THE IMPACT OF SERVICE DISRUPTIONS IN BANGLADESH DUE TO THE COVID-19 PANDEMIC

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LIST OF ABBREVIATIONS

ANC	Antenatal Care
DGFP	Directorate General of Family Planning
DGHS	Directorate General of Health Services
DHS	Demographic and Health Survey
HMIS	Health Management Information System
IUD	Intrauterine Device
LiST	Lives Saved Tool
MIS	Management Information System
SPA	Service Provision Assessment
PHCPI	Primary Health Care Performance Initiative
PNC	Postnatal Care

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EXECUTIVE SUMMARY

BACKGROUND

In recent decades, Bangladesh has made great strides in increasing access to health services and improving the quality of those services. However, the current COVID-19 crisis has the potential to set back this progress. Since early 2020, there has been justifiable concern that, in addition to directly impacting health through the spread of COVID-19, the pandemic will also indirectly impact health by disrupting the delivery of health services. This study sought to examine the disruption of maternal and child health services in Bangladesh from March 2020 to February 2021, to inform relevant policy making in the short and long term.

OBJECTIVES

1. Assess the magnitude and timing of disruptions to maternal and child health services in Bangladesh, at division and district level, using data from two HMIS data sources.
2. Explore the drivers of service disruptions, linking HMIS data with household and health facility data at district level.
3. Estimate the impact of service disruptions on child and maternal mortality using the Lives Saved Tool.

METHODS

The study used a set of maternal and child health indicators from two HMIS data sources:

- Management Information System (MIS) of the Directorate General of Family Planning
- DHIS2 system of the Directorate General of Health Services

Two measures were calculated to understand service disruptions: the magnitude of disruptions, and the rate at which service levels recovered from the disruptions. The association of these two measures was tested with several household and health facility indicators, using data from the 2017-2018 Demographic and Health Survey (DHS) and the 2017 Service Provision Assessment (SPA), in bivariate and multivariate regression analysis. Finally, the Lives Saved Tool (LiST), a mathematical modeling software package, was used to estimate changes in mortality resulting from the service disruptions. Using LiST, the number of child, neonatal, and maternal deaths was estimated in a "without pandemic" scenario and in a "with pandemic" scenario, and the difference between these scenarios was taken as the additional deaths attributable to the service disruptions under the COVID-19 pandemic.

RESULTS

SERVICE DISRUPTIONS

1. Most indicators showed a similar trend in service disruptions, with an unmistakable reduction in March, April, and May 2020; a period of recovery in June and July 2020; and subsequent smaller reductions in late 2020 and early 2021. Other indicators showed sustained, moderate disruptions throughout 2020.
2. In January and February 2021, service levels were still lower than expected for most indicators, meaning that there is still work to do in returning services to pre-pandemic levels in 2021.
3. There were striking similarities across divisions, with all divisions showing the same pattern of service disruptions over time for most indicators.

VULNERABILITY ANALYSIS

4. In this analysis, no household or facility factors were meaningfully associated at district level with the magnitude of service disruptions or rate of recovery. In general, disruptions appear to be consistent with a national shock that had a similar effect across districts and indicators.
5. The most vulnerable districts were as likely to experience service disruptions as other districts.

MORTALITY IMPACT

6. The service disruptions in 2020 led to approximately 11,337 additional child deaths and 387 additional maternal deaths (Table 1). This represents a 12.8% and 7.6% increase in child and maternal mortality compared to what would have been expected in 2020 without the pandemic.
7. The disruptions that contributed the most to increased child mortality were those to oral rehydration solution, antibiotics for pneumonia, and treatment of neonatal sepsis/pneumonia.
8. Although many lives were lost in 2020 due to the indirect effects of the pandemic, approximately 7,000 more child lives would have been lost if disruptions had remained unmitigated at 50% disruption levels throughout 2020.
9. Ending service disruptions now, rather than in December 2021, will save approximately 3,000 child lives and 100 maternal lives.

TABLE 1. ADDITIONAL DEATHS DUE TO SERVICE DISRUPTIONS AT NATIONAL LEVEL

	Total expected deaths in 2020 with no disruptions (counterfactual)	**Total estimated deaths in 2020 with observed disruptions**	**Additional deaths in 2020 due to service disruptions**	**Relative increase in mortality due to service disruptions**
Child deaths (0-59 months)	88,853	100,190	11,337	12.8%
Neonatal deaths (<1 month)	50,311	56,016	5,705	11.3%
Maternal deaths	5,084	5,471	387	7.6%

RECOMMENDATIONS

1. Continue to closely monitor changes in the level of routine health services. The analysis showed reemerging disruptions in January and February 2021, which could signal the early stage of a new period of disruption. Immediate analysis is needed to understand ongoing effects.
2. Many lives could be saved by minimizing disruptions as soon as possible and returning service delivery to pre-pandemic levels. Policies to mitigate COVID-19 transmission should consider the potential effects on the provision and utilization of routine health services.
3. Continue to focus health system interventions on the most vulnerable areas. Targeted analyses to identify these areas and understand the highest-impact interventions. Build back better to further increase access to services and fortify the health system for future crises.
4. National level events have big effects across the country. It may be better to consider division-level mitigation policies where possible, rather than national-level mitigation policies, so that mitigation efforts targeting one division do not have unnecessary adverse consequences in other divisions.

BACKGROUND

In recent decades, Bangladesh has made great strides in increasing access to health services and improving the quality of those services. However, the current COVID-19 crisis has the potential to set back this progress. Since early 2020, there has been justifiable concern with the effects of COVID-19 itself and the Bangladesh government has taken action to mitigate these effects. There is also concern that the pandemic will indirectly impact health by disrupting the delivery of health services. Anecdotal and empirical evidence suggests that interruptions and disruptions in the delivery of essential health and nutrition services have indeed occurred, due to supply-side and demand-side constraints. This study sought to examine the disruption of maternal and child health services in Bangladesh from March 2020 to February 2021, to inform relevant policy making in the short and long term.

OBJECTIVES

The government seeks to understand the nature of any disruptions, their drivers or exacerbating factors, and the impact of the disruptions on population health. This study examines these issues to inform decision makers and support health policy making in Bangladesh in the coming months.

Specifically, the study includes analyses on three topics:

1. SERVICE DISRUPTIONS

The first section analyzes the magnitude and timing of maternal and child health service disruptions, at division and district level, using HMIS data from two sources: the DGFP MIS and the DGHS DHIS2. To our knowledge, this is the first analysis of Bangladesh COVID-19 service disruptions that combines data from both sources.

2. VULNERABILITY ANALYSIS

The next section explores the drivers of service disruptions, linking HIMS data with household data from the 2017-2018 DHS and health facility data from the 2017 SPA, and examines whether there were any household or facility factors that were associated with greater or lesser disruptions across districts.

3. IMPACT ANALYSIS

The final section estimates the impact of service disruptions on child and maternal mortality using the Lives Saved Tool. The estimates quantify the “cost” of the health service disruptions in terms of lives lost (child, neonatal, and maternal mortality). The analysis compares what happened in 2020 to what might have happened in 2020 if services disruptions had been worse and compares the impact in 2021 of a slower or faster return to pre-pandemic service levels.

METHODS

To estimate the impact of service disruptions in Bangladesh, data were gathered from multiple sources and analyses were undertaken using statistical regression techniques and the Lives Saved Tool, as described below.

DATA SOURCES

For the analysis of service disruptions, data were taken from two Bangladesh HMIS sources. For the vulnerability analysis, estimates of service disruptions were combined with demographic data from the 2017-2018 Demographic and Health Survey (DHS), and health facility data from the 2017 Service Provision Assessment (SPA). For the impact analysis, various additional data were used from the set of default data included in the Lives Saved Tool (LiST), including data on baseline coverage levels, the effectiveness of interventions, and baseline mortality and cause-of-death distribution.

DATA FROM HEALTH INFORMATION MANAGEMENT SYSTEMS

The core data for this report came from two Bangladesh HMIS sources:

- Management Information System (MIS) of the Directorate General of Family Planning (DGFP)
- DHIS2 system of the Directorate General of Health Services (DGHS)

Indicators from the DHIS2 system of DGHS were different for high-level health facilities and community clinics, union level facilities, and community. All sources offered monthly count data on the service delivery of indicators for January 2018 to February 2021. In total, data were obtained for 13 indicators, including 8 general MNCH indicators and 5 family planning indicators. For most of the indicators, data was available from more than one of the sources. Table 2 shows the 13 indicators, and whether these indicators were available in 1, 2, or 3 of the data sources.

TABLE 2. LIST OF SERVICE DISRUPTION INDICATORS AND THE DATA SOURCES IN WHICH THEY WERE AVAILABLE

	Management Information System (MIS) of the Directorate General of Family Planning	**DHIS2 system of the Directorate General of Health Services – for high-level facilities**	**DHIS2 system of the Directorate General of Health Services – for community clinics, union level facilities, and community**
ANC 1, ANC 4	X	X	X
Institutional delivery	X	X	
PNC 1	X	X	X
BCG, Penta 1, Penta 3 vaccines	X		
General outpatient			X
Pill	X		X
Condom	X		X

Injectable, IUD, implant	X		

A full list of indicators is provided as Appendix 1, including details on which indicators were obtained from which data sources. Together, these sources offer data from both high-level facilities (health centers and hospitals) and lower-level facilities (community centers). Similar indicators were taken from each source to enable comparison.

The study sought to analyze service indicators and not outcome indicators. While outcome indicators were available in most cases, these numbers would be difficult to interpret. (For example, if outcome numbers were lower, it could be because fewer people came to facilities, not because there were fewer adverse outcomes among the population.) In any case, the focus was on disruptions to service delivery.

DATA FROM DEMOGRAPHIC AND HEALTH SURVEY (DHS) 2017-2018

The Bangladesh 2017-2018 DHS dataset was obtained from the DHS Program website, including GIS information to match household records and individual records to Upazilas. The HMIS dataset was collapsed and merged with the household and individual data at the Upazila, district, and division level. The key indicators from the DHS that were used in the vulnerability analysis were household wealth index, head-of-household education level, and ANC 4 as a stand-in for MNCH care-seeking.

DATA FROM SERVICE PROVISION ASSESSMENT (SPA) 2017

The Bangladesh 2017 SPA dataset was obtained from the DHS Program website. The SPA dataset was used to calculate the following PHCPI indicators for each facility:

- Availability of essential medicines and commodities for RMNCH
- Availability of essential medicines and commodities for infectious diseases
- Availability of basic equipment
- Quality comprehensiveness for RMNCH
- Proportion of ANC rooms with all infection control items
- Infection control items in all rooms

After the indicators were calculated for each facility, the indicators were aggregated at district level, for comparison with district-level service disruption estimates.

ADDITIONAL DATA FOR LIVES SAVED TOOL ANALYSIS

To run LiST analyses, several additional points of data are needed, including baseline coverage values for each of the LiST interventions, baseline mortality rates, baseline cause-of-death structure, and effectiveness values for each of the LiST interventions. These additional data were taken from the default database within LiST, which is populated from various sources including the UN Inter-Agency Mortality Estimation group and WHO maternal mortality estimation unit (for data on mortality), recent household surveys conducted in Bangladesh (including DHS and MIS where available), and the scientific literature (for the effectiveness of individual interventions).

METHODS FOR ANALYSIS OF SERVICE DISRUPTIONS

The goal for the service disruptions analysis was to describe two statistics of interest: the magnitude of disruptions, and the rate of recovery of disruptions.

MAGNITUDE

The magnitude of disruptions was calculated as the ratio of the observed number of service counts to the expected number of service counts in the absence of the pandemic. This statistic was calculated for each indicator, at the Upazila, district, and division levels, for all months from March 2020 to February 2021. To obtain the ratio values, the expected value of service counts was calculated for each Upazila at each time point. To do this, the data from March 2019 to February 2020 were used to create a model, which was then used to estimate the expected service counts for each Upazila at all time points from January 2018 to February 2021. A mixed-effects model of the log of expected value was used, with intercept coefficient varying at the Upazila level, and the months coefficients fixed at the district level.

$$\ln\left(\text{Expected}_{j}\right) = \beta_0 + \beta_1 \cdot \text{Month}_1 + \cdots + \beta_{11} \cdot \text{Month}_{11}$$

Because data were only available for one year prior to the pandemic, the model did not include a parameter for a secular trend. This likely gives more conservative estimates of the disruption effect because some year-on-year increase in service counts would be expected due to population growth and other secular factors. Once the expected values for all time points were calculated, a simple fraction was used to calculate a ratio value for each Upazila and time point.

$$\text{Ratio} = \frac{\text{Observed}}{\text{Expected}}$$

Interpretation of this ratio value is straightforward. The closer the ratio value is to zero, the larger the disruption. A ratio of 1 represents no change in service delivery because of the pandemic – i.e. no disruption. A ratio of 0.5 represents a 50% reduction in service delivery, compared to what would have been expected in the absence of the pandemic. A ratio of 0.2 represents an 80% reduction in service delivery – a very large disruption.

In this way, the study obtained a trend of the level of service disruption for March 2020 to February 2021 for each district and division, for each indicator of interest. For descriptive statistics of the magnitude of service disruption, a snapshot of Upazila, district, and division ratio values was taken for a single point in time and compared across districts and divisions. The degree and variation of disruptions were visualized using line charts, maps, histograms, and scatter plots.

RATE OF RECOVERY

The second statistic of interest that the study examined was the rate at which service levels "recovered" from their disruption levels in April 2020 to their levels in September 2020. This rate was calculated for each indicator, at Upazila, district, and division levels. Both the absolute rate of return and the relative rate of recovery was calculated.

$$\text{Absolute Rate of Recovery} = \frac{\text{Ratio}_{\text{Sept 2020}} - \text{Ratio}_{\text{Apr 2020}}}{5 \text{ months}}$$

$$\text{Relative Rate of Recovery} = \frac{\text{Ratio}_{\text{Sept 2020}} - \text{Ratio}_{\text{Apr 2020}}}{5 \text{ months}} \times \frac{1}{\left(1 - \text{Ratio}_{\text{Apr 2020}}\right)}$$

METHODS FOR VULNERABILITY ANALYSIS

The second section of the study explored the association of disruption results (as dependent variables) with a set of household and facility indicators aggregated at district level (as independent variables). When testing the relationships, a district-level "composite" indicator of service disruption was created, representing the average disruption across all indicators for a single district, and two service disruption "outcomes" were used as dependent variables: the magnitude of service disruption in April 2020; and the relative rate of recovery from April 2020 to September 2020. Each potential determinant (each household and facility factor) was calculated in turn, using bivariate regression analyses on district data, adjusted for division. Where appropriate, a log or logit transform of the independent variable was used. Scatter plots were created to visualize the relationships between outcomes and potential determinants. Finally, multivariate models with all household factors and all facility factors were created to identify any potential relationships while accounting for confounding and effect modification.

METHODS FOR IMPACT ANALYSIS USING THE LIVES SAVED TOOL

The impact of service disruptions on child and maternal mortality, was calculated using the Lives Saved Tool (LiST). The LiST software package is a mathematical model that uses changes in coverage of interventions to estimate changes in child and maternal mortality. LiST's strength is that it estimates the impact of multiple interventions at the same time – up to 70 different interventions along the continuum of care. LiST can estimate mortality changes at the subnational level, although the accuracy of subnational estimates depends on the availability and strength of data.

To use LiST for this analysis, an intermediate step was required to estimate the change in coverage of the 70 interventions due to the service disruptions. To do this, the service disruption indicators from the previous part of the analysis were mapped to the LiST interventions. This mapping is shown in Table 3. For each intervention that can be modeled in LiST, a "proxy" indicator was chosen from the shortlist of service disruption indicators from the first analysis, or it was assumed that there would be no change in the coverage of that intervention.

The baseline coverage of interventions for the LiST analysis was taken from the 2017-2018 DHS. The month-to-month utilization changes for the relevant proxy indicator were applied to the baseline coverage values to calculate coverage during the pandemic. The month-to-month changes were aggregated to generate 2020 coverage estimates in a "without pandemic" scenario (i.e. a counterfactual) and in a "with pandemic" scenario. The difference between the "with pandemic" and "without pandemic" scenarios was taken to be the additional deaths attributable to the pandemic.

TABLE 3. MAPPING OF SERVICE DISRUPTION INDICATORS TO LIST INTERVENTIONS

Service disruption indicator ("proxy")	LiST interventions
ANC 4	Iron supplementation, folic acid supplementation, tetanus toxoid vaccination, hypertensive disorder case management, etc.

Institutional delivery	Assisted vaginal delivery, parenteral administration of uterotonics and antibiotics, manual removal of placenta, neonatal resuscitation, etc.
PNC 1	Case management of neonatal sepsis and pneumonia, Kangaroo mother care, full supportive care for prematurity, etc.
Penta 3	Vaccines: pentavalent, polio, pneumococcal, hib, measles, etc.
General patient	Oral rehydration solution for diarrhea, antibiotics for pneumonia, vitamin A for treatment of measles, SAM and MAM for wasting, etc.
Pill	Contraceptive prevalence rate

RESULTS

RESULTS OF ANALYSIS OF SERVICE DISRUPTIONS

The first set of analyses describe the service disruptions themselves; specifically, the magnitude of disruptions in each month, the trend of disruptions over time, the associations between disruptions of different indicators, and the rate of recovery of services after the initial peak of disruptions in early 2020.

NATIONAL-LEVEL SERVICE DISRUPTIONS

Table 4 shows the national-level results for disruptions in Bangladesh. There were significant disruptions for all indicators, particularly in the months of March, April, and May 2020, but also in late 2020 and early 2021 for specific indicators. The disruption values range from 0.26 (meaning a 74% reduction from what would have been expected in the absence of the pandemic) to 1.35 (a 35% increase from what would have been expected). A value of 1 represents no disruption. In the tables below, greater disruptions are shaded in darker orange, smaller disruptions in lighter orange, and increases in service level in green.

TABLE 4. NATIONAL-LEVEL SERVICE DISRUPTIONS BY MONTH FOR KEY INDICATORS FROM THE DGHS DATABASE

	March 2020	April 2020	May 2020	June 2020	July 2020	August 2020	September 2020	October 2020	November 2020	December 2020	January 2021	February 2021
ANC 1	1.09	0.77	0.76	1.06	0.88	0.97	1.03	1.26	1.31	1.37	1.34	1.34
ANC 4	0.90	0.75	0.65	0.71	0.69	0.65	0.76	0.73	0.72	0.77	0.75	0.77
Institutional delivery	0.94	0.74	0.70	0.71	0.83	0.86	0.85	0.89	1.00	1.03	1.01	0.98
PNC 1	0.90	0.80	0.73	0.75	0.77	0.85	0.86	0.89	0.94	0.98	0.98	0.98
BCG vaccine	0.87	0.50	0.71	1.31	1.12	1.15	1.08	1.04	1.00	0.95	1.15	1.10
Penta 1	0.83	0.50	0.70	1.30	1.08	1.11	1.10	1.02	1.00	0.91	1.13	1.05
Penta 3	0.81	0.44	0.54	0.92	1.02	1.25	1.18	1.09	1.02	0.79	1.04	1.03
General outpatient	0.78	0.26	0.27	0.45	0.41	0.54	0.68	0.70	0.81	0.81	0.78	0.75
Pill	0.96	0.93	0.91	1.09	0.95	1.00	1.02	0.99	1.03	1.05	1.00	1.05
Injectable	0.72	0.30	0.34	0.37	0.43	0.56	0.63	0.67	0.71	0.76	0.75	0.77

DIVISION-LEVEL SERVICE DISRUPTIONS

Tables 5 and 6 show the service disruptions at division level for the month of April 2020. The study chose to highlight April 2020, because for most indicators and divisions it was the month with the greatest disruptions – the peak of the first wave of disruptions. Table 5 shows disruptions for five indicators from the DGFP database. Table 6 shows three indicators from the DGHS database of high-level facility data and two indicators from the DGHS database of community facility data. These data sources are described in more detail in the methods section, above, and in Appendix 1.

TABLE 5. DIVISION-LEVEL SERVICE DISRUPTIONS FOR APRIL 2020 FOR DGFP INDICATORS

	ANC 4 (DGFP)	Institutional Delivery (DGFP)	PNC 1 (DGFP)	Pill (DGFP)	Condom (DGFP)	Implant (DGFP)
Barishal	0.73 (0.68–0.79)	0.82 (0.78–0.87)	0.63 (0.58–0.69)	0.96 (0.93–0.99)	0.82 (0.78–0.87)	0.16 (0.13–0.2)
Chittagong	0.7 (0.66–0.75)	1 (0.95–1.06)	0.84 (0.79–0.9)	0.85 (0.84–0.87)	0.73 (0.71–0.75)	0.19 (0.16–0.22)
Dhaka	0.61 (0.58–0.64)	0.82 (0.78–0.85)	0.64 (0.6–0.69)	0.96 (0.92–1.01)	0.65 (0.63–0.67)	0.15 (0.13–0.17)
Khulna	0.66 (0.63–0.7)	0.82 (0.78–0.86)	0.62 (0.56–0.69)	1.37 (1.32–1.42)	0.77 (0.75–0.8)	0.17 (0.14–0.2)
Mymensingh	0.67 (0.61–0.73)	0.79 (0.73–0.86)	0.64 (0.57–0.71)	1.78 (1.66–1.91)	0.82 (0.79–0.85)	0.13 (0.09–0.2)
Rajshahi	0.68 (0.65–0.72)	0.83 (0.8–0.86)	0.6 (0.55–0.65)	0.97 (0.92–1.02)	0.75 (0.73–0.78)	0.19 (0.16–0.22)
Rangpur	0.62 (0.59–0.66)	0.8 (0.75–0.84)	0.71 (0.65–0.77)	1.61 (1.5–1.73)	0.79 (0.76–0.82)	0.17 (0.14–0.21)
Sylhet	0.62 (0.56–0.69)	0.94 (0.87–1.02)	0.6 (0.5–0.72)	0.85 (0.81–0.89)	0.74 (0.72–0.76)	0.18 (0.13–0.25)

TABLE 6. DIVISION-LEVEL SERVICE DISRUPTIONS FOR APRIL 2020 FOR DGHS INDICATORS

	ANC 4 (DGHS, high-level facilities)	Institutional Delivery (DGHS, high-level facilities)	PNC 1 (DGHS, high-level facilities)	ANC 4 (DGHS, community facilities)	PNC 1 (DGHS, community facilities)
Barishal	0.85 (0.71–1.01)	0.65 (0.56–0.76)	0.59 (0.5–0.7)	0.9 (0.8–1)	0.87 (0.77–0.99)
Chittagong	0.91 (0.8–1.03)	0.64 (0.56–0.73)	0.68 (0.6–0.77)	0.82 (0.74–0.9)	0.73 (0.66–0.8)
Dhaka	0.75 (0.68–0.83)	0.53 (0.48–0.59)	0.65 (0.58–0.73)	0.75 (0.69–0.81)	0.77 (0.71–0.85)
Khulna	0.92 (0.83–1.02)	0.72 (0.68–0.76)	0.74 (0.69–0.8)	0.75 (0.68–0.83)	0.65 (0.6–0.72)
Mymensingh	0.9 (0.73–1.1)	0.69 (0.57–0.84)	0.77 (0.65–0.91)	0.81 (0.72–0.93)	0.74 (0.64–0.85)
Rajshahi	0.95 (0.84–1.07)	0.73 (0.67–0.79)	0.83 (0.75–0.91)	0.8 (0.74–0.87)	0.71 (0.65–0.78)
Rangpur	1 (0.89–1.13)	0.69 (0.63–0.76)	0.72 (0.64–0.81)	0.84 (0.76–0.92)	0.69 (0.62–0.77)
Sylhet	0.67 (0.59–0.76)	0.57 (0.51–0.63)	0.62 (0.57–0.67)	0.64 (0.57–0.73)	0.68 (0.62–0.76)

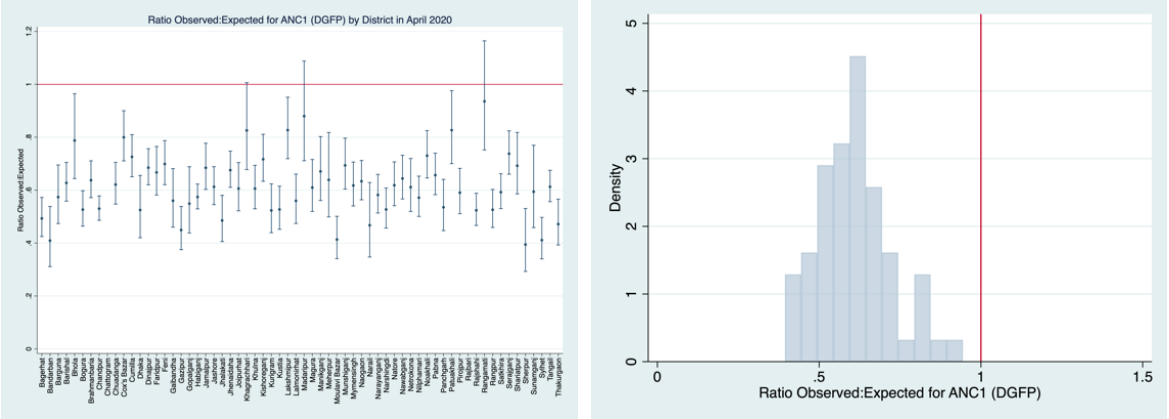
Tables 5 and 6 shows that the various magnitudes of disruption in April 2020 were similar across divisions. In general, the indicators of ANC 4 (DGFP), PNC 1 (DGFP), implants (DGFP), institutional delivery (DGHS), and

PNC 1 (DGHS) showed greater disruptions across all divisions. The indicators of pill (DGFP) and ANC 4 (DGHS) showed minimal disruptions across all divisions. This concurrence across divisions is even more evident when examining the entire trend from March 2020 to February 2021, shown below.

DISTRICT-LEVEL SERVICE DISRUPTIONS

This study also estimated the disruptions for each indicator in April 2020 by district. As expected, the variation across districts was greater than across divisions, with some districts for some indicators showing only minimal disruption or even a service increase, and other districts showing relative decreases of over 50%. Figure 1 shows the variation across districts for the indicator of ANC 1 (DGFP), with a range of disruption values from 0.4 (60% relative decrease) to 0.95 (5% relative decrease).

FIGURE 1. VARIATION IN THE MAGNITUDE OF DISRUPTION FOR ANC 1 (DGFP) IN APRIL 2020 ACROSS DISTRICTS



The maps in Figure 2 show the geographical variation in disruption at district level, for four example indicators. Exploring these maps in detail, it is hard to discern patterns in the geographical distribution of indicators. The geographical distribution of the greatest and smallest disruptions is different for each indicator. For some indicators, the greatest disruptions are in certain districts. For other indicators, the greatest disruptions are in different districts. Moreover, no geographical region stands out as having more consistent disruptions across indicators than other regions.

ASSOCIATIONS BETWEEN DISRUPTIONS OF DIFFERENT INDICATORS

The associations, or correlations, between disruptions of different indicators was tested. To do this, Upazila-level disruptions were estimated for April 2020 for each indicator and the pairwise relationships between disruptions of different indicators were analyzed.

An example of the results of these tests is shown in Figures 3 and 4. In general, only weak relationships were seen between indicators. This was surprising but was consistent with the findings from the geographical analysis of district-level disruptions (Figure 2). Most Upazilas had above-average disruptions for some indicators and below-average disruptions for other indicators. Figure 3 shows the relationships between ANC 1 and Penta 1, and between Institutional delivery and PNC 1. As the figure shows, for both pairs there is only minimal correlation between the disruptions. This was true of most indicators in the analysis. Some pairwise combinations of indicators were stronger – for example, ANC 1 and ANC 4, and Penta 1 and Penta 3 (Figure 4) – but these pairs were exceptional, and it makes sense that these specific pairs would be more highly correlated.

FIGURE 2A. ANC 1 (DGFP)

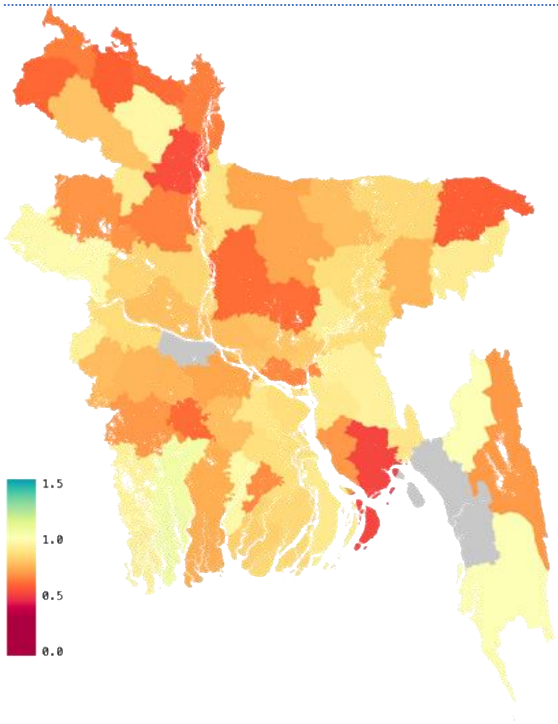


FIGURE 2B. PNC 1 (DGFP)

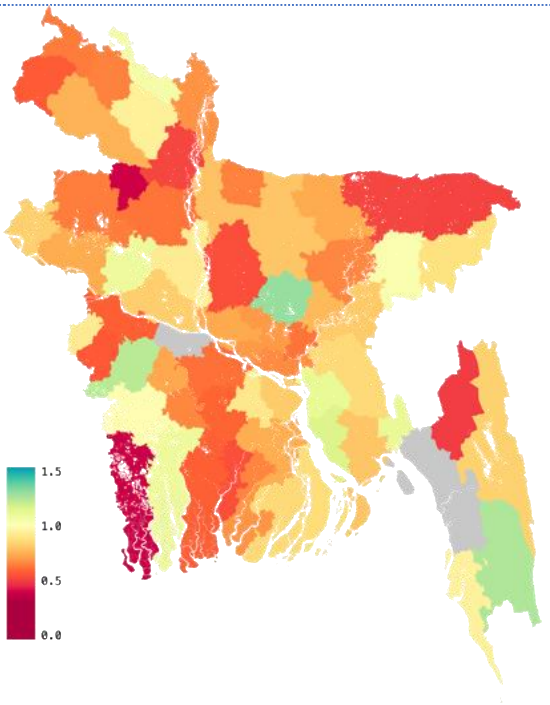


FIGURE 2C. INSTITUTIONAL DELIVERY (DGFP)

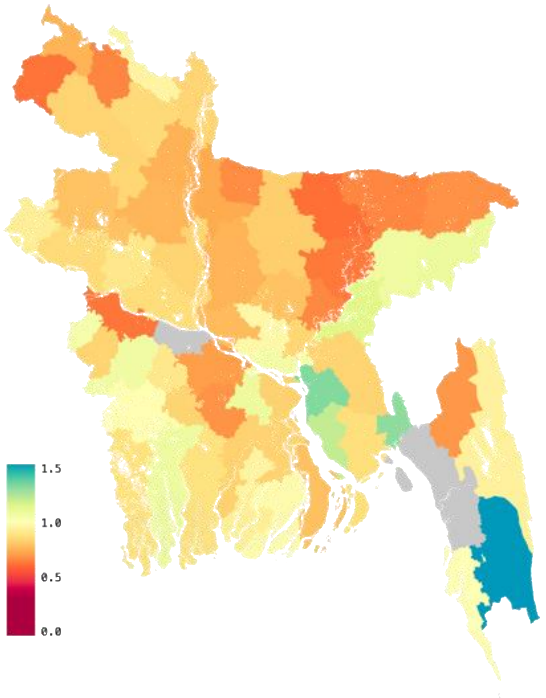


FIGURE 2D. ANC 4 (DGHS HIGH-LEVEL FACILITIES)

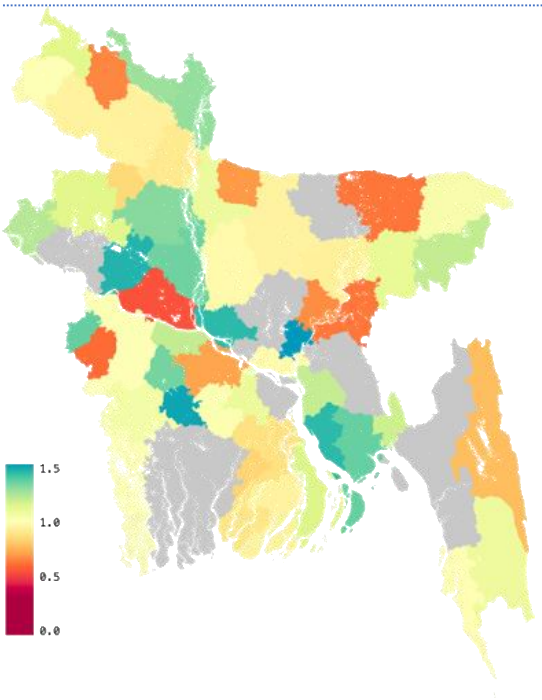
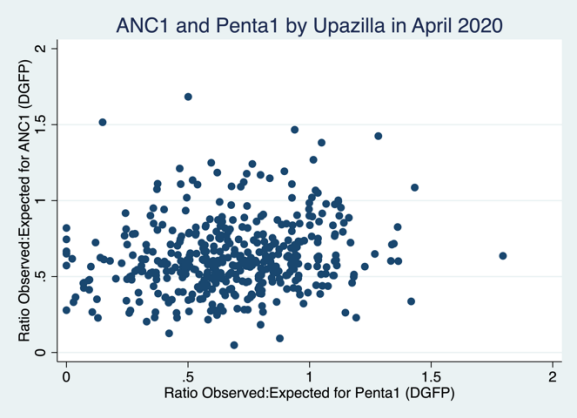


FIGURE 3. MINIMAL ASSOCIATION BETWEEN PAIRS OF INDICATORS AT UPAZILA LEVEL



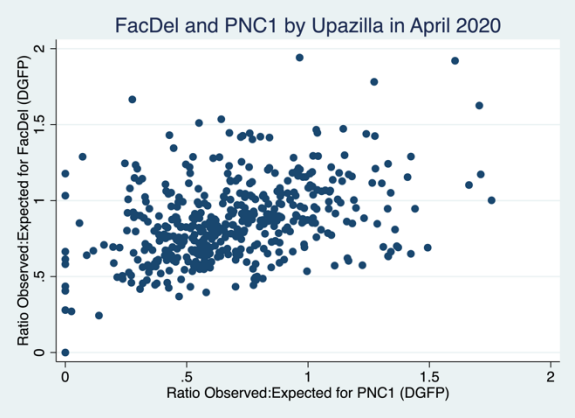
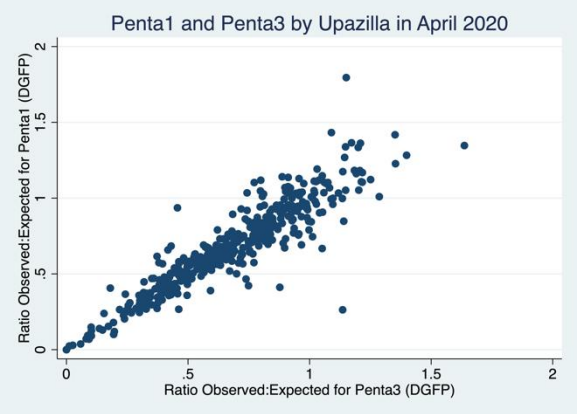


FIGURE 4. STRONG ASSOCIATION BETWEEN PENTA 1 AND PENTA 3 AT UPAZILA LEVEL

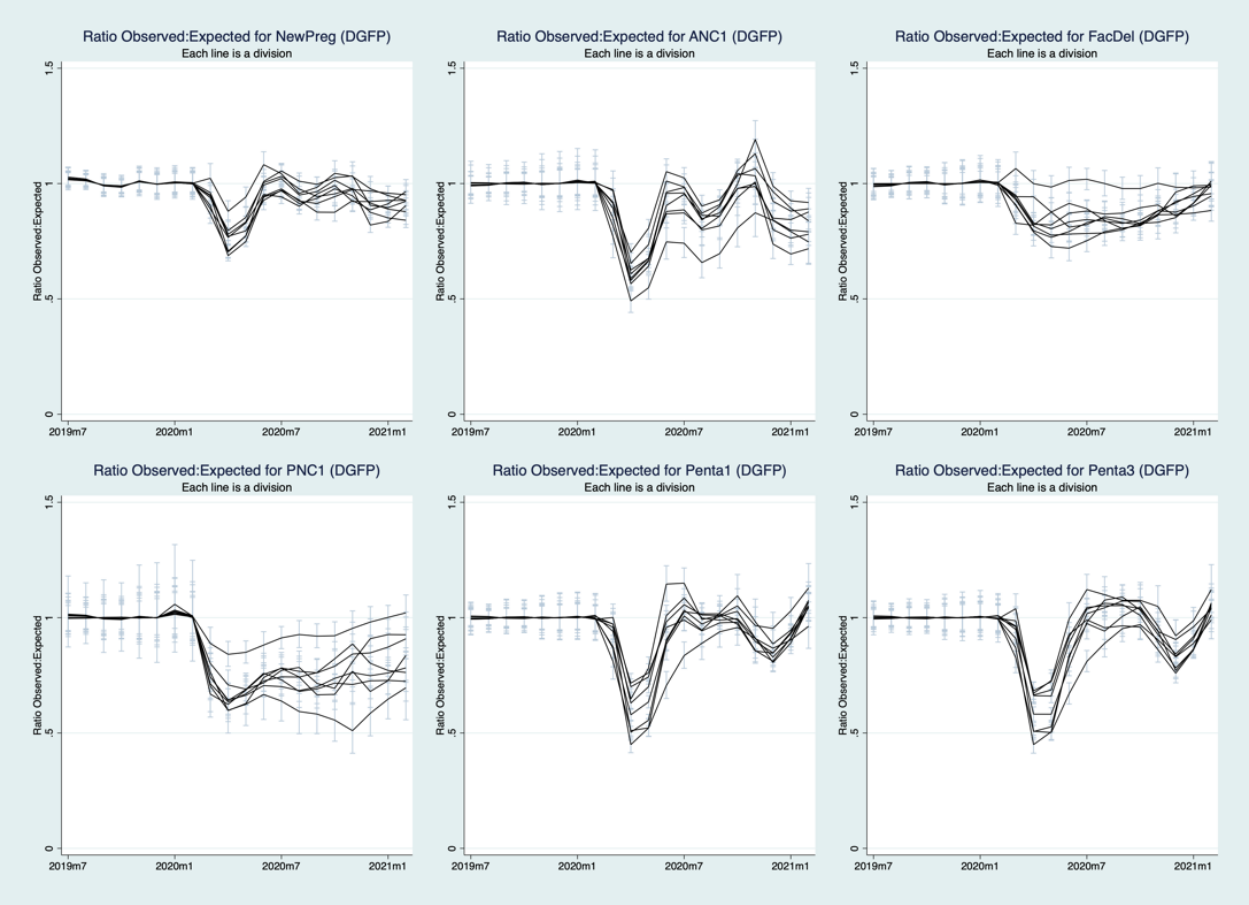


SERVICE DISRUPTION TRENDS OVER TIME

Figure 5 plots the level of disruption by month for six indicators, with each subplot representing an indicator, and each line of each plot representing a division. Most of the indicators show a strikingly similar trend, with acute disruptions in April and May, a return to expected values around June or July 2020, and subsequent smaller drops later in 2020 and early 2021. There were some trends that were slightly different. For example, in Figure 5, the charts at the top-right (institutional delivery) and bottom-left (PNC 1) show a different trend to the others, with services being disrupted and then staying disrupted until the end of the year.

Another striking feature of these charts is the similarity between the trends of each division. In most cases, the lines are almost identical in their general shape, if not their exact scale. Nothing about the analysis necessarily meant that the same trend would be seen across divisions – each district and division was analyzed independently – yet the similarities across divisions are unmistakable. This points to national-level factors affecting all divisions in the same fashion and is something addressed further in the discussion section.

FIGURE 5. DISRUPTION TRENDS FOR SIX INDICATORS FROM MARCH 2020 TO FEBRUARY 2021, BY DIVISION

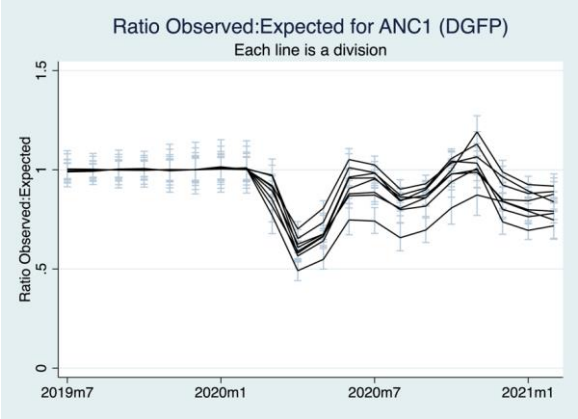


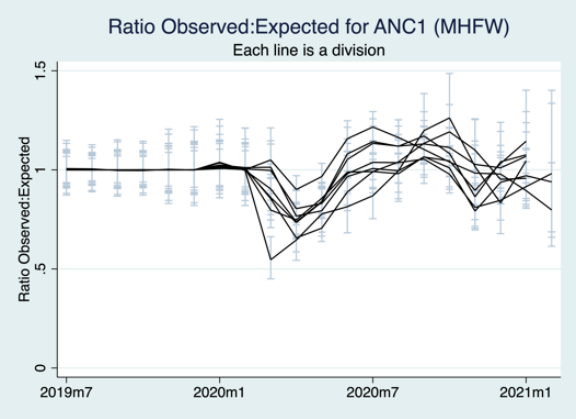
Note: The model that was constructed to create these images was fitted using data from March 2019 to February 2020. This explains why the disruption values for the first half of the trends is always equal to 1 – those months were used to create the values for the period of interest, starting March 2020.

COMPARISON OF TRENDS BY DATA SOURCE

The charts in Figure 6 show one single indicator (ANC 1) but with data from the three different sources. All three charts show a very similar trend, with a large disruption in March, April, and May, followed by a return to expected values and a later drop at the end of the year. The concordance between the data sources gives confidence that the general trend shown for ANC 1 disruptions does indeed reflect reality. Many of the other indicators were also like this, with similar trends for the same indicator across data sources. Figure 7 shows one exception, with the trend in the disruption of institutional delivery being different when using data from the DGFP database or the DGHS database. When using data from DGFP, institutional delivery has a flatter disruption trend, with small disruptions that last throughout the year.

FIGURE 6. ANC 1: AN INDICATOR WHERE THE TREND WAS SIMILAR ACROSS DATA SOURCES (TOP-LEFT, DGFP; TOP-RIGHT, DGHS HIGH-LEVEL FACILITIES; BOTTOM-LEFT, DGHS COMMUNITY FACILITIES)





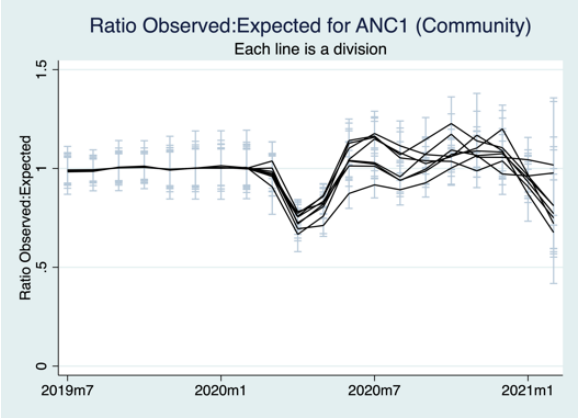
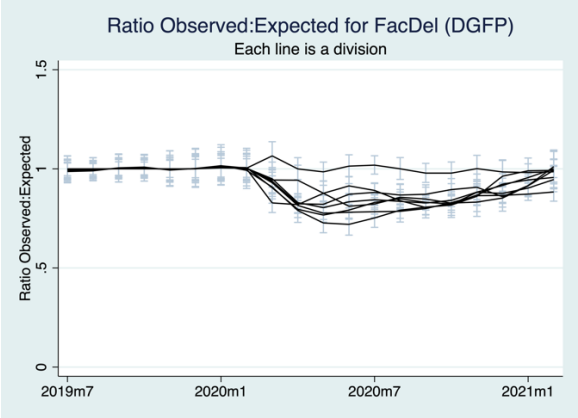
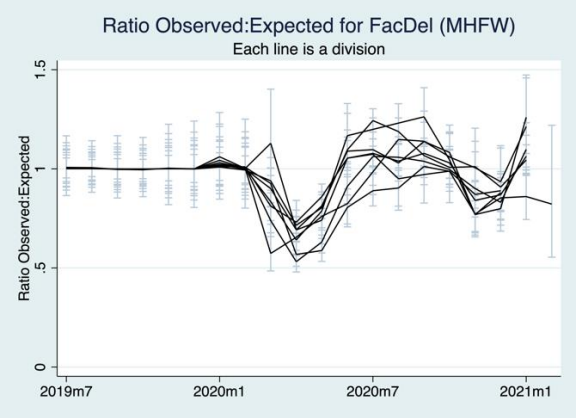


FIGURE 7. INSTITUTIONAL DELIVERY: AN INDICATOR WHERE THE TREND WAS DIFFERENT ACROSS DATA SOURCES (LEFT, DGFP; RIGHT, DGHS HIGH-LEVEL FACILITIES)





RATE OF RECOVERY

The final part of the service disruptions analysis was calculating the "rate of recovery" from April to September 2020. Tables 7 and 8 show the results for these calculations. The values represent the proportion of the disruption that was "recovered" from April to September 2020. The higher the number, the greater the recovery. Values over 1 indicate that the indicator made up all the April disruption and was "above

expected" in September. Negative values indicate that disruptions worsened from April to September. The findings here reflect the trends analysis in the previous section. The indicators with values around 0.4 to 0.6 typically recovered by June or July and then declined again in September. The indicators with values above 1 recovered beyond the levels that are would have been expected in September. More so than with other analyses, there were differences across divisions for each individual indicator (reflecting the variability in both the April and September values). However, as with the analyses of the magnitude of disruptions, there is no discernable pattern across indicators; all divisions appear to have above-average recoveries for some indicators and below-average recoveries for other indicators.

TABLE 7. RATES OF RECOVERY FROM APRIL TO SEPTEMBER 2020 FOR DGFP INDICATORS

	ANC 4 (DGFP)	Institutional Delivery (DGFP)	PNC 1 (DGFP)	Pill (DGFP)	Condom (DGFP)	Implant (DGFP)
Barishal	0.56	0.27	0.35	-1.00	0.16	0.56
Chittagong	0.60	---	0.50	0.42	0.35	0.75
Dhaka	0.50	-0.09	0.16	-5.65	0.35	0.71
Khulna	0.43	-0.08	0.11	1.31	0.48	0.68
Mymensingh	0.46	0.08	0.14	1.29	0.14	0.48
Rajshahi	0.35	-0.01	0.41	-3.65	0.54	0.67
Rangpur	0.46	0.17	0.02	1.29	0.14	0.78
Sylhet	0.20	-1.66	-0.04	-0.93	0.60	0.92

TABLE 8. RATES OF RECOVERY FROM APRIL TO SEPTEMBER 2020 FOR DGHS INDICATORS

	ANC 4 (DGHS high-level facilities)	Institutional Delivery (DGHS high-level facilities)	PNC 1 (DGHS high-level facilities)	ANC 4 (DGHS community facilities)	PNC 1 (DGHS community facilities)
Barishal	2.12	1.40	1.45	0.73	0.39
Chittagong	4.01	1.73	1.54	0.94	1.13
Dhaka	1.30	1.08	1.77	0.58	0.23
Khulna	2.27	1.24	1.18	0.70	0.81
Mymensingh	2.44	0.91	1.23	1.02	0.51
Rajshahi	1.12	1.29	1.44	1.61	0.72
Rangpur	---	1.45	1.13	0.86	0.61

Sylhet	1.75	1.03	1.28	0.64	0.62

RESULTS OF VULNERABILITY ANALYSIS

The second set of analyses explored the relationship between service disruptions and several household and facility factors, including population density, wealth, education level, pre-pandemic care-seeking, and the readiness of health facilities. These relationships were tested using a district-level composite indicator of service disruption, representing the average disruption across all indicators for a single district and month. Table 9 summarizes the results of the bivariate regression analyses for individual factors, adjusting for division.

TABLE 9. ESTIMATED PARAMETERS IN REGRESSION ANALYSIS OF A COMPOSITE MEASURE OF SERVICE DISRUPTION AND VARIOUS HOUSEHOLD AND FACILITY FACTORS AT DISTRICT LEVEL, ADJUSTING FOR DIVISION

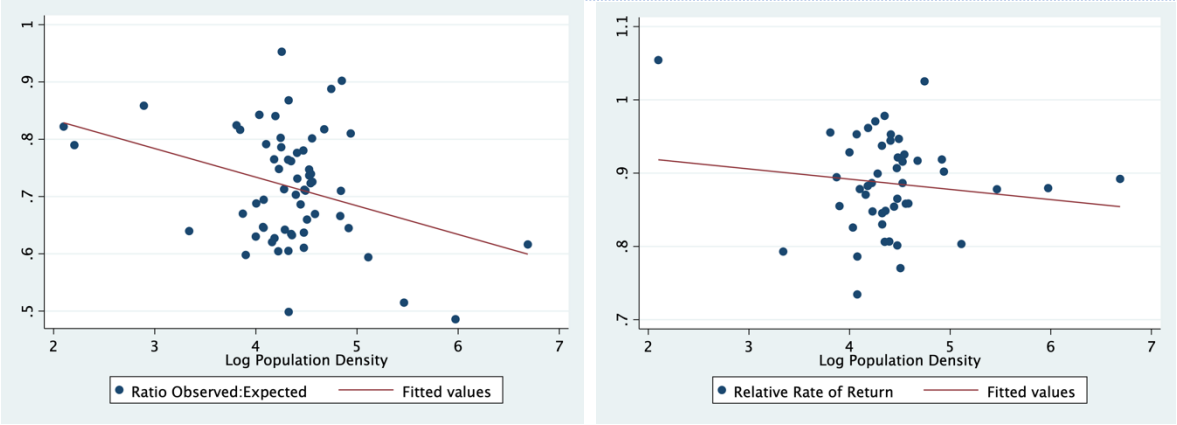
	Magnitude of service disruption in April 2020		**Relative rate of recovery from April 2020 to September 2020**	
	Beta coefficient	Adjusted R-squared	Beta coefficient	Adjusted R-squared
Household factors				
Population density (log)	-.0533 (-.1115, .0049)	0.1143	-.0434 (-.1740, .0871)	-0.0454
Wealth	-1.24e-06 (-2.22e-06, -2.52e-07)	0.1587	-3.98e-07 (-2.55e-06, 1.76e-06)	-0.0540
Education level	.0063 (-.1174, .1301)	0.0582	-.0414 (-.3163, .2334)	-0.0553
Pre-pandemic care-seeking (logit)	-.0382 (-.1039, .0274)	0.0817	-.0162 (-.1466, .1142)	-0.0561
Facility factors				
Availability of essential medicines and commodities for RMNCH (logit)	-.0616 (-.1961, .0728)	0.0728	.1977 (-.0796, .4752)	-0.0029
Availability of essential medicines and commodities for infectious diseases (logit)	-.0287 (-.1465, .0890)	0.1853	.0998 (-.1741, .3738)	-0.0429
Availability of basic equipment (logit)	-.0466 (-.1067, .0133)	0.0994	.0580 (-.0832, .1992)	-0.0390
Quality comprehensiveness for RMNCH (logit)	-.0125 (-.0658, .0407)	0.0590	.0087 (-.1050, .1225)	-0.0572
Proportion of ANC rooms with all infection control items (logit)	-.0639 (-.1373, .0094)	0.0973	-.0143 (-.1664, .1378)	-0.1320
Infection control items in all rooms (logit)	-.0450 (-.0884, -.0017)	0.1584	-.0063 (-.1080, .0952)	-0.0640

As the table shows, none of the household or facility factors displayed a meaningful relationship with the magnitude of service disruptions or the relative rate of recovery. All the adjusted R-squared values in the models were below 0.2, representing weak predictive power.

POPULATION DENSITY

The study tested the association between the population density of a district and its service disruptions. While there were greater-than-average disruptions in April 2020 for most of the high-density districts, there was not a strong relationship overall among districts, even controlling for division. At the extremes, the densest districts had greater disruptions and the least dense districts had lower disruptions. But in general, population density was not associated with the magnitude of disruption. Likewise, district-level rate of recovery showed no relationship with population density.

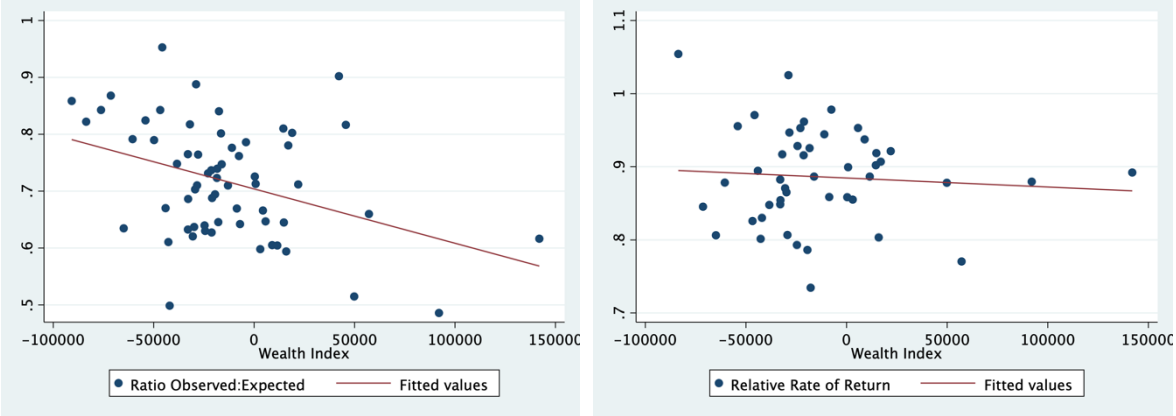
FIGURE 8. SCATTER PLOTS OF DISTRICT LOG POPULATION DENSITY AND THE MAGNITUDE OF DISTRICT SERVICE DISRUPTIONS (LEFT) AND THE RATE OF RECOVERY (RIGHT)



AGGREGATE HOUSEHOLD WEALTH

The association was tested between the aggregate wealth of a district (using the wealth indicator from the 2017-2018 DHS) and the magnitude of its service disruptions. While there was a slight tendency for wealthier districts to have greater disruptions, the model was weak and not highly predictive of either the magnitude of service disruptions in April 2020 or the rate of recovery.

FIGURE 9. SCATTER PLOTS OF DISTRICT WEALTH INDEX AND THE MAGNITUDE OF DISTRICT SERVICE DISRUPTIONS (LEFT) AND THE RATE OF RECOVERY (RIGHT)



EDUCATION

The association was tested between the education level of a district (using the head-of-household education indicator from the 2017-2018 DHS) and service disruptions. No relationship was found between the aggregate education level of a district and the magnitude of its disruption in April 2020 or rate of recovery.

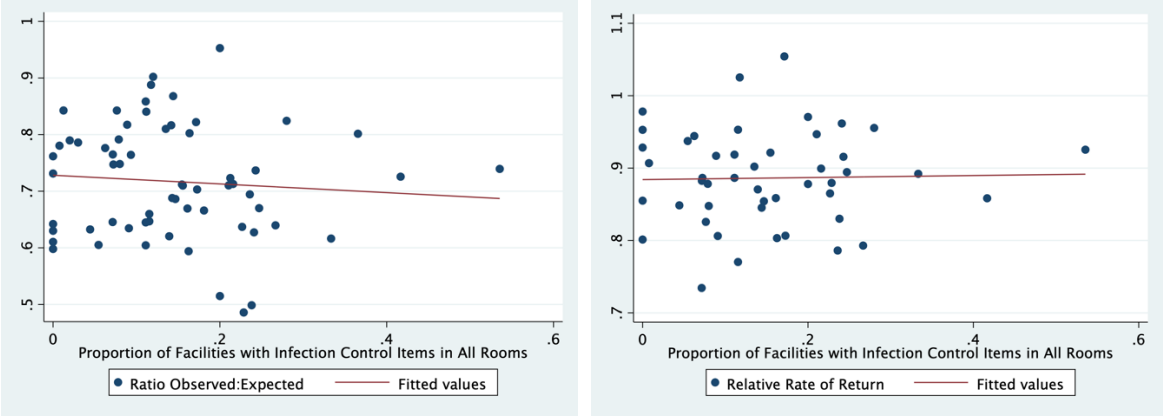
PRE-PANDEMIC CARE SEEKING

The association was tested between the ANC 4+ coverage levels of a district (as a proxy indicator for pre-pandemic care-seeking) and service disruptions. As with other predictor factors, no meaningful relationship was seen with the magnitude of district-level disruption in April 2020 or rate of recovery.

READINESS OF HEALTH FACILITIES

Finally, associations were tested between district-level disruptions and several indicators of health facility readiness calculated from the 2017 SPA aggregated at district level (listed in Table 9). These readiness indicators included the availability of supplies and equipment, a composite indicator for quality comprehensiveness of maternal and child health services, and indicators on the proportion of facilities with infection control items in ANC rooms, and in all rooms. None of the readiness indicators showed a meaningful relationship with a district's magnitude of disruption in April 2020 or its rate of recovery.

FIGURE 10. SCATTER PLOTS OF THE PROPORTION OF FACILITIES IN A DISTRICT WITH INFECTION CONTROL ITEMS IN ALL ROOMS AND THE MAGNITUDE OF DISTRICT SERVICE DISRUPTIONS (LEFT) AND THE RATE OF RECOVERY (RIGHT)



MULTI-VARIATE ANALYSES

In addition to bivariate regression analyses, multivariate regression models were also constructed for the magnitude of service disruptions and rate of recovery, including all the above household and facility factors, adjusting for division. Even in multivariate analyses, no individual household or facility factor showed a statistically significant relationship with service disruptions. The adjusted R-squared values for the multivariate models are shown in Table 10, all of which were below 0.2, indicating the weak predictive power of the models.

TABLE 10. ADJUSTED R-SQUARED VALUES FOR MULTIVARIATE REGRESSION ANALYSES

	Magnitude of service disruption in April 2020	Relative rate of recovery from April 2020 to September 2020
All household factors	0.1160	-0.1320
All facility factors	0.0997	-0.1019
All household and facility factors	0.1543	-0.2850

The lack of a significant relationship between service disruptions and any of the factors that were explored in the models was surprising. Some potential explanations for this finding are offered in the discussion section, below.

RESULTS OF IMPACT ANALYSIS USING THE LIVES SAVED TOOL

The final set of analyses quantify the impact of service disruptions on child and maternal mortality – the "additional lives lost" due to the indirect effects of the pandemic on service delivery. These estimates were calculated using the Lives Saved Tool (LiST).

Table 11 shows the total expected deaths in 2020 without disruptions (counterfactual scenario) and the total estimated deaths in 2020 with the observed service disruptions. According to the analysis, 88,853 child deaths and 5,084 maternal deaths would have been expected in 2020. Instead, the analysis suggests that because of the disruptions due to the pandemic there were 100,190 child deaths and 5,471 maternal deaths. In other words, there were 11,337 additional child deaths and 387 additional maternal deaths in 2020 due to the COVID-19 service disruptions. This represents a 12.8% increase in child mortality and a 7.6% increase in maternal mortality, compared to what would have been expected in 2020 without the pandemic.

TABLE 11. ADDITIONAL DEATHS DUE TO SERVICE DISRUPTIONS AT NATIONAL LEVEL

	Total expected deaths in 2020 with no disruptions (counterfactual)	Total estimated deaths in 2020 with observed disruptions	Additional deaths in 2020 due to service disruptions	Relative increase in mortality due to service disruptions
Child deaths (0-59 months)	88,853	100,190	11,337	12.8%
Neonatal deaths (<1 month)	50,311	56,016	5,705	11.3%
Maternal deaths	5,084	5,471	387	7.6%

The same numbers were calculated at divisional level, shown in Table 12. The greatest number of additional child deaths in 2020 were in Dhaka, with 4,229 additional child deaths, an 18.9% increase over what would have been expected without the pandemic. The greatest relative increase in deaths in 2020 was in Mymensingh, with 1,730 additional child deaths or a 24.8% relative increase. The least impact was in Khulna

division, where there were 176 fewer child deaths, due to increases in service counts in 2020. The differences across divisions are a result of several factors, including the magnitude of disruptions, the duration of disruptions, the population size of the divisions, and the baseline coverage and mortality of the divisions.

TABLE 12. ADDITIONAL DEATHS DUE TO SERVICE DISRUPTIONS AT DIVISIONAL LEVEL

	Additional child deaths (0-59 months)		**Additional neonatal deaths (<1 month)**		**Additional maternal deaths**	
	Absolute number	Relative increase	Absolute number	Relative increase	Absolute number	Relative increase
Barishal	726	14.2%	307	10.6%	15	5.0%
Chittagong	1,776	9.9%	834	8.2%	51	5.0%
Dhaka	4,229	18.9%	1,852	14.7%	101	7.9%
Khulna	-176	-1.8%	660	12.1%	37	6.7%
Mymensingh	1,730	24.8%	784	19.9%	42	10.6%
Rajshahi	1,905	16.8%	668	10.4%	35	5.4%
Rangpur	1,168	12.1%	444	8.1%	23	4.1%
Sylhet	551	9.2%	1	0.0%	5	1.4%

One of LiST's strengths is its ability to allocate changes in the number of deaths to changes in specific interventions. In this way, it can show the relative impact that changes in individual interventions had on the overall increase in mortality. Tables 13 and 14 show the interventions whose disruptions were responsible for the greatest increase in child and maternal mortality, respectively. Among child health interventions, the reduction in oral rehydration solution (ORS) alone was responsible for 34.7% of additional child deaths. Among maternal interventions, the reduction in the parenteral administration of uterotonics was responsible for 44.9% of additional maternal deaths.

TABLE 13. INTERVENTION REDUCTIONS RESPONSIBLE FOR LARGEST NUMBERS OF ADDITIONAL CHILD DEATHS

Child interventions	**Additional child deaths (0-59 months)**	**Relative contribution**
Oral rehydration solution	3,912	34.7%
Oral antibiotics for pneumonia	1,188	10.6%
Case management of neonatal sepsis or pneumonia	1,131	10.5%
Vitamin A for treatment of measles	802	6.8%

Clean cord care	705	6.4%

TABLE 14. INTERVENTION REDUCTIONS RESPONSIBLE FOR LARGEST NUMBERS OF ADDITIONAL MATERNAL DEATHS

Maternal interventions	**Additional maternal deaths**	**Relative contribution**
Parenteral administration of uterotonics	174	44.9%
Parenteral administration of anti-convulsants	56	14.5%
TT - Tetanus toxoid vaccination	44	11.3%
Removal of retained products of conception	33	8.5%
Assisted vaginal delivery	22	5.6%

In addition to modeling the exact service delivery changes that were observed, the study modeled a set of hypothetical scenarios. First, shown in Table 15, different scenarios for 2020 were modeled, to show what might have happened if the service disruptions had been greater or lesser than observed. Second, in Table 16, different scenarios for 2021 were modeled, to show the impact of service disruptions lasting until different times in the year.

In the analysis at the start of the results section, service levels nationally were estimated to be, on average, approximately 30% lower than what would have been expected, across all indicators, and on average across all months from March to December 2020. The two comparison scenarios that were modeled and shown in Table 15 were for a hypothetical reduction of 20% across all indicators and months, and a hypothetical reduction of 50% across all indicators and months. The results show that although many lives were lost in 2020 due to the indirect effects of the pandemic, approximately 7,000 more child lives would have been lost if disruptions had been unmitigated at 50% throughout 2020 – a total of 18,279 child deaths instead of the estimated 11,337 child deaths.

TABLE 15. ADDITIONAL DEATHS UNDER DIFFERENT SCENARIOS FOR 2020

	Best estimate of what happened in 2020 (from Table 11)		**Scenario if there had been only 20% service disruptions from March-December 2020**		**Scenario if there had been 50% service disruptions from March-December 2020**	
	Absolute number	Relative increase	Absolute number	Relative increase	Absolute number	Relative increase
Additional child deaths (0-59 months) in 2020	11,337	12.8%	6,953	7.8%	18,279	20.6%
Additional neonatal deaths (<1 month) in 2020	5,705	11.3%	3,788	7.5%	9,992	19.9%

Additional maternal deaths in 2020	387	7.6%	241	4.7%	618	12.2%

Table 16 shows the three scenarios that were modeled for 2021: first, if the January 2021 service disruption levels were to continue until the end of April 2021; second, if they were to continue until the end of August 2021; and third, if they were to continue until the end of December 2021. The analysis suggests that ending the current level of disruptions now, rather than in December 2021, could save around 3,000 child lives – with only 1,604 child deaths compared to 4,527 child deaths under year-long disruptions.

TABLE 16. ADDITIONAL DEATHS UNDER DIFFERENT SCENARIOS FOR 2021

	Scenario if current service disruption levels continue until end of April 2021		**Scenario if current service disruption levels continue until end of August 2021**		**Scenario if current service disruption levels continue until end of December 2021**	
	Absolute number	Relative increase	Absolute number	Relative increase	Absolute number	Relative increase
Additional child deaths (0-59 months) in 2021	1,604	1.8%	2,987	3.4%	4,527	5.1%
Additional neonatal deaths (<1 month) in 2021	935	1.9%	1,637	3.3%	2,475	5.0%
Additional maternal deaths in 2021	58	1.2%	105	2.1%	159	3.2%

DISCUSSION

The results of these analyses present clear evidence of significant disruptions to child and maternal health services in Bangladesh. The disruptions affected all indicators that were examined as part of the study, including indicators of maternal and child health services along the continuum of care, and of family planning. The period of greatest disruption was in March, April, and May 2020. For most indicators, the largest reduction in service levels was in April 2020, with a relative reduction of between 30% to 60%, across indicators and divisions. There were smaller subsequent disruptions later in 2020 for most indicators. The results also show lingering disruptions in early 2021 that could signify the start of a new wave of disruptions that are equal to, or more serious than, the disruptions in early 2020.

The study was quite fortunate to have data from two HMIS sources: the DGFP MIS and the DGHS DHIS2. There was remarkable consistency in results across these sources. With few exceptions, the same indicator showed the same trend when calculated using data from different sources. Notably, the trends for ANC 1, ANC 4, and PNC 1, for which data was available from both sources, were similar when using data from either source. This concurrence lends credibility to the findings.

The chief forces driving the disruptions appear to be national-level factors. The analysis showed only tenuous relationships between indicators at district level, and no meaningful relationship between the disruptions and any of the household or facility factors that were tested. This was surprising, as the expectation was for

some relationship between a district's service disruptions and its general level of pre-pandemic vulnerability – specifically, between a district's service disruptions and the demography of the district or the readiness of its health facilities. Instead, no substantive relationship was found at district level between any of the predictive factors and the magnitude of disruptions or the rate of recovery.

While unanticipated, this finding is consistent with other aspects of the data. Across divisions and indicators, there were similar trends in disruption, suggesting that disruptions were largely being driven by national events. At district level, there was greater variation in the magnitude of disruption, but most districts had greater disruptions for some indicators and lesser disruptions for other indicators. Without consistency in district-level disruptions across indicators, it is unlikely for there to be any relationship between disruptions and other predictive factors. Or, at least, any predictive factors would only predict some type of disruptions and not others.

Although no association was found between the level of disruption and pre-pandemic vulnerability, it is important to recognize that the disruptions nonetheless did affect vulnerable districts – and made those districts even more vulnerable. Districts that had low coverage of interventions before the pandemic experienced both smaller and larger disruptions. These exacerbated vulnerabilities should be explored further, and continued efforts made to strengthen health system capacities and mitigate against additional disruptions.

The service disruptions in 2020 were of such magnitude and duration that the analysis suggests they were responsible for approximately 11,337 additional child deaths and 387 additional maternal deaths, representing a 12.8% increase in child mortality and a 7.6% increase in maternal mortality compared to what would have been expected in 2020 without the COVID-19 pandemic. Although there were disruptions to all the indicators that were examined, the disruptions to outpatient services in the analysis were responsible for the most additional deaths; specifically, the disruptions to oral rehydration solution, antibiotics for pneumonia, and treatment of neonatal sepsis/pneumonia.

Lastly, several hypothetical scenarios were considered for 2020 in which service disruptions were greater or lesser than what was observed in the data. The analysis suggests that if disruptions had remained at 50% throughout 2020 – in other words, if disruptions had stayed roughly at their April 2020 levels through the rest of the year, there would have been approximately 7,000 more child deaths. The efforts of the government to mitigate disruptions were thus highly valuable in preventing additional mortality. Three scenarios for 2021 were also considered in which service disruptions end in April 2021, in August 2021, or in December 2021. The results show that ending services disruptions in April 2021, rather than in December 2021, will save approximately 3,000 child lives and 100 maternal lives. It is therefore imperative that all attempts are made to mitigate lingering disruptions as soon as possible.

SUMMARY OF FINDINGS

SERVICE DISRUPTIONS

1. Most indicators showed a similar trend in service disruptions, with an unmistakable reduction in March, April, and May 2020; a period of recovery in June and July 2020; and subsequent smaller reductions in late 2020 and early 2021. Other indicators showed sustained, moderate disruptions throughout 2020.
2. In January and February 2021, service levels were still lower than expected for most indicators, meaning that there is still work to do in returning services to pre-pandemic levels in 2021.
3. There were striking similarities across divisions, with all divisions showing the same pattern of service disruptions over time for most indicators.

VULNERABILITY ANALYSIS

4. In the analyses, no household or facility factors were meaningfully associated at district level with the magnitude of service disruptions or rate of recovery. In general, disruptions appear to be consistent with a national shock that had a similar effect across districts and indicators.
5. The most vulnerable districts were as likely to experience service disruptions as other districts.

MORTALITY IMPACT

6. The service disruptions in 2020 led to approximately 11,337 additional child deaths and 387 additional maternal deaths (Table 1). This represents a 12.8% and 7.6% increase in child and maternal mortality compared to what would have been expected in 2020 without the pandemic.
7. The disruptions that contributed the most to increased child mortality were those to oral rehydration solution, antibiotics for pneumonia, and treatment of neonatal sepsis/pneumonia.
8. Although many lives were lost in 2020 due to the indirect effects of the pandemic, approximately 7,000 more child lives would have been lost if disruptions had remained unmitigated at 50% disruption levels throughout 2020.
9. Ending service disruptions now, rather than in December 2021, will save approximately 3,000 child lives and 100 maternal lives.

RECOMMENDATIONS

1. **Continue to closely monitor changes in the level of routine health services.** The analysis showed reemerging disruptions in January and February 2021, which could signal the early stage of a new period of disruption. Immediate analysis is needed to understand ongoing effects of these disruptions on vulnerable populations and persons who have not received continuous care over the previous year, due to service disruptions. Close monitoring will be important both at the national and at the Divisional level to discern differences in patterns of disruptions; in the types of populations more greatly affected as well as the specific services with the greatest impact.
2. **Many lives could be saved by minimizing disruptions as soon as possible and returning service delivery to pre-pandemic levels.** Policies to mitigate COVID-19 transmission should consider the potential effects on the provision and utilization of routine health services. Continuity of services is likely to require a combination of efforts including an emphasis on provider safety to deliver care (provision of PPE), incentives and necessary arrangements for providers to be available for care, the enlisting and support of community health workers in the provision of basic care such as contraceptives and vaccinations, an emphasis on communication strategies to ensure communities know about the availability and safety of health services, among others. The faster the recovery from service disruptions, the lower the continued impact these will have on the health of the population.
3. **Continue to focus health system interventions on the most vulnerable areas.** Targeted analyses to identify these areas and understand the highest-impact interventions are an essential component of the strategies for recovery. Building back better to further increase access to services and fortify the health system for future crises will be essential in the years to come. The analyses showed differentiated geographic impact of disruptions across the country but was unable to discern specific impacts on the most vulnerable populations. Interventions that target these vulnerable populations (including women, newborns and children) by ensuring the availability and continuity of their care for basic illnesses such as

diarrhea, pneumonia and post-natal complications will likely have important benefits and mitigate some of the service disruption impact seen in this analysis.

4. **National level events have big effects across the country.** Potential to consider division-level recommendations, so that mitigation efforts targeting one division do not have unnecessary adverse consequences in other divisions. This analysis suggests that country-wide policies aimed at reducing COVID-19 transmission and transportation, economic and social factors of national impact played an important role in the generation of service disruptions across the country. Although the policies were national in level, COVID-19 did not spread with equal speeds or impact across the different Divisions. Targeted policies for pandemic control, based on analyses of risk of contagion and on service disruptions for each Division could help mitigate some of the impacts observed in these analyses.

APPENDIX 1. LIST OF INDICATORS

This appendix gives more details on the specific indicators obtained from each of the data sources.

INDICATORS FROM THE MANAGEMENT INFORMATION SYSTEM (MIS) OF THE DIRECTORATE GENERAL OF FAMILY PLANNING (DGFP)

9 indicators were taken on maternal and child health and reproductive health services from the DGFP MIS, to give a representative sample of services along the continuum of care, and to match similar indicators available from the other DHIS2 sources, for comparison.

1. NewPreg (DGFP): Number of newly pregnant mothers registered (mch_87)
2. ANC1 (DGFP): ANC 1 (mch_91)
3. ANC4 (DGFP): ANC 4 (mch_94)
4. FacDel (DGFP): Normal delivery at hospital or clinic (mch_102)
5. MisoDel (DGFP): Number of mother feeding Misoprostol (mch_108)
6. PNC1 (DGFP): PNC 1 (mch_111)
7. BCG (DGFP): BCG (mch_159)
8. Penta1 (DGFP): OPV and Pentavalent (DPT, Hep-B, Hib) Dose 1 (mch_160)
9. Penta3 (DGFP): OPV and Pentavalent (DPT, Hep-B, Hib) Dose 3 (mch_162)

The following 6 indicators were also taken from the DGFP MIS on the distribution and delivery of family planning commodities and services.

1. Pill (DGFP): Oral pill: total of Shukhi and Apon counts (fp_pill)
2. Condom (DGFP): Condom Nirapad (fp_condom)
3. Injectable (DGFP): Injectable vial (fp_injectable)
4. IUD (DGFP): IUD (fp_iud)
5. Implant (DGFP): Implant: total of Implanon and Jadel counts (fp_implant)
6. MisoFP (DGFP): Misoprostol for abortion (fp_miso)

INDICATORS FROM THE DHIS2 SYSTEM OF THE DIRECTORATE GENERAL OF HEALTH SERVICES (DGHS)

Data were obtained on MNCH service delivery at health centers and hospitals:

1. ANC1 (DGHS, high-level facilities): ANC 1 (ha_anc1)
2. ANC4 (DGHS, high-level facilities): ANC 4 (ha_anc4)
3. FacDel (DGHS, high-level facilities): Deliveries at a health facility (ha_facdel)
4. PNC1 (DGHS, high-level facilities): PNC 1 (ha_pnc1)

Additional data were obtained on MNCH and FP service delivery at community clinics. In contrast to the other data sources (above), these indicators give a sense of service disruptions at the lower-level facilities.

1. TGP (DGHS, community facilities): Total treated general patient (cc_tgp)
2. ANC1 (DGHS, community facilities): ANC 1 (cc_anc1)
3. ANC4 (DGHS, community facilities): ANC 4 (cc_anc4)
4. LiveBirth (DGHS, community facilities): Live birth (cc_livebirth)
5. PNC1 (DGHS, community facilities): PNC 1 (cc_pnc1)
6. Pill (DGHS, community facilities): Oral pill distribution (cc_pill)
7. Condom (DGHS, community facilities): Condom distribution (cc_condom)

DATA FROM DEMOGRAPHIC AND HEALTH SURVEY (DHS) 2017-2018

The Bangladesh DHS 2017-2018 dataset was obtained from the DHS Program. Geospatial information was used to match household records and individual records to Upazilas, and then collapsed and merged the household and individual data at the Upazila, district, and division level. The following indicators from the DHS were used in the analysis:

1. Household wealth
2. Mother's education level
3. ANC 4+, among pregnancies (as a proxy indicator for pre-pandemic care-seeking)

DATA FROM SERVICE PROVISION ASSESSMENT (SPA) 2017

The Bangladesh SPA 2017 dataset was also obtained from the DHS Program. The SPA dataset was used to calculate the following PHCPI indicators at district level:

1. drugs_rmnch: Availability of essential medicines and commodities for RMNCH (drugs_rmnch)
2. drugs_ID: Availability of essential medicines and commodities for infectious diseases (drugs_ID)
3. equipment: Availability of basic equipment (equipment)
4. water: Availability of water (waste_disposal)
5. electricity: Availability of electricity (waste_disposal)
6. waste_disposal: Waste disposal (waste_disposal)
7. comp_RMNCH: Quality comprehensiveness for RMNCH (comp_RMNCH)
8. comp_ID: Quality comprehensiveness for infectious diseases (comp_RMNCH)
9. inf_cont_EX: Proportion of _clinical examination rooms_ with all infection control items (inf_cont_EX)
10. inf_cont_FP: Proportion of _family planning rooms_ with all infection control items (inf_cont_FP)
11. inf_cont_SC: Proportion of _sick child rooms_ with all infection control items (inf_cont_SC)
12. inf_cont_ANC: Proportion of _ANC rooms_ with all infection control items (inf_cont_ANC)
13. inf_cont_NCD: Proportion of _NCD rooms_ with all infection control items (inf_cont_NCD)
14. inf_cont_all: Infection control items in all rooms (inf_cont_all)