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ACTwatch 2010 Supply Chain Survey Results Democratic Republic of the Congo

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Definitions & Key Indicator Descriptions

Acceptable storage conditions for medicines: A wholesaler or outlet is considered to have acceptable storage conditions for medicines if it is in compliance with all the following three standards: (1) medicines are stored in a dry area; (2) medicines are protected from direct sunlight; and (3) medicines are not kept on the floor.

Adult equivalent treatment dose (AETD): The number of milligrams of an antimalarial treatment needed to treat a 60kg adult whereby all dosage types found (tablet, suspension, syrup, etc.) are converted regardless of their original presentation (whether for child or adult). The number of mg/kg used to determine the dose is defined as what is recommended for a particular drug combination in the treatment guidelines for uncomplicated malaria in areas of low drug resistance issued by the WHO. Where this does not exist, a product manufacturer's treatment guidelines are consulted. See Appendix 6.3 for additional details

Antimalarial combination therapy: The use of two or more classes of antimalarial drugs/molecules in the treatment of malaria that have independent modes of action.

Antimalarial: Any medicine recognized by the WHO for the treatment of malaria. Medicines used solely for the prevention of malaria were excluded from analysis in this report.

Artemisinin and its derivatives: Artemisinin is a plant extract used in the treatment of malaria. The most common derivatives of artemisinin used to treat malaria are artemether, artesunate, and dihydroartemisinin.

Artemisinin monotherapy (AMT): An antimalarial medicine that has a single active compound, where this active compound is artemisinin or one of its derivatives.

Artemisinin-based Combination Therapy (ACT): An antimalarial that combines artemisinin or one of its derivatives with an antimalarial or antimalarials of a different class. See to combination therapy.

Availability of any antimalarial or RDTs: The proportion of wholesalers in which the specified antimalarial medicine or RDT was found on the day of the survey, based upon an audit conducted by the interviewer. For indicators of availability, all wholesalers who were eligible to participate after screening (i.e. had any antimalarial or RDT in stock at present or at any point in the 3 months prior to interview) are included in the denominator.

Booster sample: A booster sample is an extra sample of units (or in this case outlets) of a type not adequately represented in the main survey, but which are of special interest. In the DRC, the 2009 ACTwatch Outlet Survey targeted public health facilities, pharmacies and drug stores for booster sampling. The booster sampling approach was dependent on the characteristics of each of the 76 health areas selected for the main survey. If a selected health area contained the central office for the larger health zone then no booster sample was taken for this health area. If a selected health area did not contain the central office for the larger zone, then the health area containing the zone's central office was enumerated for the booster sample. In the centre-south domain, 12 booster health areas were enumerated in addition to the 19 selected health areas; in Kinshasa, 18 additional booster health areas were enumerated; in the north-east, 5 additional booster health areas were enumerated; and in the north-west domain, 8 additional booster health areas were enumerated.

Censused sub-district: Sampled areas, corresponding to the administrative unit determined by the Ministry of Health known as health areas (*aires de santé*), each hosting a population size of approximately 10,000-15,000 inhabitants, where field teams conducted a full census of all outlets with the potential to sell antimalarials.

Combination therapy: The use of two or more classes of antimalarial drugs/molecules in the treatment of malaria that have independent modes of action.

Credit to consumers: A wholesaler is considered to provide credit to consumers based on the response of the wholesaler.

Distribution chain: The chain of businesses operating from the factory gate/port of entry down to the retail level. Also sometimes referred to as downstream value chain. In this report, the terms distribution chain and supply chain are used interchangeably. More specifically, the 'private commercial sector distribution chain' refers to any type of public or private wholesaler who served private commercial outlets, as well as private commercial wholesalers who served public sector or NGO outlets so that any transactions between public, NGO and private commercial sectors are noted.

First-line treatment: The government recommended treatment for uncomplicated malaria. The DRC's first-line treatment for *Plasmodium falciparum* malaria is artesunate-amodiaquine (4mg/10mg/kg).

Inter-quartile range (IQR): A descriptive statistic that provides a measure of the spread of the middle 50% of observations. The lower bound value of the range is defined by the 25th percentile observation and the upper bound value is defined by the 75th percentile observation.

Mark-up: The difference between the price at which a product is purchased, and that at which it is sold. Sometimes also referred to as margin. In this report, the terms mark-up and margin are used interchangeably. May be expressed in absolute or percent terms. Because it is common for wholesalers to vary their prices with the volumes they sell, minimum, mid and maximum mark-ups were calculated in this report using price data collected from interviewees. Key findings on price mark-ups at the wholesale level are reported using mid mark-up data. As maximum and minimum selling prices were not collected at the retail level, only one set of absolute and percent retail mark-ups is calculated.

Absolute mark-up: The absolute mark-up is calculated as the difference between the selling price and the purchase price per full-course adult equivalent treatment dose. In this report, absolute mark-ups are reported in US dollars. The average exchange rate during the data collection period for wholesale purchase prices (11 January to 17 March 2010) was 899.482 Congolese francs (CDF) to US\$1; the average exchange rate during the data collection period for retail purchase prices (10 August to 27 October 2009) was 823.7952 Congolese francs (CDF) to US\$1 (www.oanda.com).

Percent mark-up: The percentage mark-up is calculated as the difference between the selling price and the purchase price, divided by the purchase price.

Maximum mark-up: For wholesale level only, the absolute and percent maximum mark-ups are calculated as above using the difference between *maximum* wholesale selling price and the wholesale purchase price.

Minimum mark-up: For wholesale level only, the absolute and percent minimum mark-ups are calculated as above using the difference between *minimum* wholesale selling price and the wholesale purchase price.

Mid mark-up: For wholesale level only, the absolute and percent mid mark-ups are calculated as above using the difference between the *average* wholesale selling price (i.e. the mid-point between the maximum and minimum wholesale selling price) and wholesale purchase price.

Median: A descriptive statistic given by the middle (or 50th percentile) value of an ordered set of values (or the average of the middle two in a set with an even number of values), which is an appropriate measure of central tendency of a skewed distribution of continuous data.

Monotherapy: An antimalarial medicine that has a single mode of action. This may be a medicine with a single active compound or a synergistic combination of two compounds with related mechanisms of action.

Non-artemisinin therapy (nAT): An antimalarial treatment that does not contain artemisinin or any of its derivatives.

Non-WHO prequalified ACTs: ACTs that do not meet acceptable standards of quality, safety and efficacy as assessed by the WHO Prequalification of Medicines Programme, or have yet to be assessed as such. (See WHO prequalified ACTs below)

Oral artemisinin monotherapy: Artemisinin or one of its derivatives in a dosage form with an oral route of administration. These include tablets, granules, suspensions, and syrups and exclude suppositories and injections.

Outlet: Any point of sale or provision of a commodity to an individual. Outlets are not restricted to stationary points of sale and may include mobile units or individuals. Refer to Appendix 6.2 for a description of the outlet types visited as part of the ACTwatch Outlet Survey.

Purchase price: The price paid by businesses (i.e. wholesalers or outlets) for their most recent purchase of an antimalarial product from their suppliers. This is different from selling price (see below). Prices are reported in terms of full adult equivalent treatment dose treatment. Prices are shown in US dollars. The average exchange rate during the data collection period for wholesale purchase prices (11 January to 17 March 2010) was 899.482 Congolese francs (CDF) to US\$1; the average exchange rate during the data collection period for retail purchase prices (10 August to 27 October 2009) was 823.7952 Congolese francs (CDF) to US\$1 (www.oanda.com).

Rapid-Diagnostic Test (RDT) for malaria: A test used to confirm the presence of malaria parasites in a patient's bloodstream.

Screening/Eligibility criteria: The set of requirements that must be satisfied before the full questionnaire is administered. In the ACTwatch Supply Chain Survey, a wholesaler met the screening criteria if (1) they had any antimalarial or RDTs in stock at the time of the survey visit, or (2) they report having stocked either antimalarials or RDTs in the past three months.

Selling price: The price paid by customers to purchase antimalarials. For outlets, these customers are patients or caretakers; for wholesalers, these customers are other businesses or health facilities. Because it is common for wholesalers to vary their selling prices depending on the volumes purchased by the customer, data on maximum and minimum selling price charged for one unit by wholesalers were collected for each antimalarial product type in stock at the time of interview.

Stock outs of ACT: Reported in the affirmative as the percentage of interviewed wholesalers who reported to have always had at least one ACT in stock over the past 3 months. All eligible (see Screening criteria above) wholesalers who were successfully interviewed were included in the denominator.

Sub-district (SD): The primary sampling unit, (also referred to as cluster in the second ACTwatch Outlet Survey), corresponding to the administrative unit determined by the Ministry of Health known as health areas (*aires de santé*), each hosting a population size of approximately 10,000-15,000 inhabitants. No national census has been conducted in the DRC since 1984. The population

figures used as a sampling frame for this survey came from localized censuses in health zones conducted between 2001 and 2004, with the support of various NGOs. This is the same source as formed the basis of sampling for the 2007 Demographic & Health Survey.

Top selling antimalarial: The antimalarial with the largest volume of adult equivalent treatment doses sold or distributed in the past week as reported by individual wholesalers.

Treatment/dosing regimen: The posology or timing and number of doses of an antimalarial used to treat malaria. This schedule often varies by patient weight.

Volumes: Volumes of antimalarials sold in the previous week are reported in terms of full-course adult equivalent treatment doses (or AETDs; see above for description).

WHO prequalified ACTs: ACTs that meet acceptable standards of quality, safety and efficacy as assessed by the WHO Prequalification of Medicines Programme. This is a service provided by WHO to guide bulk medicine purchasing of international procurement agencies and countries for distribution in resource limited settings, often using funds for development aid (e.g. Global Fund grants). More details on the list of prequalified medicines and the prequalification process may be found on the WHO website at: <http://www.who.int/mediacentre/factsheets/fs278/en/index.html>.

Wholesalers: Businesses that supply other businesses, which may include retailers or other wholesalers. In this report, wholesalers are classified further into more specific categories defined by the type of businesses that they supply. As some wholesalers will supply different types of businesses (e.g. both retail outlets and other wholesalers), these categories are not mutually exclusive and such wholesalers may appear in multiple categories. These are defined below.

Terminal wholesalers: Wholesalers that supply retail outlets *directly*. For example, wholesaler X is a terminal wholesaler if it supplies antimalarials to pharmacies and drug shops from which patients buy medicines. Terminal wholesalers may supply retail outlets only, but may also supply other wholesalers.

Intermediate-1 wholesalers: Wholesalers that supply terminal wholesalers *directly*. Intermediate-1 wholesalers may supply terminal wholesalers only, but may also supply other types of wholesalers (such as other intermediate-1 wholesalers) and retail outlets.

Intermediate-2 wholesalers: Wholesalers that supply Intermediate-1 wholesalers *directly*. Intermediate-2 wholesalers may supply Intermediate-1 wholesalers only, but may also supply other types of wholesalers (such as terminal wholesalers) and retail outlets.

Intermediate-3 wholesalers: Wholesalers that supply Intermediate-2 wholesalers *directly*. Intermediate-3 wholesalers may supply Intermediate-2 wholesalers only, but may also supply other wholesalers (such as intermediate-1 or terminal wholesalers) and retail outlets.

Intermediate-4 wholesalers: Wholesalers that supply Intermediate-3 wholesalers *directly*. Intermediate-4 wholesalers may supply Intermediate-3 wholesalers only, but may also supply other wholesalers (such as intermediate-2, intermediate-1 or terminal wholesalers) and retail outlets.

Wholesalers supplying retailers: This is an analytical category specific to ACTwatch that groups together all wholesalers that may be categorised as a terminal wholesaler.

Wholesalers supplying wholesalers: This is an analytical category specific to ACTwatch that groups together all wholesalers that may be categorised as operating at an intermediate level of the supply chain (e.g. in this report, intermediate-1, intermediate-2 and intermediate-3 wholesalers).

Abbreviations

| | |
|--------------------|---|
| ACT | artemisinin-based combination therapy |
| AETD | adult equivalent treatment dose |
| AL | artemether lumefantrine |
| AMFm | Affordable Medicine Facility - malaria |
| AMT | artemisinin monotherapy |
| ASAQ | artesunate-amodiaquine |
| ASF | <i>Association de Santé Familiale</i> (PSI affiliate in the DRC) |
| ASMQ | artesunate and mefloquine |
| ASRAMES | <i>Association Régionale pour Approvisionnement en Médicaments Essentiels</i> (Regional association for the supply of essential medicines) |
| BCAF | <i>Bureau de Coordination des Achats</i> (Office for the Coordination of Purchases) |
| BCZS | <i>Bureau Central de Zone de Santé</i> (Health Zone Central Office) |
| CDF | Congolese franc |
| CDR | <i>Centrale de Distribution Régionale</i> (Regional Distribution Centre) |
| CQ | chloroquine |
| DHA | dihydroartemisinin |
| DHA+PP | dihydroartemisinin and piperaquine |
| DPM | <i>Direction de la pharmacie, médicaments et plantes médicinales</i> (Directorate of Pharmacies, Medicines, and Traditional Medicine, Ministry of Health) |
| DRC | Democratic Republic of Congo |
| FBO | faith-based organisation |
| GDP | gross domestic product |
| Global Fund | Global Fund to Fight AIDS, Tuberculosis and Malaria |
| INT | intermediate level (wholesaler of supply chain) |
| IPT | intermittent preventive treatment of malaria |
| IQR | inter-quartile range |
| IRS | indoor residual spraying |
| ITN | insecticide treated net |
| LLIN | long lasting insecticide-treated net |
| LSHTM | London School of Hygiene & Tropical Medicine |
| MEC | mutually-exclusive category of wholesalers |
| MOH | Ministry of Health, DRC |
| MQ | mefloquine |
| nAT | non-artemisinin therapy |
| NGO | non-governmental organisation |
| OS | ACTwatch Outlet Survey |
| OTC | over the counter |
| <i>Pf</i> | <i>Plasmodium falciparum</i> |
| PMI | US President's Malaria Initiative |
| PPS | probability proportional to size |
| PSI | Population Services International |
| RDT | rapid diagnostic test |
| SNAME | <i>Système National d'Approvisionnement en Médicaments Essentiels</i> (National System for Procurement of Essential Medicines) |
| SP | sulphadoxine pyrimethamine |
| WHO | World Health Organization |
| WS | wholesaler |

Executive Summary

Background

In the DRC, as in many low-income countries, private commercial providers play an important role in the treatment of malaria. To design effective interventions for improved access to accurate diagnosis and effective malaria treatment, there is a need to understand retailer behaviour and identify the factors that influence their stocking and pricing decisions. Private commercial retailers are the last link in a chain of manufacturers, importers and wholesalers and their supply sources are likely to have an important influence on the price and quality of malaria treatment that consumers can access. However, there is limited rigorous evidence on the structure and operation of the distribution chain for antimalarial drugs that serves the retail sector.

The ACTwatch Supply Chain Study, one of the ACTwatch project components, aims to address this gap by conducting quantitative and qualitative studies on distribution chains for antimalarials in the ACTwatch countries (the Democratic Republic of Congo, Cambodia, Benin, Madagascar, Nigeria, Uganda and Zambia). Other elements of ACTwatch include Retail Outlet and Household Surveys led by Population Services International (PSI). This report presents the results of a cross-sectional survey of antimalarial drug wholesalers conducted in the DRC between January and March 2010.

Methods

The Supply Chain survey was implemented by the London School of Hygiene & Tropical Medicine (LSHTM), with support from the *Association de Santé Familiale* (ASF, the PSI affiliate in the DRC), conducted soon after the second round of the ACTwatch Outlet Survey implemented by ASF and PSI. Wholesalers operating at different levels of the supply chain that served a representative sample of public and private sector outlets in four geographically defined zones in the DRC (i.e. centre-south, north-east, north-west, and Kinshasa) were sampled through a bottom-up approach during which wholesalers were identified by their customers until the top of the chain was reached. For this purpose, 32 of the 76 sub-districts (19 from each geographic zone) included in the first round of the ACTwatch Outlet Survey (2008) were used to form the sample for the ACTwatch Supply Chain Survey. The sampling procedure used the list of the two top antimalarial wholesale sources (termed the terminal wholesalers) reported by each antimalarial retail outlet that participated in the 20 selected Outlet Survey sub-districts. From these data a list of all terminal wholesalers mentioned was created. All these terminal wholesalers were visited and invited to participate in the Supply Chain survey. Wholesalers were eligible to participate if they met the following screening criteria: they had either an antimalarial or rapid diagnostic test (RDT) in stock at the time of interview, or they reported to have stocked either antimalarials or RDTs in the three months prior to interview. During the interview, eligible wholesalers were also asked about their two top supply sources for antimalarials (termed the intermediate-1 wholesalers). From these data, we created a list of all intermediate-1 wholesalers mentioned. All these intermediate-1 wholesalers were visited and invited to participate in the Supply Chain survey, during which, as at previous levels, they were asked about their two top supply sources for antimalarials (termed the intermediate-2 wholesalers). This process was repeated until the factory gate or port of entry was reached.

The supply chain survey collected data on the structure of the private commercial sector supply chain; wholesaler characteristics and business practices; wholesale outlet licensing and inspection; wholesaler knowledge, qualifications and training; and wholesale availability, purchase prices and mark-ups for antimalarials and RDTs. Retail outlets' purchase prices and mark-ups for antimalarials collected during the second round of the Outlet Survey are also presented in this report as they form the last step of the supply chain before antimalarials reached patients/care takers and are therefore relevant to the study of the distribution chain.

Results

STRUCTURE OF THE SUPPLY CHAIN: A total of 161 antimalarial wholesalers were identified, and 139 were successfully interviewed. The maximum number of steps from manufacturers' factory gate to retail outlets was 6 with wholesalers operating across 5 overlapping levels (Figure 1): intermediate-4 (INT 4 WS), intermediate-3 (INT 3 WS), intermediate-2 (INT 2 WS), intermediate-1 (INT 1 WS) and terminal (TERMINAL WS) levels. However, most antimalarials were likely to go through 2 or 3 steps as most wholesalers sold antimalarials directly to retailers (90%) with only 10% selling only to other wholesalers (Figure 2). Nearly a third (29%) of all wholesalers purchased antimalarials directly from manufacturers as one of their two top suppliers. As a result, the supply chain is shaped as a pyramid with a broad base. Each red dot on Figure 1 represents a mutually exclusive group of wholesalers and the array of arrows emanating from them describes the specific supply chain levels that each wholesaler group serves. Their percentage share is attached to each group. Figure 2 illustrates how the overlapping analytical categories used throughout this report are derived from the different mutually exclusive wholesaler categories depicted in Figure 1. The dashed line in Figure 1 from manufacturer to retailer indicates that a few retailers purchased antimalarials directly from manufacturers, although this was rare (2% of all suppliers mentioned by retailers were local drug manufacturers).

Figure 1: Representation of the antimalarial distribution chain showing interactions between supply chain levels by mutually exclusive wholesaler category

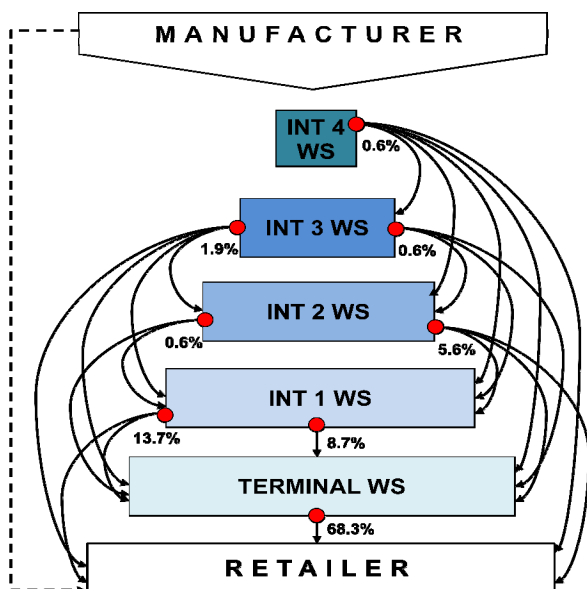
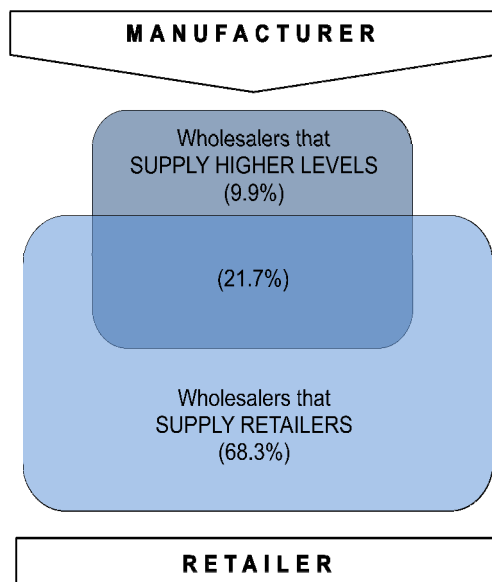


Figure 2: Representation of the antimalarial distribution chain showing the overlap between wholesaler categories used for analysis



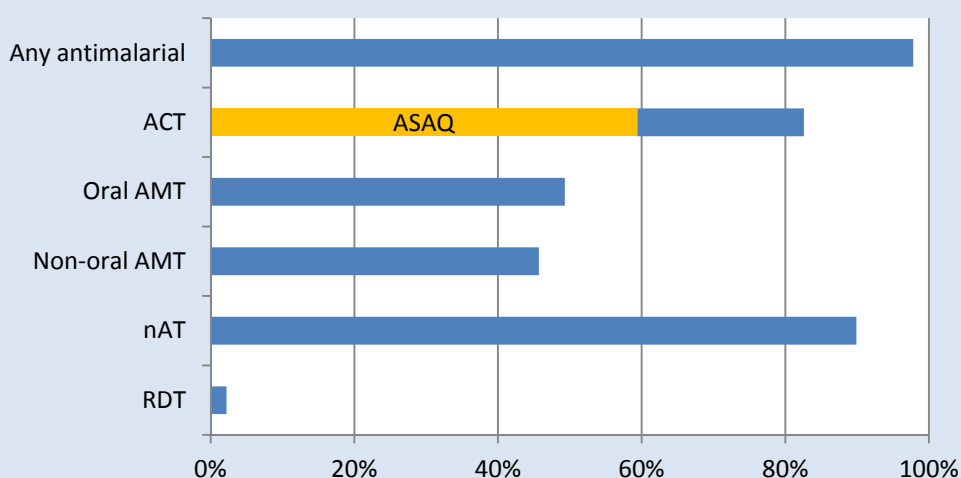
WHOLESALE CHARACTERISTICS: Wholesalers had been in operation for a median of 7 years; however, this varied considerably. Wholesale businesses supplying retailers were smaller (median of 8 workers) than those supplying other wholesalers (median of 12 workers). Nearly all wholesalers were observed to store their antimalarials appropriately (90%, i.e. off the floor, in dry areas and out of direct sunlight), reported having been visited by a pharmaceutical inspector during the past year (94%), and reported employing a member of staff with health-related qualifications (93%); however, few wholesalers were observed to have any authorisation from the *Direction des Pharmacies et des Médicaments et plantes médicinales* (DPM), to sell pharmaceuticals (20%). Just over a third (36%) of all wholesalers interviewed had provided credit facilities to their customers in the past 3 months, and less than a quarter (23%) reported delivering antimalarial orders.

% of wholesalers that...



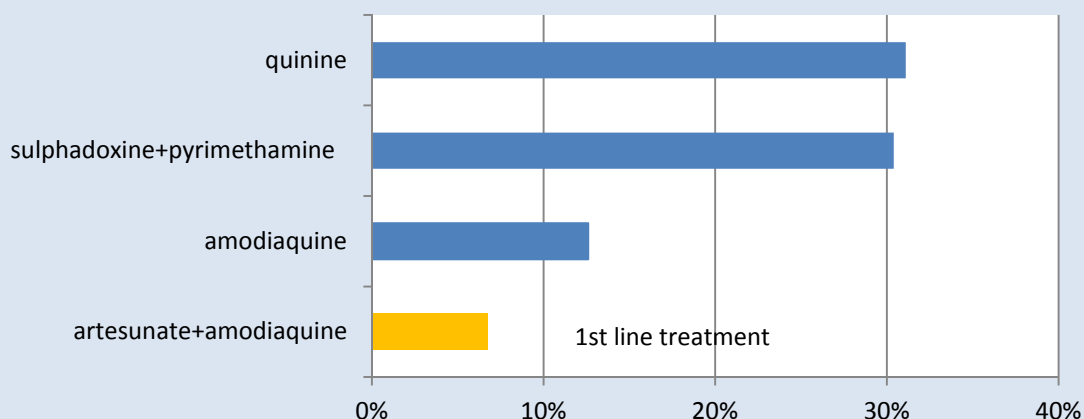
AVAILABILITY OF ANTIMALARIALS & RDTs: Nearly all wholesalers (98%) had at least one antimalarial in stock at the time of interview, 83% had ACT in stock, but only 59% stocked artesunate+amodiaquine (ASAQ), the recommended first line ACT treatment for uncomplicated *Pf* malaria in the DRC. Availability of other antimalarial drugs was high, with oral artemisinin monotherapies (AMT) being stocked by 49% of all wholesalers, and non-artemisinin therapies (nAT) by 90% of wholesalers. Only 2% of wholesalers stocked RDTs.

% of wholesalers that stocked...

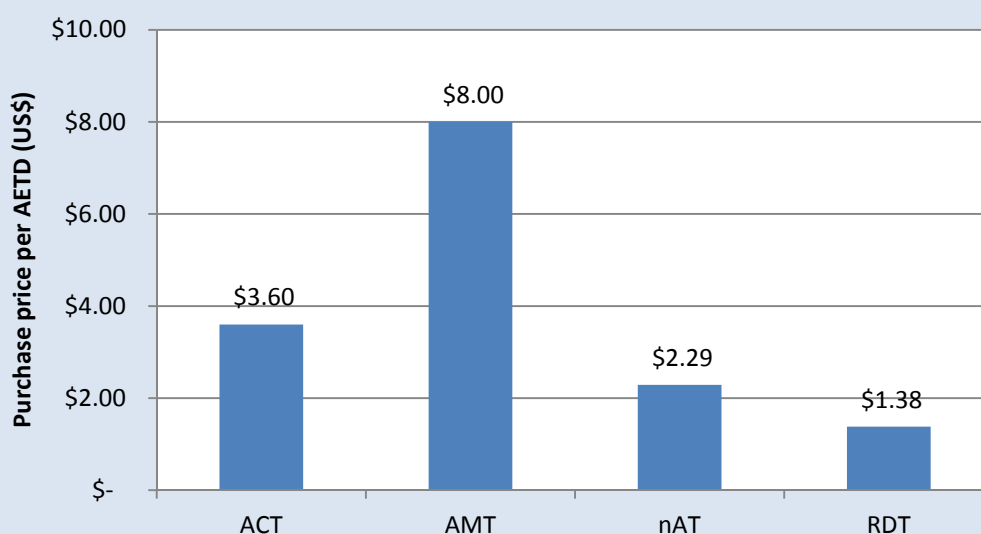


ANTIMALARIAL & RDT SALES VOLUMES: The median number of adult equivalent treatment doses (AETDs) of antimalarials sold the week preceding the survey was 68.5 for ACT, 8.3 for any AMT, and 327.8 for nATs. Among all wholesalers, the median sales volumes during the week preceding the survey for non-WHO prequalified ACTs (56.4 AETDs) was considerably higher than the median volumes for WHO prequalified ACTs (0.0 AETDs). Among wholesalers who stocked antimalarials at the time of interview (n=135), quinine was their top selling antimalarial for 31%, followed by sulphadoxine-pyrimethamine (SP) for 30% of wholesalers, and amodiaquine (13%). The government recommended first-line treatment, ASAQ, was the next most common top selling antimalarial (6%). Very few wholesalers sold RDTs during the week preceding the survey, and the median number of RDTs sold was 0.

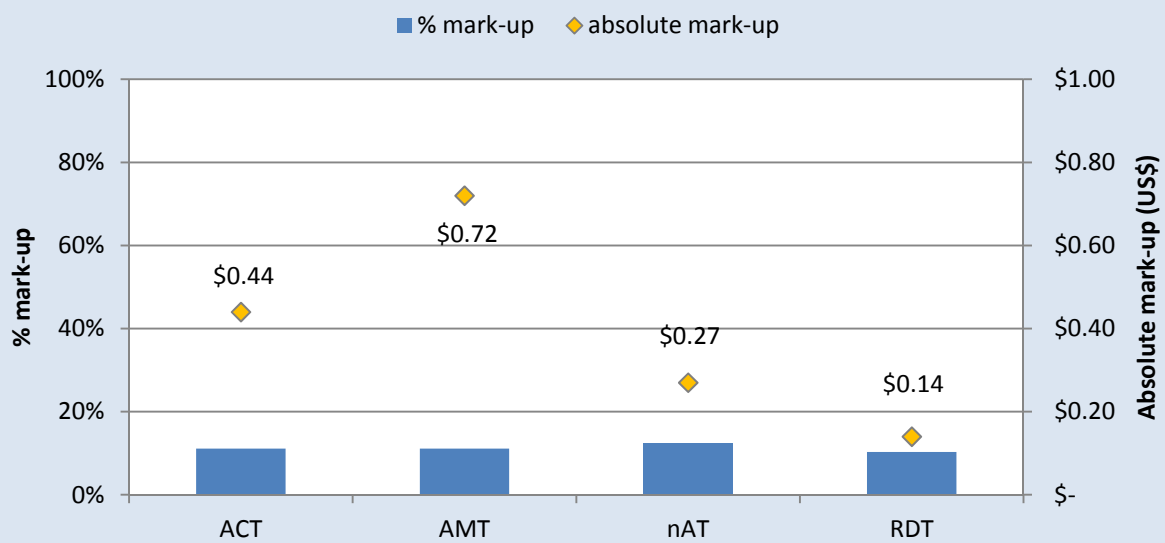
% of wholesalers who reported the top selling antimalarial was...



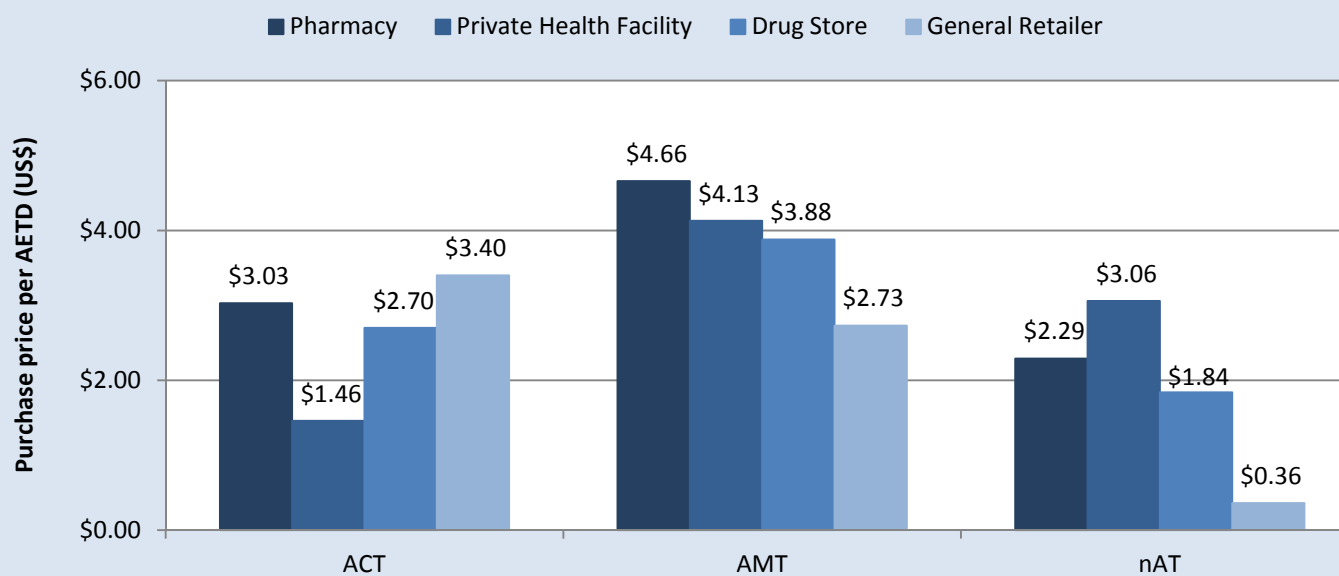
WHOLESALE PURCHASE PRICES: The median wholesale purchase price (i.e. the price paid by wholesalers to purchase stock from their suppliers) per AETD varied across antimalarial drug categories. Overall, AMTs had the highest median purchase price per AETD (US\$ 8.00), followed by ACTs (US\$ 3.60); while the median purchase price for nATs was US\$ 2.29. The median wholesale purchase price for the government recommended first-line treatment, ASAQ (US\$ 1.61), was less than half of that for all ACTs combined, but still more than 5 times the wholesale purchase price of SP (US\$ 0.24). The wholesale purchase price for RDTs was US\$ 1.38 per test.



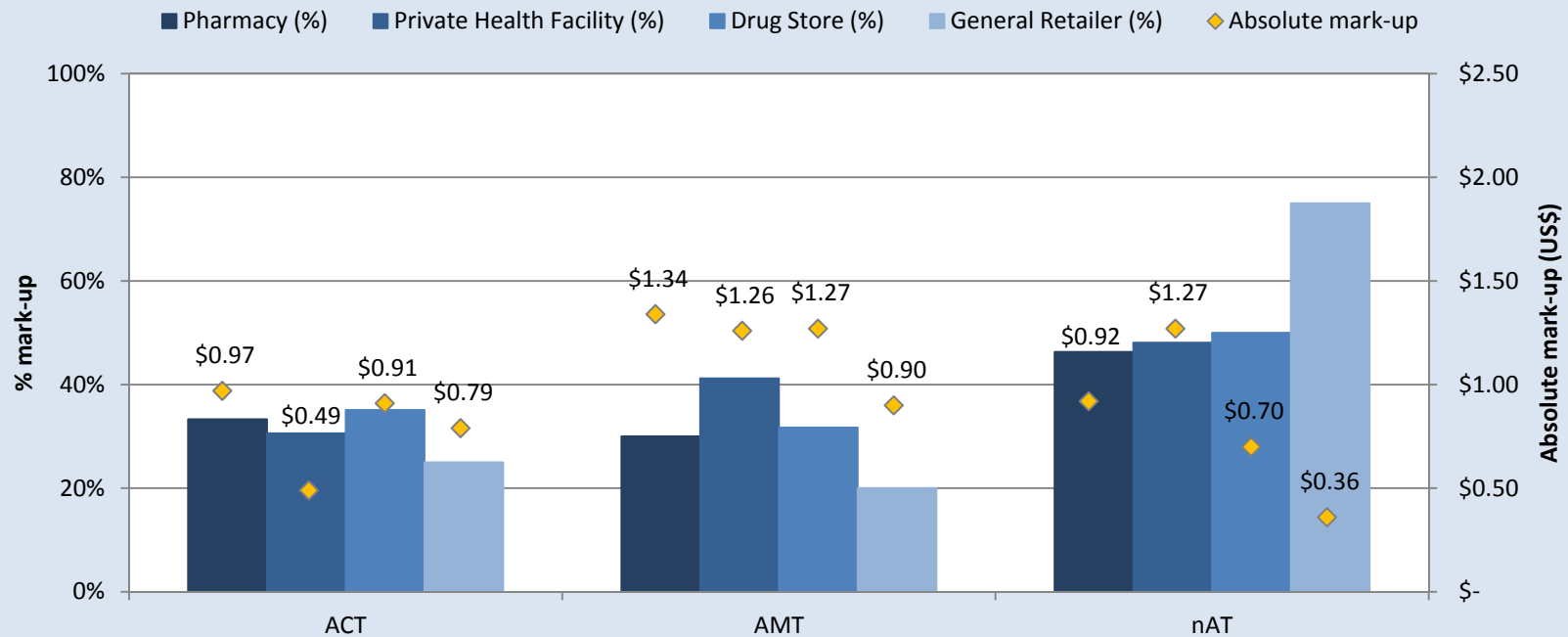
WHOLESALE MARK-UPS FOR ANTIMALARIALS & RDTs: The median mid percent mark-ups were low and consistent across antimalarial categories: 11% on ACTs and AMTs, and 12% on nATs; however, median percent mark-ups tended to be higher on WHO prequalified ACTs (19%). In absolute terms, mark-ups per AETD were the highest on AMT (US\$ 0.72), followed by ACT (US\$ 0.44) and nAT (US\$ 0.27), corresponding to the differences in purchase prices across drug categories. Wholesale percent mark-ups tended to be higher among wholesalers operating at lower levels of the distribution chain compared to those wholesalers operating at higher levels of the chain, and the differences ranged from 0.7% points on nAT oral liquids to 8.8% on WHO prequalified ACTs. Although the median mid percent mark-up for SP (20%) was higher than that for ASAQ, the recommended first-line treatment, the median mid absolute mark-up on ASAQ (US\$ 0.50) was considerably higher than the median absolute mark-up on SP (US\$ 0.05) due to differences in purchase prices. For RDTs, the median wholesale percent mark-up was 10%, equivalent to US\$ 0.14 in absolute terms.



RETAIL PURCHASE PRICES: Similar to the wholesale level, median retail purchase prices (i.e. the price paid by retailers to purchase stock from their suppliers) per AETD varied across antimalarial drug categories. In pharmacies, private health facilities and drug stores, AMTs were observed to have the highest median retail purchase prices per AETD (ranging from US\$ 3.88 at drug stores to US\$ 4.66 at pharmacies), while ACTs had the highest median retail purchase prices per AETD at general retailers (US\$ 3.40). Private health facilities were observed to pay higher prices for nATs than other outlet types but lower prices for ACTs, as private health facilities tended to stock more WHO prequalified ACTs, which were comparatively cheaper than non-WHO prequalified ACTs.



RETAIL MARK-UPS FOR ANTIMALARIALS: Median mid percent mark-ups among retailers tended to be higher compared to those observed among wholesalers, but were infrequently observed to exceed 100%. For ACTs, the median mark-up varied across retailer category from 25% at general retailers to 35% at drug stores; for AMT, median mark-up ranged between 20% at general retailers and 41% at private health facilities; and for nAT, between 46% at pharmacies and 75% at general retailers. Within specific retailer types, the highest median percent mark-ups tended to be applied to WHO prequalified ACTs, ranging from 50% at drug stores to 100% at general retailers. Variation in absolute mark-ups was also observed across antimalarial and retailer categories, corresponding closely with variations in purchase price: mark-ups on ACTs ranged between US\$ 0.49 and US\$ 0.97 across outlet categories; on AMT between US\$ 0.90 and US\$ 1.34; and on nAT between US\$ 0.36 and US\$ 1.27. Although median percent mark-ups on ASAQ (33%-100%) were similar to those typically applied to SP (46%-67%), the considerable difference in purchase prices meant that observed median absolute mark-ups on ASAQ (US\$ 0.34-US\$ 0.58) were higher than on SP (US\$ 0.10-US\$ 0.18).



Conclusions

This report has presented a number of important new insights into the market for antimalarial drugs in the DRC. The distribution chain had wholesalers operating on a number of levels giving an overall pyramidal shape. However, nearly all wholesalers supplied retailers directly and a third of wholesalers were supplied with antimalarials directly from manufacturers (as one of their top two antimalarial sources). This means that most antimalarials are likely to go through either 2 or 3 steps from manufacturer to retailer. Most wholesalers were not observed to have the required authorisation to wholesale antimalarials, echoing results from the 2009 ACTwatch Outlet Survey which showed that a high proportion of medicine retailers were unlicensed [1]; however, most private sector antimalarials in the DRC flowed through a distribution chain composed of wholesalers and retailers specialised in pharmaceutical sales, rather than generalist businesses selling a wide range of consumer goods. ACTs were available in most wholesalers; however, fewer wholesalers stocked the first-line treatment, ASAQ. nATs were available at comparable levels to ACTs, but were sold in much greater volumes than ACTs. Oral AMTs were also commonly stocked and sold by wholesalers. Percent mark-ups on antimalarials among wholesalers were particularly low and consistent across antimalarial categories, which may reflect the competitiveness of the DRC market. At retail level, percent mark-ups were higher than those at wholesale level, but were not observed to be excessive. RDTs were not widely available at wholesale level; however, their wholesale purchase prices were lower than the median wholesale purchase prices for all antimalarial types and dosage forms, including the socially marketed first-line treatment, SérénaDose.

1. Introduction & Objectives

In the Democratic Republic of Congo (DRC), as in many low-income countries, private commercial providers play an important role in the treatment of malaria. To design effective interventions for improved access to accurate diagnosis and effective malaria treatment, there is a need to understand retailers' behaviour and identify the factors that influence their stocking and pricing decisions. Private commercial retailers are the last link in a chain of manufacturers, importers and wholesalers, and their supply sources are likely to have an important influence on the price and quality of malaria treatment that consumers can access. However, there is limited rigorous evidence on the structure and operation of the distribution chain for antimalarial drugs that serves the retail sector.

This study aims to address this gap and constitutes an integral part of the ACTwatch project, a multi-country programme of research being conducted in the Democratic Republic of Congo, Benin, Cambodia, Madagascar, Nigeria, Uganda and Zambia. The overall goal of ACTwatch is to generate and disseminate evidence to policy makers on artemisinin-based combination therapy (ACT) availability and price in order to inform the development of policies designed to increase rates of access to effective malaria treatment. Along with the Supply Chain Study, the ACTwatch project also includes Outlet and Household Surveys led by PSI and L'Association de Santé Familiale (ASF) in the DRC.

The objective of the Supply Chain component of ACTwatch is to document and analyse the supply chain for antimalarials and rapid diagnostic tests (RDTs) for malaria using quantitative (structured survey) and qualitative (in-depth interviews) methods for studying providers operating at each level of the chain. This report presents the results of the structured survey of antimalarial drug wholesalers conducted in the DRC between January and March 2010. In order to provide a complete description of the supply chain for antimalarial drugs, the report also presents retail-level data on antimalarial purchase prices and mark-ups that were collected during the second ACTwatch Outlet Survey conducted by PSI and ASF/DRC between August and October 2009.

2. Country Background

Social and Economic Profile

The DRC is located in central Africa and is the second largest country by area on the continent. The first Republic of Congo was formed in 1960 upon gaining independence from Belgium; however since then, the country has experienced several name changes and incarnations of the republic – the current being the 3rd Republic. The centre of the DRC is a vast low-lying river basin exhibiting a hot and humid tropical climate. The basin experiences a long rainy season that lasts 8 to 10 months per year, with around 2m of rainfall per year and an average temperature of 26°C. To the east of the DRC mountains rise up from the river valley and the climate is cooler and wetter. In 2009 the population was estimated at 71.7 million, making it the fourth most populous country in Africa. [2] Approximately 20% of the population is under five years of age [3], and 40% of households are located in urban areas. [4] Administratively the DRC is divided into 11 provinces and 45 districts. The official language is French, with Kikongo, Lingala, Tshiluba and Swahili recognised as national languages. The country's modern history has been turbulent and in 2003 the DRC emerged from nearly a decade of civil war; however, there is continuing violence in the east of the country and an estimated 2 million people remain displaced by the conflict. [5]

Although more than 70% of economic activity in the DRC is in the agriculture and service sectors, economic growth has largely been driven by industrial activity, particularly in mining. In 2009, the economy grew by 2.9% compared to 7.2% in 2010 and 6.5% in 2011, partly due to the global recession but also to fluctuations in global market prices for the DRC's key mineral exports in 2009. [2] But despite the vast natural wealth, the country remains poor with 2009 per capita gross domestic product (GDP, adjusted for purchasing power parity) estimated at US\$ 300 – although this is based on a GDP value that excludes exchanges in the substantial informal economy – and a high degree of income inequality, with more than a third of the nation's wealth belonging to the richest 10% of households. [2] An estimated 80% of the population live on less than US\$1 a day and the country was ranked 176 out of 182 countries according to the 2009 Human Development Index. [6] Life expectancy in 2009 was under 55 years [2], and it is estimated that one in seven children die before reaching their fifth birthday. [4] These poor social conditions are exacerbated by the poor state of public infrastructure, particularly in transport and communication. Some parts of the country are considered to be unreachable, and transport in many rural areas is provided solely through private services. [7]

Health System

The health system has suffered from years of civil war and chronic underinvestment, and the government currently has limited capacity to rebuild the social sector. The health sector in the DRC is largely unregulated and scant up-to-date information exists regarding the public and private sectors. The public sector is built around the health zone (*zone de santé*), an administrative area that typically covers a population of 100,000 in rural areas and 150,000 in urban areas. Each health zone is organized around a central office (*bureau central de zone de santé*, BCZS), which includes a general referral hospital, and is further divided into health areas (*aires de santé*) where health centres operate. There are currently more than 6000 health centres offering a basic package of services scattered across 515 health zones across the country. [8] In 2009, government expenditure on health was estimated at 2% of GDP. [9] In line with the 1987 Bamako Initiative principle of community participation, public sector patients are charged user fees for almost all aspects of their health visit, from consultation and diagnostic tests to medicines, and the revenues generated are used to fund the day-to-day operations of health providers. There is no regulation of the amounts charged and fees are set at the level of the health centre or hospital.

The public health sector is characterized by low utilisation rates (providing care for as little as 30% of reported illnesses [10]); while the private sector, including private not-for-profit services provided by non-governmental organisations (NGOs) and faith-based organisation (FBOs), is estimated to provide 60% of the health services used by the population. [11] The majority of the NGO and FBO services are provided with external donor support, creating a fragmented system as each donor and partner works in specified health zones. Under this model, 391 of the 515 health zones are reported to have a partner providing malaria services, leaving 24% of health zones unsupported. [11]

Pharmaceutical Sector

There are several legislative and regulatory instruments governing the pharmaceutical sector in the DRC, with the earliest remaining in effect since 1933; although there have been several revisions and updates to regulations, most recently in 2009 with the assistance of Management Sciences for Health (MSH), USAID and WHO. The pharmaceutical regulatory authority in the DRC is the *Direction de la pharmacie, médicaments et plantes médicinales* (DPM), a section within the national Ministry of Health, which is responsible for the registration of pharmaceutical products for sale on the market inspection of premises; granting of licenses to pharmaceutical enterprises; promotion of generic medicines and local manufacturing; oversight of the

marketing of pharmaceutical products; regulation of controlled substances, veterinary, cosmetic and dietary products; pharmacovigilance, quality assurance and control; maintenance of the national formulary and pharmacopoeia; and regulation of prices at manufacturing, wholesale and retail levels. [12] However, the DPM does not actively exercise its power to regulate pharmaceutical prices. Registration of pharmacists is overseen by the Order of Pharmacists (*L'Ordre des Pharmaciens*), of which there were 1144 in 2008. [13] The DPM issues different licenses and authorisations to enterprises for the manufacture, import, wholesale, and retail of pharmaceuticals, which do not have an expiration date. Each type of pharmaceutical business must employ a full-time pharmacist with current registration and must also possess a trading license (*registre de commerce*). Within retailing, regulations define two types of enterprises: private pharmacies (*officines*), and facility/hospital pharmacies (*pharmacies internes/ hospitalières*); and within wholesaling, there are wholesalers (*établissements de vente en gros*), distribution centres (*centrales de distribution*) and centralised purchasers (*centrals d'achats*), the last two typically functioning as state-run or parastatal agencies. In practice, the distinction between wholesalers and distribution centres is not enforced, as evidenced by the March 2010 official list of authorised pharmaceutical wholesalers in the DRC, which only identifies 2 centralised purchasers from a total of 113 wholesaling establishments (it is also notable that 76 of these were located in Kinshasa). [14] In addition, there were 22 domestic pharmaceutical manufacturers registered with the DPM in 2008, with nearly as many producing antimalarial products. [13] Quinine is one of the DRC's main agriculturally derived products, much of which is exported [2], but a broad range of antimalarials are domestically produced, including several AMT and ACT products.

In the public sector the procurement and distribution of most medicines is coordinated through SNAME (*Système National d'Approvisionnement en Médicaments Essentiels*), where two national-level procurement agencies, BCAF (*Bureau de Coordination des Achats*) in Kinshasa and ASRAMES (*Association Régionale pour Approvisionnement en Médicaments Essentiels*) in Goma, purchase according to the national pharmaceutical policy and distribute to provincial-level via 15 regional distribution centres. Medicines then flow through the existing hierarchy of public health facilities (i.e. general referral hospitals and central offices to health centres) to finally reach patients. [7] A number of bilateral, multilateral, non-governmental, and faith-based organisations also procure and distribute pharmaceuticals in the DRC. Some of these pharmaceuticals are distributed through the existing public system; however, much of these are distributed through verticalised programme- or organisation-specific channels, creating a highly fragmented system. To demonstrate, one detailed study of the pharmaceutical supply system in the DRC conducted in 2009 identified 52 non-state organisations involved in the medicine supply system, of which 17 were procuring and 38 were stocking/distributing medicines using structures running parallel to the existing public system. [7] Much less is known about distribution in the private for-profit sector; however, it is generally accepted that lack of funding and capacity at the DPM has allowed the private sector to operate largely unregulated. [7, 11, 15] At retail level, medicines are distributed to patients through private pharmacies and health facilities, many of which are operated by NGOs and FBOs. Pharmaceuticals are also distributed through the informal sector (also called the parallel market), where products may be illegally imported, sold through unauthorised channels, leaked from the formal sector, or are counterfeits. [16]

Malaria Epidemiology

Malaria is one of the leading causes of mortality in DRC and the country has one of the highest malaria burdens in Africa: malaria accounts for an estimated 40% of outpatient visits by children under five, and 40% of all-cause under-five mortality. [11] Nearly 8 million suspected malaria cases were reported in 2009 [17],

and estimated annual deaths from malaria are on the order of 140,000¹. [18] Given reporting completeness of less than 70% for outpatient health facilities, coupled with the fact that many people do not seek care for illness at a formal health facility or receive parasitological confirmation, there is some uncertainty about true burden of malaria-related morbidity and mortality.

Virtually all of the population (97%) live in areas with stable, perennial malaria transmission (with seasonal peaks in the country's tropical zone) while the remaining 3% live in areas with unstable malaria. The mountainous regions in the east of the country, including parts of Katanga, the Kivus and Ituri, are generally considered unstable and at risk of malaria epidemics. *Plasmodium falciparum* is the predominant parasite species, responsible for 95% of infections. [8] In mid-2007, the country adopted a new national malaria control plan (*Faire Reculer le Paludisme Plan Strategique 2007–2011*) that encompasses the main WHO-recommended malaria control interventions. The challenge is to operationalise the plan across the country's 11 provinces given the large distances involved, poor infrastructure, limited capacity and financial resource constraints.

Malaria Control

The core interventions for malaria control in the DRC include long lasting insecticide-treated net (LLIN) distribution through antenatal care clinics and immunisation visits, universal campaigns, and subsidised and at-cost sales in the private sector; Intermittent Preventive Treatment of malaria (IPT) for pregnant women; and case management at all levels of health care. Indoor residual spraying (IRS) plays a very minor role in malaria control and is currently only practised by mining companies in select health areas in Katanga. As of August 2010 tariffs apply to all antimalarial commodities imported into the DRC (bednets, antimalarials, RDTs, IRS insecticides and pumps). [19] Figures from 2007 estimate that 9% of households owned at least one insecticide-treated net (ITN) and 6% of children under five slept under an ITN the previous night. Between 2007 and 2009 over 15 million LLINs were distributed in DRC, following the national malaria control plan's approach of mass-distribution campaigns by province. [4] The first campaign was in Kinshasa in 2008-2009 and took the form of a stand-alone campaign distributing 2 million nets on the basis of 2 nets per household. Campaigns in Maniema and Orientale provinces followed in 2009.

Malaria Treatment and Diagnosis

In 2005, the national malaria control plan adopted artesunate-amodiaquine (ASAQ) as the first-line treatment for uncomplicated malaria. Quinine is the recommended treatment should the first-line treatment fail, and for the treatment of severe malaria. Sulfadoxine-pyrimethamine (SP) is used for IPT in pregnancy. The MOH introduced community case management guidelines in 2007, which included deployment of ACTs through trained community health workers. [20] As indicated above, the public health system relies on a cost-recovery model and antimalarial treatment is available to patients for a fee that varies across public health facilities. In the private sector, PSI and ASF introduced a socially marketed, pre-packaged ASAQ product for children, called SérénaDose, in 2007 and is distributed in nine urban centres through NGO partners, with the aim of increasing access to high-quality, effective treatment. However, recent studies suggest that the use of ACTs for treating malaria continues to be rare. According to the 2007 Demographic & Health Survey, less than one percent (0.6%) of children under five with suspected malaria were treated with ACT. [4] By 2010, the ACTwatch Household Survey found that this had only risen to 4.5%. [21]

¹ Based on an estimated 193 malaria deaths per 100,000 population (2008 estimate).

Although the policy change to ACT occurred in 2005, it was not until 2006 that implementation began and scale-up has been slow. It was expected that ACTs would be available and in use in the 395 health zones supported by an external partner during 2009. [11] The 2009 ACTwatch Outlet Survey found that ACTs were available in 85.3% of public health facilities, 72.2% of private not-for-profit health facilities and 100% of registered pharmacies; however, availability of ACTs in other types of private for-profit outlets was considerably lower: 30.2% in for-profit health facilities and 56.1% in drug stores (i.e. unlicensed pharmacies). [1] Poor ACT uptake has been blamed on the difficulties in tracking ACT requirements given the fragmented supply system and poor reporting of consumption data, and anecdotal evidence of side-effects from the amodiaquine component of the drug. Also, there is a general belief among donors and partners that the government has not done enough to promote the policy change and raise awareness among healthcare providers and the general public. Findings from the 2010 ACTwatch Household survey support this as although 42.7% of children under five with fever were treated with an antimalarial, only 3.0% took ASAQ. [21]

A law banning the distribution and sale of oral artemisinin monotherapies (AMTs) was passed in 2007; however, anecdotal evidence suggests that enforcement of the ban did not begin nationwide until June 2009. [22] The ACTwatch Outlet Survey conducted between August and October 2009 found that oral AMTs were being stocked by 10.3% of public facilities, 13.8% of private for-profit facilities, 74.0% of pharmacies and 47.4% of informal drug stores. [1] Regarding diagnosis, the 2007 policy is quite narrow, restricting its focus to treatment failure and complicated malaria. At the peripheral level there is generally no diagnostic capacity and suspected malaria cases are treated based on clinical signs. At the referral level, the guideline states that laboratory confirmation is obligatory where there is no response to first-line treatment of clinically diagnosed malaria and for complicated malaria cases. The 2009 ACTwatch Outlet Survey found that 81% of public and not-for-profit health facilities had any diagnostic blood testing available, and a similar proportion (80%) of private for-profit facilities also had such testing facilities available; however, it was more common to find microscopy services rather than RDTs in each type of facility. Almost none of the other types of private sector outlets were found to have diagnostic testing services available. [1]

Malaria Financing

Malaria control is largely financed by external donors and has grown substantially since 2005, including funding for ACTs. Key donors are the World Bank, the US President's Malaria Initiative (PMI), and the Global Fund to Fight AIDS, Tuberculosis and Malaria. The government of the DRC contributes around US\$ 2 million annually to combat malaria. The DRC secured a US\$ 53.9 million Round 3 grant from the Global Fund which ran until mid-2009 and provided ACTs to approximately 25% of health zones in the country. Through a World Bank Malaria Booster grant (US\$ 130 million over 5 years), the DRC is receiving a further 6.6 million ACT treatments. The World Bank is currently providing treatments to 31% of health zones in the country. USAID provided approximately US\$ 7 million annually through the AXxes Project (2007-2009) which included ACTs for 57 health zones in 4 provinces. USAID/PMI funding increased from US\$ 15 million in 2009, to US\$ 18 million for 2010 and US\$ 37 million announced for 2011. The PMI plan includes increasing the number of health zones supported from 80 to 112 across 4 provinces. From 2008 to 2010, African Development Bank funding covered ACT procurement for 26 health zones in eastern DRC. At the same time, UNICEF is covering the ACT requirements of 40 health zones across the country.

3. Methods

3.1. *Scope of the supply chain survey*

The Supply Chain structured survey was conducted amongst wholesalers who operated in the private commercial distribution chain that served the antimalarial drug retailers described in the first round of the ACTwatch Outlet Survey conducted in 2008 by PSI and ASF. [23] The term 'private commercial sector distribution chain' refers to any type of supplier (public or private) who served private commercial outlets as well as private suppliers who served public and NGO/FBO outlets. This allows any transactions between public, NGO/FBO and private commercial sectors to be noted. Public suppliers of public outlets are, however, not included because much more is already known about the structure of the public sector chain compared to that of the private commercial sector. The focus is on suppliers who operate from the point where commodities leave the factory gate or port of entry down to those directly supplying retailers. See Figure 3.1 for a representation of the wholesale supplier interactions that are captured by the Supply Chain survey.

The Supply Chain survey explored the distribution chain for antimalarials, comprising artemisinin-combination therapy or ACT (e.g. artesunate-amodiaquine), artemisinin monotherapies or AMT (e.g. artesunate, artemether) and non-artemisinin therapies or nAT (e.g. chloroquine, quinine), and including all formulations (tablets, syrups, injectables, etc.), whether they are used for inpatient or outpatient care. It excluded complementary products, such as drips, water and syringes. It also explored the availability, sales volumes, and mark-ups on RDTs sold in the distribution chain under study, but excluded microscopy services. The latter were excluded because of the wide range of different products used in providing microscopy services and the problems in distinguishing those used for malaria diagnosis from those with other purposes.

The structured survey was cross-sectional and collected data on the structure of the private commercial sector supply chain for antimalarial drugs, wholesaler characteristics and business practices, wholesale outlet licensing and inspection, wholesaler knowledge, qualifications and training; and wholesale availability, purchase prices and mark-ups for antimalarials and RDTs. In order to provide a complete description of the distribution chain for antimalarial drugs, the report also presents retail-level data on antimalarial purchase prices and mark-ups that were collected during the second ACTwatch Outlet Survey conducted by PSI and ASF between August and October 2009.

3.2. *Sampling & data collection procedures*

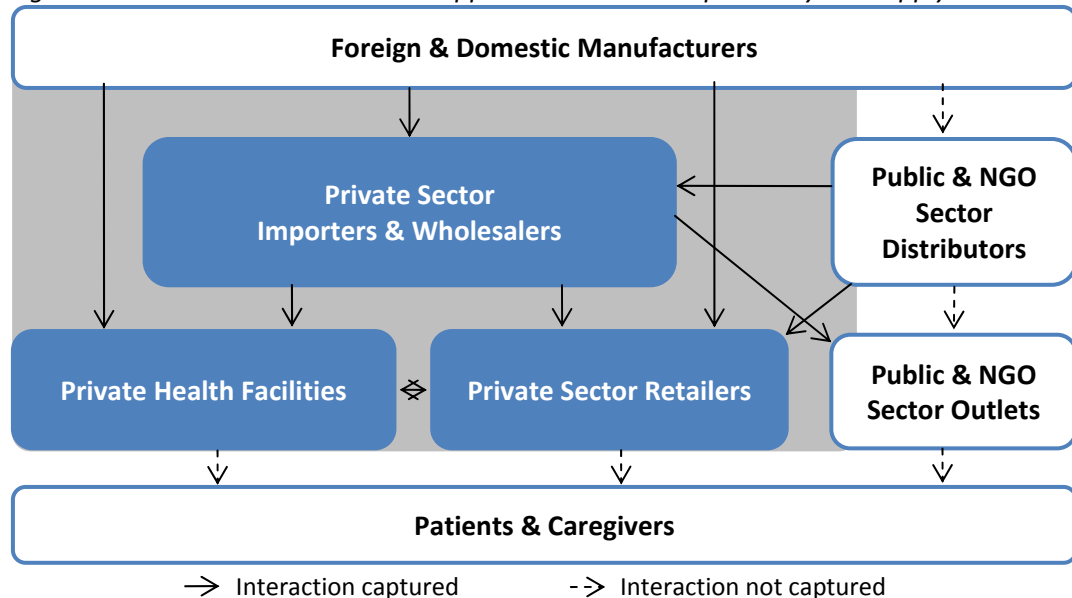
3.2.1. *Overview of sampling and data collection during the ACTwatch Outlet Survey*

For the purpose of the first ACTwatch Outlet Survey, the DRC was divided into 4 geographically-defined strata: North East, North West, Centre South, Kinshasa. In each stratum, 19 sub-districts were randomly sampled using a probability proportional to size (PPS) approach through which more populated sub-districts had a higher chance of being selected. Sub-districts corresponded to the administrative unit determined by the Ministry of Health known as health areas (*aires de santé*), each hosting a population size of approximately 10,000-15,000 inhabitants. In each sub-district, a census of all public and private outlets that had the potential to sell or distribute antimalarials was conducted and outlets that stocked antimalarials at the time of the survey or in the past 3 months were invited to participate in the Outlet Survey. In order to estimate indicators across different outlet types, this sample was supplemented by a booster sample, which is a common procedure across all ACTwatch outlet surveys to ensure adequate representation of relatively

rare but important antimalarial provider types. This report presents indicators on retail-level mark-ups and prices paid to wholesalers to purchase antimalarials using data from the 2009 ACTwatch Outlet Survey, which targeted public health facilities, pharmacies and drug stores for the booster sample. The booster sampling approach for the 2009 Outlet Survey was dependent on the characteristics of each of the 76 health areas selected for the main survey. If a selected health area contained the central office for the larger health zone then no booster sample was taken for this health area. If a selected health area did not contain the central office for the larger zone, then the health area containing the zone’s central office was enumerated for the booster sample outlet types. In the Centre South strata, 12 booster health areas were enumerated in addition to the 19 selected health areas; in Kinshasa, 18 additional booster health areas were enumerated; in the North East, 5 additional booster health areas were enumerated; and in the North West strata, 8 additional booster health areas were enumerated.

The first Outlet Survey was conducted in the sampled sub-districts and booster districts by PSI and ASF between September and November 2008, with a second outlet survey conducted between August and October 2009. The Outlet Surveys collected data on antimalarial drug availability, sales volumes and selling prices, retail outlet and shopkeeper characteristics (antimalarials stocked, other drugs stocked, number of staff, education, health-related qualifications, registration status, GPS co-ordinates) as well as other areas of importance for the Supply Chain Survey, including each retailer’s two top supply sources for antimalarials (name, location, provider type, whether they distribute, collect or both) and antimalarial wholesale purchase prices.

Figure 3.1: Antimalarial wholesale supplier interactions captured by the Supply Chain Study



3.2.2. Sampling and data collection procedures for the ACTwatch Supply Chain survey

The Supply Chain survey was implemented by LSHTM, with support from PSI and ASF, after the first round of the Outlet Survey, from January to March 2010. A random sample of 32 sub-districts from the Outlet Survey’s 76 sampled sub-districts (8 from each of the 4 strata) was used to create a list of all antimalarial wholesale sources mentioned by retailers as their two top antimalarial wholesale sources (termed the “terminal wholesalers”) during the Outlet Survey administered by PSI and ASF.² All these terminal

² Supply sources for outlets that were sampled as part of the outlet survey booster sample were excluded.

wholesalers that could be located were visited and invited to participate in the Supply Chain survey. Wholesalers were eligible to participate if they met the following screening criteria: they had either an antimalarial or RDT in stock at the time of interview, or they reported having stocked either antimalarials or RDTs in the three months prior to interview. During the interview, eligible wholesalers were also asked about their top two supply sources for antimalarials (termed the “intermediate-1” wholesalers). From these data, we created a list of all intermediate-1 wholesalers mentioned. All these intermediate-1 wholesalers were visited and invited to participate in the Supply Chain survey, during which, as at previous levels, they were asked about their top two supply sources for antimalarials (termed the “intermediate-2” wholesalers). This process was repeated until the factory gate or port of entry was reached. Some domestic antimalarial manufacturers also import other antimalarial products or sell antimalarials produced by other domestic manufacturers.³ In these cases, domestic manufacturers were treated as wholesalers for these products, and as such were included for interview.

The Supply Chain Survey used an information sheet, a consent form, a provider questionnaire, and antimalarial and RDT inventory sheets. All data collection tools were provided in French, piloted by members of the research team, and further revisions were made to adapt the tools to the specificities of the Congolese context. Before each interview, trained interviewers sought to speak with the most knowledgeable person about their antimalarial/RDT wholesale business. They informed respondents about the study by providing the information sheet in French. Interviewers stated their name, the institutions involved, aims of the study, nature of questions to be asked and length of the interview. Each respondent was given the opportunity to ask questions at any time before, during and after the interview, and received the contact details of the local research coordinator. Interviewers then invited respondents to participate in the study and obtained oral consent, witnessed by a member of the research team. Interviewers emphasised that individual information was confidential and that no information would be passed on to regulatory authorities or competitors.

The provider questionnaire was used for collecting data on each wholesale business’s characteristics and operations and on the wholesalers’ top two supply sources for antimalarials and RDTs. Inventory sheets were used for collecting data for each antimalarial/RDT stocked, on brand name, generic name and strengths (for antimalarials), package type and size, recall of volumes sold over the week before the survey, recall of last purchase value and selling and purchase prices. The Supply Chain component of the ACTwatch study received ethical approval from the *Comité d’Éthique de l’École de Santé Publique de l’Université de Kinshasa* and the LSHTM ethics review committee.

³ These types of transactions between manufacturers were described during in-depth interviews with stakeholders active within the distribution chain conducted alongside the structured survey. Findings from these interviews are presently unpublished. In addition, there may be horizontal trading at other levels of the distribution chain, for example if a terminal wholesaler purchases their antimalarial drugs from another wholesaler who has also been identified from the outlet survey as a terminal wholesaler. Where these relationships were identified at the wholesale level the supply chain survey was not administered again to this wholesaler, though the relationship was noted and accounted for in the analysis. However, in the case where horizontal trading is identified at the retail outlet level (for example, a retailer identifies another retailer as the source of their antimalarials), the supply chain survey was administered to the source of supply, even if they have already filled in the outlet survey instrument, because the questions asked were different.

3.3. Data analysis

3.3.1. Classification of outlets

A challenge in the analysis of wholesalers is their classification into sub-groups, as in practice many operate at several levels of the distribution chain. We have taken 2 approaches:

- To describe the structure of the chain, wholesalers were classified into mutually-exclusive categories (MECs) defined by the levels they supplied, for example, wholesalers supplying retailers only, wholesalers supplying retailers and terminal wholesalers only, and wholesalers supplying intermediate and terminal wholesalers only.
- For analytical purposes, wholesalers were grouped into 2 broader and overlapping categories: one including wholesalers supplying retailers and one for wholesalers supplying wholesalers. Some wholesalers may therefore be included in both analytical categories. This second approach for classifying wholesalers addresses the issue of individual MECs including very few wholesalers. Furthermore, this approach reflects the actual operations of the distribution chain.

In order to get a complete picture of the distribution chain for antimalarial drugs, data relevant to the retail level are also presented for 5 mutually exclusive categories of retailers: pharmacies (registered), private health facilities (including both for-profit and not-for-profit), drug stores (unregistered), general retailers (boutiques, shops, kiosks, market stalls, etc.), and public health facilities. See appendix 6.2 for descriptions of the type of retailers included in these categories.

3.3.2. Calculation of sales volumes

Antimalarial volumes and price data are reported for 5 dosage forms, namely tablets, oral liquids, injectables⁴, suppositories and granules; and 3 antimalarial categories⁵ namely artemisinin-based combination therapy (ACT), artemisinin monotherapies (AMT) and non-artemisinin therapies (nAT). ACTs were further sub-divided into WHO-prequalified ACT and non-WHO-prequalified ACT.

Antimalarial volumes were calculated on the basis of an adult equivalent treatment dose (AETD). An AETD was defined as the number of milligrams (mg) of an antimalarial drug needed to treat a 60 kg adult (refer to Appendix 6.3 for data used during calculation of AETDs). The number of mg/kg used to calculate one AETD was defined as what was, at the time of the study, recommended for a particular drug combination in the treatment guidelines for uncomplicated malaria in areas of low drug resistance issued by the WHO. Where WHO treatment guidelines did not exist, AETDs were based on product manufacturers' treatment guidelines. In the case of ACTs as the treatment consists of 2 or more active antimalarial ingredients packaged together (either co-formulated or co-blistered), the strength of the artemisinin-based component was used as the principal ingredient for the AETD calculations. Information collected on both the medicine strength and unit size, as listed on the product packaging, was then used to calculate the number of AETDs contained in each unit. The median number of antimalarial doses reported to have been sold during the week preceding the survey was estimated for each antimalarial category for each wholesaler category. Estimates were calculated by first summing the number of AETDs sold for the different antimalarial categories at each wholesale outlet and then by taking the median across the wholesaler category. Similar estimates were made for RDT sales volumes in each wholesaler category.

⁴ Liquid and powder injectables form a single category.

⁵ Antimalarial drugs intended for prophylaxis and drug combinations not used to treat malaria but that contain an ingredient with antimalarial action were excluded from analysis.

For wholesale outlets that stocked antimalarials/RDTs and for which some or all sales volumes were missing, missing values were imputed using the STATA 11 command *mi impute pmm*⁶. For wholesale outlets with no antimalarials of a given category in stock at the time of the survey, sales volumes over the past week were assumed to be null. For wholesale outlets without information about the type of antimalarials stocked (because of refusals to participate in the study or to provide information on the type of antimalarials stocked or because of interrupted interviews), sales volumes were treated as missing. In the case of an outlet not stocking antimalarials, sales volumes were set to zero.

3.3.3. Calculation of purchase prices and mark-ups

Wholesale purchase prices and mark-ups were calculated using data collected during the ACTwatch Supply Chain Survey. Because it is common for wholesalers to vary their prices with the volumes they sell, minimum, mid-point and maximum mark-ups were calculated using data on maximum and minimum selling price charged for one unit by wholesalers. The wholesale maximum percentage mark-up was calculated as the difference between the highest wholesale selling price (that is the price of the minimum volume sold wholesale) and the wholesale purchase price, divided by the wholesale purchase price. The wholesale minimum mark-up was calculated as the difference between lowest wholesale selling price (that is the minimum price charged for wholesale sales) and wholesale purchase price, divided by wholesale purchase price. The wholesale percent mid mark-up was calculated as:

$$\frac{(((\text{highest selling price})+(\text{lowest selling price}))/2) - (\text{wholesale purchase price})}{(\text{wholesale purchase price})}$$

Retail purchase prices and mark-ups were calculated using price data collected during the 2009 ACTwatch Outlet Survey. When calculating summary estimates for purchase prices and mark-ups, there was a need to weight outlet survey data to allow for (a) the difference in sampling probabilities due to variation in the size of strata, (b) the oversampling for the booster, and (c) the sampling strategy which involves a census of retail outlets in the sub-districts of varying size selected using PPS. Stratum-specific weights were calculated for each sub-district sampled in each of the four strata. Appendix 6.4 describes the weighting calculations.

Retail percentage mark-ups were calculated for each product as the difference between selling price and purchase price, divided by purchase price. For both retail and wholesale observations, absolute mark-ups per AETD were calculated for each product as selling price minus purchase price. Data were collected in local currencies and converted to their US\$ equivalent using the average interbank rate during the data collection period.⁷

3.3.4. Summary measures

Indicators are reported using proportions or for continuous variables, the median and inter-quartile range (IQR), which are relevant for describing distributions likely to be skewed. Given that for analytical purposes, wholesalers were classified into overlapping categories (i.e. wholesalers supplying retailers and wholesalers supplying wholesalers), it was not possible to conduct statistical tests of difference between the 2 groups.

⁶ A technique used for imputing missing values of one continuous variable whose distribution is skewed. Missing values (e.g. in the case of an outlet stocking antimalarials and with the antimalarial type identified in the audit sheet but for which sales volume data were missing) were imputed using covariates related to provider/outlet and product characteristics. Five imputations were conducted and their mean imputed to the missing values.

⁷ Outlet Survey data collection took place between 10 August and 27 October 2009 and an average exchange rate of 1 US\$ to 823.7952 Congolese francs during the data collection period was used for the calculation of retail absolute mark-ups. Supply Chain Survey data collection took place between 11 January to 17 March 2010 and an average exchange rate of 1 US\$ to 899.482 Congolese francs during the data collection period was used for the calculation of wholesale absolute mark-ups. Historical exchange rates averaged over the specified periods were obtained from <http://www.oanda.com/currency/historical-rates>.

4. Results

4.1. *Overview of the sample*

A total of 165 supply sources were mentioned by retailers sampled in the 32 selected Outlet Survey sub-districts. Of these, 18 (10.9%) were found to be duplicate wholesale businesses already identified in the supplier list following further investigation during field work, 8 (5.0%) could not be located using the information given and after advice was sought from local informants, 9 (5.5%) businesses were permanently closed, and 1 (0.6%) was not eligible as it did not meet the screening criteria of stocking antimalarials or RDTs at any point during the three months prior to interview. An additional 2 (1.8%) supply sources mentioned by retailers were manufacturers (which were not interviewed as they fell beyond the scope of the study) and 1 (0.6%) mention was discovered during fieldwork to be for a public outlet serving NGO health facilities; this outlet was not interviewed as it also fell beyond the scope of the study. Interviews were completed with all 126 eligible wholesalers invited to participate in the study. These wholesalers are called 'terminal wholesalers'.

All 126 terminal wholesalers were asked about their top two supply sources for antimalarials. From a total of 208 supplier mentions collected from terminal wholesalers, 25 referred to foreign manufacturers or suppliers, and 17 referred to local manufacturers (all of which fall beyond the scope of this study). The remaining 166 wholesaler mentions referred to 51 unique wholesale businesses, called intermediate-1 wholesalers as they supplied terminal wholesalers. Of these 51 identified intermediate-1 wholesalers, 35 had already been identified at the terminal level (as they also supplied retailers included in the Outlet Survey sample directly). As such, interviews were not re-administered to these 35 wholesalers. Of the remaining 16 newly identified intermediate-1 wholesalers, interviews were successfully administered to 12, 1 was partially administered, and 3 could not be located.

From the 48 intermediate-1 wholesalers interviewed (the 35 interviewed at terminal level and 13 newly interviewed), we obtained 73 total mentions for intermediate-2 wholesalers, of which 23 were foreign manufacturers or suppliers, and 5 referred to local manufacturers. The remaining 45 mentions referred to 15 unique wholesalers (also called intermediate-2 wholesalers), all of which had already been identified at previous levels.

These 15 intermediate-2 wholesalers produced a total of 21 mentions for intermediate-3 wholesalers, of which 9 were foreign manufacturers or suppliers, and 3 referred to local manufacturers. The remaining 9 mentions referred to 5 unique wholesalers (also called intermediate-3 wholesalers), all of which had already been identified at previous levels.

These 5 intermediate-3 wholesalers produced a total of 6 mentions for intermediate-4 wholesalers. All but one of these were foreign or local manufacturers, and the 1 remaining mention referred to a wholesaler that had already been identified and interviewed at a previous level. As this intermediate-4 wholesaler listed a local manufacturer as their sole antimalarial supplier, no new interviews were attempted at this level or beyond, and the top of the chain was deemed to have been reached, with a total of 161 wholesalers that sold antimalarials identified and 139 interviews completed (Table 4.1).

Table 4.1: Overview of the wholesalers sampled and interviewed

| Levels of operation | Initial Sample Size | Number identified at previous level(s) | Number of refusals | Number of duplicates ¹ | Number not eligible ² | Number not interviewed for other reasons ³ | Number not found | Number of interviews conducted ⁴ |
|-----------------------------|---------------------|--|--------------------|-----------------------------------|----------------------------------|---|------------------|---|
| Total | - | - | 0 | 18 | 1 | 10 | 11 | 139 |
| Terminal | 165 | - | 0 | 18 | 1 | 10 | 8 | 126 |
| Intermediate-1 | 51 | 35 | 0 | 0 | 0 | 0 | 3 | 13 |
| Intermediate-2 | 15 | 15 | 0 | 0 | 0 | 0 | 0 | 0 |
| Intermediate-3 | 5 | 5 | 0 | 0 | 0 | 0 | 0 | 0 |
| Intermediate-4 ⁵ | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |

1: Wholesalers included in the initial sample and found to be duplicates prior to data collection. 2: Outlets not stocking antimalarials or RDTs at the time of the interview or in the preceding 3 months. 3: At terminal level, 9 businesses were permanently closed and 1 was a public outlet serving NGO health facilities. 4: At intermediate-1, level 1 interview was partial and 12 were complete. 5: This is the top of the chain, defined as the level at which wholesalers who were reported to supply intermediate-3 wholesalers mentioned only manufacturers as top supply sources for antimalarials. In the ACTwatch protocol, this level was referred to as the primary level where wholesalers who receive supplies directly from manufacturers operated.

4.2. Structure of the private commercial sector distribution chain for antimalarials

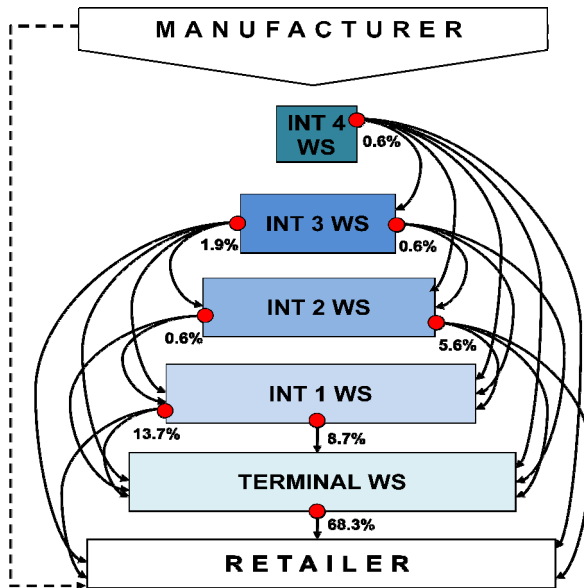
- The structure of the private commercial sector distribution chain for antimalarials in the DRC is depicted in Figures 4.2.1 and 4.2.2. In Figure 4.2.1, each red dot represents a mutually exclusive group of wholesalers which are defined by the specific supply chain levels that each wholesaler group serves (these interactions are shown by the array of arrows emanating from each dot). The relative size of each group is shown in the attached percentage. The dashed line from manufacturer to retailer indicates that a few retailers purchased antimalarials directly from manufacturers, although this was rare (1.8% of all suppliers mentioned by retailers were local drug manufacturers). Figure 4.2.2 depicts how wholesalers have been grouped into the overlapping analytical categories used throughout this report, while Table 4.2 shows how these analytical categories have been derived from the mutually exclusive categories depicted in Figure 4.2.1.
- The observed maximum number of steps from manufacturers' factory gate to retail outlet is 6: manufacturer → intermediate-4 wholesaler → intermediate-3 wholesaler → intermediate-2 wholesaler → intermediate-1 wholesaler → terminal wholesaler → retailer.
- Among all wholesalers surveyed, regardless of supply chain level, most (90.1%) were observed to sell directly to retailers, and two-thirds (68.3%) of all wholesalers sold only to retailers.
- A third (31.7%) of all wholesalers were observed to sell to other wholesalers, and a third of these supplied other wholesalers exclusively; the remaining two-thirds supplied both retailers and other wholesalers.
- Wholesalers serving the selected 32 Outlet Survey sub-districts were mostly located in large cities and towns throughout the country (Figure 4.2.3). Wholesalers supplying Outlet Survey retailers were distributed across 23 locations, with 47.0% in Kinshasa, 6.7% in Butembo, 6.0% in Lubumbashi, 5.2% each in Kisangani and Mbadanka, and 4.5% each in Matadi and Tshikapa. Wholesalers supplying other wholesalers were distributed across 10 locations, with more than half (60.4%) located in Kinshasa, 12.5% in Lubumbashi, 6.3% each in Bukavu and Matadi, and a further 4.2% in Goma.
- Transactions between sectors were observed at all levels of the antimalarial distribution chain. At outlet level, 12 of 33 mentions from public sector outlets were for private sector wholesalers, and 14 of 471 mentions from private sector outlets were for public, NGO or FBO sector suppliers, of which 10 mentioned public suppliers (such as *bureaux centraux*, hospitals, or *centrales de distribution*) and 4 mentioned NGO or FBO suppliers (ASF was mentioned by one retailer); 12 of these 14 mentions were collected from private health facilities and the remaining 2 were from drug stores. At wholesale level, ASF was mentioned as a top supplier by 2 private businesses: 1 mention each for the Bukavu and Mbadanka offices of ASF. In addition, 1 *centrale de distribution* interviewed mentioned a local manufacturer as a top supply source of antimalarials.

Table 4.2: Defining analytical categories from mutually exclusive wholesaler categories

| Wholesaler category | Total number identified | MUTUALLY EXCLUSIVE CATEGORY | | | | | | | | ANALYTICAL CATEGORY | |
|---------------------|-------------------------|-----------------------------|-------------------------------------|-------------------|-------------------|------------------------------|----------------------------------|--|---|---------------------|--------------------|
| | | Supplies int 1 & terminal | Supplies int 1, terminal & retailer | Supplies retailer | Supplies terminal | Supplies terminal & retailer | Supplies int 2, int 1 & terminal | Supplies int 2, int 1, terminal & retailer | Supplies int 3, int 2, int 1, terminal & retailer | Supply Retailers | Supply Wholesalers |
| % of WS | 100% | 0.6% | 5.6% | 68.3% | 8.7% | 13.7% | 0.6% | 1.9% | 0.6% | 90.1% | 31.7% |
| (N) | (161) | (1) | (9) | (110) | (14) | (22) | (1) | (3) | (1) | (134) | (48) |

WS: wholesaler, int: intermediate wholesaler
 Note: this table presents the number of wholesalers identified which exceeds those interviewed

Figure 4.2.1: Representation of the antimarial distribution chain showing interactions between supply chain levels by mutually exclusive wholesaler category



WS: wholesaler; INT: intermediate

Figure 4.2.2: Representation of the antimarial distribution chain showing the overlap between wholesaler categories used for analysis

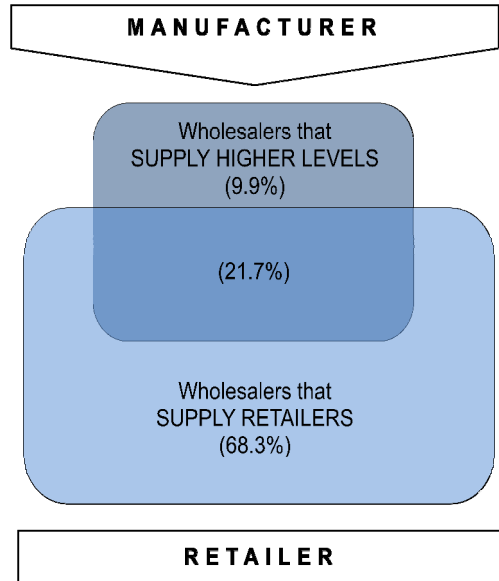


Figure 4.2.3: Locations of antimalarial wholesalers serving public and private sector outlets surveyed in the 32 selected ACTwatch Outlet Survey sub-districts

- Locality where wholesalers supplying retailers were identified
- Locality where wholesalers supplying wholesalers were identified
- △ Locality where wholesalers supplying both retailers and wholesalers were identified

4.3. Wholesaler characteristics and business practices

4.3.1. Years in operation, outlet size and range of products sold

- Wholesalers had been in operation for a median of 7 years; however, this varied considerably (IQR 4-13 years). Wholesale businesses also ranged in size with those supplying retailers having a median of 8 workers (IQR 3-12) and those supplying other wholesalers a median of 12 workers (IQR 9-20).
- More wholesalers that supply retailers (40.5%) sold other products alongside pharmaceuticals than wholesalers supplying other wholesalers (29.2%). The most common consumer products sold by wholesalers were toiletries (38.1% of all wholesalers), and very few wholesalers sold other types of consumer goods. For example, less than 5% of all wholesalers sold household goods, mobile air time, cigarettes and food. Of the wholesalers that sold other products, nearly all (97.8%) reported selling more pharmaceutical products than any other product category.
- On the other hand, many wholesalers sold complementary health products: 89.2% of all wholesalers sold medical supplies, 64.0% sold family planning products, and 32.4% sold bed nets.

Table 4.3.1: Years in operation, outlet size and range of products sold

| CHARACTERISTICS | | WHOLESALER CATEGORIES | | |
|--|---------------|-----------------------|--------------------|------------------|
| | | ALL WHOLESALERS | SUPPLY WHOLESALERS | SUPPLY RETAILERS |
| Years in operation | Median | 7 | 8 | 7 |
| | IQR | 4-13 | 6-14 | 4-13.5 |
| | (N) | (133) | (46) | (120) |
| Number of people working at outlet | Median | 9 | 12 | 8 |
| | IQR | 4-12 | 9-20 | 3-12 |
| | (N) | (138) | (48) | (125) |
| Sells other products in addition to pharmaceuticals ¹ | % | 38.9 | 29.2 | 40.5 |
| | (N) | (139) | (48) | (126) |

IQR: Inter-quartile Range; 1: other products included toiletries, household goods, mobile air time, cigarettes, groceries and/or prepared food

4.3.2. Wholesalers' customers, delivery activities and credit facilities

Customer types

- Wholesalers mentioned a broad range of antimalarial customer types in both private and public sectors, and at different levels of the distribution chain; however, the most frequently mentioned customers were enterprises specialised in the dispensing or selling of medicines. Among all wholesalers, 88.5% sold antimalarials to both licensed and unlicensed pharmacies, 86.3% to private health facilities, 79.1% to public health facilities, and 59.7% to other pharmaceutical wholesalers. In contrast, 21.7% of all wholesalers sold antimalarials to general wholesalers, 30.1% to general retailers, and 38.1% sold antimalarials directly to patients; only 4.3% mentioned selling antimalarials to other customers, including NGOs, FBOs, and national procurement agencies, such as FEDCAME.
- More wholesalers supplying retailers compared to those supplying other wholesalers reported selling antimalarials to retail customers (40.5% vs. 12.5%).
- Conversely, a higher proportion of wholesalers supplying other wholesalers compared to those supplying retailers reported selling antimalarials to public health facilities (91.7% vs. 78.6%), private health facilities (93.8% vs. 86.5%), other pharmaceutical wholesalers (87.5% vs. 56.4%), and to customers in other countries (56.3% vs. 36.8%).
- Of those who reported selling antimalarials to customers in other countries, 69.8% had customers in Angola, 60.4% in the Republic of Congo (Brazzaville), 13.2% in Zambia, 11.3% in Cameroon, 9.4% Rwanda, 7.5% Tanzania and 3.8% in the Central African Republic.

Business practices

- Compared to wholesalers supplying retailers, more wholesalers supplying other wholesalers reported importing antimalarials (45.8% vs. 27.8%), having a manufacturer as a top supplier of antimalarials (45.8% vs. 25.2%) and having a foreign supply source as a top supplier of antimalarials (33.3% vs. 9.7%).
- Of those wholesalers that mentioned a foreign supplier as a top source of antimalarials, 80% reported a supplier based in India, 10% in China, and another 10% in Belgium.
- Less than a quarter (23.0%) of all wholesalers reported delivering antimalarials to their customers; but more of the wholesalers supplying other wholesalers delivered compared to those supplying retailers (31.3% vs. 21.4%).
- Vertically integrated wholesale businesses were observed in 14 instances, where local manufacturers, importers or large distributors establish and supply subsidiary distribution points in different parts of the country.
- A third (35.5%) of all wholesalers interviewed had offered credit to customers in the past 3 months, offering a median of 30 days credit (IQR 10-30).

Table 4.3.2: Wholesalers' Customers, Delivery Activities and Credit facilities

| ANTIMALARIAL CUSTOMER TYPES | | WHOLESALER CATEGORIES | | |
|---|-----------------------------|----------------------------|----------------------------------|-----------------------------|
| | | ALL WHOLESALERS | SUPPLY WHOLESALERS | SUPPLY RETAILERS |
| Retail Customers (e.g. patients, care-takers) | % (N) | 38.1 (139) | 12.5 (48) | 40.5 (126) |
| Retail Outlets | | | | |
| Pharmacies (formal and informal/drug stores) | % (N) | 88.5 (139) | 89.6 (48) | 88.1 (126) |
| General retailers (boutiques, kiosks, etc.) ¹ | % (N) | 30.1 (133) | 30.4 (46) | 31.2 (122) |
| Public clinics, health centres or hospitals | % (N) | 79.1 (139) | 91.7 (48) | 78.6 (126) |
| Private clinics, health centres or hospitals | % (N) | 86.3 (139) | 93.8 (48) | 86.5 (126) |
| Wholesale Outlets | | | | |
| Drug wholesalers | % (N) | 59.7 (139) | 87.5 ² (48) | 56.4 (126) |
| General wholesalers ¹ | % (N) | 21.7 (138) | 27.7 (47) | 21.4 (126) |
| Customers in Other Countries | % (N) | 38.4 (138) | 56.3 (48) | 36.8 (125) |
| BUSINESS PRACTICES | | ALL WHOLESALERS | SUPPLY WHOLESALERS | SUPPLY RETAILERS |
| Import antimalarial drugs | % (N) | 30.2 (139) | 45.8 (48) | 27.8 (126) |
| Buys antimalarial directly from manufacturers ³ , either foreign or domestic | % (N) | 28.7 (136) | 45.8 (48) | 25.2 (126) |
| Buy antimalarials from foreign suppliers ³ , either manufacturers or exporters | % (N) | 14.6 (137) | 33.3 (48) | 9.7 (124) |
| Deliver antimalarials to customers | % (N) | 23.0 (139) | 31.3 (48) | 21.4 (126) |
| Provided credit to customers in the past 3 months | % (N) | 35.5 (138) | 29.8 (47) | 38.1 (126) |
| Most common terms of credit offered in the past 3 months (number of days) | Median IQR (N) | 30 10-30 (45) | 30 8-30 (12) | 30 9.5-30 (44) |

1: Some wholesalers interviewed may have understood the question asked to mean customers for 'any medicines' and not specifically antimalarials, or perhaps customers that buy 'any medicines for the management of malaria', which may include antipyretics, vitamins, etc. that are commonly sold by general wholesalers and retailers. 2: Six of the 48 wholesalers in this category reported that they did not supply drug wholesalers; however, during the supply chain survey, a wholesale respondent identified this particular wholesaler as one of their top two supply sources for antimalarials. To remain consistent across indicators, we have chosen to report this indicator as 87.5% rather than 100.0% based on the information reported by the suppliers rather than their customers. 3: As at least one of their two top antimalarial suppliers.

4.4. Licensing & inspection

- Among all wholesalers interviewed, 68.0% reported having authorisation to wholesale pharmaceuticals; however, this authorisation certificate from the DPM was observed in only 15.7% of wholesalers. Compared to wholesalers supplying retailers, more wholesalers operating at higher levels of the supply chain (i.e. wholesalers supplying wholesalers) reported having such authorisation (78.3% vs. 68.1%) and were observed to have an authorisation certificate from the DPM (27.7% vs. 15.6%).
- Only 2.2% of wholesalers operating at higher levels of the distribution chain reported having authorisation to retail pharmaceuticals, although 26.1% of wholesalers supplying retailers reported possessing retail authorisation.
- Any retail or wholesale authorisation from the DPM was observed among 19.9% of all wholesalers interviewed.
- Possession of authorisation to import pharmaceuticals was reported by nearly a quarter (23.6%) of all wholesalers, which is similar to the number of wholesalers who reported importing antimalarials (30.2%).
- Nearly all (94.2%) wholesalers interviewed reported that they had been visited by a pharmaceutical inspector in the past year.

Table 4.4: Licensing & Inspection

| REGISTRATION STATUS ¹ | | WHOLEALER CATEGORIES | | |
|---|----------|----------------------|---------------------|----------------------|
| | | ALL WHOLESALERS | SUPPLY WHOLESALERS | SUPPLY RETAILERS |
| Reported having authorisation to wholesale pharmaceuticals ² | % (N) | 68.0 (128) | 78.3 (46) | 68.1 (116) |
| Reported having authorisation to retail pharmaceuticals ³ | % (N) | 23.6 (127) | 2.2 (46) | 26.1 (115) |
| Reported having authorisation to import pharmaceuticals | % (N) | 23.5 (132) | 31.9 (47) | 22.7 (119) |
| Reported having authorisation to manufacture pharmaceuticals | % (N) | 7.6 (121) | 14.9 (47) | 6.8 (118) |
| Any retail or wholesale authorisation from the DPM (<i>Authorisation d'ouverture</i>) was observed | % (N) | 19.9 (136) | 29.2 (48) | 19.5 (123) |
| A wholesale authorisation from the DPM (<i>Authorisation d'ouverture</i>) was observed ⁴ | % (N) | 15.7 (134) | 27.7 (47) | 15.6 (122) |
| Reported they had been visited by a pharmaceutical inspector in the past year | % (N) | 94.2 (138) | 93.8 (48) | 95.2 (125) |

1: Retail pharmaceutical establishments include hospital or retail pharmacies (officines), and wholesale establishments include wholesalers (de vente en gros), distribution centre (centrales de distribution) and centralised purchasers (centrales d'achats); note that authorisations to operate these enterprises do not have expiration dates. 2: An additional 4 wholesalers reported possessing an autorisation d'ouverture', however it was unclear if these were for wholesaling or retailing; as such, they were excluded from this indicator. 3: An additional 5 wholesalers reported possessing an autorisation d'ouverture', however it was unclear if these were for wholesaling or retailing; as such, they were excluded from this indicator. 4: In two wholesalers, an authorisation d'ouverture was observed, however, it was not noted if these authorisations were issued for wholesaling or retailing, and were excluded from this indicator.

4.5. Knowledge, qualifications and training

- Three-quarters of all wholesalers interviewed (73.2%) were able to correctly identify ASAQ as the government recommended first-line treatment for uncomplicated *Pf* malaria.
- However, the proportion of wholesalers identifying an ACT as the most effective medication for treating uncomplicated malaria was lower (46.7% for children and 42.8% for adults). Quinine was most commonly mentioned as the most effective antimalarial among all wholesalers (43.8% for children and 42.8% for adults), followed by ASAQ (21.9% for children and 23.9% for adults), then artemether-lumefantrine (AL) (17.5% for children and 5.8% for adults).
- Compared to wholesalers supplying retailers, more wholesalers supplying other wholesalers identified an ACT as the most effective antimalarial for children (59.6% vs 46.4%) and adults (61.7% vs. 42.1%), and correctly identified ASAQ as the government recommended first line treatment (80.9% vs. 73.0%).
- Nearly all wholesalers interviewed (92.8%) reported employing staff with health qualifications, and the most commonly reported health qualifications were pharmacists (68.8%), followed by nurses/midwives (68.1%), and pharmacy assistants (47.8%).
- The percentage of wholesalers who indicated that staff had participated in in-service training related to malaria treatment in the past 2 years was low (11.7% of all wholesalers interviewed).

Table 4.5: Wholesalers' knowledge, qualifications and training

| HEALTH QUALIFICATIONS, TRAINING AND KNOWLEDGE | | WHOLESALER CATEGORIES | | |
|--|----------|-----------------------|---------------------|----------------------|
| | | ALL WHOLESALERS | SUPPLY WHOLESALERS | SUPPLY RETAILERS |
| Employ a member of staff with health qualifications ¹ | % (N) | 92.8 (138) | 97.9 (48) | 92.8 (125) |
| Employ staff who participated in in-service training related to malaria treatment in the past 2 years | % (N) | 11.7 (137) | 21.3 (47) | 10.5 (124) |
| Identify any ACT as the most effective medication for treating uncomplicated <i>Pf</i> malaria in adults | % (N) | 42.8 (138) | 61.7 (47) | 42.1 (126) |
| Identify any ACT as the most effective medication for treating uncomplicated <i>Pf</i> malaria in children | % (N) | 46.7 (137) | 59.6 (47) | 46.4 (125) |
| Correctly identify the government recommended first line treatment for uncomplicated <i>Pf</i> malaria | % (N) | 73.2 (138) | 80.9 (47) | 73.0 (126) |

1: Health qualifications included pharmacist, laboratory technician, pharmacy assistant, medical doctor, nurse, midwife

4.6. Storage of antimalarial drugs

- Nearly all wholesalers were observed to store antimalarials in a dry area and out of direct sunlight; although a slightly lower percentage was observed to keep them off the floor (93.0%).
- 90.4% of all wholesalers met each of the specified conditions for good storage of antimalarials (in a dry area, out of direct sunlight and off the floor).

Table 4.6: Wholesalers' storage practices

| STORAGE | | WHOLEALER CATEGORIES | | |
|---|----------|-----------------------|----------------------|-----------------------|
| | | ALL WHOLESALERS | SUPPLY WHOLESALERS | SUPPLY RETAILERS |
| Store antimalarials in a dry area | % (N) | 100.0 (114) | 100.0 (38) | 100.0 (103) |
| Store antimalarials out of direct sunlight | % (N) | 97.4 (114) | 100.0 (38) | 97.1 (103) |
| Store antimalarials off the floor | % (N) | 93.0 (114) | 94.7 (38) | 93.2 (103) |
| Store antimalarials in a dry area, out of direct sunlight & off the floor | % (N) | 90.4 (114) | 94.7 (38) | 90.3 (103) |

4.7. Availability of antimalarials & RDTs

- Nearly all wholesalers surveyed (97.8%) had at least one antimalarial in stock at the time of interview.
- nATs were stocked by 89.9% of all wholesalers surveyed, while 82.6% of all wholesalers had an ACT in stock at the time of interview. However, fewer wholesalers (73.5%) reported having had at least one ACT in stock throughout the three month period prior to interview.
- Less than a third (29.7%) of all wholesalers had WHO prequalified ACTs in stock, while most wholesalers stocked a non-WHO prequalified ACT (78.3%).
- More than half of all wholesalers (59.4%) stocked ASAQ, the recommended first-line treatment for uncomplicated *Pf* malaria, but only 15.9% of all wholesalers stocked SérénaDose, the brand of ASAQ socially marketed by ASF. Only 2.1% of private sector wholesalers supplying other wholesalers stocked SérénaDose.
- AMTs were stocked by about half of all wholesalers: 45.7% stocked non-oral AMTs, while 49.3% stocked oral AMTs.
- The most frequently observed antimalarial was quinine, accounting for 25.7% of all antimalarial products stocked by wholesalers, followed by AL, an ACT, accounting for 18.3%. The recommended first-line treatment, ASAQ, was the third most commonly encountered antimalarial, but accounted for only 9.0% of all antimalarial products stocked by wholesalers.
- Although ACTs accounted for 41.4% of all antimalarial products stocked by wholesalers, the recommended first-line treatment, ASAQ, accounted for only 21.9% of these ACTs; while AL accounted for 43.7% of all ACTs stocked by wholesalers. SérénaDose, the brand of ASAQ socially marketed by ASF, accounted for 1.1% of all antimalarial products stocked by wholesalers, 2.7% of all ACT products, and 12.6% of all ASAQ products stocked by wholesalers.
- RDTs were stocked by only 2.2% of all wholesalers.

Table 4.7: Antimalarial & RDT availability

| AVAILABILITY | | WHOLESALE CATEGORIES | | |
|---|----------|----------------------|---------------------|----------------------|
| | | ALL WHOLESALERS | SUPPLY WHOLESALERS | SUPPLY RETAILERS |
| Had antimalarials in stock | % (N) | 97.8 (138) | 97.9 (47) | 98.4 (126) |
| Had ACT in stock | % (N) | 82.6 (138) | 78.7 (47) | 85.7 (126) |
| Always had at least one ACT in stock over the past 3 months | % (N) | 73.5 (136) | 75.6 (45) | 75.8 (124) |
| Had WHO prequalified ACT in stock ¹ | % (N) | 29.7 (138) | 29.8 (47) | 28.6 (126) |
| Had non-WHO prequalified ACT in stock | % (N) | 78.3 (138) | 70.2 (47) | 83.3 (126) |
| Had oral AMT in stock | % (N) | 49.3 (138) | 42.6 (47) | 50.8 (126) |
| Had non-oral AMT in stock | % (N) | 45.7 (138) | 44.7 (47) | 48.4 (126) |
| Had nAT in stock | % (N) | 89.9 (138) | 83.0 (47) | 92.1 (126) |
| Had RDT in stock | % (N) | 2.2 (138) | 0.0 (47) | 2.4 (126) |

1: There were 12 unbranded ASAQ products manufactured in India which had insufficient product information recorded to categorise as WHO prequalified products; taking a conservative approach, these products were categorised as non-WHO prequalified ACTs

4.8. Sales volumes of antimalarials and RDTs

Sales volume data are presented first for all wholesalers (Table 4.8.1) and secondly for only those wholesalers stocking the corresponding product category (Table 4.8.2).

Among all wholesalers (Table 4.8.1)

- Among all wholesalers (n=137), the median number of adult equivalent treatment doses (AETDs) sold the week preceding the survey was highest for nATs (327.8, IQR: 65.3-1519.0), followed by ACTs (68.5, IQR 7.5-327.5) and AMTs (8.3, IQR 0.0-83.7). Looking more closely at ACTs, the median number of AETDs sold of non-WHO prequalified ACTs (56.4, IQR: 0.4-300.0) was much higher than for WHO prequalified ACTs (0.0, IQR: 0.0-2.5).
- Among all wholesalers, 81.0% reported selling an ACT during the week preceding the survey, 60.6% sold an AMT and 88.3% sold a nATs.
- Although the typical sales volume of AMTs among all wholesalers was low compared to nATs and ACTs, oral AMTs continue to be sold. For example, a similar number of wholesalers were selling AMT tablets and WHO prequalified ACTs (44 vs. 41 wholesalers); however, the typical sales volume for AMT tablets among these wholesalers was four times greater than that for WHO prequalified ACTS (39.3 AETDs vs. 10.0 AETDs).

Among wholesalers stocking specific products (Table 4.8.2)

- Among wholesalers who stocked the socially marketed ASAQ product (n=22), SérénaDose, the median number of AETDs sold of these products was 7.5 (IQR 5-16.1); volumes of these products sold were nearly ten times higher among wholesalers supplying other wholesalers (65.5 AETDs, IQR 37.5-327.5) than those supplying retailers (7.5 AETDs, IQR 5.0-10.0), however, relatively few wholesalers were stocking these products (5 wholesalers supplying wholesalers and 19 supplying retailers).
- Among all wholesalers who had antimalarials in stock at the time of interview (n=135), the top selling antimalarial was quinine for 31.1% of wholesalers, SP for 30.4%, and amodiaquine monotherapy for a further 12.6% of wholesalers. The recommended first-line treatment for uncomplicated malaria, ASAQ, was the top selling antimalarial for 6.7%, and was the fourth most commonly mentioned top selling antimalarial by all wholesalers; however, compared to wholesalers supplying retailers, a higher proportion of wholesalers supplying other wholesalers reported ASAQ as their top selling antimalarial (10.9% vs. 4.8%).⁸
- RDTs were not commonly stocked by wholesalers. Among the three wholesalers that did stock RDTs, the volume of tests sold varied widely. Among those who stocked RDTs, the median number of tests sold during the week preceding the survey was 100 (IQR 0-228).

⁸The analysis of the top selling antimalarials used sales volumes data collected for each antimalarial in stock at the time of the survey: in each outlet and for each antimalarial stocked, wholesalers were asked to recall the quantity they had sold during the week preceding the survey

Table 4.8.1: Median number of AETDs & RDTs sold during the week preceding the survey (all wholesalers)

| ANTIMALARIAL TYPE ¹ Formulation ² | | | WHOLESALER CATEGORIES | | |
|--|---------------------------|----------|--|-------------------------------|------------------------------|
| | | | ALL WHOLESALERS N=137 ³ | SUPPLY WHOLESALERS N=46 | SUPPLY RETAILERS N=126 |
| All ACT | All | Median | 68.5 | 162.3 | 80.2 |
| | | IQR | 7.5-327.5 | 37.5-843.3 | 8.0-394.3 |
| | Tablet | Median | 59.7 | 119.8 | 59.8 |
| | | IQR | 7.4-287.9 | 37.5-675.7 | 7.8-300.0 |
| | Oral liquid | Median | 1.9 | 11.3 | 3.1 |
| | | IQR | 0.0-29.3 | 0.0-79.8 | 0.0-37.5 |
| WHO prequalified ACT ⁴ | All products were tablets | Median | 0.0 | 0.0 | 0.0 |
| | | IQR | 0.0-2.5 | 0.0-3.0 | 0.0-2.0 |
| Non-WHO prequalified ACT | All | Median | 56.4 | 126.8 | 71.9 |
| | | IQR | 0.4-300.0 | 0.0-843.3 | 2.5-320.7 |
| | Tablet | Median | 38.4 | 108.7 | 56.3 |
| | | IQR | 0.0-250.0 | 0.0-675.7 | 0.4-275.0 |
| | Oral liquid | Median | 1.9 | 11.3 | 3.1 |
| | | IQR | 0.0-29.3 | 0.0-79.8 | 0.0-37.5 |
| AMT | All | Median | 8.3 | 14.3 | 11.2 |
| | | IQR | 0.0-83.7 | 0.0-135.1 | 0.0-98.3 |
| | Tablet | Median | 0.0 | 0.0 | 0.0 |
| | | IQR | 0.0-10.1 | 0.0-10.0 | 0.0-16.3 |
| | Oral liquid | Median | 0.0 | 0.0 | 0.0 |
| | | IQR | 0.0-4.3 | 0.0-8.3 | 0.0-6.8 |
| Injectable | Median | 0.0 | 0.0 | 0.0 | |
| | IQR | 0.0-15.1 | 0.0-50.0 | 0.0-21.8 | |
| nAT | All | Median | 327.8 | 926.9 | 336.2 |
| | | IQR | 65.3-1519.0 | 103.2-1984.1 | 73.6-1527.4 |
| | Tablet | Median | 226.2 | 673.9 | 285.0 |
| | | IQR | 24.5-1167.7 | 59.1-1330.6 | 30.0-1259.9 |
| | Oral liquid | Median | 6.6 | 11.6 | 7.0 |
| | | IQR | 0.0-70.6 | 0.0-84.2 | 0.0-78.6 |
| Injectable | Median | 0.0 | 0.0 | 0.0 | |
| | IQR | 0.0-0.0 | 0.0-0.0 | 0.0-0.0 | |
| | | | ALL WHOLESALERS N=137 | SUPPLY WHOLESALERS N=46 | SUPPLY RETAILERS N=126 |
| RDT ⁵ (per unit) | | Median | 0.0 | 0.0 | 0.0 |
| | | IQR | 0.0-0.0 | 0.0-0.0 | 0.0-0.0 |

1 ACT: artemisinin-based combination therapy; AMT: artemisinin monotherapy; nAT: non artemisinin therapy; RDT: Rapid diagnostic test for malaria; 2 The values for median number of AETDs sold reported for 'all' formulations include all dosage forms (tablets, suppositories, oral liquids, injectables and granules); however because so few wholesaler and retailers stocked suppositories or granules, and so few of these product types were observed during the audit, results are not presented separately for these categories in this table, but are instead provided in the appendix. 3 For antimalarials: there were a total of 137 wholesalers with antimalarial sales volumes (reported or imputed or set as null if did not stock). Note on imputation process for antimalarial sales volumes: during the study, 161 wholesalers were identified, of which 138 were interviewed successfully. Of the remaining, 1 was partially interviewed with no audit conducted, 1 was not eligible, 21 were not screened because the business had closed, could not be found or was not an eligible type, and 2 did not stock antimalarials at the time of the survey or during the three months prior to the visit (Table 1). In addition, an inventory was not conducted with 1 of the 138 completed interviews; so these 24 wholesalers were excluded from the volumes analysis. Two additional wholesalers did not stock antimalarials at the time of interview but did so in the three months prior to interview, so their sales volumes were set as 0 for all antimalarial categories. Overall, there were a total of 1939 antimalarials audited, and 174 (9.0%) had missing sales volumes that were imputed using the `mi impute pmm` command. 4 There were 12 unbranded ASAQ products manufactured in India which had insufficient product information recorded to categorise as WHO prequalified products; taking a conservative approach, these products were categorised as non-WHO prequalified ACTs. 5 For RDTs, of the 137 wholesalers completely interviewed or from whom audit information was collected, 3 reported stocking RDT and inventory data were collected on 3 observed products (1 product in each business), and information on sales volume was provided for each; therefore, imputation was not performed

Table 4.8.2: Median number of AETDs & RDTs sold during the week preceding the survey (among wholesalers stocking corresponding antimalarial drug category/RDT at the time of the survey)

| ANTIMALARIAL TYPE ¹ Formulation ² | | | WHOLESALER CATEGORIES ³ | | |
|--|---------------------------|-------------|------------------------------------|--------------------|------------------|
| | | | ALL WHOLESALERS | SUPPLY WHOLESALERS | SUPPLY RETAILERS |
| All ACT | All | Median | 130.5 | 267.5 | 124.3 |
| | | IQR | 19.5-474.6 | 116.7-1063.9 | 18.3-472.3 |
| | | (n) | (114) | (37) | (108) |
| | Tablet | Median | 102.0 | 202.0 | 94.8 |
| | | IQR | 19.5-439.7 | 87.5-888.9 | 18.0-451.1 |
| | | (n) | (112) | (37) | (106) |
| Oral liquid | Median | 21.0 | 52.1 | 21.1 | |
| | IQR | 5.6-79.8 | 9.4-207.0 | 6.8-79.1 | |
| | (n) | (79) | (31) | (76) | |
| WHO prequalified ACT ⁴ | All products were tablets | Median | 10.0 | 24.1 | 8.4 |
| | | IQR | 5.0-20.0 | 8.5-112.0 | 4.0-17.4 |
| | | (n) | (41) | (14) | (36) |
| Non-WHO prequalified ACT | All | Median | 125.5 | 267.5 | 131.1 |
| | | IQR | 16.6-464.2 | 117.5-1424.7 | 16.8-458.5 |
| | | (n) | (108) | (33) | (105) |
| | Tablet | Median | 108.5 | 202.0 | 107.3 |
| | | IQR | 17.5-434.2 | 96.7-1100.0 | 20.0-440.1 |
| | | (n) | (104) | (33) | (101) |
| Oral liquid | Median | 21.0 | 52.1 | 21.1 | |
| | IQR | 5.6-79.8 | 9.4-207.0 | 6.8-79.1 | |
| | (n) | (79) | (31) | (76) | |
| AMT | All | Median | 53.1 | 80.5 | 54.5 |
| | | IQR | 12.5-227.3 | 16.1-227.3 | 15.1-235.9 |
| | | (n) | (87) | (30) | (82) |
| | Tablet | Median | 39.3 | 82.1 | 39.3 |
| | | IQR | 15.9-107.4 | 26.3-170.0 | 16.3-95.8 |
| | | (n) | (44) | (12) | (42) |
| Oral liquid | Median | 14.1 | 14.1 | 16.2 | |
| | IQR | 2.5-71.9 | 4.4-65.5 | 2.4-77.6 | |
| | (n) | (51) | (19) | (48) | |
| Injectable | Median | 25.1 | 52.5 | 25.1 | |
| | IQR | 3.2-83.3 | 5.4-91.3 | 3.3-83.3 | |
| | (n) | (63) | (21) | (61) | |
| nAT | All | Median | 447.8 | 1014.7 | 447.8 |
| | | IQR | 113.2-1722.5 | 239.7-2394.1 | 108.1-1722.5 |
| | | (n) | (124) | (39) | (116) |
| | Tablet | Median | 404.8 | 998.0 | 413.0 |
| | | IQR | 109.1-1523.4 | 182.5-1984.1 | 98.8-1578.6 |
| | | (n) | (117) | (37) | (110) |
| Oral liquid | Median | 32.8 | 56.8 | 34.0 | |
| | IQR | 3.6-115.8 | 15.3-161.9 | 3.3-122.4 | |
| | (n) | (96) | (28) | (92) | |
| Injectable | Median | 16.3 | 49.6 | 16.2 | |
| | IQR | 4.0-79.4 | 18.3-271.4 | 2.8-59.5 | |
| | (n) | (66) | (20) | (59) | |
| RDT (units) | Median | 100 | - | 100 | |
| | IQR | 0-228 | - | 0-228 | |
| | (n) | (3) | - | (3) | |

¹ ACT: artemisinin-based combination therapy; AMT: artemisinin monotherapy; nAT: non artemisinin therapy; RDT: Rapid diagnostic test for malaria. ² The values for median number of AETDs sold reported for 'all' formulations include all dosage forms (tablets, suppositories, oral liquids, injectables and granules); however because so few wholesaler and retailers stocked suppositories or granules, and so few of these product types were observed during the audit, results are not presented separately for these categories in this table, but are instead provided in the appendix. ³ (n) is the number of wholesalers at a given level who stocked antimalarials for corresponding drug category or who stocked RDT. ⁴ There were 12 unbranded ASAQ products manufactured in India which had insufficient product information recorded to categorise as WHO prequalified products; taking a conservative approach, these products were categorised as non-WHO prequalified ACTs.

4.9. Purchase price of antimalarials and RDTs

Purchase price is the price paid by businesses (i.e. wholesalers or outlets) for their most recent purchase of an antimalarial product from their suppliers, and is reported in terms of the median price (in US dollars) per AETD. Because of the varied nature of wholesaler transactions (e.g. wholesalers may vary their price; antimalarials may pass through a number of wholesalers before reaching an outlet), wholesale purchase prices are indicative of the purchase prices paid by wholesalers in general, rather than at specific levels of the supply chain. Retail purchase prices, however, reflect the antimalarial purchase prices paid by specific outlet types to their suppliers.

Wholesale level (Table 4.9.1)

- Among all wholesalers, median purchase prices per AETD were highest for AMTs (US\$ 8.00, IQR 3.82-11.47), followed by ACTs (US\$ 3.60, IQR 2.42-6.60) and nATs (US\$ 2.29, IQR 0.94-5.63).
- Median purchase prices paid for WHO prequalified ACTs by wholesalers supplying other wholesalers were observed to be higher than the prices paid by those supplying retailers, because 13.5% of wholesalers supplying retailers stocked the socially marketed first line drug, SérénaDose, compared to 2.1% of wholesalers supplying other wholesalers. The median purchase price paid by wholesalers for SérénaDose was US\$ 1.81 (IQR 1.60-2.05); while the median purchase price of other WHO prequalified ACTs was US\$ 4.20 (IQR 1.06-6.43). In addition to SérénaDose, wholesalers supplying retailers also stocked other lower priced brands of WHO prequalified ACTs, such as Artefan, Arsuamoon and Lumartem, while wholesalers supplying other wholesalers did not.
- In the few instances where RDTs were stocked, wholesalers reported purchasing 1 RDT unit at US\$ 1.38 (IQR 1.38-1.39) (data were not collected on retailer purchase prices for RDTs).

Retail level (Table 4.9.2)

- At retail level, median purchase prices for ACTs ranged from US\$ 1.46 (IQR 0.73-3.29) in private health facilities to US\$ 3.40 (IQR 0.49-3.46) in general retailers; for AMT, purchase prices ranged from US\$ 2.73 (IQR 0.91-3.79) in general retailers to US\$ 4.66 (IQR 2.91-8.74) in pharmacies; and for nATs, purchase prices ranged from US\$ 0.36 (IQR 0.18-2.14) in general retailers to US\$ 3.06 (IQR 0.66-5.61) in private health facilities. General retailers tended to have paid the lowest purchase prices for AMTs and nATs than the other retailer types because a greater proportion of the observed products among general retailers were tablets, which tended to be cheaper than other dosage forms, such as oral liquids and injectables.
- In pharmacies and drug stores (where ACT and AMT products were most frequently observed), the median retail-level purchase prices for ACT and AMT tablets were similar, as were the purchase prices of ACT and AMT oral liquids. Retail-level median purchase prices for WHO prequalified ACTs (all tablets) were lower than those for AMT tablets, but relatively few WHO prequalified products were observed at retail level compared to non-prequalified products.
- In addition, median purchase prices for WHO prequalified ACTs were considerably lower than those for non-prequalified ACTs. Prices for prequalified products ranged from US\$ 0.29 (IQR 0.18-0.49) at general retailers to US\$ 1.46 (IQR 0.73-2.58) at pharmacies; while prices for non-prequalified products ranged from US\$ 3.16 (IQR 1.70-4.92) at drug stores to US\$ 3.88 (IQR 2.92-8.09) at pharmacies. Although part of this difference in price may be due to the availability of higher priced oral liquid and granule dosage forms of non-prequalified ACT products (while all prequalified products are tablets), median purchase prices for non-WHO prequalified ACT tablets were still notably higher than those for prequalified products.
- The socially marketed first line drug, SérénaDose, accounted for none of WHO prequalified products observed in general retailers, and up to 26.5% of WHO prequalified products observed in drug stores; and its median purchase price ranged from US\$ 0.73 (IQR 0.73-0.73) in pharmacies and private health facilities, to US\$ 2.48 (IQR 1.97-3.10) in drug stores.
- Retail-level median purchase prices were often observed to be lower than the corresponding wholesale-level prices, particularly for ACTs. For example, the median wholesale-level purchase price for WHO

prequalified ACTs was US\$ 2.10 (IQR 1.27-5.39), while median retail-level purchase prices ranged from US\$ 0.29 (IQR 0.18-0.49) at general retailers to US\$ 1.46 (IQR 0.73-2.58) at pharmacies.

- Public health facilities were observed to purchase antimalarials, which is consistent with the wide-spread practice of implementing revolving drug funds; however, they tended to pay lower purchase prices than private outlets for both WHO prequalified and non-prequalified ACTs, but similar prices for AMTs and nATs to those paid by private outlets.

First-line treatments for uncomplicated Pf malaria

- At wholesale level, the median purchase price per AETD for ASAQ (US\$ 1.61, IQR 0.81-4.10) was lower than that for quinine (US\$ 3.95, IQR 2.31-7.65), the antimalarial with the highest number of AETDs distributed, but several times higher than the median price for SP (US\$ 0.24, IQR 0.16-0.40), which had the second highest number of AETDs distributed.
- At retail level, a similar pattern was observed, where median purchase prices for ASAQ ranged from US\$ 0.29 (IQR 0.18-0.49) in general retailers to US\$ 1.21 (IQR 0.73-1.94) in drug stores; for quinine, purchase prices ranged from US\$ 2.55 (IQR 2.14-2.88) in general retailers to US\$ 4.33 (IQR 2.26-6.12) in private health facilities; and for SP, purchase prices ranged from US\$ 0.15 (IQR 0.04-0.30) in private health facilities to US\$ 0.28 (IQR 0.19-0.79) in pharmacies.

Table 4.9.1 Purchase price per AETD/RDT (US\$), wholesale level

| ANTIMALARIAL TYPE ¹ Formulation ² | | | WHOLESALER CATEGORIES | | |
|--|---------------------------|-------------|-----------------------------|-------------------------------|------------------------------|
| | | | ALL WHOLESALERS N=135 | SUPPLY WHOLESALERS N=46 | SUPPLY RETAILERS N=124 |
| All ACT | All | Median | 3.60 | 3.80 | 3.60 |
| | | IQR | 2.42-6.60 | 2.71-6.67 | 2.39-6.56 |
| | | (n) | (695) | (255) | (666) |
| | Tablet | Median | 2.90 | 3.06 | 2.89 |
| | | IQR | 2.10-4.28 | 2.28-4.42 | 2.09-4.28 |
| | | (n) | (483) | (178) | (461) |
| | Oral liquid | Median | 7.19 | 7.03 | 7.17 |
| | | IQR | 6.36-11.04 | 6.29-11.02 | 6.26-11.02 |
| (n) | | (200) | (70) | (193) | |
| Granule | Median | 31.14 | - | 31.14 | |
| | IQR | 19.89-31.17 | - | 19.89-31.17 | |
| | (n) | (9) | - | (9) | |
| WHO prequalified ACT ³ | All products were tablets | Median | 2.10 | 5.08 | 2.05 |
| | | IQR | 1.27-5.39 | 3.27-9.06 | 1.16-5.66 |
| | | (n) | (56) | (24) | (51) |
| Non WHO prequalified ACT | All | Median | 3.68 | 3.68 | 3.67 |
| | | IQR | 2.56-6.67 | 2.70-6.65 | 2.52-6.67 |
| | | (n) | (639) | (231) | (615) |
| | Tablet | Median | 2.91 | 2.98 | 2.91 |
| | | IQR | 2.15-4.23 | 2.21-4.24 | 2.15-4.22 |
| | | (n) | (428) | (155) | (411) |
| | Oral liquid | Median | 7.19 | 7.03 | 7.17 |
| | | IQR | 6.36-11.04 | 6.29-11.02 | 6.26-11.02 |
| (n) | | (200) | (70) | (193) | |
| Granule | Median | 31.14 | - | 31.14 | |
| | IQR | 19.89-31.17 | - | 19.89-31.17 | |
| | (n) | (9) | - | (9) | |
| AMT | All | Median | 8.00 | 9.46 | 8.19 |
| | | IQR | 3.82-11.47 | 5.41-11.71 | 3.82-11.47 |
| | | (n) | (275) | (94) | (267) |
| | Tablet | Median | 2.05 | 2.05 | 2.05 |
| | | IQR | 1.92-2.77 | 1.97-2.17 | 1.92-2.77 |
| | | (n) | (44) | (10) | (42) |
| | Oral liquid | Median | 5.90 | 6.30 | 5.84 |
| | | IQR | 4.75-9.83 | 5.89-9.83 | 4.69-9.89 |
| (n) | | (63) | (18) | (60) | |
| Injectable | Median | 10.08 | 10.49 | 10.36 | |
| | IQR | 6.69-12.97 | 7.68-14.71 | 6.72-12.99 | |
| | (n) | (163) | (63) | (160) | |
| nAT | All | Median | 2.29 | 2.39 | 2.29 |
| | | IQR | 0.94-5.63 | 1.53-6.27 | 1.03-5.42 |
| | | (n) | (640) | (194) | (611) |
| | Tablet | Median | 1.68 | 2.08 | 1.72 |
| | | IQR | 0.21-2.31 | 0.77-2.42 | 0.21-2.31 |
| | | (n) | (358) | (111) | (345) |
| | Oral liquid | Median | 6.50 | 6.72 | 6.48 |
| | | IQR | 2.50-9.11 | 3.36-9.30 | 2.67-9.09 |
| (n) | | (210) | (62) | (197) | |
| Injectable | Median | 3.78 | 3.35 | 3.84 | |
| | IQR | 3.18-5.06 | 3.02-5.04 | 3.20-5.08 | |
| | (n) | (63) | (19) | (60) | |
| RDT (per unit) | Median | 1.38 | - | 1.38 | |
| | IQR | 1.38-1.39 | - | 1.38-1.39 | |
| | (n) | (2) | - | (2) | |

1 ACT: artemisinin-based combination therapy; AMT: artemisinin monotherapy; nAT: non artemisinin therapy; RDT: Rapid diagnostic test for malaria. 2 The values for median number of AETDs sold reported for 'all' formulations include all dosage forms (tablets, suppositories, oral liquids, injectables and granules); however because so few wholesaler and retailers stocked suppositories, and so few of these product types were observed during the audit, results are not presented here. 3 There were 12 unbranded ASAQ products manufactured in India which had insufficient product information recorded to categorise as WHO prequalified products; taking a conservative approach, these products were categorised as non-WHO prequalified ACTs.

Table 4.9.2 Purchase price per AETD (US\$), retail level

| ANTIMALARIAL TYPE ¹ Formulation ² | | | RETAILER CATEGORIES ³ | | | | |
|--|---------------------------|---------------|----------------------------------|--|----------------------|---|--|
| | | | PHARMACIES N=30 | PRIVATE HEALTH FACILITIES N=118 | DRUG STORES N=946 | GENERAL RETAILERS ⁴ N=16 | PUBLIC HEALTH FACILITIES N=81 |
| All ACT | All | Median | 3.03 | 1.46 | 2.70 | 3.40 | 0.49 |
| | | IQR | 1.46-6.92 | 0.73-3.29 | 1.21-4.01 | 0.49-3.46 | 0.00-1.46 |
| | | (n) | (204) | (66) | (1880) | (9) | (119) |
| | Tablet | Median | 2.68 | 0.97 | 2.21 | 3.03 | 0.49 |
| | IQR | 0.85-3.82 | 0.49-2.97 | 1.03-3.34 | 0.29-3.40 | 0.00-1.46 | |
| | (n) | (149) | (53) | (1430) | (8) | (117) | |
| | Oral liquid | Median | 8.90 | 6.15 | 8.25 | 17.16 | 3.30 |
| | IQR | 6.92-11.98 | 3.49-11.65 | 6.47-11.33 | 17.16-17.16 | 3.30-3.30 | |
| | (n) | (47) | (13) | (419) | (1) | (2) | |
| | Granule | Median | 13.11 | - | 7.28 | - | - |
| | IQR | 13.11-16.99 | - | 3.64-15.30 | - | - | |
| | (n) | (8) | - | (31) | - | - | |
| WHO prequalified ACT | All products were tablets | Median | 1.46 | 0.73 | 1.38 | 0.29 | 0.37 |
| | IQR | 0.73-2.58 | 0.00-0.97 | 0.73-2.48 | 0.18-0.49 | 0.00-1.46 | |
| | (n) | (24) | (24) | (228) | (3) | (105) | |
| Non WHO prequalified ACT | All | Median | 3.88 | 3.29 | 3.16 | 3.40 | 1.21 |
| | IQR | 2.92-8.09 | 2.66-4.78 | 1.70-4.92 | 3.03-3.46 | 0.73-2.06 | |
| | (n) | (180) | (42) | (1652) | (6) | (14) | |
| | Tablet | Median | 3.03 | 2.97 | 2.91 | 3.40 | 1.21 |
| IQR | 2.06-4.10 | 1.34-4.13 | 1.44-3.62 | 3.03-3.46 | 0.61-2.06 | | |
| (n) | (125) | (29) | (1202) | (5) | (12) | | |
| | Oral liquid | Median | 8.90 | 6.15 | 8.25 | 17.16 | 3.30 |
| IQR | 6.92-11.98 | 3.49-11.65 | 6.47-11.33 | 17.16-17.16 | 3.30-3.30 | | |
| (n) | (47) | (13) | (419) | (1) | (2) | | |
| | Granule | Median | 13.11 | - | 7.28 | - | - |
| IQR | 13.11-16.99 | - | 3.64-15.30 | - | - | | |
| (n) | (8) | - | (31) | - | - | | |
| AMT | All | Median | 4.66 | 4.13 | 3.88 | 2.73 | 2.27 |
| | IQR | 2.91-8.74 | 2.43-6.56 | 2.19-7.28 | 0.91-3.79 | 1.23-4.86 | |
| | (n) | (124) | (76) | (1941) | (6) | (13) | |
| | Tablet | Median | 2.78 | 2.43 | 2.25 | 2.73 | 2.27 |
| IQR | 1.94-3.03 | 2.37-2.91 | 1.55-2.91 | 0.91-3.79 | 1.23-4.86 | | |
| (n) | (41) | (30) | (741) | (6) | (6) | | |
| | Oral liquid | Median | 6.41 | 5.39 | 6.41 | - | 4.91 |
| IQR | 5.24-10.56 | 2.48-6.99 | 5.05-9.71 | - | 2.39-4.91 | | |
| (n) | (42) | (19) | (837) | - | (5) | | |
| | Injectable | Median | 9.47 | 8.45 | 9.28 | - | 0.00 |
| IQR | 6.07-11.65 | 4.66-10.20 | 5.83-12.75 | - | 0.00-14.71 | | |
| (n) | (41) | (26) | (356) | - | (2) | | |
| nAT | All | Median | 2.29 | 3.06 | 1.84 | 0.36 | 1.56 |
| | IQR | 0.59-4.33 | 0.66-5.61 | 0.30-3.64 | 0.18-2.14 | 0.07-3.40 | |
| | (n) | (213) | (273) | (4598) | (33) | (197) | |
| | Tablet | Median | 1.12 | 0.77 | 0.46 | 0.36 | 0.76 |
| IQR | 0.30-2.37 | 0.22-2.24 | 0.24-2.29 | 0.18-2.40 | 0.05-1.89 | | |
| (n) | (122) | (140) | (2646) | (32) | (121) | | |
| | Oral liquid | Median | 6.12 | 8.67 | 5.46 | 1.46 | 5.10 |
| IQR | 2.19-9.94 | 5.61-9.69 | 1.82-9.18 | 1.46-1.46 | 2.86-5.25 | | |
| (n) | (81) | (56) | (1687) | (1) | (24) | | |
| | Injectable | Median | 4.33 | 4.59 | 4.13 | - | 3.31 |
| IQR | 4.33-4.33 | 3.82-6.12 | 3.36-4.59 | - | 1.53-4.38 | | |
| (n) | (10) | (75) | (254) | - | (52) | | |

1 ACT: artemisinin-based combination therapy; AMT: artemisinin monotherapy; nAT: non artemisinin therapy; RDT: Rapid diagnostic test for malaria. 2 The values for median number of AETDs sold reported for 'all' formulations include all dosage forms (tablets, suppositories, oral liquids, injectables and granules); however because so few wholesaler and retailers stocked suppositories, and so few of these product types were observed during the audit, results are not presented here. 3 As these are weighted medians, medians are not the average of the middle two ordered observations for instances where there are an even number of observations. 4 Private health facilities include both for-profit and not-for-profit facilities; General retailers include boutiques, shops, kiosks, market stalls and other outlet types that do not fit into any of the mentioned outlet categories. Note: 90 of 9764 (0.9%) observations (3 in pharmacies, 8 in private health facilities, 77 in drug stores, 1 in general retailers, 1 in public health facilities) were set to missing due to mark-ups in excess of 1000% which were likely due to errors during data collection. Data collected by the ACTwatch Group during the DRC 2009 Outlet Survey. www.actwatch.info

4.10. Price mark-ups on antimalarials and RDTs

4.10.1. Percent Mark-Ups on Antimalarials and RDTs

In general, the percentage mark-up is calculated as the difference between the selling price and the purchase price, divided by the purchase price. It captures both the costs of doing business and profit to the seller. Because wholesalers vary their prices, minimum, maximum and mid mark-ups were calculated using data on minimum and maximum selling price charged for one unit by wholesalers. The wholesale percent mid mark-up was calculated as the difference between the average wholesale selling price (i.e. the mid-point between the maximum and minimum wholesale selling price) and wholesale purchase price, divided by wholesale purchase price. The retail percent mark-up was calculated using the retail selling price and purchase price collected during the second ACTwatch Outlet Survey in 2009.⁹

Wholesale level (Table 4.10.1.1)

- Wholesale mark-ups were low and consistent across antimalarial categories and dosage forms: the median mid percent mark-up was 11.1% (IQR 5.8-22.7) on ACT, 11.1% (IQR 6.5-20.0) on AMTs, and 12.4% (IQR 6.8-25.0) on nAT. However, higher mark-ups were applied to WHO prequalified ACTs (19.3%, IQR 6.7-45.6), and lower mark-ups to ACTs in granule form (7.5%, IQR 5.0-17.7).
- Wholesalers supplying other wholesalers tended to apply lower median mid percent than wholesalers supplying retailers, and the difference in mark-ups applied between distribution chain levels ranged from no difference on nAT oral liquids to 8.8% points on WHO prequalified ACTs.
- Wholesalers reported varying their mark-up on 6.3% of all observed products depending on the volume being purchased (based on the 1914 observations where mark-up data were obtained). The difference between the highest and lowest median mark-ups was around 3.3% points for ACTs, 1.4% points for AMTs, and 9.5% points for nATs.
- The wholesale median mid percent mark-up on RDTs was 10.3% (IQR 0.0-20.5).

Retail level (Table 4.10.1.2)

- At retail level, percent mark-ups were higher than those observed at wholesale level and varied across retailer types and antimalarial categories. In pharmacies, median percent mark-ups ranged from 23.5-66.7%; from 26.7-66.7% in private health facilities; from 27.3-66.7% in drug stores; and from 22.8-100.0% in general retailers.
- Within specific retailer types, the highest percent mark-ups tended to be applied to WHO prequalified ACT tablet products.
- Apart from non-WHO prequalified ACTs, public health facilities tended to apply lower mark-ups compared to private outlets; and the typical mark-up on WHO prequalified ACTs applied by public facilities was 0.0% (IQR 0.0-25.0).

First-line treatments for uncomplicated Pf malaria

- At wholesale level, the median mid percent mark-up was 13.9% (IQR 5.0-29.7) for ASAQ, 11.1% (IQR 6.4-20.4) for quinine, the antimalarial with the highest number of AETDs distributed, and 19.8% (IQR 7.5-32.5) on SP, which had the second highest number of AETDs distributed.
- At retail level, the median percent mark-up for ASAQ ranged from 33.3% (IQR 33.3-66.7) at pharmacies to 100.0% (IQR 100.0-150.0) at general retailers; for quinine from 42.9% (IQR 28.-66.7) at drug stores to 66.7% (IQR 50.0-100.0) at general retailers; and for SP from 46.3% (IQR 33.3-62.5) at pharmacies to 66.7% (IQR 56.3-100.0) at general retailers.

⁹ Negative percent mark-ups were recorded in several cases, for which there are several possible explanations: (1) data collection errors (e.g. antimalarials bought in relatively large pack sizes and sold by the tablet were sometimes subject to errors); (2) some businesses may have sold products at lower prices than at which they were bought to deal with slow moving products or because the purchase price has increased and the business was still selling the 'old' product at the 'old' price.

Table 4.10.1.1: Percent price mark-ups on antimalarials and RDTs, wholesale level (%)

| ANTIMALARIAL TYPE ¹ Formulation ² | | | WHOLESALE CATEGORIES | | | | | | | | |
|--|---------------------------|---------------|--------------------------|-------------|-------------|----------------------------|-------------|-------------|---------------------------|-------------|-------------|
| | | | ALL WHOLESALERS N=135 | | | SUPPLY WHOLESALERS N=46 | | | SUPPLY RETAILERS N=124 | | |
| | | | MID | LOW | HIGH | MID | LOW | HIGH | MID | LOW | HIGH |
| All ACT | All | Median | 11.1 | 11.1 | 11.1 | 8.9 | 8.9 | 8.9 | 11.1 | 11.1 | 11.1 |
| | | IQR | 5.8-22.7 | 5.7-22.7 | 5.8-23.1 | 5.0-13.9 | 5.0-13.9 | 5.0-13.9 | 5.3-22.0 | 5.3-22.0 | 5.3-22.4 |
| | | (n) | | (685) | | | (260) | | (656) | | |
| | Tablet | Median | 11.1 | 11.1 | 11.1 | 10.0 | 10.0 | 10.0 | 11.1 | 11.1 | 11.1 |
| | IQR | 6.4-25.0 | 6.4-24.9 | 6.4-25.0 | 5.0-14.2 | 5.0-14.2 | 5.0-14.2 | 6.2-23.6 | 6.1-23.6 | 6.2-24.3 | |
| | (n) | | (472) | | | (181) | | (450) | | | |
| | Oral liquid | Median | 11.1 | 11.1 | 11.1 | 6.2 | 6.2 | 6.2 | 11.1 | 11.1 | 11.1 |
| | IQR | 5.2-21.1 | 5.2-21.1 | 5.2-21.1 | 5.0-12.5 | 5.0-12.5 | 5.0-12.5 | 5.2-21.1 | 5.2-21.1 | 5.2-21.1 | |
| | (n) | | (202) | | | (72) | | (195) | | | |
| | Granule | Median | 7.5 | 7.5 | 7.5 | 5.0 | 5.0 | 5.0 | 7.5 | 7.5 | 7.5 |
| | IQR | 5.0-17.7 | 5.0-17.7 | 5.0-17.7 | 5.0-17.7 | 5.0-17.7 | 5.0-17.7 | 5.0-17.7 | 5.0-17.7 | 5.0-17.7 | |
| | (n) | | (9) | | | (5) | | (9) | | | |
| WHO prequalified ACT³ | All products were tablets | Median | 19.3 | 19.3 | 19.3 | 8.9 | 8.9 | 8.9 | 17.7 | 17.7 | 17.7 |
| | | IQR | 6.7-45.6 | 6.7-44.2 | 6.7-45.6 | 5.0-17.7 | 5.0-17.7 | 5.0-17.7 | 6.6-42.9 | 6.6-40.0 | 6.6-42.9 |
| | (n) | | (52) | | | (22) | | (47) | | | |
| Non WHO prequalified ACT | All | Median | 11.1 | 11.1 | 11.1 | 8.8 | 8.8 | 8.8 | 11.1 | 11.1 | 11.1 |
| | | IQR | 5.6-21.6 | 5.4-21.2 | 5.6-21.8 | 5.0-13.3 | 5.0-13.3 | 5.0-13.3 | 5.3-20.8 | 5.3-20.5 | 5.3-21.1 |
| | | (n) | | (632) | | | (237) | | (608) | | |
| | Tablet | Median | 11.1 | 11.1 | 11.1 | 10.0 | 10.0 | 10.0 | 11.1 | 11.1 | 11.1 |
| | IQR | 6.4-21.7 | 6.2-21.5 | 6.4-22.0 | 5.0-14.2 | 5.0-14.2 | 5.0-14.2 | 6.1-21.3 | 5.8-20.5 | 6.1-21.3 | |
| | (n) | | (420) | | | (159) | | (403) | | | |
| | Oral liquid | Median | 11.1 | 11.1 | 11.1 | 6.2 | 6.2 | 6.2 | 11.1 | 11.1 | 11.1 |
| | IQR | 5.2-21.1 | 5.2-21.1 | 5.2-21.1 | 5.0-12.5 | 5.0-12.5 | 5.0-12.5 | 5.2-21.1 | 5.2-21.1 | 5.2-21.1 | |
| | (n) | | (202) | | | (72) | | (195) | | | |
| | Granule | Median | 7.5 | 7.5 | 7.5 | 5.0 | 5.0 | 5.0 | 7.5 | 7.5 | 7.5 |
| | IQR | 5.0-17.7 | 5.0-17.7 | 5.0-17.7 | 5.0-17.7 | 5.0-17.7 | 5.0-17.7 | 5.0-17.7 | 5.0-17.7 | 5.0-17.7 | |
| | (n) | | (9) | | | (5) | | (9) | | | |

| ANTIMALARIAL TYPE ¹ Formulation ² | | | WHOLESALE CATEGORIES | | | | | | | | |
|--|--------|----------|--------------------------|----------|----------|----------------------------|----------|----------|---------------------------|----------|----------|
| | | | ALL WHOLESALERS N=135 | | | SUPPLY WHOLESALERS N=46 | | | SUPPLY RETAILERS N=124 | | |
| | | | MID | LOW | HIGH | MID | LOW | HIGH | MID | LOW | HIGH |
| AMT | All | Median | 11.1 | 11.1 | 11.1 | 6.4 | 6.4 | 6.4 | 11.1 | 11.1 | 11.1 |
| | | IQR | 6.5-20.0 | 6.5-20.0 | 6.5-20.0 | 5.0-11.1 | 5.0-11.1 | 5.0-11.1 | 6.4-20.0 | 6.4-20.0 | 6.5-20.0 |
| | | (n) | | (273) | | | (94) | | (265) | | |
| | Tablet | Median | 11.2 | 11.2 | 11.2 | 5.3 | 5.3 | 5.3 | 12.2 | 12.2 | 12.2 |
| IQR | | 9.3-18.9 | 9.3-18.9 | 9.3-18.9 | 5.0-10.9 | 5.0-10.9 | 5.0-10.9 | 9.3-19.0 | 9.3-19.0 | 9.3-19.0 | |
| (n) | | | (44) | | | (10) | | (42) | | | |
| Oral liquid | Median | 11.1 | 11.1 | 11.1 | 9.1 | 9.1 | 9.1 | 11.1 | 11.1 | 11.1 | |
| | IQR | 6.6-17.2 | 6.6-16.0 | 6.6-17.2 | 5.3-11.6 | 5.3-11.6 | 5.3-11.6 | 7.0-17.6 | 7.0-16.6 | 7.0-17.9 | |
| | (n) | | (63) | | | (18) | | (60) | | | |
| Injectable | Median | 11.1 | 11.1 | 11.1 | 7.2 | 6.9 | 7.2 | 11.1 | 11.1 | 11.1 | |
| | IQR | 5.5-22.0 | 5.4-22.0 | 5.5-22.3 | 5.0-11.1 | 5.0-11.1 | 5.0-11.1 | 5.4-21.4 | 5.3-21.4 | 5.4-22.0 | |
| | (n) | | (161) | | | (63) | | (158) | | | |
| nAT | All | Median | 12.4 | 12.3 | 12.6 | 10.0 | 10.0 | 10.0 | 12.2 | 11.9 | 12.2 |
| | | IQR | 6.8-25.0 | 6.7-25.0 | 6.9-25.0 | 5.0-17.0 | 5.0-17.0 | 5.0-17.0 | 6.6-25.0 | 6.6-24.7 | 6.7-25.0 |
| | | (n) | | (634) | | | (194) | | (605) | | |
| | Tablet | Median | 12.4 | 12.2 | 12.7 | 9.8 | 9.8 | 9.8 | 12.2 | 11.9 | 12.6 |
| IQR | | 6.4-25.0 | 6.4-25.0 | 6.4-25.0 | 5.0-15.8 | 5.0-15.8 | 5.0-15.8 | 6.3-25.0 | 6.3-24.7 | 6.4-25.0 | |
| (n) | | | (354) | | | (111) | | (341) | | | |
| Oral liquid | Median | 12.2 | 12.1 | 12.3 | 11.2 | 11.2 | 11.2 | 11.9 | 11.8 | 11.9 | |
| | IQR | 8.5-25.0 | 8.4-24.2 | 8.5-25.0 | 5.4-17.3 | 5.4-17.3 | 5.4-17.3 | 8.0-24.2 | 7.7-23.3 | 8.0-24.9 | |
| | (n) | | (210) | | | (62) | | (197) | | | |
| Injectable | Median | 13.3 | 13.3 | 13.3 | 5.3 | 5.3 | 5.3 | 12.5 | 12.5 | 12.5 | |
| | IQR | 5.1-25.0 | 5.1-25.0 | 5.1-25.0 | 2.5-17.7 | 2.5-17.7 | 2.5-17.7 | 5.0-25.0 | 5.0-25.0 | 5.0-25.0 | |
| | (n) | | (61) | | | (19) | | (58) | | | |
| RDT (per unit) | Median | 10.3 | 10.3 | 10.3 | - | - | - | 10.3 | 10.3 | 10.3 | |
| | IQR | 0.0-20.5 | 0.0-20.5 | 0.0-20.5 | - | - | - | 0.0-20.5 | 0.0-20.5 | 0.0-20.5 | |
| | (n) | | (2) | | | - | | (2) | | | |

¹ ACT: artemisinin-based combination therapy; AMT: artemisinin monotherapy; nAT: non artemisinin therapy; RDT: Rapid diagnostic test for malaria. ² The values for median number of AETDs sold reported for 'all' formulations include all dosage forms (tablets, suppositories, oral liquids, injectables and granules); however because so few wholesaler and retailers stocked suppositories, and so few of these product types were observed during the audit, results are not presented separately for these categories in this table, but are instead provided in the appendix. ³ There were 12 unbranded ASAQ products manufactured in India which had insufficient product information recorded to categorise as WHO prequalified products; taking a conservative approach, these products were categorised as non-WHO prequalified ACTs.

Table 4.10.1.2: Percent price mark-ups on antimalarials, retail level (%)

| ANTIMALARIAL TYPE ¹ Formulation ² | | | RETAILER CATEGORIES ³ | | | | |
|--|---------------------------|----------------------|----------------------------------|--|-----------------------------|---|--|
| | | | PHARMACIES N=30 | PRIVATE HEALTH FACILITIES N=112 | DRUG STORES N=945 | GENERAL RETAILERS ⁴ N=16 | PUBLIC HEALTH FACILITIES N=76 |
| All ACT | All | Median IQR (n) | 33.3 20.0-57.7 (203) | 30.6 11.1-50.0 (64) | 35.1 22.4-66.7 (1862) | 25.0 22.8-100.0 (8) | 0.0 0.0-25.0 (95) |
| | Tablet | Median IQR (n) | 33.3 20.0-66.7 (148) | 30.6 10.0-50.0 (51) | 38.9 25.0-66.7 (1415) | 25.0 22.8-100.0 (7) | 0.0 0.0-25.0 (93) |
| | Oral liquid | Median IQR (n) | 23.5 13.2-33.3 (47) | 31.6 13.9-39.0 (13) | 29.4 17.6-36.8 (416) | 69.8 69.8-69.8 (1) | 47.1 47.1-47.1 (2) |
| | Granule | Median IQR (n) | 29.6 20.0-29.6 (8) | - - - | 33.3 23.8-42.9 (31) | - - - | - - - |
| WHO prequalified ACT | All products were tablets | Median IQR (n) | 66.7 33.3-66.7 (23) | 50.0 0.0-133.3 (22) | 50.0 33.3-84.8 (220) | 100.0 100.0-150.0 (3) | 0.0 0.0-25.0 (81) |
| Non WHO prequalified ACT | All | Median IQR (n) | 23.5 15.4-34.6 (180) | 30.6 12.9-42.9 (42) | 31.3 19.1-50.0 (1642) | 25.0 22.8-69.8 (5) | 60.0 20.0-76.5 (14) |
| | Tablet | Median IQR (n) | 23.4 15.4-40.0 (125) | 28.6 12.9-48.2 (29) | 33.3 20.0-53.8 (1195) | 22.8 22.8-25.0 (4) | 60.0 20.0-76.5 (12) |
| | Oral liquid | Median IQR (n) | 23.5 13.2-33.3 (47) | 31.6 13.9-39.0 (13) | 29.4 17.6-36.8 (416) | 69.8 69.8-69.8 (1) | 47.1 47.1-47.1 (2) |
| | Granule | Median IQR (n) | 29.6 20.0-29.6 (8) | - - - | 33.3 23.8-42.9 (31) | - - - | - - - |
| AMT | All | Median IQR (n) | 30.0 20.0-42.9 (124) | 41.2 25.0-50.0 (76) | 31.7 20.0-46.7 (1937) | 20.0 19.0-28.2 (6) | 22.0 0.0-33.7 (13) |
| | Tablet | Median IQR (n) | 25.0 20.0-33.3 (41) | 26.7 20.0-42.9 (30) | 33.3 21.2-50.0 (740) | 20.0 19.0-28.2 (6) | 27.8 -88.0-33.7 (6) |
| | Oral liquid | Median IQR (n) | 29.0 18.4-38.5 (42) | 42.9 38.9-55.6 (19) | 27.3 18.8-40.7 (834) | - - - | 22.0 18.6-22.0 (5) |
| | Injectable | Median IQR (n) | 42.9 26.3-50.0 (41) | 45.6 25.0-63.8 (26) | 33.3 25.0-50.0 (356) | - - - | 0.0 0.0-28.7 (2) |
| nAT | All | Median IQR (n) | 46.3 30.1-75.0 (213) | 48.1 25.0-96.1 (266) | 50.0 31.5-75.0 (4591) | 75.0 56.3-100.0 (33) | 23.1 0.0-50.0 (183) |
| | Tablet | Median IQR (n) | 50.0 32.1-81.8 (122) | 66.7 26.7-100.0 (138) | 50.0 33.3-87.5 (2642) | 91.1 56.3-100.0 (32) | 20.0 0.0-50.0 (113) |
| | Oral liquid | Median IQR (n) | 33.3 28.6-50.0 (81) | 33.3 20.0-38.9 (55) | 39.5 25.0-60.0 (1686) | 75.0 75.0-75.0 (1) | 33.3 0.0-50.0 (22) |
| | Injectable | Median IQR (n) | 47.1 47.1-47.1 (10) | 48.1 25.0-76.5 (71) | 60.0 33.3-81.8 (252) | - - - | 25.0 0.0-53.8 (48) |

1 ACT: artemisinin-based combination therapy; AMT: artemisinin monotherapy; nAT: non artemisinin therapy; RDT: Rapid diagnostic test for malaria. 2 The values for median number of AETDs sold reported for 'all' formulations include all dosage forms (tablets, suppositories, oral liquids, injectables and granules); however because so few wholesaler and retailers stocked suppositories, and so few of these product types were observed during the audit, results are not presented here. 3 As these are weighted medians, medians are not the average of the middle two ordered observations for instances where there are an even number of observations. 4 Private health facilities include both for-profit and not-for-profit facilities; General retailers include boutiques, shops, kiosks, market stalls and other outlet types that do not fit into any of the mentioned outlet categories. Note: 90 of 9764 (0.9%) observations (3 in pharmacies, 8 in private health facilities, 77 in drug stores, 1 in general retailers, 1 in public health facilities) were set to missing due to mark-ups in excess of 1000% which were likely due to errors during data collection. Data collected by the ACTwatch Group during the DRC 2009 Outlet Survey. www.actwatch.info

4.10.2. Absolute mark-ups on antimalarials and RDTs (US\$)

In general, the absolute mark-up is calculated as the difference between the selling price and the purchase price per AETD and is reported in US dollars. As with the percent mark-up, it captures both the costs of doing business and profit to the seller. Because wholesalers vary their prices, minimum, maximum and mid mark-ups were calculated using data on minimum and maximum selling price charged per AETD by wholesalers. The wholesale absolute mid mark-up was calculated as the difference between the average wholesale selling price (i.e. the mid-point between the maximum and minimum wholesale selling price) and wholesale purchase price. The retail absolute mark-up was calculated using the retail selling price and purchase price collected during the 2009 ACTwatch Outlet Survey. Data were collected in local currencies and converted to their US\$ equivalent using the average interbank rate for the duration of the fieldwork period.

Wholesale level (Table 4.10.2.1)

- At wholesale level, median mid absolute mark-ups were highest on AMTs (US\$ 0.72, IQR: 0.36-1.65), followed by ACTs (US\$ 0.44, IQR: 0.23-0.89), and then nATs (US\$ 0.27, IQR: 0.08-.076), generally corresponding to differences in median purchase price (i.e. because percent mark-ups did not vary considerably across antimalarial category, higher purchase price led to higher absolute mark-ups).
- Comparing across levels of the wholesale distribution chain, wholesalers supplying retailers consistently applied higher absolute mark-ups than those supplying other wholesalers. As typical purchase prices were generally comparable across these two levels of the distribution chain, these differences correspond to the higher median percent mark-ups consistently applied by wholesalers supplying retailers.
- The median absolute mid mark-up on RDTs was US\$ 0.14 (IQR 0.00-0.28) among all wholesalers.

Retail level (Table 4.10.2.2)

- At retail level, median absolute mark-ups for ACTs ranged from US\$ 0.79 (IQR 0.69-0.85) at general retailers to US\$ 0.97 (IQR 0.36-1.70) at pharmacies; for AMTs from US\$ 0.90 (IQR 0.49-1.17) at general retailers to US\$ 1.34 (IQR 0.61-2.91) at pharmacies; and for nATs from US\$ 0.36 (IQR 0.15-1.09) at general retailers to US\$ 1.27 (IQR 0.23-2.55) at private health facilities.
- Across the retailer categories, general retailers tended to apply the lowest absolute mark-ups on antimalarials because they tended to carry a greater proportion of tablet products, rather than the relatively more expensive oral liquid, injectable or granule dosage forms.
- Despite applying considerably higher *percent* mark-ups on WHO prequalified ACTs than on non-prequalified ACTs, private outlets tended to apply lower *absolute* mark-ups for WHO prequalified ACTs. This is due to the very low typical prices these types of retail outlets paid to purchase WHO prequalified ACTs compared to non-prequalified products.

First-line treatments for uncomplicated Pf malaria

- At wholesale level, the median mid absolute mark-ups were US\$ 0.27 (IQR 0.12-0.62) for ASAQ, US\$ 0.50 (IQR 0.21-1.12) for quinine, the antimalarial with the highest number of AETDs distributed, and US\$ 0.05 (IQR 0.02-0.10) on SP, which had the second highest number of AETDs distributed.
- At retail level, the median absolute mark-up for ASAQ ranged from US\$ 0.34 (IQR 0.00-0.49) at private health facilities to US\$ 0.58 (IQR 0.36-1.21) at drug stores; for quinine from US\$ 1.71 (IQR 1.02-2.45) at general retailers to US\$ 1.91 (IQR 0.92-2.52) at pharmacies; and for SP from US\$ 0.10 (IQR 0.01-0.18) at private health facilities to US\$ 0.18 (IQR 0.09-1.09) at general retailers.

Table 4.10.2.1: Absolute price mark ups on antimalarials and RDTs, wholesale level (US\$)

| ANTIMALARIAL TYPE ¹ Formulation ² | | | WHOLESALE CATEGORIES | | | | | | | | |
|--|---------------------------|-----------|--------------------------|-------------|-------------|----------------------------|-------------|-------------|---------------------------|-------------|-------------|
| | | | ALL WHOLESALERS N=135 | | | SUPPLY WHOLESALERS N=46 | | | SUPPLY RETAILERS N=124 | | |
| | | | MID | LOW | HIGH | MID | LOW | HIGH | MID | LOW | HIGH |
| All ACT | All | Median | 0.44 | 0.43 | 0.44 | 0.35 | 0.35 | 0.35 | 0.42 | 0.42 | 0.43 |
| | | IQR | 0.23-0.89 | 0.23-0.89 | 0.23-0.89 | 0.21-0.71 | 0.21-0.68 | 0.21-0.71 | 0.23-0.88 | 0.23-0.88 | 0.23-0.89 |
| | | (n) | | (679) | | | (254) | | (650) | | |
| | Tablet | Median | 0.33 | 0.32 | 0.33 | 0.29 | 0.29 | 0.29 | 0.32 | 0.32 | 0.32 |
| | IQR | 0.19-0.58 | 0.19-0.58 | 0.19-0.59 | 0.16-0.50 | 0.16-0.50 | 0.16-0.50 | 0.19-0.56 | 0.19-0.56 | 0.19-0.56 | |
| | (n) | | (468) | | | (177) | | (446) | | | |
| | Oral liquid | Median | 0.81 | 0.81 | 0.81 | 0.58 | 0.58 | 0.58 | 0.81 | 0.81 | 0.81 |
| | IQR | 0.40-1.48 | 0.40-1.48 | 0.40-1.48 | 0.35-1.11 | 0.35-1.11 | 0.35-1.11 | 0.40-1.48 | 0.40-1.48 | 0.40-1.48 | |
| | (n) | | (200) | | | (70) | | (193) | | | |
| | Granule | Median | 2.86 | 2.86 | 2.86 | 1.56 | 1.56 | 1.56 | 2.86 | 2.86 | 2.86 |
| | IQR | 1.56-3.30 | 1.56-3.30 | 1.56-3.30 | 1.00-3.30 | 1.00-3.30 | 1.00-3.30 | 1.56-3.30 | 1.56-3.30 | 1.56-3.30 | |
| | (n) | | (9) | | | (5) | | (9) | | | |
| WHO prequalified ACT ³ | All products were tablets | Median | 0.45 | 0.44 | 0.45 | 0.42 | 0.42 | 0.42 | 0.44 | 0.44 | 0.44 |
| | | IQR | 0.29-0.89 | 0.29-0.89 | 0.29-0.89 | 0.28-0.90 | 0.28-0.90 | 0.28-0.90 | 0.28-0.79 | 0.28-0.77 | 0.28-0.84 |
| | | (n) | | (52) | | | (22) | | (47) | | |
| Non WHO prequalified ACT | All | Median | 0.43 | 0.42 | 0.43 | 0.35 | 0.35 | 0.35 | 0.42 | 0.41 | 0.42 |
| | | IQR | 0.23-0.89 | 0.23-0.89 | 0.23-0.89 | 0.20-0.60 | 0.20-0.60 | 0.20-0.60 | 0.23-0.88 | 0.22-0.88 | 0.23-0.89 |
| | | (n) | | (626) | | | (231) | | (602) | | |
| | Tablet | Median | 0.32 | 0.32 | 0.32 | 0.26 | 0.26 | 0.26 | 0.31 | 0.31 | 0.31 |
| | IQR | 0.19-0.56 | 0.18-0.56 | 0.19-0.56 | 0.16-0.46 | 0.16-0.46 | 0.16-0.46 | 0.18-0.56 | 0.18-0.56 | 0.18-0.56 | |
| | (n) | | (416) | | | (155) | | (399) | | | |
| | Oral liquid | Median | 0.81 | 0.81 | 0.81 | 0.58 | 0.58 | 0.58 | 0.81 | 0.81 | 0.81 |
| | IQR | 0.40-1.48 | 0.40-1.48 | 0.40-1.48 | 0.35-1.11 | 0.35-1.11 | 0.35-1.11 | 0.40-1.48 | 0.40-1.48 | 0.40-1.48 | |
| | (n) | | (200) | | | (70) | | (193) | | | |
| | Granule | Median | 2.86 | 2.86 | 2.86 | 1.56 | 1.56 | 1.56 | 2.86 | 2.86 | 2.86 |
| | IQR | 1.56-3.30 | 1.56-3.30 | 1.56-3.30 | 1.00-3.30 | 1.00-3.30 | 1.00-3.30 | 1.56-3.30 | 1.56-3.30 | 1.56-3.30 | |
| | (n) | | (9) | | | (5) | | (9) | | | |

| ANTIMALARIAL TYPE ¹ Formulation ² | | | WHOLESALE CATEGORIES | | | | | | | | |
|--|-------------|-----------|--------------------------|-------------|-------------|----------------------------|-------------|-------------|---------------------------|-------------|-------------|
| | | | ALL WHOLESALERS N=135 | | | SUPPLY WHOLESALERS N=46 | | | SUPPLY RETAILERS N=124 | | |
| | | | MID | LOW | HIGH | MID | LOW | HIGH | MID | LOW | HIGH |
| AMT | All | Median | 0.72 | 0.72 | 0.72 | 0.58 | 0.58 | 0.58 | 0.72 | 0.72 | 0.72 |
| | | IQR | 0.36-1.65 | 0.36-1.64 | 0.36-1.70 | 0.34-1.04 | 0.34-1.04 | 0.34-1.04 | 0.36-1.65 | 0.36-1.64 | 0.36-1.70 |
| | | (n) | | (273) | | | (94) | | (265) | | |
| | Tablet | Median | 0.27 | 0.27 | 0.27 | 0.13 | 0.13 | 0.13 | 0.27 | 0.27 | 0.27 |
| | IQR | 0.20-0.51 | 0.20-0.51 | 0.20-0.51 | 0.10-0.23 | 0.10-0.23 | 0.10-0.23 | 0.20-0.53 | 0.20-0.53 | 0.20-0.53 | |
| | (n) | | (44) | | | (10) | | (42) | | | |
| | Oral liquid | Median | 0.60 | 0.60 | 0.60 | 0.59 | 0.59 | 0.59 | 0.60 | 0.60 | 0.60 |
| | IQR | 0.32-1.10 | 0.32-1.10 | 0.32-1.10 | 0.32-0.95 | 0.32-0.95 | 0.32-0.95 | 0.32-1.11 | 0.32-1.11 | 0.32-1.11 | |
| | (n) | | (63) | | | (18) | | (60) | | | |
| | Injectable | Median | 1.09 | 1.09 | 1.09 | 0.66 | 0.66 | 0.66 | 1.08 | 1.08 | 1.08 |
| | IQR | 0.50-2.31 | 0.50-2.31 | 0.50-2.33 | 0.48-1.25 | 0.48-1.25 | 0.48-1.25 | 0.50-2.23 | 0.50-2.23 | 0.50-2.31 | |
| | (n) | | (161) | | | (63) | | (158) | | | |
| nAT | All | Median | 0.27 | 0.27 | 0.27 | 0.24 | 0.24 | 0.24 | 0.26 | 0.26 | 0.27 |
| | | IQR | 0.08-0.76 | 0.08-0.75 | 0.09-0.77 | 0.10-0.61 | 0.10-0.59 | 0.10-0.61 | 0.08-0.73 | 0.08-0.70 | 0.09-0.75 |
| | | (n) | | (633) | | | (194) | | (604) | | |
| | Tablet | Median | 0.12 | 0.12 | 0.13 | 0.13 | 0.13 | 0.13 | 0.12 | 0.12 | 0.13 |
| | IQR | 0.04-0.27 | 0.04-0.27 | 0.04-0.28 | 0.04-0.30 | 0.04-0.30 | 0.04-0.30 | 0.04-0.27 | 0.04-0.27 | 0.04-0.28 | |
| | (n) | | (353) | | | (111) | | (340) | | | |
| | Oral liquid | Median | 0.70 | 0.68 | 0.70 | 0.60 | 0.60 | 0.60 | 0.67 | 0.67 | 0.69 |
| | IQR | 0.34-1.40 | 0.33-1.33 | 0.34-1.40 | 0.31-1.19 | 0.31-1.19 | 0.31-1.19 | 0.34-1.33 | 0.33-1.26 | 0.34-1.33 | |
| | (n) | | (210) | | | (62) | | (197) | | | |
| | Injectable | Median | 0.51 | 0.51 | 0.51 | 0.27 | 0.27 | 0.27 | 0.51 | 0.51 | 0.51 |
| | IQR | 0.25-1.12 | 0.25-1.07 | 0.25-1.12 | 0.09-0.59 | 0.09-0.57 | 0.09-0.59 | 0.20-1.26 | 0.20-1.12 | 0.20-1.26 | |
| | (n) | | (61) | | | (19) | | (58) | | | |
| RDT (per unit) | | Median | 0.14 | 0.14 | 0.14 | - | - | - | 0.14 | 0.14 | 0.14 |
| | | IQR | 0.0-0.28 | 0.0-0.28 | 0.0-0.28 | - | - | - | 0.0-0.28 | 0.0-0.28 | 0.0-0.28 |
| | | (n) | | (2) | | | - | | (2) | | |

¹ACT: artemisinin-based combination therapy; AMT: artemisinin monotherapy; nAT: non artemisinin therapy; RDT: Rapid diagnostic test for malaria. ² The values for median number of AETDs sold reported for 'all' formulations include all dosage forms (tablets, suppositories, oral liquids, injectables and granules); however because so few wholesaler and retailers stocked suppositories, and so few of these product types were observed during the audit, results are not presented separately for these categories in this table, but are instead provided in the appendix. ³ There were 12 unbranded ASAQ products manufactured in India which had insufficient product information recorded to categorise as WHO prequalified products; taking a conservative approach, these products were categorised as non-WHO prequalified ACTs.

Table 4.10.2.2: Absolute price mark ups on antimalarials, retail level (US\$)

| ANTIMALARIAL TYPE ¹ Formulation ² | | | RETAILER CATEGORIES ³ | | | | |
|--|---------------------------|-----------|----------------------------------|--|----------------------|---|--|
| | | | PHARMACIES N=30 | PRIVATE HEALTH FACILITIES N=113 | DRUG STORES N=946 | GENERAL RETAILERS ⁴ N=16 | PUBLIC HEALTH FACILITIES N=81 |
| All ACT | All | Median | 0.97 | 0.49 | 0.91 | 0.79 | 0.00 |
| | | IQR | 0.36-1.70 | 0.24-1.36 | 0.49-1.62 | 0.69-0.85 | 0.00-0.49 |
| | | (n) | (203) | (65) | (1864) | (8) | (118) |
| | Tablet | Median | 0.70 | 0.42 | 0.74 | 0.79 | 0.00 |
| | IQR | 0.29-1.21 | 0.07-0.97 | 0.46-1.22 | 0.49-0.85 | 0.00-0.49 | |
| | (n) | (148) | (52) | (1416) | (7) | (116) | |
| | Oral liquid | Median | 1.70 | 1.36 | 2.10 | 11.98 | 1.55 |
| | IQR | 1.29-2.91 | 1.36-1.94 | 1.62-3.24 | 11.98-11.98 | 1.55-1.55 | |
| | (n) | (47) | (13) | (417) | (1) | (2) | |
| | Granule | Median | 3.88 | - | 2.43 | - | - |
| | IQR | 3.40-3.88 | - | 1.21-3.40 | - | - | |
| | (n) | (8) | - | (31) | - | - | |
| WHO prequalified ACT | All products were tablets | Median | 0.73 | 0.36 | 0.73 | 0.44 | 0.00 |
| | | IQR | 0.24-1.70 | 0.00-0.61 | 0.37-1.46 | 0.18-0.49 | 0.00-0.49 |
| | | (n) | (23) | (23) | (220) | (3) | (104) |
| Non WHO prequalified ACT | All | Median | 0.97 | 0.91 | 0.97 | 0.85 | 0.53 |
| | | IQR | 0.58-1.70 | 0.42-1.59 | 0.49-1.65 | 0.79-3.03 | 0.30-1.55 |
| | | (n) | (180) | (42) | (1644) | (5) | (14) |
| | Tablet | Median | 0.64 | 0.64 | 0.79 | 0.79 | 0.36 |
| | IQR | 0.49-1.20 | 0.36-0.97 | 0.49-1.21 | 0.69-0.85 | 0.24-0.73 | |
| | (n) | (125) | (29) | (1196) | (4) | (12) | |
| | Oral liquid | Median | 1.70 | 1.36 | 2.10 | 11.98 | 1.55 |
| | IQR | 1.29-2.91 | 1.36-1.94 | 1.62-3.24 | 11.98-11.98 | 1.55-1.55 | |
| | (n) | (47) | (13) | (417) | (1) | (2) | |
| | Granule | Median | 3.88 | - | 2.43 | - | - |
| | IQR | 3.40-3.88 | - | 1.21-3.40 | - | - | |
| | (n) | (8) | - | (31) | - | - | |
| AMT | All | Median | 1.34 | 1.26 | 1.27 | 0.90 | 0.34 |
| | | IQR | 0.61-2.91 | 0.74-2.72 | 0.61-2.33 | 0.49-1.17 | 0.00-0.76 |
| | | (n) | (124) | (76) | (1939) | (6) | (13) |
| | Tablet | Median | 0.61 | 0.78 | 0.68 | 0.90 | 0.34 |
| | IQR | 0.58-0.78 | 0.58-1.03 | 0.47-1.07 | 0.49-1.17 | -4.27-0.76 | |
| | (n) | (41) | (30) | (740) | (6) | (6) | |
| | Oral liquid | Median | 2.01 | 2.04 | 1.94 | - | 0.91 |
| | IQR | 1.17-3.11 | 1.31-3.06 | 1.24-3.11 | - | 0.52-0.91 | |
| | (n) | (42) | (19) | (836) | - | (5) | |
| | Injectable | Median | 2.91 | 2.91 | 3.14 | - | 0.00 |
| | IQR | 1.87-4.58 | 2.23-5.39 | 1.98-4.52 | - | 0.00-4.22 | |
| | (n) | (41) | (26) | (356) | - | (2) | |
| nAT | All | Median | 0.92 | 1.27 | 0.70 | 0.36 | 0.12 |
| | | IQR | 0.31-2.04 | 0.23-2.55 | 0.18-1.82 | 0.15-1.09 | 0.00-1.21 |
| | | (n) | (213) | (266) | (4591) | (33) | (194) |
| | Tablet | Median | 0.61 | 0.38 | 0.28 | 0.20 | 0.06 |
| | IQR | 0.15-1.28 | 0.12-1.15 | 0.12-0.92 | 0.15-1.27 | 0.00-0.79 | |
| | (n) | (122) | (138) | (2642) | (32) | (119) | |
| | Oral liquid | Median | 1.53 | 2.04 | 1.78 | 1.09 | 1.05 |
| | IQR | 0.91-3.06 | 1.53-3.06 | 0.73-3.44 | 1.09-1.09 | 0.00-2.55 | |
| | (n) | (81) | (55) | (1685) | (1) | (24) | |
| | Injectable | Median | 2.04 | 2.55 | 2.45 | - | 0.92 |
| | IQR | 2.04-2.04 | 1.53-3.06 | 1.53-3.21 | - | 0.00-2.29 | |
| | (n) | (10) | (71) | (253) | - | (51) | |

1 ACT: artemisinin-based combination therapy; AMT: artemisinin monotherapy; nAT: non artemisinin therapy; RDT: Rapid diagnostic test for malaria. 2 The values for median number of AETDs sold reported for 'all' formulations include all dosage forms (tablets, suppositories, oral liquids, injectables and granules); however because so few wholesalers and retailers stocked suppositories, and so few of these product types were observed during the audit, results are not presented here. 3 As these are weighted medians, medians are not the average of the middle two ordered observations for instances where there are an even number of observations. 4 Private health facilities include both for-profit and not-for-profit facilities; General retailers include boutiques, shops, kiosks, market stalls and other outlet types that do not fit into any of the mentioned outlet categories. Note: 90 of 9764 (0.9%) observations (3 in pharmacies, 8 in private health facilities, 77 in drug stores, 1 in general retailers, 1 in public health facilities) were set to missing due to mark-ups in excess of 1000% which were likely due to errors during data collection. Data collected by the ACTwatch Group during the DRC 2009 Outlet Survey. www.actwatch.info

5. Discussion

Supply Chain Structure and Wholesaler Characteristics

Antimalarials distributed through the private sector supply chain are likely to pass through 2 or 3 steps from manufacturer to retailer: We observed antimalarials to pass through a maximum of 6 steps from the manufacturers' factory gate to retail outlets, such as pharmacies, drug stores, private health facilities and general retailers. However, because almost all wholesalers (90%) surveyed sold antimalarials directly to retail outlets and nearly a third (29%) of all wholesalers purchased antimalarials from a domestic or foreign manufacturer as one of their top two supply sources, it is likely that most antimalarials pass through 2 or 3 supply chain steps to reach retail outlets (i.e. manufacturer → 1 or 2 wholesalers → retailer).

Intersectoral transactions were observed mainly at the lower level of the distribution chain, with private supplier-to-public facility transactions the most common: At outlet level, 12 of 33 top antimalarial supplier mentions collected from public health facilities were for private sector wholesalers, most of which were instances where small rural health posts and health centres purchased from pharmacies and drug stores in the nearest town. Where the public sector distribution network experiences irregular supply, stock outs and difficulties reaching some areas, the private sector is likely to fill the gap. But because public facilities typically charge fees for dispensing medicines using revolving drug fund mechanisms, this could potentially lead to unaffordable end-user prices if appropriate antimalarials cannot be purchased for reasonable prices from their private sector suppliers. Looking at interactions from the other direction, it is interesting to note that, unlike other countries where pharmaceutical procurement agencies operated by government and FBOs are key distributors of antimalarials to private retailers (such as the role of CAME in Benin and JMS in Uganda [24, 25]), only 14 of 471 mentions collected from private outlets in the DRC were for public, NGO or FBO sector suppliers. Of these 14 mentions, 10 listed public facilities as important supply sources, including *bureaux centraux*, hospitals, and *centrales de distribution*, and 4 listed NGO or FBO suppliers. Considering that public health facilities sell medicines in order to generate revenue, it is conceivable that small private outlets, such as drug stores, purchase low priced first-line treatment from these public facilities in small volumes. As the survey instrument used for this study is designed to capture information on the two most important suppliers only, such low-volume public-to-private transactions are likely to be missed; however, retail-level findings on purchase prices for WHO prequalified ACTs seem to support this notion: median purchase prices for WHO prequalified ACTs observed in private retail outlet were consistently higher than the purchase prices paid by public health facilities, and lower than the purchase prices observed at wholesale level. This finding suggests that retailers may be bypassing private sector wholesalers to purchase low-priced WHO prequalified ACTs from other sources. In addition to public facilities, these sources could include the many multilateral, bilateral, NGO and FBO actors that all bring high quality treatment into the country under various programmes for distribution through an array of often uncoordinated verticalised efforts. [7] If this is indeed the case, perhaps there is the potential to increase the scope of these types of supplier transactions to improve access to quality treatment in the retail sector – particularly given the infrastructure already in place to distribute health commodities in the public sector, with two national-level procurers and 15 regional *centrales de distribution*.

A third of wholesalers in the DRC are supplied directly by domestic and foreign manufacturers: Given the DRC's large population, malaria burden, and access to natural resources (including the starting material for quinine), it is not surprising that the country has considerable domestic capacity to manufacture antimalarials. Unpublished data from the 2009 ACTwatch Outlet Survey found that 41.5% of all audited products were manufactured in the DRC, followed by 30.4% in India. The pharmaceutical wholesale sector in

the DRC is similar to other countries in East Africa in that many large wholesalers are owned and operated by individuals who may be ethnically identified as South Asian, and continuing trade links between these wholesalers and suppliers in India may explain the prominence of Indian antimalarials in the Congolese market. More recently, the country's openness to foreign investment has certainly contributed to the proliferation of antimalarial product lines that are now locally produced. For example, following receipt of a license from a company in South Korea, a local manufacturer in Kinshasa, Co-Life Congo, began producing an oral AMT product, artemether, prior to 2004; and since then their portfolio has expanded to include dihydroartemisinin, artesunate+SP and dihydroartemisinin+SP preparations. However, by 2010 only one domestic manufacturer, Zenufa, was producing the government recommended first-line treatment, ASAQ, and oral AMTs continued to be manufactured in the DRC, despite being banned since 2007. [1] Tariffs of 10-19% also continue to be applied to imported antimalarials [19], which clearly work to protect the domestic pharmaceutical industry; but such high tariffs have consequences for any efforts to improve access to quality first-line treatment for malaria, as all quality assured ASAQ must be imported into the country.

Competition and wholesaler business practices: Percentage mark-ups at wholesale level ranged from 11% to 13% across antimalarial categories and dosage forms. These relatively low mark-ups may indicate a high degree of competition in the wholesale antimalarial market, alongside our findings that most wholesalers tended to be concentrated in Kinshasa and in several other urban areas across the country. Unpublished data from in-depth interviews conducted with wholesalers as part of this study also describe business practices indicative of a competitive environment. For example, although our survey data showed that wholesalers rarely provided volume discounts on individual products, respondents said that it was common for wholesalers to give bonuses, gifts and discounts to customers for large aggregate purchases and as end-of-year rewards to high value customers. Respondents also mentioned that large wholesalers and domestic manufacturers often sent sales representatives to conduct product detailing. However, only a third (36%) of all wholesalers reported offering credit to customers in the 3 months preceding the survey and less than a quarter (23%) delivered orders to their customers, two added-value services typically offered by wholesalers in order to differentiate themselves from competitors. While this could be an indication of a lack of competition, this may also reflect the difficulties of transporting goods in the country due to the poor state of transportation infrastructure, the degree of vertically integrated operations observed among wholesalers (i.e. no need to offer credit if "supplier" and "customer" are owned by the same business), or a general desire to keep operating costs low.

Access to First-Line Treatment

Private sector availability of first-line treatment is low: The critical role of the private sector in providing access to malaria treatment in the DRC is clear: the ACTwatch Household Survey conducted in 2010 showed that 37% of respondents sought care for a febrile child at drug stores or pharmacies, and a further 10% at private health facilities. [21] This study also showed that 51% of the antimalarials used to treat febrile children came from drug stores or pharmacies, and 15% were sourced from private health facilities; however, of the febrile children who received antimalarial treatment, only 4.5% received an ACT and 3% received the first-line treatment, ASAQ. [21] A large part of this disparity may be explained by the low private sector retail availability of ACTs, as demonstrated by the results from the 2009 ACTwatch Outlet Survey which found that ACTs were available in only 13% of private outlets and quality assured first-line ACTs were available at 6% of private outlets. [1] Our study has shown that most (83%) wholesalers stocked ACTs and over half (59%) stocked ASAQ, but these products do not seem to be making their way to the end of the private sector distribution chain. One notable gap in the first-line treatment market relates to SérénaDose, the pre-packaged paediatric ASAQ that has been socially marketed in nine urban centres by

PSI/ASF since 2007. The ACTwatch Outlet Survey conducted in 2009 found SérénaDose to be stocked by only 2% of private sector outlets and to comprise 0.3% of the total antimalarial market [1]; and our study found only 16% of wholesalers stocking SérénaDose. Also, ASF was rarely mentioned as a top antimalarial supplier, only once by a private sector retailer and twice by wholesalers. So, increasing the availability and market share of SérénaDose at both wholesale and retail levels could present one viable means of improving access to quality first-line treatment in the private sector. Another barrier to more widespread access to ACTs, and ASAQ in particular, may be their high wholesale purchase prices. Among all wholesalers, the median purchase price for ACTs was US\$ 3.60 (IQR 2.42-6.60) compared to US\$ 2.29 (IQR 0.94-5.63) for nATs, and this difference is likely to be exacerbated by the domestic production and tariff issues described above (unpublished 2009 ACTwatch Outlet Survey data show that 13% of observed ACT products were manufactured in the DRC compared to 54% for nAT products). Given what we have learned from this study about percentage mark-ups at wholesale and retail levels, this difference in price will be propagated as products move down the chain to reach end-users, affecting demand of ACTs in favour of cheaper nATs.

Demand for first-line treatment in the private sector is hindered by poor perceptions of ASAQ: Several factors identified by this study suggest that greater first-line treatment availability in the private sector distribution chain may also be hindered by poor perceptions of ASAQ. For example, although 73% of all wholesalers interviewed correctly identified ASAQ as the recommended first-line treatment, less than a quarter believed it to be the most effective antimalarial for children or adults. As mentioned in the background section of this report, it is widely believed that too little has been done to promote and raise awareness of ASAQ as the first-line treatment among healthcare providers and the general public; and this may also be applied to private sector wholesalers. Our finding that very few wholesalers (12%) had staff who had participated in training related to malaria treatment in the past 2 years seems to echo this notion. Negative perceptions of ASAQ may also be related to side-effects that have been anecdotally associated with the use of amodiaquine, leading some wholesalers, retailers and providers to prefer other antimalarials over ASAQ.

Oral AMTs continue to compete with first-line treatment in the private sector: It should be of particular concern that, despite being banned since 2007, the 2009 private sector market share of oral AMTs (6.5%) was comparable to that for ACTs (6.8%). [1] Although typical sales volumes of oral AMTs at wholesale level were low compared to ACTs and nATs, half of all wholesalers were observed to stock them and typical wholesale-level purchase prices for oral AMTs were comparable to those for ACTs. For example, the median wholesale purchase price for AMT tablets was US\$ 2.05 (IQR 1.92-2.77) and US\$ 2.90 (IQR 2.10-4.28) for ACT tablets. Domestic production of oral AMTs is a likely factor contributing to the persistence of low-priced oral AMTs in the market, as a third of all AMTs audited during the 2009 ACTwatch Outlet Survey were locally produced.

Preferences likely drive demand for SP and quinine: The non-artemisinin therapies SP and quinine continue to dominate the Congolese antimalarial market. According to the 2009 ACTwatch Outlet Survey, SP was the most distributed antimalarial in the DRC, accounting for 44% of the total antimalarial market, while quinine represented 17% of the total market and was the second most distributed antimalarial. [1] Wholesale-level findings mirror these figures, as quinine was the top selling antimalarial for 31% of wholesalers, followed by SP (30%), while ASAQ was the top selling antimalarial for only 7% of wholesalers. Combined with its very low price, familiarity with SP (the former recommended first-line treatment prior to the shift to ASAQ) is a likely driver of demand. Regarding quinine, unpublished data from in-depth interviews conducted with wholesalers indicate that this nAT continues to be regarded as a highly effective treatment, and that quinine tablets manufactured by Pharmakina, in particular, are viewed as high quality domestically manufactured

products. Our finding that quinine was most frequently mentioned by wholesalers as the most effective treatment for malaria in both children and adults – despite widespread knowledge of ASAQ as the first-line treatment among wholesalers – certainly reflects these perceptions. The importance of quinine and products manufactured by Pharmakina to the domestic pharmaceutical sector is also evident when one considers that 34% of all antimalarial products audited during the 2009 ACTwatch Outlet Survey were quinine, of which more than half (54%) were manufactured by Pharmakina.

Limited Role of RDTs

The 2009 ACTwatch Outlet Survey found that in public and private health facilities, where the availability of malaria diagnostic testing ranged from 80% to 90%, most had microscopy services available rather than RDTs; while neither was available in private sector retailers. [1] Given that most public and private health facilities are supplied through dedicated public and NGO distribution networks, and that the policy on parasitological confirmation does not include uncomplicated cases, it is not surprising that RDTs were not available among private sector wholesalers (only 2.2% had RDTs in stock). However, when wholesalers did stock RDTs, their median purchase price was US\$ 1.38, which was less than the median wholesale purchase price for ACT treatment (US\$ 3.60) and for the socially marketed ASAQ, SérénaDose (US\$ 1.81).

Regulation of the Pharmaceutical Sector

Few wholesalers comply with licensing requirements: Although most wholesalers (68%) reported being authorised by the DPM to wholesale pharmaceuticals, authorisation certificates issued by the DPM were observed among only a few wholesalers (16%). Considering that DPM authorisation only needs to be obtained once prior to opening a business, our finding that nearly a third of all wholesalers self-reported as not possessing the required authorisation suggests that those operating without authorisation do not fear being reprimanded or pursued by the regulatory authorities. While this may reflect the DPM's limited capacity to enforce regulations as previously noted [7, 11, 15], this argument is also supported by our finding that 94% of wholesalers reported having been visited by an official at least once during the twelve months preceding the survey. Nevertheless, most wholesalers tended to be very specialised, focusing on sales of medicines and other health-related products, rather than general consumer goods, and unauthorised wholesalers did not have markedly different characteristics to authorised ones.

Considerable proportion of the pharmaceutical retail sector in the DRC also operates without a license: In addition to the number of unauthorised wholesalers described above, the 2009 ACTwatch Outlet Survey found that unlicensed pharmacies, or drug shops, accounted for 59% of all outlets stocking antimalarials and that these unlicensed outlets dispensed 59% of all antimalarials in the DRC. [1] While these types of businesses are a common feature in most African pharmaceutical sectors, DRC regulations do not provide for an official tier of retailers permitted to sell over-the-counter medicines as is done in other countries, such as the Patent Proprietary Medicine Vendors in Nigeria, the Class C Drug Shops in Uganda or the Part II Pharmacies in Tanzania. Although it may be argued that introducing a layer of bureaucracy to formalise the sector will only place further strain on the DPM's already limited resources, implementing a new class of pharmaceutical retailers could have some clear benefits. For example, the resulting register of authorised drug shops could provide crucial information on the physical distribution of medicine dispensers in the private sector. Such registers may also help to facilitate the dissemination of information, such as changes in treatment policy or product recalls, to those actually dispensing medication and health advice to a large portion of the population. In Tanzania, registers of Part II Pharmacies have been used to identify drug shops to receive an intervention combining financial incentives with training on dispensing and regulation in order to improve the quality of medicines and pharmaceutical services they provide. [26]

Traditional markets are not involved in the wholesaling or retailing of antimalarials in the DRC: One particularly encouraging observation about the pharmaceutical sector in the DRC that has emerged from ACTwatch activities is that traditional markets do not appear to play a significant role in the wholesaling or retailing of antimalarials, as they do in other countries with similarly limited regulatory capacities. Although it is recognised that pharmaceuticals are traded in such markets [16], markets were not mentioned as important antimalarials supply sources by either wholesalers or retailers. In addition, only 75 of the 2245 general retailers censused as part of the 2009 ACTwatch Outlet Survey were market stalls, virtually none of which stocked antimalarials. [1] This certainly bodes well for the future prospects of regulating the pharmaceutical sector in the DRC.

Conclusion

This report has presented a number of important new insights into the market for antimalarial drugs in the DRC. The distribution chain had wholesalers operating on a number of levels giving an overall pyramidal shape. However, nearly all wholesalers supplied retailers directly and a third of wholesalers were supplied with antimalarials directly from manufacturers (as one of their top two antimalarial sources). This means that most antimalarials are likely to go through either 2 or 3 steps from manufacturer to retailer. Most wholesalers were not observed to have the required authorisation to wholesale antimalarials, and a considerable proportion of private sector antimalarials were dispensed to consumers through unlicensed retailers; however, most private sector antimalarials in the DRC flowed through a distribution chain composed of wholesalers and retailers specialised in pharmaceutical sales, rather than in the selling of other consumer goods. ACTs were available in most wholesalers; however, fewer wholesalers stocked the first-line treatment, ASAQ. nATs were available at comparable levels to ACTs, but were sold in much greater volumes than ACTs. Oral AMTs were also commonly stocked and sold by wholesalers. Percent mark-ups on antimalarials among wholesalers were particularly low and consistent across antimalarial categories, which may reflect the competitiveness of the DRC market. At retail level, percent mark-ups were higher than those at wholesale level, but were not observed to be excessive. RDTs were not widely available at wholesale level; however, their wholesale purchase prices were lower than the median wholesale purchase prices for all antimalarial types and dosage forms, including the socially marketed first-line treatment, SérénaDose.

6. Appendices

6.1. Supplemental tables for median number of suppository and granule AETDs sold

Table 4.8.1a: Median number of AETDs sold during the week preceding the survey (all wholesalers, suppositories and granules only)

| ANTIMALARIAL TYPE ¹ Formulation ² | | | WHOLESALE CATEGORIES | | |
|--|-------------|--------|--|-----------------------------|------------------------------|
| | | | ALL WHOLESALE N=137 ³ | SUPPLY WHOLESALE N=46 | SUPPLY RETAILERS N=126 |
| All ACT | All | Median | 68.5 | 162.3 | 80.2 |
| | | IQR | 7.5-327.5 | 37.5-843.3 | 8.0-394.3 |
| | Suppository | Median | 0.0 | 0.0 | 0.0 |
| | | IQR | 0.0-0.0 | 0.0-0.0 | 0.0-0.0 |
| | Granule | Median | 0.0 | 0.0 | 0.0 |
| | | IQR | 0.0-0.0 | 0.0-0.0 | 0.0-0.0 |
| Non-WHO prequalified ACT ⁴ | All | Median | 56.4 | 126.8 | 71.9 |
| | | IQR | 0.4-300.0 | 0.0-843.3 | 2.5-320.7 |
| | Suppository | Median | 0.0 | 0.0 | 0.0 |
| | | IQR | 0.0-0.0 | 0.0-0.0 | 0.0-0.0 |
| | Granule | Median | 0.0 | 0.0 | 0.0 |
| | | IQR | 0.0-0.0 | 0.0-0.0 | 0.0-0.0 |
| AMT | All | Median | 8.3 | 14.3 | 11.2 |
| | | IQR | 0.0-83.7 | 0.0-135.1 | 0.0-98.3 |
| | Suppository | Median | 0.0 | 0.0 | 0.0 |
| | | IQR | 0.0-0.0 | 0.0-0.0 | 0.0-0.0 |
| | Granule | Median | 0.0 | 0.0 | 0.0 |
| | | IQR | 0.0-0.0 | 0.0-0.0 | 0.0-0.0 |
| nAT | All | Median | 327.8 | 926.9 | 336.2 |
| | | IQR | 65.3-1519.0 | 103.2-1984.1 | 73.6-1527.4 |
| | Suppository | Median | 0.0 | 0.0 | 0.0 |
| | | IQR | 0.0-0.0 | 0.0-0.0 | 0.0-0.0 |
| | Granule | Median | 0.0 | 0.0 | 0.0 |
| | | IQR | 0.0-0.0 | 0.0-0.0 | 0.0-0.0 |

1 ACT: artemisinin-based combination therapy; AMT: artemisinin monotherapy; nAT: non artemisinin therapy; RDT: Rapid diagnostic test for malaria; 2 The values for median number of AETDs sold reported for 'all' formulations include all dosage forms (tablets, suppositories, oral liquids, injectables and granules); however because so few wholesaler and retailers stocked suppositories or granules, and so few of these product types were observed during the audit, results for these dosage forms are instead provided in the appendix. 3 For antimalarials: there were a total of 137 wholesalers with antimalarial sales volumes (reported or imputed or set as null if did not stock). Note on imputation process for antimalarial sales volumes: during the study, 161 wholesalers were identified, of which 138 were interviewed successfully. Of the remaining, 1 was partially interviewed with no audit conducted, 1 was not eligible, 21 were not screened because the business had closed, could not be found or was not an eligible type, and 2 did not stock antimalarials at the time of the survey or during the three months prior to the visit (Table 1). In addition, an inventory was not conducted with 1 of the 138 completed interviews; so these 24 wholesalers were excluded from the volumes analysis. Two additional wholesalers did not stock antimalarials at the time of interview but did so in the three months prior to interview, so their sales volumes were set as 0 for all antimalarial categories. Overall, there were a total of 1939 antimalarials audited, and 174 (9.0%) had missing sales volumes that were imputed using the `mi impute pmm` command. 4 There were 12 unbranded ASAQ products manufactured in India which had insufficient product information recorded to categorise as WHO prequalified products; taking a conservative approach, these products were categorised as non-WHO prequalified ACTs.

Table 4.8.2a: Median number of AETDs sold during the week preceding the survey (among wholesalers stocking corresponding antimalarial drug category/RDT at the time of the survey, suppositories and granules only)

| ANTIMALARIAL TYPE ¹ Formulation | | | WHOLEALER CATEGORIES ³ | | |
|---|-------------|------------|-----------------------------------|----------------------|---------------------|
| | | | ALL WHOLEALERS | SUPPLY WHOLEALERS | SUPPLY RETAILERS |
| All ACT | All | Median | 130.5 | 267.5 | 124.3 |
| | | IQR | 19.5-474.6 | 116.7-1063.9 | 18.3-472.3 |
| | | (n) | (114) | (37) | (108) |
| | Suppository | Median | 3.0 | 1.5 | 3.0 |
| | | IQR | 0.0-15.5 | 0.0-3.0 | 0.0-15.5 |
| | | (n) | (3) | (2) | (3) |
| Granule | Median | 2.2 | 1.0 | 2.2 | |
| | IQR | 1.0-5.0 | 0.5-1.4 | 1.0-5.0 | |
| | (n) | (8) | (4) | (8) | |
| Non-WHO prequalified ACT ⁴ | All | Median | 125.5 | 267.5 | 131.1 |
| | | IQR | 16.6-464.2 | 117.5-1424.7 | 16.8-458.5 |
| | | (n) | (108) | (33) | (105) |
| | Suppository | Median | 9.3 | 3.0 | 9.3 |
| | | IQR | 3.0-15.5 | 3.0-3.0 | 3.0-15.5 |
| | | (n) | (2) | (1) | (2) |
| Granule | Median | 2.2 | 1.0 | 2.2 | |
| | IQR | 1.0-5.0 | 0.5-1.4 | 1.0-5.0 | |
| | (n) | (8) | (4) | (8) | |
| AMT | All | Median | 53.1 | 80.5 | 54.5 |
| | | IQR | 12.5-227.3 | 16.1-227.3 | 15.1-235.9 |
| | | (n) | (87) | (30) | (82) |
| | Suppository | Median | 0.2 | 0.3 | 0.2 |
| | | IQR | 0.0-1.1 | 0.0-1.9 | 0.0-1.1 |
| | | (n) | (4) | (3) | (4) |
| Granule | Median | - | - | - | |
| | IQR | - | - | - | |
| | (n) | - | - | - | |
| nAT | All | Median | 447.8 | 1014.7 | 447.8 |
| | | IQR | 113.2-1722.5 | 239.7-2394.1 | 108.1-1722.5 |
| | | (n) | (124) | (39) | (116) |
| | Suppository | Median | 0.5 | 1.4 | 0.5 |
| | | IQR | 0.2-1.6 | 0.5-2.4 | 0.2-1.6 |
| | | (n) | (9) | (2) | (9) |
| Granule | Median | - | - | - | |
| | IQR | - | - | - | |
| | (n) | - | - | - | |

1 ACT: artemisinin-based combination therapy; AMT: artemisinin monotherapy; nAT: non artemisinin therapy; RDT: Rapid diagnostic test for malaria. 2 The values for median number of AETDs sold reported for 'all' formulations include all dosage forms (tablets, suppositories, oral liquids, injectables and granules); however because so few wholesaler and retailers stocked suppositories or granules, and so few of these product types were observed during the audit, results for these dosage forms are instead provided in the appendix. 3 (n) is the number of wholesalers at a given level who stocked antimalarials for corresponding drug category. 4 There were 12 unbranded ASAQ products manufactured in India which had insufficient product information recorded to categorise as WHO prequalified products; taking a conservative approach, these products were categorised as non-WHO prequalified ACTs.

6.2. Range of health and non-health retail outlets selling pharmaceutical drugs in the DRC

| Public Health Facilities | N | Description |
|--|------|---|
| Referral hospital (<i>Hôpital général de référence</i> or larger) | 33 | Government-run health facilities that provide prescription medicine following medical consultation or diagnosis. Fees are usually charged for consultations and medicines. Health posts provide preventive and curative care to outpatients in rural areas who cannot access health centres. They typically provide health cover for several villages, and are generally staffed by one nurse. Health centres provide care at the health area-level and are staffed by two nurses. Referral health centres are found in geographically large health zones, where some health areas are otherwise distant from higher-level facilities. A referral health centre will include at least one medical doctor, although they may not necessary be based at the centre permanently. Hospital centres and referral hospitals operate at the health zone-level (and higher, for the national referral hospital in Kinshasa). They include more specialised services, such as paediatrics, obstetrics and surgery. Each health zone should have a referral hospital. |
| Hospital centre / <i>Centre hospitalier</i> | 6 | |
| Referral health centre | 17 | |
| Health centre | 42 | |
| Health post | 13 | |
| Private Health Facilities | N | Description |
| Not-for profit non-governmental organisation (NGO), faith-based organisation (FBO) and Missionary hospital / health centre | 33 | These facilities provide prescription medicine at a nominal price following medical consultation or diagnosis. They are usually staffed with qualified health practitioners, though some smaller clinics run by NGOs have less well qualified staff. |
| For-profit private hospital / clinic | 204 | Private health facilities are generally licensed by the Ministry of Health -though an unknown proportion of these outlets are not registered -and provide all classes of drugs at commercial rates following medical consultation or diagnosis. |
| Pharmacies | N | Description |
| Pharmacy (formal) | 33 | Formal pharmacies are licensed by the National Drug Authority (NDA) and regulated by both the NDA and the Pharmacists' Council. They must display their <i>Certificat d'exercer la pharmacie</i> from the Pharmacists' Council to operate as a pharmacy, as well as an <i>Authorisation d'ouverture d'un établissement pharmaceutique</i> from the Ministry of Health. Formal pharmacies are staffed by qualified pharmacists, who provide oversight and supervision to the rest of the staff. They sell all classes of drugs, including prescription medicines, at commercial rates. Formal pharmacies are overwhelmingly located in large urban areas. |
| Drug Stores | N | Description |
| Drug store (informal pharmacy) | 1089 | Smaller than formal pharmacies, these outlets typically sell medicines from the ground floor of a house or small boutique, and store drugs in cupboards or on basic shelves. They do not have a license to sell prescription drugs, although they may have general trading authorizations issued by local authorities. Drug stores often sell the same types of medicine as formal registered pharmacies, despite not being licensed to do so. These outlets are not usually staffed by qualified pharmacists. |
| General Retailers | N | Description |
| Boutique / Shop | 1181 | Businesses/points of sale which sell fast moving consumer goods (e.g. food, household products), in addition to some medicines (most often antipyretics). Drugs sold at these locations are not regulated. Boutiques are more formal structures than kiosks, which in turn are more solid in structure than market stalls. |
| Kiosk | 980 | |
| Market stall | 75 | This category includes a small number of traditional healers (3) and hawkers (6) that were enumerated. |
| Other | 9 | |

6.3. Calculating AETDs: antimalarial treatment and equivalent adult treatment dose

| Antimalarial Category | Dose used for calculating 1 AETD (mg to treat a 60kg adult) | Generic product used for AETD mg dose value for combination therapies | Notes | Source |
|---------------------------------------|---|---|---|---|
| Amodiaquine | 1800mg | | | WHO Use of Antimalarials, 2001 |
| Amodiaquine-Sulfadoxine-Pyrimethamine | 1800mg | Amodiaquine | | WHO Model Formulary, 2008 |
| Arteether | 1050mg | | | WHO Use of Antimalarials, 2001 |
| Artemether | 960mg | | | WHO Use of Antimalarials, 2001 |
| Artemether-Lumefantrine | 480mg | Artemether | | WHO Model Formulary, 2008 |
| Artemisinin-Naphthoquine | 2400mg | Artemisinin | Manufacturer Guidelines for this product are 1000mg Artemisinin in a single dose. Such a short ACT regimen is highly suspect. This treatment dose is based upon the WHO Artemisinin-MQ recommendation of a total dose of 40mg/kg. | WHO Use of Antimalarials, 2001 |
| Artemisinin-Piperaquine | 576mg | Artemisinin | Treatment dose based on Artemisinin-Piperaquine-Primaquine value, below. | As below |
| Artemisinin-Piperaquine-Primaquine | 576mg | Artemisinin | | Tangpukdee, N. et al. 2008. Efficacy of <i>Artequick</i> versus artesunate-mefloquine in the treatment of acute uncomplicated falciparum malaria in Thailand. The Southeast Asian Journal of Tropical Medicine and Public Health. 39(1): 1-8 http://imsear.hellis.org/handle/123456789/33676 |
| Artesunate | 960mg | | | WHO Use of Antimalarials, 2001 |
| Artesunate-Amodiaquine | 600mg | Artesunate | | Manufacturer Guidelines (<i>Winthrop/Coarsucam – Sanofi Aventis</i>) |
| Artesunate-Halofantrine | 600mg | Artesunate | Relatively uncommon combination; dosing information is difficult to find and the value here is based on the Artesunate-Amodiaquine, Artesunate-SP, and Artesunate-Mefloquine values. | - |

| Antimalarial Category | Dose used for calculating 1 AETD (mg to treat a 60kg adult) | Generic product used for AETD mg dose value for combination therapies | Notes | Source |
|---------------------------------------|---|---|--|---|
| Artesunate-Lumefantrine | 600mg | Artesunate | Relatively uncommon combination; dosing information is difficult to find and the value here is based on the Artesunate-Amodiaquine, Artesunate-SP, and Artesunate-Mefloquine values. | - |
| Artesunate-Mefloquine | 600mg | Artesunate | | Manufacturer Guidelines (<i>Artequin Adult – Mepha</i>) |
| Artesunate-Piperaquine | 600mg | Artesunate | Relatively uncommon combination; dosing information is difficult to find and the value here is based on the Artesunate-Amodiaquine, Artesunate-SP, and Artesunate-Mefloquine values. | - |
| Artesunate-Pyronaridine | 600mg | Artesunate | Relatively uncommon combination; dosing information is difficult to find and the value here is based on the Artesunate-Amodiaquine, Artesunate-SP, and Artesunate-Mefloquine values. | - |
| Artesunate-Sulfadoxine-Pyrimethamine | 600mg | Artesunate | | Manufacturer Guidelines (<i>Co-arinat – Dafra</i>) |
| Atovaquone-Proguanil | 3000mg | Atovaquone | | Manufacturer Guidelines (<i>Malanil – GSK</i>) |
| Chloroquine | 1500mg | | | WHO Model Formulary, 2008 |
| Chloroquine-Sulfadoxine-Pyrimethamine | 1500mg | Chloroquine | | WHO Model Formulary, 2008 |
| Chlorproguanil-Dapsone | 360mg | Chlorproguanil | | Manufacturer Guidelines (<i>LapDap – GSK</i>) |
| Dihydroartemisinin | 480mg | | | Manufacturer Guidelines (<i>Cotecxin – Holleypharm; MALUether – Euromedi</i>) |

| Antimalarial Category | Dose used for calculating 1 AETD (mg to treat a 60kg adult) | Generic product used for AETD mg dose value for combination therapies | Notes | Source |
|--|--|--|--|---|
| Dihydroartemisinin-Amodiaquine | 360mg | Dihydroartemisinin | Relatively uncommon combination; dosing information is difficult to find and the value here is based on the most common Dihydroartemisinin-combinations with sources listed below. | - |
| Dihydroartemisinin-Halofantrine | 360mg | Dihydroartemisinin | Relatively uncommon combination; dosing information is difficult to find and the value here is based on the most common Dihydroartemisinin-combinations with sources listed below. | - |
| Dihydroartemisinin-Lumefantrine | 360mg | Dihydroartemisinin | Relatively uncommon combination; dosing information is difficult to find and the value here is based on the most common Dihydroartemisinin-combinations with sources listed below. | - |
| Dihydroartemisinin-Piperaquine | 360mg | Dihydroartemisinin | | Manufacturer Guidelines (<i>Duo-cotexin – Holleypharm</i>) |
| Dihydroartemisinin-Piperaquine-Trimethoprim | 256mg | Dihydroartemisinin | | Manufacturer Guidelines (<i>Artecxin – Medicare Pharma; Artecorm – Ctonghe</i>) |
| Dihydroartemisinin-Pyronaridine | 360mg | Dihydroartemisinin | Relatively uncommon combination; dosing information is difficult to find and the value here is based on the most common Dihydroartemisinin-combinations with sources listed below. | - |
| Dihydroartemisinin-Sulfadoxine-Pyrimethamine | 360mg | Dihydroartemisinin | | Manufacturer Guidelines (<i>Dalasin – Adams Pharma</i>) |
| Dihydroartemisinin-Mefloquine | 360mg | Dihydroartemisinin | | Manufacturer Guidelines (<i>Meflodisin – Adams Pharma</i>) |
| Halofantrine | 1500mg | | This dose is for halofantrine hydrochloride as the strength is normally reported in this manner. The total dose for halofantrine base is 1398 mg. | Manufacturer Guidelines (<i>Halfan – GSK</i>) |

| Antimalarial Category | Dose used for calculating 1 AETD (mg to treat a 60kg adult) | Generic product used for AETD mg dose value for combination therapies | Notes | Source |
|--------------------------------------|---|---|---|--|
| Hydroxychloroquine | 2000mg | | | Manufacturer Guidelines (<i>Plaquenil – Sanofi Aventis</i>) |
| Mefloquine | 1000mg | | | WHO Use of Antimalarials, 2001 |
| Mefloquine-Sulfadoxine-Pyrimethamine | 1000mg | Mefloquine | | WHO Use of Antimalarials, 2001 |
| Primaquine | 45mg | | This dose is for the gametocytocidal treatment of <i>P. falciparum</i> . | WHO Model Formulary, 2008 |
| Quinacrine | 2212mg | | Recommendations for malaria treatment are very dated. This value is the treatment regimen for giardiasis, which has also been used in the treatment for malaria. | Gardner, T. B. and Hill, D. R. 2001. Treatment of Giardiasis. Clinical Microbiology Reviews. 14(1): 114-128 http://cmr.asm.org/cgi/content/full/14/1/114#T2 |
| Quinimax | 10500mg | | | Manufacturer Guidelines (<i>Quinimax – Sanofi Aventis</i>) |
| Quinine | 12600mg | | This dose is for quinine sulphate, a salt, as quinine strengths are normally reported for salts. The total dose for quinine base based on 24mg/kg is 10080mg for a 60kg adult. | WHO Model Formulary, 2008 |
| Quinine-Sulfadoxine-Pyrimethamine | 12600mg | Quinine | This dose is for quinine sulphate, a salt, as quinine strengths are normally reported for salts. The total dose for quinine base based on 24mg/kg is 10080mg for a 60kg adult. | WHO Model Formulary, 2008 |
| Sulfadoxine-Pyrimethamine | 1500mg | Sulfadoxine | | WHO Model Formulary, 2008 |

6.4. Rationale & method to calculate weights and how to use weights to calculate indicators

Study design

Stratification based on geographic region allowed for four appropriate domains for the outlet survey: centre-south, Kinshasa, north-east, and north-west. The centre-south domain comprised the provinces of Katanga, Kasai Oriental, and Kasai Occidental; the north-east domain comprised the provinces of Oriental, Nord Kivu, Sud Kivu, and Maniema; the north-west domain comprised the provinces of Bas-Congo, Bandundu, and Equateur; Kinshasa was the fourth domain.

A one-stage probability proportional to size (PPS) technique was used to select 19 sub-districts (health areas, *aire de santé*) within each domain, with the sub-district population as the measure of size.

Booster Sample

As with other *ACTwatch* countries, a booster sample of PHFs and pharmacies was taken to increase the count of these important, but relatively rare, outlet types in the collected data. DRC is divided into 515 health zones (zone de santé). Each health zone is organized around a central office; includes a general referral hospital (which may be public or private); and is divided into health areas (*aire de santé*). These health areas formed the sampling frame from which 19 areas were selected within each geographic domain, as described above.

If a selected health area contained the central office for the larger health zone, then no booster sample was extended for the selected area. However, if a selected health area did not contain the central office for the larger zone, then the health area containing the zone's central office was enumerated for the booster sample.

In the centre-south domain, 12 booster health areas were enumerated in addition to the selected health areas; in Kinshasa, 18 booster health areas were enumerated; in the north-east, 5 booster health areas were enumerated; and in the north-west domain, 8 booster health areas were enumerated.

Outlets included in the booster sample were all PHFs, and all pharmacies and drug stores in the booster health areas. Given the difficulty in DRC of assessing which pharmacies/drug stores are licensed with the Pharmacy Board (the "POP" category in other *ACTwatch* countries), all pharmacies/drug stores were enumerated as part of the booster sample and included in the analysis.

Weighting approach

Weights were calculated differently for PHFs, Pharmacies/Drug Stores, and other outlet types, and were specific to analysis type, but generally involved the inverse of the selection probability and corresponding population size. We used health area populations for non-PHF non-Pharmacies/Drug Stores, and for analysis involving only the non-booster sample (i.e. estimation of volumes for all outlet types). The combined selected and booster health area populations were used for PHF and Pharmacy/Drug Store outlet types where analysis included the booster sample (i.e. availability and price). In the tables that follow this population is referred to as the *selected-and-boostered* population.

Weights were not scaled. This was partly for convenience, but also driven by the key indicators being proportions and medians, which are invariant under scaling. In analysis the weights indicate the probability of selection, and are invoked using the `pweight` option in *Stata* commands.

Availability and Price analysis:

- i. Non-PHF non-Pharmacy/Drug Store outlets enumerated in a selected health area;

$$Weight_i = \frac{\text{Stratum Population}}{19 \times \text{HealthArea Population}}$$

- ii. All PHFs and Pharmacies/Drug Store enumerated in a selected-and-boostered health area pair;

$$Weight_i = \frac{\text{Stratum Population}}{\text{Number of health areas visited in Stratum} \times (\text{Population of selected area} + \text{Population of booster area})}$$

where the number of health areas visited is 31 for centre-south, 37 for Kinshasa, 24 for north-east, and 27 for north-west; and where the population of the booster health area takes the value 0 if no booster health area was visited for a given selected health area.

Volumes analysis:

- i. All outlets enumerated in a selected health area (non-booster sample);

$$Weight_i = \frac{\text{Stratum Population}}{19 \times \text{Health Area Population}}$$

Data provided for weight estimation

- i. Population size by health area with information on health zone and province (used to define domains).
No national census has been conducted in DRC since 1984. These population figures come from localized censuses in health zones conducted between 2001 and 2004, with the support of various INGOS. This is the same source as formed the basis of sampling for the 2007 DHS.
- ii. A list of the 76 selected health areas and the additional 43 health areas visited for the booster sample.

Tables

The tables on the following pages list the population figures used to calculate weights. The three tables presented are:

1. PHF and Pharmacy/Drug Store weights by health area for availability and price estimates
2. Non-PHF non-POP weights by health area for availability and price estimates
3. All non-booster outlet weights by health area for volume estimates

Note that Table 2 and Table 3 are identical. Both have been included here for completeness, as weighting is often discussed in terms of the type of analysis being conducted and whether or not the booster sample is included in the analysis.

Table 6.4.1: PHF and Pharmacy/Drug Store weights by health area for availability and price estimates

Stratum: Centre-South, Population: 22,741,733

| Health zone | Selected health area | Booster health area (if visited) | Selected health area population | Booster health area population | Total selected-and-boostered population | Weight (Availability and Price) |
|---------------|----------------------|----------------------------------|---------------------------------|--------------------------------|---|---------------------------------|
| Kanzala | Aéroport | Clinique | 8959 | 10784 | 19743 | 37.16 |
| Dilala | Biashara | Kolwezi | 10026 | 18385 | 28411 | 25.82 |
| Mwene-Ditu | Bondoyi | Illunga Matobo | 26631 | 14115 | 40746 | 18.00 |
| Lukelenge | DAIPN | Lukelenge 1 | 11717 | 13290 | 25007 | 29.34 |
| Fungurume | Dipeta I | Dipeta II | 6592 | 7684 | 14276 | 51.39 |
| Kananga | Hôpital de Kanaga | - | 13871 | - | 13871 | 52.89 |
| Tshikapa | Hôpital de Tshikapa | - | 27735 | - | 27735 | 26.45 |
| Kambove | Kiwewe | Kambove | 10024 | 23060 | 33084 | 22.17 |
| Manika | Kizito | HGR Mwangezi | 15287 | 19465 | 34752 | 21.11 |
| Kapolowe | Lupidi I | Lupidi 2 | 12879 | 8672 | 21551 | 34.04 |
| Dibindi | Markal | - | 20263 | - | 20263 | 36.20 |
| Nzaba | Mbikayi | - | 14618 | - | 14618 | 50.18 |
| Kikula | Musumba | - | 24204 | - | 24204 | 30.31 |
| Ndesha | Ndesha I | - | 10476 | - | 10476 | 70.03 |
| Rwashi | Polylumière | Bendera | 43770 | 46026 | 89796 | 8.17 |
| Kipushi | Saint Raphaël | Betty | 9966 | 21670 | 31636 | 23.19 |
| Kafubu | Sambwa | Kafubu | 13932 | 6957 | 20889 | 35.12 |
| Demba | Sancta Maria | - | 19923 | - | 19923 | 36.82 |
| Kalonda-Ouest | Trois Z | Kalonda Ouest | 15127 | 8011 | 23138 | 31.71 |

Stratum: Kinshasa, Population: 5,996,336

| Health zone | Selected health area | Booster health area (if visited) | Selected health area population | Booster health area population | Total selected-and-boostered population | Weight (Availability and Price) |
|--------------|----------------------|----------------------------------|---------------------------------|--------------------------------|---|---------------------------------|
| Masina 1 | Abattoir 1 | Efoloko | 70856 | 16462 | 87318 | 1.86 |
| Camp Kokolo | Camp Kokolo | - | 58005 | - | 58005 | 2.79 |
| Lemba | Commercial | Plateau | 11324 | 5932 | 17256 | 9.39 |
| Kisenso | Dingi-Dingi | Mission | 21052 | 21419 | 42471 | 3.82 |
| Binza Meteo | Djelo | Bangu | 23164 | 18231 | 41395 | 3.92 |
| Kikimi | Kikimi | Bosembo | 22820 | 30859 | 53679 | 3.02 |
| Mont Ngafula | Kimbondo 1 | Matadi Mayo | 28681 | 8349 | 37030 | 4.38 |
| Gombe | Lemera | Clinique/Gombe | 1577 | 2674 | 4251 | 38.12 |
| Bandalungwa | Lubudi / Bandalungwa | Adula | 29633 | 21195 | 50828 | 3.19 |
| Selembao | Lubudi / Selembao | Madiata | 27596 | 9409 | 37005 | 4.38 |
| Binza Ozone | Lukungu | Kinsuka Pecheur | 45506 | 20554 | 66060 | 2.45 |
| Masina 2 | Mandiangu | Congo | 18495 | 27672 | 46167 | 3.51 |
| Kimbanseke | Maviokele | Kutu | 16776 | 17044 | 33820 | 4.79 |
| Limete | Mfumumvula | Industrielle 1 | 25996 | 19643 | 45639 | 3.55 |
| Bumbu | Mongala | Mbaki | 19201 | 35622 | 54823 | 2.96 |
| Ngaba | Mpila | Mukulua | 21111 | 29179 | 50290 | 3.22 |
| Kingasani | Mubie | Atandele | 55842 | 11551 | 67393 | 2.40 |
| Ndjili | Quartier 3 | Quartier 7 | 17838 | 9867 | 27705 | 5.85 |
| Makala | Uele | Salongo | 17857 | 13183 | 31040 | 5.22 |

Stratum: North-east, Population: 19,634,158

| Health zone | Selected health area | Booster health area (if visited) | Selected health area population | Booster health area population | Total selected-and-boostered population | Weight (Availability and Price) |
|--------------|----------------------|----------------------------------|---------------------------------|--------------------------------|---|---------------------------------|
| Kadutu | Cepac Kadutu | - | 27520 | - | 27520 | 29.73 |
| Mangala | De'Na | - | 18625 | - | 18625 | 43.92 |
| Mwenga | Hgr Mwenga | - | 9257 | - | 9257 | 88.38 |
| Kampene | Kampene | - | 8256 | - | 8256 | 99.09 |
| Lubero | Kasalala | Lubero Cite | 18351 | 7459 | 25810 | 31.70 |
| Uvira | Kasenga Cepac | - | 12884 | - | 12884 | 63.50 |
| Goma | Keshero | - | 20891 | - | 20891 | 39.16 |
| Kabare | Kinjuba | - | 5561 | - | 5561 | 147.11 |
| Wanie-Rukula | Kipokoso | - | 7575 | - | 7575 | 108.00 |
| Bafwasende | Lindi | - | 9408 | - | 9408 | 86.96 |
| Karisimbi | Mabanga Sud | Virunga | 59884 | 14132 | 74016 | 11.05 |
| Makiso | Makiso | - | 15985 | - | 15985 | 51.18 |
| Mangobo | Mama Mwilu | - | 12384 | - | 12384 | 66.06 |
| Basoko | Mamandu | - | 8576 | - | 8576 | 95.39 |
| Katwa | Muchanga | Masuli | 23879 | 32971 | 56850 | 14.39 |
| Bunia | Mudzipela | - | 20001 | - | 20001 | 40.90 |
| Kasongo | Mufala | - | 11480 | - | 11480 | 71.26 |
| Ubundu | Ndjale | Hgr De Ubundu | 3158 | 15023 | 18181 | 45.00 |
| Musienene | Nduko | Ivatama | 10208 | 15689 | 25897 | 31.59 |

Stratum: North-west, Population: 16,953,425

| Health zone | Selected health area | Booster health area (if visited) | Selected health area population | Booster health area population | Total selected-and-boostered population | Weight (Availability and Price) |
|-----------------|----------------------|----------------------------------|---------------------------------|--------------------------------|---|---------------------------------|
| Masimanimba | Bibodi | - | 5747 | - | 5747 | 109.26 |
| Bikoro | Bikoro | - | 6871 | - | 6871 | 91.38 |
| Monieka | Bokote | Monieka | 14604 | 5198 | 19802 | 31.71 |
| Mbandaka | Boyeka | Hopital-Clinique | 2370 | 8523 | 10893 | 57.64 |
| Tandala | Boyndonge | Bongbia Tandala | 7013 | 16880 | 23893 | 26.28 |
| Lusanga | Bumba Puta | - | 6928 | - | 6928 | 90.63 |
| Lolanga Mampoko | Cadelu | Mampoko | 7570 | 7150 | 14720 | 42.66 |
| Bulungu | Cbco/Bulungu | - | 15002 | - | 15002 | 41.85 |
| Kenge | De La Barriere | - | 17267 | - | 17267 | 36.36 |
| Gungu | Gungu 1/Cbco | - | 23237 | - | 23237 | 27.02 |
| Kikwit Sud | Kaggwa | Mungindu 2 | 12652 | 11004 | 12652 | 49.63 |
| Karawa | Karawa | Mopela | 12676 | 14790 | 12676 | 49.53 |
| Mungindu | Kikandji | Kimbala | 8047 | 6851 | 19051 | 32.96 |
| Bwamanda | Kombo | - | 15956 | - | 30746 | 20.42 |
| Kimpese | Malanga | - | 4733 | - | 11584 | 54.20 |
| Matadi | Mongo | - | 8248 | - | 8248 | 76.13 |
| Muanda | Nsiamfumu | - | 4683 | - | 4683 | 134.08 |
| Lukula | Patu | - | 10687 | - | 10687 | 58.75 |
| Gemena | Ville | Libenge Moke | 20152 | 17613 | 37765 | 16.63 |

Table 6.4.2: Non-PHF non-POP weights by health area for availability and price estimates

| Domain | Domain Population | Health zone | Selected health area | Selected health area population | Weight (Availability and Price) |
|--------------|-------------------|---------------|----------------------|---------------------------------|---------------------------------|
| Centre-south | 22,741,733 | Kanzala | Aéroport | 8959 | 133.60 |
| Centre-south | 22,741,733 | Dilala | Biashara | 10026 | 119.38 |
| Centre-south | 22,741,733 | Mwene-Ditu | Bondoyi | 26631 | 44.95 |
| Centre-south | 22,741,733 | Lukelenge | DAIPN | 11717 | 102.15 |
| Centre-south | 22,741,733 | Fungurume | Dipera I | 6592 | 181.57 |
| Centre-south | 22,741,733 | Kananga | Hôpital de Kanaga | 13871 | 86.29 |
| Centre-south | 22,741,733 | Tshikapa | Hôpital de Tshikapa | 27735 | 43.16 |
| Centre-south | 22,741,733 | Kambove | Kiwewe | 10024 | 119.41 |
| Centre-south | 22,741,733 | Manika | Kizito | 15287 | 78.30 |
| Centre-south | 22,741,733 | Kapolowe | Lupidi I | 12879 | 92.94 |
| Centre-south | 22,741,733 | Dibindi | Markal | 20263 | 59.07 |
| Centre-south | 22,741,733 | Nzaba | Mbikayi | 14618 | 81.11 |
| Centre-south | 22,741,733 | Kikula | Musumba | 24204 | 49.45 |
| Centre-south | 22,741,733 | Ndesha | Ndesha I | 10476 | 114.25 |
| Centre-south | 22,741,733 | Rwashi | Polylumière | 43770 | 27.35 |
| Centre-south | 22,741,733 | Kipushi | Saint Raphaël | 9966 | 120.10 |
| Centre-south | 22,741,733 | Kafubu | Sambwa | 13932 | 79.13 |
| Centre-south | 22,741,733 | Demba | Sancta Maria | 19923 | 60.08 |
| Centre-south | 22,741,733 | Kalonda-Ouest | Trois Z | 15127 | 79.13 |
| Kinshasa | 5,996,336 | Masina 1 | Abattoir 1 | 70856 | 4.45 |
| Kinshasa | 5,996,336 | Camp Kokolo | Camp Kokolo | 58005 | 5.44 |
| Kinshasa | 5,996,336 | Lemba | Commercial | 11324 | 27.87 |
| Kinshasa | 5,996,336 | Kisenso | Dingi-Dingi | 21052 | 14.99 |
| Kinshasa | 5,996,336 | Binza Meteo | Djelo | 23164 | 13.62 |
| Kinshasa | 5,996,336 | Kikimi | Kikimi | 22820 | 13.83 |
| Kinshasa | 5,996,336 | Mont Ngafula | Kimbondo 1 | 28681 | 11.00 |
| Kinshasa | 5,996,336 | Gombe | Lemera | 1577 | 200.12 |
| Kinshasa | 5,996,336 | Bandalungwa | Lubudi/Bandalungwa | 29633 | 10.65 |
| Kinshasa | 5,996,336 | Selembao | Lubudi/Selembao | 27596 | 11.44 |
| Kinshasa | 5,996,336 | Binza Ozone | Lukungu | 45506 | 6.94 |
| Kinshasa | 5,996,336 | Masina 2 | Mandiangu | 18495 | 17.06 |
| Kinshasa | 5,996,336 | Kimbanseke | Maviokele | 16776 | 18.81 |
| Kinshasa | 5,996,336 | Limete | Mfumu Mvula | 25996 | 12.14 |
| Kinshasa | 5,996,336 | Bumbu | Mongala | 19201 | 16.44 |
| Kinshasa | 5,996,336 | Ngaba | Mpila | 21111 | 14.95 |
| Kinshasa | 5,996,336 | Kingasani | Mubie | 55842 | 5.65 |
| Kinshasa | 5,996,336 | Ndjili | Quartier 3 | 17838 | 17.69 |
| Kinshasa | 5,996,336 | Makala | Uele | 17857 | 17.67 |

| Domain | Domain Population | Health zone | Selected health area | Selected health area population | Weight (Availability and Price) |
|------------|-------------------|-----------------|----------------------|---------------------------------|---------------------------------|
| North-east | 19,634,158 | Kadutu | Cepac Kadutu | 27520 | 37.55 |
| North-east | 19,634,158 | Mangala | De'Na | 18625 | 55.48 |
| North-east | 19,634,158 | Mwenga | Hgr Mwenga | 9257 | 111.63 |
| North-east | 19,634,158 | Kampene | Kampene | 8256 | 125.17 |
| North-east | 19,634,158 | Lubero | Kasalala | 18351 | 56.31 |
| North-east | 19,634,158 | Uvira | Kasenga Cepac | 12884 | 80.21 |
| North-east | 19,634,158 | Goma | Keshero | 20891 | 49.47 |
| North-east | 19,634,158 | Kabare | Kinjuba | 5561 | 185.83 |
| North-east | 19,634,158 | Wanie-Rukula | Kipokoso | 7575 | 136.42 |
| North-east | 19,634,158 | Bafwasende | Lindi | 9408 | 109.84 |
| North-east | 19,634,158 | Karisimbi | Mabanga Sud | 59884 | 17.26 |
| North-east | 19,634,158 | Makiso | Makiso | 15985 | 64.65 |
| North-east | 19,634,158 | Mangobo | Mama Mwilu | 12384 | 83.44 |
| North-east | 19,634,158 | Basoko | Mambandu | 8576 | 120.50 |
| North-east | 19,634,158 | Katwa | Muchanga | 23879 | 43.28 |
| North-east | 19,634,158 | Bunia | Mudzipela | 20001 | 51.67 |
| North-east | 19,634,158 | Kasongo | Mufala | 11480 | 90.02 |
| North-east | 19,634,158 | Ubundu | Ndjale | 3158 | 327.23 |
| North-east | 19,634,158 | Musienene | Nduko | 10208 | 101.23 |
| North-west | 16,953,425 | Masimanimba | Bibodi | 5747 | 155.26 |
| North-west | 16,953,425 | Bikoro | Bikoro | 6871 | 129.86 |
| North-west | 16,953,425 | Monieka | Bokote | 14604 | 61.10 |
| North-west | 16,953,425 | Mbandaka | Boyeka | 2370 | 376.49 |
| North-west | 16,953,425 | Tandala | Boyndonge | 7013 | 127.23 |
| North-west | 16,953,425 | Lusanga | Bumba Puta | 6928 | 128.79 |
| North-west | 16,953,425 | Lolanga Mampoko | Cadelu | 7570 | 117.87 |
| North-west | 16,953,425 | Bulungu | Cbco/Bulungu | 15002 | 59.48 |
| North-west | 16,953,425 | Kenge | De La Barriere | 17267 | 51.58 |
| North-west | 16,953,425 | Gungu | Gungu 1/Cbco | 23237 | 38.40 |
| North-west | 16,953,425 | Kikwit Sud | Kaggwa | 12652 | 70.53 |
| North-west | 16,953,425 | Karawa | Karawa | 12676 | 70.39 |
| North-west | 16,953,425 | Mungindu | Kikandji | 8047 | 110.88 |
| North-west | 16,953,425 | Bwamanda | Kombo | 15956 | 55.92 |
| North-west | 16,953,425 | Kimpese | Malanga | 4733 | 188.52 |
| North-west | 16,953,425 | Matadi | Mongo | 8248 | 108.18 |
| North-west | 16,953,425 | Muanda | Nsiamfumu | 4683 | 190.54 |
| North-west | 16,953,425 | Lukula | Patu | 10687 | 83.49 |
| North-west | 16,953,425 | Gemena | Ville | 20152 | 44.28 |

Table 6.4.3: All non-booster outlet weights by health area for volume estimates

| Domain | Domain population | Health zone | Selected health area | Selected health area population | Weight (Volume) |
|--------------|-------------------|---------------|----------------------|---------------------------------|-----------------|
| Centre-south | 22,741,733 | Kanzala | Aéroport | 8959 | 133.60 |
| Centre-south | 22,741,733 | Dilala | Biashara | 10026 | 119.38 |
| Centre-south | 22,741,733 | Mwene-Ditu | Bondoyi | 26631 | 44.95 |
| Centre-south | 22,741,733 | Lukelenge | DAIPN | 11717 | 102.15 |
| Centre-south | 22,741,733 | Fungurume | Dipera I | 6592 | 181.57 |
| Centre-south | 22,741,733 | Kananga | Hôpital de Kanaga | 13871 | 86.29 |
| Centre-south | 22,741,733 | Tshikapa | Hôpital de Tshikapa | 27735 | 43.16 |
| Centre-south | 22,741,733 | Kambove | Kiwewe | 10024 | 119.41 |
| Centre-south | 22,741,733 | Manika | Kizito | 15287 | 78.30 |
| Centre-south | 22,741,733 | Kapolowe | Lupidi I | 12879 | 92.94 |
| Centre-south | 22,741,733 | Dibindi | Markal | 20263 | 59.07 |
| Centre-south | 22,741,733 | Nzaba | Mbikayi | 14618 | 81.11 |
| Centre-south | 22,741,733 | Kikula | Musumba | 24204 | 49.45 |
| Centre-south | 22,741,733 | Ndesha | Ndesha I | 10476 | 114.25 |
| Centre-south | 22,741,733 | Rwashi | Polylumière | 43770 | 27.35 |
| Centre-south | 22,741,733 | Kipushi | Saint Raphaël | 9966 | 120.10 |
| Centre-south | 22,741,733 | Kafubu | Sambwa | 13932 | 79.13 |
| Centre-south | 22,741,733 | Demba | Sancta Maria | 19923 | 60.08 |
| Centre-south | 22,741,733 | Kalonda-Ouest | Trois Z | 15127 | 79.13 |
| Kinshasa | 5,996,336 | Masina 1 | Abattoir 1 | 70856 | 4.45 |
| Kinshasa | 5,996,336 | Camp Kokolo | Camp Kokolo | 58005 | 5.44 |
| Kinshasa | 5,996,336 | Lemba | Commercial | 11324 | 27.87 |
| Kinshasa | 5,996,336 | Kisenso | Dingi-Dingi | 21052 | 14.99 |
| Kinshasa | 5,996,336 | Binza Meteo | Djelo | 23164 | 13.62 |
| Kinshasa | 5,996,336 | Kikimi | Kikimi | 22820 | 13.83 |
| Kinshasa | 5,996,336 | Mont Ngafula | Kimbondo 1 | 28681 | 11.00 |
| Kinshasa | 5,996,336 | Gombe | Lemera | 1577 | 200.12 |
| Kinshasa | 5,996,336 | Bandalungwa | Lubudi/Bandalungwa | 29633 | 10.65 |
| Kinshasa | 5,996,336 | Selembao | Lubudi/Selembao | 27596 | 11.44 |
| Kinshasa | 5,996,336 | Binza Ozone | Lukunga | 45506 | 6.94 |
| Kinshasa | 5,996,336 | Masina 2 | Mandiangu | 18495 | 17.06 |
| Kinshasa | 5,996,336 | Kimbanseke | Maviokele | 16776 | 18.81 |
| Kinshasa | 5,996,336 | Limete | Mfumu Mvula | 25996 | 12.14 |
| Kinshasa | 5,996,336 | Bumbu | Mongala | 19201 | 16.44 |
| Kinshasa | 5,996,336 | Ngaba | Mpila | 21111 | 14.95 |
| Kinshasa | 5,996,336 | Kingasani | Mubie | 55842 | 5.65 |
| Kinshasa | 5,996,336 | Ndjili | Quartier 3 | 17838 | 17.69 |
| Kinshasa | 5,996,336 | Makala | Uele | 17857 | 17.67 |

| Domain | Domain population | Health zone | Selected health area | Selected health area population | Weight (Volume) |
|------------|-------------------|-----------------|----------------------|---------------------------------|-----------------|
| North-east | 19,634,158 | Kadutu | Cepac Kadutu | 27520 | 37.55 |
| North-east | 19,634,158 | Mangala | De'Na | 18625 | 55.48 |
| North-east | 19,634,158 | Mwenga | Hgr Mwenga | 9257 | 111.63 |
| North-east | 19,634,158 | Kampene | Kampene | 8256 | 125.17 |
| North-east | 19,634,158 | Lubero | Kasalala | 18351 | 56.31 |
| North-east | 19,634,158 | Uvira | Kasenga Cepac | 12884 | 80.21 |
| North-east | 19,634,158 | Goma | Keshero | 20891 | 49.47 |
| North-east | 19,634,158 | Kabare | Kinjuba | 5561 | 185.83 |
| North-east | 19,634,158 | Wanie-Rukula | Kipokoso | 7575 | 136.42 |
| North-east | 19,634,158 | Bafwasende | Lindi | 9408 | 109.84 |
| North-east | 19,634,158 | Karisimbi | Mabanga Sud | 59884 | 17.26 |
| North-east | 19,634,158 | Makiso | Makiso | 15985 | 64.65 |
| North-east | 19,634,158 | Mangobo | Mama Mwilu | 12384 | 83.44 |
| North-east | 19,634,158 | Basoko | Mambandu | 8576 | 120.50 |
| North-east | 19,634,158 | Katwa | Muchanga | 23879 | 43.28 |
| North-east | 19,634,158 | Bunia | Mudzipela | 20001 | 51.67 |
| North-east | 19,634,158 | Kasongo | Mufala | 11480 | 90.02 |
| North-east | 19,634,158 | Ubundu | Ndjale | 3158 | 327.23 |
| North-east | 19,634,158 | Musienene | Nduko | 10208 | 101.23 |
| North-west | 16,953,425 | Masimanimba | Bibodi | 5747 | 155.26 |
| North-west | 16,953,425 | Bikoro | Bikoro | 6871 | 129.86 |
| North-west | 16,953,425 | Monieka | Bokote | 14604 | 61.10 |
| North-west | 16,953,425 | Mbandaka | Boyeka | 2370 | 376.49 |
| North-west | 16,953,425 | Tandala | Boyndonge | 7013 | 127.23 |
| North-west | 16,953,425 | Lusanga | Bumba Puta | 6928 | 128.79 |
| North-west | 16,953,425 | Lolanga Mampoko | Cadelu | 7570 | 117.87 |
| North-west | 16,953,425 | Bulungu | Cbco/Bulungu | 15002 | 59.48 |
| North-west | 16,953,425 | Kenge | De La Barriere | 17267 | 51.58 |
| North-west | 16,953,425 | Gungu | Gungu 1/Cbco | 23237 | 38.40 |
| North-west | 16,953,425 | Kikwit Sud | Kaggwa | 12652 | 70.53 |
| North-west | 16,953,425 | Karawa | Karawa | 12676 | 70.39 |
| North-west | 16,953,425 | Mungindu | Kikandji | 8047 | 110.88 |
| North-west | 16,953,425 | Bwamanda | Kombo | 15956 | 55.92 |
| North-west | 16,953,425 | Kimpese | Malanga | 4733 | 188.52 |
| North-west | 16,953,425 | Matadi | Mongo | 8248 | 108.18 |
| North-west | 16,953,425 | Muanda | Nsiamfumu | 4683 | 190.54 |
| North-west | 16,953,425 | Lukula | Patu | 10687 | 83.49 |
| North-west | 16,953,425 | Gemena | Ville | 20152 | 44.28 |

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