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Cost-effectiveness analysis comparing integrated and malaria-only social and behavior change programming in Nigeria: Midline analysis

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TECHNICAL REPORT

Cost-effectiveness Analysis Comparing Integrated and Malaria-only Social and Behavior Change Programming in Nigeria: Midline analysis

FEBRUARY 2023



USAID
FROM THE AMERICAN PEOPLE



U.S. President's Malaria Initiative



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Breakthrough RESEARCH catalyzes social and behavior change (SBC) by conducting state-of-the-art research and evaluation and promoting evidence-based solutions to improve health and development programs around the world. Breakthrough RESEARCH is a consortium led by the Population Council in partnership with Avenir Health, ideas42, Institute for Reproductive Health at Georgetown University, Population Reference Bureau, and Tulane University.



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Avenir Health

List of Acronyms

BE Fever CM	Behavioral economics fever case management
BSS	Behavior sentinel surveillance
CCSI	Centre for Communication and Social Impact
CEA	Cost-effectiveness Analysis
COVID-19	Novel Coronavirus 2019
DALYs	Disability adjusted life years
DHS	Demographic and Health Survey
GDP	Gross domestic product
ICER	Incremental cost effectiveness ratio
IPC	Interpersonal communication
IPTp	Intermittent preventive treatment of malaria for pregnant women
ITN	Insecticide-treated bed nets
LiST	Lives Saved Tool
MCH	Maternal and child health
PMI	United States President's Malaria Initiative
SBC	Social and behavior change
USAID	United States Agency for International Development
USD	United States dollar
WRA	Women of reproductive age

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Executive Summary

The United States Agency for International Development (USAID)/Nigeria is working closely with the Nigerian government to improve the practice of priority health behaviors through the Breakthrough ACTION project. Breakthrough RESEARCH is leading an evaluation of Breakthrough ACTION's program comparing the integrated social and behavior change (SBC) program (malaria, family planning, maternal and child health, and nutrition) in Kebbi and Sokoto states and vertical SBC program (malaria-only) in Zamfara state. While the first initial cost report covered the time frame from program initiation in April 2018 through December 2019, this midline report covers January 2020 through December 2021. This report examines four important areas: 1) program expenditures and cumulative expenditures during this time period; 2) COVID-19 related expenditures; 3) unit costs for SBC interventions; and 4) program impact in integrated Kebbi state from the baseline to midline behavioral sentinel surveillance (BSS) survey.

The midline report focuses on the program expenditures incurred by Breakthrough ACTION/Nigeria from 2020 and 2021. Breakthrough ACTION supplied data on all program implementation and support accounting entries for the period, which were identified by location, health area, and activity. Personnel expenditures for the Breakthrough ACTION prime (Johns Hopkins Centers for Communication Programs) was separately obtained by Breakthrough ACTION via an Excel template and other partner data were also collected via an Excel template. Unit costs (based on expenditures) were calculated for three SBC activity areas: community SBC, radio, and mobile digital interventions using expenditures from April 2018 through December 2021 and as annual unit costs. To assess impact at midline in Kebbi, results from the baseline and midline BSS survey and the Lives Saved Tool (LiST) were used to model the number of estimated disability adjusted life years (DALYs) from 2019 to 2021, adjusting the underlying population figures to represent the areas where Breakthrough ACTION community programming occurs.

The total program and personnel expenditures during the midline period totaled over US\$6 million across the three study states, averaging approximately \$270,000 per month during this period compared to \$485,000 during the initial period. Across all study states, the total expenditures on COVID-19 programming, including personnel were approximately \$445,351 incurred during the midline period only, which accounts for roughly 7% of the total amount of \$6 million expended. In looking at

unit costs¹ for community SBC from program initiation through 2021, the results are \$7.46, \$6.12, and \$7.49 for Kebbi, Sokoto, and Zamfara, respectively per targeted woman in the areas where Breakthrough ACTION conducts community SBC programming. When looking at annual community SBC unit costs, the unit costs drop considerably to \$1.36, \$1.06, and \$1.97 per targeted woman in the three states. For radio unit costs from initiation through 2021, the costs per person exposed are \$3.06 in Kebbi, \$2.09 in Sokoto, and \$1.18 in Zamfara. The annual costs are substantially lower at \$0.73 in Kebbi, \$0.53 in Sokoto, and \$0.31 in Zamfara. Mobile digital unit costs were only calculated for Kebbi state due to the reliance on the BSS midline data, which result in a unit cost of \$0.88 per person who heard of the Airtel 3-2-1 and Kacici Kacici mobile digital interventions and \$1.81 per person who used or played with the interventions at midline. Annual unit costs are much lower at \$0.11 per person who heard of and \$0.23 per person engaging with the interventions.

Between the baseline and Kebbi midline BSS surveys there were both positive and negative changes to key health indicators used in the LiST applications. Improvements were seen in several of the key indicators, including modern contraceptive use, facility-based births, intermittent preventive treatment of malaria for pregnant women (IPTp), and exclusive breastfeeding. However, the only outcome that was statistically significantly different between baseline and the Kebbi midline based

¹Note that the term "unit costs" is used, although the analysis is based on expenditure data and does not include costs to the government or individuals or opportunity costs.

on Chi-square tests of $p < 0.05$ was ownership of at least one long-lasting insecticide-treated net (ITN) per household for the prevention of malaria, which declined from 68% to 53% from baseline to midline. When applying this decline in a Kebbi LiST application, it results in approximately 10,000 DALYs. Because the net impact was estimated to be negative (i.e., negative DALYs were averted), the cost per DALY averted was not calculated.

The COVID-19 pandemic had a noticeable impact on Breakthrough ACTION expenditures, with an approximate 50% decline in monthly expenditures between the initial period (April 2018–December 2019) and midline period (January 2020–December 2021). The unit costs from program initiation through the midline period reported for Nigeria for community SBC and mobile digital intervention are comparable to the median SBC unit costs reported in the literature, while annual unit costs are substantially lower for these interventions. Breakthrough ACTION's radio programming shows higher cumulative unit costs than reported in the literature, which is likely due to the more intensive nature of the Albishirin Ku! radio program as a serial drama versus a simpler radio message and the low levels of radio listenership among women, particularly in Kebbi state. Looking ahead, Breakthrough RESEARCH is conducting the next BSS survey in all three states and thus the comparison between the integrated and malaria-only states will enable the inclusion of more health outcome changes for the final cost-effectiveness analysis report.

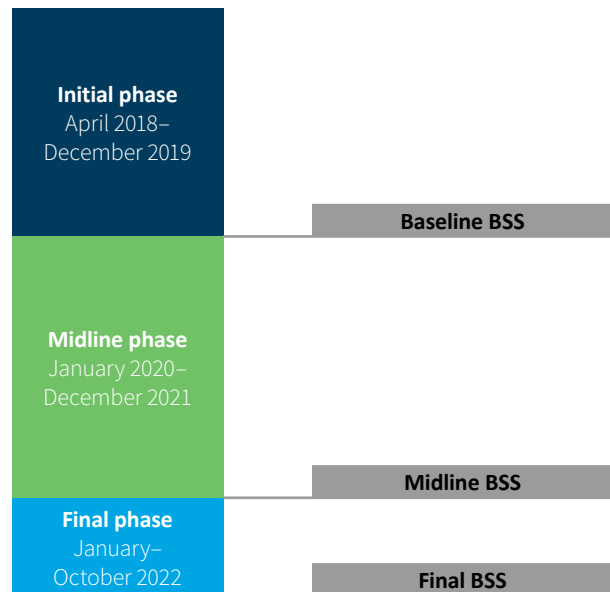
Background

The United States Agency for International Development (USAID)/Nigeria is working closely with the Nigerian government to improve the practice of priority health behaviors, with a focus on maternal, newborn and child health and nutrition, family planning and reproductive health, malaria, and tuberculosis through the Breakthrough ACTION project. Breakthrough ACTION commenced in Nigeria in April 2018 and is primed by Johns Hopkins Center for Communication Programs (CCP) along with partners Save the Children International, ThinkPlace, ideas42, and Viamo.² Different approaches to social and behavior change (SBC) programming are being utilized in different states. Starting in three states, Bauchi, Kebbi, and Sokoto, an integrated SBC approach is focused on multiple health behaviors for women aged 15–35 years, who are either currently pregnant, or are within the 1,000-day window following childbirth. Integrated programming extended to Ebonyi state and the Federal Capital Territory starting in late 2020. Some of the SBC interventions that have been conducted by Breakthrough ACTION in Nigeria include advocacy efforts involving opinion leaders and community influencers, community health dialogues with individual and group interpersonal communication (IPC), radio programming, mobile digital interventions, and provider behavior change focused on addressing barriers to malaria diagnosis and treatment.

Breakthrough RESEARCH is leading an evaluation of Breakthrough ACTION’s integrated (malaria, family planning, maternal and child health [MCH], and nutrition) and vertical (malaria-only) SBC programming in northwestern Nigeria. The cost-effectiveness activity includes three consecutive costing reports. First, the initial phase costing report examined expenditures from the program inception in April 2018 through December 2019, differentiating between the start-up and implementation expenditures during the initial phase of the program (Avenir Health 2021a). A second midline report was planned to align the midline behavioral sentinel surveillance (BSS) survey and expenditure data collection to assess expenditures and at midline. The third and final report will focus on comparing the cost-effectiveness of the integrated vs. malaria-only

interventions when the final Breakthrough RESEARCH BSS is conducted to determine which approach generates better value for money. Figure 1 details these three timeframes.

FIGURE 1 COSTING TIME FRAMES CORRESPONDING TO BSS DATA COLLECTION



Over the period covered by this midline report, important events occurred that had a significant impact on both Breakthrough ACTION’s SBC programming and the feasibility of analyzing cost-effectiveness at midline. In March 2020, the Coronavirus disease 2019 (COVID-19) was declared a global pandemic. The COVID-19 mitigation and control measures made it difficult to implement the Breakthrough ACTION/Nigeria SBC interventions as originally conceived. Mass media and digital media interventions were able to continue but community SBC activities were disrupted for several months. Alternative implementation approaches had to be devised to try and keep the program on track. Additionally, Breakthrough ACTION was provided further funding to implement SBC to address behaviors related to the pandemic, such as social distancing, use of personal protective equipment, and vaccination.

Another program disruption in the northwest of Nigeria occurred due to local unrest and security concerns,

²Additionally, the Centre for Communication and Social Impact is a Nigerian non-governmental organization that is a subaward under CCP and oversees community activities in malaria-only intervention states.

which have sharply escalated since late 2020. By the second half of 2021, with the military having been deployed in the region, the crisis had reached such a point in the malaria-only state of Zamfara and parts of the integrated SBC state of Sokoto that program implementation ceased. Importantly, data collection for the midline BSS of the program could not take place in Sokoto and Zamfara states and thus was conducted in the integrated SBC state of Kebbi only (integrated SBC). Because the BSS midline round was only conducted in one state, it is not possible to calculate the relative cost-effectiveness of the integrated vs. malaria-only SBC programs in this costing report; however, data collection is planned for all three study states starting in October 2022. This midline report continues to build the costing evidence base for integrated SBC and seeks to address four primary questions:

1. *What program expenditures have been incurred during the study period between the baseline survey (reported on in the initial costing report) and midline survey?* These results will feed into the final cost-effectiveness analysis (CEA) to be conducted in 2023 following the next round of BSS data collection in all three study states.
2. *What are the COVID-19-related programming expenditures from Breakthrough ACTION?* While these COVID-19 programming expenditures will not be included in the total program expenditures associated with the originally intended behavioral outcomes, they are interesting to consider during this unique time.
3. *What are the unit costs for SBC interventions during the midline period?* Unit costs for specific SBC interventions—excluding COVID expenditures—are explored where appropriate denominators were available (e.g., cost per person reached by mass media).
4. *What is the impact from baseline to midline in Kebbi State?* Using both baseline and midline data for Kebbi state, a pre-post analysis of the key health behaviors and the corresponding impact on mortality and morbidity can be conducted using the Lives Saved Tool.³

³The Lives Saved Tool (www.livessavedtool.org) is a mathematical modeling tool which allows users to estimate the impact of coverage change on mortality in low- and middle-income countries.

Methodology

Costing approach

As with the initial costing report, the framework for the costing approach for the midline costing report is based on Breakthrough RESEARCH's Guidelines for Costing of Social and Behavior Change Health Interventions, which include 17 principles of design, data collection, analysis, and presentation for SBC costing studies (Box 1). For this midline report, the costing perspective is that of the provider, in this instance the implementing agency, which is Breakthrough ACTION/Nigeria. The report captures and analyzes the expenditures incurred by Breakthrough ACTION/Nigeria and its implementing sub-partners to deliver both the integrated SBC programs being implemented in Kebbi and Sokoto, and a vertical, malaria-only SBC program being implemented in Zamfara state. It does not include costs for providing additional health services due to behavior change or costs to clients in terms of time spent engaging with SBC interventions or accessing additional health services. While the primary aim of the costing component is to provide a basis upon which the relative cost-effectiveness of the two program approaches can be estimated in terms of improving targeted health behaviors, this aspect of the evaluation, as explained above, will not be addressed in this report. The report does, however, provide useful insights into the allocation of program expenditures during 2020 and 2021 and the estimated unit costs for specific SBC activities.

The audience for this report is donors, program managers, other agencies, and governments who fund, design, and implement such programs. The primary concern of this audience is to understand the financial cost of the program (i.e., what resources are expended), and how effectively that expenditure translates into the achievement of program objectives.

Expenditure data collection

Expenditures serve as the data source for this analysis, including program expenditures (e.g., those funds spent on either implementing or supporting the implementation of activities) and personnel expenditures. Expenditure data for the midline period were collected from the Breakthrough ACTION partners (Johns Hopkins Center for Communication Programs,

Save the Children International, ThinkPlace, ideas42, and Viamo) beginning in January 2022 through April 2022. CCP supplied data on all non-personnel accounting entries from the midline period of January 2020 through December 2021 that were identified by location, health area, and activity. To help facilitate personnel reporting, CCP was provided with an Excel template, which asked for total personnel expenditures over the same period to be allocated across locations and activities. Sub-partners of CCP were provided with an Excel template, which they populated with their expenditure data from January 2020 through December 2021, broken down into direct and indirect costs, cost category, and program/state (i.e., vertical malaria program in Zamfara, or integrated SBC program in Kebbi and Sokoto).

Expenditure categorization and analysis

Table 1 (page 6) is a breakdown of the various expenditure categories used to conduct and present the analysis in this report.

Once data were collected, they were reviewed and validated where necessary. Data gaps were noted and follow-ups made to the relevant organizations. Program activity expenditures and personnel expenditures were aggregated into tables displaying results across each state and for two time periods: the period of the initial costing report (April 2018–December 2019) and the period of the midline report (January 2020–December 2021). These expenditures were adjusted for inflation using the gross domestic product (GDP) deflator for 2021 so that all expenditures are in a common US dollars (USD) value. Expenditures were also categorized by state, funding stream, and activity.

Breakthrough ACTION personnel expenditures for implementation and support were provided by Breakthrough ACTION broken down by state and activity. Abuja and Baltimore (USA) serve as administrative hubs for the project across all 14 Breakthrough ACTION states, not just the 3 study states. As such, personnel expenditures for Abuja and Baltimore were provided as a proportion of total personnel costs. These were then broken down into the amount of the total that should be apportioned to each study state, using the percentage each study state accounted for of total expenditures

TABLE 1 BREAKDOWN OF EXPENDITURES BY CATEGORY AND INPUT TYPE/SOURCE

CATEGORY	INPUT TYPE/SOURCE
By activity	Advocacy
	Behavioral economics fever case management (BE Fever CM)
	Capacity strengthening
	Community SBC
	SBC support to insecticide-treated net (ITN) distribution campaigns
	Mass media
	Mobile digital
By location	Kebbi state
	Sokoto state
	Zamfara state
By program element	Implementation/activities
	Operations/support
By cost type	Design
	Implementation
	Operations
	Strategy and coordination
By funding stream	Family planning
	MCH
	Nutrition
	United States President’s Malaria Initiative (PMI)
	Global Health Security Agenda

across all intervention states (Kebbi 5.5%, Sokoto 5.3%, and Zamfara 2.8%). These apportioned totals were then further broken down by activity using the proportion of expenditure on each activity in each study state to come up with Abuja and headquarters personnel expenditure by activity and state. Total sub-partner expenditures per state were apportioned across activities in the same way to derive sub-partner personnel expenditure by activity.

COVID-19 expenditures were calculated using the same methodology but examined separately and not included in the analysis and presentation of total program expenditures as relevant to the CEA since these expenditures were not aimed at the key behavioral

outcomes relevant to the impact analysis and were funded under a different program. We assessed unit expenditure for three activity areas: 1) community SBC, which comprises ongoing community health dialogues, compound meetings, household visits, referrals, and other direct health messaging and engagement within communities to directly influence individual and household health behaviors that covers 11 local government areas each in Sokoto and Kebbi states and 10 local government areas in Zamfara state; 2) mass media (primarily radio) that involves complementary integrated SBC messaging mostly through the Albishirin Ku! (Glad Tidings!) radio program—that covers an entire state; and 3) mobile digital, consisting of Airtel 3-2-1, Kacici Kacici (mobile games), and mobile reminder messages for community referrals. The Albishirin Ku! radio program is a weekly radio drama that is part of a broader package of SBC interventions focused on increasing engagement to mobilize communities in addressing multiple health areas, including family planning, nutrition, malaria, maternal, newborn, and child health (USAID 2022). The Airtel 3-2-1 activity is a digital application that began in 2016 which allows mobile phone users to access health information based on voice prompts in multiple languages (Nigerian Tribune 2016). The Breakthrough ACTION/Nigeria partnership with Airtel, launched in 2019, markedly increased utilization of the service in the focal states as well as nationwide. Connected to the Airtel 3-2-1 intervention, callers can access the Kacici Kacici mobile game where users win points for correctly answering questions on health and social concepts (Desmon 2020).

To generate unit costs—the cost per person receiving the SBC intervention—we need to calculate the costs for the numerator for a specific SBC activity based on expenditures and have a denominator for the number of persons exposed to or participating in the SBC activity. For the numerator of the unit costs, the initial period of the project (April 2018–December 2019) for Kebbi, Sokoto, and Zamfara were added to the non-COVID-19 expenditures from the midline period (January 2020–December 2021) to give us the total expenditure per program area for each state, which was then adjusted to 2021 USD. Next, denominators were needed on the number of persons exposed to or participating in SBC interventions. Denominators were available for three different activities: mass media, mobile digital, and community SBC.

Population denominators were estimated based on four main data sources. First, the country-validated Spectrum age- and sex-disaggregated population estimates for 2022 were used to determine the number of women of reproductive age (WRA) in each state.⁴ Second, Nigeria’s 2018 Demographic and Health Survey (DHS) data were used to determine the proportion of WRA pregnant and/or with a child under two years in each state. DHS data also provided the proportion of women and men in each state that listened to the radio at least once a week and the proportion that owned mobile phones. Third, ward- and state-level 2020 projections of population data for Kebbi, Sokoto, and Zamfara states were used to determine the proportion of the population living in the Breakthrough ACTION intervention wards, which were applied to 2022 population estimates. Finally, the BSS midline was used to determine the proportion of women and men who heard of any Breakthrough ACTION radio program and the proportion that heard of or engaged with the Airtel 3-2-1 or the Kacici Kacici activities (Hutchinson et al. 2022). Unit costs were calculated using relevant expenditures for the entire period from April 2018 through December 2021. Additionally, the unit costs were also examined as annual unit costs, meaning the expenditures needed to provide the SBC intervention for one year.

Assessing impact

The incremental cost-effectiveness ratio (ICER) is calculated as the total costs over total impact, measured by disability adjusted life years (DALYs) averted. Originally, the intention at midline was to compare the costs and impacts in the integrated program states of Kebbi and Sokoto to the malaria-only program state of Zamfara. However, due to the security concerns in Sokoto and Zamfara described earlier in this report, the midline BSS was only conducted in Kebbi. As such, we can examine the impact in Kebbi thus far at midline and compare this impact achieved to overall expenditures attributed to the programming in Kebbi, however, we cannot calculate a relative cost-effectiveness ratio.

To estimate the potential DALYs averted at midline in Kebbi, results from the baseline and midline BSS surveys and the Lives Saved Tool (LiST) were used to model the number of estimated averted deaths from 2019 to 2021. A Kebbi-specific Spectrum file was created capturing

Kebbi-specific parameters under the USAID-supported Integrated Health Program (IHP) project in Nigeria and validated with key country stakeholders. Because Breakthrough ACTION’s community level interventions work in areas with approximately 42% of Kebbi state population, the underlying demographic data were adjusted to reflect the project reach. This does not include the mass media and digital interventions which reach a much larger audience, effectively statewide. Next, two LiST scenarios were constructed:

1. *Baseline scenario*—where coverage for key health behaviors was held constant over the study period based on the baseline results.
2. *Midline scenario*—where coverage changed for years 2020 and 2021 based on observed statistically significant changes between the baseline and midline BSS. The midline BSS coverage was used for 2021 and an intermediate value for 2020 was generated using linear interpolation between 2019 and 2021 values. Since the midline BSS was only conducted in Kebbi state, the changes from baseline to midline are at the bivariate level only, and do not include multivariate modeling.

The difference in deaths between the two scenarios were then translated into DALYs by using Institute for Health Metrics and Evaluation’s Global Burden of Disease Results tool for the causes of death relevant to the Breakthrough ACTION SBC program. Using these data, the number of DALYs per death were calculated for each cause of death and then that factor was applied to the difference in deaths between the two scenarios.

⁴Validation of state-specific population figures was conducted under the Integrated Health Program in Nigeria.

Results

Total expenditures by state

To assess the total program costs from program initiation to midline, costs were aggregated from the initial report period (April 2018–December 2019) and the midline period (January 2020–December 2021). Figure 2 below presents the total program and personnel costs by state from the initial costing period, totaling just over \$10 million in 2021 adjusted USD across the three study states. Of this total amount, an estimated 29% was spent on the design and development of new or adapted SBC interventions. Among the three states, approximately 85% was spent on the Kebbi and Sokoto states and the remaining 15% was spent in Zamfara.

FIGURE 2 TOTAL PROGRAM AND PERSONNEL COST BY STATE—INITIAL REPORTING PERIOD (APRIL 2018–DECEMBER 2019)

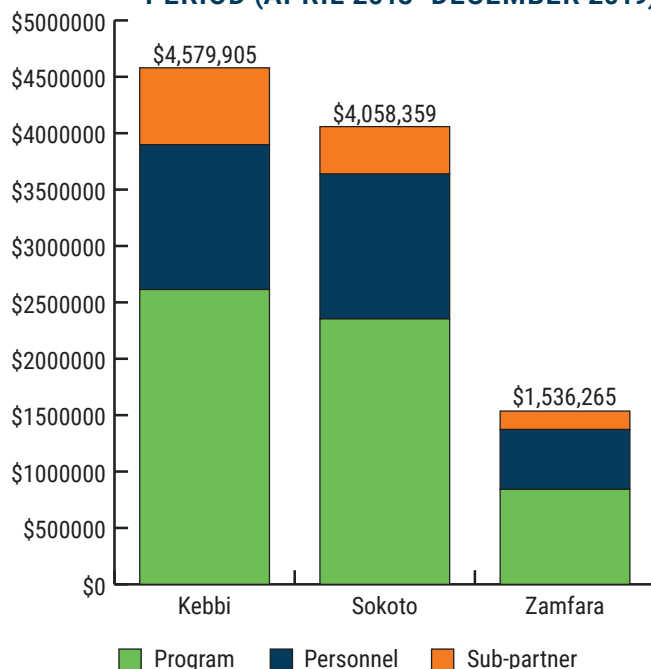
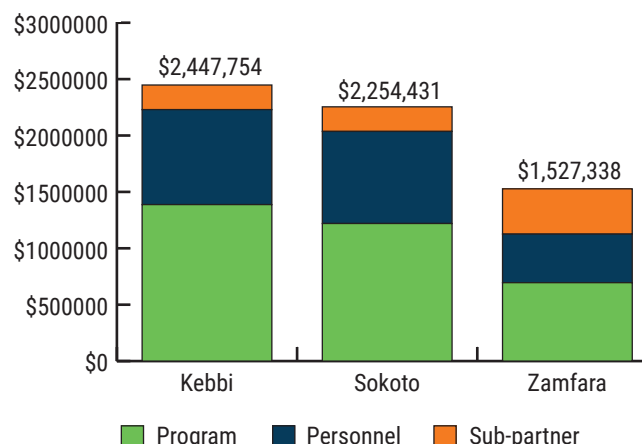


Figure 3 shows the total program and personnel costs for the midline period, totaling over \$6 million across the same three states. Noting the challenges to implementation over the midline period, the expenditures were lower than the previous period, averaging approximately \$270,000 per month during this period compared to \$485,000 during the initial pre-COVID-19 period. Another notable difference is the percentage of total costs allocated to Zamfara, which

FIGURE 3 TOTAL PROGRAM AND PERSONNEL COST BY STATE—MIDLINE REPORTING PERIOD (JANUARY 2020–DECEMBER 2021)



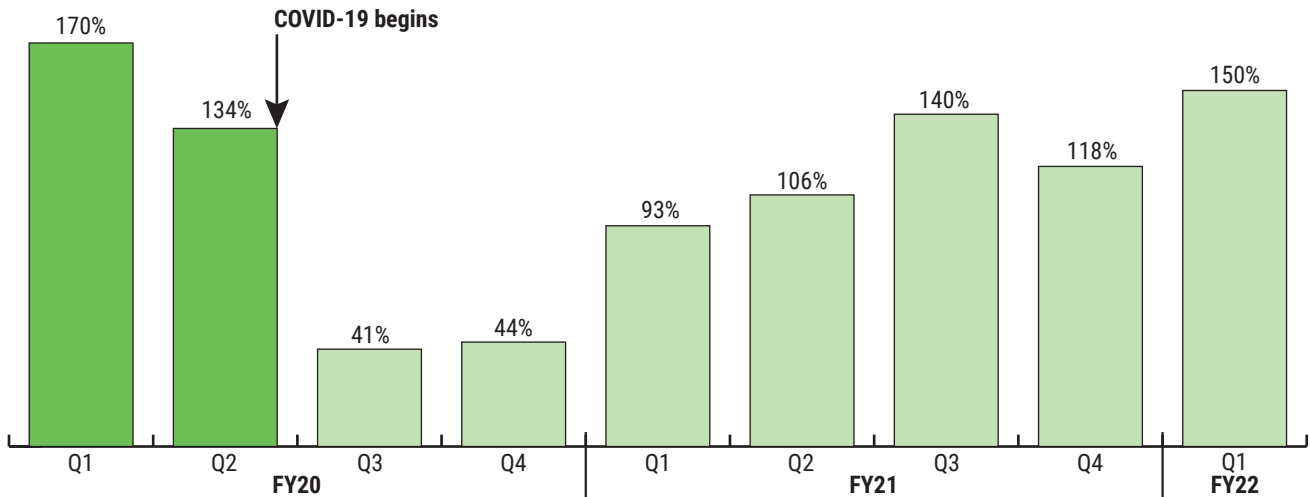
increased from 15% during the initial costing period to 25% during the midline costing period.

When examining the prime organization’s program expenditure data by quarter⁵, the drop in expenditures between the initial costing period and the midline costing period appear to directly correspond to the COVID-19 pandemic. Figure 4 shows the quarterly expenditures for fiscal year 2020 and 2021 as percentage of expenditures from the same quarter in 2019. Note the precipitous drop immediately following the start of the pandemic, with the subsequent two quarters showing expenditures of 41% and 44% of the prior year’s quarterly expenditures, respectively. The third quarter post-pandemic initiation shows recovery at 93% and by the fourth quarter, expenditures are exceeding the fiscal year 2019 expenditures.

Returning to the overall expenditures for the project, Figure 5 presents the program and personnel costs for both the initial and midline periods, adding the midline costs to the costs from the initial program period and adjusting for inflation. The total program and personnel costs from the study states (midline costs + initial costs) over the period April 2018 to December 2021 amount to over \$16 million. Kebbi state, with 43%, accounted for the

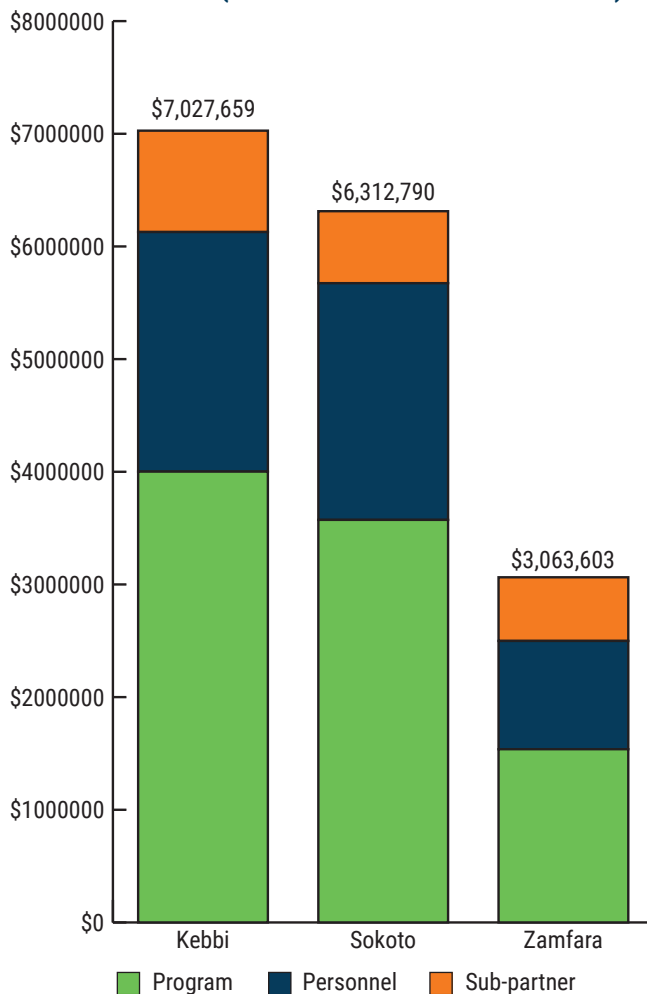
⁵Only the prime organization’s program expenditure data are available for quarterly analysis and thus the data for Figure 4 does not include personnel costs or subaward costs for all years.

FIGURE 4 QUARTERLY EXPENDITURES AS A PERCENTAGE OF FY2019 QUARTERLY EXPENDITURES



greatest proportion of all costs, followed by Sokoto with 38%, and Zamfara with nearly 19%.

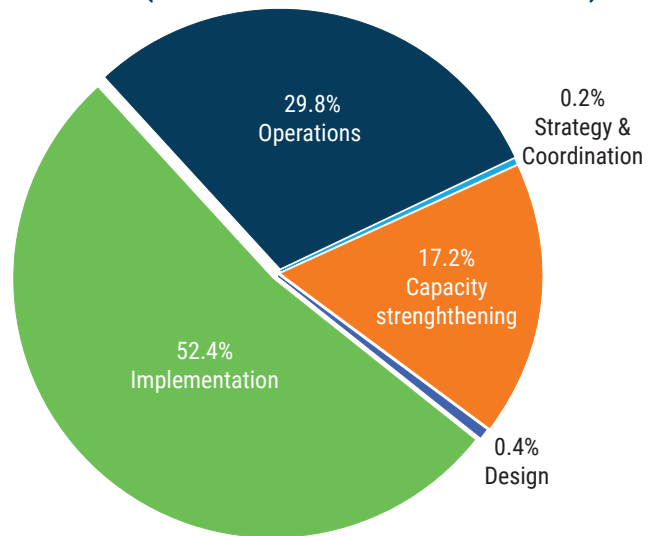
FIGURE 5 TOTAL AND PROGRAM AND PERSONNEL COSTS BY STATE—TO-DATE (APRIL 2018–DECEMBER 2021)



Expenditure breakdowns

Figure 6 presents aggregated expenditures over the midline period from January 2020 through December 2021 as a proportion of total expenditures by type for all three study states. More than half of all expenditures by type (52%) are devoted to implementation across the study states. The second greatest proportion of costs by type (30%) are accrued by operations largely in support of program implementation and management, followed by capacity strengthening (17%). Only a very small percentage of costs by type are accrued through design and strategy and coordination functions, each with <1% compared with just under 30% over the initial period (April 2018–December 2019) (Avenir Health 2021a).

FIGURE 6 MIDLINE EXPENDITURE TYPE AS PROPORTION OF TOTAL EXPENDITURES FOR STUDY STATES (JANUARY 2020–DECEMBER 2021)

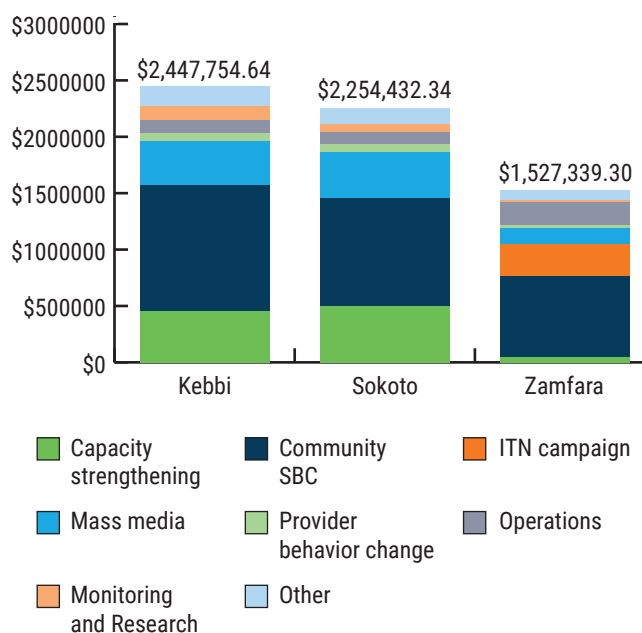


Over the midline period, there were no expenditures associated with either capacity strengthening or strategy and coordination in Zamfara state, although it is reported that some capacity-strengthening and coordination activities were conducted by the local sub-awardee in Zamfara, but the expenditures were not disaggregated to capture these expenditures.

Table 2 presents expenditures by activity across the three study states. Again, the largest proportion of activity expenditure occurred in Kebbi state (39%) with Sokoto and Zamfara states accounting for 36% and 25%, respectively. Over half of all expenditure for activities in the three study states were for community SBC, accounting for 45% of total activity costs across the three states. Capacity strengthening accounted for about 16% of total activity expenditure despite only being implemented in Kebbi and Sokoto states. Mass media made up the third largest proportion (15%) across all three study states. Of the \$935,000 spent on mass media during the midline period, expenditures were split fairly evenly between Sokoto and Kebbi states, with substantially less in Zamfara state. Expenditures for all other activities ranged between 0.1% for knowledge management and documentation to 6.9% for operations.

In Figure 7, the relative proportion of expenditure for each activity is presented for each of the study states. Kebbi and Sokoto states account for most expenditure

FIGURE 7 TOTAL MIDLINE PROGRAM AND PERSONNEL COSTS BY STATE AND ACTIVITY (JANUARY 2020–DECEMBER 2021)



Note: "Other" category contains advocacy, BE Fever CM, HCD, mobile digital, strategy & coordination, and knowledge management & documentation activities. These activities were combined when they accounted for 2% or less of total expenditure in all three states.

across nearly all activities, with Zamfara incurring little expense relative to the other two states. Perhaps not

TABLE 2 MIDLINE PROGRAM AND PERSONNEL EXPENDITURES (JANUARY 2020–DECEMBER 2021) BY ACTIVITY AND STATE, IN USD AND PERCENT OF TOTAL

	KEBBI	SOKOTO	ZAMFARA	TOTAL	%
Advocacy	\$55,680	\$42,905	\$5,554	\$104,138	1.7
Capacity strengthening	\$457,937	\$501,186	\$50,060	\$1,009,183	16.2
Community SBC	\$1,111,575	\$953,406	\$717,438	\$2,782,419	44.6
HCD	\$35,100	\$26,003	\$18,652	\$79,755	1.3
ITN campaign	\$3,545	\$3,399	\$279,767	\$286,710	4.6
Mass media	\$388,741	\$407,746	\$138,056	\$934,543	15.0
Mobile digital	\$34,613	\$31,665	\$27,376	\$93,655	1.5
Provider behavior initiative	\$92,800	\$85,823	\$56,461	\$235,084	3.8
Operations	\$116,854	\$115,177	\$200,507	\$432,538	6.9
Monitoring & research	\$132,177	\$70,722	\$18,932	\$221,832	3.5
Strategy & coordination	\$15,441	\$13,516	\$12,239	\$41,196	0.6
Knowledge management & documentation	\$3,290	\$2,883	\$2,298	\$8,471	0.1
TOTAL	\$2,447,755	\$2,254,432	\$1,527,339	\$6,229,523	100^a
% of TOTAL	39.3%	36.2%	24.5%	100%	

Note: The activity BE Fever CM was subsumed under Provider Behavior Initiative as the area of work is considered a sub-set
^aSum of percentages does not equal 100 due to rounding error.

surprisingly, with Zamfara being the only study state to conduct an ITN campaign during the midline period, it has the largest proportion of activity expenditure for ITN compared to Kebbi and Sokoto, which are scheduled to have their mass distribution campaigns in 2022. Also of note are the differences in the monitoring and research activity, which is higher in Kebbi state due to the monitoring and evaluation mobile scale up training conducted in March 2020, whereas a subsequent Sokoto training was cancelled due to COVID-19.

Table 3 presents the program expenditure for each of the study states by the various funding streams for the project. Expenditures on MCH make up over 41% of the total over the midline period. Expenditure from PMI represents the next highest proportion at just under 29%. Zamfara state accounted for nearly three-quarters

TABLE 3 MIDLINE PROGRAM EXPENDITURES BY FUNDING STREAM AND STATE (MINUS COVID-19 EXPENDITURE; JANUARY 2020–DECEMBER 2021)

	FAMILY PLANNING	MCH	NUTRITION	PMI	TOTAL
Kebbi	\$306,727	\$717,040	\$204,489	\$135,742	\$1,374,571
Sokoto	\$263,477	\$636,842	\$182,239	\$112,780	\$1,195,338
Zamfara	\$0	\$0	\$0	\$693,310	\$693,310
TOTAL	\$570,205	\$1,353,882	\$386,729	\$941,832	\$3,252,648
% of TOTAL	17.5	41.6	11.9	29.0	100

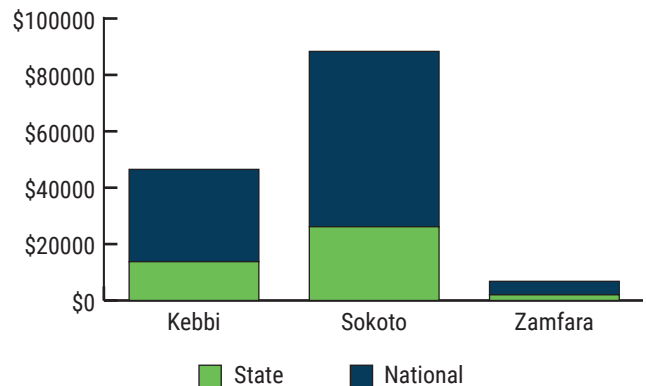
Note: The tuberculosis funding stream was removed as no expenditure was made through this stream over the midline period.

of all PMI funding. Family planning and nutrition funding streams made up the remainder of the total amount by funding stream in each state with approximately 17% and 12%, respectively.

COVID-19 expenditures

Across all Breakthrough ACTION states, the total expenditures on COVID-19 programming, all of which occurred during the midline period, including personnel costs, were approximately \$445,351. Figure 8 details the proportion of COVID-19 expenditures that were incurred by each of the three study states and at the national level. When disaggregated at the state level, the totals for each of the three study states were: Kebbi State \$43,567; Sokoto \$82,770; and Zamfara \$6,369. Included in these figures are expenditures incurred in Abuja, which were allocated to Kebbi, Sokoto, and Zamfara, based on the proportion of total COVID-19 expenditure that each

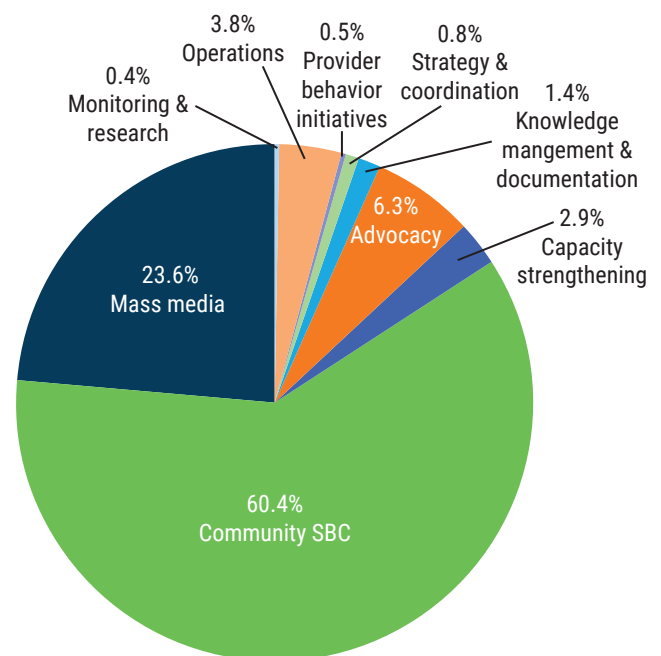
FIGURE 8 COVID-19 EXPENDITURES DISAGGREGATED BY STATE AND NATIONAL LEVEL (JANUARY 2020–DECEMBER 2021)



state represented out of all the Breakthrough ACTION states. For the three study states, 52% of all COVID-19 expenditure was attributed as a direct state expenditure and 48% was a portion of national COVID-19 expenditures allocated to the states.

Figure 9 details COVID-19 expenditures by activity across the three study states at the time of the midline reporting period. Across all states, the greatest proportion of expenditures are attributed to community SBC interventions (60%), followed by mass media (24%) and

FIGURE 9 COVID-19 EXPENDITURES BY ACTIVITY



advocacy (6%). The remaining activities all had 4% or less of program expenditures.

Estimating unit costs

Unit costs were estimated for three activities: community SBC, mass media, and mobile digital interventions. These three activities were selected for unit costs based on the availability of data on the numerators (expenditures) and denominators (persons reached).

Numerators

Table 4 presents total expenditures for the three activities. Total expenditures are presented in Kebbi, Sokoto, and Zamfara from the initial costing period of April 2018 through December 2019 and the midline period from January 2020 through December 2021. At this point in program implementation, expenditures on community SBC continue to account for the greatest proportion of overall expenditure in the three focus activities presented here, followed by mass media, and lastly mobile digital. These costs include program and personnel costs, and a portion of administrative expenditures from Abuja and headquarters, but do not include COVID-19 costs.

Denominators

A variety of data sources were used to determine the denominators used in calculating unit expenditures, as described in the methods section above. For community SBC, the denominator used is the number of WRA living in the Breakthrough ACTION intervention areas that are pregnant and/or have a child under the age of two (targeted women). This gives us the cost of community SBC activities per targeted woman. Over half the women in the intervention states were pregnant and/or had a child under two during the 2018 DHS, with 55% in Kebbi, 60% in Sokoto, and 59% in Zamfara.

For mass media, the Breakthrough ACTION expenditures indicate that the primary activity is radio programming, which are distributed state-wide as opposed to only in the Breakthrough ACTION intervention areas. Examining DHS data, it appears that regular radio listenership varies substantially by location and sex (Figure 10). In Kebbi, there is a wide variation based on sex, with 30% of males listening to the radio at least weekly compared to only 7% of females. Sokoto has a more even distribution between males and females with slightly more females listening once a week (23%) compared to males (20%).

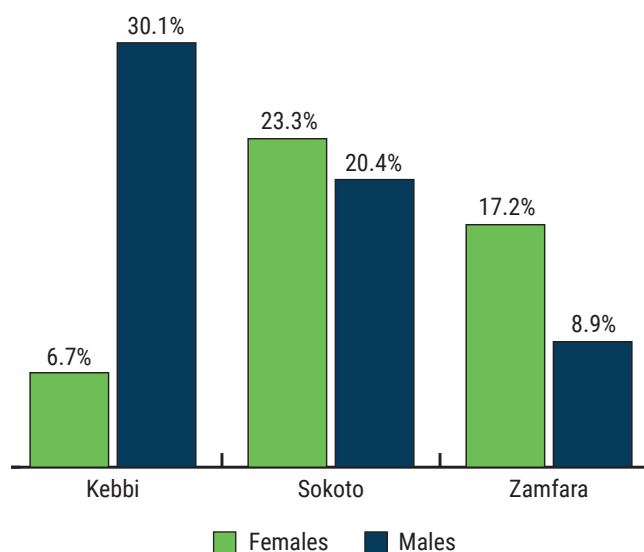
TABLE 4 CUMULATIVE ACTIVITY EXPENDITURES (APRIL 2018–DECEMBER 2021) BY STATE FOR CALCULATING UNIT COSTS (USD 2021)

	KEBBI	SOKOTO	ZAMFARA
Initial period: April 2018–December 2019			
Community SBC	\$2,053,227	\$1,840,802	\$700,842
Mass media	\$416,587	\$381,151	\$112,773
Mobile digital	\$105,307	\$96,349	\$28,507
Midline period: January 2020–December 2021			
Community SBC	\$1,117,700	\$939,831	\$727,872
Mass media	\$379,248	\$399,170	\$122,278
Mobile digital	\$35,116	\$32,126	\$27,774
Expenditures to-date: April 2018–December 2021			
Community SBC	\$3,170,928	\$2,780,633	\$1,428,715
Mass media	\$795,835	\$780,321	\$235,052
Mobile digital	\$140,423	\$128,475	\$56,282

Females in Zamfara also listen to the radio weekly more than males (17% vs. 9%).

For Kebbi state, we can also use the BSS midline results to get a more accurate denominator of exposure to Breakthrough ACTION radio programs. The BSS midline survey found that 18% of females who were pregnant and/or had a child under two years and 23% of their partners had heard of one of the Breakthrough ACTION radio programs.

FIGURE 10 PROPORTION OF FEMALES AND MALES THAT LISTEN TO THE RADIO AT LEAST ONCE A WEEK (DHS 2018)



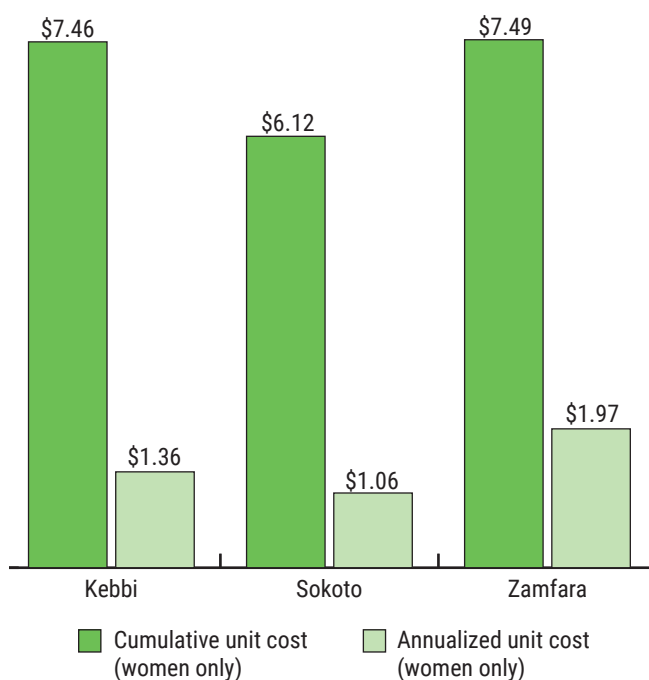
For the mobile digital interventions, we can only calculate unit costs for Kebbi state, where exposure to the Breakthrough ACTION mobile digital interventions were assessed at midline, with 9% of females and 14% of males responding that they heard of the Airtel 3-2-1 or the Kacici Kacici game and 3% of females and 8% of males responding that they interacted with these mobile digital interventions.

Unit costs

Putting the numerators and denominators together, we generated estimated unit costs. Figure 11 shows the unit expenditures from program initiation through the midline cost period per targeted woman, which are \$7.46, \$6.12, and \$7.49 for Kebbi, Sokoto, and Zamfara, respectively. Annualizing unit costs allow us to examine the cost per person for a one-year period instead of the entire period of April 2018 through December 2021. As such, when looking at annual community SBC costs, the unit costs drop considerably to \$1.36, \$1.06, and \$1.97 per targeted woman. As a point of reference, the median comparable unit cost for community SBC reported in the literature is shown at \$6.84 for total community SBC costs (Avenir Health 2021b).⁶

⁶Unit costs for IPC plus other SBC interventions are most comparable to Breakthrough ACTION program due to the inclusion of community engagement activities. The 2020 costs from the report have been inflated to 2021 using the Federal Reserve GDP deflators.

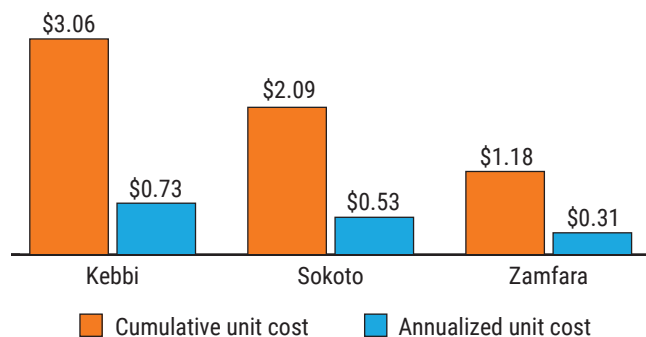
FIGURE 11 COMMUNITY SBC UNIT COSTS PER TARGETED WOMAN (2021 USD)



Assuming that all weekly radio listeners, as reported in the DHS, are exposed to Breakthrough ACTION programming, we apply the percentages to population estimates to generate the unit costs per person exposed shown in Figure 12. Looking at unit expenditures to-date, the costs of mass media per person exposed are \$3.06 in Kebbi, \$2.09 in Sokoto, and \$1.18 in Zamfara for the entire period. The annual costs are substantially lower at \$0.73 in Kebbi, \$0.53 in Sokoto, and \$0.31 in Zamfara. When using the midline BSS figures to estimate the denominator in Kebbi, the unit costs are \$2.76 per person exposed to-date and \$0.68 annually. As a reference point, the median unit costs for SBC radio interventions reported in the literature is \$0.29 in 2021 USD (Avenir Health 2021b).

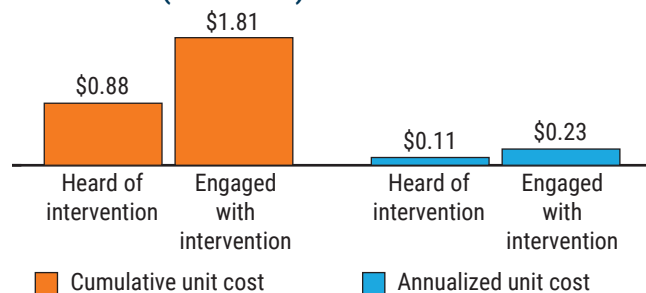
In Figure 13, the accumulated unit costs for mobile digital in Kebbi state are \$0.88 per person who heard of the interventions and \$1.81 per person who engaged with the interventions at midline. Engagement means that individuals called into the Airtel 3-2-1 messaging system or played the Kacici Kacici game, whereas those who

FIGURE 12 RADIO PROGRAMMING UNIT COSTS PER PERSON EXPOSED (USD 2021)^a



^aDenominator for radio based on DHS data on the proportion of target population who listen to the radio at least once a week.

FIGURE 13 KEBBI STATE UNIT COSTS FOR MOBILE DIGITAL INTERVENTIONS (USD 2021)



heard of the interventions only need to be familiar that they exist and are available. Annual unit costs are much lower at \$0.11 per person who heard of and \$0.23 per person engaging with the interventions. The median unit cost for mobile digital interventions reported in the literature is \$0.96 in 2021 USD (Avenir Health 2021b).

Program impact

The BSS baseline and midline surveys in Kebbi examined numerous behavioral health outcomes. Table 5 details the values of the key behavioral outcome indicators used as parameters for the LiST scenarios for the CEA. There are several indicators that improved during this period, despite the challenges that COVID-19 posed to health services utilization and implementation of SBC activities. Modern contraceptive use, in particular, increased from 9% at baseline to 14.5% at midline, a substantial shift for the region, albeit not statistically significant. Other health indicators that improved over the period include IPTp, facility-based births, and exclusive breastfeeding. Health indicators that declined between baseline and midline include ownership of an ITN, some childhood vaccinations, and medication use for malaria, pneumonia, and diarrhea.

While both positive and negative changes occurred between the baseline and midline periods, only one

of the selected outcomes was statistically significantly different between baseline and midline based on chi-square tests and using $p < 0.05$ to mark statistical significance. Ownership of at least one ITN per household for the prevention of malaria, declined from 68% to 53% from baseline to midline. According to the BSS midline impact report, the most recent mass distribution of ITNs occurred just before the baseline BSS was conducted and during the intervening years no subsequent mass distribution was conducted and thus ownership declined due to net damage, net loss, or other factors (Hutchinson et al. 2022).

When the baseline to midline coverage decline of ITN use is applied to the Breakthrough ACTION area of reach between 2019 and 2021, the net impact was estimated to be negative (i.e., negative DALYs were averted), and thus the cost per DALY averted was not calculated.

TABLE 5 KEBBI STATE BEHAVIORAL OUTCOMES FROM BASELINE AND MIDLINE BSS

VARIABLE	KEBBI BASELINE 2019 %	KEBBI MIDLINE 2021 %	DIRECTION AND STATISTICAL SIGNIFICANCE
Owns at least one ITN	68.0	52.7	Decrease; SS ($p < 0.05$)
IPTp among pregnant women	23.7	28.6	Increase; NSS
Acetaminophen treatment for fevers—kids under 2	28.8	23.0	Decrease; NSS
Modern contraceptive prevalence	9.0	14.5	Increase; NSS
At least 1 antenatal care visit	42.1	36.8	Decrease; NSS
At least 4 antenatal care visits	23.6	26.6	Increase; NSS
Facility-based birth	14.8	18.8	Increase; NSS
New blade to cut chord	85.6	89.5	Increase; NSS
Breastfeeding within 1 hour	42.4	46.3	Increase; NSS
Exclusive breastfeeding first days	21.6	21.6	Same; NSS
Exclusively breastfed under 6 months	20.3	27.1	Increase; NSS
Any breastfeeding 6+ months	87.5	90.2	Increase; NSS
Diphtheria, pertussis, and tetanus (3 doses) vaccine	5.7	7.9	Increase; NSS
Measles vaccine (1 dose)	15.9	14.7	Decrease; NSS
Oral antibiotics for pneumonia	41.0	38.0	Decrease; NSS
Oral rehydration solution for diarrhea	47.7	33.1	Decrease; NSS
Zinc for diarrhea	29.9	26.6	Decrease; NSS

Discussion

Expenditure analyses

An examination of total program and personnel expenditures over the period April 2018 to December 2021, shows that around 85% was spent in Kebbi and Sokoto states, where integrated SBC programming is being undertaken, and 15% going to the vertical program in Zamfara. This difference is explained by both the geographic coverage and the intensity of the SBC programming in integrated versus vertical states. Geographically, Breakthrough ACTION implemented community activities in far more wards per state in Kebbi and Sokoto than Zamfara, resulting in working in 241 wards in the two integrated states versus a total of 54 wards in Zamfara. The intensity of the mass media activities was also greater in the integrated states, which included the Albishirin Ku! radio show and spots as compared to only radio spots in Zamfara. Also, community capacity strengthening and the SBC Advocacy Core Group activities were more intensely delivered in integrated states. Additionally, while expenditure for ITN mass campaigns were found to be greater in Zamfara than in Kebbi and Sokoto where integrated programs are being implemented, this is due largely to the ITN campaign cycle and the fact that there were no ITN mass campaigns in Kebbi and Sokoto during the midline period.

There are two interesting findings from the expenditure analysis related to the COVID-19 pandemic. First, the overall expenditures notably declined from the initial period before 2020 to the midline period from January 2020 through December 2021. The total monthly costs dropped approximately 50% between the two periods. This is not surprising given the COVID-19 pandemic and its restrictions on in-person activities, travel, and normal partner activities. However, despite the drop in overall expenditure, the proportions allocated to each study state changed during the midline, with expenditure in Zamfara increasing from 15% during the initial period (April 2018–December 2019) to 25% from January 2020 to December 2021. This shift is a result of decreased community focused activities again, due to COVID-19 restrictions, in the integrated states (Kebbi and Sokoto).

A second change likely due to COVID-19 was the allocation of expenditures among the different SBC activities. One noticeable difference is the increased expenditures related to capacity strengthening in the

integrated states. The proportion of expenditures focused on capacity strengthening increased from 5% to 19% during the midline period in Kebbi and from 4% to 24% in Sokoto. This increase in capacity strengthening was potentially partly due to the inability to travel and thus increased reliance on local staff and the shift from strategy and coordination during the initial period to more capacity building with the ward development committees (WDCs) and other partners. However, this is explained in large part by the expansion of Breakthrough ACTION's community capacity strengthening approach during the period, which includes training and supportive supervision to WDCs to plan, fund, and implement their own targeted health activities for their communities. Activities include phased transitioning of community-level SBC activities from volunteer structures to WDCs.

In interpreting the unit cost findings, it is helpful to compare the results to those identified in the literature. The unit costs reported in the literature vary substantially based on costing methodology, the denominators used, and the intensity of the SBC intervention (Avenir Health 2021b). Despite these variations, the median unit costs are useful for gauging how the Breakthrough ACTION/Nigeria program compares to the broader field of reported unit costs. For community SBC, the unit costs reported for Nigeria vary based on whether one looks at the cumulative unit costs from April 2018 through December 2021 or the annualized unit costs. Typically, the unit costs are not annualized in the literature, however, the median duration for costing studies for IPC is 12 months. As such, the unit costs for community SBC in Breakthrough ACTION/Nigeria range from \$1.06 per woman in Sokoto using annualized costs to \$7.49 per woman in Zamfara using cumulative costs. The high range (cumulative costs, no partners) of results is close to the median unit cost of \$6.84 per person participating in IPC interventions conducted in conjunction with other SBC interventions such as community engagement (Avenir Health, 2021b). This category of SBC interventions, called "IPC plus other SBC interventions" is the most appropriate benchmark from the literature for these analyses because Breakthrough ACTION programs work with community leaders, as well as individuals, on changing attitudes and norms around key health barriers. As such, many individuals may be exposed to the SBC interventions of Breakthrough

ACTION without necessarily participating in an individual or group counseling activity but rather they are being exposed to Breakthrough ACTION programming via their community and religious leaders. Given that the unit costs that factor in annualization are substantially lower, one can conclude that the Breakthrough ACTION/Nigeria community SBC costs are consistent with or below what has been previously reported in the literature.

The radio unit costs range from annualized costs of \$0.31 per person exposed in Zamfara to cumulative costs of \$3.01 per person exposed in Kebbi. These cumulative unit costs are substantially higher than reported in the literature, which is \$0.29 per person exposed. The annual unit costs, however, are more in line with these estimates. The higher costs for radio programming can be explained by the fact that *Al Abushirin Ku!* is a serial drama that requires more intensive development than typical SBC radio interventions providing information on health issues. Additionally, low listenership of radio among women in the region, particularly in Kebbi state, contribute to higher unit costs than previously reported. Comparing the results from using two different denominators in Kebbi—weekly radio listeners as estimated using DHS data and those reporting having heard one of Breakthrough ACTION’s radio programs as reported in the BSS midline survey – yields similar results, indicating that the DHS measure of weekly listenership performs well as a measure of exposure for these kinds of unit cost calculations.

For the mobile digital interventions, the unit costs in Kebbi ranged from an annualized \$0.11 per person who heard of the interventions to a cumulative \$1.81 per person engaging with the interventions. In the literature, the median unit cost per person exposed to an SMS/text message SBC intervention is \$0.96. The per person engaging is a more appropriate comparison, indicating that the Breakthrough ACTION/Nigeria costs are somewhat more expensive if using the cumulative figure (\$1.81 per person) and somewhat less expensive using the annualized figure (\$0.88 per person). Perhaps more importantly is that with overall current low levels of engagement in these interventions in Kebbi (3% females and 8% males), there is room for substantial growth in engagement, since 22% of females and 63% of males report having a mobile phone according to the 2018 DHS. Increases in engagement with these interventions would substantially reduce the unit costs.

Program impact findings

The next report will compare the program impact from baseline to the final Breakthrough RESEARCH BSS in the integrated states of Kebbi and Sokoto and malaria-only state of Zamfara. At midline, however, only the results from Kebbi are known. While several behavioral health outcomes showed increases from baseline to midline, only one change was statistically significant, the outcome showing the decline of ITN ownership, and could thus be included in the modeling. Since there is no comparison area due to the security issues preventing data collection in Zamfara, we cannot compare the integrated SBC approach to the malaria-only approach. It is possible that the changes in the non-malaria outcomes from baseline to midline in Kebbi would be statistically significant when compared to the same measures in Zamfara, particularly during this tumultuous period, where the COVID-19 pandemic is known to have influenced health seeking behaviors (Lusambili et al. 2020; Burt et al. 2021). In particular, the non-statistically significant increase in modern contraceptive use from 9.0% at baseline to 14.5% reported in the midline survey could have substantial implications. If this increase was applied to the LiST model, it would result in 12,705 unintended pregnancies avoided in 2020 and 2021. Looking ahead, Breakthrough RESEARCH is hopeful that the next BSS survey will be conducted in all three states and thus this comparison can be made for the third CEA report.

For the one modeled behavioral outcome, the decline in ITN ownership is almost assuredly because a net distribution program was conducted in 2019 just before the baseline and no subsequent distribution was made prior to the midline two years later. The 15-percentage point drop in ITN ownership during this period, while notable, is not surprising based on prior research on ITN retention over time. One study in Uganda found much sharper declines post distribution, with only one-third of households retaining the ITN 18 months after distribution (Clark et al. 2016). Still, the modeling of the decline of ITN ownership in LiST translates to approximately 10,000 negative DALYs averted for 2020 and 2021. This highlights the importance that ITNs play in preventing malaria deaths and the need for SBC interventions to encourage retention and continued use of ITNs post-distribution.

Limitations

There are two primary limitations to this analysis. First, while one strength of the expenditure reporting

analysis is that Breakthrough ACTION has organized their expenditure data to allow for a detailed analysis, there are still several assumptions that had to be made to allocate costs and thus results should not be considered exact amounts but rather best estimates. Expenditures incurred at the headquarters or administrative levels (e.g., staff based in Washington, DC and Abuja), for example, were allocated to activities and states based on estimates from Breakthrough ACTION instead of line-item expenditures in order to protect the confidentiality of individual employees and their salaries. A bottom-up costing approach, where the inputs of each intervention are measured in detail, would allow for more precise estimation of costs. However, given the multifaceted nature of the Breakthrough ACTION program, it would not be realistically feasible to take a bottom-up approach.

A second limitation is our inability to properly assess impact in Sokoto and Zamfara states at midline due to the security problems in northern Nigeria. While the two cross-sectional surveys in Kebbi have generated important insights, which Breakthrough RESEARCH is exploring in separate reports and publications, they have limited utility for the CEA since there is no comparison location. The drop in ITN ownership between baseline and midline is clearly not because of the Breakthrough ACTION program but rather an expected deterioration of ownership after distribution. Similarly, changes in other indicators cannot necessarily be directly attributed to the Breakthrough ACTION programming and may be due to other factors in the region. The ability to compare the integrated and malaria-only approach in the next BSS will enhance our ability to make more causal statements about impact that can be translated into the CEA.

vs. malaria-only approach to SBC programming following the collection of the final round of BSS survey data in all three states.

Conclusions and looking forward

The midline reporting period coincided with the COVID-19 pandemic, which clearly had an impact on program expenditures in the short run and created programmatic challenges, but also had some potential positive programmatic implications in terms of capacity strengthening. While the impact and cost-effectiveness at midline could not be properly assessed due to the extenuating security situation, these analyses allow for the examination of current expenditures and unit costs. The unit cost results largely keep with what has been previously identified in the literature. As Breakthrough ACTION/Nigeria moves forward with programming after this phase of the pandemic, we anticipate being able to examine the relative cost-effectiveness of the integrated

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