Independent observer of the Global Fund

Procurement Cost Trends for Global Fund Commodities

Analysis of Trends for Selected Commodities 2005–2012

By Frank Wafula, Ambrose Agweyu and Kate Macintyre

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P.O. Box 66869–00800, Nairobi, Kenya

TEL +254 (0) 774 135 984 **EMAIL** info@aidspan.org

www.aidspan.org

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List of abbreviations

ACT	Artemisinin-based Combination Therapy
AL	Artemether/Lumefantrine
AMFm	Affordable Medicine Facility-malaria
ARV	Anti-retroviral therapy
EAP	East Asia and the Pacific
EECA	Eastern Europe and Central Asia
GPRM	Global Price Reporting Mechanism
LAC	Latin America and the Caribbean
LLIN	Long lasting insecticide-treated net
MDR-TB	Multi-drug resistant tuberculosis
MENA	Middle East and North Africa
MSH	Management Sciences for Health
PEPFAR	President's Emergency Plan for AIDS Relief
RDT	Rapid diagnostic test
RHZE	Rifampicin + Isoniazid + Pyrazinamide + Ethambutol
SSA	Sub-Saharan Africa
VPP	Voluntary pooled procurement
WHO	World Health Organization

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Preface

Aidspan (www.aidspan.org) is an international NGO based in Nairobi, Kenya, whose mission is to reinforce the effectiveness of the Global Fund. Aidspan performs this mission by serving as an independent watchdog of the Fund, and by providing services that can benefit all countries wishing to obtain and make effective use of Global Fund financing.

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Executive Summary

Background

The Global Fund has approved over $22.9 billion in grants for HIV, TB and malaria programmes since 2002. Nearly 40% of the money has gone towards procurement, making the Global Fund a major player in the market for commodities. With such leverage, the Fund is always looking to influence prices. One way the Fund achieves this is through collecting procurement data from recipient countries using the web-based Price and Quality Reporting (PQR) system. The PQR collects price data for six types of commodities: antiretroviral medicines (ARVs), antimalarial medicines, anti-TB medicines, HIV and malaria diagnostic test kits, bednets and condoms.

The Global Fund has collected procurement data since 2005, but up to now little analysis has been done to describe regional variations and temporal trends in procurement costs for HIV, TB and malaria commodities. In this paper, we describe these and also compare the PQR costs with those for commodities procured through the voluntary pooled procurement (VPP) mechanism. This is a Global Fund facility that buys commodities on behalf of willing countries. It too is designed to lower procurement costs for commodities through pooled purchasing. VPP procurement data is not entered into the PQR system.

Methodology

We selected seven out of the 99 commodities entered into the PQR. In so doing, we prioritized the most commonly bought commodities, ensuring that all three diseases were included. The commodities were (1) male condoms; (2) long-lasting insecticide-treated nets (LLINs); (3) HIV rapid test kits; (4) malaria rapid diagnostic tests (RDTs); (5) the anti-TB combination of rifampicin–isoniazid–pyrazinamide–ethambutol (RHZE); (6) the ARV combination of lamivudine–nevirapine–zidovudine (3TC/NVP/AZT); and (7) the artemether–lumefantrine (AL) combination therapy for malaria. Unit cost data were obtained for the seven commodities for the period from 2005 to 2012. All costs were adjusted for inflation and reported in US dollars.

The costs were plotted against time and a regression line fitted for each commodity. We also compared PQR and VPP procurement costs. Finally, median costs and inter-quartile ranges were reported per commodity per region.

Key findings

Our data included 3,969 entries for the seven commodities, derived from 580 grants in 126 countries.

Procurement costs for LLINs and the 3TC/NVP/AZT ARV combination showed a substantial decline over the period of analysis. However, the costs of condoms and HIV test kits remained relatively unchanged; and the costs of malaria RDTs, the AL antimalarial, and the RHZE anti-TB combination showed a very gradual reduction.

Some regional variations were also seen. The median costs varied more for LLINs and bed-nets, compared to the costs for medicines. The cost for per tablet of AL, for instance, varied between $0.06 and 0.08, compared to a range of $4.30 - $6.10 for a single LLIN in East Asia and the Eastern Europe and Central Asian (EECA) regions respectively.

The cost of malaria RDTs ranged between $0.57 in West and Central Africa to $1.1 in the Latin America and Caribbean region, while the cost of HIV test kits varied from $0.23 in South Asia to $1.5 in the EECA region. Brand details were not provided for test kits, so we could not ascertain whether the variations we observed were for products with the same specifications.

Comparing PQR and VPP costs showed that use of the VPP mechanism resulted in lower costs for condoms and malaria RDTs. However, procurement through the VPP mechanism for LLINs, ARVs, AL, and HIV test kits did not produce visibly lower costs. Because the VPP was only introduced in 2009, the PQR–VPP comparisons could only be done for a three-year period.

Conclusion

Our analyses clearly showed the value of the PQR data in assessing global trends for HIV, TB and malaria commodities. We have demonstrated how this data can inform the health community about year-to-year trends in prices for these commodities, and how procurement costs vary by region.

As the Global Fund and other donors continue to fight these three diseases, it is important that every precaution is taken to ensure resources are used well. Periodic analysis of procurement data can identify market insufficiencies, and suggest appropriate solutions.

Future analyses can go further. The causes of the observed variations should be described, and assessments done of the relative effectiveness of different market-shaping interventions. The effectiveness of the VPP mechanism could also be examined over a longer period of time.

1. Introduction

The Global Fund to Fight AIDS, TB and Malaria (the Global Fund) is a leading funder for programmes targeting the three diseases in low- and middle income countries. By the end of 2012, the Fund had contributed to the treatment of 4.2 million HIV patients and 9.7 million TB patients, and had helped to provide over 310 million insecticide-treated bednets for malaria control [1]. The Fund has approved over $22.9 billion of grants in 151 countries since 2002 [1].

Nearly 40% of the money approved for grants is directed towards procurement, making the Global Fund a major player in the market for commodities [1, 2]. As a result, over the years, the Global Fund Board has sought ways of leveraging its position to influence commodity market dynamics [3, 4]. Recently, this has included introducing a Voluntary Pooled Procurement (VPP) mechanism [5], engaging in direct negotiation with artemisinin combination therapy (ACT) manufacturers through the Affordable Medicines Facility for malaria (AMFm) subsidy programme[6, 7], and establishing the Price and Quality Reporting (PQR) system to collect information on procurement costs [8]. These strategies are designed, among other things, to lower costs, reduce stock-outs and improve the overall quality of the commodities in the market.

Whereas the AMFm and VPP mechanism were introduced as voluntary interventions covering a few countries, the web-based PQR system has been fully integrated into the Fund's operational architecture since its introduction in 2005.[1] All grant recipients are expected to enter procurement information each time a consignment is delivered (except for VPP commodities). Inaccurate or incomplete entering of procurement information may result the recipient getting a poor grant rating and lower subsequent disbursements as a consequence [9, 10].

The PQR system collects procurement data for six types of commodities: antiretroviral medicines (ARVs), antimalarial medicines, anti-TB medicines, HIV and malaria diagnostic test kits, bednets and condoms. The Global Fund Secretariat (the Secretariat) uses the information to warn recipients whose costs fall outside reference ranges.[2] The Secretariat also prepares periodic reports that show recipients how their costs compare to others in their regions, with the aim of encouraging recipients with higher costs to choose cheaper suppliers or negotiate better terms with existing ones.

To date, the PQR system has allowed the Global Fund to collect a large amount of data. However, little analysis of the data has been done over the years. To the best of our knowledge, no effort has been made to describe temporal variations in costs across the range of commodities reported through the PQR system. Indeed, little work has been done overall to assess global-level commodity cost trends for the three diseases, despite the presence of price reporting mechanisms

[1] The PQR was referred to as the price reporting mechanism (PRM) before 2007.

[2] The reference price ranges are taken from equivalent procurement agencies such as Médecins Sans Frontières (MSF) and the Clinton Health Access Initiative (CHAI).

such as the PQR system and the Global Price Reporting Mechanism (GPRM) operated by the World Health Organization (WHO).

Past analyses have focused on comparing consumer prices in countries (country-level comparison), rather than procurement costs across regions (global-level comparison). For instance, the WHO and Health Action International have published analyses on consumer medicine prices across different countries [11, 12]. The Management Sciences for Health (MSH) published International Drug Price Indicator Guides provide procurement-level information across a large number of countries [13]. However, these reviews cover only medicines, leaving out other key commodities such as test kits and bednets. Further, the MSH reports give prices over the past year only, meaning they do not show trends over extended periods of time.

It is against this background that we describe procurement cost trends for selected HIV, TB and malaria commodities over a 7-year period.

2. Methodology

We used three datasets from the Global Fund – one containing procurement information reported through the PQR, including costs, quantities and purchase date; the second containing information similar to the first, but for commodities procured through the Global Fund's VPP mechanism; and the final dataset containing broader information on the grant recipients, including region where located.

The Global Fund provides grants across eight regions: East Asia and the Pacific (EAP), Eastern Europe and Central Asia (EECA), Latin America and the Caribbean (LAC), Middle East and North Africa (MENA), South Asia – plus three regions in Sub-Saharan Africa (SSA): East Africa (SSA-EA), Southern Africa (SSA-SA) and West and Central Africa (SSA-WCA).

Next, we selected a number of commodities from the list of all commodities entered into the PQR system. Priority was given to the most commonly procured commodities, with the argument being that these would provide a better picture of unit cost variations across recipient countries. We also ensured that the selection reflected all three Global Fund disease components. Seven commodities were selected out of a total of 99 unique commodity entries entered into the PQR system. (See Table 1 for the commodities selected and the reasons why they were selected. See also Appendix 1 for a table showing all 99 unique commodity categories entered into the PQR system).

Initial inspection of the data revealed the presence of several outliers for the main outcome variable (unit costs of commodities). Consequently, we decided to report the medians and interquartile ranges (IQRs), which tend to be less sensitive to outliers compared to the means. Earlier analyses of prices have similarly used the medians and IQRs [12]. All costs were reported in US dollars following inflation adjustment. Adjustment for inflation was done using ratios derived from the World Bank GDP deflator data for the respective countries [14].

Unit costs were calculated in the smallest units, which varied by commodity. These included the cost of a single tablet for AL, the cost of a single combination of tablets for the ARV and anti-TB combinations, and the cost of a single unit for LLINs, condoms and diagnostic devices. Brand information was unavailable for diagnostic test kits, so we could not compute unit costs for items with the same exact specifications. Nonetheless, we calculated the unit cost trends in order to show how the overall costs of conducting diagnosis have changed over the period. Caution should be exercised, however, when interpreting the results for both types of test kits.

Extreme values resulting from data entry errors were omitted from the analyses of medians.

Table 1: Commodities selected for the analyses

Selected commodity	Product Category	Reason for selection
Male Condoms	Condom	The most procured type of condom
Long-lasting insecticide treated nets (LLINs)	Bed net	The most procured type of bednet
HIV rapid test kits	Diagnostic test	The only type of diagnostic equipment for HIV
Malaria rapid diagnostic tests (RDTs)	Diagnostic test	The only type of diagnostic equipment for malaria that was procured
Ethambutol+ Isoniazid + Pyrazinamide + Rifampicin (**RHZE**) (275mg/75mg/400mg/150mg)	Anti-TB medicine	The most procured fixed-dose combination for first-line TB treatment
Lamivudine + Nevirapine + Zidovudine (**3TC/NVP/AZT**) (150mg/200mg/300mg)	Antiretroviral	The most procured fixed-dose combination for first-line HIV treatment
Artemether lumefantrine (**AL**) (120mg/20mg)	Antimalarial	The commonly procured antimalarial

Scatter plots of unit costs were plotted against time (2005–2012) for each of the tracer commodities in Table 1. A line derived from the linear regression of the unit cost against time was superimposed on the scatter plots to illustrate the trend. Regional median prices were calculated and presented in tables, with corresponding interquartile ranges.

Next, we compared the PQR costs with those reported through the VPP mechanism. We described the difference in unit cost trends between commodities procured directly by grant recipients, and those procured via the pooled system. As explained earlier, the VPP mechanism is designed, among other things, to lower procurement prices for commodities. The regression line for the VPP was superimposed on the graph showing the PQR regression line, and the differences discussed. All analyses were conducted using STATA version 12 (Stata Corp, Texas, US).

3. Findings

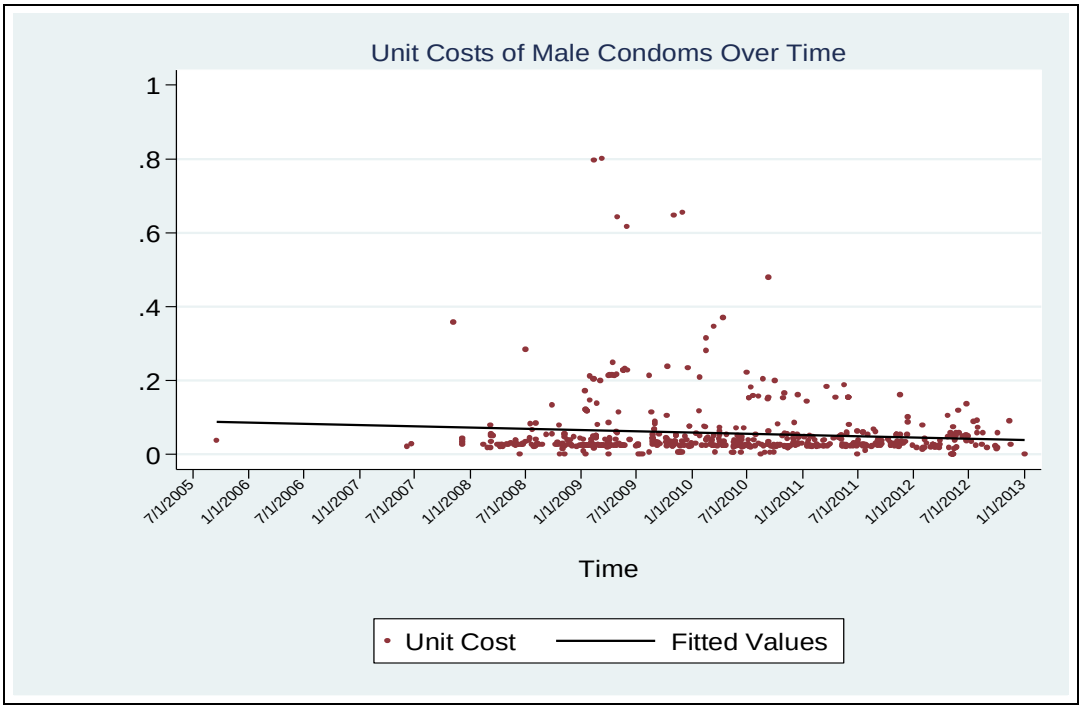
A total of 3,969 entries were made for the seven commodities across eight regions (years 2005–2012). The dataset contained observations from 580 grants in 125 countries.

3.1. Procurement cost trends over the period of analysis (2005-2012)[3]

The cost trends had varied patterns across different commodities. Procurement costs for condoms and HIV test kits were relatively stable over the period of analysis (Figures 1 and 2), whereas those for malaria RDTs, the RHZE anti-TB combination, and the AL antimalarial combination showed very gradual declines (Figures 3–5).

Regression lines for LLINs and the ARV combination were relatively steeper, suggesting that the procurement costs fell substantially over the period of analysis (Figures 6 and 7).

Figure 1: Unit cost of male condoms over time



[3] The period of analysis varied across commodities, depending on availability of data

Figure 2: Unit costs of HIV diagnostic tests over time

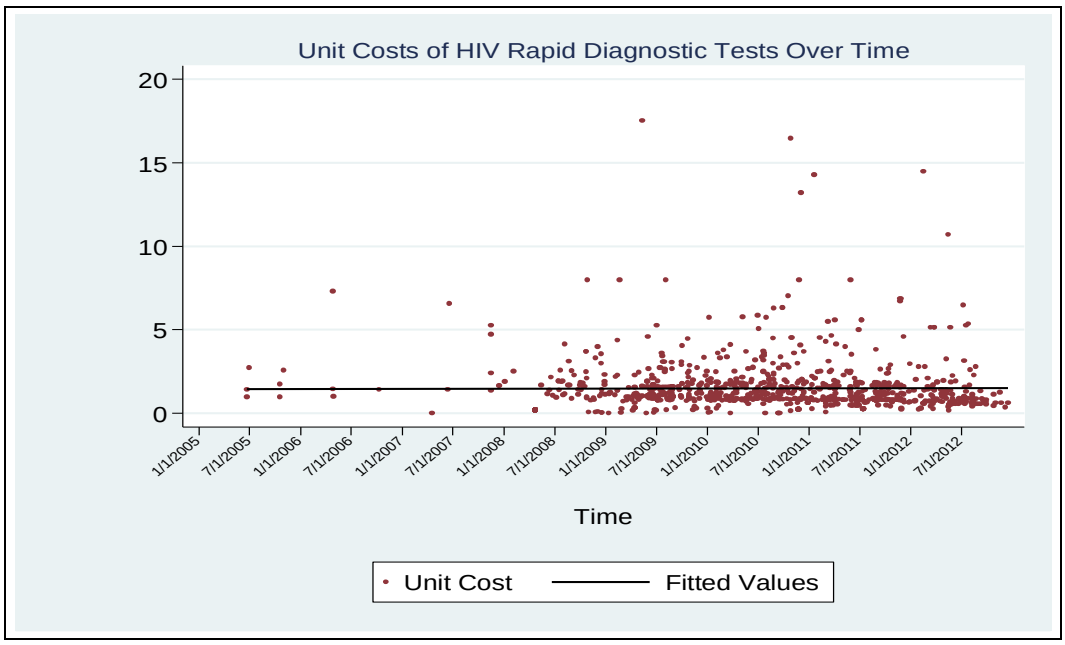


Figure 3: Unit costs of malaria RDTs over time

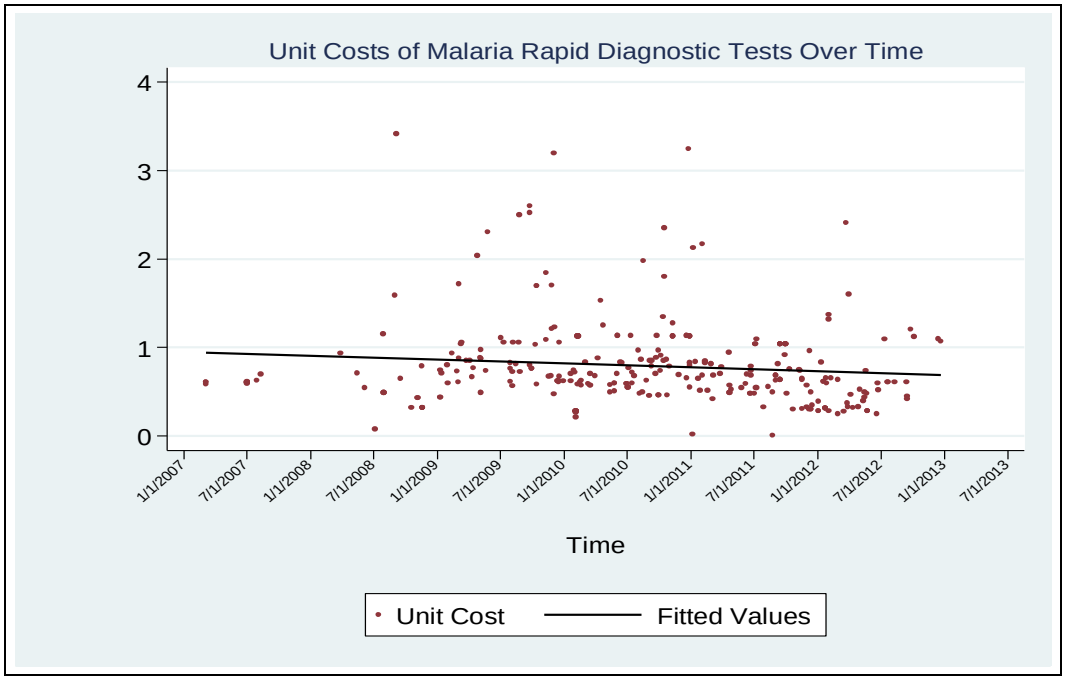


Figure 4: Unit costs of the RHZE anti-TB combination over time

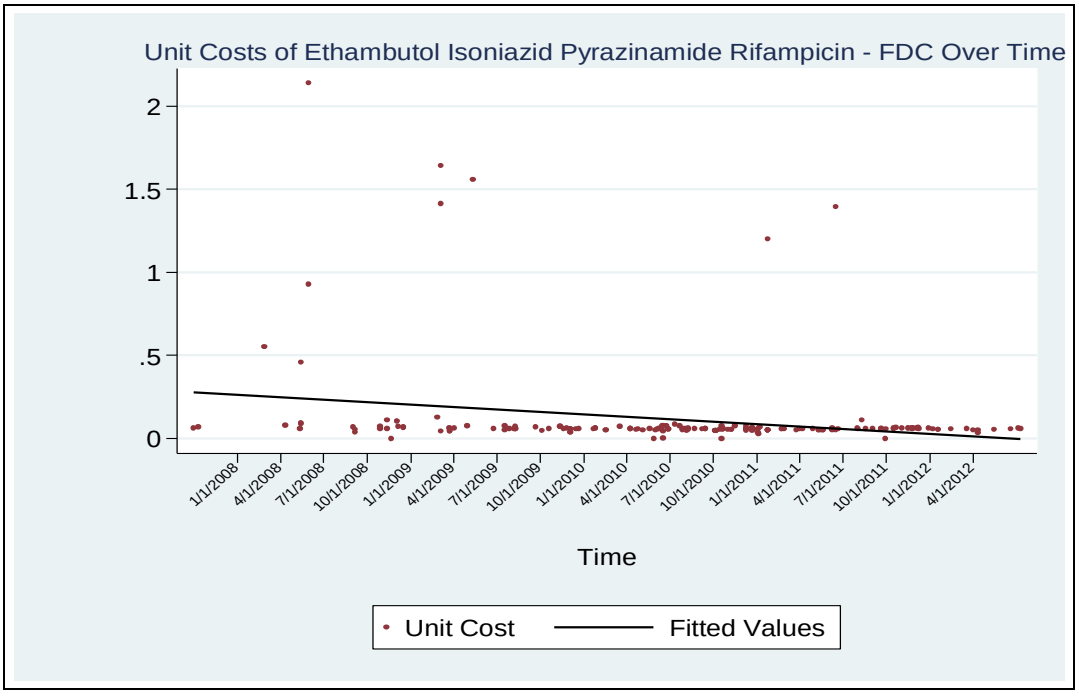


Figure 5: Unit costs of the artemether–lumefantrine combination over time

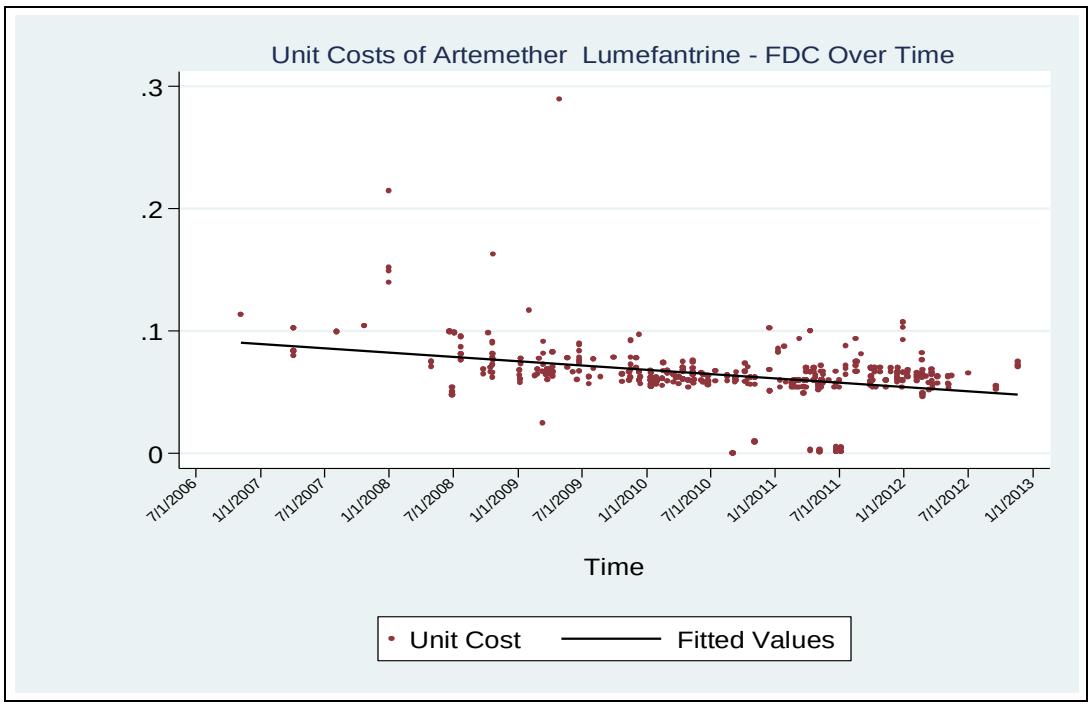


Figure 6: Unit costs of long-lasting insecticide-treated nets over time

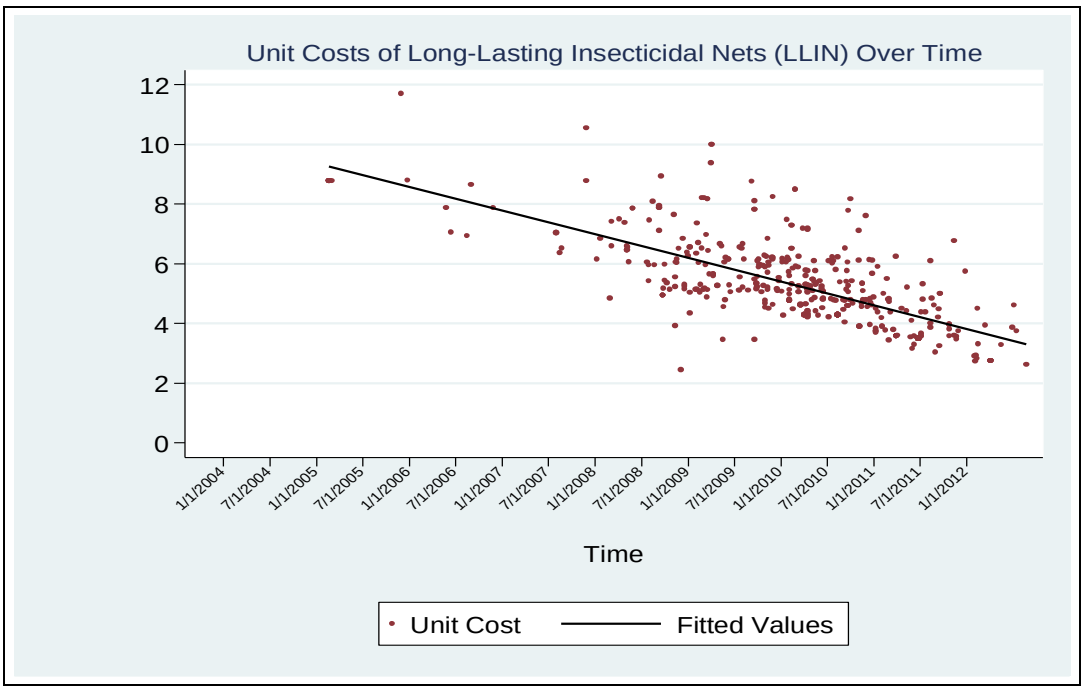
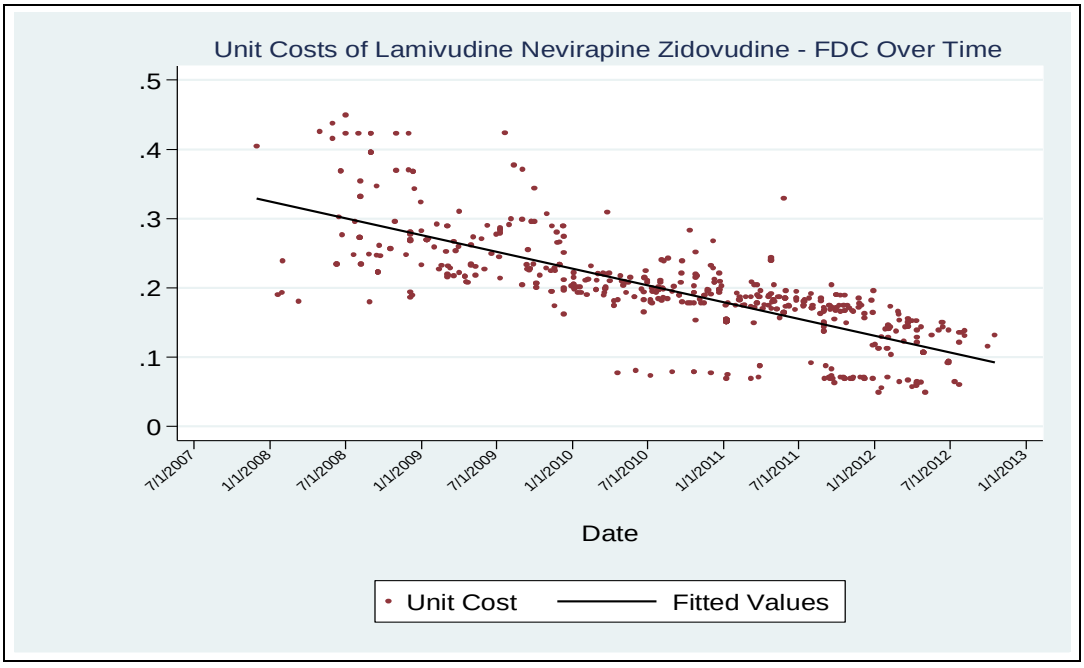


Figure 7: Unit costs of the lamivudine–nevirapine–zidovudine ARV combination over time



3.2. Comparing cost trends for VPP and non-VPP procurement

Procurement through the VPP mechanism appeared to have reduced the cost of purchasing condoms and malaria RDTs when compared to individual country procurement (or non-VPP procurement) (Figures 8 and 9). However, differences were less pronounced for HIV test kits and LLINs (Figures 10 and 11).

Findings were mixed for AL and ARVs (figures 12 and 13). For AL, the VPP appeared to have higher benefits in the latter years (2011-2012), whereas for ARVs, the system was more beneficial in the earlier years (before 2011).

Figure 8: VPP and non-VPP procurement of condoms

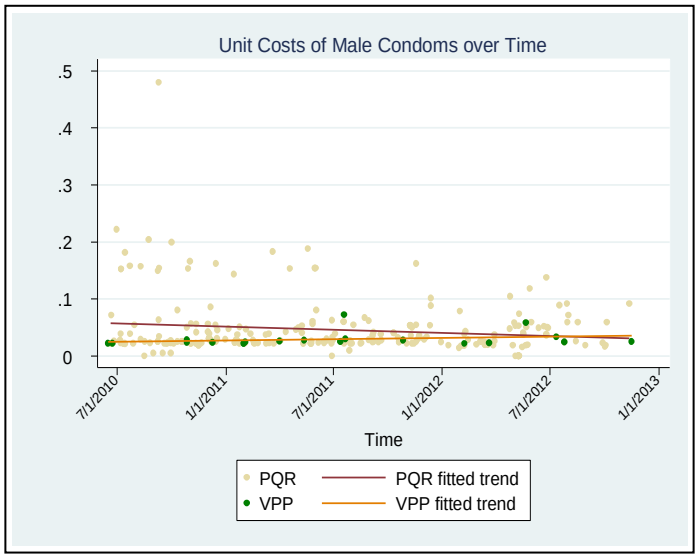


Figure 9: VPP, non-VPP procurement of malaria RDTs

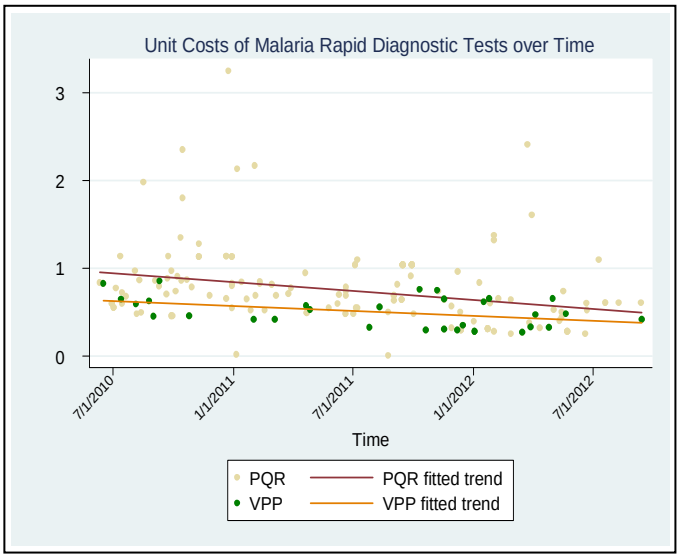


Figure 10: VPP, non-VPP procurement of HIV test kits

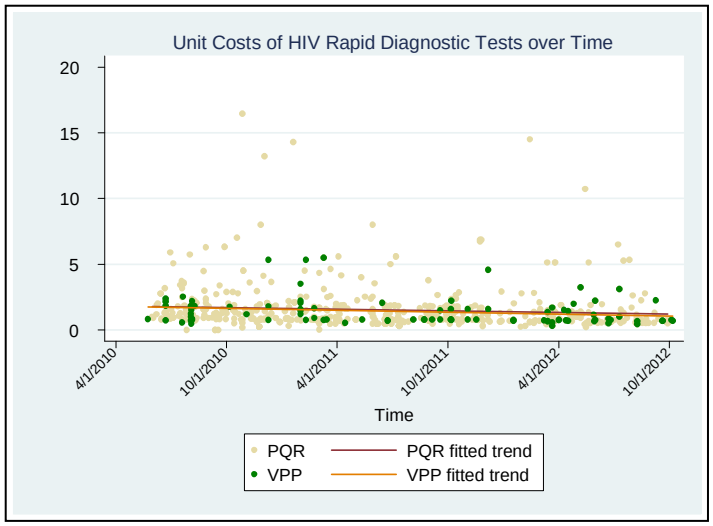


Figure 11: VPP and non-VPP procurement of LLINs

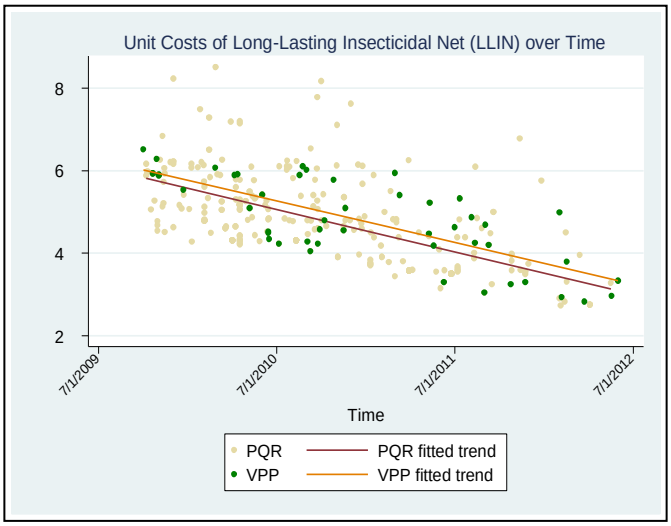


Figure 12: VPP and non-VPP procurement of AL

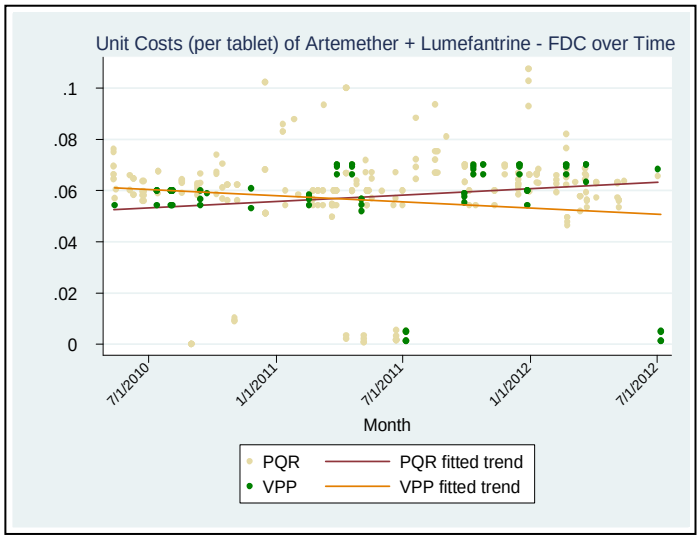
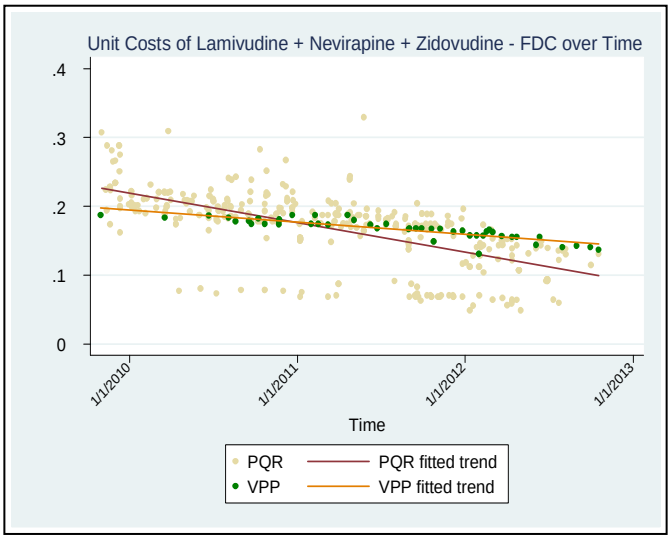


Figure 13: VPP and non-VPP procurement of ARV



3.3. Median procurement costs by Global Fund region

Male condoms

The median cost of condoms was lowest in the SSA-WCA, South Asia and MENA regions, at $0.02 (IQR raging from 0.01-0.04) (Table 2). The EECA region had the highest median cost ($0.07, IQR 0.05 – 0.15), as well as the highest number of purchases reported (146). The MENA region reported the lowest number of purchases (20).

Long-lasting insecticide-treated nets

The SSA-EA region recorded the highest number of purchases LLINs (95), with the EECA region reporting only 19 orders. The median cost was relatively even across all regions, ranging from $4.3 (IQR 3.9 – 4.8) in East Asia to $5.0 (IQR 4.4 – 6.0) in the SSA-WCA region.

HIV diagnostic tests

There were considerable differences across regions, with the EECA region, for instance, reporting median costs of $1.5 for 143 orders (IQR 0.86 – 3.5), while the SSA-SA region and the MENA region recorded median costs of $0.84 and 0.94, respectively. The median cost ranged between $1.3 and $1.5 for most of the regions.

Details on the test kit brands were not provided, making it difficult to describe whether variations represented commodities from different manufacturers with different specifications.

Malaria rapid diagnostic tests (RDTs)

The malaria RDT median costs were lowest in SSA-WCA and South Asia ($0.57, IQR 0.46 – 0.97, and $0.61, IQR 0.32 – 0.83, respectively), and highest in the LAC region ($1.1, IQR 0.82 – 1.6). The EECA region had only one purchase reported over the period of analysis. As with the HIV test kits, brand details were not provided, making it impossible to understand how unit costs varied for malaria RDTs with similar specifications.

The ethambutol–isoniazid–pyrazinamide–rifampicin (RHZE) anti-TB treatment

The median cost of the RHZE anti-TB treatment (unit cost per tablet combination) was $0.06 for all but one region: LAC. The median cost for the LAC region was $0.05 (IQR 0.05 – 0.06). This was also the region with the lowest number of purchases (three).

The lamivudine–nevirapine–zidovudine (3TC/NVP/AZT) ARV combination

The median cost for the HIV treatment of 3TC/NVP/AZT (unit cost per tablet combination) varied between $0.15 (IQR 0.15 – 0.18) in South Asia and $0.23 (IQR 0.19 – 0.25) in the EECA region.

Artemether lumefantrine (AL)

The median cost of AL (unit cost per tablet combination) was relatively even across the regions, with a median cost of $0.06 in South Asia and the three SSA regions (Table 2). The highest unit costs were reported in the LAC and EECA regions (both $0.08).

Table 2: Median and inter-quartile costs (2005-2012) for commodities by GF region

Global Fund region	Median costs (number of purchases) (inter-quartile ranges) for the 2005-2012 period						
	Condoms	LLINs	HIV test kits	Malaria test kits	RHZE anti-TB	3TC/NVP/ AZT ARV	AL anti-malarial
East Asia / Pacific	.03 (89)* (02-.04)	4.3 (92) (3.9-5.2)	1.3 (129) (.80-1.6)	.63(59) (.55-.76)	.06(16) (.06-.06)	.18(47) (.13-.19)	.07 (115) (.06-.07)
Eastern Europe / Central Asia	.07 (146) (.05-.15)	6.1(19) (5.5-7.1)	1.5 (143) (.86-3.5)	.80 (1) (.80-.80)	.06(19) (.05-.06)	.23(6) (.19-.25)	.08 (5) (.06-.08)
Latin America / Caribbean	.04 (89) (.03-.06)	5.2(32) (4.0-6.0)	1.3 (147) (.95-1.8)	1.1(29) (.82-1.6)	.05(3) (.05-.06)	.19(42) (.18-.22)	.08 (20) (.06-.09)
North Africa / Middle East	.02 (20) (.02-.03)	4.8(59) (3.5-6.1)	.94(140) (.80-1.8)	.64 (22) (.56-.81)	.06(29) (.05-.06)	.19(64) (.15-.22)	.07 (24) (.06-.07)
South Asia	.02 (121) (.02-.03)	5.2(59) (4.6-5.7)	.23(125) (.22-.80)	.61(59) (.32-.83)	.06(36) (.05-.06)	.15(81) (.15-.19)	.06 (27) (.06-.08)
SSA: East Africa	.03 (52) (.03-.03)	6.0(95) (4.8-7.8)	1.3 (115) (.90-1.9)	.87(72) (.56-1.1)	.06(47) (.05-.08)	.20(108) (.16-.23)	.06 (206) (.06-.07)
SSA: Southern Africa	.04 (27) (.03-.05)	5.5(20) (5.1-6.2)	.84 (92) (.76-1.0)	.68 (23) (.55-.77)	.06(11) (.05-.06)	.22(82) (.19-.27)	.06 (81) (.06-.07)
SSA: West and Central Africa	.02 (51) (.01-.04)	5.5(80) (4.5-6.6)	1.4(194) (.83-2.3)	.57 (57) (.46-.97)	.06(31) (.05-.06)	.19(145) (.16-.23)	.06 (142) (.06-.07)

* Results are presented as medians, number of purchases reported and inter-quartile ranges. Medians and IQRs are aggregated over the entire period (2005-2012).

4. Discussion

In economic theory, when you hold all things constant, prices are expected to fall as more suppliers enter a market, and as newer, more sophisticated commodities are introduced and demand rises (manufacturers produce more and the prices drop with the scale of production). However, the laws of economics do not always apply in health care markets, where incidences of market failure are more common. Past experiences have shown, for instance, that the markets for health care commodities and services have more information asymmetry[4] and a higher risk of monopolization,[5] both being contributors to reduced competition and increased prices [15, 16]. For this reason, prices for health care–related products should be monitored conscientiously, and appropriate interventions sought where inadequacies are detected. This report contributes to knowledge of the global health care market by describing procurement costs for HIV, TB and malaria commodities over a 7-year period.

Temporal variations were observed in the procurement costs of commodities, with ARVs and LLINs, for instance, showing substantial cost reductions over the period of analysis (2005–2012), while the AL antimalarial, malaria RDTs and the RHZE anti-TB had less pronounced reductions. Procurement costs were relatively stable for condoms and HIV test kits.

A variety of factors may explain the variations in trends across different types of commodities.

The price reduction for ARVs was most likely a reflection of increased competition among suppliers. Strong competition has been well documented in the market for ARVs, with studies showing the presence of many generic manufacturers,[6] mostly from the Asian region. In 2010, a study showed that over 80% of donor-funded ARVs were purchased from Indian manufacturers of generics [17]. Generic manufacturers supply over 95% of solid-form ARVs across Global Fund grant recipients, according to one report [3].

Several organisations have combined efforts to negotiate lower manufacturer prices, and to encourage countries to purchase generic HIV medicines. These include the (US) President's Emergency Plan for AIDS Relief (PEPFAR), the Clinton Health Access Initiative (CHAI) and the Global Fund [18–20]. While prices for newer ARVs such as tenofovir remain high, declines have already began showing, with further reductions being expected as more manufacturers enter the competitive ARVs market [21, 22].

The fall in the global procurement costs has resulted in reduced overall annual treatment costs per patient. Data from the WHO Global Price Reporting Mechanism showed a median cost

[4] Market situations where buyers and sellers have different levels of information, leading to the one with more information taking advantage of the one with less information.

[5] Market characterized by one dominant supplier, leading to restricted supply and inflated prices.

[6] Manufacturers of non-branded medicines not covered by patent.

reduction of nearly a half (from $162 in 2005 to $93 in 2012 for HIV treatment per person per year) [23]. Elsewhere, the annual treatment cost for the stavudine–lamivudine–nevirapine adult fixed-dose combination declined from $339 to $200 between 2007 and 2010 [22].

Although the cost-effectiveness of ARVs has been demonstrated in the past [24], further price reductions would result in even better use of Global Fund resources. However, fears have emerged over how sustainable the ARVs market would be, and how attractive it would be for new manufacturers, if the prices were to drop further [25].

Like ARVs, the cost for LLINs showed a gradual decline over the period. While this is a positive finding on face value, lower costs for LLINs may not necessarily mean the best use of resources over time. Efforts are now being made to encourage funders and programmes to procure LLINs with higher longevity, rather than using cost as the only criteria [26]. The argument here is that despite a higher initial cost, a longer-lasting product reduces the cost per year and leads to higher savings [26, 27]. The Global Fund has been criticized for over-emphasising low unit cost at the expense of longevity[7] [26]. Our data had no information on the brand names, so we could not estimate the relationship between unit cost and longevity. Future analyses should examine the cost benefits of procuring LLINs of varying durability and longevity across different settings. Despite the absence of information on brands, the overall downward price trend is an indication that the market for LLINs is likely to be competitive.

Procurement costs for the fixed-dose combination of artemether–lumefantrine (100mg/20mg) remained relatively steady over the period. This can be attributed largely to a decade-long agreement between the Global Fund and Novartis, the first manufacturer to begin producing AL. The agreement stated that Novartis would supply AL to Global Fund–supported public sector buyers at cost price [28]. This may explain why the procurement costs remained stable despite a volatile market for the artemisinin raw material [29].

Another factor that may have contributed to the stability is the growth of the ACT[8] market. On the supply side, the number of WHO-prequalified ACT manufacturers has increased from one manufacturer producing a single product in 2005, to seven producing at least 11 different ACT formulations [22]. On the demand side, the number of ACT doses purchased by donors increased from 11.2 million to 217 million between 2005 and 2010 [22]. It is also likely that the price benefits from the overall market growth were accentuated by economies of scale, further stabilising the price. What has not been seen clearly for AL in our analysis is a steep annual cost reduction similar to the one observed for LLINs and ARVs. This may be because the price of AL is already relatively low. Those who hold this view argue that the production processes for ACTs

[7] The Global Fund encourages recipients to buy the lowest priced WHO-prequalified LLINs; however, the WHO-prequalified bednets vary in quality and durability

[8] AL is one of several ACT products. Changes in the wider ACT market will therefore be expected to affect AL.

are already optimum, and that costs are unlikely to fall further, unless other combination molecules are introduced [30].

Unlike AL, procurement costs for RDTs showed an increase, albeit a subtle one. This result should be interpreted with caution, though, because the information on brands and manufacturers was unavailable. Unlike other commodities such as AL and ARVs, the RDTs vary considerably, from simple kits designed to test the *plasmodium falciparum* parasite only, to more sophisticated brands that can be used for the *plasmodium falciparum* and *plasmodium vivax* strains [31]. The absence of this specification information limited our analysis because we were unable to infer the unit costs for particular brands.

The gradual decline in procurement costs for malaria RDTs is nonetheless welcome, especially considering the growing importance of diagnostic testing in malaria case management. RDTs have been linked to better case management and reduced wastage [32]. However, while demand for AL is expected to fall in concert with a shrinking malaria map, the demand for RDTs is unlikely to decline with the same magnitude, particularly in areas where fevers are common [30]. This underscores the importance of promoting lower prices for RDTs. The fact that the decline has been very gradual suggests the market is maturing.

In contrast to malaria RDTs, HIV test kits showed minimal cost variation across the period of analysis. This stability may be linked to the fact that HIV testing is mandatory for treatment, and has been available over a longer period. Making malaria testing mandatory for case confirmation on the other hand, is a recent policy shift [33, 34]. The market for HIV test kits is, therefore, more mature than the one for malaria RDTs. The Global Fund's Market Dynamics Advisory Committee has in the past recognized the Fund's inability to influence commodities whose prices have already stabilized [35].

The unit procurement cost for the RHZE TB combination treatment was relatively stable over the period, and across the regions. Indeed, the RHZE anti-TB medicine was the commodity with the narrowest variation in cost across all regions. This is likely explained by the fact that TB medicines are procured centrally through the Global Drug Facility (GDF) [36].

According to UNITAID, the market for the first-line TB treatment is mature, so we are unlikely to see sizeable price reductions in the coming years [22]. This means that the costs can only be lowered through alternative strategies. Suggestions include developing shorter treatment regimens (current regimens last six months) and developing more effective diagnostic methods (particularly those that can identify resistant strains) [37]. While prices for first-line TB medicines have stabilised, concerns persist over the price of second-line treatments used for multi-drug resistant strains. These cost nearly 50 times as much as the first-line combinations [22]. More effort is certainly needed here.

Regional cost variations were minimal across the majority of commodities. This may be linked to the fact that countries tend to procure commodities from a common market – for instance, most ARV purchases from Asian manufacturers [17]. This may also suggest good awareness

among countries on prices for commodities in the global market. The most striking exceptions were costs for HIV and malaria diagnostic kits. However, as explained earlier, these wider variations may have resulted from countries procuring test kits with different specifications.

The final part of the analysis compared individual country procurement with the VPP mechanism procurement costs. The analysis gave a mixed picture, with the cost benefits of the VPP showing clearly for some commodities but not for others. But the VPP mechanism was only introduced in 2009, so this comparison is only available across three years, making it quite challenging to use the few data points to gauge the extent to which the pooled system was beneficial.

Despite these concerns, the results show a positive benefit with respect to cost for the procurement of the AL antimalarial combination, malaria RDTs and condoms. This agrees with other analyses by the Global Fund, which showed the VPP prices to be either at par, or slightly lower than those reported through the PQR [4, 38]. However, benefits were invisible for LLINs, and HIV ARVs and diagnostic test kits. This may be because the markets for these commodities are already relatively competitive, and thus countries have a better chance to negotiate lower prices directly.

Failure to show a direct cost reduction does not mean the VPP mechanism has no other benefits. Indeed, some non-cost advantages have been linked with the system, including improved transparency, accountability and governance of procurement processes, improved payment terms and conditions for purchasing countries (including countries buying in small volumes), more reliability in availability of commodities (particularly in countries with a high risk of stock-outs), and provision of technical support on supply chain issues by the procuring agents [4].

The cost trend variations seen across commodities may reflect an overall change in commodity production costs, or it may be linked to procurement-related factors such as order lead times (delayed ordering may attract higher unit costs). What cannot be overlooked is the important role the Global Fund and other global health initiatives have played in stabilising markets for commodities for the three diseases. As more data becomes available, research should aim to describe the causes of variations in greater depth, including by type of PR doing the procurement, as well as the effect of using the VPP mechanism over longer periods of time.

Limitations

While the dataset was relatively complete and well-organised, there were outliers. The PQR data verification by the local fund agents is not yet fully effective; for instance, roughly 15% of data points reported in the PQR system in 2009 that were found to be outliers, most were data entry errors [8]. While the Global Fund says that the number of errors has been reduced [personal communication from the Global Fund's Procurement Support Services staff], there are still concerns over the rate of verification. The use of medians, rather than means, would have reduced but not eliminated the effect of the outliers.

Another limit of our study is the level of missing data prior to 2008. While the system has been operational since 2005, there were few data entries in the first three years. This limited our ability to check the trends over the entire 7-year period (2005–2012). The lack of clarity on the characteristics of countries or transactions that are not captured creates a risk of bias. It is possible that countries that did not report data into the PQR system paid more or less for the commodities compared to the countries that report data accurately.

Finally, we did not analyse other factors that may influence the unit costs. These include things like order lead times, commodity brands (particularly for the diagnostic test kits) and risk of non-payment. Future analyses could focus on fewer countries or regions, but provide a more detailed analysis of the association of such factors with commodity price trends.

5. Conclusion

The analyses demonstrated the value of the PQR-collected data in assessing regional variations and price trends for HIV, TB and malaria commodities. We showed that these data can inform policy on how well global markets are working. As the Global Fund and other donors continue supporting the fight against the three diseases, it is important that every caution be taken to ensure resources are used in the best possible way. By analyzing this regularly collected procurement information, market inadequacies can be identified early and appropriate strategies developed.

Future analyses should describe the causes of variations in unit costs of commodities in greater depth, and assess the relative effectiveness of different market-shaping interventions. The effectiveness of the VPP mechanism should also be examined over a longer period of time.

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Appendix: PQR Product Purchases by Product Category (2003 to 2012)

Commodities selected for analyses are highlighted in yellow

HIV Antiretrovirals

Anti-Retrovirals	Number of purchases
Abacavir (ABC)	540
Abacavir + Lamivudine + Zidovudine – FDC[9]	25
Abacavir + Lamivudine - FDC	45
Atazanavir (ATV)	78
Atazanavir+Ritonavir	4
Darunavir (TCM)	60
Didanosine (ddI)	514
Efavirenz (EFV)	1150
Efavirenz + Emtricitabine + Tenofovir - FDC	80
Efavirenz + Lamivudine + Tenofovir - FDC	62
Efavirenz + [Lamivudine + Zidovudine] - FDC	24
Emtricitabine (FTC)	6
Emtricitabine + Tenofovir - FDC	188
Enfuvirtide	18
Etravirine (ETV)	20
Fosamprenavir (FPV)	13
Indinavir (IDV)	105
Lamivudine (3TC)	712
Lamivudine + Nevirapine + Stavudine – FDC	467
Lamivudine + Nevirapine + Zidovudine - FDC	576
Lamivudine + Stavudine - FDC	335
Lamivudine + Tenofovir - FDC	134
Lamivudine + Zidovudine - FDC	790
Lopinavir (LPV) + Ritonavir (RTV) - FDC	912
Maraviroc	1
Nelfinavir (NFV)	36
Nevirapine (NVP)	882
Raltegravir	13
Ritonavir (RTV)	281
Saquinavir (SQV)	46
Stavudine (d4T)	422
Tenofovir (TDF)	366
Tipranavir (TPV)	4
Zidovudine (AZT or ZDV)	749

[9] FDC-fixed –dose combination

Condoms

Condoms	Number of purchases
Male Condoms	613
Female Condoms	82

Bednets

Bed Nets	Number of purchases
Health Net	1
Insecticide-treated net (ITN)	36
Interceptor	1
Long-Lasting Insecticidal Net (LLIN)	492
MAGNet	3
Netprotect	6
Non-treated net	3
Yorkool LN	2
zz-Deltamethrin-WP	1

Diagnostic devices

Diagnostic Tests	Number of purchases
HIV Rapid Diagnostic Test	1148
Malaria Rapid Diagnostic Test	330
TB Diagnostic Test	7

Antimalarials

Antimalarials	Number of purchases
Arteether (alpha, beta arteether)	15
Artemether	17
Artemether + Lumefantrine - FDC	632
Artemotil (beta arteether)	6
Artesunate	28
Artesunate + Amodiaquine - Co-blister	59
Artesunate + Amodiaquine - FDC	343
Artesunate + Mefloquine - Co-blister	17
Artesunate + [Sulfadoxine + Pyrimethami	71
Chloroquine	37
Chloroquine phosphate	7
Dihydroartemisinin + Piperaquine - FDC	10
Mefloquine	12
Primaquine	27
Quinine	67
Quinine-resorcine	5
Sulfadoxine + Pyrimethamine - FDC	37

Tuberculosis treatments

Anti-TB medicines	Number of purchases
Amikacin	64
Amoxicillin / Amoxicillin + Clavulanate	42
Capreomycin	186
Clarithromycin	6
Cycloserine	286
Ethambutol	133
Ethambutol + Isoniazid + Pyrazinamide + Rifampicin	191
Ethambutol + Isoniazid + Rifampicin - F	67
Ethambutol + Isoniazid - FDC	21
Ethionamide	159
Isoniazid	76
Isoniazid + Pyrazinamide + Rifampicin -	28
Isoniazid + Rifampicin - FDC	204
Kanamycin	135
Levofloxacin	234
Moxifloxacin	89
Ofloxacin	101
PAS Sodium	257
Prothionamide	120
Pyrazinamide	222
Rifampicin	10
Streptomycin	135
TB Cat. I+III Patient Kit A	40
TB Cat. I+III Patient Kit B	2
TB Cat. I+III Patient Kit C	8
TB Cat. I+III Patient Kit C UNICEF (DPR	3
TB Cat. II Patient Kit A1	5
TB Cat. II Patient Kit A2	16
TB Cat. II Patient Kit B1 UNICEF (DPRK)	7
TB Cat. II Patient Kit B1 UNICEF (DPRK)	1
TB Cat. II Patient Kit B2	3
TB India PC1 Cat-I Patient Kit	45
TB India PC10	3
TB India PC13 Ped PWBs 6-10kg	11
TB India PC14 Ped PWBs 11-17 kg	18
TB India PC15 Ped PPs 18-25 kg	12
TB India PC2 Cat-II Patient Kit	43
TB India PC3	17
TB India PC4	8
TB India PC5	1
Terizidone	1
Water for injection	59