TECHNICAL REPORT

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

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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

ACT	artemisinin-based combination therapy
ANC	antenatal care
BSS	behavioral sentinel surveillance
CCP	Johns Hopkins Center for Communication Programs
COVID-19	coronavirus disease 2019
DALY	disability-adjusted live year
DPT3	diptheria-pertussis-tetanus series
GDP	gross domestic product
GHSA	Global Health Security Agenda
ICER	incremental cost-effectiveness ratio
IHP	Integrated Health Program
IPTp	intermittent preventive treatment in pregnancy
ITN	insecticide treated net
LiST	Lives Saved Tool
ORS	oral rehydration salts
SBC	social and behavior change
TB	tuberculosis
USAID	United States Agency for International Development
US$	United States Dollar
WHO	World Health Organization
YLD	years of life lost to death
YLL	years of life lived with disability

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Executive Summary

In Nigeria, the Breakthrough ACTION project, funded by 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. Within the broader program, Breakthrough ACTION uses different social and behavior change (SBC) approaches in different states. In northern Nigeria, Breakthrough RESEARCH compared the cost-effectiveness of the integrated SBC approach addressing multiple health areas in Kebbi and Sokoto states to a malaria-only approach in Zamfara. This cost-effectiveness study examined whether the additional cost required for an integrated SBC approach (as compared to a malaria-only approach) is a cost-effective investment. Additionally, this study examined malaria-specific impacts within an integrated SBC program compared to a malaria-only program.

Methods

There are three fundamental steps for estimating the relative cost-effectiveness of the two different SBC approaches: 1) estimate the impact, 2) estimate the costs, and 3) calculate the relative incremental cost-effectiveness ratio (ICER) using a difference-in-difference approach. The foundation for the impact analysis is the Breakthrough RESEARCH baseline (2019) and endline (2022) behavioral sentinel surveillance (BSS) surveys, which include 16 health behavioral outcomes related to Breakthrough ACTION's SBC programming that are available for modeling in the Lives Saved Tool (LiST). LiST is a linear deterministic causal model that calculates how changes in population coverage of specific interventions result in lives saved over a specified time period. Two scenarios were generated: one that used all 16 outcomes, and another that only used the outcomes that showed a statistically significant difference between the integrated state(s) and malaria-only state from baseline to endline, based on a difference-in-differences analysis. The number of lives saved from the LiST scenarios were then translated into disability-adjusted life years (DALYs) averted using data obtained from the Global Burden of Disease (GBD) Results Tool for Nigeria.

Program and personnel expenditure data were provided by Breakthrough ACTION. SBC expenditures were summarized for each of the three study states, examining all SBC expenditures and malaria-only expenditures. In addition to SBC expenditures, service delivery costs associated with changes in the behavioral health outcomes were estimated using default values from the LiST costing module and were also included. All costs were adjusted to 2022 US dollars (US$) using the U.S. gross domestic product (GDP) deflator.

Once the impacts and costs were obtained, the ICER was calculated as the cost per DALY averted, measuring the additional cost needed to achieve the additional impact from the integrated states vs. the malaria-only state. The cost per DALY averted was then compared to the GDP per capita to assess cost-effectiveness, where health interventions with a cost per DALY averted that are less than the GDP per capita are considered "highly cost-effective" and those between one- and three-times GDP per capita are "cost-effective".[1] The most recent GDP per capita estimates were used and adjusted to 2022 US$, resulting in a national threshold of $2,252 and a three-state GDP average of $860.

Results

The results of the scenario using all health outcomes measured by the BSS resulted in a net of 967 lives saved in the integrated SBC states and 555 lives lost in the malaria-only SBC state. When looking at the outcome-specific results, one of the biggest changes is from a reduction in insecticide treated net (ITN) ownership from baseline to endline in the integrated states, resulting in a loss of 1,631 lives in the integrated states. This contrasts a gain of 403 lives in Zamfara, where there was an increase in ITN ownership. Antibiotic use for respiratory illness also showed substantial gains and losses, with a gain of 1,590 lives in the integrated states and a loss of 1,211 lives in the malaria-only state. The change in the use of oral rehydration salts (ORS) and zinc for diarrhea

from baseline to endline results in lives lost in a gain of 443 lives in the integrated states and a loss of 762 in the malaria-only state. When translating the number of lives saved to the additional DALYs averted in the integrated SBC states, compared to the malaria-only state, the scenarios in Kebbi and Sokoto yielded 47,605 more DALYs averted than the malaria-only scenario in Zamfara. For malaria-specific DALYs, however, the malaria-only SBC approach in Zamfara yielded a net DALY advantage of over 66,000 DALYs compared to integrated SBC, due to a drop in ITN ownership in the integrated SBC states from baseline to endline.

The SBC expenditures during the study timeframe totaled $8.1 million in Kebbi (integrated SBC), $7.2 million in Sokoto (integrated SBC), and $3.0 million in Zamfara (malaria-only SBC). The SBC expenditures are then combined with the service delivery costs associated with changes in the behavioral outcomes to get total costs. When combined with impact, the ICER (meaning the cost per additional DALY averted in the integrated states compared to the malaria-only state) is $278 for the scaled-up scenario and $426 for the limited scaled-up scenario. When compared to the national GDP per capita of $2,252 and the three-state average GDP per capita of $860, both results are below the "highly cost-effective" threshold.

Because the SBC interventions are not delivered in a vacuum and it is likely that some of the impact captured by the BSS is attributable to factors other than SBC, further analysis examined the proportion of the impact (the additional DALYs averted in the integrated SBC areas) that would need to be attributed to SBC interventions for the investment in integrated SBC states to be cost-effective. The most difficult threshold to reach is that for the three-state average highly cost-effective at $860. Using this threshold in the scaled-up scenario, 33% of the impact seen in the BSS from baseline to endline would need to be due to SBC to be considered highly cost-effective. This increases to 50% using the limited scaled-up scenario. To be considered cost-effective, however, based on the three-state average threshold, only 11% of impact needs to be attributed to SBC in the scaled-up scenario or 17% in the limited scaled-up scenario. Reaching cost-effectiveness is easier using the national thresholds, where only 13% of impact needs to be attributed to SBC to be considered highly cost-effective in the scaled-up scenario; 19% is required in the limited scaled-up scenario. Finally, using the national threshold for cost-effectiveness, only 5% of impact must be attributed to SBC under the scaled-up scenario, which increases to 7% in the limited scaled-up scenario.

Discussion

The overall ICER calculations indicate that the additional investments for integrated SBC relative to malaria-only SBC are highly cost-effective based on both national and regional thresholds. The primary drivers of the positive results are the increased use of antibiotics for respiratory infections and the use of ORS and zinc for diarrhea in the integrated states versus the drop in use in the malaria-only state. While these priority health behaviors are addressed in Breakthrough ACTION's SBC programming in the integrated states in both community activities (household visits, community dialogues, and community meetings) and mass media programming, in addition to Breakthrough ACTION programming, there are other differences between the integrated and malaria-only states that are likely contributing to these impacts. These include antibiotic stockouts in the malaria-only state of Zamfara and the presence of the Integrated Health Program (IHP), which is working in Kebbi and Sokoto on a complementary project to improve these outcomes through improved primary care services.

In contrast to the overall findings, the malaria-specific outcomes do not appear to be well served by integrated SBC. However, there is also an important caveat to consider when interpreting these results, as an ITN distribution campaign was conducted in the malaria-only state during the study time frame but not in the integrated SBC states. It is notable, that while there was a drop in ITN ownership, ITN use among pregnant women and young children in the integrated states remained stable from baseline to endline, while increasing substantially in Zamfara. Unfortunately, the ITN use figures cannot be used in LiST due to the underlying parameters operating in the model. Still, while a change to ITN use instead of ownership would be more favorable to the integrated states, it would not change the conclusions that the integrated SBC investments were deemed highly cost-effective but malaria-only results fared better in Zamfara.

The primary limitation of this study is that Zamfara does not appear to be a good comparator district for Kebbi and Sokoto, due to the stockouts of antibiotics in Zamfara, the IHP program presence in Kebbi and Sokoto, and the distribution of ITNs in Zamfara but not in Kebbi and Sokoto during the study period. However, despite

this and other limitations, the findings indicate that even if only a relatively small proportion of the overall impact modeled is attributed to the SBC activities, the SBC investments would be cost-effective. As such, these findings are promising for the cost-effectiveness of integrated SBC, but not definitive. Future research should continue to explore the cost-effectiveness of integrated SBC.

Background

In the last decade, many social and behavior change (SBC) programs in health have shifted from working in a single health area to a more integrated approach that includes multiple health areas and communication channels.[2] While it is hypothesized that integrated SBC will result in programs that are more reflective of clients' needs and thus more cost-effective, these claims are largely unproven given the lack of robust studies of integrated SBC approaches.[3,4] Additionally, while some studies have examined the costs of integrated SBC programs, no studies were identified that compared the costs of an integrated SBC approach to a stand-alone approach.[5] To address these knowledge gaps, Breakthrough RESEARCH compared the cost-effectiveness of the integrated SBC approach versus malaria-only SBC approach in three states (Kebbi, Sokoto and Zamfara) of northwestern Nigeria.

In Nigeria, the Breakthrough ACTION project, funded by 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 (TB). Breakthrough ACTION began implementation in April 2018, led by Johns Hopkins Center for Communication Programs (CCP) with partners Save the Children International, ThinkPlace, Ideas42, and Viamo.[a] Breakthrough ACTION uses different SBC approaches in different states. In northern Nigeria, an integrated SBC approach started in Bauchi, Kebbi, and Sokoto, where SBC activities focus on multiple health behaviors (malaria, family planning, maternal and child health, and nutrition) for women of reproductive age who are either currently pregnant or are within the 1,000-day window following childbirth.[b] In contrast, a malaria-only SBC approach is being used in Zamfara state. 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, radio programming, mobile digital interventions, and provider behavior change focused on addressing barriers to malaria diagnosis and treatment, family planning uptake, positive maternal and child health seeking behavior, as well as nutrition.

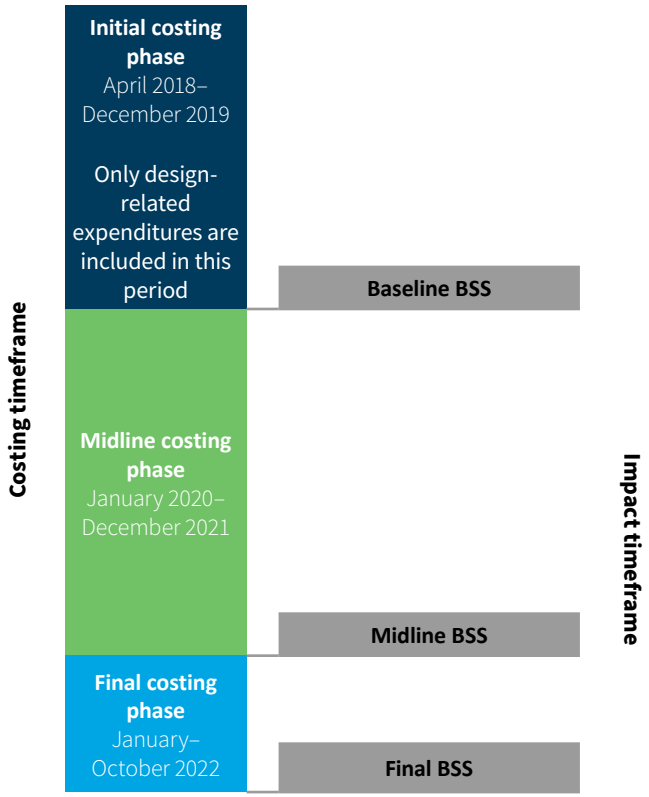
Breakthrough RESEARCH led an evaluation of Breakthrough ACTION's integrated (malaria, family planning, maternal and child health, and nutrition) and vertical (malaria-only) SBC programming in northern Nigeria, including a study that explored the relative cost-effectiveness of the two approaches. The cost-effectiveness activity consists of three consecutive reports. First, the initial phase costing report examined expenditures from the program inception in April 2018 through December 2019, differentiating between start-up and implementation expenditures during the initial phase of the program.[6] A midline report was aligned to the midline behavioral sentinel surveillance (BSS) survey and reported SBC expenditures at midline (December 2020) and an analysis of the impact of the COVID-19 pandemic on SBC expenditures.[7] This third and final report is focused on calculating the cost-effectiveness of the integrated SBC approach vs. malaria-only SBC approach interventions from April 2018 through October 2022, when the endline BSS survey was conducted. Note that the Breakthrough ACTION program has been extended beyond the Breakthrough RESEARCH evaluation timeframe to 2025; however, no further BSS is planned at this time. **Figure 1** details the timeline for the cost data collection and BSS surveys.

The overall study period includes the beginning of the coronavirus disease 2019 (COVID-19) global pandemic, which disrupted Breakthrough ACTION Nigeria's community SBC activities for several months starting February 2020 through January 2021.[6] Additionally, local unrest and security concerns in northwest Nigeria escalated in 2021, resulting in a temporary cessation of program implementation in parts of Sokoto and Zamfara states. Despite these program disruptions, the continued

[a]Additionally, 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.

[b]Integrated programming extended to Ebonyi state and the Federal Capital Territory starting in late 2020.

FIGURE 1 EVALUATION TIMELINE



collection of SBC-related expenditures and data from the endline BSS allow for an examination of the relative cost-effectiveness of the programming between the integrated (Kebbi and Sokoto) and malaria-only (Zamfara) states as of October 2022.

There are three primary research questions addressed in this report:

1. What are the total program expenditures incurred during the total study time period from program initiation (April 2018) through October 2022?
2. Are the investments needed for an integrated SBC program cost-effective, compared to a malaria-only approach?
3. How do malaria-specific investments perform within an integrated SBC program compared to a malaria-only program?

Methods

There are three fundamental steps for estimating the relative cost-effectiveness of the two different SBC approaches: 1) estimate the impact of each, 2) estimate the costs of each, and 3) calculate the relative incremental cost-effectiveness ratio (ICER) using a difference-in-difference approach.

Estimating Impact

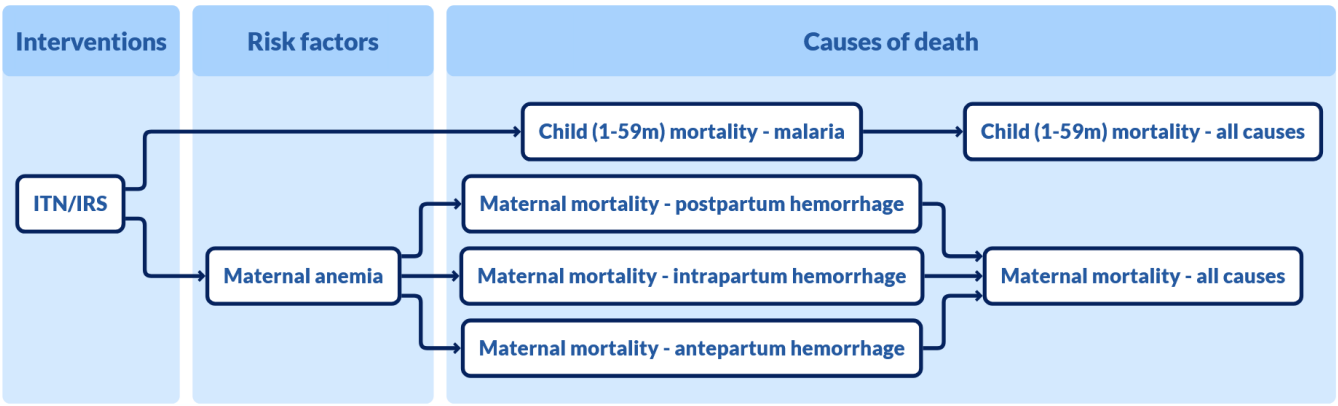
The foundation for the impact analysis is the Breakthrough RESEARCH Nigeria BSS study, which is a multi-round quasi-experimental study designed to assess the impact of Breakthrough ACTION programming implemented in two integrated SBC states (Kebbi and Sokoto) compared to a malaria-only SBC approach in Zamfara. The baseline, midline, and endline BSS involve interviews with women with a child under two years of age in Breakthrough ACTION programming areas and assess the ideational factors, behaviors, and outcomes associated with key health areas. This analysis relies on the behavioral health outcome findings from the women's sample, with 3,020 women interviewed among the three states at baseline in December 2019 and 3,144 in the endline BSS in October 2022.[8] Further details on the Breakthrough RESEARCH Nigeria study and the BSS methodology can be found at: [insert link to endline report on website].

To examine the relative cost-effectiveness of an integrated vs. malaria-only SBC approach, a common impact measure is needed that can be compared across multiple health areas. To achieve this, we used the health behavioral outcomes from the BSS as inputs into the Lives Saved Tool (LiST). LiST is a linear deterministic causal model that was initially developed in 2003 to estimate the impact of clinical, hospital, and community-based interventions on mortality for children under five years and expanded to include maternal mortality.[9] LiST is widely used by donors, policy makers, academics, and health system stakeholders to examine the impact associated with scaling-up key maternal and child health, nutrition, and water, sanitation and hygiene interventions, including the Bill & Melinda Gates Foundation, Gavi, the World Bank Group, Johns Hopkins, and UNICEF (**www.livessavedtool.org/projects**).

The tool examines how changes in population-level coverage of specific interventions translate into the number of lives saved over a specified time period. For example, **Figure 2** shows how the ownership and use of insecticide treated nets (ITNs) results in decreased deaths among children and mothers. Underlying parameters in the tool use validated research studies that capture the impact of ITN ownership, which is then translated to ITN use through an efficacy factor, to malaria deaths for children and maternal deaths from hemorrhage due to maternal anemia.[10]

Table 1 details the 16 behavioral health outcomes assessed by the baseline and endline surveys in each state that are available to be used in LiST modeling and the percentage point change for each outcome in each state. Three outcomes are specific to malaria—ownership of an ITN, at least two doses of intermittent preventive treatment in pregnancy (IPTp), and the use of artemisinin-based combination therapy (ACT) for fever

FIGURE 2 MAPPING IMPROVEMENTS IN ITN OWNERSHIP TO REDUCED DEATHS IN LIST



Source: www.Listvisualizer.org

TABLE 1 BEHAVIORAL HEALTH OUTCOME CHANGES FROM BASELINE TO ENDLINE BSS AVAILABLE FOR USE IN LIST

BEHAVIORAL HEALTH OUTCOMES	KEBBI			SOKOTO			ZAMFARA		
	BASELINE	ENDLINE	% PT CHANGE	BASELINE	ENDLINE	% PT CHANGE	BASELINE	ENDLINE	% PT CHANGE
Owns at least one ITN	77.9	45.6	-32.3*	79.7	61.2	-18.5*	74.4	87.7	13.3
IPTp among pregnant women (at least 2)	33.5	47.0	13.5	25.6	33.1	7.5	38.3	42.3	4
ACT for children under 2	28.8	23.9	-4.9	17.9	27	9.1	26.1	34.5	8.4
Modern contraceptive prevalence	8.6	15.0	6.4	10.7	8.7	-2	14.7	18.1	3.4
At least 1 ANC visit	42.1	45.9	3.8	24.6	31.9	7.3	38.2	48.5	10.3
At least 4 ANC visits	23.6	32.0	8.4	17	21.9	4.9	26.1	37.7	11.6
Facility-based birth	14.8	22.7	7.9	13.8	13.6	-0.2	16.3	26.6	10.3
Early initiation of breastfeeding	41.6	39.2	-2.4	31.6	24.2	-7.4	46.1	43.2	-2.9
Exclusive breastfeeding (under 1 month)	8.9	19.8	10.9	27.3	9.2	-18.1	43.6	22.3	-21.3
Exclusive breastfeeding (under 6 months)	20.3	16.6	-3.7	29.3	11	-18.3	45.9	37.4	-8.5
Any breastfeeding (6+ months)	97.9	96.3	-1.6	97.1	98.6	1.5	94.9	96.6	1.7
DPT vaccine	5.7	12.2	6.5	9.6	6.5	-3.1	10.7	18.1	7.4
Measles vaccine	15.9	18.9	3.0	16.5	12	-4.5	19.2	22.5	3.3
Oral antibiotics for respiratory illnesses	38.3	58.7	20.4	20.7	33.3	12.6*	45.1	22.9	-22.2
ORS for diarrhea	51.8	47.7	-4.1	27.2	37	9.8*	56	42.4	-13.6
Zinc for diarrhea	30.4	45.0	14.6	18.7	34.8	16.1*	36.8	41.4	4.6

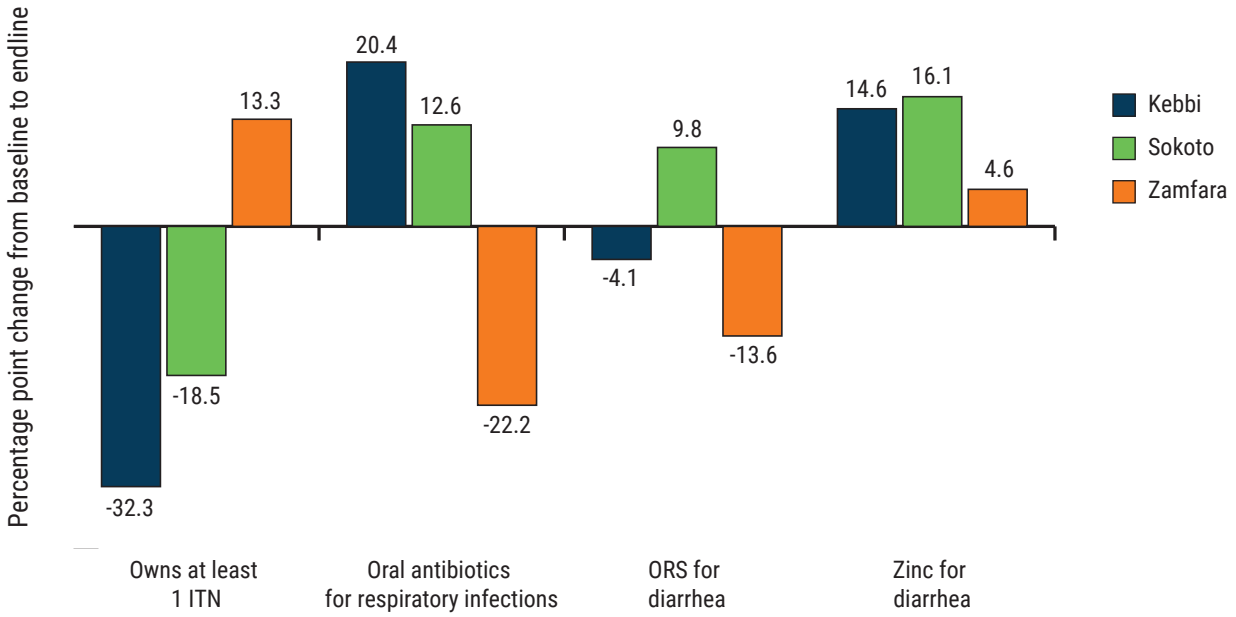
*Indicates a statistically significant difference ($p<0.05$) when compared to changes in Zamfara using a difference-in-differences analysis.

in children under two years old. Other reproductive, maternal, and child health behavioral outcomes include the use of modern contraception among married/in-union women, attending at least one antenatal (ANC) visit and/or at least four ANC visits during the most recent pregnancy, breastfeeding behaviors, completing the diptheria-pertussis-tetanus series (DPT3) and measles vaccines, the use of oral antibiotics for child respiratory infections, and the use of oral rehydration salts (ORS) and zinc for childhood diarrhea.

While several changes occurred between the baseline and endline BSS, only four of the behavioral health outcomes had statistically significant changes ($p<0.05$) when comparing the integrated SBC states to the malaria-only SBC state using a difference-in-differences analysis, with one of the indicators having a negative significant change.[8] As the name implies, difference-in-differences analyses examine two sets of differences at the same time. The first difference is the change in an indicator (e.g., current modern family planning use) from baseline to endline in an integrated state. This difference is then compared with the difference from baseline to endline in the same indicator in the comparison state.

In looking at the statistically significant results from the difference-in-differences analyses, first, ITN ownership declined substantially in the integrated states of Kebbi and Sokoto (32 and 19 percentage points, respectively), while it increased by 13 percentage points in the malaria-only state of Zamfara. Conversely, the use of oral antibiotics increased in Sokoto by 13 percentage points and decreased in Zamfara by 22 percentage points. The use of ORS also increased in Sokoto by 9 percentage points and decreased in Zamfara by 14 percentage points. Finally, the use of zinc increased in all three states, but more so in Sokoto (16 percentage points) compared to Zamfara (5 percentage points). These changes are shown in **Figure 3**.

FIGURE 3 PERCENTAGE POINT CHANGES FROM BASELINE TO ENDLINE FOR HEALTH OUTCOMES THAT WERE STATISTICALLY SIGNIFICANTLY DIFFERENT WHEN COMPARING KEBBI AND/OR SOKOTO TO ZAMFARA



Other outcomes related to ITNs that are not available in LiST but are of interest in terms of the effectiveness of malaria SBC interventions are shown in Table 2. Note that while ITN ownership declined substantially in Kebbi and Sokoto from baseline to endline as shown in Table 1, the actual use of ITNs by pregnant women and children did not decline substantially from baseline to endline, but rather made small improvements, albeit a very slight reduction (0.4 percentage points) for children under two years in Kebbi. These small changes, however, still contrast with the substantial gains in net use in Zamfara. While it would be preferred to use the proportion of pregnant women and young children sleeping under an ITN as reported in the BSS for the LiST modeling, unfortunately, this is not feasible due to the underlying parameters that link the behaviors to the impacts, as shown in Figure 2.

TABLE 2 ADDITIONAL INDICATORS RELATED TO ITNS NOT AVAILABLE IN THE LIST

MALARIA INDICATOR	KEBBI	SOKOTO	ZAMFARA
Pregnant women sleeping under a long-lasting insecticide treated net (LLIN)	22.7%–27.0% (+4.3)	24.0%–26.4% (+2.4)	30.5%–70.5% (+40.0%)
Children under 2 sleeping under an LLIN	31.0%–30.6% (-0.4)	37.1%–39.8% (+2.7)	40.1%–78.5% (+38.4%)

The percentage change values shown in **Table 1** were used to populate a LiST file for each of the three states. Each state-specific file uses inputs that have been previously validated by stakeholders at the state-level. To begin, the default population data from LiST were adjusted to reflect the population of those living in the Breakthrough ACTION intervention wards for community-level interventions at midline, as provided by Breakthrough ACTION. **Appendix A** details the intervention wards and population estimates used for each state. The proportion of the state population living in the intervention wards amounted to 60% in Kebbi, 53% in Sokoto, and 25% in Zamfara, which translates into over 6 million living in the intervention wards in the integrated states versus approximately 1.3 million in malaria-only state at midline. Next, three LiST scenarios were run for each state:

1. A "baseline" scenario that uses the baseline BSS values for each of the 16 behavioral health outcomes and keeps these values constant from 2019 through 2022.
2. A "scaled-up" scenario that uses the baseline BSS values for 2019, the endline BSS values for 2022, and uses linear interpolation between 2019 (baseline) and 2022 (endline) to estimate outcome values for

2020 and 2021, when BSS data were not collected for all the behavioral health outcomes measured in the BSS.

3. A "limited scaled-up" scenario similar to the scaled-up file, but this scenario only uses values for the behavioral health outcomes that had statistically significant changes from baseline to endline in the BSS.

The number of lives saved was estimated for each state based on comparing both the scaled-up and limited scaled-up scenarios to the baseline scenario. Due to underlying population dynamics, the best approach for calculating the number of lives saved based on changes in the behavioral health outcomes differs for mothers and children.[c,11] To calculate maternal lives saved, the number of deaths from the two scaled-up scenarios measuring program impact was subtracted from the baseline scenario for each cause of death. For children, the number of lives saved were estimated for each intervention in the scaled-up scenarios.

The number of lives saved from LiST were then translated into disability-adjusted life years (DALYs) averted using data obtained from the Global Burden of Disease (GBD) Results Tool for Nigeria. Total DALYs averted are the years of life lost to death (YLL) and the years of life lived with disability (YLD). Their value lies in being able to aggregate outcomes along a common metric versus using a variety of disparate outcomes across different health domains, such as the number of new users of modern contraception, the number of fully vaccinated children, or the number of health facility visits for treatment of fever. Using DALYS also permits the aggregation of both mortality and morbidity from health causes. **Figure 4** shows an illustrative example of how changes in health behaviors map to DALYs averted.[12]

To estimate the number of DALYs averted due to changes in behavioral health outcomes in Nigeria, we calculated the number of DALYs per death for each relevant cause of death and applied it to the estimated number of lives saved from LiST. The resulting DALYs averted were then discounted at 3%, following standard practices for cost-effectiveness evaluation.[13] The DALYs averted for Kebbi and Sokoto states were aggregated to compare integrated SBC to the malaria-only approach in Zamfara. See **Appendix B** for state-specific results.

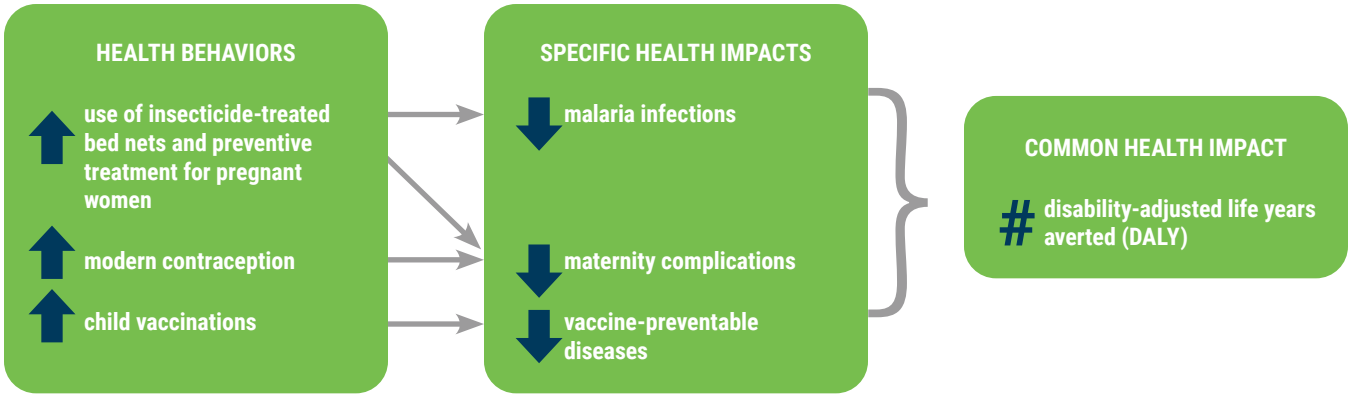
Estimating expenditures/costs

What follows is a brief synopsis of the methods employed to arrive at estimates of expenditures for the cost-effectiveness analysis of Breakthrough ACTION's integrated and malaria-only SBC programs. For a more detailed and in-depth examination of the methodology and results, please refer to **Appendix C**. SBC program implementation and personnel expenditure[d] data were provided through Breakthrough ACTION's financial and accounting system for the three costing phases of the evaluation timeline as outlined in Figure 1: initial

[c]Increases in contraception averts maternal deaths, which are best captured when subtracting the deaths from the scaled-up scenario from the deaths in the baseline scenario. Using this approach for children however, results in an overestimate of deaths averted because it includes the prevention of deaths of children who were never born due to contraception increases. As such, using the "lives saved" estimates from LiST is preferable when examining impacts on children.

[d]Program implementation expenditures include all funding expended on training, equipment, supplies, travel, utilities, and other overheads, etc., for the implementation of each program area. Personnel costs were isolated from these other program expenditures due to the way in which they were captured and presented in the data provided by Breakthrough ACTION.

FIGURE 4 ILLUSTRATIVE EXAMPLE OF AGGREGATING HEALTH IMPACTS INTO DALYS AVERTED



costing phase (April 2018 to December 2019); midline costing phase (January 2020 to December 2021); and the endline costing phase (January 2022 to October 2022). Once expenditure data for each phase were received, they were evaluated and validated through direct communication with Breakthrough ACTION. Expenditure analyses for the initial and midline costing reports were each discussed with Breakthrough ACTION to agree on the approach and findings.

SBC program expenditures were aggregated across all three time periods. Since the radio program was delivered state-wide and the impacts are being assessed among the intervention areas, the mass media expenditures were adjusted by multiplying the total mass media expenditures to the percent of the population living in the community SBC program intervention wards in each state as compared to the total population. Malaria-only SBC expenditures in each state were also examined, using the same approach for allocating mass media expenditures.

Expenditures for personnel at site-level (the point of implementation) and above-site (Abuja and organizational headquarters) were aggregated, along with partner expenditures to arrive at a total expenditure for personnel for each of the study states. Program design expenditures were included as an important investment throughout the life of the project. Design expenditures were aggregated for each of the initial, midline, and endline costing phases. These were then allocated across the life of the project starting from the year the investment was first made, to the end year of the project in 2025.

In addition to SBC-related program and personnel expenditures, we included additional service delivery expenditures that could be associated with the desired changes in behavioral health outcomes. Using the LiST costing module, we estimated the potential change in total intervention service delivery expenditure based on the two modeled scenarios: scaled-up and limited scaled-up. These service delivery expenditures were then added to all other SBC-related expenditures to present an aggregated total.

Finally, all costs were adjusted to 2022 US dollars (US$) using the GDP deflator as published by the Federal Reserve Bank of St. Louis, on the FRED Economic Data website (**https://fred.stlouisfed.org/series/GDPDEF#**).

Calculating cost-effectiveness

Using the total costs and total impact described above, the incremental cost-effectiveness ratio (ICER) was calculated by examining the additional costs of integrated SBC relative to malaria-only SBC needed to achieve an additional DALY averted.[12] This was calculated by dividing the additional costs by the additional impacts:

$$\text{Incremental cost-effectiveness ratio (ICER)} = \frac{\text{Integrated costs} - \text{Malaria only costs}}{\text{Integrated DALYs averted} - \text{Malaria only DALYs averted}}$$

The resulting ICER is the cost per DALY averted for integrated SBC relative to malaria-only SBC. To determine if the cost per DALY averted falls within ranges considered cost-effective by the World Health Organization, the ICER is compared to both the national gross domestic product (GDP) per capita and the average GDP per capita across the three study states. According to World Health Organization's guidelines, health interventions with a cost per DALY averted that are less than one-times GDP per capita are considered "highly cost-effective" and those with a cost per DALY averted between one- and three-times GDP per capita are "cost-effective".[1]

For Nigeria, the most recent estimate for GDP per capita is $2,066 in 2021.[14] Because this study is conducted in three specific states in northern Nigeria with lower GDPs per capita than the national GDP per capita, an average of the three state-level GDP per capita values were also included as a regional threshold for cost-effectiveness.[e] To ensure comparability with the costs, the GDPs per capita were adjusted to 2022 US$; the resulting thresholds are shown in **Table 3**.

TABLE 3 THRESHOLDS FOR COST-EFFECTIVENESS

	THREE STATE AVERAGE	NATIONAL
Cost-effective	$2,580	$6,755
Highly cost-effective	$ 860	$2,252

A comparison of the ICER with the thresholds in Table 3 was used to determine whether the additional

[e]Kingmakers - State of States - GDP Size Ranking

investments needed for integrated SBC are cost-effective based on the health outcomes captured at baseline and endline in the BSS.

Further analyses were conducted to see what proportion of the overall impact from baseline to endline would need to be attributed to SBC differences for the additional investments in integrated SBC to be cost-effective. To estimate these proportions, the ICER was calculated keeping the costs constant but multiplying the total DALYs averted by each percentage point between 1 and 100 and compared to the thresholds.

RESULTS

Impact

Breakthrough ACTION-Nigeria's SBC programming aims to improve health behaviors and thus improve the health and wellbeing of the people in northern Nigeria. As such, positive impact in the key health behaviors would facilitate progress toward the Sustainable Development Goals by reducing maternal mortality and preventable deaths in newborns and children under five years.[15]

The number of lives saved based on the changes in behavior between the baseline and endline BSS in each state as modeled in LiST are shown in Table 4, disaggregated by reproductive, maternal, and child interventions. The number of lives saved in **Table 4** corresponds to Table 1, so that increases in coverage of outcomes generate positive lives saved and decreases in coverage result in lives lost (expressed as negative numbers). For the scaled-up scenario, the changes from baseline to endline yield a net of 967 lives saved in the integrated SBC states, and 555 lives lost in the malaria-only SBC state. When looking at the outcome-specific results, some of the biggest changes are from ITN coverage, resulting in a loss of 1,631 lives in the integrated SBC states where ITN coverage decreased from baseline to endline, respectively, and a gain of 403 lives in Zamfara. Antibiotic use for respiratory illness is another outcome where there are substantial gains and losses in life estimated, resulting in 1,590 lives saved in the integrated SBC states and a loss of 1,211 lives in the malaria-only SBC state. The change in the use of ORS and zinc for diarrhea from baseline to endline results in lives lost in a gain of 443 lives in the integrated SBC states and a loss of 762 in the malaria-only SBC state.

The limited scaled-up scenario uses only values for the behavioral health outcomes where there was a statistically significant difference in changes between an integrated SBC and malaria-only SBC state. These include changes in ITN ownership, changes in antibiotics for respiratory infections, ORS/zinc for diarrhea.[f] In this scenario, there is a net loss of 571 lives in the integrated SBC states due to the elimination of the non-statistically

[f]The difference-in-difference analyses found statistically significant ($p<0.05$) changes in ITN ownership when comparing both Kebbi and Sokoto states to Zamfara; however, only the Sokoto changes were statistically significant for changes in antibiotics for respiratory infections, ORS use, and zinc use.

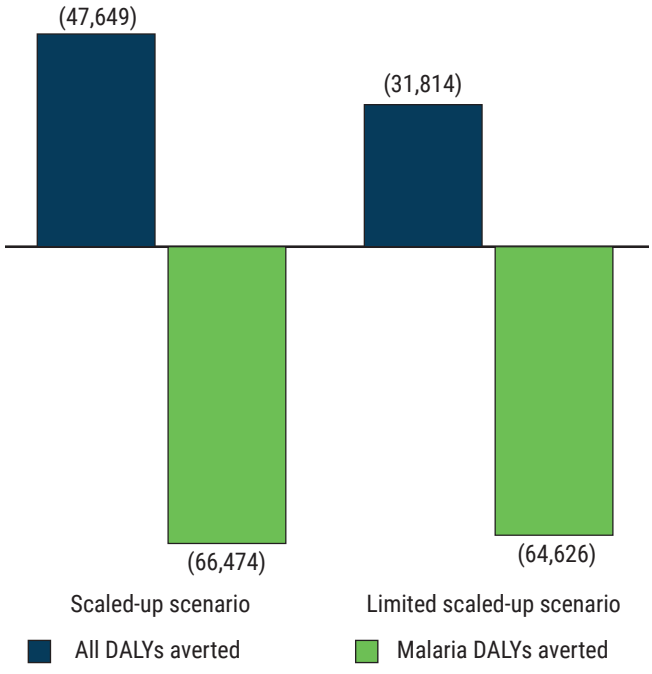
TABLE 4 LIVES SAVED FROM INTEGRATED SBC AND MALARIA-ONLY SBC SCENARIOS (2020–2022)

	SCALED-UP		LIMITED SCALED-UP	
	INTEGRATED	MALARIA-ONLY	INTEGRATED	MALARIA-ONLY
Maternal				
Pregnancy	23	15	0	0
Childbirth	75	101	0	0
Contraception	117	103	0	0
Subtotal	215	219	0	0
Child				
Prenatal care	140	44	0	0
ITN coverage	-1631	403	-1654	408
Childbirth	313	420	0	0
Breastfeeding	-265	-19	0	0
Vaccines (DPT and measles)	3	25	0	0
ACT use	159	326	0	0
ORS and zinc for diarrhea	443	-762	521	-768
Antibiotics for respiratory illness	1590	-1211	562	-1226
Subtotal	752	-774	-571	-1586

significant outcome variables. The malaria-only SBC state saw an increase in lives lost, resulting in 1,586 lives lost.

When converting the number of lives saved in the scaled-up scenarios to the additional DALYs averted in the integrated SBC states relative to the malaria-only SBC state, the integrated states yielded 47,605 more DALYs averted than the malaria-only state (**Figure 5**). The limited scaled-up scenario that considers just the statistically significant outcomes results in fewer DALYs averted, 31,814. Figure 5 also shows the number of malaria-specific DALYs averted in the integrated states compared to the malaria-only state, where the difference between the integrated and malaria-only states is negative because there were substantially more DALYs averted in the malaria-only state than in the two integrated states. The negative DALYs averted—or DALYs lost—was 66,474 for the scaled-up scenario and 64,626 for the limited scaled-up scenario.

FIGURE 5 ADDITIONAL DALYS AVERTED IN THE INTEGRATED SBC STATES COMPARED TO MALARIA-ONLY STATES (2020–2022)



Expenditures

The total expenditure for all SBC programming for the total evaluation period, by component, for the integrated and malaria-only program study states is shown in **Figures 6 and 7**.

FIGURE 6 EXPENDITURES FOR ALL SBC PROGRAMMING BY COMPONENT FOR INTEGRATED STUDY STATES

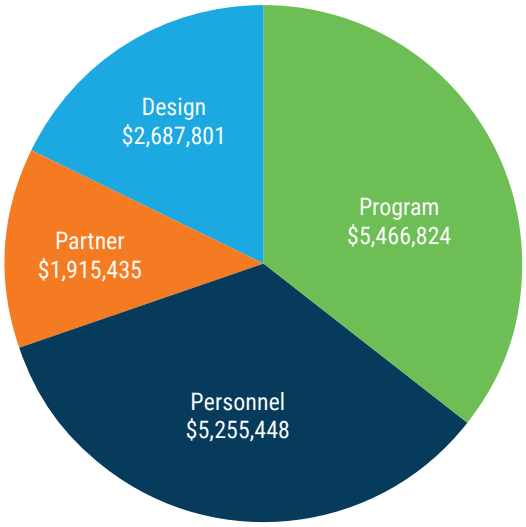
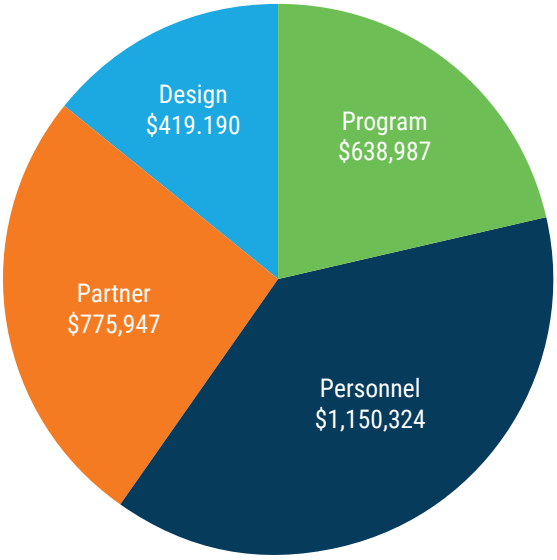


FIGURE 7 EXPENDITURES FOR ALL SBC PROGRAMMING BY COMPONENT FOR MALARIA-ONLY STUDY STATES



Over the total evaluation period, more than $18 million was spent in the study states. Looking at the individual study states, the integrated program in Kebbi had the largest expenditure over the total evaluation period at around $8.1 million. Sokoto's integrated program had the next largest total expenditure at just over $7.2 million, and Zamfara, with its stand-alone malaria program, had the lowest expenditure overall with just under $3 million.

Table 5 shows the total SBC expenditures and the expenditures per person in the intervention areas for each of the integrated and malaria-only study states. In

TABLE 5 EXPENDITURE PER PERSON REACHED FOR INTEGRATED AND MALARIA-ONLY SBC STUDY STATES

	INTEGRATED	MALARIA ONLY
Total expenditure all SBC	$15,325,508	$2,984,448
Total expenditure malaria SBC	$2,120,488	$2,112,597
Total population	10,757553	5,066,557
Target population	6,123,722	1,327,297
Target population as % of total population	56.3%	25.0%
Expenditure per person all SBC	$2.51	$2.25
Expenditure per person malaria SBC	$0.35	$1.59

total, the two study states implementing an integrated SBC program (Kebbi and Sokoto) expended over $15.3 million, of which, about 14% ($2.1 million) on average was allocated for malaria-focused SBC and the remaining 86% ($13.2 million) went to all other SBC programs. In the malaria-only study state (Zamfara), around $3 million was spent on all SBC with 71% ($2.1 million) of this being for malaria focused programming. The other 29% of expenditures were for TB and the Global Health Security Agenda (GHSA) and their associated personnel expenses as well as above-site costs. The expenditure per person for all SBC programs was $2.51 per person in integrated program areas, and $2.25 per person in the malaria-only program areas in Zamfara. The malaria-specific expenditures per person living in the integrated areas was $0.35 and $1.59 per person living in the malaria-only intervention areas.

To estimate the total cost of the SBC interventions, we calculated the additional service delivery costs using default values from the LiST costing module associated with the anticipated expanded coverage and then added them to the SBC expenditures in each state. The differences between the scaled-up scenarios and the baseline scenario were then used in the cost-effectiveness analysis. **Table 6** shows the effect of the additional service delivery costs when added to the malaria-only SBC costs and all other SBC costs for each of the three study states. Note that service delivery costs are negative in some instances due to a reduction in health services. More state-specific details on the SBC expenditures can be found in **Appendix C**.

Cost-effectiveness

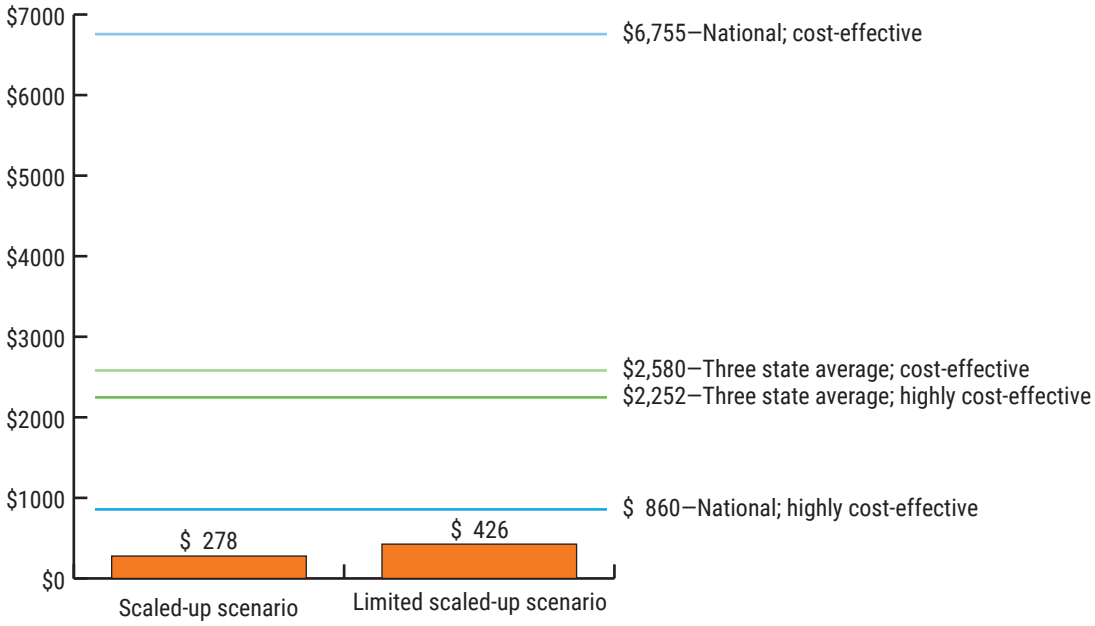
The impact and cost findings combine to calculate the ICER as the additional costs for integrated SBC in Kebbi and Sokoto relative to the additional costs for malaria-only programming in Zamfara divided by the additional impact for integrated SBC relative to the additional impact for malaria-only programming (see Equation above). **Figure 8** displays the ICER results compared to the national and three state average GDP per capita benchmarks. The scaled-up scenarios resulted in an ICER of $278 per DALY averted, while the scaled-up scenario yielded $426 per DALY averted, both of which are "highly cost-effective" using either the national GDP per capita threshold of $2,252 or the three-state average GDP per capita threshold of $860.

As described in the methods section, further analysis examined what proportion of the impact (additional DALYs averted in the integrated SBC areas) would need to be attributed to SBC, given other concurrent factors in each state that could be affecting the results during the study period, for the investments in integrated SBC to be considered cost-effective. **Appendix D** shows the cost

TABLE 6 ADDITIONAL SERVICE DELIVERY EXPENDITURES FOR INTEGRATED & MALARIA ONLY STATES FOR THE SCALED-UP AND LIMITED SCALED-UP SCENARIOS

	INTEGRATED		MALARIA ONLY	
	SCALED-UP SCENARIO	LIMITED SCALED-UP SCENARIO	SCALED-UP SCENARIO	LIMITED SCALED-UP SCENARIO
Total SBC expenditures	$15,325,508	$15,325,508	$2,984,448	$2,984,448
Added service delivery expenditures	$1,192,883	$339,859	$425,864	-$873,565
Total expenditures (2022)	$16,518,391	$15,665,366	$3,410,312	$2,110,883
Malaria SBC expenditures	$2,120,488	$2,120,488	$2,112,597	$2,112,597
Added service delivery expenditures	-$592,455	-$909,129	$425,864	$108,377
Total malaria expenditures (2022)	$1,528,033	$1,211,359	$2,538,461	$2,220,973

FIGURE 8 COST-EFFECTIVENESS RESULTS FOR ADDITIONAL COST PER DALY AVERTED FOR INTEGRATED SBC (2020–2022)



per DALY averted when multiplying the DALYs averted to each percentage point possible, from 1 to 100%, that could be attributed to the SBC activities.

Table 7 displays the comparison of those values to the four cost-effectiveness thresholds under the scaled-up and limited scaled-up scenarios. The most difficult threshold to reach is the three-state average highly cost-effective threshold at $860. Using this threshold in the scaled-up scenario, 33% of the impact seen in the BSS from baseline to endline would need to be due to SBC to be considered highly cost-effective. This increases to 50% using the limited scaled-up scenario. To be considered cost-effective, however, based on the three-state average threshold, only 11% of impact needs to be attributed to SBC in the scaled-up scenario or 17% in the limited scaled-up scenario. Reaching cost-effectiveness is easier using the national thresholds, where only 13% of impact needs to be attributed to SBC to be considered highly cost-effective in the scaled-up scenario, and 19% is required in the limited scaled-up scenario. Finally, using the national threshold for cost-effectiveness, only 5% of impact must be attributed to SBC under the scaled-up scenario, which increases to 7% in the limited scaled-up scenario.

TABLE 7 PROPORTION OF IMPACT ATTRIBUTED TO SBC NEEDED TO REACH COST-EFFECTIVENESS THRESHOLDS

	THREE STATE AVERAGE		NATIONAL	
	SCALED-UP SCENARIO	LIMITED SCALED-UP SCENARIO	SCALED-UP SCENARIO	LIMITED SCALED-UP SCENARIO
Cost-effective	11%	17%	5%	7%
Highly cost-effective	33%	50%	13%	19%

DISCUSSION

To answer the three primary research questions, we explored SBC program expenditures, the relative cost-effectiveness of integrated SBC, and how malaria-specific outcomes fared within integrated SBC.

Question 1—What are the total program expenditures incurred during the total study time period from program initiation (April 2018) through October 2022?

Among the study states, the total SBC expenditures in the integrated SBC states were higher when compared to the malaria-only SBC state, approximately US$15 million versus US$3 million. However, the expenditure per target population was similar across both approaches with integrated SBC at $2.53 per person and $2.36 per person in the malaria-only state. When SBC expenditures focused only on malaria were examined, $0.35 per person was spent in the integrated states vs. $1.67 in the malaria-only state.

Question 2—Are the expenditures required for an integrated SBC program, compared to malaria-only SBC program, a cost-effective investment?

The ICER calculation indicates that the investments for integrated SBC, as compared to malaria-only SBC, are highly cost-effective based on both the national and the three-state average thresholds. The primary driver of this result is the increased use of antibiotics for respiratory infections in the integrated states versus the drop in use in the malaria-only state, resulting in a net difference between the integrated and malaria-only programs of 2,801 lives in the scaled-up scenarios. Similarly, the changes in use patterns for ORS and zinc for childhood diarrhea result in a net difference of 1,205 lives in favor of integrated programming (scaled-up applications). Improving these health behaviors are priority objectives addressed in Breakthrough ACTION's SBC programming in the integrated states in both community activities (household visits, community dialogues, and community meetings) and mass media programming.

In addition to Breakthrough ACTION programming, however, there are other differences between the integrated and malaria-only states that could be contributing to these behavioral outcomes. Specifically, a recent report noted that Zamfara experienced antibiotic stockouts during the study period that likely contributed to the drop in antibiotic use for respiratory infections.[16] Additionally, the USAID-funded Integrated Health Program (IHP) is working in Kebbi and Sokoto on a complementary project to reduce maternal and child mortality by working at the health system and health facility level to improve the provision of essential primary care services.[17]

For these reasons, the results from Table 6 on the proportion of the impact that would need to be generated by SBC interventions to be considered cost-effective are informative. Based on the national benchmark, a modest 5% to 7% of the total impact seen from baseline to endline in the BSS needs to be attributed to the SBC interventions to be cost-effective and 13% to 19% to be highly cost-effective. The three-state average threshold increases the proportion required to be considered highly cost-effective but still only 11% (scaled-up) to 17% (limited scaled-up) of the total impact is needed to be considered cost-effective. These results indicate that while it is unlikely that the different approaches in SBC is the primary driver in the different outcomes between the integrated and malaria-only states, the SBC contributions from the intervention activities to improving antibiotic use for respiratory infections and ORS/zinc for childhood diarrhea are likely cost-effective.

Question 3—How do malaria-specific outcomes perform within an integrated SBC program compared to a malaria-only program?

In contrast to the overall findings, malaria-specific outcomes do not appear to be well served by integrated SBC. However, there are important caveats to consider when interpreting these results. The malaria-specific lives saved/lost calculated in the LiST model are primarily due to ITN ownership, where ownership increased in the malaria-only SBC state of Zamfara and decreased in the

integrated SBC states of Kebbi and Sokoto. These changes in ownership result in a net gain of 2,034 lives for the malaria-only SBC approach relative to the integrated SBC approach. This substantial impact likely has much more to do with the fact that an ITN distribution campaign was conducted in Zamfara during the study period and not in Kebbi and Sokoto, although an ITN campaign in Kebbi state coincided partly with the endline BSS.[g] SBC accompanying ITN distribution has been found to be effective in increasing the use of ITNs, but ownership itself is closely tied to distribution campaigns and steady declines are typically seen thereafter.[18]

For this reason, it would be very appealing to use the ITN use measures in Table 2 instead of the ITN ownership measures in Table 1. However, for reasons explained previously, the underlying modeling structure does not allow for that option. Still, it should be noted that if such a change were possible, it would not alter the overall conclusions that the malaria-only SBC state fared better in terms of malaria lives saved and DALYs averted due to ITN use since the improvements were much greater in the malaria-only areas. In contrast, if ITN distribution campaigns had fully occurred in the integrated SBC states during this time period, it is likely the ITN ownership results would be comparable across all three states like the other two malaria-related outcomes, IPTp use and ACT use. Although the changes from baseline to endline in the BSS were not statistically significant, the percentage of women receiving at least two doses of IPTp increased in all three states, with higher increases in the integrated states (14 and 7 percentage points) than in the malaria-only state (4 percentage points). ACT use dropped in Kebbi by 5 percentage points but increased in Sokoto and Zamfara by 9 and 8 percentage points, respectively, although these changes were also not statistically significant. Note that, since SBC expenditures are not allocated specifically to outcomes, it is not possible to calculate ICERs for these two specific outcomes, but instead the ICERs need to be calculated for SBC investments in malaria.

Limitations

As noted in the discussion above, the primary limitation of this study is that Zamfara does not appear to be a good comparator for Kebbi and Sokoto due to the stockouts of antibiotics in Zamfara, the IHP program presence in Kebbi and Sokoto, and the distribution campaign of ITNs in Zamfara only during the study period. In addition, as with all modeling exercises, the results are based on numerous inputs and assumptions. Among other things, the expenditure data for the initial evaluation period and those for both the midline and endline periods differed slightly in terms of form and content. While each of the reports presented rational estimations of cost, calculating these estimations required assumptions on the allocation of above-site costs and the distribution of personnel costs.

On the impact side, while the DALYs-averted metric used in this analysis does allow for comparison across different health areas, it does not fully capture the entire impact of the Breakthrough ACTION's integrated SBC program, which also influences social norms and attitudes as well as building local SBC capacity that may not have yet translated into measurable health behavior change during the study time period. Where there were observable changes, few were noted to be statistically significant. The LiST modeling also does not allow for the changes in the number of people living in the intervention areas over time, but rather takes the midpoint population as the best proxy for the program. Another clear limitation previously discussed is the use of the ITN ownership variable for this particular study due to the focus on malaria-related outcomes and the different results seen in terms of ownership and use.

Conclusions

This study is one of the first to examine the cost-effectiveness of integrated SBC. Overall, the findings indicate that even if only a relatively small proportion of the overall impact modeled is attributed to SBC, the SBC investments would be considered cost-effective. As such, these findings are promising, but not definitive given the challenges of using Zamfara as a comparator to the integrated states during this time period. Leveraging further Breakthrough ACTION work could potentially address some of the challenges in this analysis; future work should continue to explore the cost-effectiveness of integrated SBC programs.

[g] At the time of the endline BSS, ITN distribution had begun in Kebbi state.

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APPENDIX A

POPULATION DATA ON BREAKTHROUGH ACTION INTERVENTION COVERAGE

To estimate the population for the LiST applications, the proportion of the total state population living in the intervention areas at midline was used. **Table A1** details the 2020 population estimates for each Breakthrough ACTION intervention ward included in the analysis. Next, the percentage of the state population represented in the Breakthrough ACTION areas was applied to the 2022 population estimates in each state, as provided by the Spectrum models, which were previously validated under another program. **Table A2** details the population numbers included in the LiST applications.

TABLE A1 INTERVENTION STATES, LGAS, WARDS, AND 2020 POPULATION ESTIMATES

STATE	LGA	WARD	2020 POPULATION
Kebbi	Arewa	Bachaka	32,489
Kebbi	Arewa	Chibike	16,898
Kebbi	Arewa	Falde	9,479
Kebbi	Arewa	Feske/Jefeji	22,941
Kebbi	Arewa	Gorun Dikko	10,967
Kebbi	Arewa	Lema/Jan Tullu	37,961
Kebbi	Arewa	Sarka	22,513
Kebbi	Arewa	Bui	31,706
Kebbi	Arewa	Gumundai	27,811
Kebbi	Arewa	Kangiwa	28,270
Kebbi	Arewa	Yeldu	24,422
Kebbi	Bagudo	Bani Tsamiya	38,976
Kebbi	Bagudo	Lafagu Gante	24,836
Kebbi	Bagudo	Matsinkai Geza	18,995
Kebbi	Bagudo	Kende Kurgu	23,294
Kebbi	Bagudo	Zagga Kwasara	27,153
Kebbi	Bagudo	Kaoje Gwamba	65,501
Kebbi	Bagudo	Bagudo Tuga	37,220
Kebbi	Bagudo	Bahindi Khaliel	25,265
Kebbi	Bagudo	Illo Sabon Gari	28,801
Kebbi	Bagudo	Lolo Giris	40,749
Kebbi	Bagudo	Sharabi Kwanguwai	21,336
Kebbi	Birnin Kebbi	Gawasu Damana	16,228
Kebbi	Birnin Kebbi	Gulumbe	17,572
Kebbi	Birnin Kebbi	Kardi	34,877
Kebbi	Birnin Kebbi	Lagga Randali	15,716
Kebbi	Birnin Kebbi	Makera	19,743
Kebbi	Birnin Kebbi	Karyo	25,134
Kebbi	Birnin Kebbi	Asarara	18,345
Kebbi	Birnin Kebbi	Zauro	15,031
Kebbi	Birnin Kebbi	Ambursa	21,970
Kebbi	Birnin Kebbi	Dangaladima	37,023
Kebbi	Birnin Kebbi	Gwadangwaji	30,099
Kebbi	Birnin Kebbi	Kola Tarasa	19,141
Kebbi	Birnin Kebbi	Marafa	31,304
Kebbi	Birnin Kebbi	Nassarawa I	45,121
Kebbi	Birnin Kebbi	Nassarawa II	54,018
Kebbi	Fakai	Bangu	21,792
Kebbi	Fakai	Fakai Kukah	16,073
Kebbi	Fakai	Gulbin Kukah	15,475
Kebbi	Fakai	Kangi	15,780
Kebbi	Fakai	Marafa	19,460
Kebbi	Fakai	Penipeni	14,326
Kebbi	Fakai	Bajida	18,765
Kebbi	Fakai	Birnin Tudu	11,239
Kebbi	Fakai	Mahuta	21,091
Kebbi	Fakai	Maikende	20,843
Kebbi	Gwandu	Cheberu	28,048
Kebbi	Gwandu	Dalijan	27,298
Kebbi	Gwandu	Gwandu Marafa	21,048
Kebbi	Gwandu	Masama	20,949
Kebbi	Gwandu	Gulmare	23,413
Kebbi	Gwandu	Dodoru	20,044
Kebbi	Gwandu	Gwandu Dangaladima	20,660
Kebbi	Gwandu	Kambaza	17,440
Kebbi	Gwandu	Malisa	20,298

STATE	LGA	WARD	2020 POPULATION
Kebbi	Koko Besse	Dada Alelu	12,133
Kebbi	Koko Besse	Zaria	16,094
Kebbi	Koko Besse	Takware	21,048
Kebbi	Koko Besse	Damba Bakoshi	17,536
Kebbi	Koko Besse	Jadadi	14,711
Kebbi	Koko Besse	Koko Firchin	22,769
Kebbi	Koko Besse	Hirini Madacci	13,284
Kebbi	Koko Besse	Illela Sabon Gari	22,868
Kebbi	Koko Besse	Besse	19,867
Kebbi	Koko Besse	Dutsi Mari	25,000
Kebbi	Koko Besse	Koko Magaji	19,980
Kebbi	Koko Besse	Lani Shiba	17,720
Kebbi	Maiyama	Gidiga	23,266
Kebbi	Maiyama	Giwatazo	21,406
Kebbi	Maiyama	Kawara	25,182
Kebbi	Maiyama	Karaye	25,533
Kebbi	Maiyama	Andarai	23,570
Kebbi	Maiyama	Liba	23,475
Kebbi	Maiyama	Gubunkure	23,450
Kebbi	Maiyama	Maiyama	18,363
Kebbi	Maiyama	Mungadi	26,628
Kebbi	Maiyama	Sambawa Mayalo	24,594
Kebbi	Maiyama	Sarandosa	24,941
Kebbi	Wasagu/Danko	Dan Umaru	35,739
Kebbi	Wasagu/Danko	Gwanfi Kele	19,680
Kebbi	Wasagu/Danko	Kyanbu Kandu	27,705
Kebbi	Wasagu/Danko	Wasagu	36,719
Kebbi	Wasagu/Danko	Yalmo Shindy Wari	16,001
Kebbi	Wasagu/Danko	Ayu	25,305
Kebbi	Wasagu/Danko	Bena	45,410
Kebbi	Wasagu/Danko	Danko Maga	25,329
Kebbi	Wasagu/Danko	Kanya	52,483
Kebbi	Wasagu/Danko	Ribah Machika	44,885
Kebbi	Wasagu/Danko	Waje	67,229
Kebbi	Shanga	Dugu Tsoho	21,016
Kebbi	Shanga	Kawara	20,863
Kebbi	Shanga	Rafin Kirya	13,419
Kebbi	Shanga	Atuwo	15,905
Kebbi	Shanga	Yarbesse	11,746
Kebbi	Shanga	Gebbe	22,633
Kebbi	Shanga	Sakace	27,744
Kebbi	Shanga	Sawashi	18,508
Kebbi	Shanga	Shanga	16,484
Kebbi	Shanga	Takware	15,086
Kebbi	Suru	Aljannare	31,082
Kebbi	Suru	Bandan	22,470
Kebbi	Suru	Ginga	13,712
Kebbi	Suru	Dandane	16,120
Kebbi	Suru	Barbarejo	19,191
Kebbi	Suru	Kwaifa	14,533
Kebbi	Suru	Bakuwai	24,979
Kebbi	Suru	Dakin Gari	29,841
Kebbi	Suru	Dandiya Shema	8,536
Kebbi	Suru	Giro	9,723
Kebbi	Suru	Suru	32,784
Kebbi	Zuru	Daben Seme	18,080
Kebbi	Zuru	Zodi	15,215
Kebbi	Zuru	Manga Ushe	32,680
Kebbi	Zuru	Rikoto	33,017
Kebbi	Zuru	Senchi	21,294
Kebbi	Zuru	Bedi	26,085
Kebbi	Zuru	Dabai	22,187
Kebbi	Zuru	Isgogo Dago	22,758
Kebbi	Zuru	Rafin Zuru	31,352
Kebbi	Zuru	Tadurga	23,587
KEBBI		**TOTAL**	**2,950,235**
Sokoto	Binji	Jamali	13,074
Sokoto	Binji	Tudun Kose	11,352
Sokoto	Binji	Gawazai	14,233
Sokoto	Binji	Bunkari	16,757
Sokoto	Binji	Soro Gabas	16,354
Sokoto	Binji	Binji	33,823
Sokoto	Binji	Inname	10,233
Sokoto	Binji	Maikulki	17,910
Sokoto	Binji	Samama	12,175
Sokoto	Binji	Soron Yamma	15,479
Sokoto	Bodinga	Bagarawa	14,215
Sokoto	Bodinga	Bangi/Dabaga	33,334
Sokoto	Bodinga	Dingyadi	28,255
Sokoto	Bodinga	Sifawa Lukuyawa	17,118
Sokoto	Bodinga	Tulluwa	20,031
Sokoto	Bodinga	Badau	10,550
Sokoto	Bodinga	Bodinga	33,539
Sokoto	Bodinga	Danchadi	38,970
Sokoto	Bodinga	Kauramiyo-Mazan Gari	32,065
Sokoto	Bodinga	Kwacciyo Lalle	14,050
Sokoto	Bodinga	Takatuku	28,590

STATE	LGA	WARD	2020 POPULATION
Sokoto	Dange/Shuni	Bodai	32,365
Sokoto	Dange/Shuni	Dange	36,205
Sokoto	Dange/Shuni	Fajaladu	18,915
Sokoto	Dange/Shuni	Gere-Gajere	18,915
Sokoto	Dange/Shuni	Rikina	36,345
Sokoto	Dange/Shuni	Rudu/ Amanawa	36,205
Sokoto	Dange/Shuni	Ruggar Gidado	17,810
Sokoto	Dange/Shuni	Shuni	31,085
Sokoto	Dange/Shuni	Tsafanade S	16,670
Sokoto	Dange/Shuni	Tuntube Tsefe	65,555
Sokoto	Dange/Shuni	Wababe	26,820
Sokoto	Gada	Kadadi	27,433
Sokoto	Gada	Kiri	33,194
Sokoto	Gada	Kwarma	27,414
Sokoto	Gada	Gilbadi	34,965
Sokoto	Gada	Tsitse	22,642
Sokoto	Gada	Dukamaje	17,057
Sokoto	Gada	Gada	35,546
Sokoto	Gada	Kadassaka	24,260
Sokoto	Gada	Kaddi	24,839
Sokoto	Gada	Kaffe	9,794
Sokoto	Gada	Kyadawa/Holai	39,326
Sokoto	Gwadabawa	Asara	40,300
Sokoto	Gwadabawa	Atakwanyo	22,975
Sokoto	Gwadabawa	Chimmola	35,395
Sokoto	Gwadabawa	Gidan Kaya	24,945
Sokoto	Gwadabawa	Gigane	53,400
Sokoto	Gwadabawa	Gwadabawa	42,460
Sokoto	Gwadabawa	Huchi	16,995
Sokoto	Gwadabawa	Mamman Suka	32,470
Sokoto	Gwadabawa	Mammande	59,065
Sokoto	Gwadabawa	Salame	63,280
Sokoto	Gwadabawa	Tambagarka	11,211
Sokoto	Illela	Araba	20,935
Sokoto	Illela	Darna Sabon Gari	21,260
Sokoto	Illela	Garu	12,798
Sokoto	Illela	Rungumawar Gatti	17,674
Sokoto	Illela	Tozai	15,855
Sokoto	Illela	Darna Tsolawo	45,191
Sokoto	Illela	Gidan Hamma	73,535
Sokoto	Illela	Gidan Katta	26,060
Sokoto	Illela	Damba	72,623
Sokoto	Illela	Kalmalo	27,500
Sokoto	Illela	Illela	35,960

STATE	LGA	WARD	2020 POPULATION
Sokoto	Kebbe	Fakku	59,065
Sokoto	Kebbe	Girkau	32,325
Sokoto	Kebbe	Kebbe east	22,410
Sokoto	Kebbe	Kebbe west	18,790
Sokoto	Kebbe	Kuchi	31,635
Sokoto	Kebbe	Margai east	52,790
Sokoto	Kebbe	Margai west	19,892
Sokoto	Kebbe	Nasagudu	30,765
Sokoto	Kebbe	Sangi	25,150
Sokoto	Kebbe	Ungushi	19,690
Sokoto	Kware	Basansan	16,854
Sokoto	Kware	Durbawa	15,418
Sokoto	Kware	Gandu Modibbo	16,472
Sokoto	Kware	More Gidan Rugga	17,799
Sokoto	Kware	Sabon Birni	17,083
Sokoto	Kware	Bankanu	10,060
Sokoto	Kware	Hamma Ali	41,095
Sokoto	Kware	Kabanga	14,095
Sokoto	Kware	Kware	27,875
Sokoto	Kware	Tsaki-Walaka'e	26,363
Sokoto	Kware	Tunga-Mallamawa	22,834
Sokoto	Shagari	Dandin/Mahe	32,040
Sokoto	Shagari	Horo	17,227
Sokoto	Shagari	Kambama	20,144
Sokoto	Shagari	Jaredi	19,033
Sokoto	Shagari	Lambara	26,279
Sokoto	Shagari	Kajiji	26,685
Sokoto	Shagari	Mandera	11,576
Sokoto	Shagari	Sanyin Lawal	29,510
Sokoto	Shagari	Shagari	21,357
Sokoto	Shagari	Gangam	18,307
Sokoto	Wamakko	Arkilla/Gwiwa	43,415
Sokoto	Wamakko	Bado/Kasarawa	15,965
Sokoto	Wamakko	Dundaye/ Gumburawa	24,607
Sokoto	Wamakko	Gidan Bubu	22,770
Sokoto	Wamakko	Gidan Hamidu	19,450
Sokoto	Wamakko	Gumbi/Wajake	16,755
Sokoto	Wamakko	Gwamatse	32,345
Sokoto	Wamakko	Kalambaina/ Girafshi	27,400
Sokoto	Wamakko	Kammata	21,431
Sokoto	Wamakko	Kaurar Gedawa	25,870
Sokoto	Wamakko	Wamakko	25,870

STATE	LGA	WARD	2020 POPULATION
Sokoto	Wurno	Achida	20,257
Sokoto	Wurno	Kwasare Sissawa	23,198
Sokoto	Wurno	Tunga	15,983
Sokoto	Wurno	Dinawa	24,428
Sokoto	Wurno	Magarya	25,387
Sokoto	Wurno	Chacho/Marnona	25,387
Sokoto	Wurno	Dimbiso	24,428
Sokoto	Wurno	Alkamu	20,390
Sokoto	Wurno	Kwargaba	14,911
Sokoto	Wurno	Lahodu	27,790
Sokoto	Wurno	Marafa	13,803
SOKOTO		**TOTAL**	**3,109,812**
Zamfara	Bakura	Dankado	34,547
Zamfara	Bakura	Yargida	17,818
Zamfara	Bakura	Yarkofoji	39,358
Zamfara	Bakura	Rini	27,500
Zamfara	Bakura	Danmannau	32,050
Zamfara	Bukkuyum	Bukkuyum	30,074
Zamfara	Bukkuyum	Kyaram	60,802
Zamfara	Bukkuyum	Nasarawa	37,125
Zamfara	Bukkuyum	Yashi	18,704
Zamfara	Bukkuyum	Zarumai	28,292
Zamfara	Bukkuyum	Zauma	18,243
Zamfara	Gunmi	Magaji	54,839
Zamfara	Gunmi	Gayari	29,614
Zamfara	Gunmi	Gyalange	27,830
Zamfara	Gunmi	Birnin Magaji	23,220
Zamfara	Gunmi	Birnin Tudu	53,952
Zamfara	Gunmi	Falale	16,071
Zamfara	Gusau	Galadima	114,078
Zamfara	Gusau	Madawaki	48,781
Zamfara	Gusau	Mayana	78,542
Zamfara	Gusau	Sabon Gari	45,049
Zamfara	Gusau	Tudun Wada	150,936
Zamfara	Gusau	Wanke	48,385
Zamfara	Maradun	Dosara Birnin Kaya	40,209
Zamfara	Maradun	Faru Magami	70,316
Zamfara	Maradun	Goran Namaye	23,998
Zamfara	Maradun	Janbako	26,620
Zamfara	Maradun	Maradun North	31,544
Zamfara	Maradun	Maradun South	36,093
ZAMFARA		**TOTAL**	**1,264,590**

TABLE A2 AGE-SPECIFIC POPULATION ESTIMATES FOR THE LIST APPLICATIONS

	KEBBI		SOKOTO		ZAMFARA	
	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE
0 to 4	281,004	285,746	291,264	292,463	122,559	124,188
5 to 9	231,101	237,797	258,419	262,528	118,316	120,788
10 to 14	197,353	200,058	229,952	230,709	91,058	91,445
15 to 19	177,484	172,783	173,936	166,700	74,482	71,705
20 to 24	133,795	125,339	132,307	120,015	56,079	51,898
25 to 29	96,673	91,016	95,838	86,379	40,358	37,754
30 to 34	75,378	89,296	73,279	85,985	31,059	37,782
35 to 39	60,616	92,167	57,323	90,424	24,590	39,561
40 to 44	52,975	71,159	50,497	71,512	21,987	30,393
45 to 49	47,282	49,704	45,887	51,804	20,221	21,009
50 to 54	38,219	36,887	38,075	38,543	16,292	15,421
55 to 59	29,593	25,942	30,572	26,863	12,491	10,648
60 to 64	22,412	18,405	23,671	19,379	9,534	7,572
65 to 69	15,865	12,450	17,106	13,415	6,821	5,176
70 to 74	10,513	8,261	11,282	8,768	4,456	3,333
75 to 79	6,094	5,021	6,410	5,159	2,519	1,933
80+	4,938	4,383	5,083	4,469	2,117	1,751
TOTAL	**1,481,293**	**1,526,413**	**1,540,900**	**1,575,116**	**654,939**	**672,359**

APPENDIX B
STATE-SPECIFIC RESULTS

While the primary objective of the cost-effectiveness analysis is to compare the results from the integrated states (Kebbi and Sokoto) to the malaria-only state (Zamfara), there are some additional interesting patterns to examine when looking at the individual state results. Using the scaled-up scenarios, the number of lives saved in each state is shown in **Table B1**. As discussed in the overall report, the are two primary drivers of the cost-effectiveness results: 1) the loss of lives in the integrated states due to ITN coverage compared to gains in Zamfara and 2) the loss of lives in Zamfara due to reduced use of antibiotics for respiratory infections compared to gains in the integrated states. These results do not change when looking state-specific results, however, there are some interesting differences between Kebbi and Sokoto to consider.

TABLE B1 NUMBER OF LIVES SAVED USING THE SCALED-UP SCENARIOS FROM BASELINE (2019) TO ENDLINE (2022)

	INTEGRATED		MALARIA-ONLY
	KEBBI	SOKOTO	ZAMFARA
Maternal			
Pregnancy	14	9	15
Childbirth	75	0	101
Contraception	180	-63	103
TOTAL maternal lives saved	**269**	**-54**	**219**
Child			
Prenatal care	82	58	44
ITN coverage	-1006	-625	403
Childbirth	317	-4	420
Breastfeeding	-78	-187	-19
Vaccines (DPT and measles)	22	-19	25
ACT use	-270	429	326
ORS and zinc for diarrhea	-93	536	-726
Antibiotics for respiratory illness	1014	576	-1211
TOTAL child lives saved	**-12**	**764**	**-774**
TOTAL maternal & child lives saved	**257**	**710**	**-555**

First, Kebbi shows a net 269 maternal lives saved in mothers, primarily due to improvements in modern contraceptive use and more facility-based births whereas Sokoto has a net loss of 54 lives. Zamfara results were more in line with Kebbi, seeing an overall gain of 219 lives due to improvements in contraception and facility-based birth. Facility-based birth results are also reflected among the child lives saved, showing 317 lives saved for Kebbi and 420 for Zamfara, but a loss of 4 lives in Sokoto.

In contrast, Sokoto performed better for other outcomes, with many lives saved due to ACT use and ORS and zinc in Sokoto (429 and 536, respectively) but losses in Kebbi (-270, and -93, respectively). It is unclear to what extent these differences in commodities use are being driven by differential SBC successes in each state or rather external supply chain issues or program disruptions.

On the cost side, **Table B2** shows a detailed breakdown of the SBC expenditures per person living in the Breakthrough ACTION community SBC intervention areas for each of the study states. Among the study states, the highest expenditures occurred in the two integrated programs, Kebbi (US$8.1 million) and Sokoto (US$7.2 million), while the stand-alone malaria SBC program in Zamfara spent approximately US$3 million. When adding the additional service delivery costs associated with improvements in health behaviors, the total program costs were $9.2m for Kebbi, $7.3m for Sokoto, and $3.4m for Zamfara.

When combining the impact and costs to examine cost-effectiveness, it is possible to make two comparisons: 1) Kebbi vs. Zamfara and 2) Sokoto vs. Zamfara. **Box B1**

TABLE B2 ALL SBC EXPENDITURE PER PERSON REACHED IN ALL THREE STUDY STATES

	KEBBI $	SOKOTO $	ZAMFARA $
SBC expenditures	8,117,297	7,208,211	2,984,448
Additional service delivery costs	1,103,633	89.251	425,864
TOTAL	**9,220,929**	**7,297,462**	**3,410,312**

shows the two separate cost per DALY averted estimates comparing the integrated state to the malaria-only state. Both results are far below the thresholds to be deemed highly cost-effective, using either the national threshold of $2,066 or the two-state average thresholds of $767 for Kebbi/Zamfara and $980 for Sokoto/Zamfara. For the Kebbi vs. Zamfara comparison, the cost per DALY averted is $229.82, while the cost per DALY averted is even lower in the Sokoto vs. Zamfara comparison at $96.63.

Interestingly, both estimates are less than what is found when we combined Kebbi and Sokoto, which generates a cost per DALY averted of $278. Due to the differences-in-differences approach, some of the gains in one state are cancelled out by the losses in another and thus the overall results are more favorable using a single integrated state as a comparison.

Still, the primary conclusions, as well as study limitations, remain the same whether examining the relative cost-effectiveness by state or analyzing them together as the "integrated program", as originally proposed. Future work in this area can continue to explore these dynamics in cost-effectiveness studies.

BOX B1 COST PER DALY AVERTED FOR INTEGRATED VS. MALARIA-ONLY STATES

KEBBI VS. ZAMFARA	
Maternal DALYs averted (Kebbi - Zamfara)	1,419
Child DALYs averted (Kebbi - Zamfara)	23,864
Additional impact for Kebbi	25,283
Additional costs for Kebbi	$ 5,810,618.00
ICER = (Additional cost/Additional impact)	**$ 229.82**

SOKOTO VS. ZAMFARA	
Maternal DALYs averted (Sokoto - Zamfara)	(7,881)
Child DALYs averted (Sokoto - Zamfara)	48,110
Additional impact for Sokoto	40,229
Additional costs for Sokoto	$ 3,887,150.00
ICER = (Additional cost/Additional impact)	**$ 96.63**

APPENDIX C
FURTHER SBC EXPENDITURES DETAILS

SBC program implementation and personnel expenditure data were provided by Breakthrough ACTION for the three costing phases of the evaluation timeline as outlined in Figure 1: initial costing phase (April 2018 to December 2019); midline costing phase (January 2020 to December 2021); and the endline costing phase (January 2022 to October 2022).

To calculate total SBC expenditures for each phase, we extracted all programmatic expenditures for each of the study states except for mass media. Program expenditures are comprised of all funding expended on the implementation of each program area including direct costs such as those for personnel, training, consulting services, supplies, travel, and indirect costs such as equipment and furniture, vehicles, maintenance, rent, utilities, management/oversight, and other overheads. Given the that the radio programming was conducted statewide while the cost-effectiveness analysis is focused on the Breakthrough RESEARCH intervention wards, we assessed a proportion of mass media expenditures based on the population living in the intervention areas for the study relative to the population of the entire state (Kebbi: 60.1%; Sokoto: 53.1%; Zamfara: 25%). For example, in Kebbi, 60.1% of all expenditure on mass media programs were allocated based on the Breakthrough ACTION intervention wards for community SBC. The same principle was used for mass media expenditure in Sokoto and Zamfara. These state proportions of mass media expenditure were then added to all other SBC expenditures by state, resulting in total program expenditures by state.

A similar approach was used to determine malaria-only expenditures for each state. The SBC program expenditures focused on malaria for each of the study states were extracted from the expenditure data. Expenditures for the mass media component were treated in the same way as mass media for total SBC expenditures, i.e., using the proportion of the intervention area population to the population of the overall state to determine the share of mass media costs to apply in each state. These were then added to all other malaria SBC costs to arrive at malaria-only program costs by state.

Personnel expenditures for site-level and above-site (Abuja and organizational headquarters) and partners for each study state were extracted from the data for each costing period. For the initial reporting period (April 2018–December 2019) personnel expenditures are documented in the initial costing report.[6] Personnel expenditures for the midline and endline costing periods were estimated based on the proportions of total personnel expenditures borne by each state as provided in the Breakthrough ACTION expenditure data. The total site level and above-site level personnel and partner expenditures, for each state were added to the total SBC program implementation expenditures, to arrive at total program and personnel expenditures by state for each costing period. To determine the proportion of personnel and partner expenditures for the malaria-only programming in each of the study states, it was first determined what proportion of total program implementation expenditures was made up of malaria-only programming. This proportion was then used to allocate a percentage of total personnel and partner expenditures per state to malaria-only programming for each period. These expenditures were then added to the malaria-only program implementation expenditures to provide an estimate of total malaria-only program and personnel expenditures by state.

To add program design expenditures to the total expenditures for each study state, we extracted what was spent on program design in each of the years of the project. Program design expenditures were largely frontloaded, constituting a significant investment in the initial costing period, but then declining in the subsequent midline and endline periods. Expenditures made on program design have an impact over the lifetime of the project (anticipated end in 2025). Therefore, design expenditures made during the initial costing period were spread from 2018 through 2025. Similarly, design expenditures made over the midline and endline costing periods were spread from 2020 and 2022, respectively, to the end of the project. The investment

made in program design was then added to the total SBC program and personnel expenditures already calculated for each of the study states. To estimate the design cost for the malaria-only program, the same approach used to derive personnel and partner costs was employed. Using the proportion of total program costs attributable to malaria-only programming, we allocated a percentage of total design costs per state to malaria-only programming for each period.

In addition to the SBC expenditures, there are service delivery costs associated with changes in the behavioral health outcomes. For example, increases in modern contraceptive prevalence will result in additional commodity costs. LiST contains a costing module with default values that estimate the total intervention costs associated with health behavior outcomes modeled in the scenarios.[19] For each scenario, the total intervention costs relevant to the included health behavior outcomes were examined and the difference between the scaled-up scenarios and the limited scaled-up scenario were used to calculate the changes in service delivery costs associated with the changes in the outcome variables. These changes were added to the SBC expenditures to generate the total costs for each application.

All expenditures on COVID-19, such as those for advocacy, community SBC, capacity strengthening, mass media, and operational costs, among others, were excluded from our analysis.

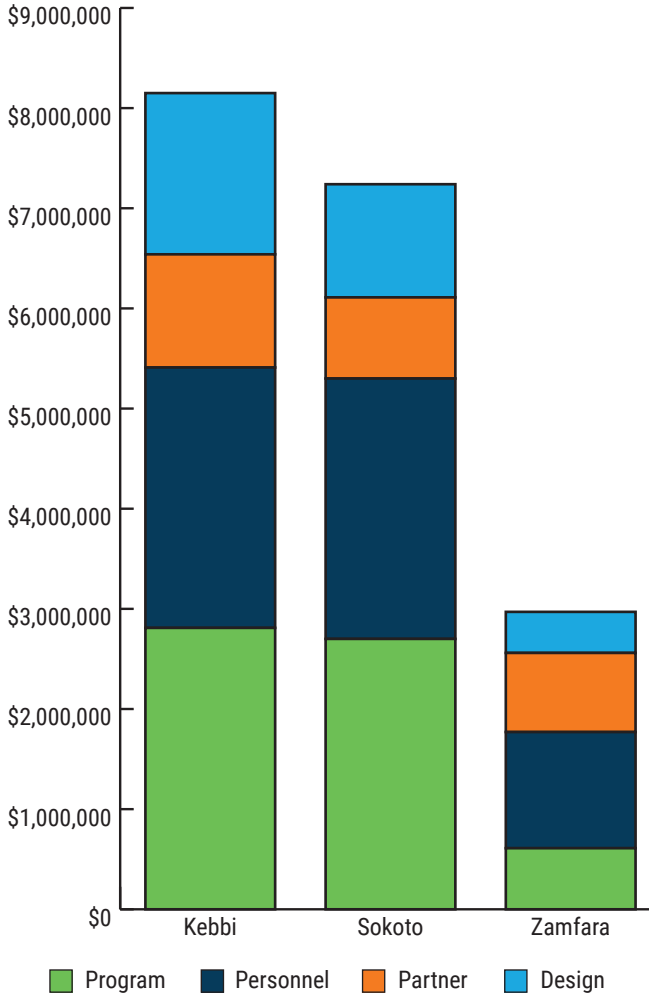
Finally, all costs were adjusted to 2022 US$ using the GDP deflator as published by the Federal Reserve Bank of St. Louis, on the FRED Economic Data website (**https://fred.stlouisfed.org/series/GDPDEF#**).

Expenditure Analysis Results

The total cost for all SBC programming for the three evaluation periods, by component, in the three study states is shown in **Figure C1**.

Of the states included in the study, Kebbi had the highest expenditures over the three evaluation periods and, with only a stand-alone malaria program, Zamfara had the lowest expenditures overall. Program implementation expenditures as a proportion of total expenditures in each state was fairly consistent, making up 34% and 37% in Kebbi and Sokoto respectively, and around 21% in Zamfara. Interestingly, personnel

FIGURE C1 EXPENDITURES FOR ALL SBC PROGRAMMING BY STATE AND COMPONENT



expenditures were higher in Zamfara (39%) compared with either Kebbi (33%) or Sokoto (36%). Similarly, partner expenditures, which include both personnel and programmatic expenses, in Zamfara were 26% of total expenditures, which was significantly higher than in Kebbi, where partner expenditures were 14% of total costs or in Sokoto, where they were only 11%. Design expenditures were highest in Kebbi, comprising 20% of total expenditures, declining to only 15% of total costs in Sokoto and 14% in Zamfara.

Figure C2 displays malaria-only expenditures for each of the three study states disaggregated by cost component. Zamfara, with its stand-alone malaria program, had the highest expenditures for malaria-only SBC over the three evaluation periods; 1.5 times more than Kebbi and nearly three times more than Sokoto. Expenditures on design for all three states were very similar, ranging

FIGURE C2 EXPENDITURES FOR MALARIA-ONLY SBC PROGRAMMING BY STATE AND COMPONENT

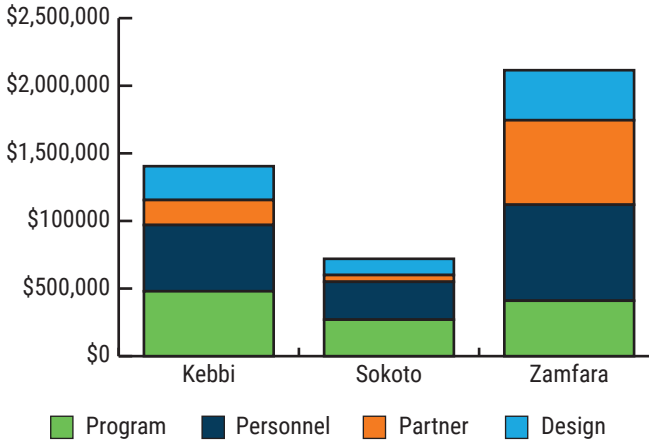
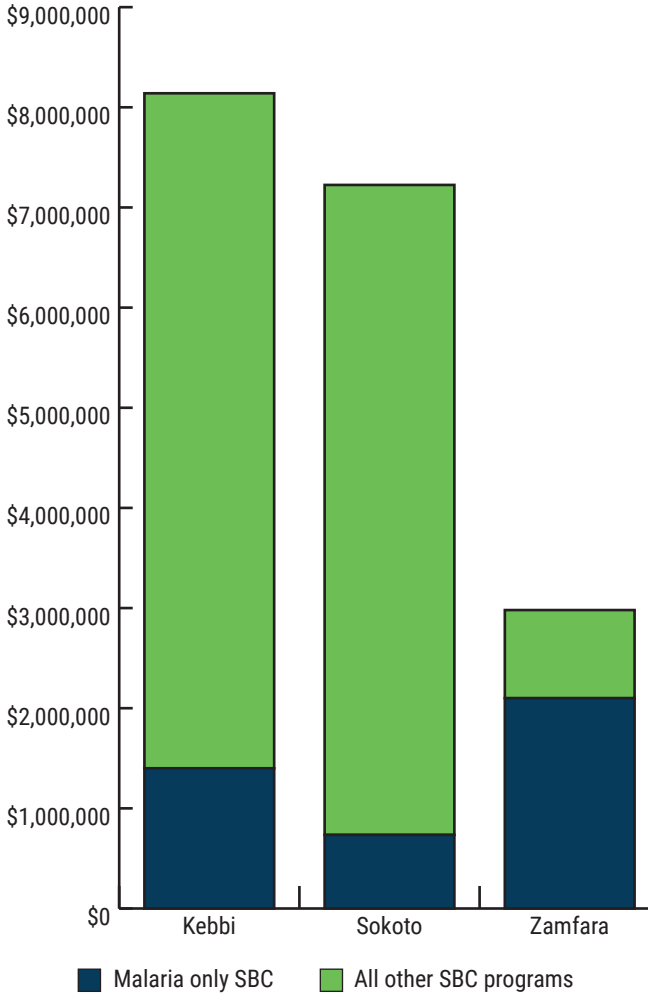


FIGURE C3 PROPORTION OF ALL EXPENDITURE FOR MALARIA-ONLY AND ALL OTHER SBC PROGRAMMING BY STATE



from 16% in Sokoto to 18% in Kebbi. Of the total malaria SBC expenditures, the allocation of the expenditures varied by state. In Sokoto only 7% of total malaria SBC expenditures were expended by partners, which increased to 13% in Kebbi and to over 30% in Zamfara. All other personnel costs consumed about a third of total expenditures in each of the three study states.

Figure C3 examines the proportion of overall expenditures for malaria-only SBC programming versus all other SBC programming in the two states with integrated programs (Kebbi and Sokoto), and the stand-alone malaria program in Zamfara. The integrated program in Kebbi expended 83% of all resources on all other SBC programs with 17% going to malaria SBC. Sokoto was more skewed with just over 90% of all expenditure going towards all other SBC programs and only 10% going to malaria programs. In Zamfara there were only a few program implementation expenditures that were not malaria-related, such as small interventions for TB and GHSA. The bulk of all other non-malaria expenditures were program design and above-site personnel costs.

APPENDIX D

EXAMINING ICER WITH VARYING LEVELS OF IMPACT ATTRIBUTION

PERCENT IMPACT ATTRIBUTED TO SBC	COST PER DALY AVERTED	
	SCALED-UP	LIMITED
1%	$ 27,802	$ 42,605
2%	$ 13,901	$ 21,303
3%	$ 9,267	$ 14,202
4%	$ 6,951	$ 10,651
5%	$ 5,560	$ 8,521
6%	$ 4,634	$ 7,101
7%	$ 3,972	$ 6,086
8%	$ 3,475	$ 5,326
9%	$ 3,089	$ 4,734
10%	$ 2,780	$ 4,261
11%	$ 2,527	$ 3,873
12%	$ 2,317	$ 3,550
13%	$ 2,139	$ 3,277
14%	$ 1,986	$ 3,043
15%	$ 1,853	$ 2,840
16%	$ 1,738	$ 2,663
17%	$ 1,635	$ 2,506
18%	$ 1,545	$ 2,367
19%	$ 1,463	$ 2,242
20%	$ 1,390	$ 2,130
21%	$ 1,324	$ 2,029
22%	$ 1,264	$ 1,937
23%	$ 1,209	$ 1,852
24%	$ 1,158	$ 1,775
25%	$ 1,112	$ 1,704
26%	$ 1,069	$ 1,639
27%	$ 1,030	$ 1,578
28%	$ 993	$ 1,522
29%	$ 959	$ 1,469
30%	$ 927	$ 1,420
31%	$ 897	$ 1,374
32%	$ 869	$ 1,331
33%	$ 842	$ 1,291
34%	$ 818	$ 1,253
35%	$ 794	$ 1,217
36%	$ 772	$ 1,183
37%	$ 751	$ 1,151
38%	$ 732	$ 1,121

PERCENT IMPACT ATTRIBUTED TO SBC	COST PER DALY AVERTED	
	SCALED-UP	LIMITED
39%	$ 713	$ 1,092
40%	$ 695	$ 1,065
41%	$ 678	$ 1,039
42%	$ 662	$ 1,014
43%	$ 647	$ 991
44%	$ 632	$ 968
45%	$ 618	$ 947
46%	$ 604	$ 926
47%	$ 592	$ 906
48%	$ 579	$ 888
49%	$ 567	$ 869
50%	$ 556	$ 852
51%	$ 545	$ 835
52%	$ 535	$ 819
53%	$ 525	$ 804
54%	$ 515	$ 789
55%	$ 505	$ 775
56%	$ 496	$ 761
57%	$ 488	$ 747
58%	$ 479	$ 735
59%	$ 471	$ 722
60%	$ 463	$ 710
61%	$ 456	$ 698
62%	$ 448	$ 687
63%	$ 441	$ 676
64%	$ 434	$ 666
65%	$ 428	$ 655
66%	$ 421	$ 646
67%	$ 415	$ 636
68%	$ 409	$ 627
69%	$ 403	$ 617
70%	$ 397	$ 609
71%	$ 392	$ 600
72%	$ 386	$ 592
73%	$ 381	$ 584
74%	$ 376	$ 576
75%	$ 371	$ 568
76%	$ 366	$ 561

PERCENT IMPACT ATTRIBUTED TO SBC	COST PER DALY AVERTED	
	SCALED-UP	LIMITED
77%	$ 361	$ 553
78%	$ 356	$ 546
79%	$ 352	$ 539
80%	$ 348	$ 533
81%	$ 343	$ 526
82%	$ 339	$ 520
83%	$ 335	$ 513
84%	$ 331	$ 507
85%	$ 327	$ 501
86%	$ 323	$ 495
87%	$ 320	$ 490
88%	$ 316	$ 484
89%	$ 312	$ 479
90%	$ 309	$ 473
91%	$ 306	$ 468
92%	$ 302	$ 463
93%	$ 299	$ 458
94%	$ 296	$ 453
95%	$ 293	$ 448
96%	$ 290	$ 444
97%	$ 287	$ 439
98%	$ 284	$ 435
99%	$ 281	$ 430
100%	$ 278	$ 426

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