Two Years of the COVID-19 Pandemic: Estimating the Effects on Essential Health Services Utilization in Uganda and Bangladesh

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Research Article

Keywords:

Posted Date: March 7th, 2022

DOI: <https://doi.org/10.21203/rs.3.rs-1371550/v1>

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Abstract

Background

Since March 2020, the COVID-19 pandemic has been a major shock to health systems across the world. We examined national usage patterns for selected basic, essential health services, before and during the COVID-19 pandemic, to determine whether COVID-19 affected reporting of service utilization and the use of health services.

Methods

We used routine health information system data since January 2017 to analyze reporting and service utilization patterns for a variety of health services. Using time series models to replicate pre-COVID-19 trajectories over time we estimated what levels would have been observed if COVID-19 had not occurred during the pandemic months, starting in March 2020. The difference between the observed and predicted levels is the COVID effect on health services.

Findings:

The time trends models for Uganda and Bangladesh closely replicated the levels and trajectories of service utilization during the 38 months prior to the COVID-19 pandemic. Our results indicate that COVID-19 had severe effects across all services, particularly during the first months of the pandemic, but COVID-19 impacts on health services and subsequent recovery varied by service type. In general, recovery to expected levels was slow and incomplete across the most affected services.

Conclusion

Our analytical approach based on national information system data could be very useful as a form of surveillance for health services disruptions from any cause leading to rapid responses from health service managers and policymakers.

Background

On March 11, 2020, the World Health Organization characterized the COVID-19 outbreak as a pandemic.¹ With cases reported in more than 110 countries and territories at the time,² countries took steps to attempt to prevent further spread by resorting to social distancing, closing of schools and businesses, and implementing lockdowns. Since March 2020, there have been countless ways the COVID-19 pandemic has directly and indirectly affected societal structure and function, from movement restrictions to personnel shortages, and global supply chain interruptions.

The COVID-19 pandemic and the countries' response delivered a massive shock to the supply and demand of goods and services in the entire economy. These also disrupted the availability, access, and use of health services unrelated to COVID-19. A scoping review that summarizes existing work on the effects of COVID-19 on other essential health services found that most research in this area focuses on high income countries.³ Several studies found that COVID-19 had negative effects on health service use in low- and middle-income countries.⁴⁻⁸ However, these effects have not necessarily been evenly distributed across all health services, facilities, or geographies. Studies by Ayele and colleagues and Hategeka and colleagues found that COVID-19 had negative impacts on illness- and disease-specific utilization,^{4,6} but effects on vaccinations as well as maternal and infant health services were not consistent.^{4-7,9} For example, Shapira and colleagues found that while several countries experienced significant decreases in the utilization of maternal and child health services (MCH), including vaccinations, the magnitude and timing of COVID effects varied across countries.⁷ Ayele and colleagues and Hategeka and colleagues also found no difference in service utilization for selected MCH services in Addis Ababa and Kinshasa, respectively, whereas Wanyana and colleagues found a significant negative impact of COVID-19 in Rwanda.^{4,6,9}

These studies are all important contributions for further understanding the extent of COVID-19 interruptions to health systems. Yet, there are still some challenges that remain when trying to interpret the results across systems. There is heterogeneity in methodological strategies, services selected for analysis, and pre-COVID time frames for estimating effects during the COVID-19 period that makes ascertaining whether inconsistent COVID-19 effects across countries reflects country differences or methodological differences. Some studies have opted for descriptive analyses, comparing 2019 pre-COVID months to 2020 COVID-19 months.^{4,9-11} Other researchers estimated changes in time trends before and during COVID-19,^{5,6} or used time trend models with unique variables to estimate month-specific COVID-19 effects.^{7,8}

Additionally, especially during the initial lockdown periods, it is difficult to tell at which level negative effects of COVID-19 occurred. There could have been challenges to the information system, such as outages, that could have affected the quality of reporting. Under this circumstance, COVID-19 effects on utilization could be misattributed to reduced patient demand when, in fact, such effects could be caused by lower reporting. Shapira and colleagues addressed both of these issues by applying the same analytical strategy for eight countries in Sub Saharan Africa, which includes investigations on facility-level information system reporting.⁷ In addition, most of the published studies have analyzed a relatively short time frame, only looking at COVID-19 effects through mid-2020,^{4,6-10} which is clearly important, given the need to provide information about a major crisis. As the pandemic has been ongoing, the effects on health services may evolve over time as well. Such information is important for policy decisions.

This study estimates the effects of COVID-19 from two countries in Africa and Asia, Uganda and Bangladesh, on selected non-COVID-19-related health services using routine health information system

(RHIS) data collected prior to COVID-19 and throughout the first year of the pandemic. The two main objectives of this research are to determine whether the COVID-19 pandemic affected 1) reporting of health service utilization, and 2) utilization of health services.

Methods

Data

This study uses data available through the existing RHIS in each country (see basic information in Table 1). We worked with the government agencies in the respective countries to access the government's routine data on service delivery and gathered the publicly available datasets for analysis. The data were anonymized and aggregated at facility or the administrative levels without any personal identifiers before use. Data were compiled monthly starting in January 2017, about three years before the pandemic. We used three years pre-COVID to better identify any seasonality patterns in service use. A specific cleaning process was applied to all data prior to analysis to identify and remove outliers. For each service, unit-specific (district for Uganda, upazila or sub-district for Bangladesh) time series graphs were generated to identify extreme values. We then calculated the mean and standard deviation for each unit. The graphs and summary statistics helped to inform rules by which to remove outliers, such as removing values that exceeded five or six standard deviations above the unit-specific mean. The choice of outlier cutoff was made by examining the time trajectories of the specific units where outliers were suspected and their relative volatility over time. Such rules were adjusted based on service and country. Less than 0.2% of data points for each service within each country were deemed outliers.

Table 1
Dataset description

Country	RHIS system used	Data unit-level	Time range	Selected Services
Uganda	District Health Information System (DHIS2)	District (N = 136)	January 2017- May 2021	New outpatient visits (overall attendance) 1st antenatal visits 4th antenatal visits Facility deliveries Family planning visits* Diarrhea cases (28 days-5 years) Malaria cases (28 days-5 years) Pneumonia cases (28 days-5 years) BCG doses Measles doses 1st DPT doses
Bangladesh	Management Information System 3 (MIS3)	Upazila (N = 489)	January 2017-August 2020	Outpatient visits (overall attendance) 1st antenatal visits 4th antenatal visits Facility deliveries Family planning**
	Expanded Program on Immunization (EPI)	Upazila health complex (N = 424)	January 2017- April 2021	BCG Measles-rubella doses 1st pentavalent
RHIS: routine health information system; BCG: Bacillus Calmette–Guérin vaccine; DPT: diptheria, pertussis, and tetanus toxoids vaccine				
*Uganda family planning data is a composite of the most common methods that were consistent across time, which include male and female condoms, injectables, implants, and oral contraceptives. Other methods such as IUDs, emergency contraceptives, and natural methods were not included.				
**Bangladesh family planning data available ends in July 2020				

Measures of service use

The basic health services included in this analysis fall broadly in four categories: maternal and child health (first and fourth antenatal care [ANC1 and ANC4] visits, facility deliveries, common childhood illnesses); childhood immunization (BCG, measles, and DPT/pentavalent vaccination); family planning visits; and outpatient attendance to capture the overall service utilization (see Table 1).

For each service analyzed, to answer the first research question (i.e., did COVID-19 affect reporting?), we generated variables that counted the number of units reporting each month. For the second question, (i.e., did COVID-19 affect utilization of health services?), we examined two measures of use: total services provided, and average services provided each month included in the analysis.

Analytical Approach

There were two stages in analyzing the data. The goal of the first stage was to examine pre-COVID patterns and fit a time trends model that most closely replicated those observed pre-COVID trajectories of service utilization over time. The goal of the second stage was to estimate what levels of service use would have been observed had COVID-19 not occurred during the COVID-19 months. To do this, we extended the models fitted to pre-COVID patterns from the first process through the COVID-19 period by generating predicted values. The difference between the observed and the predicted levels for each month of the pandemic is the “COVID effect”. Because each country first reported COVID-19 cases in March 2020 and experienced subsequent shutdowns/restrictions in movement, the COVID-19 period goes from March 2020 onward. Time between January 2017 and February 2020 was defined as the pre-COVID period. This study was reviewed by the University of North Carolina at Chapel Hill’s Office of Human Research Ethics and all methods in this study were carried out in accordance with guidelines and regulations for research involving human participants.

Descriptive analysis and examining pre-COVID patterns

We used descriptive analysis to answer the first question: did COVID-19 affect reporting? We counted the number of units reporting in each time point for each service and examined any variation over time using graphs. Time trends model estimation procedures were used to answer the second question: did COVID-19 affect service utilization? For each service, several tests and pieces of information were used to make final determinations on which model to use for estimating the COVID effect. In particular, we undertook several steps to determine which functional form of time better replicated the trajectories of service utilization before COVID-19 (detailed in Supplementary Material S1).

Replicating pre-COVID service use patterns and estimating COVID effects

We estimated various regression models to best replicate the observed levels and trajectories of each service indicator for each country. The functional form analysis indicated that most services followed a

linear time trend. However, to confirm these conclusions, we also estimated models with quadratic specifications of time. For each functional form, we explored a variety of estimation approaches, including ordinary least squares (OLS), fixed effects, random effects, and autoregressive models. All models examined included seasonal (i.e., quarterly or monthly dummy variables) and yearly controls. For estimating the COVID effect on total service use we included the total number of units reporting the service as a regressor in the model. More details on the model fit assessment can be found in Supplementary Material S2.

Linear OLS models with monthly seasonal controls best replicated pre-COVID trajectories of total service utilization in both countries. We used the following specification:

$$TotalUseK_t = \alpha_0 + \alpha_1 time_t + \beta Month_t + \gamma year_t + \delta NUnitsK_t + \epsilon_t, \text{ for } t \leq 38 \quad (1)$$

where $TotalUseK_t$ is the number of total services reported as provided in month t during the pre-COVID period (January 2017-February 2020; $t \leq 38$) for service K ; $time_t$ is the number of months since January 2017 up to t ; $Month_t$ is a set of monthly dummy variables to control for seasonality; $year_t$ is a set of yearly dummy variables; $NUnitsK_t$ is the number of units reporting service K in month t ; and ϵ_t is the error term.

We then used estimated model (1) to obtain predicted total service use values had COVID-19 not occurred during the COVID period ($\widehat{TotalUseK_t}$, for $t \geq 39$), and estimated the COVID effect with the following expression:

$$COVIDEffect_t = TotalUseK_t - \widehat{TotalUseK_t}, \text{ for } t \geq 39$$

For vaccination services in Bangladesh, EPI data was available at the health facility level (the upazilla health complex). By using graphs, we observed fluctuations in the number of facilities reporting during the COVID period which suggested that COVID might have affected reporting of these vaccination services. To control for this indirect effect of COVID on reporting, we also estimated reporting-adjusted COVID effects on total vaccination services. We first modelled the number of health units reporting vaccination services K ($NUnitsK_t$) in the pre-COVID period as follows:

$$NUnitsK_t = \beta_0 + \beta_1 time_t + \pi Month_t + \tau Year_t + \epsilon_t, \text{ for } t \leq 38 \quad (2)$$

and then we obtained the predicted number of health units that would have reported vaccination service K had COVID-19 not occurred from March 2020 onwards ($\widehat{NUnitsK_t}$, $t \geq 39$). We used these predicted values to recalculate the predicted total service use using the estimated parameters from model (1):

$$\widehat{TotalUseK_t}^{Adjusted} = \hat{\alpha}_0 + \hat{\alpha}_1 time_t + \hat{\beta} Month_t + \hat{\gamma} year_t + \hat{\delta} \widehat{NUnitsK_t}, \text{ for } t \geq 39$$

Then, the reporting-adjusted COVID effects for vaccinations are estimated with:

$$COVIDEffect_t^{Adjusted} = TotalUseK_t - \widehat{TotalUseK_t}^{Adjusted}, \text{ for } t \geq 39$$

For examining average service use, we found that the linear fixed effects model best replicated trajectories of average use during the pre-COVID period for Uganda and Bangladesh. We estimated the following model:

$$UseK_{jt} = \alpha_0 + \alpha_1 time_t + \beta Month_t + \gamma Year_t + \delta_j + \epsilon_{jt}, \text{ for } t \leq 38 \quad (3)$$

where $UseK_{jt}$ is the number of services K provided in administrative unit j in month t ; δ_j is a set of administrative units (i.e., district or upazila) dummy indicators included to control for time-invariant unobserved factors specific to each administrative unit that influence the demand and supply for services; and ϵ_{jt} is the error term. Model (3) allowed us to obtain predicted average service use had COVID-19 not occurred ($\widehat{UseK_t}$, for $t \geq 39$). We then estimated the COVID effect on average service use with:

$$COVIDEffect_t = UseK_t - \widehat{UseK_t}, \text{ for } t \geq 39$$

Quantifying the effects of COVID-19

After deciding on the model specification for each country and service, we then used those models to predict levels of service utilization and obtained standard errors for the entire time series, including the COVID-19 period. We estimated 95% confidence intervals, test statistics, and p-values to test the null hypothesis that the difference between observed and predicted values was not significantly different than zero for a given month in the COVID-19 period. If the difference between observed and predicted was significantly different from zero, then there was a COVID effect in that month.

An example of one of these models is in Fig. 1, which shows observed and predicted levels of total outpatient visits in the city of Kampala. The black line is the observed number of total outpatient visits. The red line is the respective values predicted by our time trends model. The vertical dashed line at February 2020 divides the time series into the pre- and post-COVID periods. Our goal was first to identify the model specifications that best replicate the trajectories observed in the area to the left of the vertical line. The model mostly replicates well the observed trajectories. The blue area represents the 95% confidence interval during COVID-19 months, had COVID-19 not occurred. Time points where the black line extends beyond the shaded blue area are months where the observed levels do not fall within the predicted range. In Fig. 1, COVID-19 significantly impacted total outpatient visits in Kampala for the entire pandemic period except March and September 2020. The difference between the predicted and observed during the pandemic months is the COVID effect.

We present COVID effect estimates in terms of percentage units relative to the predicted values to assess the magnitude of the COVID effect relative to situation of service use had COVID not occurred. We used the following equation:

$$COVID-19 \text{ effect perc} = \left(\frac{Use_{t,observed} - \widehat{Use}_t}{\widehat{Use}_t} \right) \times 100 \quad (4)$$

Results

Effects of COVID-19 on reporting

Our initial descriptive analysis centered around first research question: did COVID affect the reporting of services to the health information system? Fig. 2 shows the number of units reporting in each dataset, across all services. In all services in Uganda and all services in Bangladesh except for the immunization-related services, there was very little change in reporting across the time series and no change in reporting during the COVID-19 period. Therefore, there is no evidence of COVID-19 effects on reporting, except for vaccination reporting in Bangladesh.

Effects of COVID-19 on outpatient attendance

There were severe negative COVID effects on total and average overall attendance in Uganda and Bangladesh (see Fig. 3). The COVID effects on outpatient attendance both in terms of the average and totals were more severe in Kampala compared to Uganda nationally. In both countries and in Kampala, outpatient attendance largely did not recover by the end of each time series, despite some improvements after the initial months of the pandemic.

Effects of COVID-19 on maternal and newborn health services

The effects of COVID on maternal and infant health services varied across countries (see Fig. 4). In Uganda, the total and average ANC1 visits models show oscillating COVID effects. Some months were significantly lower than predicted and some months were significantly higher. This volatility in terms of maximum and minimum differences between observed and predicted values extends beyond the range of variability observed during the pre-COVID months, suggesting that the instability is due to COVID-19. For ANC4, there are negative COVID effects seen in the first three months of the pandemic in total and average visits, and it does appear that ANC4 visit levels recovered from June 2020 onward. Such patterns are even more pronounced when looking at the graphs for ANC specific to Kampala. For facility deliveries, at the national level, there are small initial, but significant negative COVID effects in both models in March-May 2020, which then recovers and exceeds predicted levels by November 2020 onward, approximately eight to nine months after the pandemic began. Kampala shows a different pattern: there are negative COVID effects in Kampala all throughout the COVID months with just a small sign of recovery at the end of the time period.

In Bangladesh, there were severe negative COVID effects for both total and average levels of ANC1 and ANC4 visits, and facility deliveries. With the exception of one month of first ANC visits, there was no consistent recovery in the levels of maternal and infant health services by August 2020 in Bangladesh.

Effects of COVID-19 on child health services

There were consistent negative impacts of COVID on illness-specific visits among children under five in Uganda (see Fig. 5). Nationally, there were negative COVID effects on diarrhea visits in April-June 2020, and higher-than-predicted levels from August 2020 onward for both average and total models. There were also strong negative effects on malaria and pneumonia-related visits among young children in Uganda in terms of the total and average models. However, for malaria, there is large and significant variability in the pre-COVID period which indicates that the models didn't replicate the observed service trajectories well. However, the entire curve of COVID effects is in negative values after March 2020, except for one month, suggesting persistent COVID effects. Levels of pneumonia-related visits in Uganda exceeded expected levels only in January and February 2021. In Kampala, there were also initial negative COVID effects that were more severe compared to what occurred nationally for all three illnesses. Later patterns in the pandemic period in Kampala resembled national patterns except for diarrhea-related visits. In Kampala, diarrhea-related visits among young children met predicted values from July 2020 onward.

Effects of COVID-19 on childhood immunization

In terms of child vaccinations (see Fig. 6), in Uganda, all three vaccines saw temporary negative COVID effects at the beginning of the pandemic in March and April 2020. BCG and DPT vaccination levels showed some signs of recovery but alternated between higher and lower than expected levels throughout the entire rest of the time series. The measles vaccination pattern in Uganda had a similar shape in the pandemic period but alternated between achieving and exceeding expected levels from June 2020 onward. Recovery was achieved for all three vaccination types; however, it was only consistently sustained for measles vaccinations. In Kampala specifically, similar negative COVID effects were detected compared with national patterns. However, in Kampala, the patterns differ from the national. For BCG and DPT vaccinations in Kampala, the graphs indicate significant negative and persistent COVID effects toward the end of the time series.

In Bangladesh, pandemic period patterns were similar across vaccinations. There were large negative COVID effects at the beginning of the pandemic, through May 2020. For all three vaccines, levels all recovered and exceeded predictions by June 2020. At the end of 2020, levels started to decline again, and were significantly lower than expected for all three vaccines by December 2020, but then quickly recovered by February 2021.

Effects of COVID on family planning

Figure 7 shows the results on overall FP visits. There was a sharp negative COVID effect in Bangladesh, while nationally in Uganda, there was no noticeable initial COVID effect. There was more volatility during the pandemic period compared to the pre-COVID period, particularly in Kampala, which experienced negative COVID effects on FP services in September 2020, immediately followed by much higher than predicted levels in October.

Discussion

In this analysis, we investigated two research questions on the effects of COVID on health systems in Uganda and Bangladesh. We aimed to understand how COVID affected reporting in routine information systems and how COVID affected health service utilization.

For the first research question, we found that COVID affected reporting for some services at the health facility level. COVID negatively affected reporting of immunization services in Bangladesh, for which data was reported at the upazila health complex level by the EPI reporting system. This general finding, that COVID had impacts on facility reporting of services, is reflected in other research. Shapira and colleagues also found drops in facility-level reporting for four of eight countries included in the analysis during COVID-19.⁷ When data was aggregated at higher levels, such as the upazila level for Bangladesh MIS3 services or district services in Uganda, no COVID effects were detected. However, this does not mean that there were no COVID effects on reporting at lower levels. COVID effects could have occurred at the facility level but been masked by the higher-level aggregation if any one facility reported providing any given service.

For the second research question, we found that health service utilization was affected by COVID in both countries. For many of the services, the most severe impacts were experienced within the first three months of the pandemic, corresponding with the same time during which most governments implemented shutdown policies to prevent spread. Overall outpatient attendance as well as malaria and pneumonia visits among young children were the services most persistently negatively affected by COVID nationally during the pandemic period and lacked stable recovery to expected levels. These results reflect existing studies that found negative impacts on overall utilization,^{4–8} as well as disease-specific service utilization.^{4,6}

COVID effects on maternal and infant health services were not consistent across countries. In Bangladesh, there were clear negative effects on ANC1, ANC4, and facility deliveries. There were some initial negative COVID effects for all three services in Uganda, but after May 2020, there were multiple months exceeding levels predicted by our models. These inconsistent findings across countries were found by other studies. Research from Rwanda found significant decreases in ANC visits, facility deliveries, and live births nationally.⁹ A study from Ethiopia found month-to-month comparisons of ANC1 and ANC4 levels before and during COVID to be similar.⁴

During the COVID-19 period, supply-based services, which include family planning and vaccinations, were more volatile than what models had predicted. This volatility is particularly prominent in the graphs depicting vaccinations in Uganda and Bangladesh. There were initial negative COVID effects for the first several months in Uganda and Bangladesh, which is consistent with several other studies.^{7,9,11} Both countries either periodically achieved recovery or exceeded expected levels for multiple months in the remaining COVID period, during months that had not been included in those other studies.

It is also important to note the drastic negative COVID effects in Bangladesh on immunization services that occurred at the end of 2020. During this time, there was a health worker strike, particularly among the health workers whose responsibility it is to administer and implement national immunization programs. This drop in measles vaccinations is particularly prominent because this strike immediately preceded a national measles vaccination campaign.¹² Due to a nationwide campaign, measles vaccinations that occurred in January 2021 were reported to a separate reporting system that was not integrated with the routine EPI information system.

When comparing national COVID effect patterns in Uganda to those in Kampala the COVID effects on Kampala were more severe. This pattern was consistent across almost every service investigated in this study. Relative to what occurred nationally, the increased severity in terms of COVID effects presented as both larger gaps between observed and predicted values toward the beginning of the pandemic as well as delayed recovery later into the pandemic period in Kampala. This finding is not surprising as urban areas had COVID outbreaks first and were often targeted for more stringent lockdown measures. Thus, the effects of the disruptions and lockdowns are likely to be more exacerbated in capital cities such as Kampala.

This study has several strengths and further contributes to the expanding body of literature on the impact of COVID-19 on health service utilization from low and middle-income countries. The inclusion of data from two different countries allows for conclusions to be drawn across borders, while also illustrating the variety of ways COVID could impact both reporting and service utilization. This research expands upon existing work that investigates similar questions. For almost all services in these countries, we predicted COVID effects for at least one year after the start of the pandemic. Additionally, we use rigorous, but simple modeling and prediction estimation strategies, that consider time trends, seasonal patterns, and unit-level fixed effects. These models are easily replicable as they do not depend on information found outside the RHIS and can be implemented by widely available statistical software. Instead of very sophisticated, novel statistical modeling, we applied a general estimation strategy with the aim for wider use of such analytical approaches on routinely available data. We, however, found that the service delivery trajectories varied considerably by country and services, which requires analysts to be careful adapting the estimation model specification to the peculiarities of each specific service.

There are several limitations to our analysis pertaining to the models that we use to estimated COVID effects. As time increases, the time trend estimated from pre-COVID data becomes less relevant, and thus, the potential for error in the counterfactual prediction increases. Such inaccuracies could stem from not just coefficient inaccuracy, but also changes in model functional form. An analyst should be careful about the uncertainty of medium- and long-term predictions.

Bangladesh's routine information system for maternal and child health services delivery expanded during the pre-COVID period (in January 2019). Such changes were accounted for using the yearly control variables. In Uganda, the DHIS2 also changed in 2019, which had a new reporting mechanism and service definitions. However, we found consistency in the time series across years. Finally, we want to mention

that adjusting for COVID effects on reporting in total models influenced the conclusions drawn from this analysis. Had we not considered the potential impact of COVID on facility reporting for EPI services in Bangladesh, we may have over-estimated COVID effects for some services and under-estimated others.

Conclusion

Our analysis indicates the COVID-19 pandemic affected both health system reporting and health service utilization for non-COVID services. Which services were effected, the magnitude of these effects, and the recovery patterns or lack thereof varied across and within countries. Overall attendance, and visits among children under 5 for malaria and pneumonia were most persistently affected during the first year of the pandemic. Services in Bangladesh were universally and severely affected by COVID-19, with additional severe impacts later in the year on vaccination services due to health workforce strikes. Delayed negative impacts and persistent instability were also seen in Uganda. The analytical approach used in this paper could be very useful as a form of surveillance for health services disruptions from any cause (such as strikes or disasters/floods or outbreaks) leading to rapid responses from health service managers and policy makers. Government agencies may consider including the type of analysis presented in this paper as a routine practice for assessing their provision of essential health services.

Declarations

Acknowledgments

This publication was produced with the support of the United States Agency for International Development (USAID) under the terms of the Data for Impact (D4I) associate award 7200AA18LA00008, which is implemented by the Carolina Population Center at the University of North Carolina at Chapel Hill, in partnership with Palladium International, LLC; ICF Macro, Inc.; John Snow, Inc.; and Tulane University. The views expressed in this publication do not necessarily reflect the views of USAID or the United States government.

For access to the Bangladesh data, we are grateful to the Directorate General of Health Services (DGHS) and, in particular, Dr. Md. Shamsul Haque, Line Director of Maternal, Newborn, Child and Adolescent Health (MNCAH), and Dr. Md. Tanvir Hossen, Deputy Program Manager, EPI & Surveillance. We are also thankful to the Directorate General of Family Planning (DGFP), in particular, Abu Taher Md. Sanaullah Nury, Deputy Director (MIS); Mir Sajedur Rahman, Assistant Director, Habiganj; and Krishna Pratim Datta, Senior Statistician (MIS).

Author contributions

GA and WW conceptualized the analyses, which were done by them and HS. MGK and NAR prepared the Bangladesh data and analysis of contextual factors with assistance from KZA. KS, JM and ES prepared the data from Uganda. HS, GA and KZA produced the first draft of the paper, which was reviewed by GE, MGK, NAR, KS, JM, ES, and WW. All authors contributed to subsequent drafts and approved the final

version for publication. The corresponding author had final responsibility for the decision to submit for publication.

Data availability statement

Routine health information data used for this analysis are open for public access using the data portals of the respective government agencies. For Bangladesh, the data is available from the Directorate General of Family Planning's Management information system's website (<https://dgfpmis.org/>). For Uganda, data are available from the Ministry of Health's DHIS2 system (<http://hmis2.health.go.ug/>). The datasets developed and analyzed during the current study will be available in the USAID repository, Dataverse [persistent web link to datasets will be provided once datasets are available].

Declaration of interests

All authors declare no competing interests.

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Figures

Figure 1

Observed and predicted total outpatient attendances visits before and after COVID-19 in Kampala Metropolitan Area

Figure 2

Number of units reporting across services in Uganda and Bangladesh

Figure 3

Estimated COVID-19 effects on overall outpatient attendance in Uganda and Bangladesh

Note 1: Solid circles indicate months when the difference is statistically significant ($p < 0.05$).

Note 2: Overall attendance is measured differed across countries. In Bangladesh, overall attendance was defined as the sum of all male and female outpatient visits. In Uganda, overall attendance was the number of new outpatient visits.

Uganda: National

Uganda: Kampala

Bangladesh: National

Figure 4

Estimated COVID-19 effects on maternal and newborn health services in Uganda and Bangladesh

Note: Solid circles indicate months when the difference is statistically significant ($p < 0.05$).

Uganda: National

Uganda: Kampala

Figure 5

Estimated COVID-19 effects on the management of common childhood illnesses in Uganda

Note: Solid circles indicate months when the difference is statistically significant ($p < 0.05$).

Figure 6

Estimated COVID-19 effects on childhood immunization in Uganda and Bangladesh

Note 1: Solid circles indicate months when the difference is statistically significant ($p < 0.05$).

Note 2: Measles vaccinations in Uganda reflect any single dose administered, while in Bangladesh reflect the first of two doses of measles-rubella vaccinations.

Note 3: Pentavalent/DPT vaccinations in Bangladesh reflect first pentavalent doses. In Uganda, values reflect first DPT doses.

Figure 7

Estimated COVID-19 effects on FP in Uganda and Bangladesh

Note 1: Solid circles indicate months when the difference is statistically significant ($p < 0.05$).

Note 2: FP visits in Uganda did not reflect all family planning methods but were calculated as the sum of visits for implants, oral contraceptives, condoms, and injectables.

Supplementary Files

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- [Supplements.pdf](#)