Final Report

A360 Cost-Effectiveness Analysis

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Disclaimer

The views expressed in this report are those of the evaluators. They do not represent those of any of the individuals and organisations referred to in the report.

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List of Acronyms

A360	Adolescents 360
BMGF	Bill & Melinda Gates Foundation
CI	Confidence interval
CIFF	Children’s Investment Fund Foundation
DALY	Disability-adjusted life year
GDP	Gross domestic product
HEW	Health extension worker
LGA	Local Government Area, Nigeria
mCPR	Modern contraceptive prevalence rate
MMA	Matasa Matan Arewa
PSI	Population Services International
SFH	Society for Family Health, Nigeria

Executive Summary

Background and Objective

This document reports results from the cost-effectiveness analysis of the Population Services International (PSI)-led, BMGF and CIFF-funded girl-centred approach to contraceptive programming, Adolescents 360 (A360). A360 designed and operated four interventions in three countries: Smart Start in Ethiopia, Matasa Matan Arewa (MMA) in Northern Nigeria, 9ja Girls in Southern Nigeria, and Kuwa Mjanja in Tanzania. For each intervention, the cost-effectiveness analysis focused on a subset of program geographies, referred to as the "study geographies."

The main goal of A360 was to increase use of modern contraception among girls 15-19 years old. The project came about partly in response to several decades of disappointing results from adolescent-focused contraceptive programs in low- and middle-income countries. The backers of A360 believed that poor intervention design was a big reason for this history of ineffective programming.

The A360 approach encompassed a new, multidisciplinary design process and the resulting interventions. Intensive and iterative design activities took place in 2016-17, combining expertise in human-centred design with social marketing, developmental neuroscience, sociocultural anthropology, public health, and youth engagement. For A360, PSI, an international organization with years of experience in design and implementation of contraceptive programs, drew on highly-specialized outside expertise to carry out the activities of human-centred design, a methodology that the global health field has only recently begun to adopt. A360 proponents believed the emphasis on human-centred design, combined with the other disciplines, would better take into account the unique needs of adolescents, and the social, cultural, religious and economic forces that underlie their access to and choices about contraception, and produce more effective interventions.

The resulting interventions were implemented from 2018-2020. While sharing the same goal, the A360 interventions differed in focus population. The interventions in Ethiopia and Northern Nigeria focused on serving married girls; in Southern Nigeria unmarried girls; in Tanzania, both married and unmarried girls. The interventions, while tailored to local contexts, shared components that included community engagement, counselling, life skills, and clinical contraceptive services. The A360 consortium of nongovernmental organizations played a strong managerial and technical assistance role during implementation of interventions while relying mainly on existing government infrastructure, medical supplies, and personnel for activities at service sites. Community volunteers also had important roles.

A cost-effectiveness analysis requires a comparator approach, and this study defined the comparator for A360 as the status quo for design and implementation. For design, this meant PSI's DELTA design methodology, the standard used at the time A360 initiated. Compared with A360, DELTA took less time overall, required fewer international trips, had much less in-depth pretesting and prototyping, and did not use designers from outside PSI. The study defined the intervention comparator as the existing contraceptive programming available to adolescents in the A360 geographies.

While the expectation beforehand was that the A360 design process would be costlier than the comparator DELTA process, the extent to which implementation costs would differ between A360 and its comparator was unknown. Nonetheless, A360 proponents believed that expected higher design costs would be offset by better-designed interventions that would improve on the limited success of previous adolescent programs.

Whether this was true, that is, assessing whether A360 was cost-effective in relation to comparator approaches, was the main aim of this study. The results should help expand the evidence base on the design and implementation of adolescent sexual and reproductive health programs.

Methods

The main analytic aim of the study was to estimate incremental cost-effectiveness ratios for the study geographies. Incremental costs were the costs of A360 design and implementation minus the comparator cost. Costs of A360 design and implementation were collected from 2016-2020 combining top-down costing drawing on PSI and partner financial systems with multiple rounds of bottom-up costing from surveys, interviews, and site visits. A360 costs included the costs of PSI and its partners, the government, and community volunteers, and excluded client costs. The comparator cost included the cost of DELTA, and the cost to keep contraceptive prevalence constant in the study geographies. Costs of DELTA were collected in 2017 through interviews and document review. Comparator implementation costs were modelled combining measured contraceptive prevalence rates with the yearly cost per adolescent family planning user from Guttmacher Institute's Adding It Up 2019 report. The comparator cost is the cost to maintain the status quo, defined as the cost to maintain baseline contraceptive prevalence among adolescents. Incremental effectiveness was measured in disability-adjusted life-years (DALYs) averted, calculated from the results of representative household surveys conducted as part of the A360 external evaluation that estimated change in modern contraceptive prevalence between baseline and endline, over about 3 years. One-way and multiway sensitivity analyses generated plausible ranges for incremental costs. Sensitivity analysis around effectiveness took into account the 95% confidence intervals for measured change in modern contraceptive use. Probabilistic sensitivity analysis incorporated uncertainty ranges for cost and effectiveness in a Monte Carlo simulation using 10,000 iterations.

Results

Design costs. A360 spent $8.1 million to design the four interventions. After splitting these costs by country, amortizing these costs over a five-year useful life, and prorating costs based on the number of geographies where A360 was implemented and the duration of each intervention, A360 design costs for the study geographies totalled $123,724 for Ethiopia, $85,603 for Northern Nigeria, $46,643 for Southern Nigeria, and $17,024 for Tanzania. These were 7 to 9 times the cost of the comparator DELTA process. After subtracting DELTA from A360 costs, incremental design costs in the study geographies were $107,684 for Ethiopia, $73,262 for Northern Nigeria, $39,919 for Southern Nigeria, and $15,164 for in Tanzania.

Implementation costs. A360 implementation costs for the study geographies were $964,987 in Ethiopia, $423,000 in Northern Nigeria, $550,679 in Southern Nigeria, and $233,234 in Tanzania[1]. Comparator implementation costs were much lower in Ethiopia ($102,003), Northern Nigeria ($11,361), and Southern Nigeria ($77,378). Comparator costs were more similar to A360 in Tanzania ($127,920). After subtracting comparator from A360 costs, incremental implementation costs were $862,938 in Ethiopia, $411,638 in Northern Nigeria, $473,302 in Southern Nigeria, and $105,314 in in Tanzania.

Total costs. Summing incremental design and implementation costs produced a total incremental cost for the study geographies of $970,667 for Ethiopia, $484,900 for Northern Nigeria, $513,220 for Southern Nigeria, and $120,479 for Tanzania.

Effectiveness. The absolute change in the modern contraceptive prevalence rate attributable to A360 was 5.1% points in Ethiopia;[2] -0.6% points in Northern Nigeria;[3] 3.6% points in Southern Nigeria;[4] and -9.0%

[1] Cost figures in 2020 constant dollars. Figures vary slightly from costs shown in the Implementation Cost Reports for Ethiopia and Nigeria due to revaluing costs in constant 2020 dollars. Nigeria costs were also updated to reflect using international standards for commodity costs rather than data collected locally on Government commodity costs.

[2] (95% confidence interval [CI]: 0.7% to 9.5%; p-value: 0.03)

[3] (95%CI: -3.8% to 3.4%; p-value: 0.74)

[4] (95%CI: -3.6% to 11.6%; p-value = 0.34)

points in Tanzania.[5] These mCPR changes translated to 31 DALYs averted in Ethiopia, 4 in Northern Nigeria, 17 in Southern Nigeria, and 5 in Tanzania. Despite declines in modern contraceptive prevalence in Northern Nigeria and Tanzania, DALY impacts were positive due to increases in the number of eligible adolescents that result in positive additional users over the life of the project.

Incremental cost-effectiveness ratio. Combing incremental costs with incremental effectiveness, produced an incremental cost per DALY averted of $30,855 (33 times gross domestic product [GDP] per capita) in Ethiopia, $111,416 (53 times GDP per capita) in Northern Nigeria, $30,114 (14 times GDP per capita) in Southern Nigeria, and $25,579 (24 times gross domestic product [GDP] per capita) in Tanzania. These incremental cost-effectiveness ratios are far above the three times per capita GDP threshold for a cost-effective health intervention, per WHO-CHOICE standards. They are also much higher than the $225 per DALY averted proposed as a cut-off for inclusion of interventions in Universal Health Care package, and far above the cost per DALY averted reported for other family planning interventions (between $235 and $587).

Even a much more optimistic scenario of health impacts would generally not have resulted in the A360 approach being cost-effective. In Ethiopia, no manner of success in increasing mCPR would have made A360 cost-effective given the scope and scale at which A360 was implemented. In Nigeria, reaching minimum thresholds for cost-effectiveness would have required very rapid, almost unheard-of increases in mCPR. In Tanzania, by contrast, had A360 merely maintained a constant mCPR, the program would have been cost-effective.

Sensitivity analysis. Probabilistic sensitivity analysis confirmed the findings of the point estimates, that the A360 interventions were not cost-effective.

Discussion

Keeping in mind the important methodological and other limitations of the study, the results clearly show that A360 was not a cost-effective approach. In other words, the more costly design effort, and the interventions that resulted from that design effort, were not worthwhile in relation to the size of health outcomes achieved related to the program's primary objective of increasing modern contraceptive use. In Ethiopia and Nigeria, program implementation was simply too costly in relation to potential impact, thus suggesting that, along with changes to increase effectiveness, it will take efforts to reduce implementation costs or adjust program scope and scale to produce a cost-effective model. Actions currently underway in Ethiopia and Nigeria to shift management, demand creation, and service delivery responsibilities for the A360 legacy interventions governments may lower costs, and PSI should continue to monitor closely their cost and health impact. In Tanzania, A360 costs were more in line with potential impact, suggesting that tweaks to the current intervention model to generate better health impact could more easily produce a cost-effective intervention. The results highlight the continuing difficulty the family planning community faces in significantly moving the needle on adolescent contraceptive use, and doing so in a cost-effective way. Programmers should continue to search for ways to improve program design and implementation to reach this key group with contraceptive services.

[5] (95%CI: -17.0% to -0.3%; p-value = 0.04)

1 Background and objectives

1.1. Background and purpose of the study

The Adolescents 360 (A360) project was a five-year, US$30 million investment to increase modern contraceptive use among girls aged between 15 and 19. The Bill & Melinda Gates Foundation (BMGF) and the Children's Investment Fund Foundation (CIFF) funded A360 via a consortium led by Population Services International (PSI). The project began in January 2016 and ended in September 2020. The consortium carried out interventions in Ethiopia, Northern Nigeria, Southern Nigeria, and Tanzania.

This cost-effectiveness analysis, led by Avenir Health, is part of a broader external evaluation of A360 led by Itad, which also includes an outcome evaluation[6] led by London School of Hygiene and Tropical Medicine and a process evaluation led by Itad. This report on cost-effectiveness synthesizes separate, more detailed reports on the costs of designing A360 interventions, on the costs of implementing A360 interventions, and on A360 effectiveness (see References).

Although many programs in low- and middle-income countries have tried to reach adolescents with contraceptive services, their effectiveness has mostly been limited (Chandra-Mouli et al 2015). Moreover, little is known about the costs and cost-effectiveness of such approaches.

Proponents of the A360 approach believed it would be more successful than previous adolescent programs by using a new way of intervention design that would better take into account the unique needs of adolescents, and the social, cultural, religious and economic forces that underlie their access to and choices about contraception. While the expectation beforehand was that the A360 design process would be costlier than standard methods, the extent to which implementation costs would differ between A360 and comparative programs was unknown. Nonetheless, A360 proponents believed that expected higher design costs would be offset by better-designed interventions that would improve on the limited success of previous adolescent programs. Whether the A360 design process and the resulting interventions were cost-effective in relation to other approaches was the main question this cost-effectiveness analysis aimed to answer. Results of this study should help expand the evidence base on the design and implementation of adolescent contraceptive programs.

1.2. The A360 approach

The A360 approach included both a design process and the implementation of the interventions that resulted from that design process.

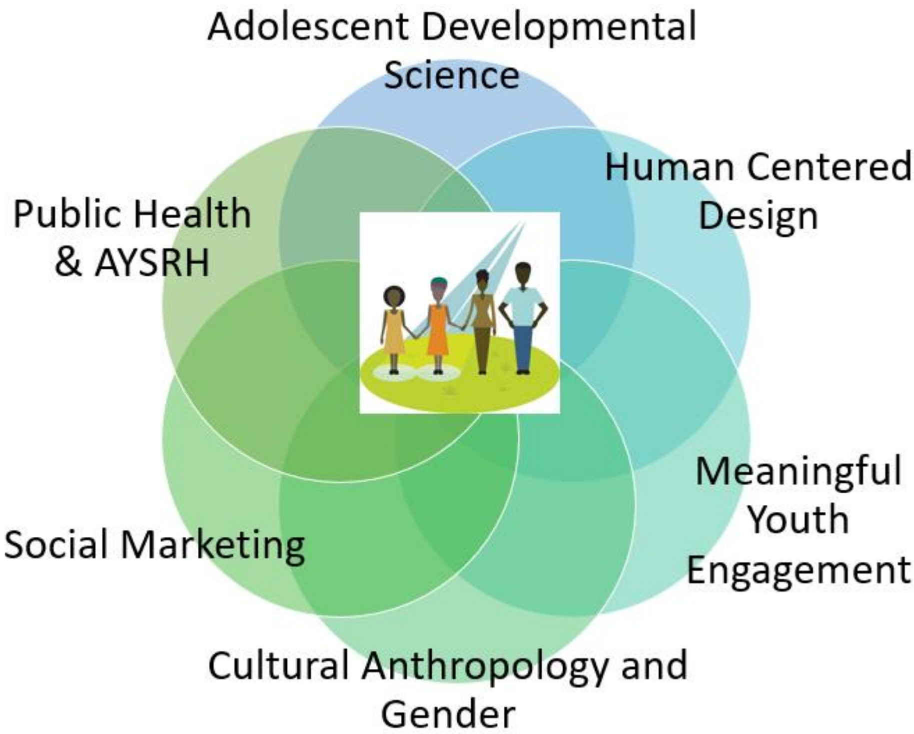
1.2.1. The A360 design process

PSI and its partners designed interventions in 2016 and 2017, with a process that combined human-centred design with social marketing, developmental neuroscience, sociocultural anthropology, public health, and youth engagement (

).

[6] The outcome evaluation focused on four intervention woredas (districts) in Ethiopia; two Local Government Areas in Northern Nigeria; one Local Government Area in Southern Nigeria; and one district in Tanzania.

Figure 1: A360 disciplines brought to bear on intervention design



Source: Krug et al (2021)

After an initial Inception phase to set up the A360 consortium and create the A360 approach, design took place in three phases—Inquiry, Insight Synthesis, and Prototyping.[7] The Inquiry and Insight Synthesis phases took place mainly in 2016, involving formative research and analysis conducted by a team of design experts, implementers, and young people. Some activities in these two phases took place in Tanzania in 2015 with funding from a private philanthropist. During the Prototyping phase in 2017, designers developed country-specific prototypes, which they tested and iterated to give rise to four distinct A360 interventions (or "solutions") for Ethiopia, Northern Nigeria, Southern Nigeria, and Tanzania.

1.2.2. The A360 interventions

The consortium rolled out these interventions in late 2017, scaling them up and further iterating them between 2018 and the end of the program in September 2020. The four A360 interventions shared the goal of increasing contraceptive uptake but focused on different populations and used different approaches.

[7] A360 initially referred to the phases using language from IDEO.org's approach to human-centered design: Inspiration, Ideation, Pilot, and Scale. The terminology was adapted in 2019 to improve clarity to wider audiences. The Inspiration phase is equivalent to the Inquiry and Insight Synthesis Phases; the Ideation and Pilot phases are now known as Prototyping, and the Scale phase became Adaptive Implementation.

Smart Start, Ethiopia. PSI Ethiopia implemented Smart Start, using financial planning as an entry point to discuss contraception with newly married couples. The program leveraged the nationwide government Health Extension Worker (HEW) network, supported by paid A360 mobilizers called Smart Start Navigators and community volunteers from the government-sponsored Women's Development Army. Smart Start framed contraception as a tool to help couples achieve financial security and raise healthy children. HEWs were trained to host conversations about financial planning and provide contraceptive services in an approachable way to rural, married girls and their husbands, using a visual discussion guide. Smart Start operated in four of Ethiopia's 10 regions and 39 of Ethiopia's roughly 800 woredas (districts).

Matasa Matan Arewa, Northern Nigeria. The Society for Family Health (SFH), a Nigerian nongovernmental organization, implemented the Matasa Matan Arewa (MMA) program via a sub-award with PSI. Operating in two the 19 states in Northern Nigeria, MMA focused on married adolescent girls and their husbands. MMA used a two-pronged approach. Female mentors recruited girls to take part in four Life, Family and Health classes, which incorporated life skills and vocational skills training as well as an opportunity for one-to-one contraceptive counselling with a provider. Meanwhile, male mobilizers started conversations with husbands by informing them about the benefits of healthy timing and spacing of pregnancies and encouraging them to refer their adolescent wives to a clinic for walk-in counselling. MMA was delivered by A360 Young Providers working alongside government providers through publicly-owned health facilities, in a Hub-and-Spoke model, with a permanent presence at some "hub" facilities and regular outreach services through more remote "spoke" facilities linked to each hub.

9ja Girls, Southern Nigeria. SFH also implemented the separate 9ja Girls program in seven of the 16 states in Southern Nigeria. 9ja Girls combined walk-in contraceptive counselling with life-skills sessions for unmarried adolescent girls. Walk-in counselling was provided alongside Saturday sessions on the Life, Love and Health curriculum, which featured vocational skills, future-planning exercises, and discussions about love, sex, and dating. The program aimed to make contraception relevant by helping girls tap into their aspirations and see contraception as a tool to reach their goals. 9ja Girls was delivered through publicly-owned health facilities, where A360 Young Providers worked alongside government providers to deliver classes and contraceptive counselling. Paid community mobilizers recruited girls into the program. Also use a Hub-and-Spoke model, 9ja Girls had a permanent presence at some "hub" facilities and provided regular outreach services through more remote "spoke" facilities linked to each hub.

Kuwa Mjanja, Tanzania. PSI Tanzania implemented Kuwa Mjanja in 20 of the 25 mainland regions of Tanzania. Kuwa Mjanja focused on providing married and unmarried girls with life and entrepreneurial skills training alongside youth-friendly contraceptive counseling and services. Out-of-clinic pop up events aimed to provide a safe, non-medicalized space for girls to access contraceptive services. The program framed events as wellbeing events rather than contraceptive events, incorporating targeted messaging on body changes or 'achieving dreams' depending on girls' life stage and priorities, and entrepreneurial skills training designed to empower girls and enlist the support of communities. In-clinic events provided dedicated times and spaces for girls to access counseling at local facilities, with contraception linked to their goals and dreams. Outreach teams delivered Kuwa Mjanja, rotating districts each month and working with local government service providers who delivered contraceptive counseling and services.

1.3. The comparator to A360

Any cost-effectiveness analysis requires comparing one intervention to another. What is the proper comparator to A360?[8] Analysts choose from three different comparators, depending on the aim of the analysis (Meunnig 2008). "Standard of care" is what a particular field considers to be best practice and may be a suitable choice of comparator when such best practices are clearly defined. "Status quo" refers to real world practice, which may be a relevant comparator when information on best practice is lacking.

[8] Analysts also commonly refer to the comparator as the "counterfactual," "comparison intervention," or "alternative."

The “do-nothing” comparator can be chosen when no comparable intervention exists, or when information is lacking on best practice or real-world practice.

1.3.1. The design comparator

A do-nothing comparison was not meaningful given that all comparator interventions will have some (even minimal) design process. Best practice in design is ill-defined, thus limiting its use as a comparator. That left the status quo, represented by PSI’s DELTA design methodology used at the time A360 initiated. DELTA typically began with formative research that fed into an in-country planning workshop. After the workshop, the design continued with solidifying activities and pretesting concepts. DELTA used both PSI international and local staff. Compared with the A360 method, DELTA took less time overall, needed fewer international trips, had much less in-depth pretesting and prototyping, and did not use external designers.

1.3.2. The intervention comparator

Like for design, a do-nothing comparison was not meaningful. In the study geographies, absent of A360 many adolescents would still find their way to contraceptive services, even if programs were not specifically designed to meet adolescent needs. “Best practice” does not exist for adolescent contraceptive programming, making it a poor choice for comparator. The study thus chose the status quo comparator, where the status quo was the existing contraceptive programming available to adolescents in the A360 geographies (either before the introduction of A360 in geographies where the outcome evaluation used before and after analysis of impact, or in the comparison geographies where the outcome evaluation used comparison analysis, which was done only in Nigeria). For purposes of this study, the comparator was not meant to be a program similar to A360 in terms of its operation or its components, but rather reflect the available services in the absence of A360. Regular government provision of contraceptive services to adolescents would have been the predominant model of service delivery in the study geographies in the absence of A360. See section 2.15.2 for more details on how these comparator services were costed.

2 Methods

This section discusses how we collected and analyzed data on cost and effectiveness for A360 and its comparators.

2.1. Study perspective

The choice of perspective or viewpoint determines whose costs and whose benefits to include. Ideally, any costing should adopt the perspective of society, and include all related costs, regardless of who pays for them or who benefits. This costing took something less than a full societal perspective, by including costs incurred by PSI and its partners, the government, and volunteers, while excluding client costs. The chosen perspective, as agreed to by the funders, came from the objectives of the cost-effectiveness analysis and its primary audiences. These audiences include in-country and global program managers who decide on design and intervention approaches, as well as the donors, governments or other agencies that fund such programs. Although these audiences care primarily about what they need to budget from their own resources, the analysis strove to measure economic (opportunity) costs, valuing inputs based on their alternative uses, and not only what someone paid for a resource (the financial cost). This meant placing a market value on non-budgeted inputs such as volunteers' time and donated or subsidized goods.[9] Valuing such inputs at market rates provides a more comprehensive understanding of costs and acknowledges that an off-budget input can become on-budget with a change in program approach or funder. The benefits of the program were limited to those clients who received the services, without consideration of the potential broader social benefits of contraceptive uptake.

2.2. Geographic scope of A360 interventions and evaluation focus

While not national in scale, each of the A360 interventions were implemented across multiple geographies in each country. Following the lead of the outcome evaluation, the cost-effectiveness analysis focused on only a subset of the program geographies:

- ***Smart Start, Ethiopia.*** PSI Ethiopia implemented Smart Start in four regions (Amhara, Oromia, SNPPR, and Tigray) and 39 woredas (districts) out of a total of 9 regions and 800 woredas. The cost-effectiveness analysis focuses on four woredas (districts) in Oromia Region: Adea, Fentale, Lume, and Wara Jarso.
- ***MMA, Northern Nigeria.*** SFH implemented MMA in Kaduna and Nasarawa states in Northern Nigeria. States are subdivided into Local Government Areas (LGAs). SFH implemented in 7 LGAs in the two states. The cost-effectiveness analysis focused on two intervention LGAs, Doma and Karu, and two paired comparison LGAs, Nasarawa paired with Karu*)* and Toto (paired with Doma), all located in Nasarawa State. There are a total of 19 states and 391 LGAs in Northern Nigeria.
- ***9ja Girls, Southern Nigeria.*** SFH implemented 9ja Girls in seven states in the south of Nigeria (Lagos, Osun, Ogun, Oyo, Edo, Delta, and Akwa Ibom). SFH implemented in 19 LGAs in the seven states.[10] The cost-effectiveness analysis focused on one intervention LGA, Ado-Odo/Ota, and one comparison LGA, Shagamu, both in Ogun State. There are a total of 16 states and 383 LGAs in Southern Nigeria.

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[9] Costing of design activities measured only financial costs.

[10] The number of States and LGAs with active A360 implementation changed over the course of the project; this number is based on the total number over the entire implementation period.

- ***Kuwa Mjanja, Tanzania.*** PSI Tanzania operated Kuwa Mjanja in 20 of Tanzania's 25 mainland regions and 100 of the country's 169 districts. The cost-effectiveness analysis focused on Ilemela district in Mwanza region.

2.3. Time frame and analytic horizon

A360 design and implementation took place over about 5 years, with variations by geography (Table 1). Design occurred mainly in 2016-17 and included some design activities that took place in Tanzania in 2015. Although implementation start dates varied by geography, this study uses a September 2020 cutoff for implementation in all geographies. Thus, implementation ranged from 16 months in Doma LGA to 34 months in Ado-Odo/Ota LGA. The time frame for impact analysis was the time between baseline and endline outcome evaluation surveys. This was 38 months in Ethiopia, 39 months in Nigeria, and 46 months in Tanzania. The analytic horizon (the period over which the costs and impacts that occur as result of the program were considered) was the same as the time frame for both cost and health impacts.

Table 1. Analysis time frame

Study Geography	Design	Implementation			Months between baseline and endline outcome evaluation survey		
	Dates	Start Date	End Date	Months	Baseline	Endline	Months
Ethiopia							
Adea woreda	2016-2017	Aug 2018	Sept 2020	26	Oct 2017	Dec 2020	38
Fentale woreda		Jan 2018	Sept 2020	33			
Lume woreda		Aug 2018	Sept 2020	26			
Wara Jarso woreda		Aug 2018	Sept 2020	26			
Nigeria							
North – Doma LGA	2016-2017	June 2019	Sept 2020	16	Sept 2017	Dec 2020	39
North – Karu LGA		Apr 2018	Sept 2020	30			
South – Ado-Odo/Ota LGA		Dec 2017	Sept 2020	34			
Tanzania							
Ilemela District	2015-2017	Jan 2018	Sept 2020	33	Jan 2018	Oct 2021	46

2.4. Measuring costs

Within the chosen perspective, measured costs included:

- On-budget global and country funding provided through the A360 project by BMGF and CIFF
- Nonbillable costs borne by PSI and not reimbursed by its A360 funders[11]
- Funding from other foundations and donors for design and implementation[12]
- Off-budget, leveraged counterpart costs, including the market value of in-kind provision of goods and services from PSI-affiliated, public sector, or private sector providers, including
    - Government personnel who helped to manage the program or provide counseling and services
    - Government-funded contraceptives and other health supplies
    - Volunteers

[11] After renegotiating with BMGF and CIFF on what constituted billable expenses, PSI stopped using nonbillable as a category in early 2019 and no longer counted nonbillable expenses.
[12] This was only applicable to Tanzania, where a foundation other than the A360 funders funded some design costs, and two international bilateral donors funded some implementation costs.

The study excluded:

- The opportunity cost of client time and any client out-of-pocket fees
- Other costs not needed for the functioning of the intervention:
  - BMGF and CIFF management costs (e.g., time and travel costs)
  - External evaluation costs
  - A360 costs that did not support the interventions, including costs associated with:
    - Creating the A360 approach and replicating or adopting the A360 approach in other settings
    - Developing and carrying out the A360 learning strategy
    - A360 evaluation efforts that tracked project progress beyond routine monitoring
    - International and national dissemination activities (conferences, brochures, briefs, etc.)
    - Advocacy activities unrelated to the functioning of the interventions

The scope of included costs is important to note when comparing to other studies that may use a different perspective. This is to minimize drawing mistaken conclusions about the cost of A360 in relation to other programs.

2.5. Cost categorization

The study tagged costs according to seven categories to allow appropriate analysis and ensure consistency over the measurement period: country, timing of cost, intervention model, input type, program element, level, and funding source. More details on cost categorization can be found in the design cost report and the four implementation cost reports (see references).

2.6. Cost data collection and processing

Data collection blended top-down and bottom-up costing. The design costing used a top-down approach drawing on the routine cost accounting systems of PSI and its partners, supplemented by surveys of A360 staff involved in design. Analysts collected and processed data on design costs from 2016-2020 and produced preliminary reports for each phase. Data collection for implementation costs blended top-down costing drawing on routine cost accounting systems of PSI and its partners with targeted, bottom-up studies of key inputs external to PSI, site visits, and surveys of PSI staff and other actors involved in implementation. Analysts collected implementation cost data in three rounds, corresponding roughly to 2018, 2019, and the first 9 months of 2020. Locally contracted consultants led cost data collection, with support from U.S.-based Avenir Health staff. Data were processed in Excel.

2.7. Valuing inputs

The study valued inputs to reflect their economic (opportunity) cost. Except for some government-funded and volunteer inputs (see section 2.9 below), the economic cost was the same as the financial cost (the amount somebody paid for the input). Inputs were valued in local currency or in US dollars as appropriate, and the study shows results in constant 2020 US dollars, using average exchange rates for the relevant periods.

2.8. Allocation of costs not associated with a specific geography

PSI and partner accounting systems did not provide enough detail to associate many managerial, administrative, and technical costs with a specific country or subnational geography. The study thus developed the following allocation rules to distribute these costs to subnational geographies, the main unit of analysis.

Allocation of international managerial and technical support costs. PSI and its consortium partners gave significant international managerial and technical support to the design and implementation of the A360 interventions. To allocate such costs not already associated with a specific A360 country, A360 headquarters staff completed periodic surveys on how they split their time between countries and where they travelled. These calculations yielded a total spent by country. From this total, a portion was allocated to the study geographies based on the total number of A360 geographies in each country.

Allocation of national costs. For many of the national-level managerial, administrative, and technical support costs as well as for some costs for inputs used directly for site-level services, routine accounting systems were not detailed enough to identify where within a country a particular cost was incurred. To allocate these costs, analysts developed country-specific rules based on factors such as the study geographies' share of activities in the total number of activities for the project, the number of study geographies as a proportion of the total number of geographies, and the share of a geography's visible costs as a proportion of the total visible geography-level costs.[13]

2.9. Cost of government and volunteer resources

The study estimated A360-related costs of government and volunteer personnel, and donated space and commodities.[14]

- *Government personnel and volunteers.* Analysts interviewed government administrative, supervisory, and service staff and community volunteers to estimate A360 time use, valuing time based on government salary scales or daily wage equivalents for community volunteers.
- *Space.* The study valued government-provided office, clinic, and counselling space at commercially equivalent market rates.
- *Contraceptive commodities and associated supplies.* The study valued government-provided contraceptive commodities and associated supplies using information on the number of client visits, international standards for unit cost of contraceptives and supplies, and norms for number of contraceptives provided per visit.

2.10. Impact of COVID-19 on costs

Much of the final round of cost data collection coincided with the onset of the COVID-19 pandemic in March 2020. PSI responded by first curtailing services, then quickly adjusting the program in response to COVID precautions and resuming full operations. The overall impact of COVID-19 on costs is difficult to ascertain because while the shutdown likely reduced some costs (travel, materials associated with some types of services), other costs increased, such as funds required to adapt and restart the program to operate under COVID-related restrictions. Moreover, the accounting systems did not include sufficient detail to allow easy identification of COVID-related costs. Thus, other than excluding identifiable costs of personal protective equipment, the base case cost estimate assumed no change in cost due to COVID.

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[13] Allocation rules varied by country to account for differences in intervention structure and in country-level accounting systems and programmatic databases. See intervention specific cost reports for more details.

[14] For Nigeria, the study also obtained information on government utilities costs.

2.11. Measuring effectiveness

Change in modern contraceptive use in adolescents was the main outcome measured in the study geographies. For purposes of the cost-effectiveness analysis, analysts translated that measure into a number of additional contraceptive users, and then a number of disability adjusted life-years (DALYs) averted. A DALY is a year lost to poor health, disability, or early death. The number of DALYs that any particular health intervention averts is a standard way of comparing effectiveness across a range of health interventions.

2.12. Change in modern contraceptive prevalence

The outcome evaluation led by the London School of Hygiene and Tropical Medicine[15] produced baseline and endline estimates of the modern contraceptive prevalence rate (mCPR), defined as the proportion of fecund, sexually active[16] girls aged 15-19 using modern contraceptive methods.[17] Note this mCPR definition diverges from the Demographic and Health Surveys definition of mCPR which includes in its denominator non-fecund and non-sexually active women. Depending on the geography, the outcome evaluation varied in its focus population and study design (Table 2). This analysis used an adjusted absolute change in mCPR[18] that was adjusted for confounding factors, as described below for each country.

Table 2. Outcome evaluation focus population and study design, by country

Country	Focus population	Study design
Ethiopia	fecund, sexually active, married, 15–19 girls	before-and-after pooled cross-sectional
Nigeria (North)	fecund, sexually active, married, 15–19 girls	quasi-experimental, paired before-and-after cross-sectional study with comparison groups
Nigeria (South)	fecund, sexually active, unmarried, 15–19 girls	quasi-experimental, before-and-after cross-sectional study with comparison groups
Tanzania	fecund, sexually active, married and unmarried 15–19 girls	before-and-after pooled cross-sectional

Ethiopia. The outcome evaluation used a before-and-after cross-sectional evaluation design focused on married adolescent girls aged 15-19 years. Baseline surveys were conducted in September and October 2017 and endline surveys were conducted between November and December 2020. The impact of A360 on mCPR was assessed using linear regression models fitted to obtain the average difference at the kebele level (the administrative unit below the woreda) between endline and baseline. Results were adjusted for pre-defined confounding factors reflecting characteristics of the study populations, including age, education level, number of living children, religion and wealth quintile averaged at the kebele level. The outcome evaluation report gives further details on the full range of analyses (Krug et al 2021a).

[15] See Krug et al 2021a, Krug et al 2021b, and Prakash et al. 2022.

[16] Fecund girls: those who have started menstruating, are not pregnant, and do not report that they are infertile.
Sexually active girls: those who report having sexual intercourse in the last 12 months.

[17] Modern methods include female sterilization, male sterilization, contraceptive pill (oral contraceptives), intrauterine device, injectables, implants, female condom, male condom, diaphragm, contraceptive foam and contraceptive jelly, lactational amenorrhea method, standard days method, cycle beads.

[18] For Nigeria, the outcome evaluation published risk ratios (RR) that accounted for changes in the study versus comparison areas, in addition to adjusting for confounding factors. The authors of this study converted the RR into an absolute % point change in mCPR as follows: % point change in mCPR = Baseline mCPR*(RR-1).

Northern and Southern Nigeria. The outcome evaluation used as a quasi-experimental, cross-sectional study with comparison groups design. In Northern Nigeria, the study conducted before and after surveys of married girls aged 15-19 years in two pairs of LGAs: Toto (comparison) v. Doma (intervention), and Nasarawa (comparison) v. Karu (intervention). In Southern Nigeria, the study conducted before and after surveys of unmarried girls aged 15-19 years in one intervention LGA (Ado-Odo/Ota) and one comparison LGA (Shagamu) in Ogun State. Baseline surveys were conducted between August and September 2017 and endline surveys were conducted between November and December 2020. The impact of A360 on mCPR in the two studies was assessed primarily by quantifying difference in differences change between baseline and endline, using regression models fitted to data from the baseline and endline surveys. For modern contraceptive use, the analysis corresponds to dividing endline mCPR by baseline mCPR to obtain a ratio in each area (intervention and comparison), and then dividing the intervention mCPR ratio by the comparison mCPR ratio. The resulting risk ratio represents the effect of the intervention adjusted for background trend in mCPR; it is interpreted as a positive effect of A360 if it is above one, and a negative effect if it is below one. The difference in differences is interpreted as a positive effect of A360 if it is above zero, and a negative effect of A360 if it is below zero. The study adjusted for pre-defined confounding factors including age, education level, number of living children, religion and wealth quintile of the study populations. Comparison and intervention LGA were selected in pairs, therefore the main (descriptive and regression) analyses were conducted separately for each matched pair. For Nasarawa state, the main result was the effect of time on mCPR over all intervention and comparison LGAs, i.e. the four LGAs were analyzed together in one model. The reason for this was that the study was powered to detect an impact overall for all four LGAs. The outcome evaluation reports give further details on the full range of analyses (Krug et al 2021b).

Tanzania. The outcome evaluation used a cross-sectional before and after study focused on married and unmarried girls aged 15-19 in Ilemela district in Mwanza region. The baseline population-based survey data was collected between 8 September 2017 and 31 January 2018 and endline survey data between 28 May and 12 October 2021. For the primary analysis, the impact of Kuwa Mjanja was assessed by quantifying the changes between the baseline and endline. Linear regression models were fitted to obtain the average street-level difference between endline and baseline. The linear regression model was adjusted for pre-defined confounders, which included age, education level, religion, wealth quintiles and parity averaged at the street-level. The outcome evaluation report gives further details on the full range of analyses (Prakash et al 2022).

2.13. Calculation of contraceptive users

Calculating the number of additional contraceptive users combined estimate of the number of eligible girls (based on the defined focus population for each intervention) with change in mCPR data.

2.13.1. Estimating the number of eligible girls

Estimating the number of contraceptive users[19] first required calculating for each study geography the number of eligible girls as defined by the focus population for the outcome evaluation (
Table 3). We did this by estimating the total number of girls 15-19 and then adjusting that number by marital status, fecundity, and sexual activity. Because national census data was relatively old (2007 in Ethiopia, 2006 in Nigeria, 2012 in Tanzania) we opted to use a standard source for population of 15-19 year old girls, the U.S. Census Bureau sub-national projections by age and sex to obtain estimates for the relevant subnational geographies (U.S. Census Bureau, 2021). This source provided year by year estimates

[19] The number of contraceptive users calculated for purposes of the cost-effectiveness analysis differed from the "adopter" numbers the A360 consortium derived from its database on service use. While number of adopters appropriately reflected program activity, the outcome evaluation looked at population-level changes in use that also account for demographic changes and for the dynamics of contraceptive continuation and discontinuation.

of girls 15-19 from baseline through endline. Marital status was derived from various sources depending on the country; subnational estimates were used for the smallest area for which the survey was powered (DHS and MICS for Nigeria; DHS for Ethiopia). For Tanzania, a combined married and unmarried population was used to align with the outcome evaluation. The outcome evaluation surveys provided estimates of fecundity and sexual activity.

Table 3. Eligible focus population of girls, by country and subnational geography

Country & Subnational Geography	Focus population	2017	2018	2019	2020	2021
Ethiopia						
Adea	married	1,275	1,362	1,450	1,536	1,621
Fentale	married	691	758	826	894	961
Lume	married	1,451	1,487	1,521	1,552	1,579
Wara Jarso	married	1,672	1,637	1,599	1,556	1,507
Northern Nigeria						
Doma	married	716	728	737	743	748
Karu	married	1,167	1,223	1,278	1,327	1,378
Southern Nigeria						
Ado-Odo/Ota	unmarried	5,009	5,003	4,965	4,880	4,776
Tanzania						
Ilemela	married and unmarried	6,273	6,653	7,033	7,412	7,804

2.13.2. Calculating the cumulative number of additional users

For each study geography, we calculated an adjusted endline mCPR by adding the adjusted change in mCPR to the baseline mCPR.[20] We then calculated mCPR for each year (or fraction of a year) using a linear interpolation of the difference between adjusted endline and baseline mCPR. Multiplying the eligible population by the mCPR for each year produced a yearly number of users. This can be interpreted as the number of users the program has to serve to achieve the expressed contraceptive prevalence. The yearly number of additional users is the difference between the number of users in that year and the number of users at baseline. For the final year, only a fraction of additional users were calculated based on the timing of the endline survey. The cumulative number of additional users is the number of additional users attributable to the program effort that raised prevalence. In the example (Table 4), prevalence increased from 50% at baseline to 58% at endline (adjusted), generating a cumulative number of additional users of 364. In this example, the endline survey was conducted in February so only 0.17 (2/12) of the additional users in that year are included.

Table 4. Illustration of cumulative additional user calculation

	Baseline	Y1	Y2	Y3	Y4 (fractional)
Eligible population	1,300	1,339	1,379	1,421	1,463
Adjusted Change in mCPR	50.0%	52.5%	55.1%	57.6%	58.0%
Users	650	703	759	818	849
Additional users		53	109	168	33
Cumulative additional users					364

[20] For Nigeria, published adjusted RRs were translated into changes in mCPR as adjusted changes to mCPR were not published. The RR adjust for confounding factors as well as changes in the comparison geographies.

2.14. Calculating Maternal DALYs averted

From the number of additional users, we calculated the number of maternal DALYs averted by combining information on country-, method-, and age-specific DALY averted coefficients with information on method use from the baseline and endline surveys. Maternal DALYs averted are the main impact measure for this analysis; related results for unintended pregnancies averted and maternal deaths averted can be found in Appendix 2.

2.14.1. Country-specific DALY averted coefficients by method for 15-19 year olds

The numbers of DALYs averted from contraceptive use varies depending on the mix of contraceptive methods used and the underlying risks of pregnancy-related illness and death in a particular country and age group. We calculated DALY averted coefficients specific to each A360 country. We used MSI Reproductive Choice's Impact 2 model to calculate maternal DALYs averted per user by method for each country. We used the models default assumptions for each country, except that we adjusted down the age of insertion for implants and IUDs from 30 to 18 to account for the younger age of A360 clients. Additional adjustments to default data (including MMR, comparison pregnancy rate, and DALY ratios) to reflect the 15-19 age group were considered, however insufficient data existed to robustly make these changes, and the impact on the DALY coefficients would likely be minimal. This procedure produced estimates of DALYs averted per user per year coefficients by country and method (Table 5).

Table 5. Estimates of age-adjusted country- and method-specific DALYs averted per user per year

	Maternal DALYs averted per user per year			
Method	**2018**	**2019**	**2020**	**2021**
DALY averted coefficients, Ethiopia				
Implant	0.05	0.04	0.04	0.03
IUD	0.05	0.04	0.04	0.03
Injectable	0.04	0.03	0.03	0.02
Pill	0.03	0.03	0.02	0.02
Emergency pill	0.02	0.01	0.01	0.01
Condom	0.02	0.02	0.02	0.01
Other	0.02	0.02	0.02	0.01
DALY averted coefficients, Nigeria				
Implant	0.15	0.15	0.15	0.15
IUD	0.15	0.15	0.15	0.15
Injectable	0.11	0.11	0.10	0.10
Pill	0.10	0.10	0.09	0.09
Emergency pill	0.05	0.05	0.05	0.05
Condom	0.07	0.07	0.07	0.07
Other	0.07	0.07	0.07	0.07
DALY averted coefficients, Tanzania				
Implant	0.06	0.06	0.06	0.05
IUD	0.07	0.06	0.06	0.05
Injectable	0.05	0.04	0.04	0.04
Pill	0.04	0.04	0.04	0.03
Emergency pill	0.02	0.02	0.02	0.02
Condom	0.03	0.03	0.03	0.02
SDM	0.04	0.04	0.04	0.03
Other	0.03	0.03	0.03	0.02

Source: Authors calculations using the MSI Reproductive Choices Impact 2 model (version 2.5, November 2020)

2.14.2. Weighted Maternal DALYs averted per user per year

Using the method mix measured by the baseline and endline surveys in each study geography, we used linear interpolation to estimate a year-by-year method mix (see Appendix 1 for detailed method mix trends). From that estimate, we derived a weighted DALY averted per user per year for each geography, weighted by method mix (Table 6).

Table 6. DALY averted per user per year, weighted by method mix

	Maternal DALY averted per user per year				
Geography	baseline	Y1	Y2	Y3	endline
Ethiopia - All study woredas	0.04	0.03	0.03	0.02	0.02
Ethiopia - Adea	0.04	0.03	0.03	0.02	0.02
Ethiopia - Fentale	0.04	0.03	0.03	0.02	0.02
Ethiopia - Lume	0.04	0.03	0.03	0.02	0.02
Ethiopia - Wara Jarso	0.04	0.03	0.03	0.02	0.02
Nigeria North - All study LGAs	0.10	0.10	0.10	0.10	0.10
Nigeria North - Doma	0.10	0.10	0.10	0.09	0.09
Nigeria North - Karu	0.10	0.10	0.10	0.10	0.10
Nigeria South - Ado-Odo/Ota	0.07	0.07	0.06	0.06	0.06
Tanzania - Ilemela	0.04	0.03	0.03	0.03	0.03

2.14.3. Cumulative Maternal DALYs averted

To derive a cumulative total number of maternal DALYs averted between baseline and endline, we multiplied the number of additional users (section 2.13) by the weighted DALY coefficients, and then summed these. In the example (Table 7), the 364 cumulative additional users shown from Table 4 translate to a cumulative number of 11 DALYs averted attributable to the intervention.

Table 7. Illustrated calculation of cumulative number of DALYs averted

	Baseline	**Y1**	**Y2**	**Y3**	**Y4 (fractional)**
Eligible population	1,300	1,339	1,379	1,421	1,463
mCPR	50.0%	52.5%	55.1%	57.6%	58.0%
Users	650	703	759	818	849
Additional Users		53	109	168	33
Weighted DALY averted per user per year		0.03	0.03	0.02	0.04
DALYs averted		2	4	5	1
Cumulative additional users					364
Cumulative DALYs averted					11

See Appendix 1 for detailed calculations for each study geography.

2.15. Costing the comparator

The comparator to A360 included both a design and an implementation component (see section 1.3).

2.15.1. Costing the comparator design

The comparator to the A360 design process was PSI's DELTA design process. Information on DELTA costs came from interviews with PSI design experts and a review of DELTA spending reports.

2.15.2. Costing the comparator implementation

As noted above, the comparator was not meant to be a program similar to A360 in its operation or components, but rather reflect available contraceptive services in the absence of A360 in the study geographies. We assume that in the absence of A360, regular government provision of contraceptive services to adolescents would have been the predominant model of service delivery. Therefore, for this study, the comparator to A360 implementation was the existing contraceptive programming available to adolescents in the A360 geographies. We defined this as the program effort needed to serve the number of users associated with maintaining a constant modern contraceptive prevalence rate with a typical government-led service delivery program in study geographies. We calculated the cost of comparator implementation as the yearly cost per adolescent family planning user from Guttmacher Institute's Adding It Up 2019[21] (Table 8) times the number of users in the comparator interventions over the period between baseline and endline (calculated using methods described in section 2.13).

Table 8. Cost per user per year for comparator implementation

Country	Cost per adolescent user per year
Ethiopia	$9.34
Nigeria	$10.79
Tanzania	$9.35

Source: Riley et al 2020; Sully et al 2021
Note: Figures adjusted to 2020 USD

The Adding It Up unit costs include direct costs (commodities, supplies, health care worker salaries) as well as indirect costs (program and system costs, including supervision, training, demand generation, advocacy, M&E, facility maintenance). Direct costs are calculated based on the method mix of adolescent girls in each country using a mix of country specific and regional unit costs, while indirect costs are added proportionally using regional assumptions.

2.16. Measuring cost-effectiveness

We combined cost and effectiveness data to produce incremental cost-effectiveness ratios for A360, using the following equation:

$$\text{Incremental cost-effectiveness ratio} = \frac{cost\ of\ A360 - cost\ of\ comparator}{impact\ of\ A360 - impact\ of\ comparator}$$

For the two countries (Ethiopia and Tanzania) where the outcome evaluation does not include comparison geographies, we defined the terms of this equation as:

- **Cost of A360** = Cost of designing A360 intervention + Cost of implementing the A360 intervention
- **Cost of comparator** = Cost to design using DELTA process + Cost to maintain constant the modern contraceptive prevalence rate in the study geography

[21] Country specific costs per adolescent user costs were calculated from the Adding it Up 2019 Adolescent Dataset by dividing current adolescent costs (direct + indirect) by current adolescent users.

- **Impact of A360** – **Impact of comparator** = adjusted change in mCPR in the study geography associated with A360, translated into DALYs averted

For the interventions in Northern and Southern Nigeria, where the outcome evaluation includes comparison geographies, we defined the terms of this equation as:

- **Cost of A360** = Cost of designing A360 intervention + Cost of implementing the A360 intervention
- **Cost of Comparator** = Cost to design using DELTA process + Cost to maintain constant the modern contraceptive prevalence rate in the study geography
- **Impact of A360** – **Impact of comparator** = adjusted change in mCPR in the study geography associated with A360 relative to the change in the comparison area, translated into DALYs averted

2.17. Sensitivity analysis

Sensitivity analysis is important in showing how cost-effectiveness results might change when considering the uncertainty of estimates of costs and effectiveness. In this study, uncertainty around cost came from limitations in data collection; missing or incomplete data; assumptions around differentiating between costs to design and carry out the interventions and costs to create the A360 approach and to replicate/adopt the approach in other settings; and decisions on how to allocate costs to the study geographies. To model this uncertainty, we conducted one-way and multi-way sensitivity analyses for the design and implementation costing that varied key parameters to produce plausible upper and lower boundaries for incremental costs.[22] In this study, the main source of uncertainty around effectiveness came from the inherent limitations of the household survey approach. Sensitivity analysis on effectiveness considered the 95% confidence intervals in measured mCPR change derived from the outcome evaluation. Probabilistic sensitivity analysis combined lower and upper ranges for cost and effectiveness in a Monte Carlo simulation using 10,000 iterations.

2.18. Ethical and other research considerations

No clients were interviewed for the costing. Where the costing involved interviews of health personnel, the study operated under the ethical considerations of IRB approvals for the process evaluation component of the evaluation. A non-disclosure agreement with the PSI consortium permitted Itad and its subcontractors to view and analyse cost data needed to carry out the study analyses while protecting confidentiality. The non-disclosure agreement allows the publication of cost data at an appropriate level of aggregation. To protect the identity of individual personnel or health facilities, this or other publicly available documents do not identify them by name. No results were publicly released until all institutions whose data has been used had a chance to review.

[22] The design and implementation costing reports provide full details on these parameters and on results of the sensitivity analyses.

3 Results

We present point estimates of costs, effectiveness, and cost-effectiveness, and then the results of the probabilistic sensitivity analysis. Further details on cost results can be found in the separate design and intervention cost reports (see references).

3.1. Costs

3.1.1. Design cost

Table 9 shows the costs of A360, the comparator, and the incremental cost, for each study geography.

A360. A360 spent $8.1 million to design the four interventions, split between $2.6 million for Smart Start in Ethiopia, $2.3 million combined for MMA in Northern Nigeria and 9ja Girls in Southern Nigeria, and $3.1 million for Kuwa Mjanja in Tanzania. After amortizing these costs over a five-year useful life and prorating costs based on the number of geographies where A360 was implemented and the duration of each intervention, A360 design costs in the study geographies were $123,724 for Ethiopia, $85,603 for Northern Nigeria, $46,643 for Southern Nigeria, and $17,024 for Tanzania.

Comparator. Using the comparator DELTA design process to produce an intervention equivalent in complexity to an A360-style intervention was estimated to cost $338,546 per country in 2020 US dollars.[23] After amortizing these costs over a five-year useful life of the design and prorating costs based on the number of geographies where A360 was implemented and the duration of each intervention, DELTA design costs were estimated at $16,040 for Ethiopia, $12,342 for Northern Nigeria, $6,725 for Southern Nigeria, and $1,860 for Tanzania.

Incremental design cost. Subtracting DELTA costs from A360 costs resulted in incremental design costs in the study geographies of $107,684 for the four woredas in Ethiopia, $73,262 for the two Local Government Areas in Northern Nigeria, $39,919 for the Local Government Area in Southern Nigeria, and $15,164 for the district in Tanzania. A360 design was between 7 and 9 times as costly as the comparator DELTA approach.

Table 9. Design costs in the study geographies

Study geography	A360 Design Cost	Comparator design cost	Incremental Design Cost	Ratio: cost of A360 to comparator
Ethiopia - All study woredas	$123,724	$16,040	$107,684	8
Ethiopia - Adea	$28,978	$3,757	$25,221	8
Ethiopia - Fentale	$36,790	$4,770	$32,020	8
Ethiopia - Lume	$28,978	$3,757	$25,221	8
Ethiopia - Wara Jarso	$28,978	$3,757	$25,221	8
Nigeria North - All study LGAs	$85,603	$12,342	$73,262	7
Nigeria North - Doma	$29,756	$4,290	$25,466	7
Nigeria North - Karu	$55,847	$8,052	$47,795	7
Nigeria South – Ado-Odo/Ota	$46,643	$6,725	$39,919	7
Tanzania - Ilemela	$17,024	$1,860	$15,164	9

[23] It was expected that there would be some joint efforts between the design of the two interventions in Nigeria, therefore the cost of one DELTA design was assigned to the whole country rather than to each intervention, split evenly across the two interventions.

3.1.2. Implementation cost

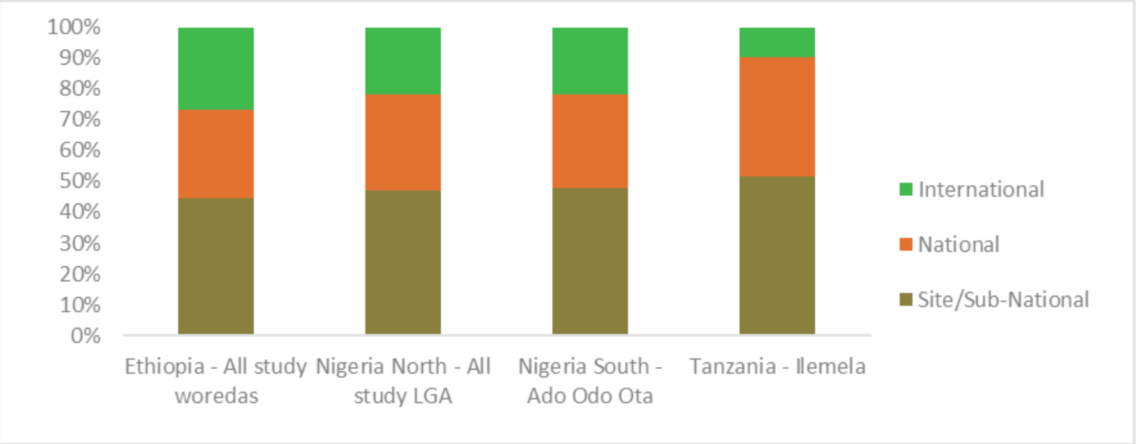
Table 10 shows the costs of A360, the comparator, and the incremental cost, for each study geography.

A360. A360 implementation costs were $964,987 for the four study geographies in Ethiopia, $423,000 for the two geographies in Northern Nigeria, $550,679 for the study geography in Southern Nigeria, and $233,234 for the study geography in Tanzania.[24]

Detailed breakdown of cost are available in the intervention-specific Implementation Cost Reports (see references); highlights are provided below.

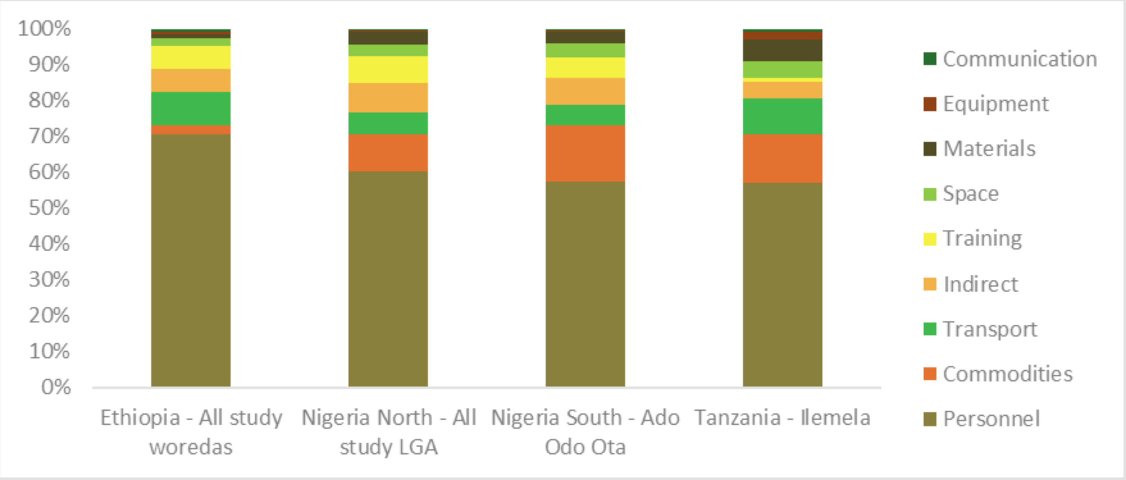
Level: Site and sub-national) accounted for 45% to 52% of implementation costs across the study geographies. National level costs accounted for the next largest share (29% to 38%), with the remaining came from the international level (10% to 27%).

Figure 2 Implementation Cost by Level in Study Geographies



Input: Personnel costs accounted for the largest share of costs, ranging from 57% to 75% of the total implementation costs across the study geographies. Commodities accounted for the next largest share the study geographies in Northern Nigeria, Southern Nigeria, and Tanzania (ranging from 10% to 16%). In Ethiopia, transport accounted for the next largest share (9%).

Figure 3 Implementation Cost by Input in Study Geographies



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[24] Cost figures vary slightly from costs shown in the Implementation Cost Reports for Ethiopia and Nigeria due to revaluing costs in constant 2020 dollars. Nigeria costs were also updated to reflect using international standards for commodity costs rather than data collected locally on Government commodity costs.

Comparator. The cost of the comparator intervention implementation was the yearly cost per user (from Table 8) times the number of users had there been no change in mCPR over the period between baseline and endline (calculated per the methods described in section 2.13). Implementation of the comparator intervention cost $102,003 in the four study geographies in Ethiopia, $11,361 in Northern Nigeria, $77,378 in Southern Nigeria, and $127,920 in Tanzania.

Incremental implementation cost was A360 implementation cost less comparator implementation cost. Incremental implementation cost was $862,938 in the four study geographies in Ethiopia, $411,638 in the two study geographies in Northern Nigeria, $473,302 in the study geographies in Southern Nigeria, and $105,314 in the study geography in Tanzania.

Table 10. Implementation cost, by study geography

Study geography	A360 Implementation Costs	Comparator implementation costs	Incremental implementation cost
Ethiopia - All study woredas	$964,987	$102,003	$862,983
Ethiopia - Adea	$245,829	$28,630	$217,199
Ethiopia - Fentale	$239,685	$4,581	$235,104
Ethiopia - Lume	$234,231	$37,204	$197,027
Ethiopia - Wara Jarso	$245,242	$34,755	$210,488
Nigeria North - All study LGAs	$423,000	$11,361	$411,638
Nigeria North - Doma	$143,228	$1,964	$141,265
Nigeria North - Karu	$279,771	$9,588	$270,183
Nigeria South - Ado-Odo/Ota	$550,679	$77,378	$473,302
Tanzania - Ilemela	$233,234	$127,920	$105,314

3.1.3. Total incremental cost

Total incremental cost is the sum of incremental design and incremental implementation cost. Total cost was $970,667 for Ethiopia, $484,900 for Northern Nigeria, $513,220 for Southern Nigeria, and $120,479 for Tanzania (
Table 11). Incremental design costs accounted for 11% of total costs in Ethiopia, 15% in Northern Nigeria, 8% in Southern Nigeria, and 13% in Tanzania.

Table 11. Total incremental cost

Study geography	Incremental design cost		Incremental implementation cost		Total incremental cost
	Amount	% of total	Amount	% of total	
Ethiopia - All study woredas	$107,684	11%	$862,983	89%	$970,667
Ethiopia - Adea	$25,221	10%	$217,199	90%	$242,420
Ethiopia - Fentale	$32,020	12%	$235,104	88%	$267,124
Ethiopia - Lume	$25,221	11%	$197,027	89%	$222,248
Ethiopia - Wara Jarso	$25,221	11%	$210,488	89%	$235,709
Nigeria North - All study LGAs	$73,262	15%	$411,638	85%	$484,900
Nigeria North - Doma	$25,466	15%	$141,265	85%	$166,731
Nigeria North - Karu	$47,795	15%	$270,183	85%	$317,979
Nigeria South – Ado-Odo/Ota	$39,919	8%	$473,302	92%	$513,220
Tanzania - Ilemela	$15,164	13%	$105,314	87%	$120,479

3.2. Effectiveness and Cost-Effectiveness

3.2.1. mCPR change

The absolute change in the modern contraceptive prevalence rate attributable to A360 was 5.1% points (95% confidence interval [CI]: 0.7% to 9.5%; p-value: 0.03) in Ethiopia; -0.6% points in Northern Nigeria (95%CI: -3.8% to 3.4%; p-value: 0.74); 3.6% points in Southern Nigeria (95%CI: -3.6% to 11.6%; p-value = 0.34); and -9.0% points in Tanzania (95%CI: -17.0% to -0.3%; p-value = 0.04). (Table 12).

Table 12. Adjusted Change in mCPR from baseline to endline, study geographies, midpoint and 95% confidence interval

Geography	% point mCPR change			
	midpoint	95% confidence interval		
		low	high	p-value
Ethiopia - All study woredas	5.1%	0.7%	9.5%	0.03
Ethiopia - Adea	5.6%	-4.4%	15.6%	0.25
Ethiopia - Fentale	-5.3%	-12.7%	2.1%	0.14
Ethiopia - Lume	-0.5%	-7.5%	6.5%	0.88
Ethiopia - Wara Jarso	12.4%	1.3%	23.6%	0.03
Nigeria North - All study LGAs*	-0.6%	-3.8%	3.4%	0.74
Nigeria North – Doma*	4.0%	-0.6%	11.5%	0.10
Nigeria North – Karu*	-4.0%	-8.1%	0.9%	0.10
Nigeria South – Ado-Odo/Ota*	3.6%	-3.6%	11.6%	0.34
Tanzania - Ilemela	-9.0%	-17.0%	-0.3%	0.04

Source: Outcome Evaluation Reports
*calculated from published adjusted RRs, accounts for change in comparison geographies
Note: For Ethiopia and Northern Nigeria results by LGA and Woreda don't sum to total, as totals calculated from total change across study geographies

3.2.2. Cumulative additional users, cumulative DALYs averted, and cost per DALY averted

Converting mCPR change to the number of cumulative additional users and DALYs averted between baseline and endline (per section 2.13), the program generated 1,218 cumulative additional users in Ethiopia, 44 in Northern Nigeria[25], 263 in Southern Nigeria, and 146 in Tanzania. These additional users translated to 31 DALYs averted in Ethiopia, 4 in Northern Nigeria, 17 in Southern Nigeria, and 5 in Tanzania. See Appendix 1 for detailed calculations for each study geography.

Incremental cost per DALY averted was $30,855 (33 times GDP per capita) in Ethiopia, $111,416 (53 times GDP per capita) in Northern Nigeria, $30,114 (14 times GDP per capita) in Southern Nigeria, and $25,579 (24 times GDP per capita) in Tanzania. For the two geographies with negative health impact (Fentale in Ethiopia and Karu in Northern Nigeria), cost per DALY averted is not reported (

[25] Cumulative additional users are positive in Northern Nigeria despite a small decline in mCPR due to an increase in the number of eligible girls.

Table 13).

Table 13. Cumulative additional users, Incremental DALYs averted, cost per DALY averted, and cost per DALY averted as a multiple of GDP per capita

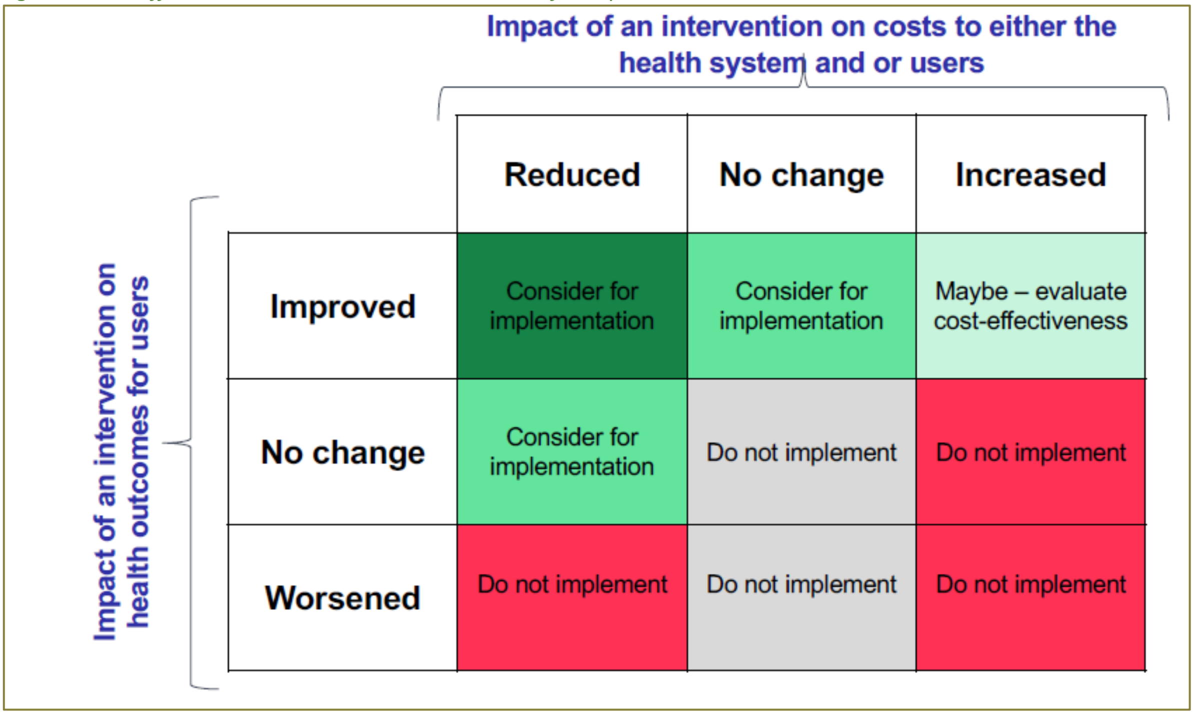
	Cumulative additional users	Cumulative Incremental DALYs averted	Cost per DALY averted	Cost per DALY averted times GDP per capita
Ethiopia - All study woredas	1,218	31	$30,855	33
Ethiopia - Adea	558	15	$16,538	18
Ethiopia - Fentale	(10)	(0)	n.a.	n.a.
Ethiopia - Lume	173	5	$47,923	51
Ethiopia - Wara Jarso	219	5	$42,961	46
Nigeria North - All study LGAs*	44	4	$111,416	53
Nigeria North - Doma	66	6	$26,535	13
Nigeria North - Karu	(30)	(3)	n.a.	n.a.
Nigeria South - Ado-Odo/Ota*	263	17	$30,114	14
Tanzania - Ilemela	146	5	$25,579	24

Source: Authors' calculations
n.a. = not applicable because of negative impact; cost per DALY averted not relevant
Note: For Ethiopia and Northern Nigeria results by LGA and Woreda don't sum to total, as totals calculated from total change across study geographies
*accounts for change in comparison geographies

3.2.3. Interpretation of the incremental cost-effectiveness ratio

Per cost-effectiveness analysis guidelines, interventions considered for implementation (shaded in green in Figure 4) are those that either are the same or less costly and as or more effective, or as or more costly but more effective.

Figure 4. Cost-effectiveness outcomes and consideration for implementation



Source: Mercy Mvundura, September 30, 2021. Case study: Evaluation the programmatic costs and cost-effectiveness of self-injection of DMPA-SC. Presentation at the September Evidence and Learning Working Group Meeting. Self-Care Trailblazer Group. September 30, 2021

By these criteria, the A360 intervention should not be considered for implementation in three geographies where cost increased and effectiveness decreased: Fentale in Ethiopia, and Karu in Northern Nigeria (Table 15). For the remaining geographies, where costs increased but effectiveness also increased, the cost-effectiveness of A360 can be gauged by comparing the A360 ICERs against standard international cost-effectiveness thresholds. Following the recommendations of the Commission on Macroeconomics and Health, WHO-CHOICE set standards for cost-effectiveness across health interventions in terms of cost per DALY averted, classifying interventions as:

- Highly cost-effective (if the ICER is less than one times gross domestic product (GDP) per capita)
- Cost-effective (if the ICER is between one and three times GDP per capita) or
- Not cost-effective (if the ICER is higher than three times GDP per capita)

Table 14 shows the cost-effectiveness thresholds for the three A360 countries.

Table 14. Cost-effectiveness thresholds for A360 countries in terms of GDP per capita, 2020 USD

	Highly cost-effective (< 1 times GDP per capita)	**Cost-effective** (between 1 and 3 times GDP per capita)	**Not cost-effective** (> 3 times GDP per capita)
Ethiopia	< $936	> $936 and < $2,809	>$2,809
Nigeria	< $2,097	> $2,178 and < $6,291	>$6,291
Tanzania	< $1,077	> $1,077 and < $3,230	>$3,230

Measured against these standards, A360 is not cost-effective in any of the study geographies (Table 15).

Table 15. Consideration for implementation and evaluation of A360 cost-effectiveness against WHO-CHOICE thresholds

	A360 Cost and effectiveness outcomes*	**Implementation consideration decision**	**Evaluation of cost-effectiveness**
Ethiopia - All study woredas	Cost ↑ effect ↑	Maybe, evaluate CEA	Not cost-effective
Ethiopia - Adea	Cost ↑ effect ↑	Maybe, evaluate CEA	Not cost-effective
Ethiopia - Fentale	Cost ↑ effect ↓	Do not implement	n.a.
Ethiopia - Lume	Cost ↑ effect ↑	Maybe, evaluate CEA	Not cost-effective
Ethiopia - Wara Jarso	Cost ↑ effect ↑	Maybe, evaluate CEA	Not cost-effective
Nigeria North - All study LGAs	Cost ↑ effect ↑	Maybe, evaluate CEA	Not cost-effective
Nigeria North - Doma	Cost ↑ effect ↑	Maybe, evaluate CEA	Not cost-effective
Nigeria North - Karu	Cost ↑ effect ↓	Do not implement	n.a.
Nigeria South - Ado-Odo/Ota	Cost ↑ effect ↑	Maybe, evaluate CEA	Not cost-effective
Tanzania - Ilemela	Cost ↑ effect ↑	Maybe, evaluate CEA	Not cost-effective

*Effect determination based on additional users and DALYs calculated from median mCPR change (adjusted)

Another way to gauge cost-effectiveness is to compare A360 to other health interventions with similar aims. A recent synthesis of cost-effectiveness studies included 93 health interventions in low- and middle-income countries (Horton, et al., 2017). The synthesis recommended including in Universal Health Care packages any intervention costing less than $200 per DALY averted (about half of interventions), equivalent to $225 in 2020 USD. The cost per DALY averted of the A360 approach is 50 to 100 times the proposed cut-off for inclusion in Universal Health Care packages.

A 2016 review of cost-effectiveness of family planning interventions in low- and middle-income countries (Zakiyah et al 2016) found values of between $235 and $587 (either cost per DALY averted or cost per year of life saved), expressed in 2014 USD adjusted for purchasing power parity. The A360 ICERs are substantially higher than these benchmarks.

Comparing with ICERs of other youth-focused family planning efforts would allow for further judgment as to the cost-effectiveness of A360. However, the current literature does not support such a comparison.

Cost per DALY averted comparisons for contraceptive programs are notably difficult because of differences in valuation of inputs, in discounting of costs and effectiveness, and whether or not studies included child health impacts in DALY averted calculations. Nonetheless, the ICERs for A360 interventions are so far above what is reported from other programs that such differences would likely not change the conclusion that A360 interventions are not cost-effective.

3.2.4. Cost-effectiveness under an optimistic scenario of health impact

At the reported, modest levels of health impact, the study did not find A360 to be cost-effective. Would A360 have been cost-effective under more optimistic scenarios of health impact within the study geographies? We explored the answer to that question in the analysis below (Table 16); assuming that the A360 design and implementation costs within each study geography remained the same. In Ethiopia, even under the highly unlikely scenario where A360 increased mCPR to cover all eligible girls, cost per DALY averted would still have been $7,972 or 8.5-times GDP per capita. In Nigeria, to reach the minimum, three times GDP per capita threshold for cost-effectiveness would have required increasing mCPR in Northern Nigeria from 16% to 32% and in Southern Nigeria from 44.7% to 58%. Such large increases were unlikely to have occurred in the roughly three years from baseline to endline. In Tanzania, by contrast, an outcome showing no increase in mCPR would have generated a cost per DALY averted of less than 3 times GDP per capita. This is because the population of eligible girls increased rapidly from baseline to endline, thus increasing the cumulative number of DALYs averted.

Table 16. What health impact would have been required to make A360 cost-effective?

Study geography	Baseline mCPR	Measured % point mCPR increase attributable to A360*	% point mCPR increase needed to get cost per DALY averted below the 3 times GDP per capita threshold
Ethiopia - All study woredas	63.8%	5.1%	not achievable, even at 100% mCPR
Ethiopia – Adea	66.4%	5.6%	not achievable, even at 100% mCPR
Ethiopia – Fentale	18.6%	-5.3%	not achievable, even at 100% mCPR
Ethiopia – Lume	82.6%	-0.5%	not achievable, even at 100% mCPR
Ethiopia - Wara Jarso	73.8%	12.4%	not achievable, even at 100% mCPR
Nigeria North - All study LGAs	16.0%	-0.6%	32.0%
Nigeria North - Doma	7.6%	4.0%	17.4%
Nigeria North - Karu	21.3%	-4.0%	16.7%
Nigeria South - Ado-Odo/Ota	44.7%	3.6%	13.8%
Tanzania - Ilemela	50.8%	-9.0%	0.0%

*adjusted for confounders; for Nigeria also accounts for changes in the comparison geographies

3.3. Sensitivity analysis

Sensitivity analysis considered uncertainty in both costs and effectiveness. Multiway sensitivity analyses generated plausible ranges for incremental costs (Table 17).[26]

Table 17. Plausible range for incremental costs

		Plausible cost range	
Intervention geography	**Midpoint**	**Low**	**High**
Ethiopia - All study woredas	$970,667	$642,238	$1,211,723
Ethiopia – Adea woreda	$242,420	$148,417	$294,278
Ethiopia – Fentale woreda	$267,124	$178,619	$333,212
Ethiopia – Lume woreda	$222,248	$136,103	$286,469
Ethiopia - Wara Jarso woreda	$235,709	$141,506	$295,683
Nigeria North - All study LGAs	$484,900	$279,295	$655,738
Nigeria North – Doma	$166,731	$90,180	$224,793
Nigeria North – Karu	$317,979	$188,926	$430,754
Nigeria South - Ado-Odo/Ota	$513,220	$260,050	$693,697
Tanzania – Ilemela District	$120,479	$14,982	$194,350

For uncertainty in effectiveness, we calculated a mean and standard deviation for incremental DALYs averted (
Table 18).

Table 18. Mean and standard deviation for incremental DALYs averted

Intervention geography	Mean	Standard deviation
Ethiopia - All study woredas	31	6
Ethiopia – Adea woreda	15	4
Ethiopia – Fentale woreda	(0)	2
Ethiopia – Lume woreda	5	3
Ethiopia - Wara Jarso woreda	5	5
Nigeria North - All study LGAs	4	8
Nigeria North – Doma	6	6
Nigeria North – Karu	(3)	7
Nigeria South – Ado-Odo/Ota	17	27
Tanzania – Ilemela District	5	17

Note: For Ethiopia and Northern Nigeria results by LGA and Woreda don't sum to total, as totals calculated from total change across study geographies

Probabilistic sensitivity analysis combined these cost and effectiveness ranges in a Monte Carlo simulation using 10,000 iterations, run for each intervention geography. For only three of the ten geographies (Doma LGA in Northern Nigeria, Ado-Odo/Ota LGA in Southern Nigeria, and Ilemela District in Tanzania did the probabilistic sensitivity analysis produce any cost per DALY averted value below the 3 times per capita GDP threshold for cost-effectiveness (Table 19, Appendix 1. Additional Calculation Details
Method Mix

[26] See separate country implementation cost reports and design cost report for details on the sensitivity analysis.

The method mix trends used to calculate weighted maternal DALYs averted per use for each study geography are shown in tables A.1 to A.10 below. Baseline and endline values are aligned to the Outcome Evaluation, with a linear trend interpolated between. Method mix is shown among the eligible population of girls considered in each study geography.

Table A.1 Method Mix Trends Ethiopia All Study Woreda

	baseline	Y1	Y2	Y3	endline
Implant	16%	18%	21%	24%	24%
IUD	1%	1%	1%	1%	1%
Injectable	78%	75%	72%	69%	69%
Pill	5%	5%	4%	4%	4%
Emergency pill	0%	0%	1%	1%	1%
Condom	0%	0%	0%	0%	0%
Other	0%	1%	1%	2%	2%
Total	100%	100%	100%	100%	100%

Table A.2 Method Mix Trends Ethiopia, Adea

	baseline	Y1	Y2	Y3	endline
Implant	21%	23%	25%	27%	27%
IUD	1%	1%	1%	1%	1%
Injectable	69%	69%	68%	68%	67%
Pill	6%	5%	5%	4%	4%
Emergency pill	0%	0%	0%	0%	0%
Condom	0%	0%	0%	0%	0%
Other	3%	2%	1%	1%	1%
Total	100%	100%	100%	100%	100%

Table A.3 Method Mix Trends Ethiopia, Fentale

	baseline	Y1	Y2	Y3	endline
Implant	16%	24%	32%	40%	42%
IUD	0%	1%	1%	2%	2%
Injectable	66%	57%	48%	40%	38%
Pill	9%	8%	6%	4%	4%
Emergency pill	2%	3%	4%	5%	6%
Condom	0%	0%	0%	0%	0%
Other	0%	0%	0%	0%	0%
Total	100%	100%	100%	100%	100%

Table A.4 Method Mix Trend Ethiopia, Lume

	baseline	Y1	Y2	Y3	endline
Implant	27%	29%	31%	32%	32%
IUD	0%	0%	0%	1%	1%
Injectable	68%	64%	61%	57%	57%
Pill	4%	5%	7%	8%	8%
Emergency pill	1%	1%	0%	0%	0%
Condom	0%	0%	0%	1%	1%
Other	0%	0%	1%	1%	1%
Total	100%	100%	100%	100%	100%

Table A.5 Method Mix Trend Ethiopia, Wara Jarso

	baseline	Y1	Y2	Y3	endline
Implant	5%	7%	9%	11%	11%
IUD	1%	1%	0%	0%	0%
Injectable	87%	87%	87%	87%	87%
Pill	5%	4%	3%	1%	1%
Emergency pill	0%	0%	0%	0%	0%
Condom	0%	0%	0%	0%	0%
Other	1%	1%	1%	1%	1%
Total	100%	100%	100%	100%	100%

Table A.6 Method Mix Trend Northern Nigeria, All Study LGAs

	baseline	Y1	Y2	Y3	endline
Implant	25%	27%	28%	30%	30%
IUD	1%	1%	0%	0%	0%
Injectable	24%	21%	18%	15%	14%
Pill	8%	9%	10%	11%	12%
Emergency pill	6%	7%	8%	9%	10%
Condom	31%	31%	31%	30%	30%
Other	5%	4%	4%	4%	3%
Total	100%	100%	100%	100%	100%

Table A.7 Method Mix Trends Northern Nigeria, Doma

	baseline	Y1	Y2	Y3	endline
Implant	16%	19%	22%	25%	26%
IUD	0%	0%	0%	0%	0%
Injectable	47%	36%	25%	14%	11%
Pill	3%	5%	7%	9%	9%
Emergency pill	0%	2%	4%	6%	7%
Condom	32%	36%	41%	45%	46%
Other	3%	2%	2%	1%	1%
Total	100%	100%	100%	100%	100%

Table A.8 Method Mix Trends Northern Nigeria, Karu

	baseline	Y1	Y2	Y3	endline
Implant	27%	29%	30%	31%	32%
IUD	1%	1%	1%	0%	0%
Injectable	19%	18%	17%	16%	15%
Pill	9%	10%	11%	12%	12%
Emergency pill	7%	8%	9%	10%	11%
Condom	31%	29%	28%	26%	26%
Other	5%	5%	5%	4%	4%
Total	100%	100%	100%	100%	100%

Table A.9 Method Mix Trends Southern Nigeria, Ado-Odo

	baseline	Y1	Y2	Y3	endline
Implant	0%	1%	1%	2%	2%
IUD	0%	0%	0%	0%	0%
Injectable	1%	1%	2%	2%	2%
Pill	4%	3%	3%	2%	2%
Emergency pill	23%	26%	28%	30%	30%
Condom	70%	67%	65%	62%	61%
Other	2%	2%	2%	2%	2%
Total	100%	100%	100%	100%	100%

Table A.10 Method Mix Trends Tanzania, Illemela

	baseline	Y1	Y2	Y3	endline
Implant	6%	8%	10%	12%	14%
IUD	1%	1%	1%	1%	1%
Injectable	8%	7%	7%	6%	6%
Pill	1%	1%	1%	1%	1%
Emergency pill	1%	1%	2%	3%	3%
Condom	67%	62%	56%	50%	46%
SDM	16%	19%	22%	25%	28%
Other	1%	1%	1%	1%	2%
Total	100%	100%	100%	100%	100%

Additional Users and DALYS

The detailed calculations of users, additional users, and additional DALYs averted are shown in tables A.11 to A.20 below. Calculations are shown for the midpoint estimates; similar calculations were done for the low and high mCPR change estimates (to feed into sensitivity analysis) and for constant mCPR (to develop the comparator costs). Note that additional users and DALYs averted are adjusted in year 4 to account for partial year coverage, based on the number of years from baseline to endline.

Table A.11 Additional User and DALY Calculation Details Ethiopia, All Study Woreda

	baseline	Y1	Y2	Y3	Y4 (partial)
Eligible population (denominator)	5,089	5,244	5,397	5,539	5,668
mCPR	63.8%	65.4%	67.0%	68.6%	68.9%
Years from baseline to endline	3.2				
Users	3,247	3,430	3,617	3,801	3,905
Additional Users	0	183	370	555	110
Maternal DALYs averted		6	10	13	3
Cumulative Additional Users					1,218
Cumulative Maternal DALYs Averted					31

Table A.12 Additional User and DALY Calculation Details Ethiopia, Adea

	baseline	Y1	Y2	Y3	Y4 (partial)
Eligible population (denominator)	1,275	1,362	1,450	1,536	1,621
mCPR	66.4%	68.2%	69.9%	71.7%	72.0%
Years from baseline to endline	3.2				
Users	846	928	1,014	1,102	1,167
Additional Users	0	82	168	255	53
Maternal DALYs averted		3	5	6	1
Cumulative Additional Users					558
Cumulative Maternal DALYs Averted					15

Table A.13 Additional User and DALY Calculation Details Ethiopia, Fentale

	baseline	Y1	Y2	Y3	Y4 (partial)
Eligible population (denominator)	691	758	826	894	961
mCPR	18.6%	16.9%	15.3%	13.6%	13.3%
Years from baseline to endline	3.2				
Users	129	128	126	121	128
Additional Users	0	0	-3	-7	0
Maternal DALYs averted		0.0	-0.1	-0.2	0.0
Cumulative Additional Users					-10
Cumulative Maternal DALYs Averted					-0.3

Table A.14 Additional User and DALY Calculation Details Ethiopia, Lume

	baseline	Y1	Y2	Y3	Y4 (partial)
Eligible population (denominator)	1,451	1,487	1,521	1,552	1,579
mCPR	82.6%	82.4%	82.3%	82.1%	82.1%
Years from baseline to endline	3.2				
Users	1,199	1,226	1,252	1,275	1,297
Additional Users	0	27	53	76	16
Maternal DALYs averted		1	2	2	0
Cumulative Additional Users					173
Cumulative Maternal DALYs Averted					5

Table A.15 Additional User and DALY Calculation Details Ethiopia, Wara Jarso

	baseline	Y1	Y2	Y3	Y4 (partial)
Eligible population (denominator)	1,672	1,637	1,599	1,556	1,507
mCPR	73.8%	77.7%	81.6%	85.5%	86.2%
Years from baseline to endline	3.2				
Users	1,234	1,272	1,306	1,331	1,299
Additional Users	0	39	72	97	11
Maternal DALYs averted		1	2	2	0
Cumulative Additional Users					219
Cumulative Maternal DALYs Averted					5

Table A.16 Additional User and DALY Calculation Details Northern Nigeria, All Study LGAs

	baseline	Y1	Y2	Y3	Y4 (partial)
Eligible population (denominator)	1,883	1,951	2,015	2,069	2,125
mCPR	16.0%	15.8%	15.6%	15.4%	15.4%
Years from baseline to endline	3.3				
Users	302	309	315	320	327
Additional Users	0	7	13	18	6
Maternal DALYs averted		1	1	2	1
Cumulative Additional Users					44
Cumulative Maternal DALYs Averted					4

Table A.17 Additional User and DALY Calculation Details Northern Nigeria, Doma

	baseline	Y1	Y2	Y3	Y4 (partial)
Eligible population (denominator)	716	728	737	743	748
mCPR	7.6%	8.8%	10.0%	11.2%	11.6%
Years from baseline to endline	3.3				
Users	54	64	74	84	86
Additional Users	0	10	20	29	8
Maternal DALYs averted		1	2	3	1
Cumulative Additional Users					66
Cumulative Maternal DALYs Averted					6

Table A.18 Additional User and DALY Calculation Details Northern Nigeria, Karu

	baseline	Y1	Y2	Y3	Y4 (partial)
Eligible population (denominator)	1,167	1,223	1,278	1,327	1,378
mCPR	21.3%	20.1%	18.8%	17.6%	17.3%
Years from baseline to endline	3.3				
Users	249	245	240	233	238
Additional Users	0	-3	-8	-16	-3
Maternal DALYs averted		0	-1	-2	0
Cumulative Additional Users					-30
Cumulative Maternal DALYs Averted					-3

Table A.19 Additional User and DALY Calculation Details Southern Nigeria, Ado-Odo Ota

	baseline	Y1	Y2	Y3	Y4 (partial)
Eligible population (denominator)	5,009	5,003	4,965	4,880	4,776
mCPR	44.7%	45.8%	46.9%	48.0%	48.3%
Years from baseline to endline	3.3				
Users	2,239	2,292	2,329	2,343	2,305
Additional Users	0	53	90	104	17
Maternal DALYs averted		3	6	7	1
Cumulative Additional Users					263
Cumulative Maternal DALYs Averted					17

Table A.20 Additional User and DALY Calculation Details Tanzania, Illemela

	baseline	Y1	Y2	Y3	Y4 (partial)
Eligible population (denominator)	6,273	6,653	7,033	7,412	7,804
mCPR	50.8%	48.4%	46.0%	43.6%	41.8%
Years from baseline to endline	3.8				
Users	3,186	3,219	3,235	3,231	3,261
Additional Users	0	33	49	45	19
Maternal DALYs averted		1	2	1	1
Cumulative Additional Users					146
Cumulative Maternal DALYs Averted					5

Appendix 2. Additional Impact Results

Following the same methodology used to estimate DALYs averted, estimates were made of two additional health impacts: (1) unintended pregnancies averted and (2) maternal deaths averted. Coefficients for impacts per user derived from Impact 2 are shown below in Tables A.21 to A.23. These were weighted by annual method mix estimates in each geography to calculate a weighed impact per user. These were then applied to estimates of additional users to estimate cumulative incremental impact (Table A.24).

Table A.21 Impacts Per User by Method, Ethiopia

	Pregnancies Averted Per User				Maternal Deaths Averted Per User			
	2018	**2019**	**2020**	**2021**	**2018**	**2019**	**2020**	**2021**
Implant	0.487	0.499	0.503	0.503	0.0009	0.0008	0.0006	0.0005
IUD	0.504	0.509	0.510	0.510	0.0009	0.0008	0.0007	0.0005
Injectable	0.350	0.350	0.350	0.350	0.0006	0.0005	0.0004	0.0004
Pill	0.320	0.320	0.320	0.320	0.0006	0.0005	0.0004	0.0003
Emergency pill	0.160	0.160	0.160	0.160	0.0003	0.0002	0.0002	0.0002
Condom	0.230	0.230	0.230	0.230	0.0004	0.0003	0.0003	0.0002
Other	0.230	0.230	0.230	0.230	0.0004	0.0003	0.0003	0.0002

Table A.22 Impacts Per User by Method, Nigeria

	Pregnancies Averted Per User				Maternal Deaths Averted Per User			
	2018	**2019**	**2020**	**2021**	**2018**	**2019**	**2020**	**2021**
Implant	0.486	0.498	0.501	0.501	0.0026	0.0026	0.0026	0.0025
IUD	0.503	0.508	0.508	0.508	0.0026	0.0026	0.0026	0.0026
Injectable	0.350	0.350	0.350	0.350	0.0018	0.0018	0.0018	0.0018
Pill	0.320	0.320	0.320	0.320	0.0017	0.0017	0.0016	0.0016
Emergency pill	0.160	0.160	0.160	0.160	0.0008	0.0008	0.0008	0.0008
Condom	0.230	0.230	0.230	0.230	0.0012	0.0012	0.0012	0.0012
Other	0.230	0.230	0.230	0.230	0.0012	0.0012	0.0012	0.0012

Table A.23 Impacts Per User by Method, Tanzania

	Pregnancies Averted Per User				Maternal Deaths Averted Per User			
	2018	**2019**	**2020**	**2021**	**2018**	**2019**	**2020**	**2021**
Implant	0.486	0.497	0.500	0.500	0.0011	0.0011	0.0010	0.0009
IUD	0.503	0.507	0.508	0.507	0.0012	0.0011	0.0010	0.0009
Injectable	0.350	0.350	0.350	0.350	0.0008	0.0007	0.0007	0.0006
Pill	0.320	0.320	0.320	0.320	0.0007	0.0007	0.0006	0.0006
Emergency pill	0.160	0.160	0.160	0.160	0.0004	0.0003	0.0003	0.0003
Condom	0.230	0.230	0.230	0.230	0.0005	0.0005	0.0005	0.0004
SDM	0.320	0.320	0.320	0.320	0.0007	0.0007	0.0006	0.0006
Other	0.230	0.230	0.230	0.230	0.0005	0.0005	0.0005	0.0004

Table A.24 Cumulative Incremental Pregnancies Averted and Maternal Deaths Averted and Cost per Pregnancy and Maternal Death Averted

	Cumulative Incremental Pregnancies Averted	Cumulative Incremental Maternal Deaths Averted	Cost per Pregnancy Averted	Cost per Maternal Deaths Averted
Ethiopia - All study woredas	463.63	0.55	$2,094	$1,774,953
Ethiopia - Adea	216.54	0.25	$1,120	$951,388
Ethiopia - Fentale	-3.99	0.00	n.a.	n.a.
Ethiopia - Lume	68.09	0.08	$3,264	$2,756,791
Ethiopia - Wara Jarso	79.63	0.10	$2,960	$2,471,362
Nigeria North - All study LGA	14.74	0.08	$32,899	$6,461,954
Nigeria North - Doma	21.29	0.11	$7,833	$1,539,014
Nigeria North - Karu	-10.06	-0.05	n.a.	n.a.
Nigeria South – Ado-Odo Ota	57.61	0.29	$8,908	$1,746,591
Tanzania - Ilemela	42.21	0.08	$2,854	$1,473,981

Appendix 3). In the case of Doma, only 6 of the 10,000 iterations (0.1%) produced a value below the threshold (

). For Ado-Odo/Ota , only 122 of 10,000 iterations (1.2%) produced a value below the 3 times per capita GDP threshold. For Ilemela, 431 of 10,000 iterations (4.3%) produced a value below the 3 times per capita GDP threshold (

). For all other intervention geographies, probabilistic sensitivity analysis did not produce any results for which cost per DALY averted was below the threshold for a cost-effective health intervention. In other words, the probabilistic sensitivity analyses confirmed the results of the point estimates that the A360 interventions were not cost-effective when gauged against GDP per capita thresholds.

Table 19. Summary results of probabilistic sensitivity analysis

Intervention geography	Of 10,000 iterations, number of iterations producing a result below the 3x per capita GDP threshold	As % of all iterations
Ethiopia - All study woredas	0	0%
Ethiopia – Adea woreda	0	0%
Ethiopia – Fentale woreda	0	0%
Ethiopia – Lume woreda	0	0%
Ethiopia - Wara Jarso woreda	0	0%
Nigeria North - All study LGAs	0	0%
Nigeria North – Doma	6	0.1%
Nigeria North – Karu	0	0%
Nigeria South - Ado-Odo/Ota	122	1.2%
Tanzania – Ilemela District	431	4.3%

4 Discussion

Proponents of the A360 approach believed it would be more successful than previous adolescent contraceptive programs by using a new design methodology to produce interventions that would better take into account the unique needs of adolescents, and the social, cultural, religious and economic forces that underlie their access to and choices about contraception. This cost-effectiveness analysis, combining information on the costs of A360 and its health impact, was one way to measure whether A360 was successful in relation to other approaches. For the purposes of this study, health impact was measured through the primary outcome for A360, change in modern contraceptive use among adolescents. Decision makers should consider the cost-effectiveness results alongside other measures of program reach and impact, including secondary outcomes measured by the Outcome Evaluation. The results are meant to contribute to expanding the small evidence base on the design and implementation of adolescent contraceptive programs.

4.1. Overarching findings

The A360 approach is not cost-effective in any of the study geographies. Incremental cost per DALY averted for the A360 interventions was $30,855 (33 times GDP per capita) in Ethiopia, $111,416 (53 times GDP per capita) in Northern Nigeria, $30,114 (14 times GDP per capita) in Southern Nigeria, and $25,579 (24 times GDP per capita) in Tanzania. These incremental cost-effectiveness ratios are far above the WHO-CHOICE standards for cost-effective health interventions (an ICER of less than three times GDP per capita). They are even farther above the $225 per DALY averted proposed as a cut-off for inclusion of interventions in Universal Health Care package, and far above the cost per DALY averted for other family planning interventions (between $235 and $587). Moreover, probabilistic sensitivity analysis that took into account a wide range of uncertainty in costs and health impact estimates confirmed the results of the point estimates that A360 interventions were not cost-effective.

What are explanations for this finding?

Positive health impact was small or nonexistent. Adjusting for confounding variables, the outcome evaluation found an increase in mCPR for only 5 of the 10 study geographies, and in just two of those five was the increase significantly greater than zero at the 95% confidence interval. The study in Nigeria, which featured the most robust outcome evaluation design, failed to find a significant impact of A360 at the 95% confidence interval. When translated into DALYs averted, health impact of A360 was negative in 3 of the 10 geographies. Per standard cost-effectiveness guidelines, interventions that worsen health outcomes should not be considered for implementation. Even in those geographies with positive health outcomes, effect sizes were small. The outcome evaluation reports explore in detail the reasons why A360 did not perform well in most geographies.

A360 costs were high in relation to the comparator. A360 costs were substantially higher than the comparator intervention that represented the programming status quo, more than ten times as costly in 7 of 10 study geographies. Implementation costs rather than design costs accounted for most of these differences. Although A360's design process cost 7 to 9 times as much as the comparator DELTA process, design costs in general accounted for at most 16% of total costs in any one study geography. In other words, even without the substantially higher design effort under A360, overall A360 costs would have been high, and not have significantly changed the cost-effectiveness results.

Given the substantial costs of A360, even a much more optimistic scenario of health impacts within each study geography would generally not have resulted in a cost-effective intervention. In Ethiopia, no manner of success in increasing mCPR in the study geography would have made A360 cost-effective. In Nigeria, reaching minimum thresholds for cost-effectiveness would have required very rapid, almost unheard-of increases in mCPR. In Tanzania, by contrast, had A360 merely kept a constant mCPR, the program would have been cost-effective.

4.2. Limitations

It is important to keep in mind that these results reflect a specific program scale and scope. Had A360 been implemented at a different scale and scope, both costs and health impacts may have differed. For example, increasing the number of geographies or the program's reach within geographies may have generated economies of scale, but such an increase may also have negatively affected health impact. This analysis does not consider alternative scale and scope scenarios.

4.2.1. Limitations in the costing

Although the costing study benefitted from a consistent approach, repeated measures, and reliance on robust accounting systems, several important limitations should be kept in mind when interpreting these results:

- **Recall error.** Using retrospective surveys and interviews may have generated potential recall error in estimates of leveraged costs and in estimates of how A360 staff split their time between design and other activities. Moreover, reliance on interviews and limited document review to identify costs of DELTA, the comparator design methodology, may have also produced error.

- **Choice of useful life of design.** Design costs were amortized assuming a five-year useful life of the intervention design. Estimates of design costs were sensitive to the choice of useful life. More research is needed to expand the scarce literature on useful life of intervention design, particularly for an A360-style approach, which is more costly than typical design methodologies.
- **Underestimate of design costs.** Design costs included only on-budget expenditures by PSI and its consortium partners. The costing may have missed some costs incurred by other, non-consortium counterparts such as government officials and others who contributed to the design phase. This may have resulted in an underestimate of the true cost of design.
- **Reliance on allocation rules to distribute many unassigned costs to study geographies.** The mostly top-down costing approach relied on PSI and subawardee financial systems, which did not provide full detail on costs specific to the study geographies. We tried to address this limitation by developing appropriate rules to allocate costs to the study geographies.
- **Constraints to collection of leveraged costs.** For leveraged costs of the government, we used a bottom-up approach that relied on interviews and site-specific data collection. Although for some inputs we were able to use a census approach, for others we relied on nonrepresentative sampling. Moreover, for some inputs we had incomplete data collection due to inability to contact some personnel, and COVID-19 pandemic related restrictions.
- **Limited geographic coverage.** Due to evaluation resource constraints, and following the lead of the Outcome Evaluation, the costing focused on a limited number of geographical areas. Thus, while our cost and cost-effectiveness findings may apply to the selected geographies, they may not be generalizable to other areas of the countries where A360 was implemented.
- **Caution in cross-country comparison***.* Readers should take caution in comparing these results across the four A360 interventions because of inherent differences in program structure and target population, as well as differences in price levels across countries. Caution is similarly warranted in the comparison of A360 results to other studies that may use different methods to calculate costs or of programs that operate at different scale.

One-way and multi-way cost sensitivity analysis addressed many of these methodological limitations and produced plausible lower and upper ranges to total cost used in the probabilistic sensitivity analysis. Employing a full, bottom-up ingredients costing approach—for example using time and motion studies to estimate level of effort—might have yielded more accurate cost estimates, but also would have required more evaluation resources.

4.2.2. Limitations in measurement of effectiveness

Measurement of effectiveness similarly shared positive factors to increase the robustness of the results including consistency in data collection, representativeness of survey respondents, collection of data on self-exposure to A360, and a quasi-experimental design in Nigeria that used comparison geographies. Yet, the effectiveness study also had several limitations:

- **Lack of comparison group**. In Ethiopia and Tanzania, mCPR could have changed over time for reasons other than the A360 intervention itself. The alternative explanations for a change in mCPR include a time trend in modern contraceptive use (maturation), other competing interventions ongoing in the study geographies during the course of A360 implementation, or changes in instrumentation (Marsden and Torgerson, 2012, Shadish et al., 2002, Robson et al., 2001, Penfold and Zhang, 2013). To minimize the maturation threat to validity, the study analysed mCPR data from other sources to assess whether mCPR was increasing, static or decreasing in the region our study was situated in. In Ethiopia, alternative data did not show a clear trend in either direction. Anecdotal data shows that other sexual and reproductive health programs that may have also contributed to mCPR change were in place during the implementation of A360 in two of the four study geographies in Ethiopia. In Tanzania, analysis of secondary data showed a general upward trend, but overlapping confidence intervals overlap indicating no statistical difference. In addition, the political environment in Tanzania was not supportive of contraception during the intervention period which may have impacted on contraceptive use.

- **Instrumentation differences**. The mode of baseline and endline surveys was slightly different due to modifications to reduce the risk of COVID-19 transmission. Changes at endline in included the use of personal protective equipment such as face masks and having the second section of the questionnaire administered by phone (Ethiopia and Nigeria only). Selection bias from the change is unlikely because response rates were high at baseline and endline. Similarly, information bias is unlikely because the share of girls reporting to me married and sexually active in the last 12 months was similar between baseline and endline. To address any validity threats related to having the second section of the questionnaire collected by phone, interviewers were usually able to see the interviewee from afar. The order of questions changed slightly, which may affect girls' responses. However, we believe that this is unlikely to affect the outcome measurement because the order of very personal questions did not change. In addition, for Nigeria, having a comparison and an intervention site reduces such threats to validity, because there is no reason to believe that bias would be lower or greater in comparison vs intervention sites rates.
- **Reliance on self-reporting.** We relied on respondent self-reporting to measure modern contraceptive use, sexual activity and exposure to the program; these outcomes are thus subject to information bias. Since both the use of contraceptives and sexual activity are sensitive topics, girls may report that they are not contraceptive users or that they are not sexually active, even though they are. To minimize misclassification due to self-reporting impacting on the evaluation findings, we used identical question sequences for very personal questions at baseline and endline surveys and provided extensive interviewer training. Furthermore, all interviews were conducted in privacy, and away from husband and other adults, as much as possible.
- **Limited geographic coverage.** Due to resource constraints, we focused on a limited number of geographical areas. Thus, while our findings may apply to the selected geographies, they may not be generalizable to other areas of the countries where A360 was implemented.
- **Differences in sociodemographic factors.** For Ethiopia, baseline and endline samples were not entirely comparable in terms of sociodemographic factors, including wealth quintile and mobile phone ownership. While we adjusted for the factors which were imbalanced between baseline and endline, the adjustment for these may have been insufficient, and there may be some residual confounding.
- **Lack of clarity over implementation plans.** Finally, an important limitation of the effectiveness study in all three countries was the lack of clarity over implementation plans when planning the outcome evaluation, because the package of A360 interventions was still under development. This is well described in Atchison et al. (2018) and in Doyle et al. (2019).

5 Conclusion

When placed against international standards for cost-effectiveness and compared to cost-effectiveness findings from other studies of health and family planning interventions, this study did not find the A360 approach to be cost-effective in any of the study geographies. In other words, the more costly design effort, and the interventions that resulted from that design effort, were not worthwhile in relation to the size of health outcomes achieved. In Ethiopia and Nigeria, program implementation was simply too costly in relation to potential impact, thus suggesting that, along with changes to increase effectiveness, it will take efforts to reduce implementation costs to produce a cost-effective model. Actions currently underway in Ethiopia and Nigeria to shift management and service delivery responsibilities for the A360 legacy interventions governments may lower costs, and PSI should continue to monitor closely their cost and health impact. In Tanzania, A360 costs were more in line with potential impact, suggesting that tweaks to the current intervention model to generate better health impact could more easily produce a cost-effective intervention. The results highlight the continuing difficulty the family planning community faces in significantly moving the needle on adolescent contraceptive use and doing so in a cost-effective way. Programmers should continue to search for ways to improve program design and implementation to reach this key group with contraceptive services.

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7 Appendices

Appendix 1. Additional Calculation Details

Method Mix

The method mix trends used to calculate weighted maternal DALYs averted per use for each study geography are shown in tables A.1 to A.10 below. Baseline and endline values are aligned to the Outcome Evaluation, with a linear trend interpolated between. Method mix is shown among the eligible population of girls considered in each study geography.

Table A.1 Method Mix Trends Ethiopia All Study Woreda

	baseline	Y1	Y2	Y3	endline
Implant	16%	18%	21%	24%	24%
IUD	1%	1%	1%	1%	1%
Injectable	78%	75%	72%	69%	69%
Pill	5%	5%	4%	4%	4%
Emergency pill	0%	0%	1%	1%	1%
Condom	0%	0%	0%	0%	0%
Other	0%	1%	1%	2%	2%
Total	100%	100%	100%	100%	100%

Table A.2 Method Mix Trends Ethiopia, Adea

	baseline	Y1	Y2	Y3	endline
Implant	21%	23%	25%	27%	27%
IUD	1%	1%	1%	1%	1%
Injectable	69%	69%	68%	68%	67%
Pill	6%	5%	5%	4%	4%
Emergency pill	0%	0%	0%	0%	0%
Condom	0%	0%	0%	0%	0%
Other	3%	2%	1%	1%	1%
Total	100%	100%	100%	100%	100%

Table A.3 Method Mix Trends Ethiopia, Fentale

	baseline	Y1	Y2	Y3	endline
Implant	16%	24%	32%	40%	42%
IUD	0%	1%	1%	2%	2%
Injectable	66%	57%	48%	40%	38%
Pill	9%	8%	6%	4%	4%
Emergency pill	2%	3%	4%	5%	6%
Condom	0%	0%	0%	0%	0%
Other	0%	0%	0%	0%	0%
Total	100%	100%	100%	100%	100%

Table A.4 Method Mix Trend Ethiopia, Lume

	baseline	Y1	Y2	Y3	endline
Implant	27%	29%	31%	32%	32%
IUD	0%	0%	0%	1%	1%
Injectable	68%	64%	61%	57%	57%
Pill	4%	5%	7%	8%	8%
Emergency pill	1%	1%	0%	0%	0%
Condom	0%	0%	0%	1%	1%
Other	0%	0%	1%	1%	1%
Total	100%	100%	100%	100%	100%

Table A.5 Method Mix Trend Ethiopia, Wara Jarso

	baseline	Y1	Y2	Y3	endline
Implant	5%	7%	9%	11%	11%
IUD	1%	1%	0%	0%	0%
Injectable	87%	87%	87%	87%	87%
Pill	5%	4%	3%	1%	1%
Emergency pill	0%	0%	0%	0%	0%
Condom	0%	0%	0%	0%	0%
Other	1%	1%	1%	1%	1%
Total	100%	100%	100%	100%	100%

Table A.6 Method Mix Trend Northern Nigeria, All Study LGAs

	baseline	Y1	Y2	Y3	endline
Implant	25%	27%	28%	30%	30%
IUD	1%	1%	0%	0%	0%
Injectable	24%	21%	18%	15%	14%
Pill	8%	9%	10%	11%	12%
Emergency pill	6%	7%	8%	9%	10%
Condom	31%	31%	31%	30%	30%
Other	5%	4%	4%	4%	3%
Total	100%	100%	100%	100%	100%

Table A.7 Method Mix Trends Northern Nigeria, Doma

	baseline	Y1	Y2	Y3	endline
Implant	16%	19%	22%	25%	26%
IUD	0%	0%	0%	0%	0%
Injectable	47%	36%	25%	14%	11%
Pill	3%	5%	7%	9%	9%
Emergency pill	0%	2%	4%	6%	7%
Condom	32%	36%	41%	45%	46%
Other	3%	2%	2%	1%	1%
Total	100%	100%	100%	100%	100%

Table A.8 Method Mix Trends Northern Nigeria, Karu

	baseline	Y1	Y2	Y3	endline
Implant	27%	29%	30%	31%	32%
IUD	1%	1%	1%	0%	0%
Injectable	19%	18%	17%	16%	15%
Pill	9%	10%	11%	12%	12%
Emergency pill	7%	8%	9%	10%	11%
Condom	31%	29%	28%	26%	26%
Other	5%	5%	5%	4%	4%
Total	100%	100%	100%	100%	100%

Table A.9 Method Mix Trends Southern Nigeria, Ado-Odo

	baseline	Y1	Y2	Y3	endline
Implant	0%	1%	1%	2%	2%
IUD	0%	0%	0%	0%	0%
Injectable	1%	1%	2%	2%	2%
Pill	4%	3%	3%	2%	2%
Emergency pill	23%	26%	28%	30%	30%
Condom	70%	67%	65%	62%	61%
Other	2%	2%	2%	2%	2%
Total	100%	100%	100%	100%	100%

Table A.10 Method Mix Trends Tanzania, Illemela

	baseline	Y1	Y2	Y3	endline
Implant	6%	8%	10%	12%	14%
IUD	1%	1%	1%	1%	1%
Injectable	8%	7%	7%	6%	6%
Pill	1%	1%	1%	1%	1%
Emergency pill	1%	1%	2%	3%	3%
Condom	67%	62%	56%	50%	46%
SDM	16%	19%	22%	25%	28%
Other	1%	1%	1%	1%	2%
Total	100%	100%	100%	100%	100%

Additional Users and DALYS

The detailed calculations of users, additional users, and additional DALYs averted are shown in tables A.11 to A.20 below. Calculations are shown for the midpoint estimates; similar calculations were done for the low and high mCPR change estimates (to feed into sensitivity analysis) and for constant mCPR (to develop the comparator costs). Note that additional users and DALYs averted are adjusted in year 4 to account for partial year coverage, based on the number of years from baseline to endline.

Table A.11 Additional User and DALY Calculation Details Ethiopia, All Study Woreda

	baseline	Y1	Y2	Y3	Y4 (partial)
Eligible population (denominator)	5,089	5,244	5,397	5,539	5,668
mCPR	63.8%	65.4%	67.0%	68.6%	68.9%
Years from baseline to endline	3.2				
Users	3,247	3,430	3,617	3,801	3,905
Additional Users	0	183	370	555	110
Maternal DALYs averted		6	10	13	3
Cumulative Additional Users					1,218
Cumulative Maternal DALYs Averted					31

Table A.12 Additional User and DALY Calculation Details Ethiopia, Adea

	baseline	Y1	Y2	Y3	Y4 (partial)
Eligible population (denominator)	1,275	1,362	1,450	1,536	1,621
mCPR	66.4%	68.2%	69.9%	71.7%	72.0%
Years from baseline to endline	3.2				
Users	846	928	1,014	1,102	1,167
Additional Users	0	82	168	255	53
Maternal DALYs averted		3	5	6	1
Cumulative Additional Users					558
Cumulative Maternal DALYs Averted					15

Table A.13 Additional User and DALY Calculation Details Ethiopia, Fentale

	baseline	Y1	Y2	Y3	Y4 (partial)
Eligible population (denominator)	691	758	826	894	961
mCPR	18.6%	16.9%	15.3%	13.6%	13.3%
Years from baseline to endline	3.2				
Users	129	128	126	121	128
Additional Users	0	0	-3	-7	0
Maternal DALYs averted		0.0	-0.1	-0.2	0.0
Cumulative Additional Users					-10
Cumulative Maternal DALYs Averted					-0.3

Table A.14 Additional User and DALY Calculation Details Ethiopia, Lume

	baseline	Y1	Y2	Y3	Y4 (partial)
Eligible population (denominator)	1,451	1,487	1,521	1,552	1,579
mCPR	82.6%	82.4%	82.3%	82.1%	82.1%
Years from baseline to endline	3.2				
Users	1,199	1,226	1,252	1,275	1,297
Additional Users	0	27	53	76	16
Maternal DALYs averted		1	2	2	0
Cumulative Additional Users					173
Cumulative Maternal DALYs Averted					5

Table A.15 Additional User and DALY Calculation Details Ethiopia, Wara Jarso

	baseline	Y1	Y2	Y3	Y4 (partial)
Eligible population (denominator)	1,672	1,637	1,599	1,556	1,507
mCPR	73.8%	77.7%	81.6%	85.5%	86.2%
Years from baseline to endline	3.2				
Users	1,234	1,272	1,306	1,331	1,299
Additional Users	0	39	72	97	11
Maternal DALYs averted		1	2	2	0
Cumulative Additional Users					219
Cumulative Maternal DALYs Averted					5

Table A.16 Additional User and DALY Calculation Details Northern Nigeria, All Study LGAs

	baseline	Y1	Y2	Y3	Y4 (partial)
Eligible population (denominator)	1,883	1,951	2,015	2,069	2,125
mCPR	16.0%	15.8%	15.6%	15.4%	15.4%
Years from baseline to endline	3.3				
Users	302	309	315	320	327
Additional Users	0	7	13	18	6
Maternal DALYs averted		1	1	2	1
Cumulative Additional Users					44
Cumulative Maternal DALYs Averted					4

Table A.17 Additional User and DALY Calculation Details Northern Nigeria, Doma

	baseline	Y1	Y2	Y3	Y4 (partial)
Eligible population (denominator)	716	728	737	743	748
mCPR	7.6%	8.8%	10.0%	11.2%	11.6%
Years from baseline to endline	3.3				
Users	54	64	74	84	86
Additional Users	0	10	20	29	8
Maternal DALYs averted		1	2	3	1
Cumulative Additional Users					66
Cumulative Maternal DALYs Averted					6

Table A.18 Additional User and DALY Calculation Details Northern Nigeria, Karu

	baseline	Y1	Y2	Y3	Y4 (partial)
Eligible population (denominator)	1,167	1,223	1,278	1,327	1,378
mCPR	21.3%	20.1%	18.8%	17.6%	17.3%
Years from baseline to endline	3.3				
Users	249	245	240	233	238
Additional Users	0	-3	-8	-16	-3
Maternal DALYs averted		0	-1	-2	0
Cumulative Additional Users					-30
Cumulative Maternal DALYs Averted					-3

Table A.19 Additional User and DALY Calculation Details Southern Nigeria, Ado-Odo Ota

	baseline	Y1	Y2	Y3	Y4 (partial)
Eligible population (denominator)	5,009	5,003	4,965	4,880	4,776
mCPR	44.7%	45.8%	46.9%	48.0%	48.3%
Years from baseline to endline	3.3				
Users	2,239	2,292	2,329	2,343	2,305
Additional Users	0	53	90	104	17
Maternal DALYs averted		3	6	7	1
Cumulative Additional Users					263
Cumulative Maternal DALYs Averted					17

Table A.20 Additional User and DALY Calculation Details Tanzania, Illemela

	baseline	Y1	Y2	Y3	Y4 (partial)
Eligible population (denominator)	6,273	6,653	7,033	7,412	7,804
mCPR	50.8%	48.4%	46.0%	43.6%	41.8%
Years from baseline to endline	3.8				
Users	3,186	3,219	3,235	3,231	3,261
Additional Users	0	33	49	45	19
Maternal DALYs averted		1	2	1	1
Cumulative Additional Users					146
Cumulative Maternal DALYs Averted					5

Appendix 2. Additional Impact Results

Following the same methodology used to estimate DALYs averted, estimates were made of two additional health impacts: (1) unintended pregnancies averted and (2) maternal deaths averted. Coefficients for impacts per user derived from Impact 2 are shown below in Tables A.21 to A.23. These were weighted by annual method mix estimates in each geography to calculate a weighed impact per user. These were then applied to estimates of additional users to estimate cumulative incremental impact (Table A.24).

Table A.21 Impacts Per User by Method, Ethiopia

	Pregnancies Averted Per User				Maternal Deaths Averted Per User			
	2018	**2019**	**2020**	**2021**	**2018**	**2019**	**2020**	**2021**
Implant	0.487	0.499	0.503	0.503	0.0009	0.0008	0.0006	0.0005
IUD	0.504	0.509	0.510	0.510	0.0009	0.0008	0.0007	0.0005
Injectable	0.350	0.350	0.350	0.350	0.0006	0.0005	0.0004	0.0004
Pill	0.320	0.320	0.320	0.320	0.0006	0.0005	0.0004	0.0003
Emergency pill	0.160	0.160	0.160	0.160	0.0003	0.0002	0.0002	0.0002
Condom	0.230	0.230	0.230	0.230	0.0004	0.0003	0.0003	0.0002
Other	0.230	0.230	0.230	0.230	0.0004	0.0003	0.0003	0.0002

Table A.22 Impacts Per User by Method, Nigeria

	Pregnancies Averted Per User				Maternal Deaths Averted Per User			
	2018	**2019**	**2020**	**2021**	**2018**	**2019**	**2020**	**2021**
Implant	0.486	0.498	0.501	0.501	0.0026	0.0026	0.0026	0.0025
IUD	0.503	0.508	0.508	0.508	0.0026	0.0026	0.0026	0.0026
Injectable	0.350	0.350	0.350	0.350	0.0018	0.0018	0.0018	0.0018
Pill	0.320	0.320	0.320	0.320	0.0017	0.0017	0.0016	0.0016
Emergency pill	0.160	0.160	0.160	0.160	0.0008	0.0008	0.0008	0.0008
Condom	0.230	0.230	0.230	0.230	0.0012	0.0012	0.0012	0.0012
Other	0.230	0.230	0.230	0.230	0.0012	0.0012	0.0012	0.0012

Table A.23 Impacts Per User by Method, Tanzania

	Pregnancies Averted Per User				Maternal Deaths Averted Per User			
	2018	**2019**	**2020**	**2021**	**2018**	**2019**	**2020**	**2021**
Implant	0.486	0.497	0.500	0.500	0.0011	0.0011	0.0010	0.0009
IUD	0.503	0.507	0.508	0.507	0.0012	0.0011	0.0010	0.0009
Injectable	0.350	0.350	0.350	0.350	0.0008	0.0007	0.0007	0.0006
Pill	0.320	0.320	0.320	0.320	0.0007	0.0007	0.0006	0.0006
Emergency pill	0.160	0.160	0.160	0.160	0.0004	0.0003	0.0003	0.0003
Condom	0.230	0.230	0.230	0.230	0.0005	0.0005	0.0005	0.0004
SDM	0.320	0.320	0.320	0.320	0.0007	0.0007	0.0006	0.0006
Other	0.230	0.230	0.230	0.230	0.0005	0.0005	0.0005	0.0004

Table A.24 Cumulative Incremental Pregnancies Averted and Maternal Deaths Averted and Cost per Pregnancy and Maternal Death Averted

	Cumulative Incremental Pregnancies Averted	Cumulative Incremental Maternal Deaths Averted	Cost per Pregnancy Averted	Cost per Maternal Deaths Averted
Ethiopia - All study woredas	463.63	0.55	$2,094	$1,774,953
Ethiopia - Adea	216.54	0.25	$1,120	$951,388
Ethiopia - Fentale	-3.99	0.00	n.a.	n.a.
Ethiopia - Lume	68.09	0.08	$3,264	$2,756,791
Ethiopia - Wara Jarso	79.63	0.10	$2,960	$2,471,362
Nigeria North - All study LGA	14.74	0.08	$32,899	$6,461,954
Nigeria North - Doma	21.29	0.11	$7,833	$1,539,014
Nigeria North - Karu	-10.06	-0.05	n.a.	n.a.
Nigeria South – Ado-Odo Ota	57.61	0.29	$8,908	$1,746,591
Tanzania - Ilemela	42.21	0.08	$2,854	$1,473,981

Appendix 3. Sensitivity analyses

About the sensitivity analysis
Probabilistic sensitivity analysis combined the plausible cost and effectiveness ranges in a Monte Carlo simulation using 10,000 iterations. These figures show the results of those analyses for each intervention geography.

What the graphs include
Each blue dot stands for one of the 10,000 combinations of incremental cost (on the vertical axis) and incremental DALYs averted (on the horizontal axis). The red dot represents the mean values for incremental cost and incremental DALYs averted. The green dotted line represents the cost per DALY averted at the one time per capita GDP threshold. The orange dotted line represents the cost per DALY averted at the three times per capita GDP threshold.

Interpreting the graphs
A positive value for incremental cost means the cost of the A360 intervention is greater than the cost of the comparator. All incremental cost values are positive in these results. A positive value for DALYs averted mean A360 was more effective than the comparator. A negative value for DALYs averted mean that the comparator was more effective than A360. Many of the results are negative for DALYs averted because DALYs averted reflect the underlying findings from the outcome evaluation, in which either mean values for mCPR change were negative, or the 95% confidence interval for mCPR change spanned negative and positive values.

A blue dot below the green dotted line means a cost per DALY averted below the one times per capita GDP threshold, the threshold at which an intervention is considered “highly cost-effective.” A blue dot below the orange dotted line (and above the green dotted line) would translate to a cost per DALY averted between one and three times per capita GDP threshold, a result in which an intervention is considered “cost-effective.” A blue dot above the orange dotted line means the cost per DALY averted is above the three times per capita GDP threshold, and thus considered “not cost-effective.”

Figure A.1 Cost-effectiveness scatter plot A360 versus comparator, Ethiopia, all 4 study Woredas

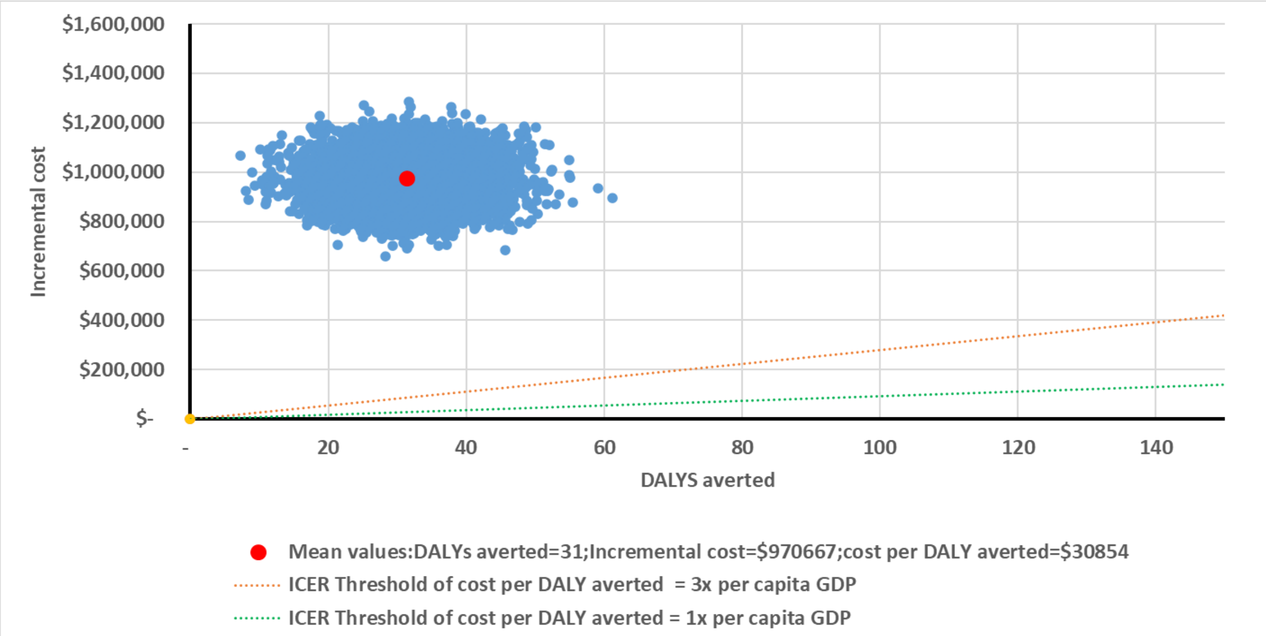

Figure A 2 Cost-effectiveness scatter plot A360 versus comparator, Ethiopia, Adea

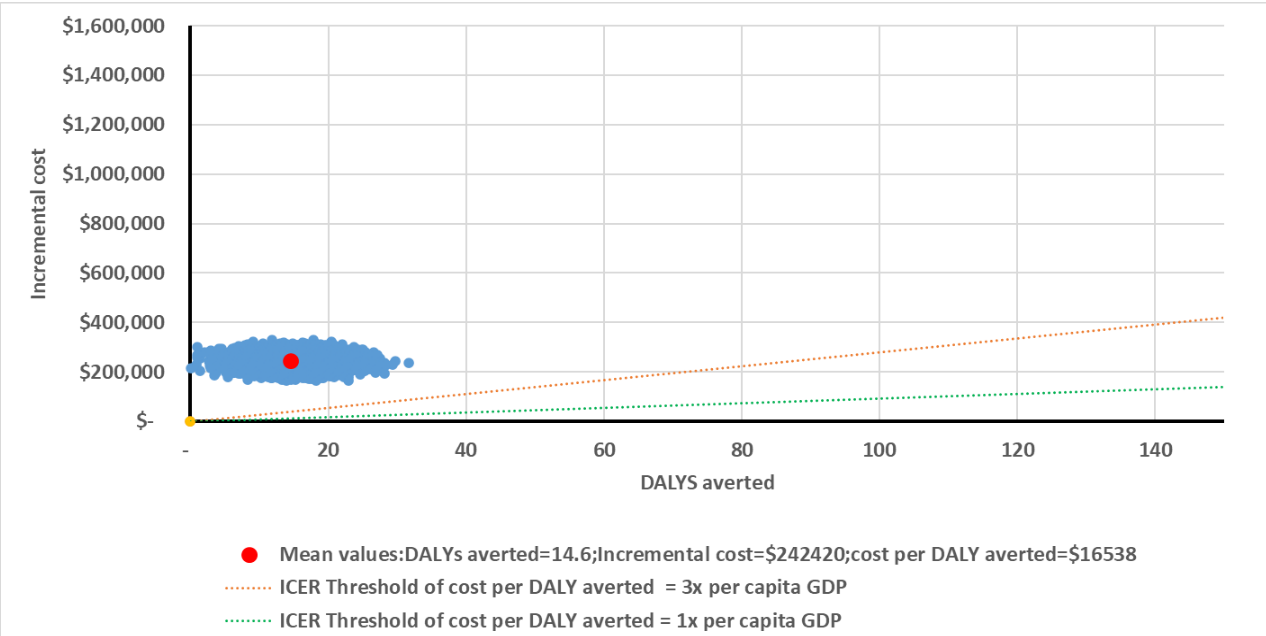

Figure A.3 Cost-effectiveness scatter plot of A360 versus comparator, Ethiopia, Fentale

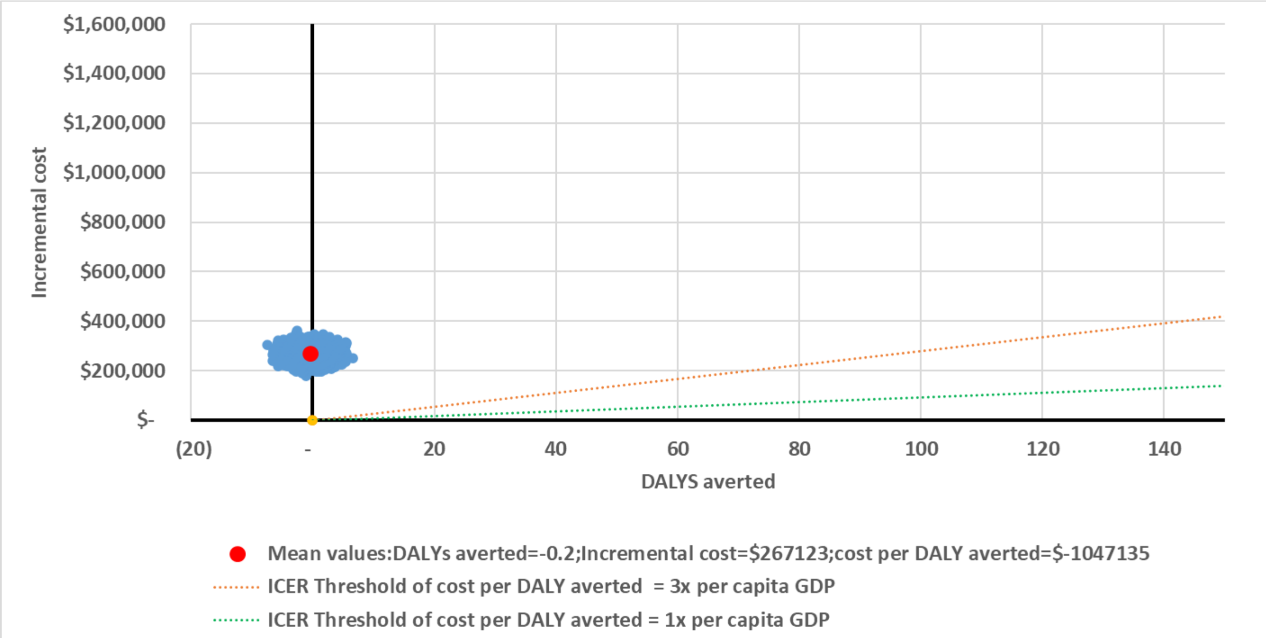

Figure A.4 Cost-effectiveness scatter plot of A360 versus comparator, Ethiopia, Lume

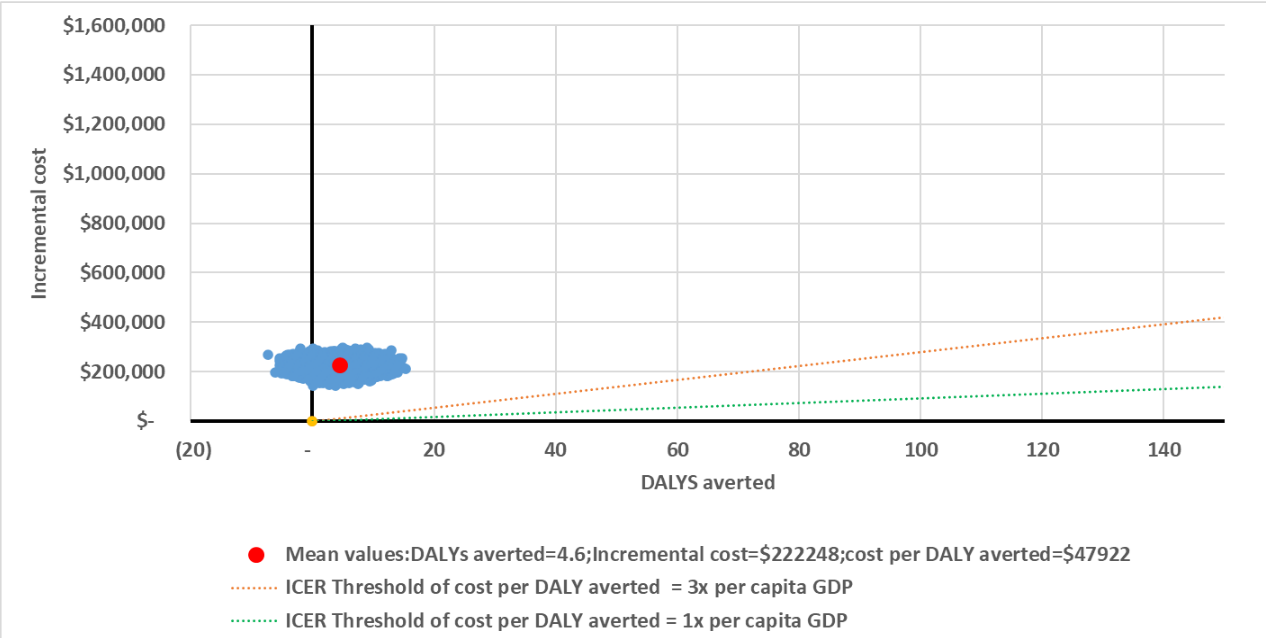

Figure A.5 Cost-effectiveness scatter plot of A360 versus comparator, Ethiopia, Wara Jarso

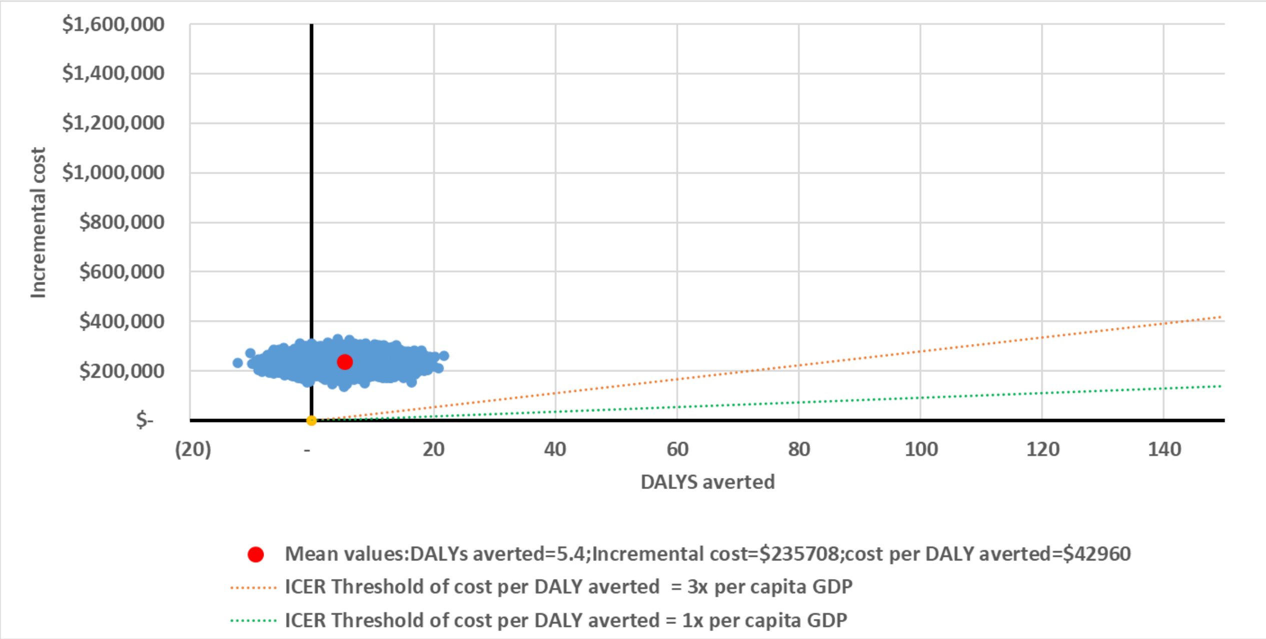

Figure A 6 Cost-effectiveness scatter plot of A360 versus comparator, Northern Nigeria, all study LGAs

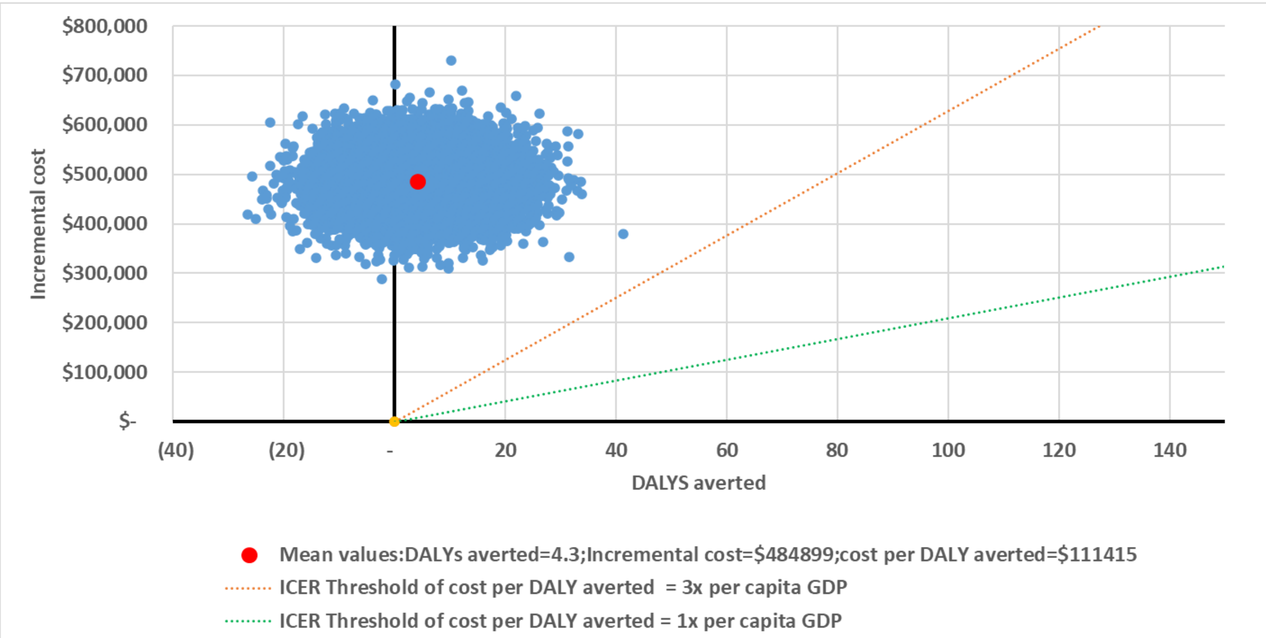

Figure A 7 Cost-effectiveness scatter plot of A360 versus comparator, Northern Nigeria, Doma

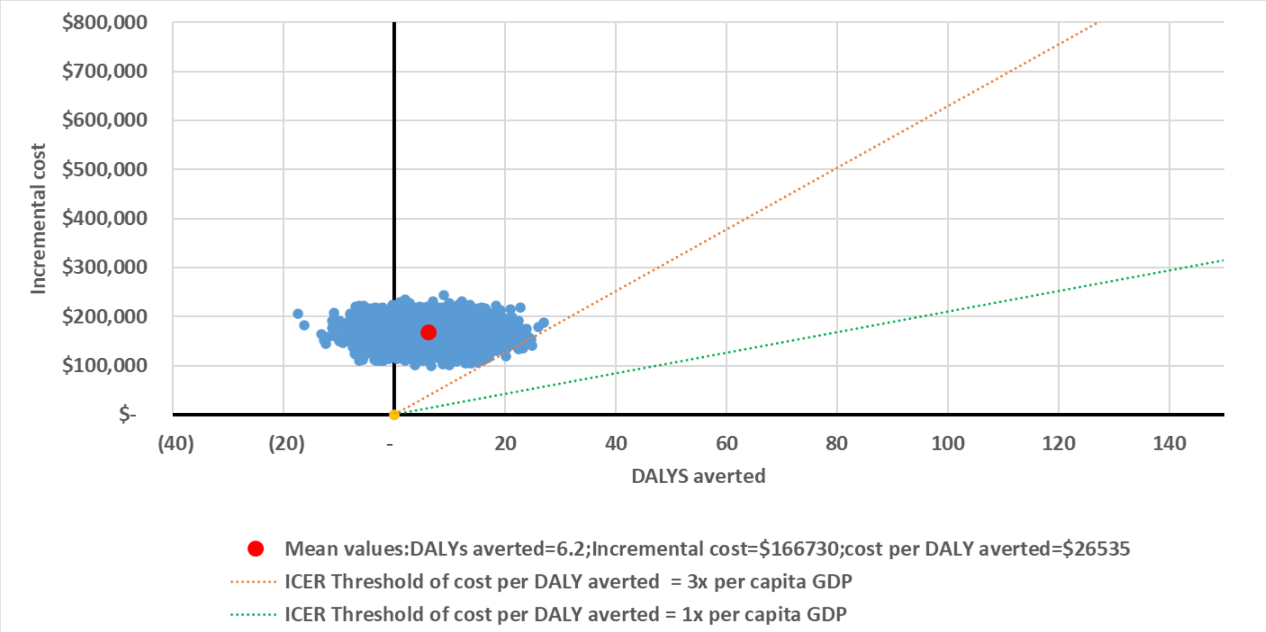

Figure A.8 Cost-effectiveness scatter plot of A360 versus comparator, Northern Nigeria, Karu

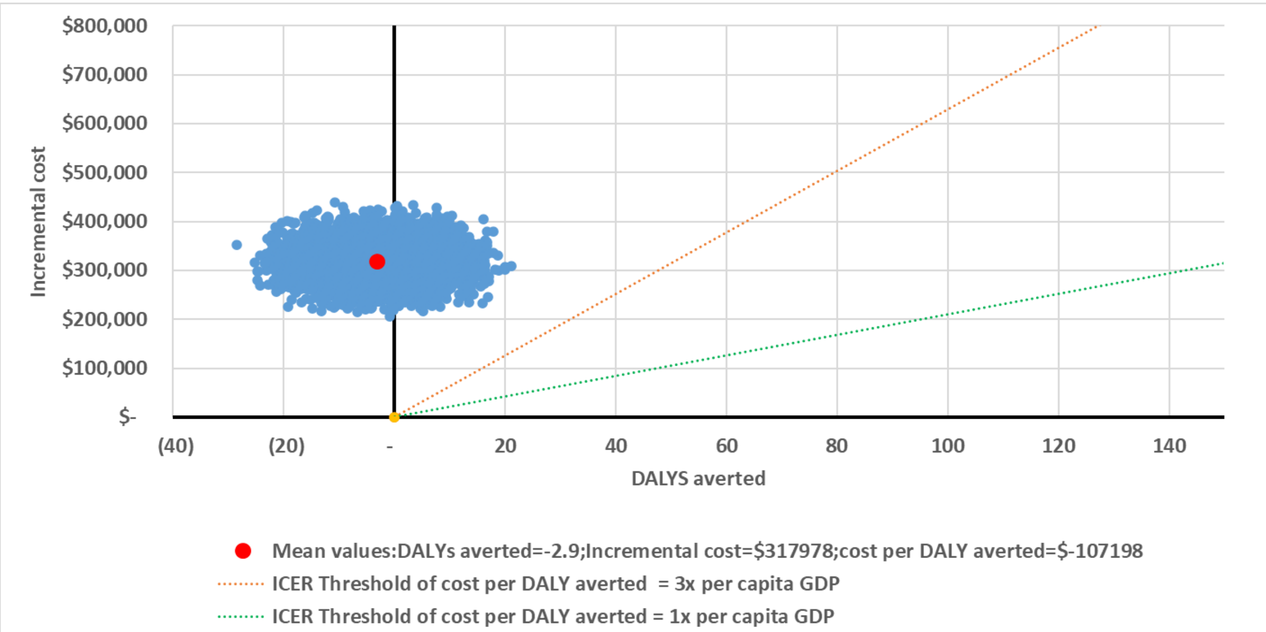

Figure A.9 Cost-effectiveness scatter plot of A360 versus comparator, Southern Nigeria, Ado-Odo/Ota

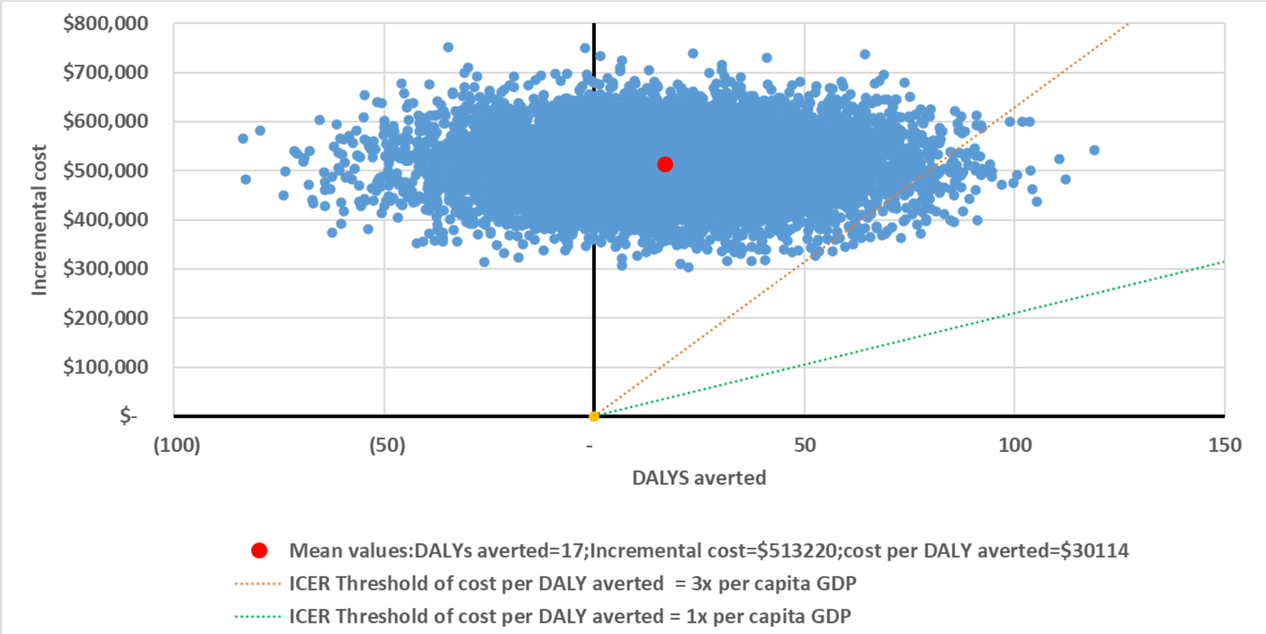

Figure A.10 Cost-effectiveness scatter plot of A360 versus comparator, Tanzania, Ilemela