverage in 2021** | Scenario 3

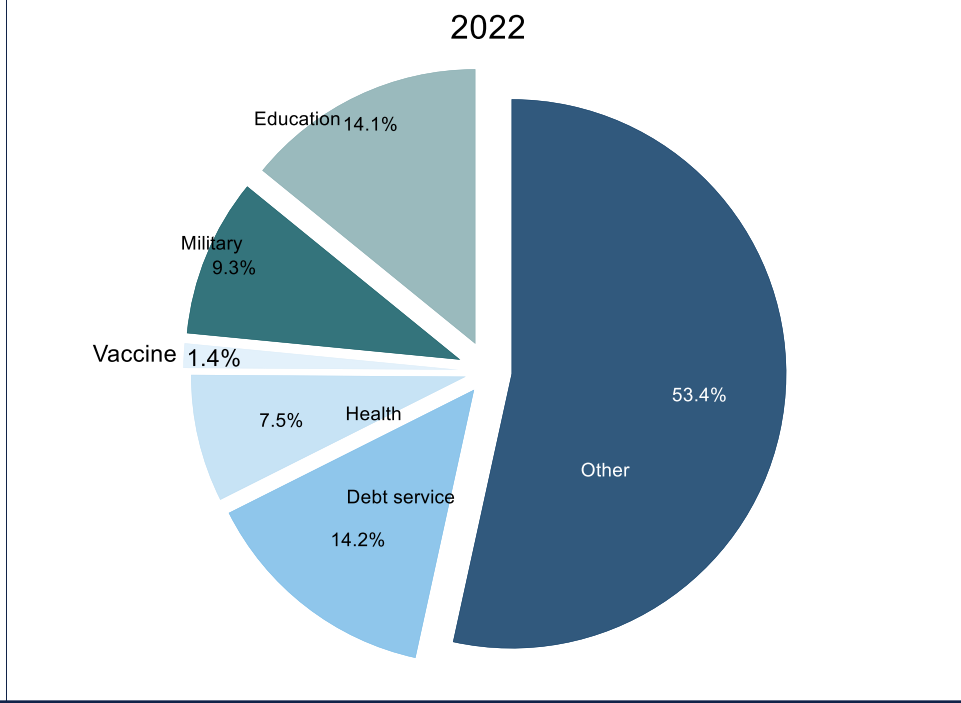
Assumes country-specific costs based on expected/potential procurement agreements/gifts:

A constant 10% wastage rate is again assumed



Assumes 20% coverage from COVAX in 2021, 50% self-financed by countries (10% in 2021 and 40% in 2022) to reach the target 70% for herd immunity.





Scenario 2:
Percent of government spending on vaccines in contrast to other sectors, associated with 20% coverage from COVAX and 50% self-financing (10% in 2021, 40% in 2022), assuming country-specific costs for all countries in SAR

SCENARIO 2: COUNTRY-SPECIFIC

20% coverage from COVAX and 10% self-financed in 2021, 40% self-financed by countries in 2022, assuming country-specific costs, by country in SAR

Country	Coverage (millions)		Vaccine cost ($millions)		Share health (%)		Share budget (%)		Share GDP (%)	
	2021	2022	2021	2022	2021	2022	2021	2022	2021	2022
Afghanistan	11.7	15.9	84.5	229.6	33.6	85.6	1.5	3.9	0.43	1.10
Bangladesh	51.0	68.7	369.3	990.4	21.7	51.6	0.7	1.7	0.11	0.27
Bhutan	0.2	0.3	0.8	1.1	1.1	1.6	0.1	0.1	0.03	0.04
India	418.7	563.8	2,450.1	5,780.3	8.4	18.5	0.3	0.6	0.09	0.19
Maldives	0.1	0.2	0.4	2.3	0.1	0.5	0.0	0.1	0.01	0.04
Nepal	8.8	11.8	63.4	170.5	11.6	30.0	0.6	1.5	0.19	0.46
Pakistan	63.7	86.6	601.6	1,819.2	18.0	52.0	0.9	2.7	0.22	0.61
Sri Lanka	6.6	8.9	47.9	128.0	3.4	8.2	0.3	0.7	0.06	0.14
SAR ave.					12.2	31.0	0.6	1.4	0.14	0.35

- Estimated costs in 2022 exceed 3% of government budget in Afghanistan (3.9%), which is likely to be difficult for the government to cover.
- For all countries, cost is less than the total health budget in both 2021 and 2022.
- Notably lower than Scenario I (pessimistic), but costs remain high for some countries - likely to still need to mobilize additional financing.

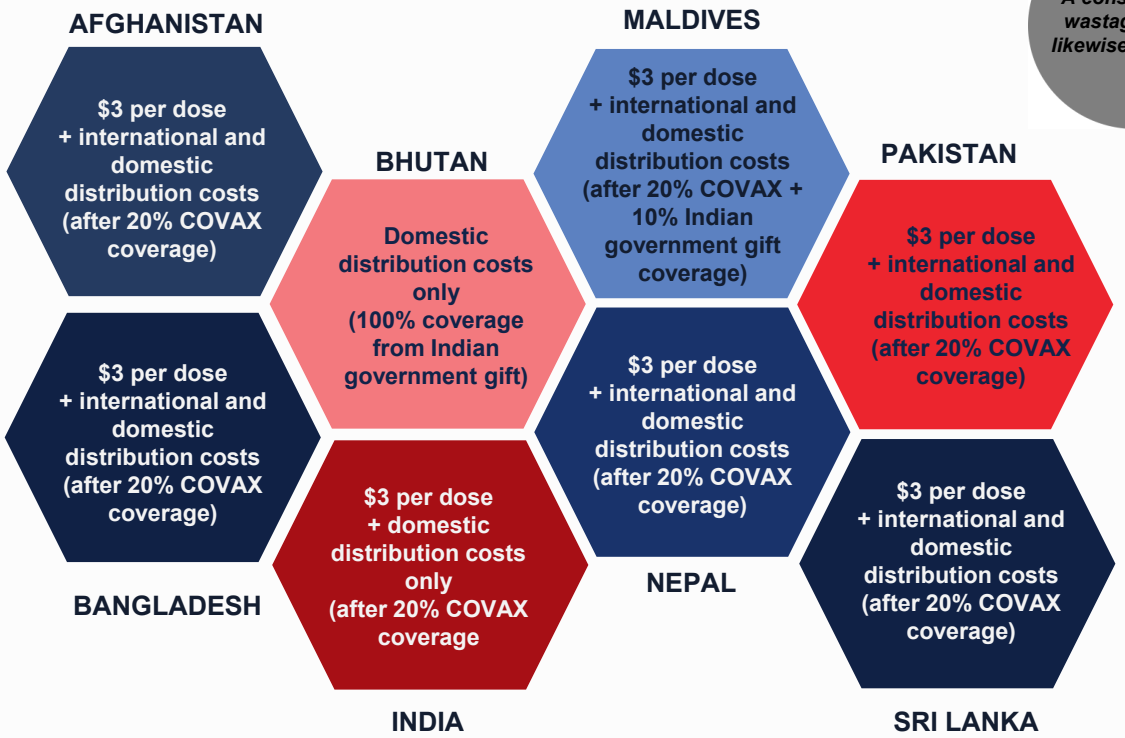
SCENARIOS

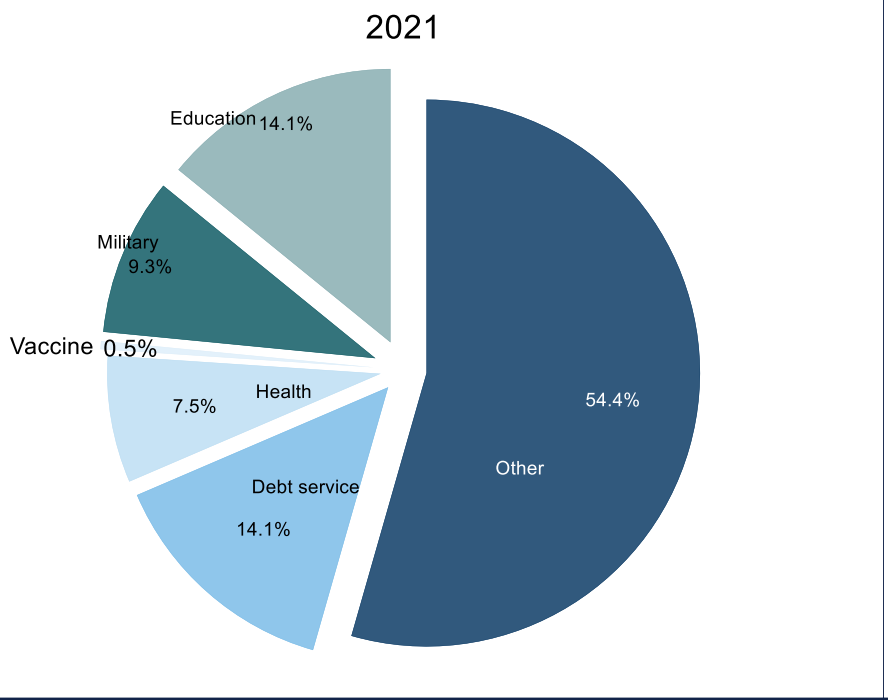
Scenario 1 → Scenario 2 → **Scenario 3: "Optimist" costs and "realistic" coverage in 2021**

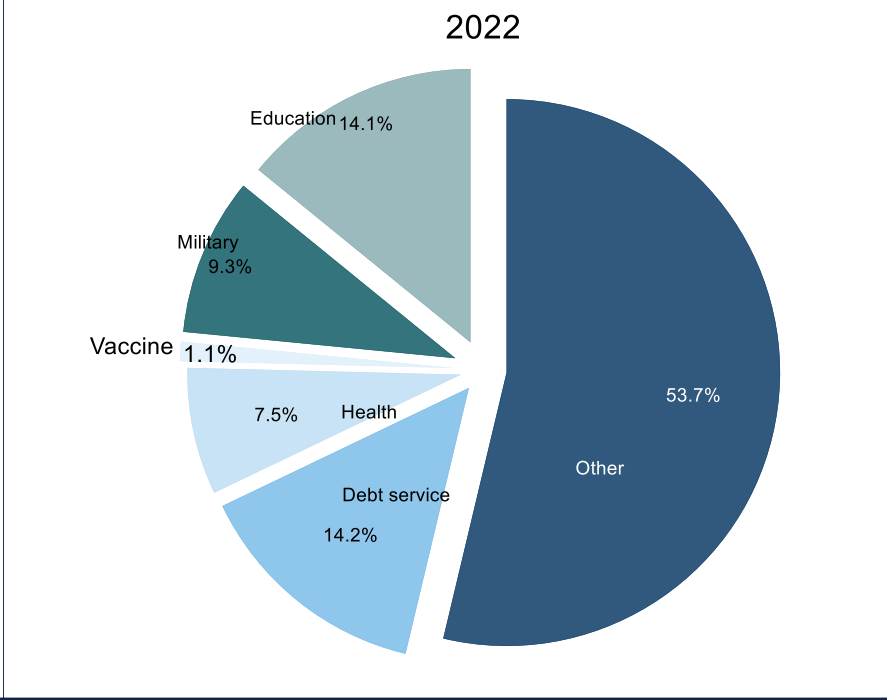
Assumes vaccine costs can be negotiated down to a maximum of $3 per dose (plus international and domestic transport costs = total $11.10 per vaccinated person), mirroring the vaccine costs in India:

A constant 10% wastage rate is likewise assumed

Assumes 20% coverage from COVAX in 2021, 50% self-financed by countries (10% in 2021 and 40% in 2022) to reach the target 70% for herd immunity.







Scenario 3:
Percent of government spending on vaccines in contrast to other sectors, associated with 10% self-financing in 2021 and 40% self-financing in 2022, assuming vaccine costs are negotiated down to no more than $11.10 per vaccinated person, for all countries in SAR.

SCENARIO 3: COUNTRY-SPECIFIC

20% coverage from COVAX and 10% self-financed in 2021, 40% self-financed by countries in 2022, assuming vaccine costs are negotiated down to no more than $11.10 per vaccinated person, by country in SAR.

Country	Coverage (millions)		Vaccine cost ($millions)		Share health (%)		Share budget (%)		Share GDP (%)	
	2021	2022	2021	2022	2021	2022	2021	2022	2021	2022
Afghanistan	11.7	15.9	76.0	194.5	30.2	72.5	1.4	3.3	0.39	0.93
Bangladesh	51.0	68.7	331.8	839.2	19.5	43.7	0.7	1.5	0.10	0.23
Bhutan	0.2	0.3	0.8	1.1	1.1	1.6	0.1	0.1	0.03	0.04
India	418.7	563.8	2,450.1	5,780.3	8.4	18.5	0.3	0.6	0.09	0.19
Maldives	0.1	0.2	0.4	1.9	0.1	0.4	0.0	0.1	0.01	0.03
Nepal	8.8	11.8	57.0	144.5	10.4	25.4	0.5	1.3	0.17	0.39
Pakistan	63.7	86.6	414.6	1,057.2	12.4	30.2	0.7	1.6	0.15	0.35
Sri Lanka	6.6	8.9	43.1	108.5	3.0	6.9	0.3	0.6	0.05	0.12
SAR ave.					10.6	24.9	0.5	1.1	0.12	0.28

- Reasonably affordable (~0.5% of budget in 2021, ~1.1% in 2022)
- Demonstrates impact of negotiating price down to Serum level
- However, still potentially unaffordable for Afghanistan (3.3%) in 2022 – only country with cost exceeding 3% of budget

05. VACCINE ALLOCATION IN SOUTH ASIA

OVERVIEW OF VACCINE ALLOCATION PROBLEM

- New SARS-CoV-2 vaccines developed in record time
- In order for vaccination scheme to be effective, a significant percentage of the population needs to be vaccinated
- Large-scale vaccination hampered by constraints:
  - Limited number of doses
  - Limited distribution capacity
- Prioritization + distribution plans required to make the most effective use of vaccine stock

DISCUSSION OF VACCINE POLICY OBJECTIVES

- **Vaccines save lives and livelihoods → two types of benefit:**
  health* and *economic

  Natural immunity of recovered patients means their health value of vaccination is lower, but they experience *economic* benefits from a vaccination program

- **Maximizing these health and economic benefits in aggregate may not be the only objective;**

  - Vaccination plans must be cognizant of ethical, political, and social concerns when making equity and efficiency trade-off decisions
  - Here we describe a positive analysis, not policy recommendations (normative analyses).

- **Determining effect of vaccination requires defining an alternative public health policy whose effects are compared to that of vaccination (counterfactual choice; *some restrictions, voluntary or mandated, of the transmission of the virus*).**

DEVELOPING A VACCINATION ALLOCATION STRATEGY

1. Define subpopulations by variables allowing prioritization at scale (e.g. breakdowns by age, sex, employment category, location, etc.)
2. Calculate the value of vaccinating a given person in each subpopulation
3. Aggregate these values to guide purchase/subsidy schedule to target highest-value subpopulations

Key here is calculation of the **VALUE of vaccinating**

HOW TO MEASURE THE VALUE OF VACCINATION (1 / 2)

1. Survival benefits

- Quantify the number of years of life lost (YLL) due to vaccination
- Disease risk data is spotty, especially in developing-world context
- Need to make a choice on modeling hazards (e.g. epidemiological models, curve fitting, constant hazards)

2. Income benefits

- Quantify additional income gained due to survival from vaccination
- Poor real-time economic quality data in general, we use CMIE data (monthly panel dataset for India)
- Other countries lack this data, leading to lower-precision estimates

HOW TO MEASURE THE VALUE OF VACCINATION (2/ 2)

3. Disease externalities

- Model reduction in the reproductive rate, R_t: the average number of secondary infections caused by each current infection
- Requires assumptions on reproductive rate estimation techniques, and subpopulations mixing structure

4. Economic externalities

- Measure non-health benefits to general population as socioeconomic activity resumes (incomes rise as societies re-open)
- Difficult to disentangle

THE CHALLENGE OF EQUITY

Both efficiency (maximizing the number of lives saved or income gains) and equity (equal opportunities or doses) are important.

Equity is an issue along multiple dimensions:

- Region
- Income
- Other (gender, age)

Sometimes equity is hard to define. E.g., should we weight lives equally or life years?

Unfortunately, equity and efficiency are sometimes at odds:

- **Region:** Spreading limited vaccines out over multiple regions may not enable release from suppression (lockdown) in any one area. This means equity sacrifices income.
- **Income:** Poor areas have been hit harder (incidence of infection). But higher levels of natural immunity imply lower returns to vaccination.
- **Demographics:** Males may be more at risk of dying.

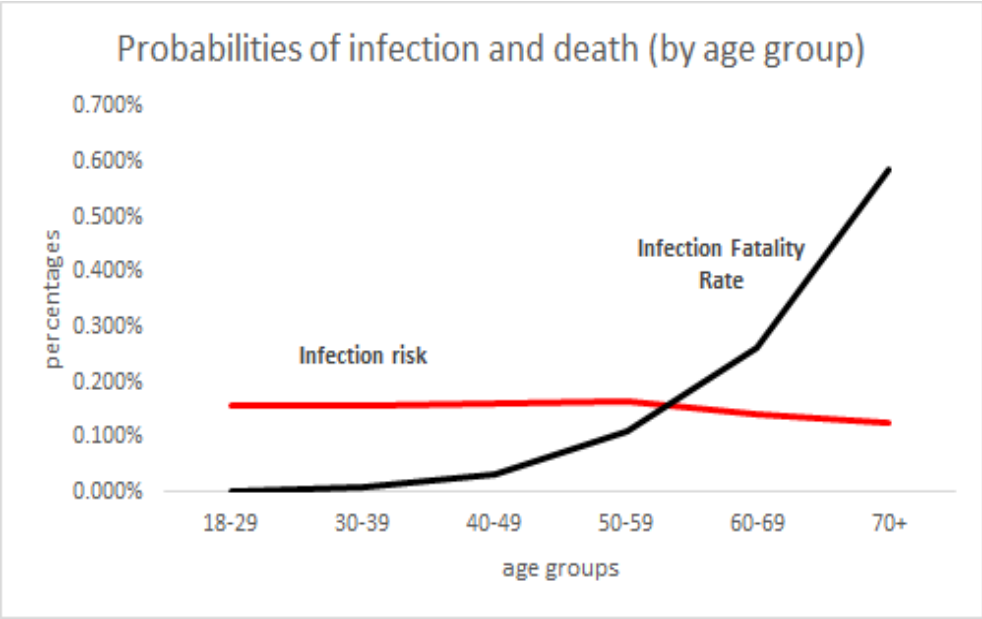
Application: **India (Tamil Nadu)**

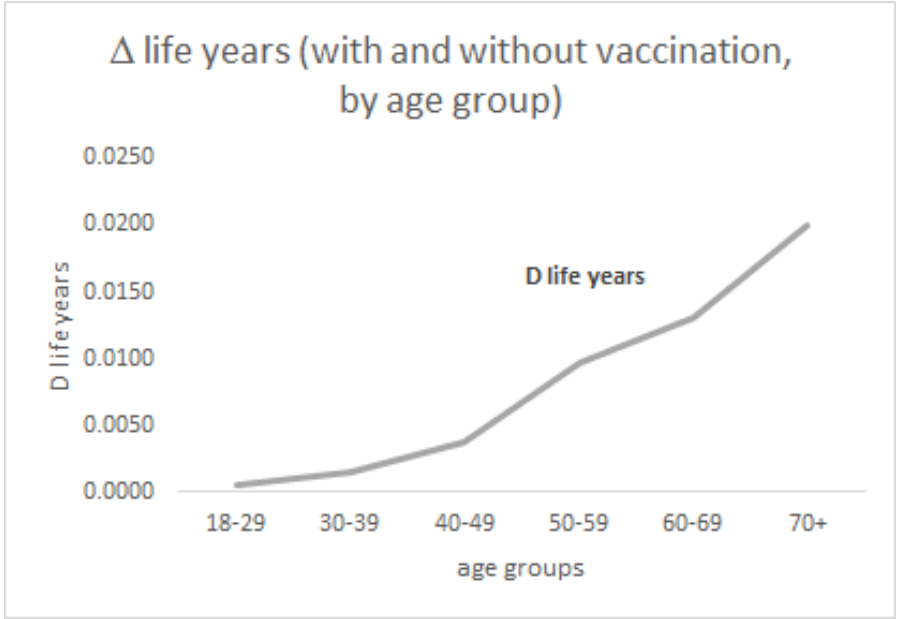
HEALTH AND ECONOMIC DATA FOR TAMIL NADU

- **Epidemiological data:**
  - Daily case and death data, by age and district (from TN state government)
  - New, district population representative sero-prevalence survey in TN with N = 26,140 from October-November 2020 [Malani et al., 2021]
  - Contact rates from AP & TN [Laxminarayan et al., 2020]

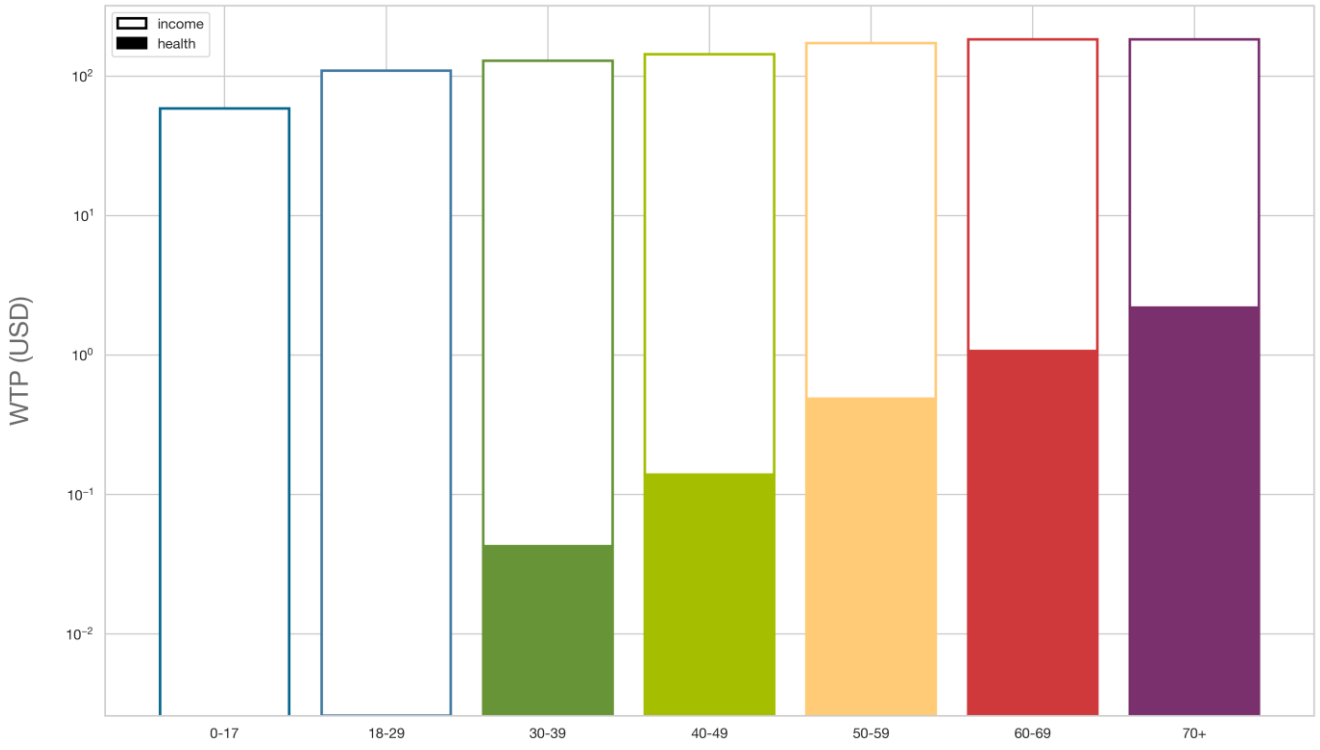
- **Economic data:**
  - CMIE Consumer Pyramids Household Survey (panel of 174,000 households across India, 11,148 in TN, surveyed every 4 months)

HEALTH IMPACT OF VACCINATION IN TAMIL NADU (BY AGE GROUPS)

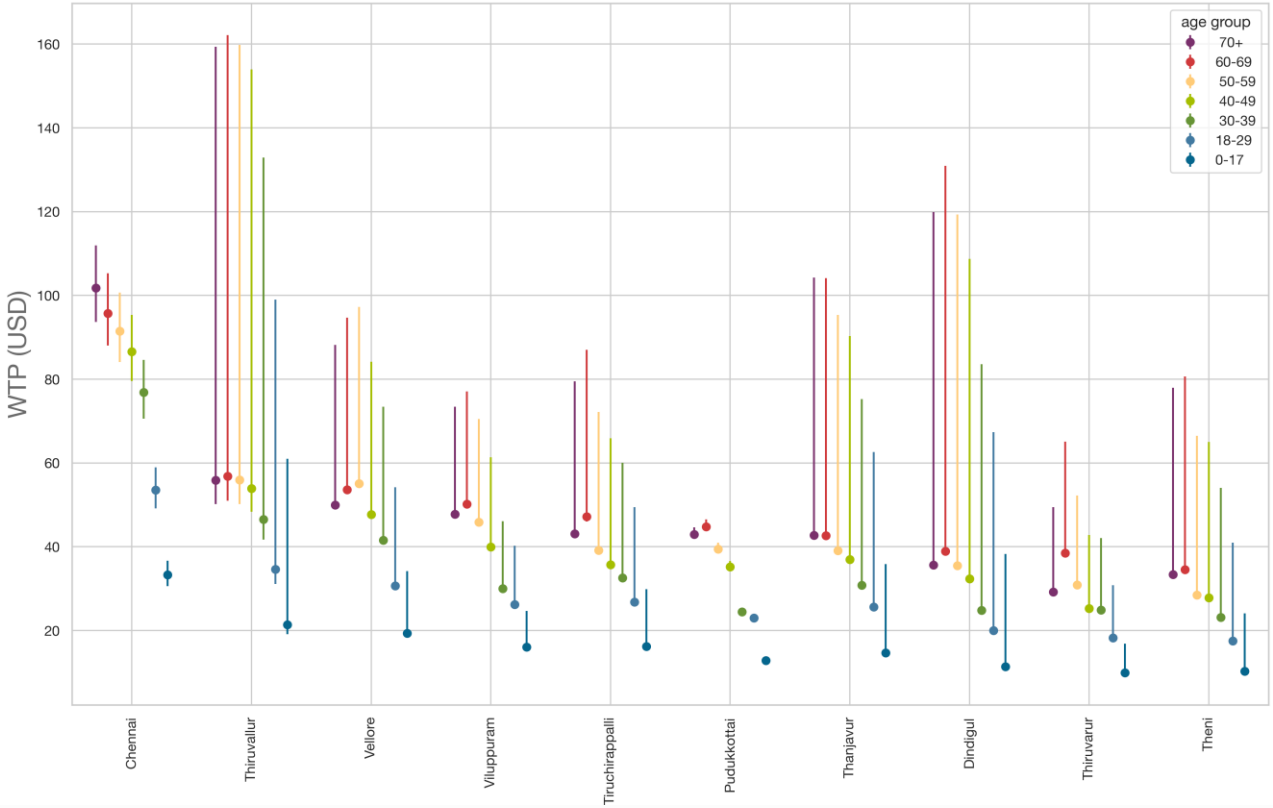




TOTAL (HEALTH + ECONOMIC) IMPACT OF VACCINATION IN TAMIL NADU (BY AGE GROUPS)



IMPACT OF VACCINATION IN TAMIL NADU (BY AGE GROUPS AND DISTRICTS



06. PREPAREDNESS OF THE HEALTH SYSTEMS AND EQUITY ISSUES

PREPAREDNESS OF THE HEALTH SYSTEM AND INEQUALITY DIMENSIONS

Backward-looking assessment: what have been the main challenges and bottlenecks of the health systems in SAR in the recent past (as these may be affecting COVID-19 vaccine campaign).

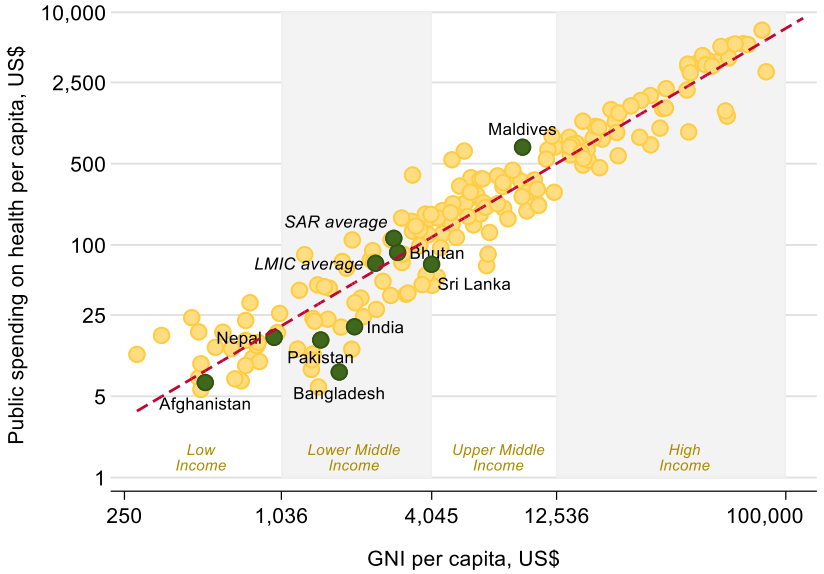
1. **The capacity and performance of the health systems:**
   a. Health expenditure and immunization per capita in SAR countries
   b. Supply side health services issues including immunization
   c. Demand side health services issues including immunization

2. **The inequality dimension of health outcomes in the SAR countries**
   a. Economic and disease burden according to socioeconomic characteristics
   b. Socio-economic indicators impacting selected health outcomes including immunization

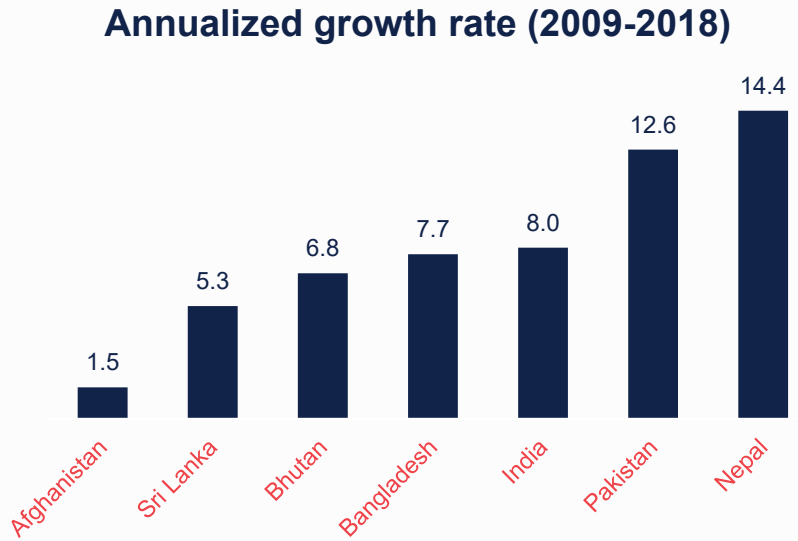
SAR Health Systems:
overall size and performance, comparisons with respect to other countries regions

PUBLIC HEALTH SPENDING PER CAPITA IN SAR COUNTRIES

Public spending on health per capita, US$, 2017

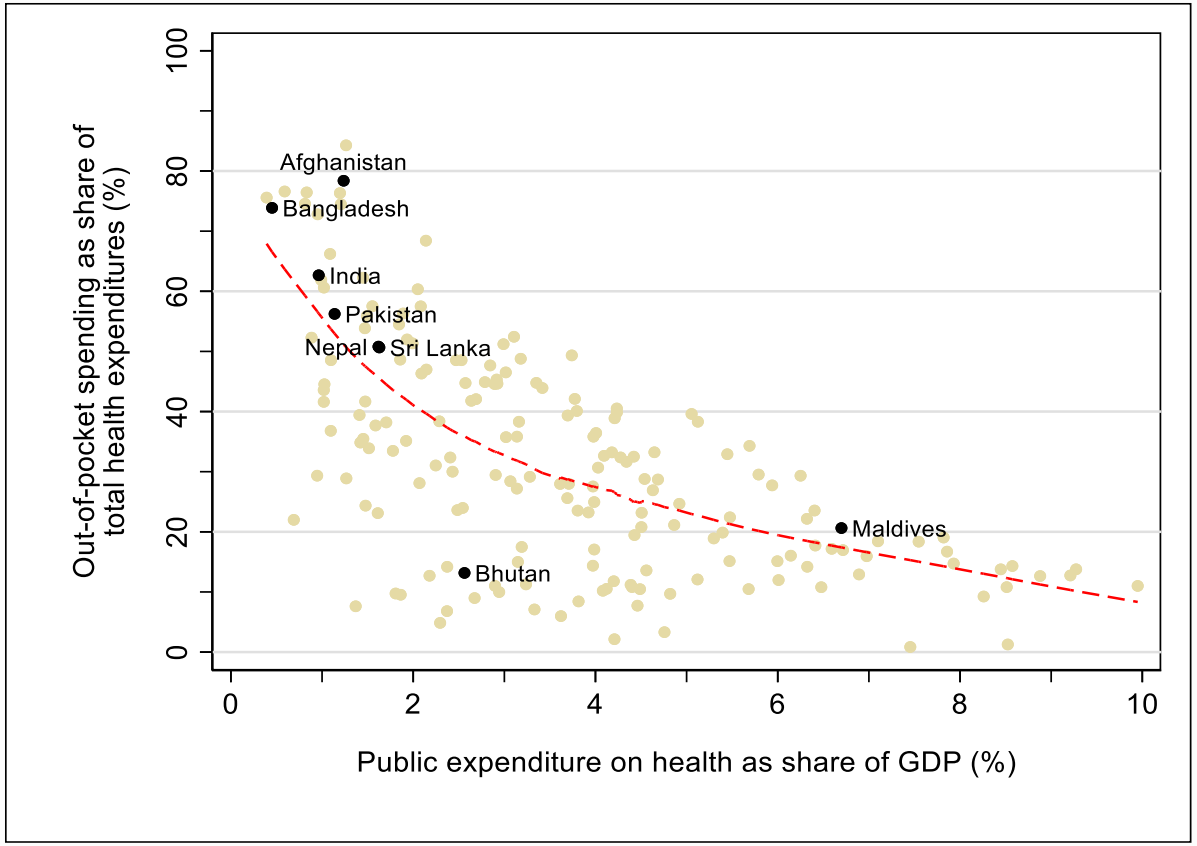


Public spending on health per capita



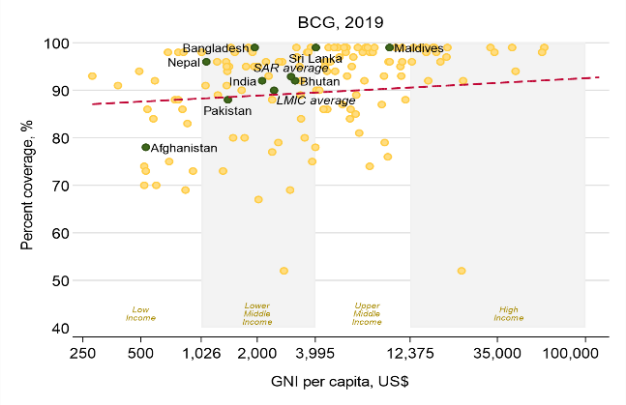
Source: World Development Indicators.
Note: Both X- and Y-axes expressed in logarithmic scale (left graph)

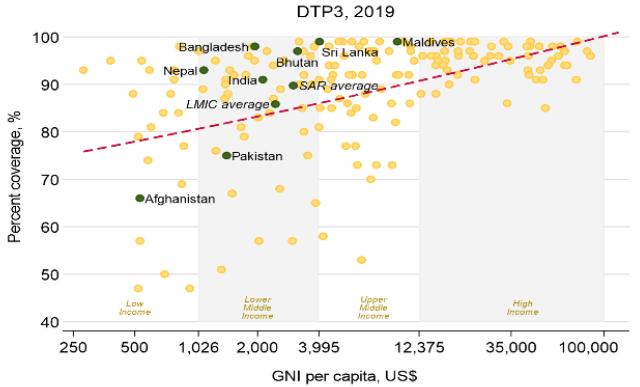
PUBLIC AND PRIVATE HEALTH EXPENDITURES IN SAR COUNTRIES

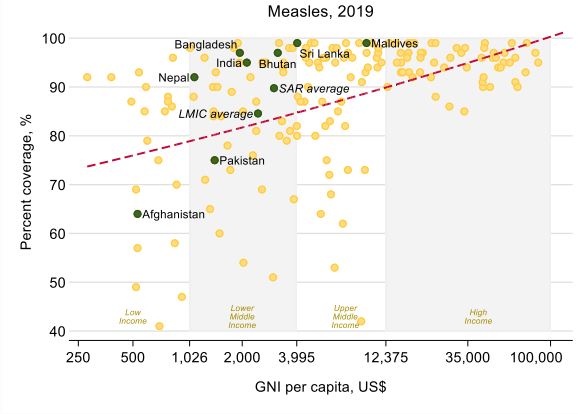


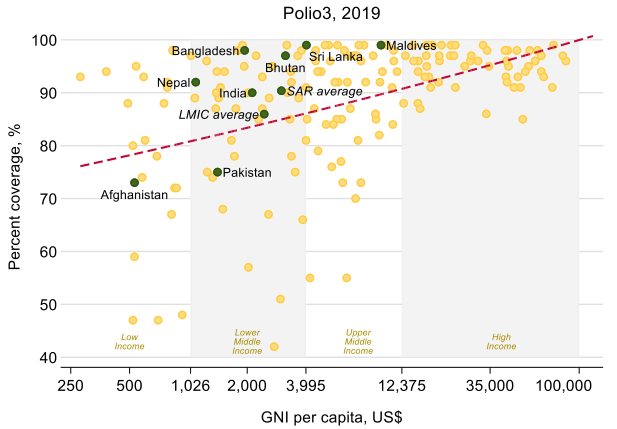
Both overall and public financing for health are relatively low in SAR and private OOP financing dominates: the region has the lowest average per capita total spending on health as well as the lowest total health spending share of GDP; this low prioritization of health in government financing suggests that additional resources may be required to ensure smooth vaccine delivery

Immunization coverage (%) including Bacillus Calmette–Guérin (BCG) and Diphtheria, Tetanus Pertussis third dose (DTP3), Measles and Polio for Children between 12 and 23 months of age in SAR countries





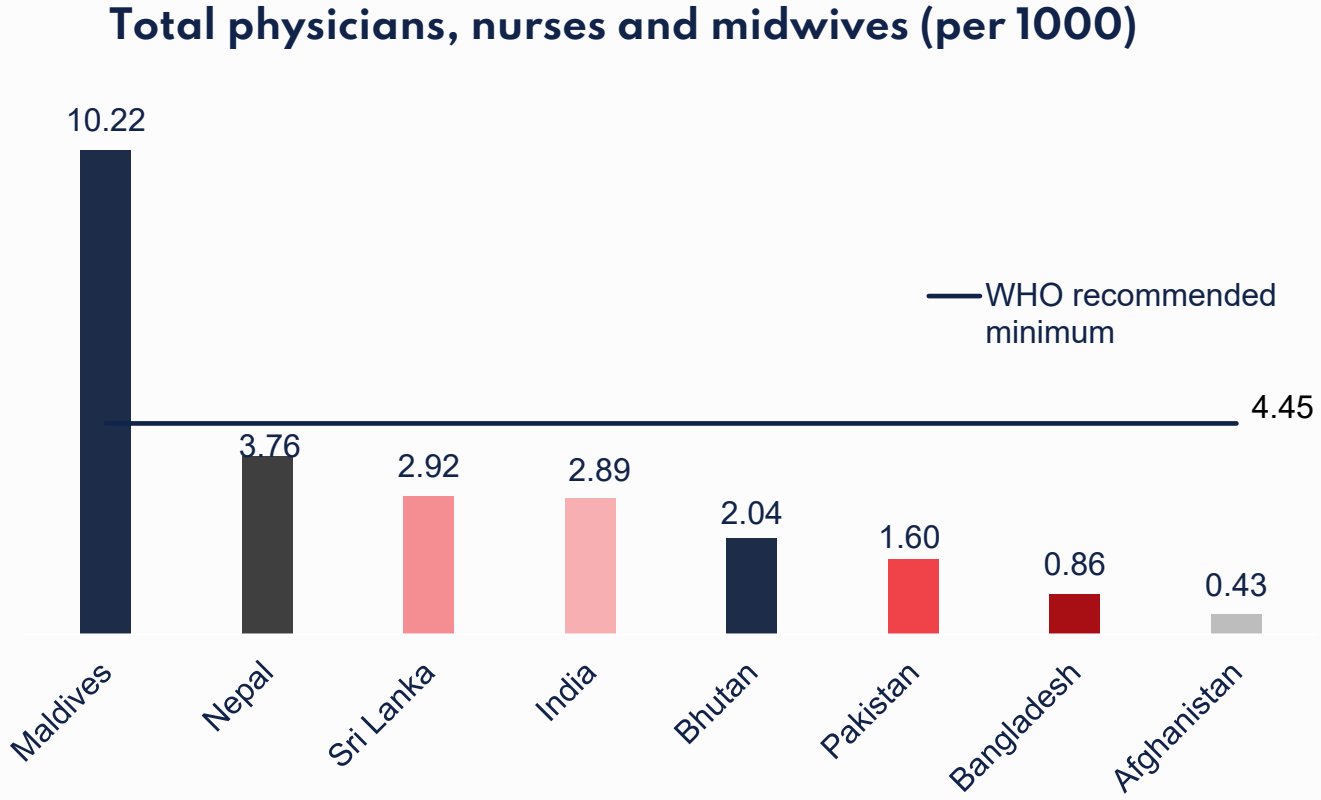




Source: World Development Indicators.
Note: Both X- and Y-axes expressed in logarithmic scale

Supply side issues

SUPPLY SIDE BARRIERS: NUMBER OF DOCTORS, NURSES AND MIDWIFES IN SAR COUNTRIES EXCLUDING MALDIVES

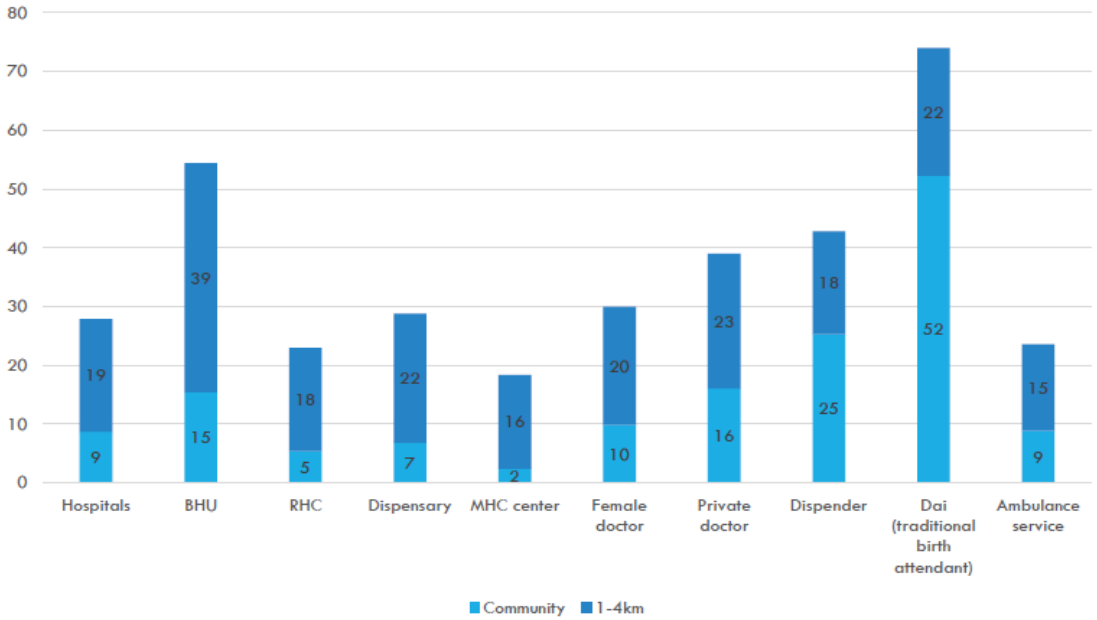


Source: World Bank Group
* Latest data available, 2017 and 2018

SUPPLY SIDE BARRIERS: ACCESS TO HEALTH FACILITIES WITHIN 5 KM DISTANCE IN PAKISTAN

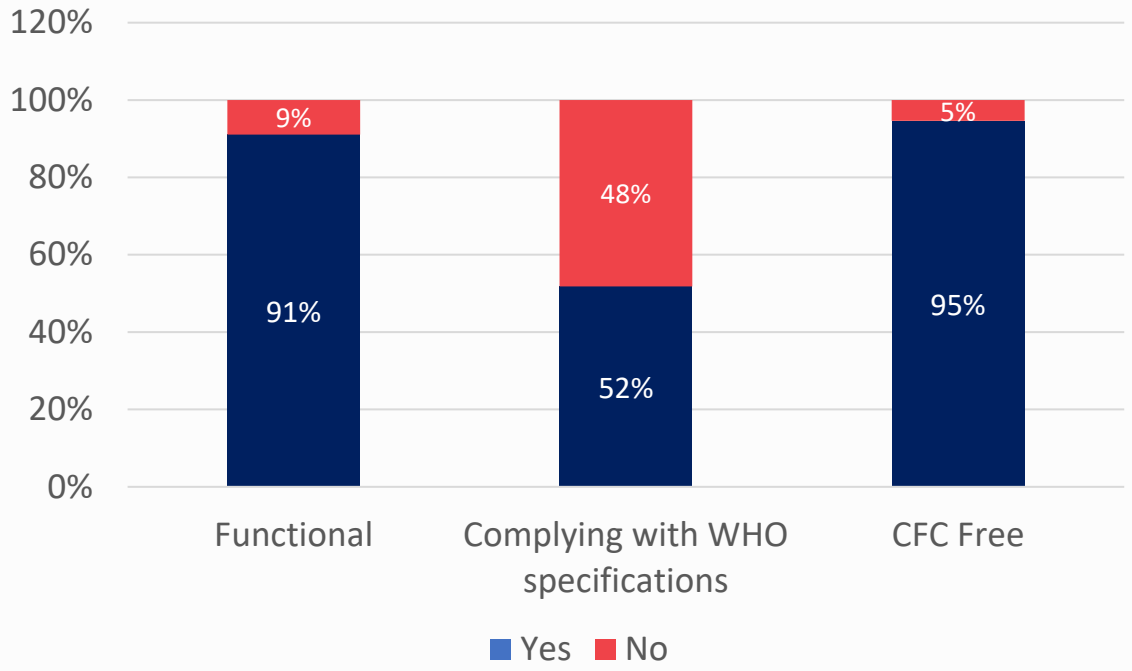
About 50% of the population has access to primary care services within 5km (Basic Health Unit, BHU)

- access to Rural Health Center is even less at 23%
- access to hospitals is 28%



Source: author's production using DHS 2017-18 data.

SUPPLY SIDE BARRIERS: A CROSS-SECTIONAL DESCRIPTIVE ASSESSMENT OF THE IMMUNIZATION COLD CHAIN INFRASTRUCTURE IN A DISTRICT OF DELHI IN INDIA



Kumar et al. Assessment of cold chain equipments and their management in government health facilities in a District of Delhi: A cross-sectional descriptive study. Indian J Public Health 2020

Out of 56 electrical Cold chain equipments, 9% were nonfunctional, 48% were noncompliant with WHO standards, 5% were not chlorofluorocarbon free

These problems on the cold chain equipments could be an important supply limitation in the introduction of the COVID-19 vaccine.

Demand side issues

With a 90% effective vaccine, need 77.7% acceptance rate to get to 70% (herd immunity);
With a 70% effective vaccine, need 100% acceptance rate!

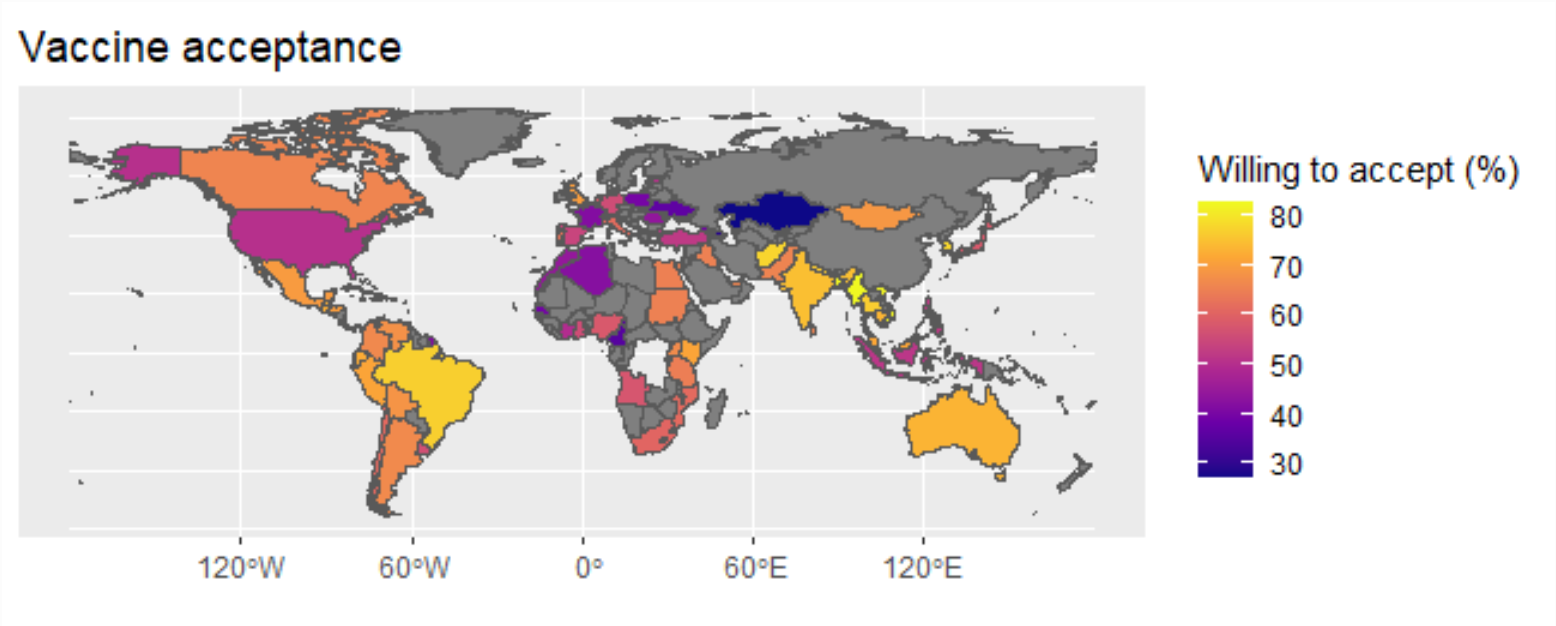
COVID-19 BELIEFS, BEHAVIORS & NORMS SURVEY

JOINT STUDY BY WHO, JOHNS HOPKINS, FB, GOARN AND MIT

- Sample survey of more than 1.2 million Facebook users in 67 countries.
- Incorporated weights to reduce bias due to nonresponse and to target each country's adult or Internet-using population.
- Survey contains both snapshots and waves for different countries. However, current results use only aggregated country-level data.
- Micro-data includes more information on preventive norms, access and trust regarding COVID-19 information. (pending request approval)

WILLINGNESS TO ACCEPT A VACCINE

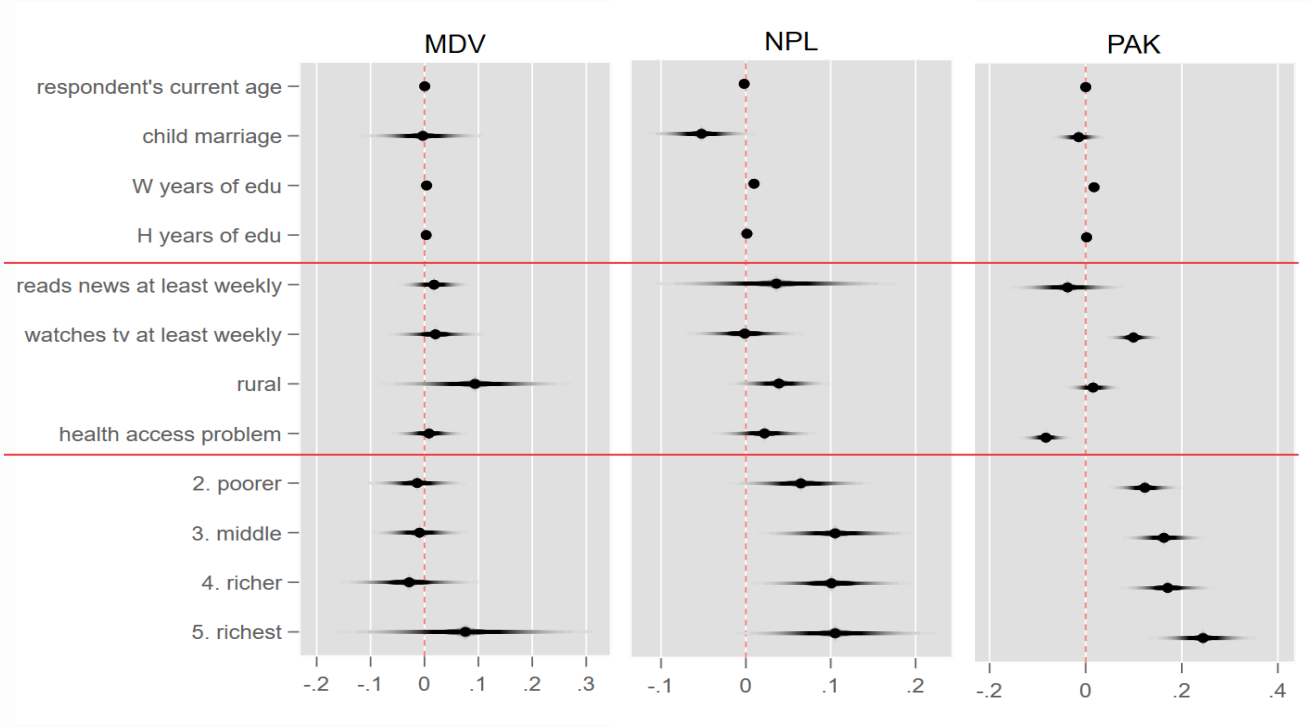
AS REPORTED IN A JOINT SURVEY CONDUCTED BY WHO, JOHNS HOPKINS, MIT AND OTHERS ON FACEBOOK



Vaccine acceptance is high in South Asia with a regional average of 74% of the population relative to other regions (North America average is 52%)

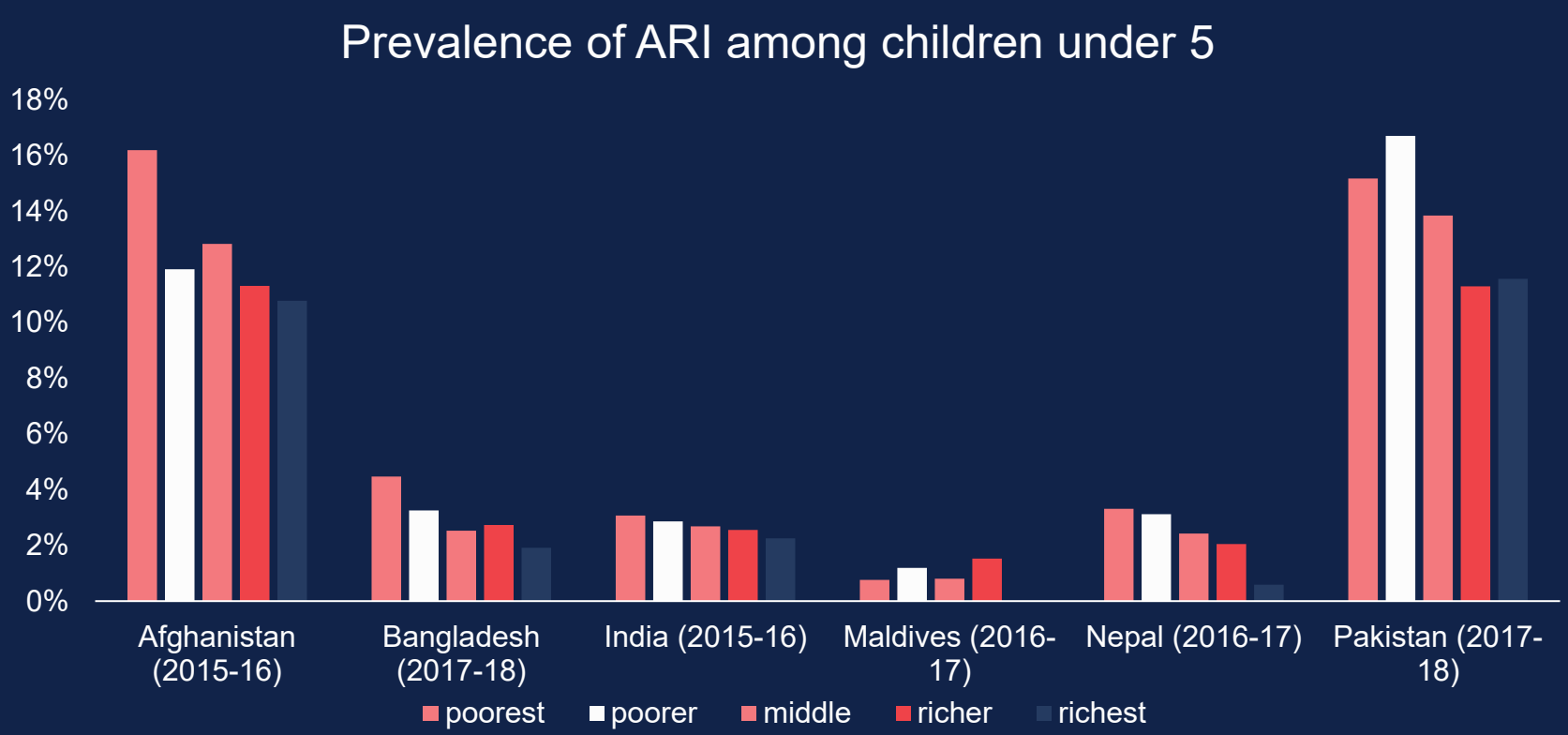
Source: COVID-19 Beliefs, Behaviors & Norms Survey of more than 1.2 million Facebook users in 67 countries. Data are weighted to reflect adult population/population using the internet.

DHS Data (eligible women): Wealth is a significant predictor of tetanus toxoid vaccination only in Nepal and Pakistan, but not so in other countries.

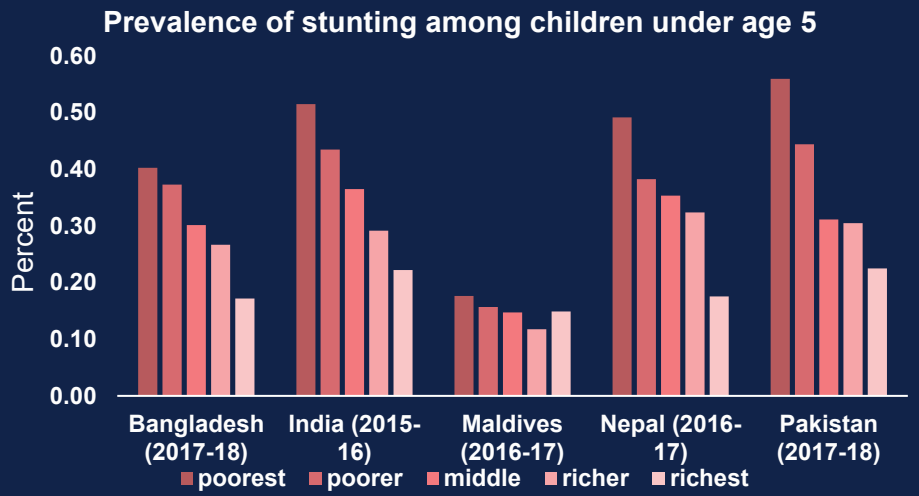


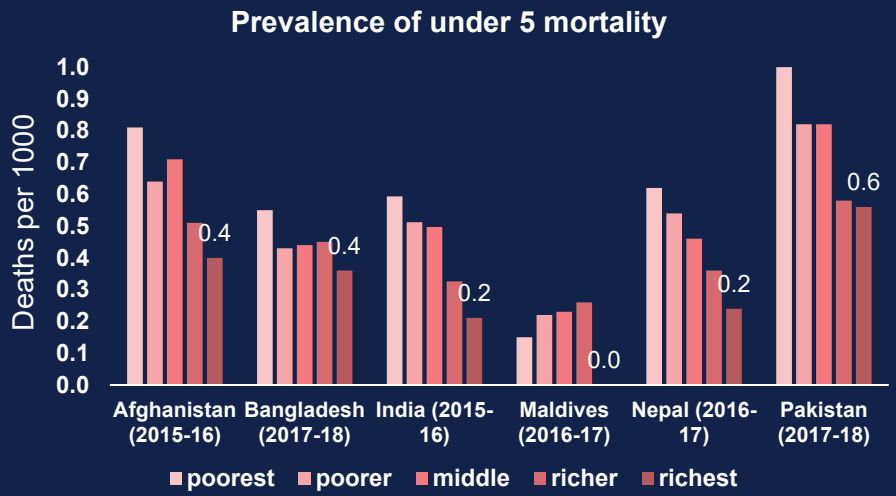
SAR Health and inequality

COMMUNICABLE DISEASE BURDEN I.E ARI (CHILDREN UNDER AGE 5) BY WEALTH CATEGORIES



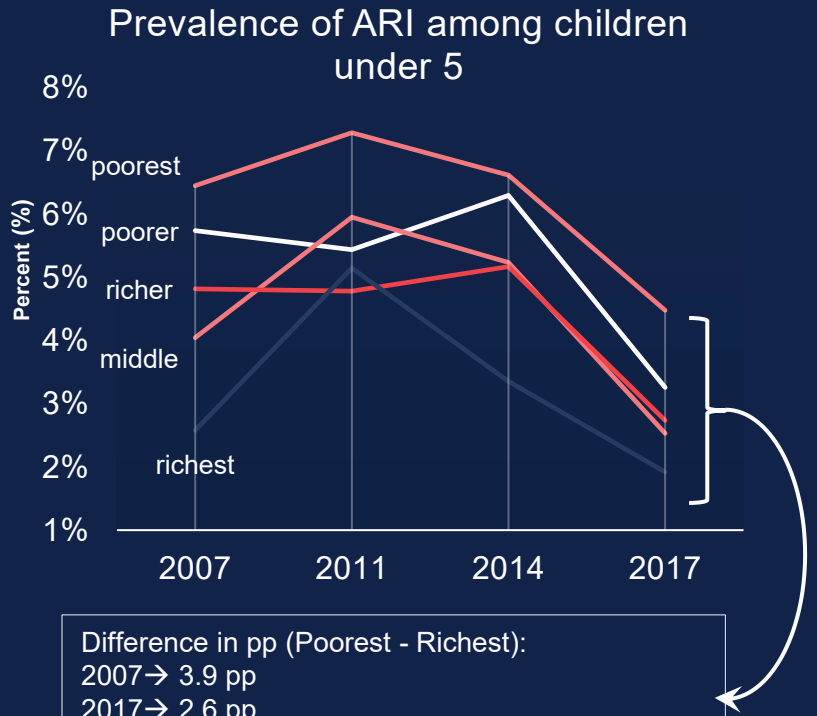
STUNTING AND UNDER 5 MORTALITY





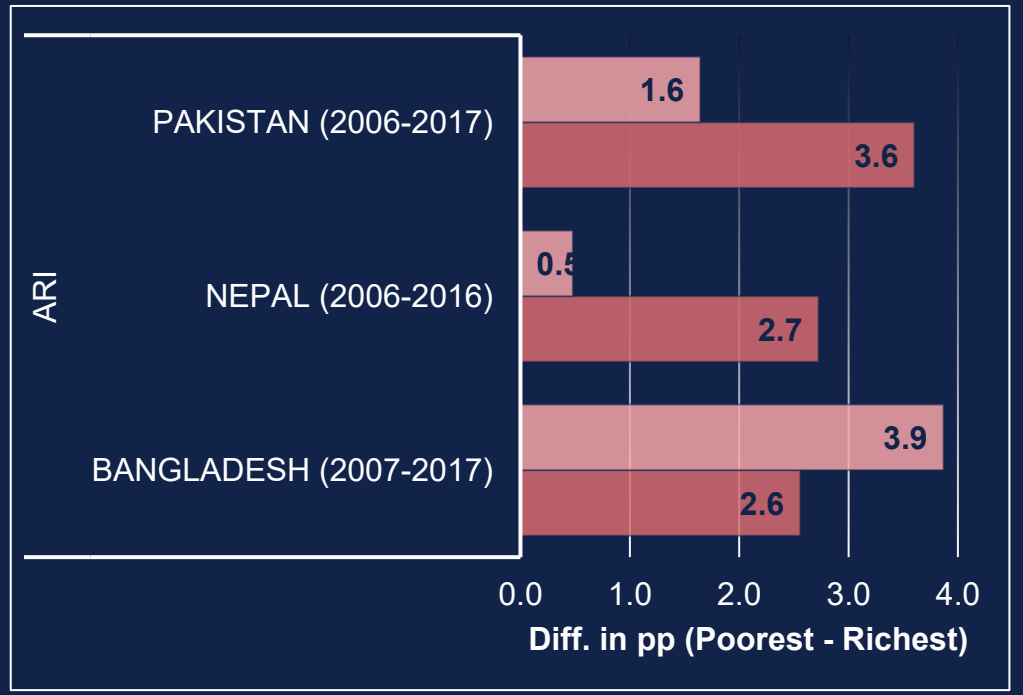
ACUTE RESPIRATORY INFECTION : TRENDS

Bangladesh



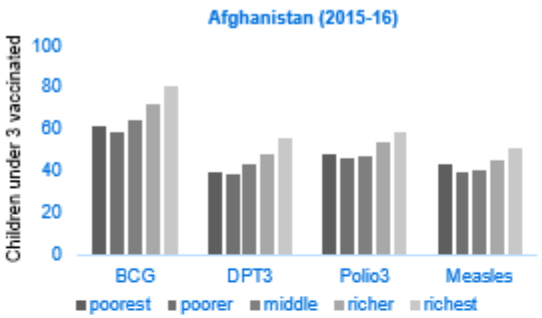
Difference in pp (Poorest - Richest):
2007→ 3.9 pp
2017→ 2.6 pp

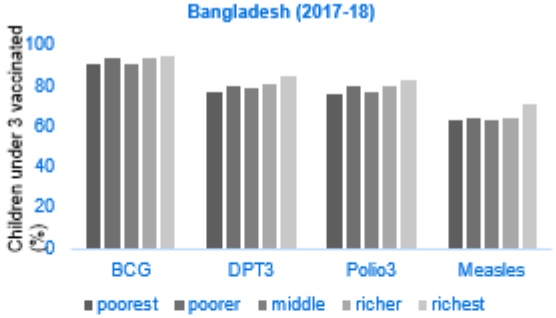
Diff in diff (how much the gap has closed or not):
1.3 = 3.9 – 2.6

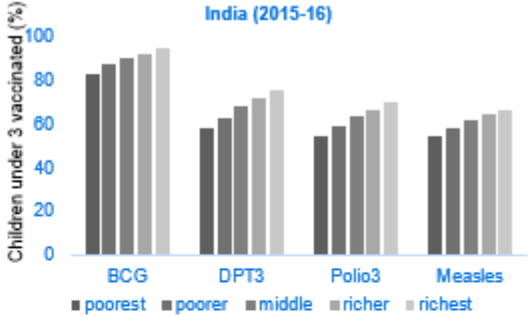


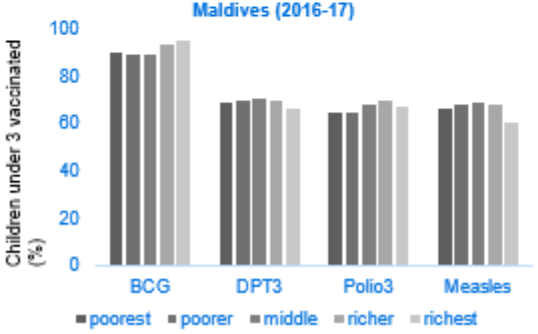
Child immunization coverage

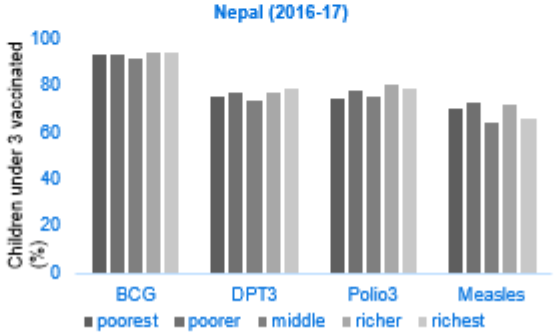
CHILD IMMUNIZATION COVERAGE
(BCG, DPT3, POLIO3, MEASLES)

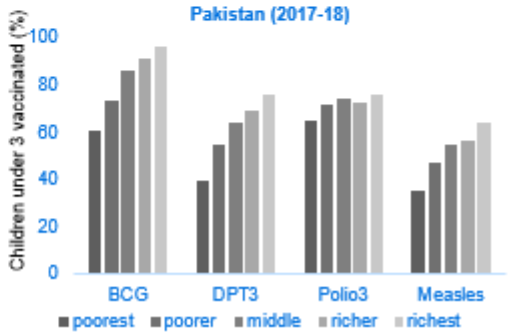




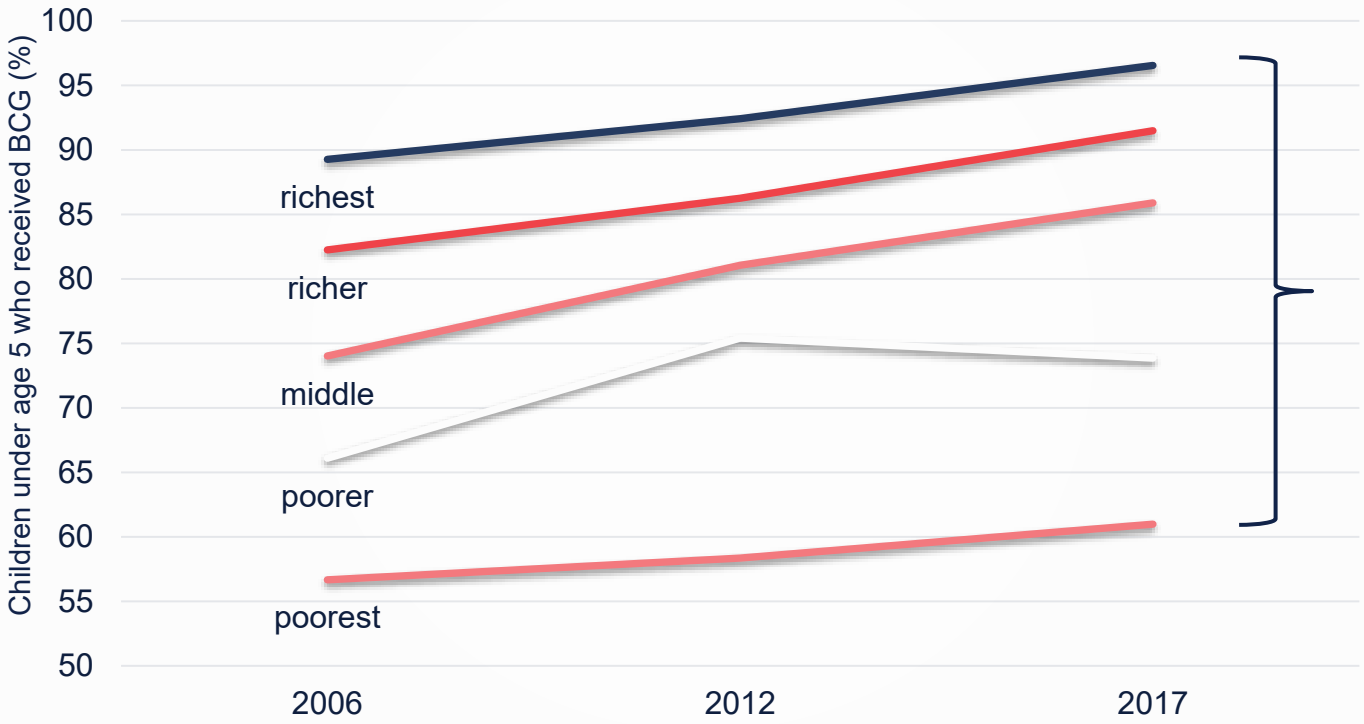








BCG VACCINATION : TRENDS -- AN EXAMPLE FOR PAKISTAN



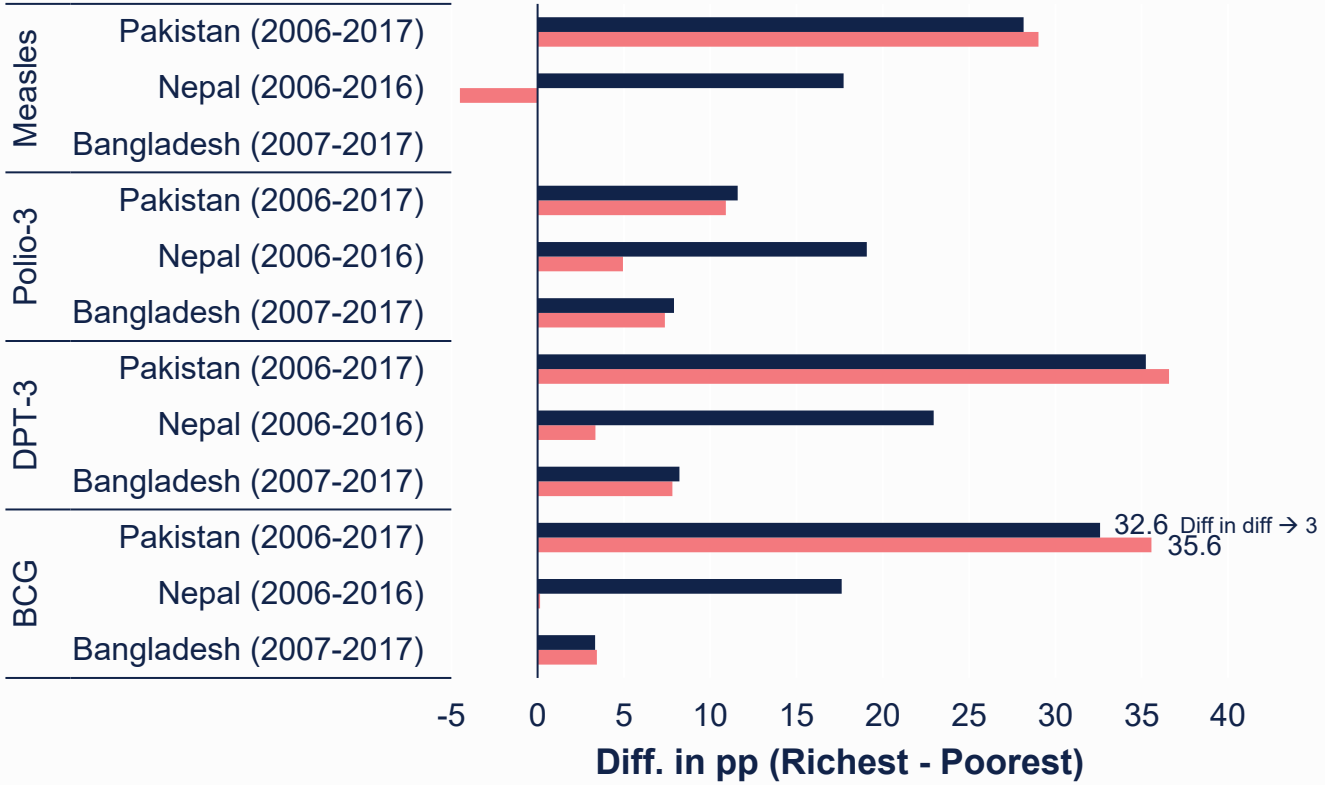
Difference in pp (Richest - Poorest):

2017→ 35.6 pp
2006→ 32.6 pp

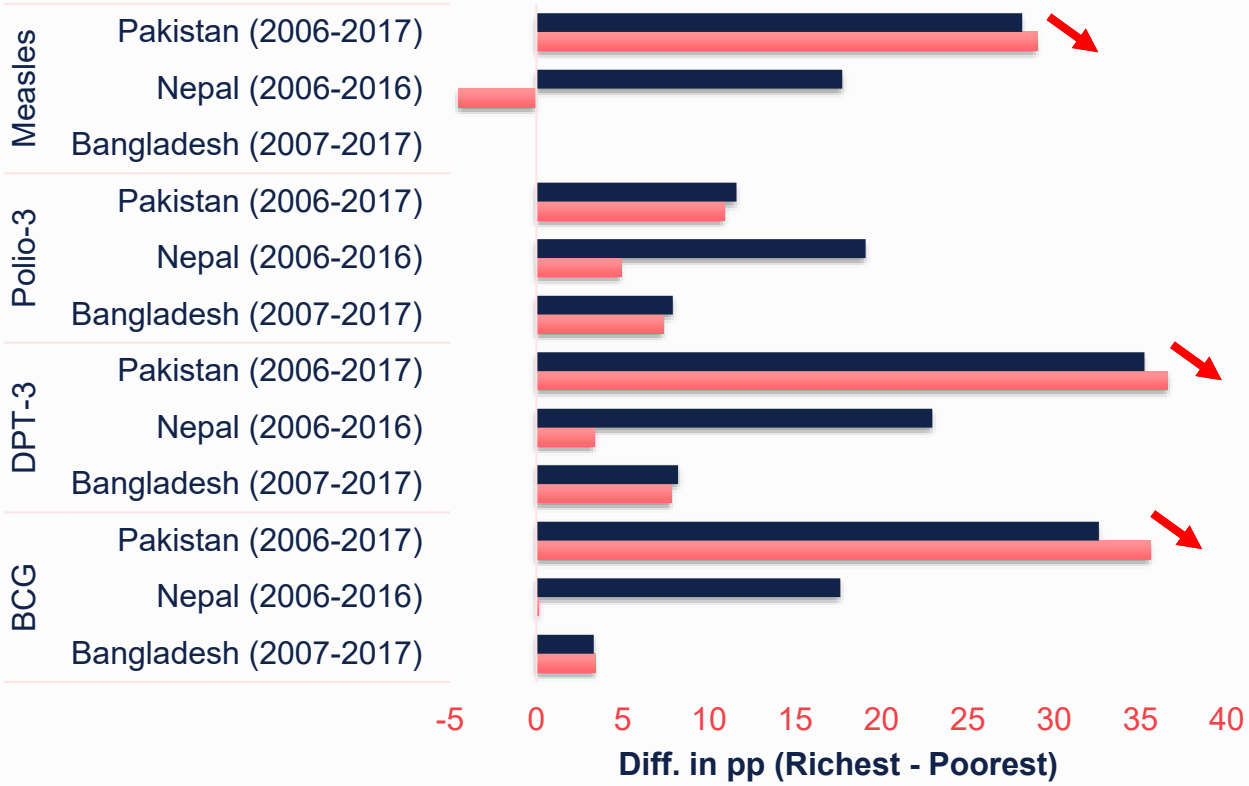
Diff in diff (how much the gap has closed or not):

3 = 35.6 – 32.6

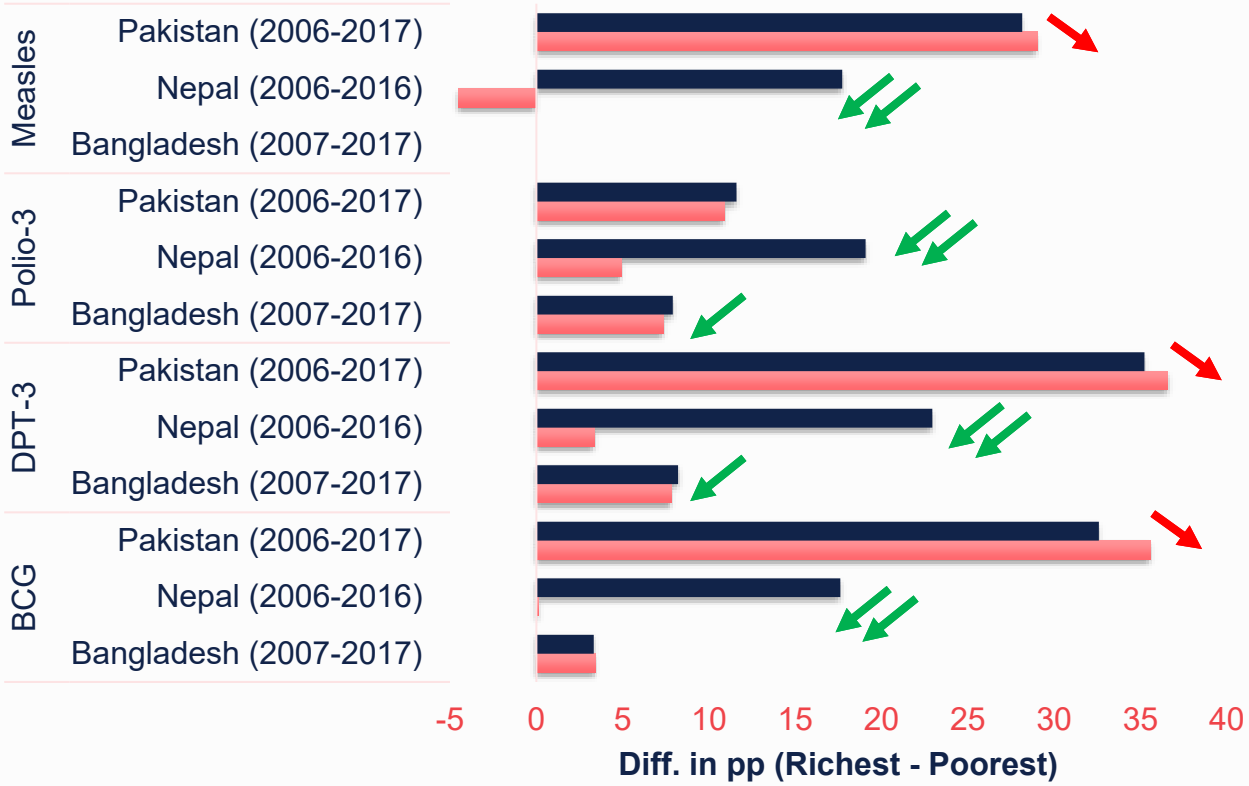
VACCINATION: TRENDS IN THE GAPS BETWEEN POOREST AND RICHEST GROUPS



VACCINATION: TRENDS IN THE GAPS BETWEEN POOREST AND RICHEST GROUPS



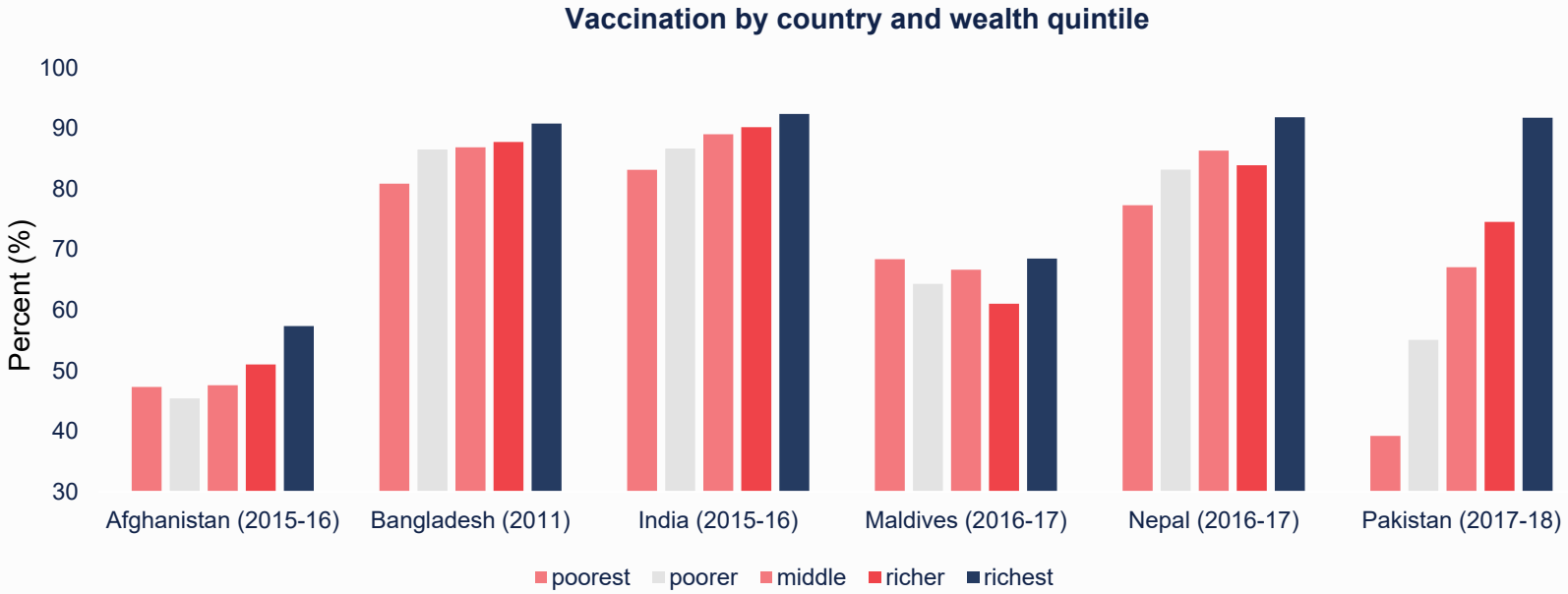
VACCINATION: TRENDS IN THE GAPS BETWEEN POOREST AND RICHEST GROUPS



Adult immunization coverage

ADULT VACCINATION COVERAGE

WOMEN AGE 15-49 WHOSE LAST LIVE BIRTH IN THE PAST 5 YEARS WAS PROTECTED AGAINST NEONATAL TETANUS THROUGH TETANUS TOXOID VACCINATION



SOUTH ASIA VACCINATES AGAINST COVID-19

The COVID-19 pandemic has been an unprecedented shock to the global economy, has exacerbated inequalities and has been a dramatic setback towards eradicating poverty;

Therefore, vaccination is a key development priority; unlike other policy measures, such as lockdowns, vaccines save lives and livelihoods.

However, vaccinating at the scale and speed required to end the pandemic is a daunting task never attempted before. This presentation highlights:

- Vaccination has a high benefit/cost ratios;
- Having features of a public good, herd immunity by vaccination requires government intervention and its financing, while high, seems 'feasible';
- However, financing is one of the challenges; allocation of the vaccine, at least in the short run, presents trade-offs between equity and efficiency;
- And delivering the vaccines – given the current preparedness of the health systems and potential vaccine hesitancy – is an additional key obstacle;
- It is especially important to ensure that vaccines are reaching all those eligible, not just those with the privilege and resources to obtain them.

THANKS!

Do you have any questions?