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By Sarah Tougher, Andrea G. Mann, ACTwatch Group, Yazoume Ye, Idrissa A. Kourgueni, Rebecca Thomson, John H. Amuasi, Ruilin Ren, Barbara A. Willey, Daniel Ansong, Katia Bruxvoort, Graciela Diap, Charles Festo, Boniface Johanes, Admirabilis Kalolella, Oumarou Mallam, Blessing Mberu, Salif Ndiaye, Samuel Blay Nguah, Moctar Seydou, Mark Taylor, Marilyn Wamukoya, Fred Arnold, Kara Hanson, and Catherine Goodman

# Improving Access To Malaria Medicine Through Private-Sector Subsidies In Seven African Countries

**Sarah Tougher** (Sarah.Tougher@lshtm.ac.uk) is a research fellow in the Department of Global Health and Development, London School of Hygiene and Tropical Medicine, in the United Kingdom.

**Andrea G. Mann** is a lecturer in the Department of Infectious Disease Epidemiology, London School of Hygiene and Tropical Medicine.

**The ACTwatch Group** is recognized in an acknowledgment at the end of the article.

**Yazoume Ye** is a fellow and technical director at ICF International in Rockville, Maryland.

**Idrissa A. Kourgueni** is general director of the Centre International d'Etudes et de Recherches sur les Populations Africaines and of the Institut National de la Statistique de Niger, both in Niamey, Niger.

**Rebecca Thomson** is a research fellow at the London School of Hygiene and Tropical Medicine.

**John H. Amuasi** is a doctoral candidate in the School of Public Health, University of Minnesota, in Minneapolis, and a researcher at the Komfo Anokye Teaching Hospital (KATH), in Kumasi, Ghana.

**ABSTRACT** Improving access to quality-assured artemisinin combination therapies (ACTs) is an important component of malaria control in low- and middle-income countries. In 2010 the Global Fund to Fight AIDS, Tuberculosis, and Malaria launched the Affordable Medicines Facility—malaria (AMFm) program in seven African countries. The goal of the program was to decrease malaria morbidity and delay drug resistance by increasing the use of ACTs, primarily through subsidies intended to reduce costs. We collected data on price and retail markups on antimalarial medicines from 19,625 private for-profit retail outlets before and 6–15 months after the program's implementation. We found that in six of the AMFm pilot programs, prices for quality-assured ACTs decreased by US\$1.28–\$4.34, and absolute retail markups on these therapies decreased by US\$0.31–\$1.03. Prices and markups on other classes of antimalarials also changed during the evaluation period, but not to the same extent. In all but two of the pilot programs, we found evidence that prices could fall further without suppliers' losing money. Thus, concerns may be warranted that wholesalers and retailers are capturing subsidies instead of passing them on to consumers. These findings demonstrate that supranational subsidies can dramatically reduce retail prices of health commodities and that recommended retail prices communicated to a wide audience may be an effective mechanism for controlling the market power of private-sector antimalarial retailers and wholesalers.

**I**n many low- and middle-income countries, patients frequently seek treatment for serious illnesses such as malaria, diarrhea, and tuberculosis in the private for-profit sector, where medicines may vary in quality and be expensive, preventing their use. Subsidies for high-quality medicines for certain diseases have been a prominent glob-

al health strategy for improving treatment outcomes in the private for-profit sectors in these countries. A key concern with this type of intervention is that subsidies are not passed along to patients in the form of lower prices for targeted medications in the private sector but instead are “captured” before they can get to patients by wholesalers and retailers, who use the subsidies

to earn “supernormal” profits.

To determine whether suppliers were capturing the subsidy intended to benefit patients, we analyzed Affordable Medicines Facility—malaria (AMFm), the largest subsidy program to date for the private sectors of low- and middle-income countries. This article examines whether there is potential for further reductions in the prices of subsidized medicines through greater adherence to recommended retail prices and through further reductions in retail markups.

## Malaria Treatment And AMFm

Malaria is the fifth-leading cause of years of life lost from premature mortality worldwide.<sup>1</sup> Improving access to first-line treatments known as artemisinin combination therapies (ACTs) is critical to malaria control.

Even though ACTs are provided for free in the public sectors of many low-income countries, use of these therapies remains low because of unreliable public-sector supplies and the long distances that patients must travel to facilities to obtain the therapies. In private for-profit outlets, where patients frequently seek malaria treatment, less-effective medicines are widely available and substantially cheaper than ACTs.<sup>2,3</sup>

The use of antimalarials other than ACTs has two important implications for public health. First, mortality increases when medicines are used that are no longer effective because of drug resistance. Second, the use of antimalarials other than ACTs such as artemisinin or other monotherapies likely contributes to the spread and intensification of drug resistance. Drug resistance is less likely to develop when combination therapies with two independent modes of action are used, because a malaria parasite is less likely to spontaneously mutate so that it becomes resistant to both drugs simultaneously.<sup>4</sup>

To increase the appropriate use of quality-assured ACTs and decrease the use of other antimalarials, the Global Fund to Fight AIDS, Tuberculosis, and Malaria launched AMFm in 2010. AMFm operated as eight national-scale pilots in seven countries—Ghana, Kenya, Madagascar, Niger, Nigeria, Tanzania (mainland and Zanzibar, a semi-autonomous part of Tanzania), and Uganda—until 2012. It was then incorporated into the Global Fund’s regular financing stream.<sup>5</sup>

AMFm had three components: price negotiations with manufacturers of quality-assured ACTs to obtain lower-cost supplies of these medicines; the provision of subsidies in the form of copayments from the Global Fund to manufacturers for purchases of these therapies by approved importers; and demand- and supply-side

interventions to facilitate program implementation and the rational use of such therapies through recommended retail prices and communications campaigns.<sup>6</sup> Further details on the operation of AMFm can be found elsewhere.<sup>7–9</sup>

We conducted an independent evaluation of AMFm in 2010–12 that assessed changes in quality-assured ACT prices, availability, market share, and use against predefined benchmarks of success 6–15 months after the start of program implementation. The evaluation reported large improvements—particularly in the private for-profit sector—in the availability of such therapies, with lower prices and increased market share for these products in most pilots.<sup>7,8</sup> The few pilots with appropriately timed household survey data showed some limited evidence of improved use of quality-assured ACTs for the treatment of fever.<sup>10–12</sup>

In spite of observed improvements, there is still concern that the AMFm subsidy was captured by wholesalers and retailers. Maximizing price reductions is critical to subsidy interventions, because poorer households may not benefit from the intervention and patients may continue to purchase nonrecommended treatments if prices of the targeted drugs remain high.<sup>13</sup>

## Study Data And Methods

The AMFm independent evaluation used a pre-post study design with thorough documentation of the implementation process and context, in accordance with current guidance for evaluating complex interventions.<sup>14</sup>

Price and markup data were collected using nationally representative surveys of antimalarial outlets. In most pilots, baseline data collection took place in the period August–December 2010. Existing surveys conducted by ACTwatch in Nigeria (September–November 2009) and Madagascar (April–June 2010) were used as baselines.<sup>15</sup> End-line data collection in all pilots took place in the period October 2011–January 2012, which was 6–15 months after the start of the program implementation.

The surveys were timed to coincide with malaria transmission seasons, and baseline data collection was intended to take place before the arrival of subsidized ACTs. However, collection in Kenya began one month after the first imports of drugs subsidized by AMFm.

**STUDY SAMPLE** Outlet surveys used a cluster sampling approach. Clusters were administrative areas with approximately 10,000–15,000 inhabitants (for example, subdistrict level). Sampling frames were stratified by urban or rural domain, and clusters were selected using probability proportional to size sampling.

**Ruilin Ren** is a senior technical specialist at ICF International in Rockville, Maryland.

**Barbara A. Willey** is a lecturer in the Department of Infectious Disease Epidemiology, London School of Hygiene and Tropical Medicine.

**Daniel Ansong** is a senior lecturer in the Department of Child Health, School of Medical Sciences, Kwame Nkrumah University of Science and Technology, and deputy director of the Research and Development Unit, KATH.

**Katia Bruxvoort** is a research fellow at the London School of Hygiene and Tropical Medicine.

**Graciela Diap** is a medical coordinator at the Drugs for Neglected Diseases initiative, in Geneva, Switzerland.

**Charles Festo** is a researcher at the Ifakara Health Institute, in Dar es Salaam, Tanzania.

**Boniface Johanes** is a researcher at the Ifakara Health Institute.

**Admirabilis Kalolella** is a researcher at the Ifakara Health Institute.

**Oumarou Mallam** is head of central services at the Institut National de la Statistique du Niger.

**Blessing Mberu** is a research scientist at the African Population and Health Research Centre (APHRC), in Nairobi, Kenya.

**Salif Ndiaye** is director of the Centre de Recherche pour le Développement Humain, in Dakar, Senegal.

**Samual Blay Nguah** is a researcher at the research and development unit at KATH.

**Moctar Seydou** is a specialist statistician at the Institut National de la Statistique du Niger.

**Mark Taylor** is a Slovak Academic Information Agency (SAIA)-sponsored public health scholar at the University of Trnava, in Slovakia.

**Marilyn Wamukoya** is a researcher at APHRC.

**Fred Arnold** is a senior fellow at ICF International in Rockville, Maryland.

**Kara Hanson** is a professor of health systems economics and head of the Department of Global Health and Development at the London School of Hygiene and Tropical Medicine.

**Catherine Goodman** is a senior lecturer in health economics and policy at the London School of Hygiene and Tropical Medicine.

Samples were drawn independently at baseline and end line. Sample sizes were calculated to detect a 20-percentage-point change in the availability of quality-assured ACTs in each domain, with 80 percent power and 5 percent significance. Sample size calculations at baseline assumed a design effect of four—that is, we assumed that the sample size would need to be four times larger than what would be required under simple random sampling—to allow for potential correlations between outlets within the same cluster and baseline availability of 40 percent. Sample size requirements at end line were calculated using baseline results for availability and design effect.

All of Zanzibar was surveyed because of its small population. Further details on the samples of each pilot may be found in the online Appendix.<sup>16</sup>

Because complete lists of antimalarial stockists were not available, survey teams systematically identified all outlets with the potential to sell antimalarials within a cluster by traveling through the cluster to find outlets. Official lists of registered outlets and interviews with local key informants were also used to ensure that all potential antimalarial outlets were found. Because few public health facilities and pharmacies were likely to be found in each cluster, these outlet types were oversampled by visiting all such providers within a larger administrative area (for example, a district) in which a selected cluster was located.<sup>15</sup>

Screening questions were administered at each identified outlet. Outlets that had antimalarials in stock or that had stocked them in the previous three months were eligible for interview. A questionnaire was administered at eligible outlets after obtaining informed oral consent. The questionnaire covered provider characteristics and information on each antimalarial in stock, including its retail selling price and wholesale purchase price. In total, 19,625 private for-profit retail outlets that stocked antimalarial medicines were interviewed.

Ethics approval was obtained from national ethics committees in each country and the Institutional Review Boards of ICF International and the London School of Hygiene and Tropical Medicine.

**STATISTICAL ANALYSIS** Antimalarial medicines were classified into four categories: non-artemisinin therapies, artemisinin monotherapies, non-quality-assured ACTs, and quality-assured ACTs. The Global Fund's quality assurance policy was used to identify quality-assured ACTs.<sup>17</sup> The presence of the AMFm logo on medicine packaging at end line was used to identify AMFm-subsidized therapies.

We present results in the main text for two categories: quality-assured ACTs and non-artemisinin therapies (results for other antimalarial categories may be found in the Appendix).<sup>16</sup> We focused on these two categories because AMFm sought to lower the prices of quality-assured ACTs so that they were competitive with non-artemisinin therapies.

Quality-assured ACTs are exclusively tablet formulations. Other antimalarial categories also have oral and injectable formulations. Because oral liquids and injections have different price distributions and tend to be more expensive than tablets,<sup>15</sup> analysis was restricted to tablet formulations. This ensured that price and markup data were comparable across antimalarial categories.

Price data were collected in country currencies. Baseline data for Nigeria and end-line data for all pilots were converted into 2010 dollars using national consumer price indices.<sup>18</sup> Prices were then converted to US dollars using the average interbank rate for 2010.<sup>19</sup>

Absolute retail markups were calculated for each product as retail selling price minus wholesale purchase price. Relative retail markups were calculated by dividing a product's absolute retail markup by its wholesale purchase price. Total markups, which capture the cumulative markup added by importers, other distributors, and retailers, were calculated by subtracting a particular product's mean importer price from its retail selling price. Mean importer prices were available for subsidized quality-assured ACTs only. They were calculated by pilot for each brand, age-range band, and package size using routine data collected by the Global Fund. Markups therefore cover both costs to the provider and profit margins.

Retail selling prices, absolute retail markups, and total markups are reported in terms of adult equivalent treatment doses, which are defined as the amount of active pharmaceutical ingredient required to treat a sixty-kilogram adult.<sup>20</sup>

For each pilot we present the median and interquartile range for all price and markup indicators. Point estimates were weighted using survey weights. We show the difference between baseline and end line in median retail price and absolute retail markup, and the *p* value from the Wilcoxon rank-sum test of the hypothesis of no difference between baseline and end line. Statistical analysis was conducted using Stata, version 11.0, and R, version 2.14.2.

Results are shown for private for-profit outlets only. In public health sectors of the countries where the AMFm pilots took place, antimalarials were generally free or subsidized. Furthermore, the numbers of community health workers and private not-for-profit facilities that were identi-

fied as supplying antimalarials were very small.<sup>8</sup>

**LIMITATIONS** Our study had several limitations. It was not possible to restrict the intervention geographically within participating countries to create control areas, nor was it feasible to use countries that were not participating in AMFm as comparators. The lack of formal comparators limits the degree to which changes over time in prices and markups may be attributed to AMFm. We addressed this limitation by systematically collecting data on the implementation process of the intervention—including the implementation of supporting interventions, technical assistance, and processing of orders for subsidized medicines—and context through key informant interviews and document reviews in each pilot.<sup>14</sup> Further justification for the non-experimental design of the evaluation is available elsewhere.<sup>8,21</sup>

We intended to conduct baseline surveys no more than two months before the arrival of the first subsidized ACTs, and end-line surveys were timed to maximize the length of program implementation before the end-line surveys were conducted. In practice, the midpoint of baseline data collection took place 4.5–15.0 months before the arrival of subsidized ACTs in five of the eight pilots. This was because of the use of existing surveys for baseline data and delays in program implementation.

End-line data collection took place after the program had been operating for a relatively short period of time. By the midpoint of this collection, half of the pilots had had subsidized ACTs available in their countries for more than a year; the other half had had them for 6.5–9.5 months. All pilots had supporting interventions in place for less than a year.<sup>8</sup>

It is unclear what impact a longer period of implementation of AMFm would have had on prices and markups, especially in light of order rationing by the Global Fund because of financial constraints as of mid-2011. Indeed, small-scale price tracking surveys that were conducted in six of the AMFm pilots found evidence that prices of quality-assured ACTs were increasing in Ghana, Kenya, and Uganda in 2012.<sup>22</sup>

Reporting bias might affect price and markup data collected through respondents' recall. For example, outlets might report lower prices than they actually charged or might conceal antimalarials that they were not permitted to stock. Nonresponse on wholesale purchase price is a potential source of bias. Retail selling price was reported for 91.2–99.3 percent of antimalarial observations in private for-profit outlets. However, markup data were available for only 45.4–94.0 percent of observations because of low reporting of wholesale purchase prices. High levels

of nonresponse about wholesale purchase prices might reflect concerns that the information could be shared with regulatory authorities or cases in which the respondent was not involved in purchasing stock and therefore was unaware of wholesale prices.

## Study Results

**RETAIL PRICES** At baseline, quality-assured ACTs were more expensive than non-artemisinin therapies in all pilots except Madagascar (Exhibit 1). In all other pilots, median price per adult equivalent treatment dose was US\$2.47–\$5.99 for quality-assured ACTs. In Madagascar the price was only US\$0.14, reflecting the presence of an existing national ACT subsidy program. Baseline median price per adult equivalent treatment dose of non-artemisinin therapies ranged from US\$0.31 to US\$1.39 in all pilots at baseline, making them the least expensive treatment category everywhere but Madagascar.

There were substantial decreases during the study period in median quality-assured ACT price in six of the eight pilots, ranging from US\$1.28 to US\$4.82 per adult equivalent treatment dose ( $p < 0.0001$ ) (Exhibit 1). In Madagascar there was a price increase of US\$0.46 ( $p = 0.0001$ ). In Uganda there was an apparent decrease in price of quality-assured ACTs of US\$0.83. However, we could not reject the null hypothesis that end-line and baseline prices were the same ( $p = 0.2647$ ). At end line, the median quality-assured ACT price was US\$0.58–\$1.96 across the eight pilots, which was equivalent to less than a quarter of the baseline levels in three pilots and less than half of the baseline level in three other pilots.

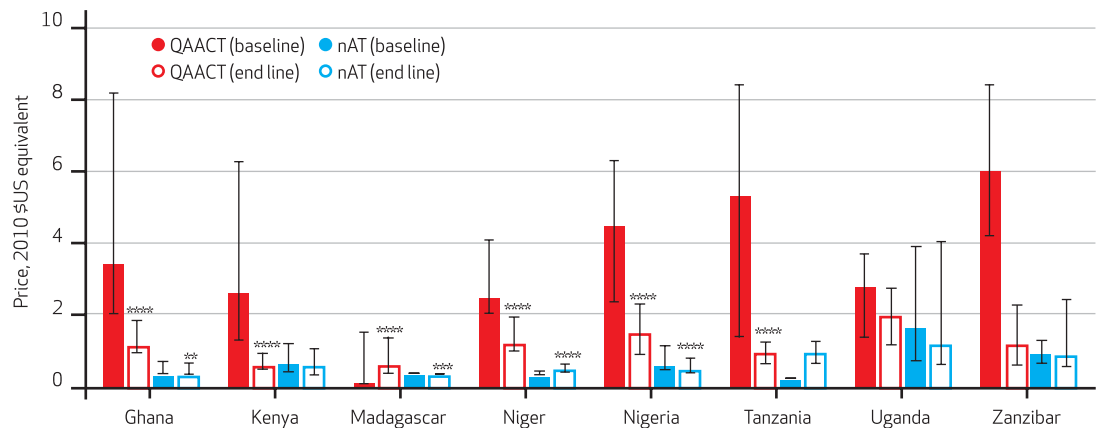
We also observed changes in the prices of drugs in other antimalarial categories. However, the magnitude of the reductions in these prices was much smaller than that of the declines in prices of quality-assured ACTs everywhere except Niger, where the price for non-artemisinin therapy increased by US\$0.17 ( $p < 0.0001$ ) (Exhibit 1). Prices of non-artemisinin therapies decreased by US\$0.03–\$0.13 in four pilots ( $p < 0.0001$  to  $p = 0.0022$ ). In the remaining three pilots there were some apparent decreases in non-artemisinin therapy prices. However, there was no statistical evidence that baseline and end-line prices differed ( $p = 0.4414$  to  $p = 0.9323$ ).

Non-artemisinin therapies were the cheapest treatments in all pilots at end line except in Tanzania mainland and Kenya. In those two pilots median quality-assured ACT prices were equal to those of non-artemisinin therapies.

In addition to the change in overall prices for

## EXHIBIT 1

## Median Price Per Adult Equivalent Treatment Dose Of Antimalarial Treatments In Private For-Profit Outlets In Seven African Countries, At Baseline And End Line, 2010 US Dollars



**SOURCE** Authors' analysis. **NOTES** The "whiskers" show the interquartile range for price. The asterisks denote the  $p$  value from a two-sided Wilcoxon rank-sum test of no difference between the baseline and end-line distributions for each antimalarial category.  $p$  values are not present for Zanzibar (a semi-autonomous part of Tanzania) because a complete census of outlets was conducted. Results did not reach the threshold of statistical significance, if  $p$  values are not indicated for pilots other than Zanzibar. Tanzania results are for the mainland only. nAT is non-artemisinin therapies. QAACT is quality-assured artemisinin-based combination therapy. \*\* $p < 0.05$  \*\*\* $p < 0.01$  \*\*\*\* $p < 0.001$

quality-assured ACTs, there were substantial decreases in prices in rural and urban areas in all pilots except Madagascar and Uganda (for further details, see the Appendix).<sup>16</sup> In all pilots at baseline, quality-assured ACTs were cheaper in rural areas compared to urban areas. In six pilots decreases in prices were larger in urban areas compared to rural areas. At end line, in all pilots except Nigeria and Uganda, quality-assured ACTs were still less expensive in rural areas compared to urban areas.

Recommended retail prices were set at different levels for each age range and were promoted through communication campaigns.<sup>9</sup> Recommended retail prices for adult packs of malaria pills ranged from US\$0.43 in Nigeria to US\$0.93 in Ghana. In Ghana, Kenya, Tanzania mainland, and Zanzibar, the median and 25th percentile prices for adult quality-assured ACT formulations were equal to or just above the recommended retail prices (Exhibit 2). In the other three pilots, the median prices exceeded the recommended retail prices—markedly so in Uganda.

**RELATIVE RETAIL MARKUPS** At baseline, non-artemisinin therapies had the highest relative retail markups in all pilots, with median markups of 40.0–81.8 percent (for more details, see the Appendix).<sup>16</sup> Median relative retail markups for quality-assured ACTs were 33.3–50.0 percent.

Median relative markups for quality-assured ACTs increased in all pilots ( $p < 0.0001$  to  $p = 0.0220$ ) except Kenya and Niger, where

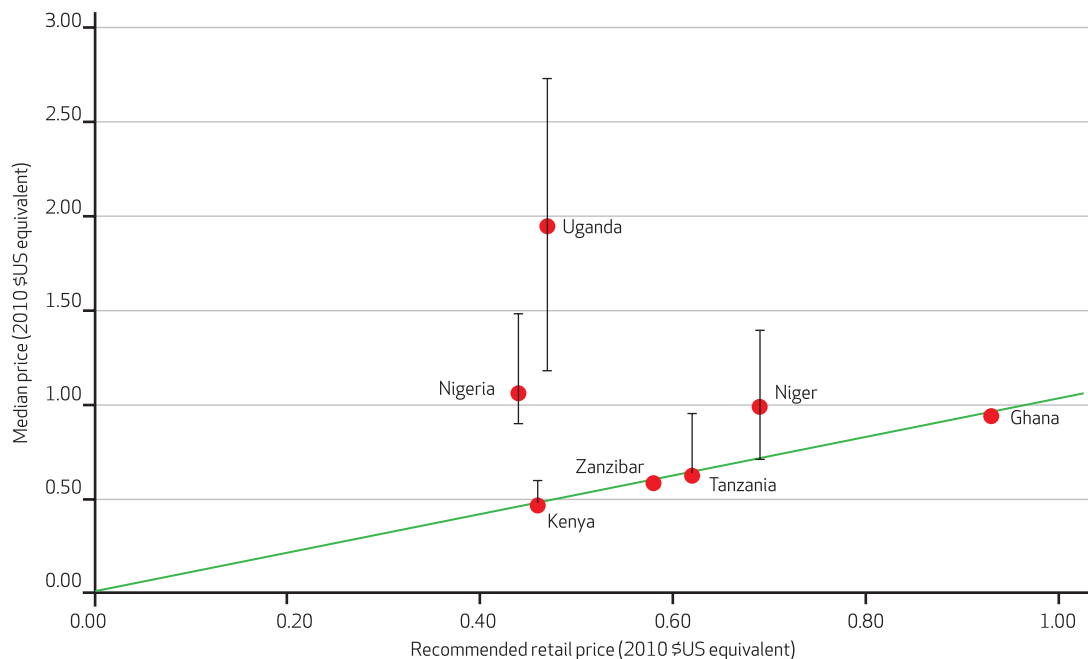
there was no statistical evidence of change ( $p = 0.2624$  and  $p = 0.4302$ , respectively). The largest increases were observed in Zanzibar and Uganda, where the median increased by 77.3 percentage points and 83.1 percentage points, respectively. The median increased by less than 16.7 percentage points in the remaining pilots.

Median relative markups for non-artemisinin therapies increased by 4.4 percentage points in Niger ( $p = 0.0252$ ) and 12.5 percentage points in Nigeria ( $p = 0.0271$ ). There was no statistical evidence of change in the other pilots ( $p = 0.4836$  to  $p = 0.9005$ ).

At end line, quality-assured ACTs had the highest relative markups in three pilots (Nigeria, Uganda, and Zanzibar). Non-artemisinin therapies still had the highest relative markups in the other five.

**ABSOLUTE RETAIL MARKUPS** Non-artemisinin therapies had the largest relative markups at baseline. However, they had the smallest absolute retail markup per adult equivalent treatment dose everywhere except Madagascar. Baseline median absolute markups on non-artemisinin therapies ranged from US\$0.14 to US\$0.35 in all pilots but Uganda, where they were US\$0.61 (Exhibit 3). Baseline absolute markups on quality-assured ACTs ranged from US\$0.68 to US\$1.41 everywhere but Madagascar, where they were US\$0.06.

There were large decreases in median absolute markups on quality-assured ACTs in six pilots, ranging from US\$0.31 to US\$1.03 per adult

**EXHIBIT 2**
**Median Price In Relation To Recommended Retail Selling Price For An Adult Pack Of Subsidized Quality-Assured Artemisinin-Based Combination Therapies (ACTs) In Six African Countries, At End Line, 2010 US Dollars**


**SOURCE** Authors' analysis. **NOTES** An adult pack is a unit-dose package intended specifically for an adult patient. The line of equality (green line) is where the median price is equal to the recommended retail price. The "whiskers" show the interquartile range for the price of an adult pack of subsidized quality-assured ACT. Where a whisker is not visible (Kenya, Zanzibar, Tanzania, and Ghana), the median is equal to the 25th or 75th percentile, or both. Zanzibar is a semi-autonomous part of Tanzania. Tanzania results are for the mainland only. Madagascar is not shown since it did not have a recommended retail price for antimalarials that received subsidies from the Affordable Medicines Facility—malaria (AMFm) initiative.

equivalent treatment dose ( $p < 0.0001$  to  $p = 0.0006$ ) (Exhibit 3). In Madagascar there was an increase of US\$0.11 ( $p = 0.0006$ ). In Uganda there was no substantial change ( $p = 0.798$ ).

Changes in median absolute markups for other categories of malaria drugs were also observed in some pilots. However, decreases were smaller in both absolute and relative terms when compared to quality-assured ACTs, with few exceptions (for more details, see the Appendix).<sup>16</sup> For non-artemisinin therapies, there were small changes of US\$0.01–\$0.02 in absolute markups in four pilots ( $p < 0.0001$  to  $p = 0.0103$ ), an increase of US\$0.09 in one pilot ( $p < 0.0001$ ), and no substantial changes in three pilots ( $p = 0.6208$  to  $p = 0.7639$ ) (Exhibit 3).

In spite of the large reductions in absolute retail markups on quality-assured ACTs in six of the eight pilots, Kenya and Tanzania mainland were the only two pilots in which these therapies had the lowest absolute retail markups at end line. In the other six pilots median absolute retail markups on quality-assured ACTs were US\$0.04–\$0.32 higher than those on non-artemisinin therapies.

**TOTAL MARKUPS** Total markups—from the importer's price to the retail selling price—of subsidized quality-assured ACTs were lowest in Kenya and Madagascar, followed by Tanzania mainland and Ghana (Exhibit 4). Total markups were above US\$1.00 in the remaining four pilots and were highest in Uganda.

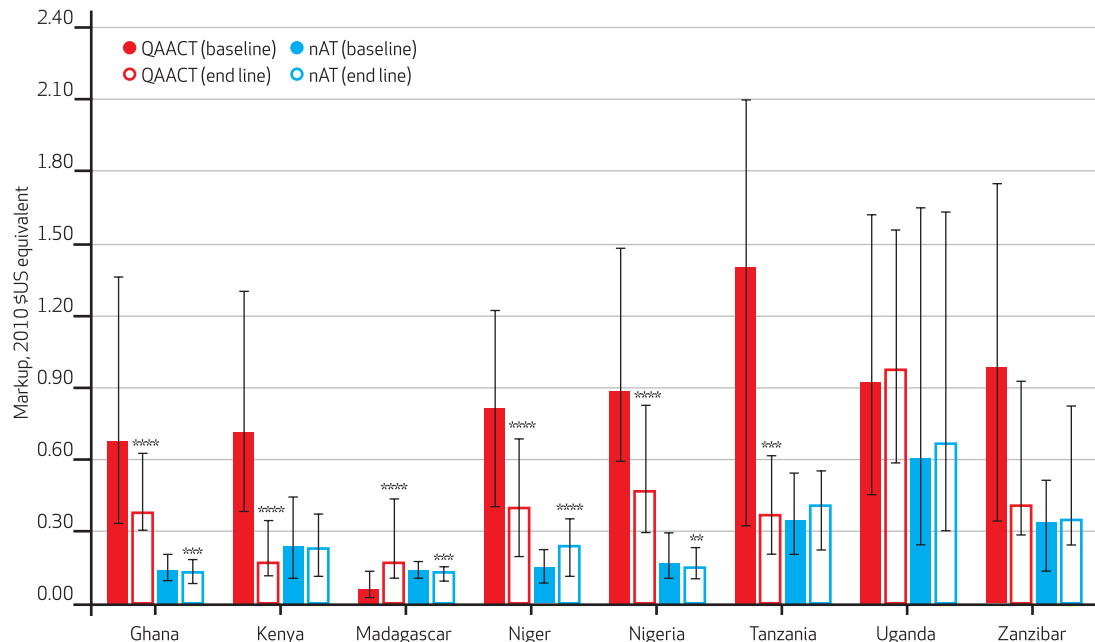
Retail markups accounted for less than 50.0 percent of total markups on subsidized quality-assured ACTs everywhere except Uganda, where the retail markup was 53.6 percent of the total markup. Retail markups were the lowest relative to total markup in Niger (30.3 percent), followed by Nigeria (35.5 percent).

### Discussion

This study presents nationally representative antimalarial price and markup data from the private for-profit sector across all AMFm pilots in seven African countries before and 6–15 months after the arrival of AMFm-subsidized ACTs. We found substantial reductions in quality-assured ACT prices and in absolute markups in six of the eight pilots.

EXHIBIT 3

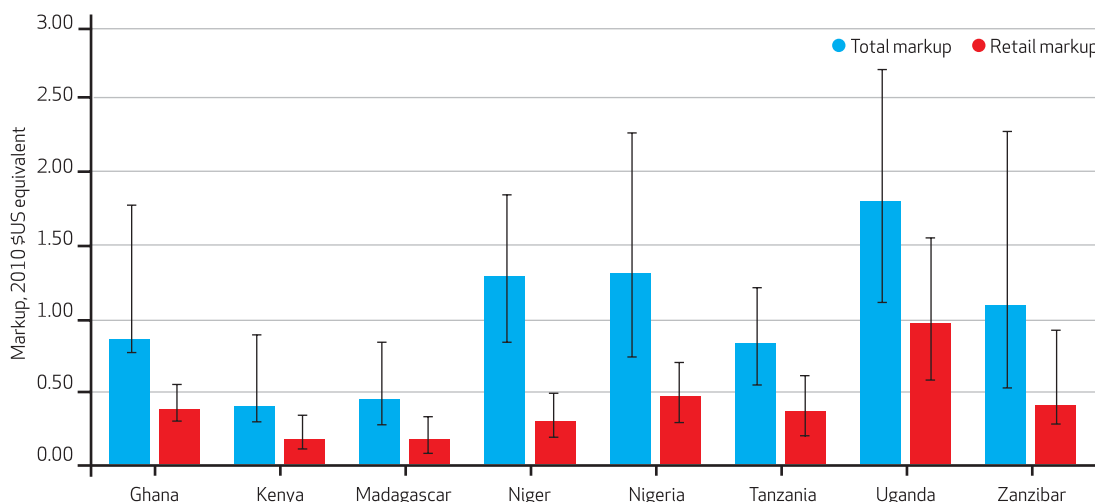
**Median Absolute Markup Between Retail Purchase Price And Retail Selling Price Per Adult Equivalent Treatment Dose Of Antimalarial Treatments In Private For-Profit Outlets In Seven African Countries, At Baseline And End Line, 2010 US Dollars**



**SOURCE** Authors' analysis. **NOTES** The "whiskers" show the interquartile range for absolute retail markups. The asterisks denote the *p* value from a two-sided Wilcoxon rank-sum test of no difference between the baseline and end-line distributions for each antimalarial category. *p* values are not present for Zanzibar (a semi-autonomous part of Tanzania) because a complete census of outlets was conducted. Results did not reach the threshold of statistical significance, if *p* values are not indicated for pilots other than Zanzibar. Tanzania results are for the mainland only. nAT is non-artemisinin therapies. QAACT is quality-assured artemisinin-based combination therapy. \*\**p* < 0.05 \*\*\**p* < 0.01 \*\*\*\**p* < 0.001

EXHIBIT 4

**Total Markup And Median Absolute Retail Markup Per Adult Equivalent Treatment Dose For Quality-Assured Artemisinin Combination Therapies (ACTs) Subsidized By The Affordable Medicines Facility—Malaria (AMFm) Initiative In Private For-Profit Outlets In Seven African Countries, At End Line, 2010 US Dollars**



**SOURCE** Authors' analysis. **NOTES** Total markup is the markup between the mean importer's price and the retail selling price. Median absolute markup is the markup between retail purchase price and retail selling price. The "whiskers" show the interquartile range. Mean importer prices were missing for 35 percent of observations of subsidized quality-assured ACT sales in Niger; 3 percent of observations in Kenya, Tanzania, and Zanzibar; and fewer than 1 percent of observations in Ghana, Madagascar, Nigeria, and Uganda. Zanzibar is a semi-autonomous part of Tanzania. Tanzania results are for the mainland only.



No decrease in the price of quality-assured ACTs was observed in Madagascar, where baseline prices were much lower than in other pilots because of the presence of a highly subsidized pediatric quality-assured ACT that was distributed through a national social marketing program. Nevertheless, Madagascar had the second-lowest prices at end line. In Uganda the lack of overall decrease in price may be attributed to very low levels of awareness of AMFm and recommended retail prices—a result of the substantial delays in the implementation of communication interventions.<sup>8,9</sup>

In addition to changes in quality-assured ACT prices and markups, we observed decreases in retail prices and in absolute retail markups of other types of antimalarials in most pilots. There are two possible explanations for the reductions observed for nonsubsidized antimalarials. First, quality-assured ACTs are substitute goods for other types of antimalarials. Thus, prices for other antimalarial categories may be lowered in response to decreased demand for nonsubsidized medicines. Second, there could be declines in the prices of antimalarial medicines for reasons unrelated to AMFm, such as reductions in marginal costs. Even if there were a downward trend in prices of antimalarials, it is likely that AMFm was responsible for a large share of the reductions in quality-assured ACT prices, since the changes in these prices in relative and absolute terms were typically much larger than the changes we observed for other antimalarial categories.

**OPPORTUNITIES FOR FURTHER PRICE REDUCTIONS** There were substantial reductions in quality-assured ACT prices in several pilots. However, it is important to assess whether there is scope for further reductions in retail prices to maximize the potential public health impact of the intervention.

Our comparison of recommended retail prices and end-line prices provides some insight into this issue. Recommended retail prices appeared to act as a price floor. The 25th percentile for prices of adult packs of quality-assured ACTs did not fall below their recommended retail prices in any pilot.

One factor that appears to help explain whether prices were close to their recommended levels was the extent of supporting communication and public awareness campaigns.<sup>8</sup> In the four pilots with high awareness of recommended retail prices and consistent implementation of communication campaigns (Ghana, Kenya, Tanzania mainland, and Zanzibar), the interquartile range for adult prices was very narrow, with most observations equal or close to the recommended retail prices. The other three pilots with recommended retail prices (Niger, Nigeria, and

Uganda) experienced various difficulties with implementing these supporting interventions, and prices there were far more variable and exceeded recommended retail prices.<sup>9</sup> This suggests that if recommended retail prices are used, both their level and sustained promotion about them are critical.

Recommended retail prices were set through a consultative process in each country, with the aim of reflecting the costs of distributing medicines and reasonable markups at different levels of distribution. The persistence of high prices relative to recommended retail prices in Niger, Nigeria, and particularly Uganda could therefore imply that actors in the distribution chain may have been earning supernormal profits on these medicines, if the recommended retail prices there were a true reflection of costs. However, even where prices were equal to recommended retail prices, there may still be scope for further price reductions, because private-sector actors may have exaggerated their costs during the consultation processes.

A second way to ascertain whether there are opportunities to reduce prices paid by patients for subsidized medicines is to compare end-line retail prices and markups for the preferred therapy with those for non-artemisinin therapies. Non-artemisinin therapies are appropriate for this comparison because they were widely and cheaply available in the private for-profit sectors of the AMFm pilots and elsewhere,<sup>8,15</sup> which indicates that retailers and wholesalers are willing to sell antimalarial medicines at these prices.

At end line, median quality-assured ACT prices were less than or equal to median prices for non-artemisinin therapies in only Kenya and Tanzania mainland. Relative and absolute retail markups on quality-assured ACTs were also lower than those on non-artemisinin therapies in these pilots. This suggests that there may not be much further scope for price reduction in these settings, but that further reductions may be possible in other pilots.

However, in all pilots but Zanzibar and Uganda, relative retail markups on quality-assured ACTs were within the range of regulated private retail markups permitted in countries in the African region that regulate pharmaceutical markups.<sup>23</sup> On this basis, relative retail markups on subsidized ACTs may be considered reasonable everywhere except in Uganda and Zanzibar.

The wholesale prices faced by retailers are a limiting factor to further price reductions. Even though absolute retail markups on quality-assured ACTs exceeded those on non-artemisinin therapies everywhere but Kenya and Tanzania mainland, if retailers were to reduce absolute markups on such therapies to the same levels as

those on non-artemisinin therapies, prices for quality-assured ACTs would still exceed the prices for non-artemisinin therapies. Indeed, even in the highly improbable circumstance of retailers charging no markups on quality-assured ACTs, such therapies would still be more expensive than non-artemisinin therapies everywhere except in Kenya, Tanzania mainland, and Uganda. This means that for end users' prices for quality-assured ACTs to reach the levels of non-artemisinin therapy prices, private-sector wholesalers and distributors operating at higher levels of the distribution chain would need to lower their selling prices.

**POSSIBLE EXPLANATIONS FOR HIGH WHOLESALE PRICES** It is not possible to determine definitively why wholesale prices for subsidized medicines remained high in some settings. However, the literature suggests several hypotheses. Limited pass-through of the savings resulting from subsidization from wholesalers to patients might reflect the high costs of distributing antimalarials to some areas. It could also reflect the nature of the supply chain. One six-country study found that antimalarials can move across as many as four to six levels between manufacturer and retailer, with markups added at each level.<sup>24</sup>

Economic theory further suggests that the total value of a subsidy will not be transmitted to the end user unless there is perfect competition. Moreover, even under perfect competition, the reduction of end users' prices is dependent on the relative elasticities of supply and demand.<sup>25</sup>

There are several reasons why antimalarial markets might be imperfectly competitive. For example, barriers to entry are created by regulatory requirements for opening and running a pharmaceutical retail or wholesale business; antimalarials are differentiated goods—that is, they are available in a multitude of brands, formulations, and other characteristics; and there may be a limited number of wholesalers or retailers supplying certain areas. Since 2012, reduced supplies of subsidized ACTs resulting

from order rationing by the Global Fund may have increased opportunities for suppliers to exert monopoly power in some of the AMFm pilots.<sup>7</sup>

## Conclusion

Our findings demonstrate that it is possible to achieve a large reduction in retail prices in a relatively short time through the application of a supranational subsidy of commodities essential to improving public health. Concerns about distributors' capturing subsidies may be warranted in some pilots but not in others. For recommended retail prices to be an effective mechanism for controlling market power, great care must be taken in setting the price level and communicating it to a wide audience. Pricing and markup decisions throughout the supply chain will also influence final prices and limit the transmission of the subsidy to the end users: the patients.

The findings that subsidies administered in the private sector may not reduce prices to the extent expected (that is, to the levels of recommended retail prices or to non-artemisinin therapies) in some settings could be relevant for other health commodities with characteristics similar to malaria treatment—that is, commodities that are highly valued by consumers and frequently purchased in the retail sector in low- and middle-income countries without consulting a health worker. These commodities include treatments for pneumonia, diarrhea, or sexually transmitted infections; condoms; and insecticide-treated bed nets.

These products have all previously been subsidized in the private sector through various mechanisms.<sup>26,27</sup> Given the role of the private sector in their provision and the importance of increasing access to them, subsidies administered through the private sector are a viable strategy for improving access to priority public health interventions. ■

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