Evidence for Malaria Medicines Policy

ACTwatch 2009 Supply Chain Survey Results
Nigeria

January 2012
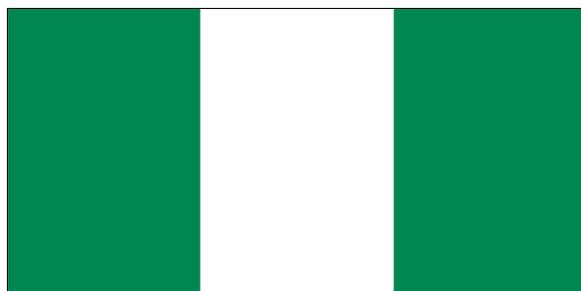
Country Program Coordinator	**Co-Investigators**	**Principal Investigator**
Mrs. Ekundayo D Arogundade	Benjamin Palafox	Kara Hanson
	Sarah Tougher	
Society for Family Health/Nigeria	Edith Patouillard	London School of Hygiene & Tropical Medicine
8 Port Harcourt Crescent	Catherine Goodman	Department of Global Health & Development
Area 11, Garki, Wuse	Immo Kleinschmidt	Faculty of Public Health & Policy
Abuja, Nigeria		15-17 Tavistock Place
Phone: + 234 8023622674		London, UK WC1H 9SH
Email: earogundade@sfhnigeria.org	London School of Hygiene & Tropical Medicine	Phone: +44 20 7927 2267
	Department of Global Health & Development	Email: kara.hanson@lshtm.ac.uk
	Faculty of Public Health & Policy	
	15-17 Tavistock Place	
	London, UK WC1H 9SH	
	Phone: +44 20 7927 2389	
	Email: benjamin.palafox@lshtm.ac.uk	

ACTwatch is a project of Population Services International (PSI), in collaboration with the London School of Hygiene & Tropical Medicine. The ACTwatch Group comprises of a number of individuals:

PSI ACTwatch Central:
Tanya Shewchuk, Project Director
Dr Kathryn O'Connell, Principal Investigator
Hellen Gatakaa, Senior Research Associate
Stephen Poyer, Research Associate
Illah Evans, Research Associate
Julius Ngigi, Research Associate
Erik Munroe, Research Associate
Tsione Solomon, Research Associate

PSI ACTwatch Country Program Coordinators:
Cyprien Zinsou, PSI/Benin
Sochea Phok, PSI/Cambodia
Dr. Louis Akulayi, SFH/DRC
Jacky Raharinjatovo, PSI/Madagascar
Ekundayo Arogundade, SFH/Nigeria
Peter Buyungo, PACE/Uganda
Felton Mpasela, SFH/Zambia

London School of Hygiene & Tropical Medicine:
Dr. Kara Hanson, Principal Investigator
Edith Patouillard, Co-investigator
Dr. Catherine Goodman, Co-investigator
Benjamin Palafox, Co-investigator
Sarah Tougher, Co-investigator
Dr. Immo Kleinschmidt, Co-investigator

Other individuals who contributed to ACTwatch research studies in Nigeria include:

Dr. Jennifer Anyanti	General Manager, Research & Evaluation Division, SFH/Nigeria
Dr. Samson Adebayo	Senior Manager, Research & Evaluation Division, SFH/Nigeria
Richard Fakolade	Research Coordinator, Research & Evaluation Division, SFH/Nigeria
Jamilah Mohammed-Jantabo	Research Coordinator, Research & Evaluation Division, SFH/Nigeria
Chinazo Ujuju	Research Coordinator, Research & Evaluation Division, SFH/Nigeria
Oladipupo Banji Ipadeola	Research Officer, Research & Evaluation Division, SFH/Nigeria
Emily Harris	Malaria and Child Survival Associate, PSI
Dr. T. O. Sofola	National Malaria Control Program, Federal Ministry of Health
Dr. Audu Bala Mohammed	National Malaria Control Program, Federal Ministry of Health
Kolapo Usman	National Population Commission
Pharm. Ubale Yusuf Hashim	National Agency for Food Drug Administration and Control, Nigeria

Acknowledgements

Contents

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 Nigeria, the second ACTwatch Outlet Survey included one additional sub-district (also referred to as locality or cluster, see below) selected per stratum, within which all public health facilities and registered pharmacies were censused (see below).

Censused sub-district: Sampled areas, (defined in the first ACTwatch Outlet Survey as aggregations of existing electoral enumeration areas encompassing 10,000-15,000 people, and defined in the second ACTwatch Outlet Survey as localities, see below), where field teams conducted a full census of all outlets with the potential to sell antimalarials as part of the first ACTwatch Outlet Survey. During the second ACTwatch Outlet Survey, a full census of outlets was not feasible in all localities due to large population sizes and a different census approach was followed: For all localities, a full census of public health facilities, private health facilities, and registered pharmacies was conducted; for localities with fewer than 50,000 inhabitants, a full census of PPMVs, general retailers, community health workers, and hawkers was conducted; for localities with more than 50,000 inhabitants, the census of PPMVs, general retailers, CHWs, and hawkers was restricted to 3 electoral enumeration areas within that locality that were also selected for the ACTwatch Household Survey.

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. Nigeria's first-line treatment for *Plasmodium falciparum* malaria is artemether-lumefantrine, 20mg/120mg, with artesunate-amodiaquine (4mg/10mg/kg) as an alternative first-line treatment.

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 (18 July to 8 September 2009) was 154.892 Nigeria Naira (NGN) to US$1; the average exchange rate during the data collection period for retail purchase prices (4 August to 16 September 2009) was 155.566 Nigeria Naira (NGN) 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 (18 July to 8 September 2009) was 154.892 Nigeria Naira (NGN) to US$1; the average exchange rate during the data collection period for retail purchase prices (4 August to 16 September 2009) was 155.566 Nigeria Naira (NGN) 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 or locality in the second ACTwatch Outlet Survey). For the first ACTwatch Outlet Survey in Nigeria, these were created by aggregating existing electoral enumeration areas such that the aggregated population is

approximately 10,000 to 15,000 inhabitants. However during the second ACTwatch Outlet Survey, sub-districts were defined as localities (i.e. existing local government administrative areas).

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.

> **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	aretesunate-amodiaquine
ASMQ	artesunate and mefloquine
CMS	Central Medical Stores
CQ	chloroquine
DHA	dihydroartemisinin
DHA+PP	dihydroartemisinin and piperaquine
FMOH	Federal Ministry of Health, Nigeria
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
LSHTM	London School of Hygiene & Tropical Medicine
MEC	mutually-exclusive category of wholesalers
MQ	mefloquine
NAFDAC	National Agency for Food and Drug Administration and Control
nAT	non-artemisinin therapy
NGN	Nigerian Naira
NGO	non-governmental organisation
NMCP	National Malaria Control Programme
OS	ACTwatch Outlet Survey
OTC	over the counter
PCN	Pharmacists Council of Nigeria
Pf	*Plasmodium falciparum*
PMG-MAN	Pharmaceutical Manufacturers Group of the Manufac. Assoc. of Nigeria
POM	prescription only medicine
PPS	probability proportional to size
PPMV	Proprietary Patent Medicine Vendor
PSI	Population Services International
RDT	rapid diagnostic test
RMM	role-model mothers
SFH	Society for Family Health, Nigeria
SP	sulphadoxine pyrimethamine
VAT	value added tax
WHO	World Health Organization
WS	wholesaler

Executive Summary

Background

In Nigeria, 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 (Nigeria, Cambodia, Benin, the Democratic Republic of Congo, Madagascar, 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 Nigeria between July and September 2009.

Methods

The Supply Chain survey was implemented by the London School of Hygiene & Tropical Medicine (LSHTM), with support from the Society for Family Health (SFH), Nigeria, conducted concurrently with the second round of the ACTwatch Outlet Survey implemented by SFH and PSI in 2009. Wholesalers operating at different levels of the supply chain that served a representative sample of four geographically defined zones in Nigeria (i.e. Lower North, South East, Upper North, South West) 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, 20 of the 76 sub-districts included in the first round of the ACTwatch Outlet Survey 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 Outlet Survey in 2009 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 205 antimalarial wholesalers were identified, and 140 interviews were conducted. 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 maximum number of steps from manufacturers' factory gate to retail outlets was 5 with wholesalers operating across 4 overlapping levels: 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 3 steps (i.e. manufacturer → any intermediate wholesaler → terminal wholesaler → retailer), as most wholesalers either sold antimalarials only to retailers (60%) or only to other wholesalers (37%), and only 4% sold to both groups (Figure 2). Wholesalers located in markets were an important source of antimalarials: 55% of all suppliers mentioned by retailers and 13% of all suppliers mentioned by wholesalers were located in large commercial markets in Lagos, Onitsha, Kano, Ibadan and Bauchi. More than half of all wholesalers (56%) purchased antimalarials directly from manufacturers as one of their two top suppliers, some of whom arranged their orders through a sales representative from the manufacturer. As a result, the supply chain is shaped as a pyramid with a broad base. 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
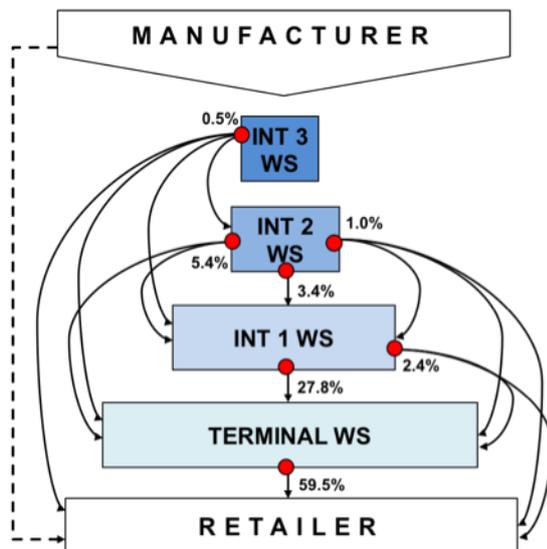
Figure 2: Representation of the antimalarial distribution chain showing the overlap between wholesaler categories used for analysis

Note: WS: wholesaler; INT: intermediate
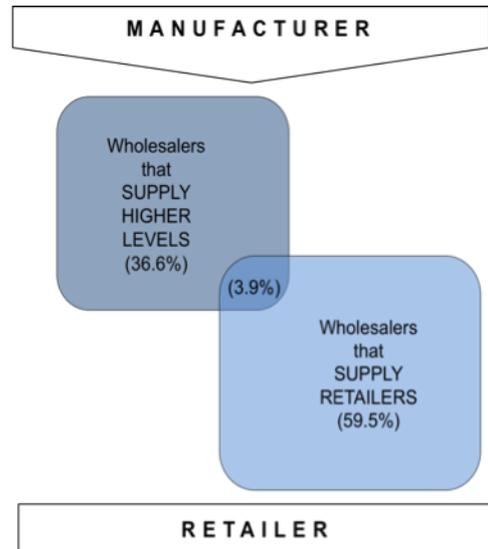
WHOLESALER CHARACTERISTICS: Wholesalers had been in operation for a median of 8 years; however, this varied considerably. Wholesale businesses supplying retailers were slightly smaller (median of 5 workers) than those supplying other wholesalers (median of 8.5 workers). Nearly all wholesalers (97%) were observed to store their antimalarials appropriately (off the floor, in dry areas and out of direct sunlight); however, fewer wholesalers reported having been visited by a pharmaceutical inspector in the past year (71%), or reported employing a member of staff with a health qualification (63%). In addition, only 9% of wholesalers were observed to have an up-to-date license (wholesale or retail) from the Pharmacists Council of Nigeria (PCN). More than three-quarters of all wholesalers interviewed had provided credit facilities to their customers in the past 3 months, but only a third (33%) reported delivering antimalarial orders.

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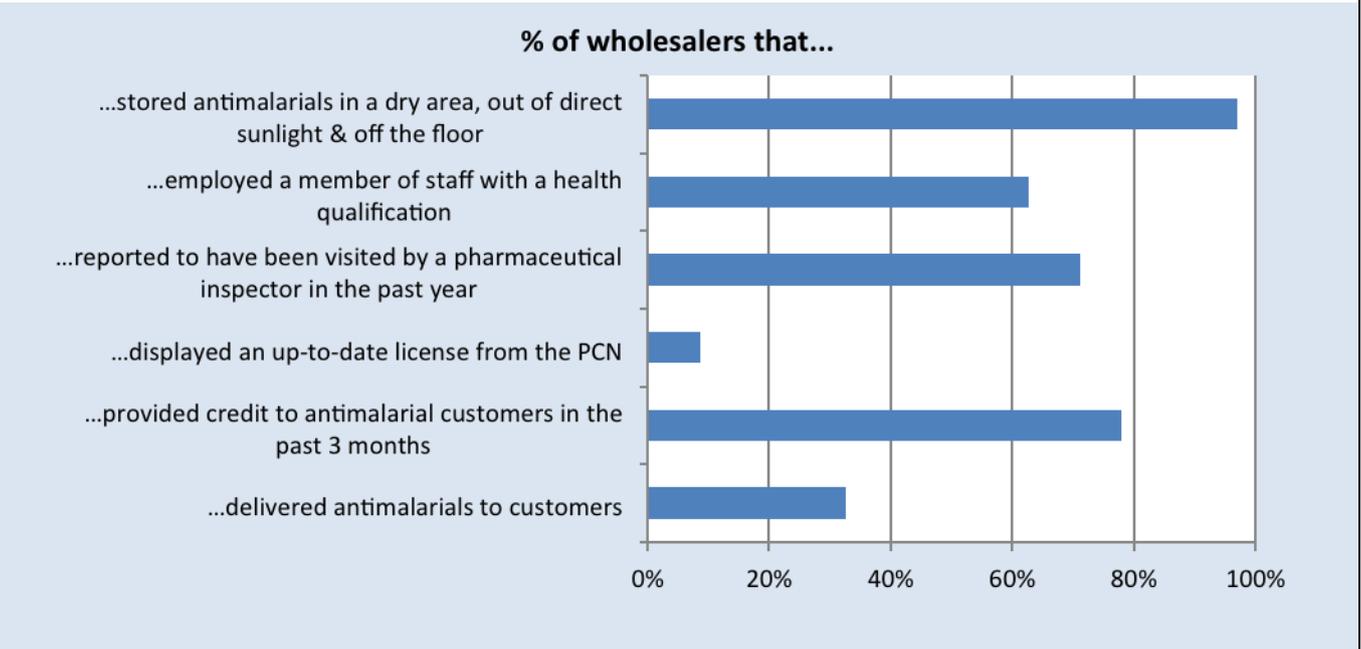
AVAILABILITY OF ANTIMALARIALS & RDTS: Nearly all wholesalers (99%) had at least one antimalarial in stock at the time of interview, 86% had ACT in stock, and 83% stocked either artemether+lumefantrine (AL) or artesunate+amodiaquine (ASAQ), the recommended first line ACT treatments for uncomplicated *Pf* malaria in Nigeria. Availability of other antimalarial drugs was comparable to that of ACT, with oral artemisinin monotherapies (AMT) being stocked by 73% of all wholesalers, and non-artemisinin therapies (nAT) by 88% of wholesalers. Only 4% of wholesalers stocked RDTs.

% of wholesalers that stocked...

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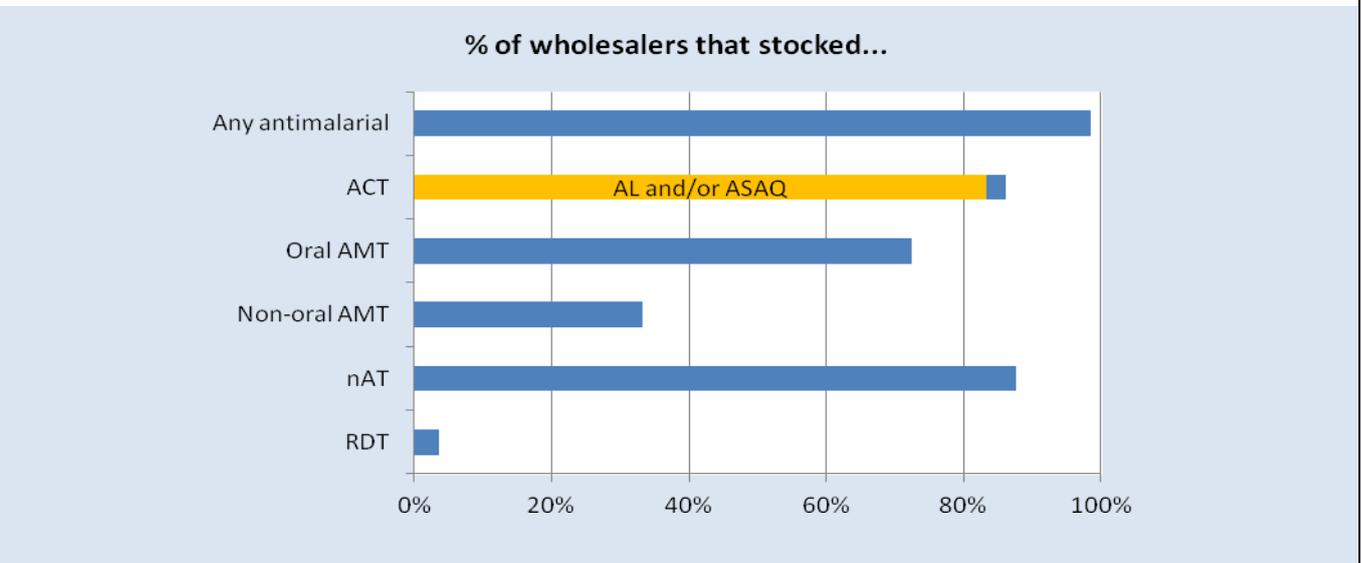
ANTIMALARIAL & RDT SALES VOLUMES: The median number of adult equivalent treatment doses (AETDs) of antimalarials sold the week preceding the survey was 137.9 for ACT, 42.0 for any AMT, and 562.9 for nATs. AMTs were predominantly sold in tablet form: the median sales volume for AMT tablets was 28.1 AETDs vs. 1.0 for oral liquid vs. 0.0 for injectable AMTs. The median sales volumes during the week preceding the survey for non-WHO prequalified ACTs (94.0 AETDs) was much higher than the volumes for WHO prequalified ACTs (4.8 AETDs). Among wholesalers who stocked antimalarials at the time of interview (n=135), for 45% the nAT sulphadoxine-pyrimethamine (SP) was their top selling antimalarial, followed by chloroquine (19%). The next most common top selling antimalarials were the government recommended first-line treatments: AL for 13% and ASAQ for 6%. Very few wholesalers sold RDTs during the week preceding the survey, and the median number of RDTs sold was 0.

% of wholesalers for whom the top selling antimalarial was...
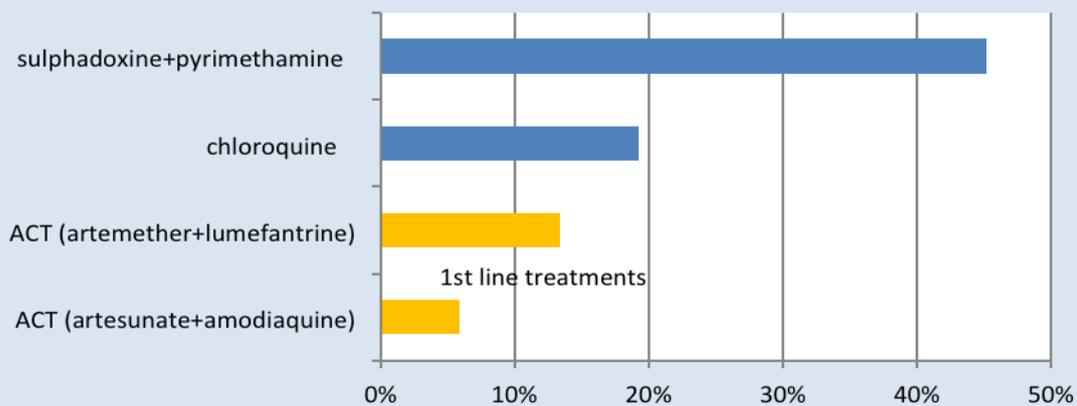
WHOLESALE PURCHASE PRICES: The median wholesale purchase price (i.e. the price paid by wholesalers to purchase stock from their suppliers) per AETD varied across antimalarial drug categories. Overall, AMTs had the highest median purchase price per AETD (US$ 4.13), followed by ACTs (US$ 3.55); while nATs had a much lower median purchase price of US$ 0.53. Tablets comprised a high proportion of all observed products in each drug category; and considering tablet dosage forms only, wholesalers purchased ACTs at a median price of US$ 3.10 per AETD, US$ 2.07 for AMT, and US$ 0.35 for nATs. The median wholesale purchase price for the government recommended first-line treatments, AL (US$ 4.13) and ASAQ (US$ 2.91), were at least 10 times the wholesale purchase price of SP (US$ 0.29). The wholesale purchase price for RDTs was US$ 0.71 per test.
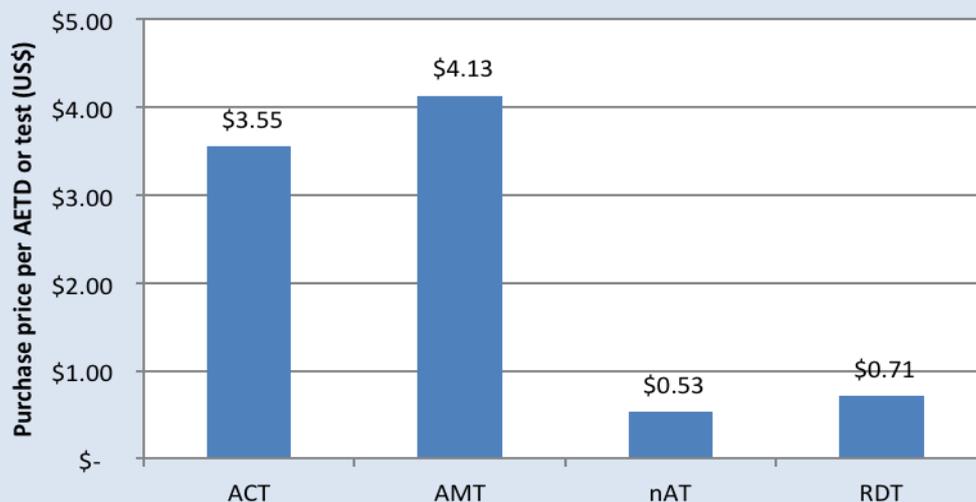
WHOLESALE MARK-UPS FOR ANTIMALARIALS & RDTS: The median mid percent mark-ups were lowest on ACTs (18%), slightly higher on AMTs (20%), and highest on nATs (25%), but within each of these antimalarial categories, mark-ups were consistent across dosage forms. In absolute terms, mark-ups per AETD were the highest on AMT (US$ 0.87), followed by ACT (US$ 0.65) and nAT (US$ 0.16), corresponding to the differences in purchase prices across drug categories. Wholesale percent mark-ups tended to be similar at different levels of the supply chain; however wholesalers supplying other wholesalers tended to apply higher percent mark-ups on non-tablet dosage forms (i.e. oral liquids and injectables) and on AMTs than wholesalers supplying retailers. For example, the median mid percent mark-up applied to AMTs by wholesalers supplying wholesalers was 26.7% (corresponding to a median mid absolute mark-up of US$ 1.03); while wholesalers supplying retailers applied a median mid percent mark-up of 19.0% (corresponding to a median mid absolute mark-up of US$ 0.83). Although the median mid percent mark-ups for AL and ASAQ were similar to that for SP (AL: 15% vs. ASAQ: 20% vs. SP: 22%), there were considerable differences between median mid absolute mark-ups due to differences in purchase prices (AL: US$ 0.71 vs. ASAQ: US$ 0.65 vs. SP: US$ 0.07). For RDTs, the median wholesale percent mark-up was 40%, equivalent to US$ 0.32 in absolute terms.
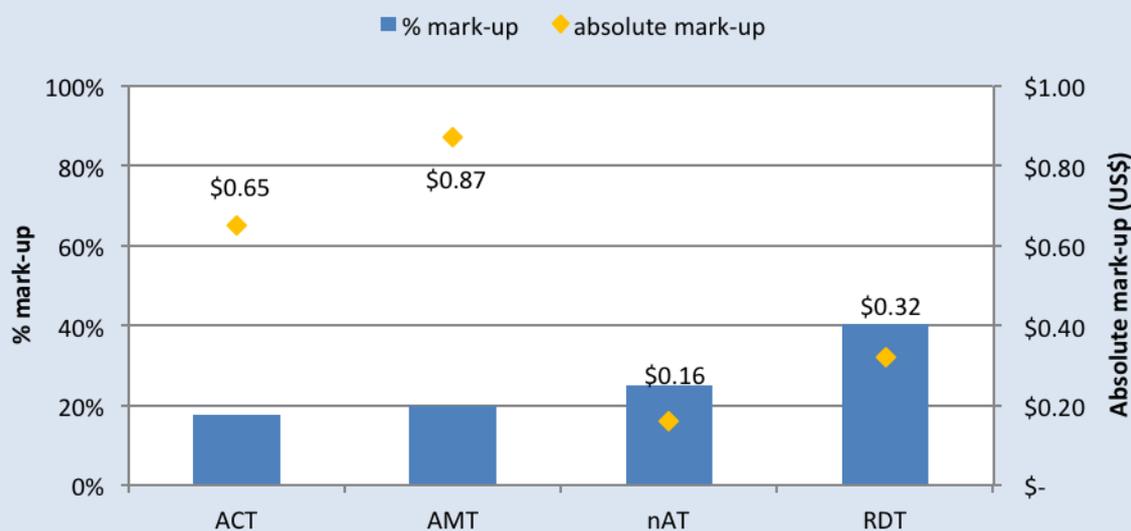
RETAIL PURCHASE PRICES: Similar to the wholesale level, median retail purchase prices (i.e. the price paid by retailers to purchase stock from their suppliers) per AETD varied across antimalarial drug categories. In private health facilities, Proprietary Patent Medicine Vendors (PPMVs)/drug stores, and "other" private outlets (supermarkets, kiosks, itinerant medicine sellers, etc.) ACTs were observed to have the highest median retail purchase prices per AETD (ranging from US$ 2.70 at private health facilities to US$ 3.21 at "other" private outlets), while nATs had the lowest median retail purchase prices per AETD (ranging from US$ 0.55 at "other" private outlets, to US$ 0.96 at private health facilities). Pharmacies were observed to pay higher prices for ACTs and AMTs than other outlet types, as pharmacies tended to stock relatively more expensive dosage forms (i.e. oral liquids and injectables rather than tablets) than PPMVs/drug stores and "other" private outlets, and also stocked the highest proportion of antimalarials imported from Western countries.

Legend: ■ Pharmacy ■ Private Health Facility ■ PPMV/Drug Store ■ Other Private Outlet

Y-axis: Purchase price per AETD (US$)

ACT: $3.99, $2.70, $2.89, $3.21
AMT: $7.42, $2.47, $2.57, $2.57
nAT: $0.75, $0.96, $0.56, $0.55
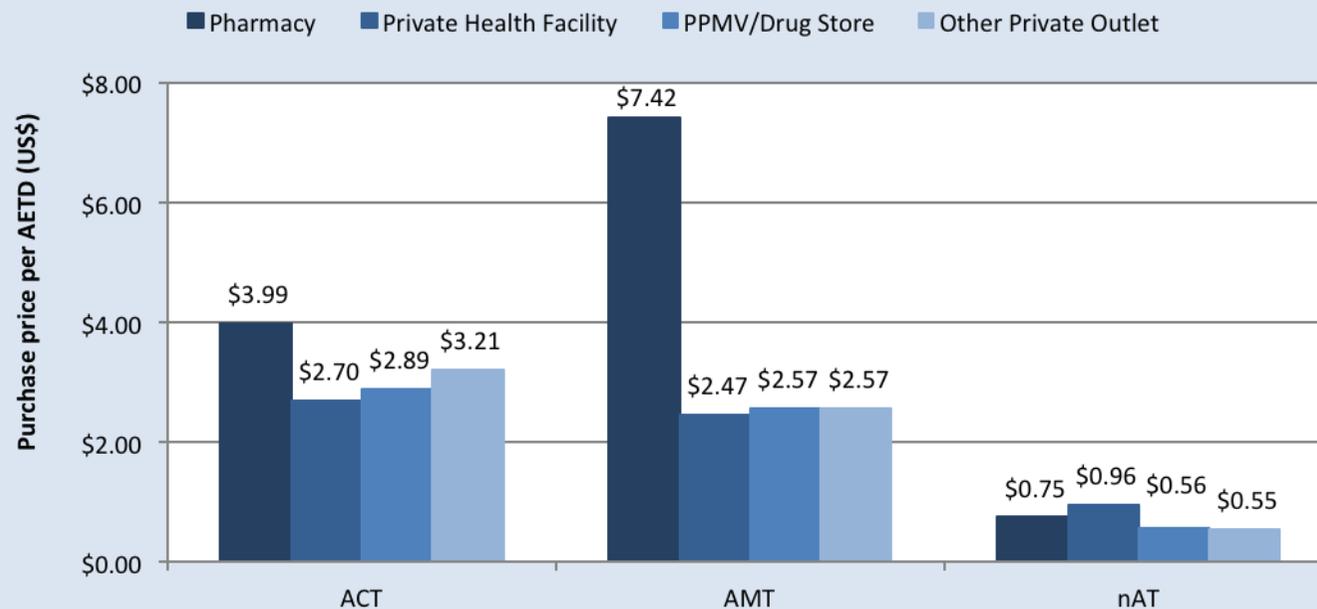
RETAIL MARK-UPS FOR ANTIMALARIALS: Median mid percent mark-ups among retailers tended to be higher compared to those observed among wholesalers. For ACTs, the median mark-up varied across retailer category from 22% at PPMVs/drug stores to 42% at private health facilities; for AMT, median mark-up ranged between 22% at "other" private outlets (supermarkets, kiosks, itinerant medicine sellers, etc.), and 40% at private health facilities; and for nAT, between 27% at "other" private outlets, and 43% at private health facilities. Mark-ups were relatively low and were infrequently observed to exceed 100%. Variation in absolute mark-ups was also observed across antimalarial and retailer categories, corresponding closely with variations in purchase price: mark-ups on ACTs ranged between US$ 0.64 and US$ 0.96 across outlet categories; on AMT between US$ 0.62 and US$ 2.57; and on nAT between US$ 0.16 and US$ 0.30. Although median percent mark-ups on ASAQ (25%-67%) were higher than on AL (13%-20%), the considerable difference in purchase prices meant that observed median absolute mark-ups on AL (US$ 0.64-US$ 1.11) were higher than on ASAQ (US$ 0.45-US$ 0.77). The median mid absolute mark-up for SP, on the other hand, ranged between US$ 0.13 at "other" private outlets and US$ 0.19 at private health facilities.
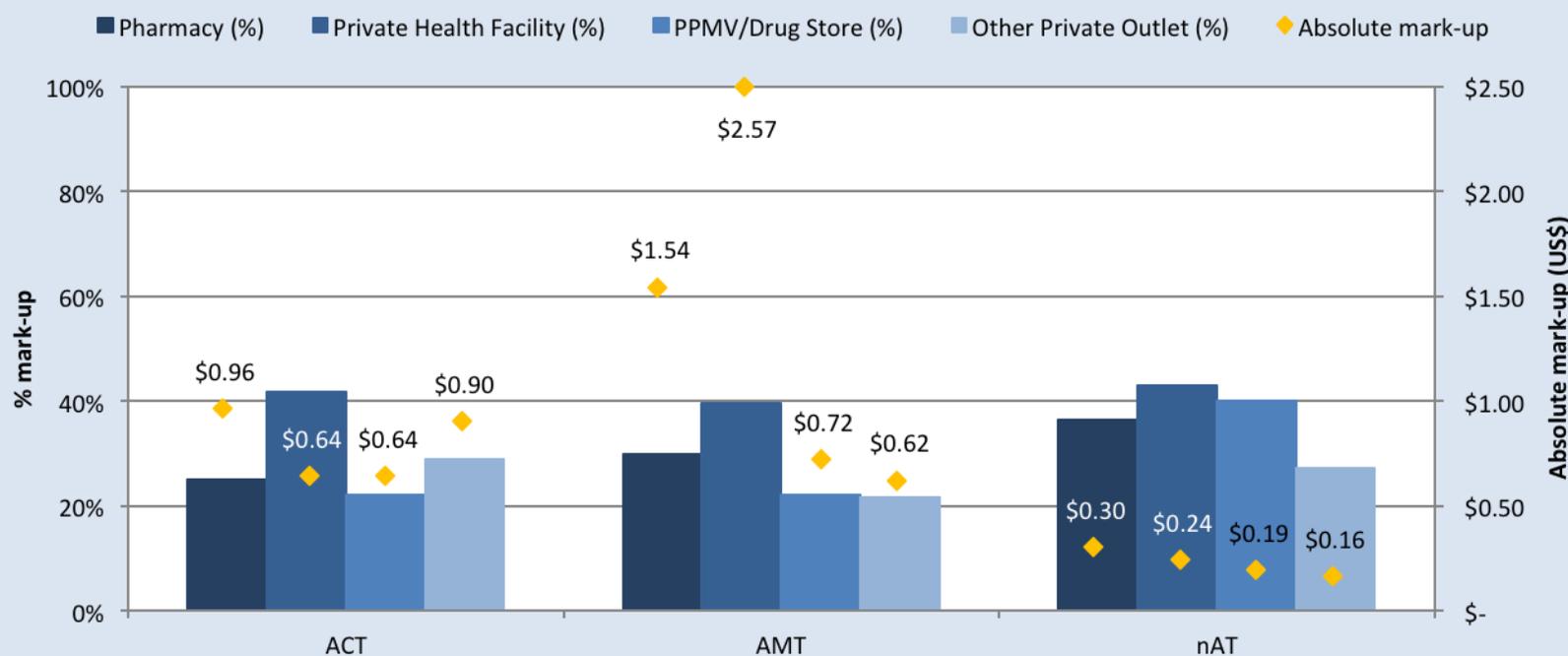
Conclusions

This report has presented a number of important new insights into the market for antimalarial drugs in Nigeria. The distribution chain had wholesalers operating on a number of levels giving an overall pyramidal shape. However, most wholesalers either supplied only other wholesalers or only retailers, and many wholesalers were supplied by manufacturers, either directly or through a network of regional depots owned by the manufacturer or by a logistics company. 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 an up-to-date license permitting the wholesale of antimalarials, and a number of those engaged in antimalarial wholesaling were only permitted to retail over-the-counter medicines. Large markets were an important source of antimalarial purchasing, particularly for retailers. Regardless of wholesaler type and location, ACTs, and in particular the first-line drugs AL and ASAQ, were observed to be available in most wholesalers. However, AMTs and nATs were also available at comparable levels, and in terms of sales volumes, those of nATs far exceeded sales volumes of ACTs. At wholesale and retail levels, percent mark-ups on antimalarials were observed to be relatively low and consistent across antimalarial category and business type. This may be due to a high degree of competition among wholesalers and retailers. RDTs were not widely available at wholesale level; however, their wholesale purchase prices were low compared to ACT purchase prices.

1. Introduction & Objectives

In Nigeria, 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 Nigeria, Benin, Cambodia, the Democratic Republic of Congo Madagascar, 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 the Society for Family Health (SFH) in Nigeria.

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 Nigeria between July and September 2009. 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 round of the ACTwatch Outlet Survey by SFH Nigeria between August and September 2009.

2. Country Background

Economic Profile

Nigeria is Africa's most populous country and the eighth largest in the world with an estimated population of 155.2 million. [1] Located in West Africa, it is bordered by Niger in the north, Benin to the west, and Cameroon and Chad in the west, it is made up of six geopolitical zones, 36 states (plus the Federal Capital Territory of Abuja), and 774 Local Government Authorities (LGAs). State governments have substantial autonomy and exercise considerable authority over the allocation and utilization of their resources, limiting the influence of the federal government over state and local government affairs. [2] Since gaining independence from Britain in 1960, Nigeria has become one of the largest oil producing countries in the world and the national economy is dependent on the petroleum industry, generating 85% of government revenue and over 90% of export earnings in 2006. [3] Driven mainly by rising oil prices, GDP growth since 2008 has been relatively strong ranging from 6 to 8.4%, and in 2010, GDP per capita was US$ 1222, categorising the country as a lower middle income country according to the World Bank. [4] However, Nigeria's oil wealth has not been well distributed throughout the population, and large income inequality persists. For example, despite generating over one-fifth of the national GDP in 2006, the petroleum industry only employed a small fraction of the national labour force, while agriculture, in comparison, employed nearly 70% of the population and accounted for around 40% of GDP [3], and in 2004, nearly two-thirds of Nigerians were living on less than $1.25 per day (adjusted for purchasing power parity). [4]

To address these issues, Nigeria launched its National and State Economic Empowerment and Development Strategies (NEEDS and SEEDS) for growth and poverty reduction in 2004 based on 3 pillars: (i) empowering people and improving social service delivery; (ii) improving the private sector and focusing on non-oil growth; and (iii) changing the way government works and improving governance. This was followed in 2007 by President Yar'Adua's 7-point agenda focussing on power and energy; food security and agriculture; wealth creation and employment, mass transportation, land reforms; security; qualitative and functional education and pursuance of the rule of law. [3] While some progress has been made since 2004, particularly in the areas of economic stability, procurement and financial sector reform, much remains to be done. For example, from 2009 to 2010, Nigeria's ranking in the World Bank's ease of doing business report decreased from 134th to 137th out of a list of 183 countries [4], and was ranked 134th out of 178 countries in Transparency International's Corruption Perception Index in 2010. [5] Nigeria has some of the worst social indicators: in 2009, life expectancy at birth was 51 years, nearly 1 out of every 6 children died under the age of 5, and only 61% of the adult population was literate. [4]

Pharmaceutical Sector
The pharmaceutical sector in Nigeria is regulated by two government agencies: the National Agency for Food and Drug Administration and Control (NAFDAC), which is responsible for regulating the importation, export, manufacture, advertisement, distribution, sale and use of drugs, cosmetics, medical devices, bottled water and chemicals, and undertakes activities to ensure the quality and safety of such products, including registration and inspection of imported, exported and manufactured products [6]; while the Pharmacists Council of Nigeria (PCN) regulates the practice of pharmacy in all regards, including training and registering of pharmacists and pharmacy technicians, and the inspection and monitoring of premises where pharmaceutical activities, such as dispensing, wholesaling and retailing, take place. [7] The PCN issues different licenses for the manufacturing, importing, wholesaling (for authorised distributors and wholesalers) and retailing of pharmaceuticals; and in order obtain each of these licenses, the business must be registered with the Corporate Affairs Commission and a registered pharmacist must be attached to the business as the superintendent pharmacist, or as an owner in the case of retail pharmacies. [7] Drug shops that are only permitted to sell a limited range of over-the-counter medicines (OTCs), known as Proprietary Patent Medicine Vendors (PPMVs), must also obtain a license from the PCN in order to operate; however, PPMVs are not required to have a pharmacist attached to the business.

Pharmaceutical manufacturing in Nigeria is relatively well developed and in 2008 there were 140 licensed drug manufacturers, and given the market size, importing is also common with 286 licensed drug importers in 2008. Domestic manufacturers may also import medicines when they do not possess the necessary capacity to produce them (e.g. injectables) or repackage imported products to suit the local market. [8] The headquarters of drug manufacturers and importers are located throughout the country, but are particularly concentrated in the major commercial centres near Lagos, Ibadan, Ilorin, Kano and Onitsha. Among the local manufacturers, over 100 of these were licensed to produce an antimalarial medication in 2008, and of these, 10 were licensed to produce an ACT, although none are WHO prequalified. [8] Several multinational pharmaceutical manufacturers have local subsidiaries that import their antimalarial products (e.g. Ipca Laboratories Ltd [India], Sanofi-Aventis [Morocco], Novartis [China, USA]), while other foreign manufacturers may deal with one or more local importers. While importers are free to change their suppliers, importers commonly act as sole agents for products manufactured outside of Nigeria, a tendency supported by the stringent product registration requirements (i.e. foreign manufacturers must be certified by NAFDAC prior to supplying drugs for import which can be a lengthy process), the amount of time that it takes to develop a relationship with the supplier, and the amount of investment that goes into developing the local market for

the imported product. [8] Duties are generally imposed on imported pharmaceuticals; however there are exceptions for medication for HIV, malaria and tuberculosis. [9]

In the public sector, procurement and distribution in Nigeria is both centralized and decentralized. Most medicines are procured and stored by the individual health care institutions, while medication for HIV, malaria and tuberculosis are centrally procured and distributed from the federal Central Medical Store (CMS). [9] Each state also has its own CMS, and procures and stores pharmaceuticals for their public facilities. [10] Private sector distribution is handled through pharmaceutical wholesalers, of which there were 616 businesses licensed to do so in 2008; although it is widely accepted that unlicensed wholesalers play a very significant role in drug distribution at this level of the supply chain. [8] Wholesaling activity is typically concentrated within commercial hubs at the regional or state level, with notable pharmaceutical markets located in Lagos, Onitsha, Kano and Ibadan. The use of vertically integrated distribution infrastructure and third-party logistics service providers is common among manufacturers and importers to achieve wide geographic coverage of their products, which is enhanced through the pervasive use of sales representatives deployed, not only for product detailing, but also for order taking and delivery. [8] In terms of retailing and dispensing, the 2009 ACTwatch Outlet Survey revealed that the most common type of outlets stocking antimalarials was PPMVs (81%), followed by general retailers (9%) then public health facilities (4%). Registered pharmacies were the least common formal source of antimalarials at 1%. [11] Regulatory capacity is limited in Nigeria, and as such, prescription only medicines are sometimes sold over-the-counter without a prescription. [9] It is also widely recognised that, while only authorized to stock OTC medicines, PPMVs usually stock all types of drugs, diagnose, prescribe, dispense and even administer injections. [10] Drug counterfeits also pose a significant challenge to regulation of the sector and patient safety. [12] Lastly, the prices of medicines are not regulated in Nigeria. [9]

Health System

In the public sector, delivery of tertiary, secondary and primary health services are the responsibility of one of the administrative levels of government: federal, state, and local, respectively. At the primary level, care in the public sector is provided by a network of PHC facilities, comprised of health posts, clinics and dispensaries providing basic services, and PHC centres providing higher level services. [2] Public health facilities charge registration fees, and in most states, medicines are financed through drug-revolving-fund schemes; therefore, medicines are financed by patients, usually out-of-pocket – however, in most states there are exemptions for selected groups and medicines (including ACTs). [10] The private health system consists of a mix of for-profit and not-for profit health facilities across all levels of care, as well as pharmacies, PPMVs and drug sellers that also provide diagnostic and treatment services. The role of the private sector in providing health services is large: For example, in the period 1999-2001, although only 2% of tertiary hospitals were private, 72% of secondary and 35% of primary health facilities were private. A household survey carried out by FMOH found that 56% of respondents who were ill in the previous two weeks purchased drugs from a private seller compared to 35% who obtained drugs from a public health facility. [2]

In 2009, total health expenditure was 5.8% of GDP, translating to approximately US$ 69 per capita. Of this, 36.3% was paid by various levels of government (constituting 6.4% of total government expenditures that year); while the remaining 63.7% private expenditure came mostly out-of-pocket. Spending on health covered by private insurance is very low and accounted for 3% of private expenditure. [13] Total pharmaceutical expenditure in 2007 accounted for 5.4% of total health expenditure and 0.35% of GDP, amounting to approximately US$ 3.88 per capita. [9]

Malaria Epidemiology and Control Strategies

Nigeria's geographic location creates a suitable climate for malaria transmission throughout the entire country, apart for the mountainous areas located in Plateau State. There are five ecological strata from South to North (mangrove swamps, rain forest, Guinea-, Sudan- and Sahel-savannah) where the duration of the transmission season decreases from perennial in most of the South to only 3 months or less in the border region with Chad. [2] The dominant malaria parasite species is *Plasmodium falciparum.*

It is estimated that approximately 30% of the population live in areas of high to very high transmission intensity and 67% in the moderate transmission zone and that a total of 70-110 million clinical cases occur each year. In 2009, the number of deaths due to malaria was estimated to be around 300 000 among children under 5 years of age and malaria was responsible for 11% of all maternal deaths. [2]

Malaria control activities to date have focussed on integrated vector management targeting children and mothers, with a strong emphasis on improving ITN coverage. Efforts to improve ITN coverage have consisted mainly of free public distribution of long-lasting insecticide treated nets (LLIN), often integrated with other public health activities such as antenatal care, immunisation campaigns, and mass drug administration for diseases like onchocerciasis. Improving coverage via distribution through the private commercial sector is another key strategy and has been done in several ways, such as subsidised and at-cost sales through social marketing organisations, and also voucher schemes which have been supported by NetMark and Exxon Mobile. Based on the 2010 Malaria Indicator Survey, the current national coverage of households with at least one net is estimated at 44% and that of ITN coverage at 42% [14]; and coverage targets for 2013 as set out in the National Malaria Strategic Plan 2009-2013 are for 85%. [2] Indoor residual spraying (IRS) does not play an important role in malaria control, although some pilot studies using IRS are taking place. Another strategy for malaria control that figures in the national plan is intermittent preventive treatment of pregnant women (IPTp). A national survey conducted in 2008 showed that 58% of pregnant women received ANC services from a skilled provider and 53% of these attended at least twice. [15] However, although 40% of women who recently gave birth took antimalarials for prevention during pregnancy, only 13% received this treatment during an antenatal visit. [14]

National Treatment Policy

In 2004, artemether-lumefantrine (AL) 20mg/120mg was adopted to replace chloroquine as the first-line treatment for uncomplicated malaria by the National Malaria Control Program (NMCP), and artesunate+amodiaquine (ASAQ) was included at a later date as an alternative. According to the treatment policy, severe malaria is to be treated at tertiary health facilities while lower level health facilities may provide pre-referral treatment with artesunate suppositories. The approved treatment for severe malaria is quinine, artesunate or artemether injection. Oral artemisinin monotherapy has been banned in Nigeria since 2006. [16]

The treatment policy includes parasitological confirmation for suspected cases of malaria where facilities exist, with the exception of children under-five who should be treated based on clinical diagnosis. Parasitological confirmation is not required as a pre-condition for initiating treatment for those with suspected severe malaria. The treatment policy acknowledges that laboratory facilities are not available at primary level and that they may not be available even at secondary level. The policy states that use of RDTs is desirable where microscopy does not exist; however, RDTs are not readily available. [17] For example, the 2009 ACTwatch Outlet Survey found that, although diagnostic testing was available at 27.5% of public health facilities, 86.1% of private not-for profit health facilities and at 37.0% of private for-profit health facilities,

this consisted of mostly microscopy, and that the availability of any diagnostic tests in other types of outlets, such as pharmacies and drug stores, was less than 3%. [11]

Antimalarial Treatment Distribution and Delivery

Patients access treatment for malaria through the public sector and a diverse range of private sector outlets. ACTs are to be provided free of charge via the public sector and non-profit health facilities, including community health extension workers (CHEW) associated with public health facilities. [9] A subsidy programme run by SFH and funded by the Global Fund has made child doses of ASAQ available since 2008 through private sector health facilities, pharmacies and PPMVs in 18 of the 36 states and the Federal Capital Territory. These products, with brand names Arsuamoon and Larimal, were sold for a wholesale purchase price of 5 NGN (US$ 0.03) per treatment with an approved retail price set at 30 NGN (US$ 0.20). However, the subsidised Arsuamoon and Larimal products distributed under this programme had identical packaging to their non-subsidised commercial equivalents that were being concurrently sold by private sector wholesalers and retailers across the entire country at considerably higher prices. Therefore, to ensure that the target retail price was achieved and also to minimise leakage of the subsidised product outside of programme areas and target retail outlet types, SFH chose to bypass private sector wholesalers and distributed these subsidised products directly to target outlets in the participating states from their own warehouses and only in limited quantities (e.g. PPMVs were permitted to purchase 2 packages from SFH per transaction). Subsidised ASAQ was also distributed through several of civil society partners (Africare Nigeria, Errand Express, Planned Parenthood Federation of Nigeria) strategically selected by SFH in order to improve coverage in underserviced rural areas.

In 2007, a total of 17.5 million doses of ACTs (AL and ASAQ) were distributed in the public and NGO sectors or sold in the private sector at subsidised prices through SFH. While this represents notable progress compared to 2006 when less than half of this volume was distributed, it still only provided treatment for about 25% of the estimated number of malaria cases. [2] In 2005, 0.1% of under-5 children were promptly treated with ACT [2], and by 2010, this figure had increased to 3.2% [14]-- both well below the coverage target of 80%. As such, considerable effort has been made to improve access to treatment at community level as part of the broader aim to improve overall case management. This has included pilot studies on home management of malaria fever and on the use of role-model mothers (RMM), and the World Bank Malaria Control Booster Project that focuses not only on improving access to prevention, treatment and RDTs in the public sector in 7 states, but also improving procurement and logistics, monitoring and evaluation, and coordination across programmes and jurisdictions. [18]

However, as in many other developing countries, care for a large proportion of febrile children in Nigeria is first sought from the private sector. The ACTwatch Household Survey conducted in 2009 found that 45.5% of such care was initially sought from private providers at health facilities (7.1%), pharmacies or PPMVs (27.1%). [19] The informal market is believed to play a very significant role in the distribution and delivery of antimalarials in Nigeria. [8]

Malaria Financing

Funds from Round 4 of the Global Fund to fight AIDS, Tuberculosis and Malaria were used to fund the private sector subsidy program for ASAQ described above since 2008. A $500 million Global Fund Round 8 grant was signed in 2008, and additional funds were made available through the World Bank Malaria Booster Program and the UK Department for International Development (DfID). The Round 8 grant will support prompt and effective treatment of malaria with ACTs, use of sulphadoxine-pyrimethamine (SP) for intermittent preventive treatment (IPT) of malaria in pregnancy, use of RDTs and microscopy, and integrated

vector management. From 2009, Nigeria has also been approved to receive US$ 300 million in additional Global Fund malaria-related grants through Round 9 in support of the Strategic Plan 2009-2013; however, a significant proportion of these funds have been reallocated to activities related to Nigeria's participation in the pilot phase of the Affordable Medicines Facility – malaria (AMFm), particularly to cover a range of 'supporting interventions'. Nigeria signed the Global Fund grant to participate in the AMFm in 2010, which is intended to increase the distribution and uptake of ACTs through the private, public, and not-for-profit channels by lowering the cost of ACTs to the end user through a high-level subsidy mechanism.

The U.S. Agency for International Development (USAID) has also been supporting malaria control efforts in Nigeria for more than ten years, with funding increasing steadily over the years from US$ 7 million in 2007 to $18 million in 2010. In 2011, Nigeria will also begin receiving funds from the US President's Malaria Initiative, and the amount of funding requested during the initial year is US$ 48.5 million. [20]

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. 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 outlets. This allows any transactions between public, NGO 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. artemether-lumefantrine), 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 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 round of the ACTwatch Outlet Survey by SFH Nigeria between August and September 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, Nigeria was divided into 4 geographically-defined strata: Lower North, South East, Upper North, South West. 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 were created by aggregating existing electoral enumeration areas such that the combined area covered a population size of approximately 10,000 to 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 antimalarial availability and price across different outlet types, this sample was supplemented by a booster sample that included all public sector outlets and registered pharmacies operating in the district within which the sampled sub-district was situated. The use of a booster sample is a common procedure across all ACTwatch outlet surveys to ensure adequate representation of relatively rare but important antimalarial provider types. All registered pharmacies and public sector outlets (e.g. health posts, health centres, hospitals) in the entire district which were not in the selected sub-district itself that stocked antimalarials were identified through a census in the relevant districts.

The first Outlet Survey was conducted in the sampled sub-districts and booster districts by SFH Nigeria in December 2008, with a second outlet survey conducted between August and September 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.
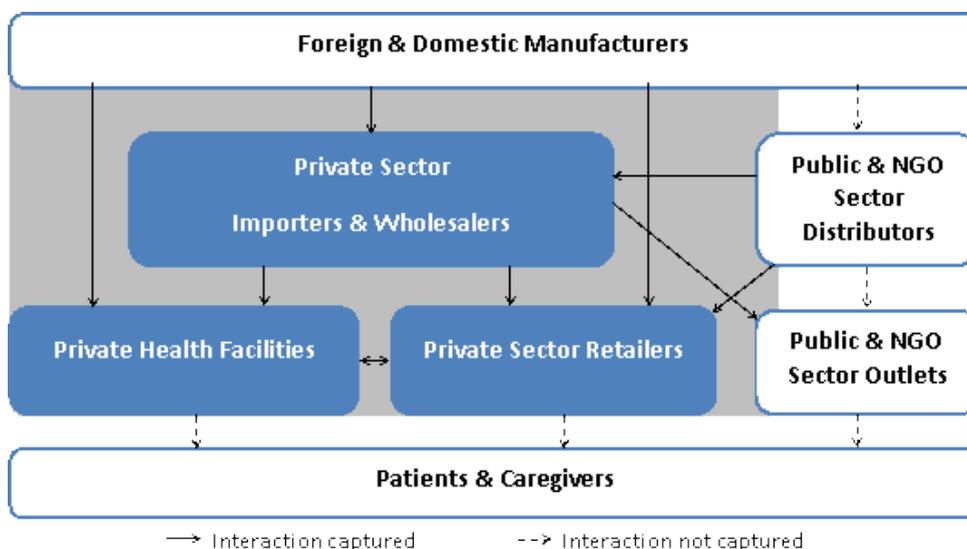
Figure 3.1: Antimalarial wholesale supplier interactions captured by the Supply Chain Study

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 SFH Nigeria, after the first round of the Outlet Survey, from July to September 2009. A random sample of 20 sub-districts from the Outlet Survey's 76 sampled sub-districts (5 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 SFH Nigeria.[1] All these terminal 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.[2] 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 English, piloted by members of the research team, and further revisions were made to adapt the tools to the specificities of the Nigerian 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 English. 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 emphasized 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 National Health Research Ethics Committee of Nigeria (reference number: NHREC/01/01/2007) and the LSHTM ethics review committee.

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

[2] There may be horizontal trading within the supply 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, private health facilities (includes both for-profit and not-for-profit facilities), PPMVs/drug stores, other private outlet types (includes retail stores, such as supermarkets, and also itinerant vendors), and public health facilities (also includes community health workers). 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, injectables[3], suppositories and granules; and 3 antimalarial categories[4] 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.

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[3] Liquid and powder injectables form a single category.
[4] 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*[5]. 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:

[[[(highest selling price)+(lowest selling price)]/2]- (wholesale purchase price)]/(wholesale purchase price)

Retail purchase prices and mark-ups were calculated using price data collected during the ACTwatch Outlet Survey 2009. 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 provides a detailed description of the calculations performed and weights used.

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.[6]

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[5] 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.

[6] Outlet Survey data collection took place between 4 August and 16 September 2009 and an average exchange rate of 1 US$ to 155.566 Nigeria Naira during the data collection period was used for the calculation of retail absolute mark-ups. Supply Chain Survey data collection took place between 18 July to 8 September 2009 and an average exchange rate of 1 US$ to 154.892 Nigeria Naira 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.

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.

4. Results

4.1. Overview of the sample

A total of 150 supply sources were mentioned by retailers sampled in the 20 selected Outlet Survey sub-districts, of which 3 (2.0%) referred to a local manufacturer, and 2 (1.3%) were listed with a general location but without a supplier name. 82 (54.7%) mentioned a supplier in a main market in large commercial centres in Bauchi, Ibadan, Kano, Lagos and Onitsha, of which 19 mentioned only the market name and no specific supplier (4 in Kano, 6 in Lagos, 9 in Onitsha). One supplier (0.7%) mentioned by a private sector retailer was 'government drug stores'. For the remaining 125 supply sources, other uncertainties around supplier business names or locations were clarified by calling suppliers, and in the absence of contact numbers, advice on location was sought from local informants, including SFH staff members and data collectors who had participated in the Outlet Survey data collection. This process identified 8 (5.3%) duplicates, leaving a total of 117 suppliers to form the sample of terminal wholesalers. To account for the 19 supplier mentions that listed only a main market, additional wholesaler interviews were attempted in the 3 locations (Kano, Lagos and Onitsha), 13 of which were successful. Out of the 130 total attempted interviews among terminal level wholesalers, 1 was ineligible to participate as they did not meet the screening criteria, 7 could not be located, and a suitable respondent was not available following several visits in 3 wholesalers. Among those eligible to participate, 15 refused and 2 stopped the interview before completing all sections of the provider questionnaire or the inventory of antimalarials, leaving 104 terminal wholesalers with completed or partially interviews.

All 102 terminal wholesalers who were successfully interviewed were asked about their top two supply sources for antimalarials. From a total of 182 wholesaler mentions, 6 referred to foreign manufacturers (which are beyond the scope of this study), and 59 referred to local manufacturers (17 of which were supplied via sales representatives or depots). Of these 59 mentions of local manufacturers, 32 referred to local manufacturers that only sell their own domestically produced antimalarials (and are therefore beyond the scope of this study), while the remaining 27 mentioned local manufacturers that either imported antimalarials or sold antimalarials produced by other local manufacturers. The remaining 144 wholesaler mentions referred to 76 unique wholesale businesses, called intermediate-1 wholesalers as they supplied terminal wholesalers. Of these 76 identified intermediate-1 wholesalers, 8 had already been identified at the terminal level (as they also supplied retailers included in the Outlet Survey sample directly), one of which refused. As such, an interview was not re-administered to these 8 wholesalers. Of the remaining 68 intermediate-1 wholesalers, interviews were successfully administered to 33, 1 was partially administered, 12 refused, 8 could not be located, 1 had closed permanently, a suitable respondent not available following several attempts in 9, and 4 did not meet inclusion criteria as they did not stock antimalarials or RDTs at any point in the 3 months preceding the interview.

From the 41 intermediate-1 wholesalers (the 7 interviewed at terminal level and 34 newly interviewed), we obtained 56 total mentions for intermediate-2 wholesalers of which 16 were foreign manufacturers and 6 referred to local manufacturers that only sell their own domestically produced antimalarials. The remaining 34 mentions referred to 21 unique wholesalers, of which 5 were local manufacturers that either imported antimalarials or sold antimalarials produced by other local manufacturers (2 of which supplied the wholesaler via sales representatives or depots). 14 of these had already been identified at previous levels (with whom 9 interviews were completed), leaving 7 newly identified wholesalers at this level. Of these 7 intermediate-2 wholesalers, interviews were completed with 2, another 4 could not be located, and a suitable respondent was not available in one. These 11 intermediate-2 wholesalers (9 interviewed at a previous level and 2 newly interviewed) produced a total of 11 mentions for intermediate-3 wholesalers. All but one of these were foreign manufacturers, and the 1 remaining mention referred to a wholesaler that had already been identified and interviewed at a previous level. Therefore, no new interviews were conducted at this level and the top of the chain was deemed to have been reached, with a total of 205 wholesalers that sold antimalarials identified and 140 interviews conducted (137 completed and 3 partially 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[1]	Number of duplicates[2]	Number not eligible[3]	Number not interviewed for other reasons[4]	Number not found	Number of interviews conducted[5]
Total	-	-	27	8	5	14	19	140
Terminal	130	-	15	8	1	3	7	104
Intermediate-1	76	8	12	0	4	10	8	34
Intermediate-2	21	14	0	0	0	1	4	2
Intermediate-3[6]	1	1	0	0	0	0	0	0

1: One refusal at intermediate-1 and 5 at intermediate-2 level occurred at previous levels. 2: Wholesalers included in the initial sample and found to be duplicates prior to data collection. 3: Outlets not stocking antimalarials or RDTs at the time of the interview or in the preceding 3 months. 4: At terminal level, a suitable respondent was not available in 3 wholesalers; at intermediate-1 level, 1 had closed permanently, a suitable respondent not available in 9 wholesalers; at intermediate-2 level, a suitable respondent not available in 1 wholesaler. 5: At terminal level, 8 additional interviews were conducted across markets in Kano, Lagos and Onitsha to account for the 19 supplier mentions in these locations that did not mention a specific business; partial interviews conducted with 2 wholesalers at terminal level (i.e. 2 partial and 102 completed interviews) and with 1 wholesaler at intermediate-1 level (i.e. 1 partial and 33 completed interviews). 6: This is the top of the chain, defined as the level at which wholesalers who were reported to supply intermediate-2 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 antimalarial drugs

- Markets in large commercial centres in Nigeria are an important source of antimalarial supplies, where high concentrations of businesses engage in medicine wholesaling and retailing. Many private retail outlets throughout the country mentioned these markets in several large urban areas as their two top suppliers of antimalarials: from those retailers who purchased in Onitsha, 89.5% of all supplier mentions were in markets; 57% in Bauchi; 100% in Kano; 46.4% in Lagos; and 58.8% in Ibadan. At the wholesale level, 12.8% of all supplier mentions referred to businesses located in markets. While most supplier mentions specifically named a business operating in a market, at the retail level 22.0% of all supplier mentions only mentioned the market name rather than a specific business.

- In terms of transactions between sectors, no wholesalers reported a public source as one of their two top suppliers of antimalarials; however, one private outlet reported a public source (public sector medicines stores distributing antimalarials purchased through the Global Fund) as one of their two top suppliers of antimalarials, and 2 public facilities surveyed at outlet level mentioned a private sector source as one of their two top antimalarial suppliers. In addition, one retailer (a private health facility) and 5 wholesalers mentioned the NGO, the Society for Family Health (SFH), as one of their two top antimalarial suppliers; however, all of the identified wholesalers who mentioned SFH as a supplier were also retailing antimalarials.

- The structure of the private commercial sector distribution chain for antimalarials in Nigeria 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 (2% 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 5: manufacturer → intermediate-3 wholesaler → intermediate-2 wholesaler → intermediate-1 wholesaler → terminal wholesaler → retailer.

- Among all wholesalers surveyed, regardless of supply chain level, 63.4% were observed to sell directly to retailers, nearly all of whom (93.8%) sold only to retailers.

- Nearly half (40.5%) of all wholesalers were observed to sell to other wholesalers. Most of these wholesalers (90.4%) were observed to sell only to other wholesalers, and only 3.9% of all wholesalers were observed to sell to both wholesalers and retailers.

Figure 4.2.1: Representation of the antimalarial distribution chain showing interactions between supply chain levels by mutually exclusive wholesaler category
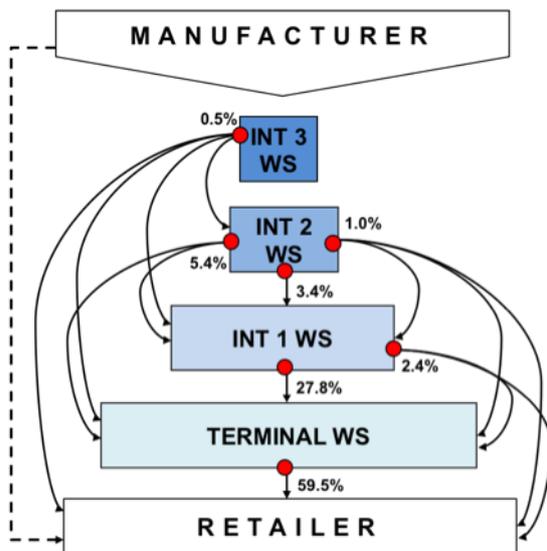
Figure 4.2.2: Representation of the antimalarial distribution chain showing the overlap between wholesaler categories used for analysis

WS: wholesaler; INT: intermediate
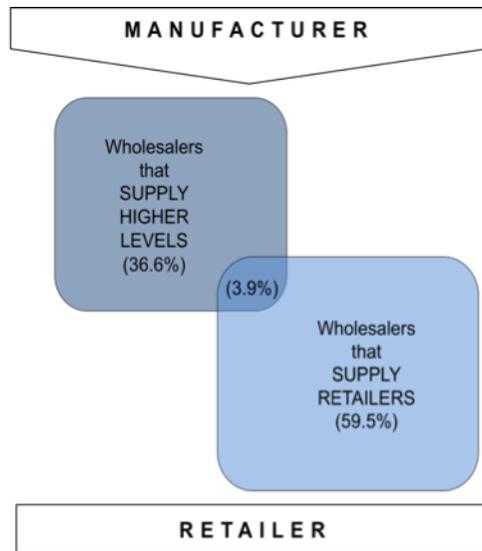
Table 4.2: Defining analytical categories from mutually exclusive wholesaler categories

WHOLESALER CATEGORIES	Total number identified	MUTUALLY EXCLUSIVE CATEGORIES							ANALYTICAL CATEGORIES	
		Supplies int 1	Supplies int 1 & terminal	Supplies int 1, terminal & retailer	Supplies retailer	Supplies terminal	Supplies terminal & retailer	Supplies int 2, int 1, terminal & retailer	Supply Retailers	Supply Wholesalers
% of WS	100%	3.4%	5.4%	1.0%	59.5%	27.8%	2.4%	0.5%	63.4%	40.5%
(N)	(205)	(7)	(11)	(2)	(122)	(57)	(5)	(1)	(130)	(83)

WS: wholesaler, int: intermediate wholesaler

Note: this table presents the number of wholesalers identified which exceeds those interviewed

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 8 years; however, this varied considerably. Wholesale businesses also ranged in size from those supplying retailers with a median of 5 workers (IQR 3-7) to those supplying other wholesalers with a median of 8.5 workers (IQR 5-25).
- Less than half of all wholesalers (43.6%) sold other products alongside pharmaceuticals. The most common consumer goods stocked by all wholesalers were toiletries (27.9%), bednets (25.7%) and food and drinks (15.0%).

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**	**8**	**9.5**	**8**
	IQR	5-17	5-17	5-18
	(N)	(129)	(38)	(97)
Number of people working at outlet	**Median**	**5**	**8.5**	**5**
	IQR	3-8	5-25	3-7
	(N)	(134)	(38)	(103)
Sells other products in addition to pharmaceuticals[1]	**%**	**43.6**	**30.2**	**49.0**
	(N)	(140)	(43)	(104)

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

4.3.2. Wholesalers' customers, delivery activities and credit facilities

Wholesalers mentioned a broad range of antimalarial customers, mainly in the private sector, and included customers in other countries. More than half of all wholesalers mentioned that one of their top two suppliers was an antimalarial manufacturer, although more wholesalers operating at higher levels of the distribution chain did so than wholesalers operating at lower levels of the chain (i.e. those that supply retailers).

Customer types
- Wholesalers mentioned a broad range of antimalarial customer types in both private and public sectors; however, the most frequently mentioned customers were in the private sector: PPMVs or drug stores (mentioned by 90.5%), pharmacies (79.1%), private clinics, health centres or dispensaries (78.7%), private hospitals (77.4%), and other drug wholesalers (74.1%). Very few wholesalers (2.9%) reported selling antimalarials to government or non-governmental organisations.
- More wholesalers supplying retailers compared to those supplying other wholesalers were observed to sell antimalarials to retail customers (80.6% vs. 25.6%), PPMVs or drug stores (96.1% vs. 78.1%), and general retailers, such as grocery stores (63.1% vs. 52.4%). Conversely, a higher proportion of wholesalers supplying other wholesalers reported selling antimalarials to private hospitals (81.0% vs. 76.5%), public hospitals (83.3% vs. 62.4%), and to customers in other countries (28.6% vs. 10.7%).
- Of those who reported selling antimalarials to customers in other countries, 45.5% had customers in Cameroon, 40.9% in Niger, 22.7% in Chad, and 18.2% each in Benin, Ghana and Mali.

Business practices
- Nearly a half (44.2%) of wholesalers supplying other wholesalers reported importing antimalarials, while only 3.9% of wholesalers supplying retailers imported antimalarials.
- More than half (55.8%) of all wholesalers identified a manufacturer as one of their two top antimalarial suppliers; but the proportion was higher among wholesalers supplying other wholesalers compared to those supplying retailers (77.8% vs. 50.0%)
- 5.6% of wholesalers supplying other wholesalers received orders from at least one of their two top antimalarial suppliers through a manufacturer sales representative or one of their regional depots, while a higher proportion of those supplying retailers (14.0%) reported doing so.
- Of those wholesalers that reported a manufacturer as one of their two top antimalarial suppliers, 20.8% reported a foreign manufacturer as one of their top two antimalarial sources, while 79.2% were supplied by domestic manufacturers.
- Of all the wholesalers that named a domestic manufacturer as at least one of their top two antimalarial suppliers, 21.1% of these reported that their orders were arranged through a sales representative or received from a depot (either owned by the manufacturer or operated by a third-party logistics company) located within their region. There were 2 instances of vertically integrated wholesale supply chains, where a domestic manufacturer operated one or more subsidiary wholesalers in regional commercial centres in different parts of the country. These subsidiary wholesalers were supplied exclusively by the 'parent' manufacturer.
- A third (32.6%) of all wholesalers reported delivering antimalarials to their customers; but more than half (59.5%) of the wholesalers supplying other wholesalers delivered compared to under a quarter (22.3%) among those supplying retailers.
- More than three quarters of all wholesalers interviewed (77.9%) had offered credit to customers in the past 3 months, offering a median of 14 days credit (IQR 7-30).

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

		WHOLESALER CATEGORIES		
ANTIMALARIAL CUSTOMER TYPES		**ALL WHOLESALERS**	**SUPPLY WHOLESALERS**	**SUPPLY RETAILERS**
Retail Customers (e.g. patients, care-takers)	**%**	**35.5**	**25.6**	**80.6**
	(N)	(139)	(43)	(103)
Retail Outlets				
Pharmacies	**%**	**79.1**	**83.7**	**78.6**
	(N)	(139)	(43)	(103)
PPMVS or drug stores	**%**	**90.5**	**78.1**	**96.1**
	(N)	(137)	(41)	(103)
General retailers (grocery stores, etc.)[1]	**%**	**59.4**	**52.4**	**63.1**
	(N)	(138)	(42)	(103)
Public clinics, health centres or dispensaries	**%**	**72.3**	**73.8**	**72.6**
	(N)	(137)	(42)	(102)
Private clinics, health centres or dispensaries	**%**	**78.7**	**76.2**	**81.2**
	(N)	(136)	(42)	(101)
Public hospitals	**%**	**67.7**	**83.3**	**62.4**
	(N)	(136)	(42)	(101)
Private hospitals	**%**	**77.4**	**81.0**	**76.5**
	(N)	(137)	(42)	(102)
Wholesale Outlets				
Drug wholesalers	**%**	**74.1**	**88.4**[2]	**69.9**
	(N)	(139)	(43)	(103)
General wholesalers[1]	**%**	**51.5**	**72.1**	**44.1**
	(N)	(138)	(43)	(102)
Customers in Other Countries	**%**	**15.9**	**28.6**	**10.7**
	(N)	(138)	(42)	(103)
BUSINESS PRACTICES		**SUPPLY WHOLESALERS**	**SUPPLY WHOLESALERS**	**SUPPLY RETAILERS**
Import antimalarial drugs	**%**	**14.5**	**44.2**	**3.9**
	(N)	(138)	(43)	(102)
Buy directly from antimalarial manufacturers (as one of two top antimalarial suppliers)	**%**	**55.8**	**77.8**	**50.0**
	(N)	(129)	(36)	(100)
Supplied via sales representative or depot (from one of two top antimalarial suppliers)	**%**	**12.4**	**5.6**	**14.0**
	(N)	(129)	(36)	(100)
Deliver antimalarials to customers	**%**	**32.6**	**59.5**	**22.3**
	(N)	(138)	(42)	(103)
Provided credit to customers in the past 3 months	**%**	**77.9**	**77.5**	**78.6**
	(N)	(136)	(40)	(103)
Most common terms of credit offered in the past 3 months (number of days)	**Median**	**14**	**24.5**	**14**
	IQR	7-30	14-30	7-30
	(N)	(102)	(28)	(79)

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 retailers. 2: Five of the 43 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 88.4% rather than 100.0% based on the information reported by the suppliers rather than their customers.

4.4. Licensing & inspection

Although wholesalers and retailers of pharmaceutical goods in Nigeria should be licensed through the Pharmacists Council of Nigeria, many were found to not hold the required licenses. However, around 70% reported that a pharmaceutical inspector had visited them in the past year.

- Among all wholesalers interviewed, 45.3% reported having a wholesale pharmacy license; however, this figure was higher among wholesalers supplying other wholesalers (73.2%) than among those supplying retailers (39.6%). However, an up-to-date wholesale pharmacy licence was observed in only 8.0% of all wholesalers interviewed. A higher proportion of wholesalers operating at higher levels of the supply chain (i.e. wholesalers supplying wholesalers) were observed to have an up-to-date wholesale license compared to wholesalers supplying retailers (19.1% vs. 3.9%).
- Less than a fifth (15.9%) of all wholesalers interviewed reported having a retail pharmacy license, although 26.8% of wholesalers did report having a PPMV license, which only permits the retail of selected over-the-counter medicines; possession of a PPMV licence was reported by 35.0% of wholesalers supplying retailers and only 4.8% of those supplying other wholesalers. In addition, 19.6% of all wholesalers reported having only a PPMV license.
- Few wholesalers (10.8%) were observed to have the required registration with the Corporate Affairs Commission.
- Possession of a pharmacy import license was reported by more wholesalers operating at higher levels of the supply chain compared to those supplying retailers (48.8% vs. 5.8%); these figures were similar to the number of wholesalers who reported importing antimalarials: 44.2% of wholesalers supplying wholesalers vs. 3.9% of wholesalers supplying retailers.
- Nearly two-thirds (73.8%) of wholesalers interviewed reported that they had been visited by a pharmaceutical inspector in the past year.

Table 4.4: Licensing & Inspection

REGISTRATION STATUS		WHOLESALER CATEGORIES		
		ALL WHOLESALERS	SUPPLY WHOLESALERS	SUPPLY RETAILERS
Reported having a license allowing wholesale of pharmaceuticals	%	45.3	73.2	39.6
	(N)	(137)	(41)	(103)
Reported having a retail pharmacy license	%	15.9	16.7	16.5
	(N)	(138)	(42)	(103)
Reported having a PPMV license	%	26.8	4.8	35.0
	(N)	(138)	(42)	(103)
Reported having an import license	%	16.8	48.8	5.8
	(N)	(137)	(41)	(103)
Reported having a manufacturer license	%	11.6	31.0	4.9
	(N)	(138)	(42)	(103)
Any up-to-date license from the PCN was observed[1]	%	8.7	19.1	4.9
	(N)	(138)	(42)	(103)
An up-to-date wholesale license from the PCN was observed	%	8.0	19.1	3.9
	(N)	(138)	(42)	(103)
Corporate Affairs Commission registration certificate was observed[2]	%	10.8	12.5	10.3
	(N)	(130)	(40)	(97)
Reported they had been visited by a pharmaceutical inspector in the past year	%	71.2	76.3	69.0
	(N)	(132)	(38)	(100)

1: This license may be either a retail or wholesale pharmacy license, but not a PPMV license intended solely for the retail of specific OTC drugs; 2: A certificate of registration with the Corporate Affairs Commission is a requirement by the PCN in order to operate a wholesale or retail pharmacy, or pharmaceutical manufacturing; this requirement, however, does not apply to operate a PPMV.

4.5. Knowledge, qualifications and training

Knowledge of ACTs and malaria-related training received were generally found to be similar across wholesaler categories, despite the fact more wholesalers operating at higher levels of the distribution chain employed staff members with health qualifications than wholesalers at lower levels of the chain.

- Half of all wholesalers interviewed (53.6%) were able to correctly identify AL or ASAQ as the government recommended first-line treatment for uncomplicated *Pf* malaria; 34.1% of all wholesalers responded that they did not know the recommended treatment.
- However, the proportion of wholesalers identifying an ACT as the most effective medication for treating uncomplicated malaria was slightly lower (45.7% for children and 43.5% for adults). AL was most commonly mentioned as the most effective antimalarial among all wholesalers (22.5% for children and 24.6% for adults) and ASAQ was mentioned as most effective for adults by 11.6% of wholesalers and for children by 18.8% of wholesalers. However, 20.3% of all wholesalers mentioned SP as the most effective treatment of malaria for adults, making it the second most commonly mentioned 'most effective' antimalarial. Among all wholesalers, 12.3% of all wholesalers mentioned chloroquine as the most effective treatment of malaria for children.
- Two thirds (62.8%) of all wholesalers reported employing staff with health qualifications; the proportion of wholesalers supplying other wholesalers that reported employing such staff was higher than among those supplying retailers (85.7% vs. 54.9%).
- Among all wholesalers who reported employing a member of staff with a health qualification, the most commonly reported health qualifications were pharmacists (88.4%), followed by pharmacy technicians/assistants (22.1%) and nurses/midwives (22.1%).
- 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 (16.9% 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]	%	62.8	85.7	54.9
	(N)	(137)	(42)	(102)
Employ staff who participated in in-service training related to malaria treatment in the past 2 years	%	16.9	13.9	17.0
	(N)	(124)	(36)	(94)
Identify any ACT as the most effective medication for treating uncomplicated *Pf* malaria in adults	%	43.5	57.1	39.8
	(N)	(138)	(42)	(103)
Identify any ACT as the most effective medication for treating uncomplicated *Pf* malaria in children	%	45.7	47.6	44.7
	(N)	(138)	(42)	(103)
Correctly identify the government recommended first line treatment for uncomplicated *Pf* malaria	%	53.6	54.8	53.4
	(N)	(138)	(42)	(103)

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

4.6. Storage of antimalarial drugs

Wholesalers were observed to practice good storage practices.

- 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 (97.0%).
- 97.0% 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		WHOLESALER CATEGORIES		
		ALL WHOLESALERS	SUPPLY WHOLESALERS	SUPPLY RETAILERS
Store antimalarials in a dry area	%	100.0	100.0	100.0
	(N)	(100)	(23)	(83)
Store antimalarials out of direct sunlight	%	100.0	100.0	100.0
	(N)	(100)	(23)	(83)
Store antimalarials off the floor	%	97.0	100.0	96.4
	(N)	(100)	(23)	(83)
Store antimalarials in a dry area, out of direct sunlight & off the floor	%	97.0	100.0	96.4
	(N)	(100)	(23)	(83)

4.7. Availability of antimalarials & RDTs

Although more than three-quarters of all wholesalers surveyed (86.2%) had an ACT in stock at the time of the interview, only 53.6% of stocked WHO prequalified ACTs. Oral AMTs were observed to be in stock in 72.5% of wholesalers while few RDTs were stocked (3.6%).

- A higher proportion of all wholesalers had non-WHO prequalified ACTs in stock (76.1%) than WHO prequalified ACTs (53.6%); only a third (35.7%) of wholesalers operating at higher levels of the supply chain stocked WHO prequalified ACTs.
- More than three-quarters of all wholesalers (85.2%) reported having had at least one ACT in stock throughout the three month period prior to interview
- A similar proportion of all wholesalers (83.3%) stocked AL and/or ASAQ, the recommended first-line treatments for uncomplicated *Pf* malaria; 64.5% stocked AL and 71.0% stocked ASAQ. In addition, 40.6% of all wholesalers stocked the brands of ASAQ, Larimal or Arsuamoon; however, a lower proportion stocked these products in states participating in the subsidy programme (26 of 84, or 30.1%) and in states not participating in the subsidy programme (30 of 54, or 55.6%).
- Oral AMTs were observed to be in stock in 72.5% of all wholesalers and nATs in 87.7% of all wholesalers; although, fewer wholesalers supplying other wholesalers were observed to stock oral AMTs and nATs compared to those wholesalers supplying retailers (AMTs: 47.2% vs. 81.6%, respectively; nATS: 69.0% vs. 94.2%, respectively). Most AMT products observed (79.5%) were in oral dosage form.
- The most frequently observed antimalarials were the first-line antimalarial, AL (accounting for 16.0% of all antimalarial products stocked by wholesalers), chloroquine (15.7%), SP (15.5%), and ASAQ (14.7%); the next three most frequently observed antimalarials were all AMTs (artesunate, dihydroartemisinin, artemether) that together accounted for 17.4% of all antimalarial products stocked by wholesalers, all of which in oral dosage form.
- AL and ASAQ accounted for the majority of ACT products observed to be stocked by all wholesalers (41.0% and 37.7%, respectively); the next most frequently observed ACT was dihydroartemisinin-piperaquine (DHA-PP), accounting for 8.3% of all ACT products stocked. A fifth (20.1%) of all the ASAQ products observed to be stocked by all wholesalers were the brands Larimal or Arsuamoon
- RDTs were stocked by only 3.6% of all wholesalers.

Table 4.7: Antimalarial & RDT availability

		WHOLESALER CATEGORIES		
AVAILABILITY		**ALL WHOLESALERS**	**SUPPLY WHOLESALERS**	**SUPPLY RETAILERS**
Had antimalarials in stock	%	**98.6**	**95.2**	**100.0**
	(N)	(138)	(42)	(103)
Had ACT in stock	%	**86.2**	**88.1**	**86.4**
	(N)	(138)	(42)	(103)
Always had at least one ACT in stock over the past 3 months	%	**85.2**	**87.5**	**85.3**
	(N)	(135)	(38)	(102)
Had WHO prequalified ACT in stock	%	**53.6**	**35.7**	**61.2**
	(N)	(138)	(42)	(103)
Had non-WHO prequalified ACT in stock	%	**76.1**	**76.2**	**76.7**
	(N)	(138)	(42)	(103)
Had oral AMT in stock	%	**72.5**	**47.6**	**81.6**
	(N)	(138)	(42)	(103)
Had non-oral AMT in stock	%	**33.3**	**33.3**	**34.0**
	(N)	(138)	(42)	(103)
Had nAT in stock	%	**87.7**	**69.0**	**94.2**
	(N)	(138)	(42)	(103)
Had RDT in stock	%	**3.6**	**7.1**	**1.9**
	(N)	(138)	(42)	(103)

4.8. Sales volumes of antimalarials and RDTs

Typical wholesale volumes were largest for non-artemisinin therapies, followed by ACTs; however, the typical sales volume for non-artemisinin therapies was four times larger than for ACTs. Moreover, the typical sales volume for non-WHO prequalified ACTs was 20 times higher than for prequalified ACTs. SP was the top selling antimalarial for nearly half of all wholesalers.

Among all wholesalers (n=136; Table 4.8.1):

- The median number of adult equivalent treatment doses (AETDs) sold the week preceding the survey was highest for nATs (562.9, IQR: 163.6-2006.6), followed by ACTs (137.9, IQR 12.8-794.0) and AMTs (42.0, IQR 3.8-272.1). Looking more closely at ACTs, the median number of AETDs sold of non-WHO prequalified ACTs (94.0, IQR: 2.6-556.4) was higher than for WHO prequalified ACTs (4.8, IQR: 0.0-60.0).
- 86.8% reported selling an ACT during the week preceding the survey; this figure was 77.9% for AMTs and 89.0% for nATs.
- More AETDs were sold as tablets than any other dosage form across antimalarial drug categories, including AMTs where there has been a ban in place for the oral form of the drug since 2006. Relative to ACTs and AMTs, high median volumes of oral liquid nATs were sold by wholesalers. The volumes of granule and suppository dosage forms sold were very low: median sales volumes among all wholesalers stocking any antimalarial across all antimalarial categories were 0 (IQR 0-0). However, 19.9% of all wholesalers did report selling an ACT in granule dosage form during the week preceding the survey. See Appendix 6.1 for additional tables on sales volumes of suppository and granule dosage forms.

Among wholesalers stocking the corresponding product category (Table 4.8.2):

- Among wholesalers who stocked ASAQ products branded as either Larimal or Arsuamoon (n=56), the median number of AETDs sold of these products was 18.8 (IQR 8.9-66.5); volumes of these products sold were slightly higher among wholesalers located in states participating in the subsidy programme (21.3 AETDs, IQR 5.0-131.0) than those in states not participating (15.7 AETDs, IQR 9.0-45.0).
- Among all wholesalers who had antimalarials in stock at the time of interview (n=135), the top selling antimalarial was AL for 13.3% of wholesalers and ASAQ for 5.9% (the two recommended first-line treatments for uncomplicated malaria), while SP was the top selling antimalarial for 45.2% and chloroquine for 19.3%.[7]
- Compared to wholesalers supplying retailers, the top selling antimalarial for wholesalers supplying other wholesalers was more likely to be AL (18.0% vs. 12.6% for wholesalers supplying retailers) and ASAQ (15.4% vs. 1.9%); however, SP was the top selling antimalarial for more wholesalers than any other antimalarial: 38.5% of wholesalers supplying other wholesalers, and 48.5% of wholesalers supplying retailers.
- WHO prequalified ACTs were sold by fewer wholesalers (54.4%) than non-WHO prequalified ACTs (75.7%), and when wholesalers stocked and sold these types of ACTs, the median volume of WHO prequalified ACTs being sold (51.9 AETDs, IQR: 13.5-222.5) was only a quarter of the typical volumes being sold for non-WHO prequalified ACTs (193.5 AETDs, IQR: 45.4-760.4). This difference was even more pronounced at higher levels of the supply chain (Table 4.8.2).
- RDTs were not commonly stocked by wholesalers. Among those who did stock RDTs, the volume of tests sold varied both within and across supply chain levels. Among those who stocked RDTs, the median number of tests sold during the week preceding the survey was 315 (IQR 30-600) among wholesalers supplying wholesalers, while wholesalers supplying retailers sold a median 25 tests (IQR 0-50).

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[7]The 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=136[3]	SUPPLY WHOLESALERS N=40	SUPPLY RETAILERS N=103
All ACT	All	**Median**	**137.9**	**787.4**	**114.8**
		IQR	12.8-794.0	117.4-4633.1	8.4-530.8
	Tablet	**Median**	**120.0**	**730.4**	**97.2**
		IQR	11.8-730.4	103.2-4200.0	7.0-518.9
	Oral liquid	**Median**	**0.0**	**0.0**	**0.0**
		IQR	0.0-26.3	0.0-42.3	0.0-26.3
WHO prequalified ACT	All products were tablets	**Median**	**4.8**	**0.0**	**9.0**
		IQR	0.0-60.0	0.0-86.6	0.0-60.0
Non-WHO prequalified ACT	All	**Median**	**94.0**	**418.0**	**70.2**
		IQR	2.6-556.4	4.9-2266.7	2.6-374.0
	Tablet	**Median**	**83.0**	**400.2**	**50.0**
		IQR	2.6-520.3	4.9-2135.4	2.6-313.3
	Oral liquid	**Median**	**0.0**	**0.0**	**0.0**
		IQR	0.0-26.3	0.0-42.3	0.0-26.3
AMT	All	**Median**	**42.0**	**165.8**	**38.7**
		IQR	3.8-272.1	0.0-934.9	11.0-206.4
	Tablet	**Median**	**28.1**	**0.0**	**31.3**
		IQR	0.0-155.3	0.0-309.5	5.6-121.9
	Oral liquid	**Median**	**1.0**	**0.0**	**1.7**
		IQR	0.0-17.3	0.0-35.0	0.0-18.3
	Injectable	**Median**	**0.0**	**0.0**	**0.0**
		IQR	0.0-2.6	0.0-16.5	0.0-1.7
nAT	All	**Median**	**562.9**	**1207.3**	**555.5**
		IQR	163.6-2006.6	0.0-8144.7	166.7-1635.3
	Tablet	**Median**	**392.3**	**607.4**	**398.6**
		IQR	90.4-1649.2	0.0-7795.9	120.0-1359.9
	Oral liquid	**Median**	**26.8**	**0.0**	**32.0**
		IQR	0.0-101.8	0.0-67.7	0.0-106.4
	Injectable	**Median**	**0.0**	**0.0**	**0.0**
		IQR	0.0-0.0	0.0-0.0	0.0-0.0
			ALL WHOLESALERS N=142	SUPPLY WHOLESALERS N=46	SUPPLY RETAILERS N=103
RDT[4] (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 136 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, 205 wholesalers were identified, of which 137 were interviewed successfully. Of the remaining, 3 were partially interviewed, 27 refused, 33 were not screened because a respondent was not available, the business had closed or could not be found, and 5 did not stock antimalarials at the time of the survey or during the three months prior to the visit (Table 1). These 68 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 2531 antimalarials audited, and 903 (35.7%) had missing sales volumes that were imputed using the mi impute pmm command. 4 For RDTs, of the 136 wholesalers completely interviewed or from whom stocking information was collected, 5 reported stocking RDT and inventory data were collected on 6 observed products. Of these, information on sales volume was not provided for 1 product from 1 wholesaler; however imputation was not performed as there were too few observations to reliably perform linear regression. Sales volumes were set as missing for the 1 wholesaler who reported stocking RDTs but from whom inventory data were not collected. Therefore for RDTs, median sales volumes at the level supplying retail outlets are estimated based on the sample of 5 products from 4 wholesalers for which volumes were not missing.

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**	**200.0**	**853.2**	**140.9**
		IQR	49.8-890.3	162.5-6807.9	35.1-715.5
		(n)	(118)	(36)	(89)
	Tablet	**Median**	**200.0**	**810.0**	**129.3**
		IQR	47.9-821.8	160.0-6587.9	28.8-605.7
		(n)	(118)	(36)	(89)
	Oral liquid	**Median**	**31.3**	**74.0**	**28.1**
		IQR	8.9-93.8	26.4-269.7	7.5-74.2
		(n)	(59)	(15)	(50)
WHO prequalified ACT	All products were tablets	**Median**	**51.9**	**138.0**	**47.5**
		IQR	13.5-222.5	50.0-798.3	12.5-184.1
		(n)	(74)	(15)	(63)
Non-WHO prequalified ACT	All	**Median**	**193.5**	**809.7**	**136.9**
		IQR	45.4-760.4	200.0-4426.3	30.6-557.9
		(n)	(103)	(30)	(79)
	Tablet	**Median**	**162.5**	**746.5**	**114.8**
		IQR	36.7-722.8	200.0-4000.0	24.3-518.9
		(n)	(103)	(30)	(79)
	Oral liquid	**Median**	**31.3**	**74.0**	**28.1**
		IQR	8.9-93.8	26.4-269.7	7.5-74.2
		(n)	(59)	(15)	(50)
AMT	All	**Median**	**90.8**	**667.6**	**61.6**
		IQR	31.5-333.8	257.1-3424.3	25.0-265.4
		(n)	(107)	(23)	(88)
	Tablet	**Median**	**66.7**	**309.5**	**51.3**
		IQR	25.0-272.5	125.0-730.0	22.5-171.9
		(n)	(95)	(20)	(79)
	Oral liquid	**Median**	**15.0**	**66.7**	**10.8**
		IQR	3.3-46.9	16.0-385.0	2.6-34.8
		(n)	(75)	(15)	(64)
	Injectable	**Median**	**14.1**	**25.2**	**6.9**
		IQR	3.3-60.5	16.3-2014.7	1.7-43.9
		(n)	(45)	(14)	(34)
nAT	All	**Median**	**840.0**	**2207.9**	**563.3**
		IQR	261.7-2149.3	1049.9-14032.1	218.7-1777.3
		(n)	(121)	(29)	(97)
	Tablet	**Median**	**579.0**	**2966.7**	**451.3**
		IQR	166.7-1800.0	300.0-16676.5	150.0-1463.0
		(n)	(117)	(27)	(95)
	Oral liquid	**Median**	**54.5**	**145.3**	**45.6**
		IQR	26.7-228.8	46.1-961.0	23.0-161.6
		(n)	(91)	(16)	(78)
	Injectable	**Median**	**91.6**	**91.6**	**63.0**
		IQR	15.4-177.2	63.0-285.7	8.7-161.3
		(n)	(40)	(10)	(31)
RDT (units)		**Median**	**40**	**315**	**25**
		IQR	30-50	30-600	0-50
		(n)	(4)	(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 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.

4.9. 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.

Among all wholesalers, median purchase prices per AETD were highest for AMTs (US$ 4.13, IQR: 2.07-9.92), followed by ACTs (US$ 3.55, IQR: 2.39-5.34) and nATs (US$ 0.53, IQR: 0.26-1.21). Tablets comprise a high proportion of all observed products in each drug category; and considering tablet dosage forms only, wholesalers purchased ACTs at a median price of US$ 3.10 per AETD, US$ 2.07 for AMT, and US$ 0.35 for nATs. Of the few RDTs observed at the wholesaler level, the median price was $0.71 per test.

- Median purchase prices paid for AMTs and nATs by wholesalers supplying other wholesalers were observed to be higher than the prices paid by those supplying retailers, because, for both categories, wholesalers supplying other wholesalers tended to stock a greater proportion of the more expensive non-tablet dosage forms (i.e. oral liquids and injectables). A similar pattern was also observed with the median purchase prices for WHO prequalified ACTs (all of which were in tablet form). However in this case, the particular brand of ASAQ, Larimal, comprised a higher proportion of observed products among wholesalers supplying retailers compared to those supplying other wholesalers (46.2% vs. 38.2%); also, the median purchase price paid for Larimal was lower among wholesalers supplying retailers (US$ 2.07 vs. US$ 2.55).

- At retail level, median purchase prices for ACTs ranged from US$ 2.70 (IQR 0.26-4.18) in private health facilities to US$ 3.99 (IQR 2.44-6.60) in pharmacies; for AMT, purchase prices ranged from US$ 2.47 (IQR 2.47-2.88) in private health facilities to US$ 7.42 (IQR 2.19-13.88) in pharmacies; and for nATs, purchase prices ranged from US$ 0.55 (IQR 0.29-0.80) in other private outlets, such as supermarkets, to US$ 0.96 (IQR 0.34-9.64) in private health facilities. Median retail purchase prices for oral AMTs were generally comparable to prices for ACT across dosage forms within retailer types; however among pharmacies, the median purchase price for AMT tablets was half of the median price for ACT tablets (US$ 1.85 vs. US$ 3.66).

- Public health facilities did not tend to pay for WHO prequalified ACTs; however, they did purchase non-WHO prequalified ACTs, AMTs and nATs; and when then did so, the median purchase prices paid tended to be lower than those paid by private outlets.

- Median purchase prices per AETD for tablets were lower compared to oral liquids across all antimalarial types and for both wholesalers and retailers. Injectables tended to have the highest purchase prices in private health facilities; however in PPMVs, drug stores and other private outlets (e.g. supermarkets), injectables were observed to have lower purchase prices than oral liquids at the retail level. Median purchase prices for ACTs in granule form were also observed to be lower than those paid for tablets or oral liquids.

- For WHO prequalified ACTs at retail level, the median purchase price paid by private health facilities was very low compared to the other retailer categories. In all types of retailer, the brand of ASAQ, Larimal, was the most commonly observed WHO prequalified product; however, the median purchase price paid for this product by private health facilities (US$ 0.13, IQR 0.13-0.26) – regardless of whether it was a for-profit or not-for-profit facility – was considerably lower compared to pharmacies (US$ 3.09, IQR: 1.80-5.14) and PPMVs/drug stores (US$ 2.25, IQR: 1.16-3.09). In turn, these differences seem to be driven by differences in median purchase prices for Larimal itself, which were lower among private

sector outlets located in states participating in the subsidy than in non-participating states: In pharmacies, the median purchase was US$ 2.44 (IQR 1.80-3.54) in participating states vs. US$ 5.14 (IQR 2.25-6.43) in non-participating states; in PPMVs, US$ 1.29 (IQR 0.64-2.57) in participating states vs. vs. US$ 2.57 (IQR 1.80-3.86) in non-participating states; and the greatest difference was observed among private health facilities, where the median purchase price was US$0.13 (IQR 0.13-0.26) in participating states vs. US$ 4.18 (IQR 2.31-5.91) in non-participating states.

- Regarding first-line treatments for uncomplicated *Pf* malaria, the median purchase price per AETD at wholesale level for AL (US$ 4.13, IQR 3.10-6.89) was higher than that for ASAQ (US$ 2.91, IQR 1.94-4.65); but both were still at least 10 times higher than the median price for SP (US$ 0.29, IQR 0.21-0.61), the antimalarial with the highest number of AETDs distributed. At retail level, a similar pattern was observed, where median purchase prices for AL ranged from US$ 3.54 (IQR 3.21-4.82) in other private outlets, such as supermarkets, to US$ 6.60 (IQR 3.86-6.60) in pharmacies; for ASAQ, purchase prices ranged from US$ 1.80 (IQR 1.71-3.34) in pharmacies to US$ 2.44 (IQR 1.83-2.57) in other private outlets, such as supermarkets; and for SP, purchase prices ranged from US$ 0.32 (IQR 0.26-0.64) in PPMVs/drug stores to US$ 0.45 (IQR 0.28-0.84) in pharmacies. However, the median purchase price for ASAQ among private health facilities (US$ 0.26, IQR 0.13-0.77) was comparable to that of SP, again, due to the high proportion of lower-priced ASAQ product observed among this outlet type branded as Larimal.

- In the few instances where RDTs were stocked, wholesalers at all levels of supply chain reported purchasing 1 RDT unit at US$ 0.71 (IQR 0.52-0.90) (data were not collected on retailer purchase prices for RDTs).

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

ANTIMALARIAL TYPE[1] Formulation[2]			WHOLESALER CATEGORIES		
			ALL WHOLESALERS N=136	SUPPLY WHOLESALERS N=40	SUPPLY RETAILERS N=103
All ACT	All	**Median**	**3.55**	**3.23**	**3.55**
		IQR	2.39-5.34	2.26-4.88	2.39-5.42
		(n)	(754)	(119)	(693)
	Tablet	**Median**	**3.10**	**3.03**	**3.16**
		IQR	2.26-4.20	2.13-3.99	2.26-4.20
		(n)	(597)	(95)	(549)
	Oral liquid	**Median**	**8.26**	**7.49**	**8.26**
		IQR	6.89-10.17	6.37-10.17	7.06-9.99
		(n)	(111)	(14)	(103)
	Granule	**Median**	**4.68**	**-**	**4.91**
		IQR	2.87-9.68	-	2.91-10.33
		(n)	(44)	-	(39)
WHO prequalified ACT	All products were tablets	**Median**	**3.87**	**3.91**	**3.68**
		IQR	1.81-5.16	2.55-5.09	1.81-5.16
		(n)	(107)	(12)	(97)
Non WHO prequalified ACT	All	**Median**	**3.55**	**3.10**	**3.55**
		IQR	2.45-5.68	2.26-4.78	2.50-5.94
		(n)	(647)	(107)	(596)
	Tablet	**Median**	**3.10**	**2.91**	**3.10**
		IQR	2.26-3.94	2.13-3.74	2.26-3.94
		(n)	(490)	(83)	(452)
	Oral liquid	**Median**	**8.26**	**7.49**	**8.26**
		IQR	6.89-10.17	6.37-10.17	7.06-9.99
		(n)	(111)	(14)	(103)
	Granule	**Median**	**4.68**	**-**	**4.91**
		IQR	2.87-9.68	-	2.91-10.33
		(n)	(44)	-	(39)
AMT	All	**Median**	**4.13**	**5.40**	**3.68**
		IQR	2.07-9.92	1.96-10.33	2.07-9.92
		(n)	(357)	(50)	(325)
	Tablet	**Median**	**2.07**	**1.96**	**2.07**
		IQR	1.81-2.30	1.50-2.22	1.81-2.32
		(n)	(180)	(21)	(167)
	Oral liquid	**Median**	**9.05**	**10.02**	**8.90**
		IQR	7.17-12.78	6.78-11.30	7.36-12.78
		(n)	(106)	(16)	(94)
	Injectable	**Median**	**14.20**	**7.10**	**15.49**
		IQR	8.39-21.69	6.20-10.33	9.04-25.57
		(n)	(69)	(13)	(62)
nAT	All	**Median**	**0.53**	**0.67**	**0.52**
		IQR	0.26-1.21	0.25-2.26	0.26-1.20
		(n)	(875)	(110)	(783)
	Tablet	**Median**	**0.35**	**0.42**	**0.34**
		IQR	0.21-0.89	0.17-1.10	0.21-0.86
		(n)	(496)	(63)	(444)
	Oral liquid	**Median**	**0.73**	**0.79**	**0.73**
		IQR	0.50-1.60	0.52-3.39	0.50-1.29
		(n)	(306)	(36)	(275)
	Injectable	**Median**	**1.01**	**2.26**	**0.58**
		IQR	0.27-4.07	0.27-5.15	0.27-4.07
		(n)	(70)	(9)	(62)
RDT (per unit)		**Median**	**0.71**	**0.52**	**0.90**
		IQR	(0.52-0.90)	(0.52-0.52)	(0.90-0.90)
		(n)	(2)	(1)	(1)

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.

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

ANTIMALARIAL TYPE[1] Formulation[2]			PHARMACIES N=276	PRIVATE HEALTH FACILITIES N=227	PPMVs DRUG STORES N=906	OTHER PRIVATE OUTLETS N=96	PUBLIC HEALTH FACILITIES N=198
					RETAILER CATEGORIES[3,4]		
All ACT	All	**Median**	**3.99**	**2.70**	**2.89**	**3.21**	**0.00**
		IQR	2.44-6.60	0.26-4.18	1.80-4.29	2.25-4.18	0.00-0.13
		(n)	(2163)	(251)	(785)	(39)	(241)
	Tablet	**Median**	**3.66**	**1.61**	**2.89**	**3.21**	**0.00**
		IQR	2.70-4.63	0.13-3.86	1.80-3.99	1.99-3.86	0.00-0.13
		(n)	(1690)	(189)	(692)	(36)	(212)
	Oral liquid	**Median**	**6.60**	**15.91**	**8.40**	**8.57**	**0.00**
		IQR	6.60-9.43	10.46-61.71	7.07-10.29	8.57-8.57	0.00-7.20
		(n)	(336)	(39)	(72)	(3)	(26)
	Granule	**Median**	**1.71**	**1.71**	**0.90**	**-**	**0.34**
		IQR	1.71-1.71	1.54-2.57	0.77-2.14	-	0.34-0.34
		(n)	(120)	(22)	(18)	-	(3)
WHO prequalified ACT	All products were tablets	**Median**	**4.82**	**0.26**	**2.57**	**3.86**	**0.00**
		IQR	3.09-5.46	0.13-0.77	1.29-3.86	1.80-5.46	0.00-0.00
		(n)	(298)	(72)	(334)	(13)	(83)
Non WHO prequalified ACT	All	**Median**	**3.98**	**4.18**	**3.21**	**3.21**	**0.90**
		IQR	2.31-6.60	2.70-7.71	2.25-4.50	2.25-3.73	0.00-3.92
		(n)	(1865)	(179)	(451)	(26)	(158)
	Tablet	**Median**	**3.54**	**3.86**	**3.09**	**3.21**	**1.36**
		IQR	2.70-4.50	2.70-4.18	2.12-3.99	2.25-3.54	0.00-3.92
		(n)	(1392)	(117)	(358)	(23)	(129)
	Oral liquid	**Median**	**6.60**	**15.91**	**8.40**	**8.57**	**0.00**
		IQR	6.60-9.43	10.46-61.71	7.07-10.29	8.57-8.57	0.00-7.20
		(n)	(336)	(39)	(72)	(3)	(26)
	Granule	**Median**	**1.71**	**1.71**	**0.90**	**-**	**0.34**
		IQR	1.71-1.71	1.54-2.57	0.77-2.14	-	0.34-0.34
		(n)	(120)	(22)	(18)	-	(3)
AMT	All	**Median**	**7.42**	**2.47**	**2.57**	**2.57**	**1.85**
		IQR	2.19-13.88	2.47-2.88	2.12-7.33	2.47-2.93	0.00-9.26
		(n)	(820)	(182)	(761)	(34)	(96)
	Tablet	**Median**	**1.85**	**2.47**	**2.37**	**2.47**	**1.85**
		IQR	1.65-2.37	2.47-2.47	2.06-2.57	2.37-2.78	1.85-2.37
		(n)	(442)	(91)	(494)	(26)	(42)
	Oral liquid	**Median**	**9.26**	**16.58**	**9.26**	**15.04**	**19.28**
		IQR	7.42-13.88	15.43-16.58	7.33-14.66	12.34-17.36	8.85-19.28
		(n)	(226)	(33)	(213)	(8)	(12)
	Injectable	**Median**	**19.28**	**23.14**	**8.49**	**-**	**9.26**
		IQR	12.86-27.00	13.88-65.57	6.94-11.57	-	0.00-9.26
		(n)	(149)	(57)	(54)	-	(41)
nAT	All	**Median**	**0.75**	**0.96**	**0.56**	**0.55**	**0.45**
		IQR	0.39-1.37	0.34-9.64	0.29-0.85	0.29-0.80	0.00-0.96
		(n)	(2165)	(532)	(5224)	(359)	(446)
	Tablet	**Median**	**0.45**	**0.32**	**0.32**	**0.32**	**0.10**
		IQR	0.27-0.96	0.15-0.39	0.24-0.58	0.26-0.58	0.00-0.51
		(n)	(1254)	(237)	(2704)	(203)	(245)
	Oral liquid	**Median**	**0.96**	**0.96**	**0.80**	**0.80**	**0.63**
		IQR	0.72-3.21	0.80-4.32	0.64-1.12	0.64-1.08	0.48-1.12
		(n)	(788)	(144)	(2303)	(151)	(98)
	Injectable	**Median**	**0.48**	**9.64**	**0.32**	**0.30**	**0.45**
		IQR	0.28-1.45	9.64-9.64	0.24-0.40	0.21-0.45	0.32-1.45
		(n)	(123)	(151)	(212)	(5)	(103)

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 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; Other private outlets include supermarkets, kiosks, itinerant medicine sellers (hawkers) and outlet types that do not fit into any of the mentioned outlet categories; Public health facilities includes community health workers. Note: 61 of 21,031 (0.3%) purchase price observations (19 in pharmacies, 11 in private health facilities, 29 in PPMVs/drug stores, 2 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 Nigeria 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

The percentage mark-up is calculated in general terms 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 ACTwatch Outlet Survey.[8]

- Although wholesaler mark-ups did not vary considerably across antimalarial categories or dosage forms, median mid percent mark-ups were highest on nATs (25.0%, IQR 11.4-47.7), followed by AMTs (20.0%, IQR 10.0-37.5), then ACTs (17.6%, IQR 10.7-33.3).
- Wholesalers supplying other wholesalers tended to apply higher median mid percent mark-ups on non-tablet dosage forms within antimalarial categories, while wholesalers supplying retailers applied more consistent mark-ups across dosage forms. For example, among wholesalers supplying other wholesalers, the median mid percent mark-up on ACT was 16.0% for tablets, 19.6% for oral liquids and 29.4% for granules.
- Wholesalers reported varying their mark-up on 61.4% of all observed products depending on the volume being purchased (based on the 2305 observations where mark-up data were obtained). The difference between the highest and lowest median mark-ups was around 11% points for ACTs, 13% points for AMTs, and 20% point for nATs.
- At retail level, percent mark-ups did not vary considerably across antimalarial categories within specific retailer types; however, private health facilities tended to apply the highest percent mark-ups. In pharmacies, median percent mark-ups ranged from 25.0-36.4%; in PPMVs/drug stores, from 22.2-40.0%; in other private outlets (such as supermarkets), from 21.7-33.3%; while in private health facilities, median percent mark-ups ranged from 39.5-66.7%.
- Percent mark-ups on oral liquids at retail level tended to be lower than or similar to those for tablets, while injectables tended to have higher percent mark-ups than tablets or oral liquids in private health facilities. Retail median percent mark-ups were also observed to be generally higher than those for wholesalers.
- It was rare for public health facilities to report taking payments for antimalarials; however, when applied, the median percent mark-ups added varied considerably across dosage form and drug type.
- Regarding first-line treatments for uncomplicated *Pf* malaria, median percent mark-ups for ASAQ were higher than those for AL both at wholesale and retail level. At wholesale level, the median mid percent mark-up for ASAQ was 20.3% (IQR 12.8-37.5) and 15.0% (IQR 9.0-28.7) for AL. At retail level, the median percent mark-up for ASAQ ranged from 25.0% (IQR 25.0-33.3) at pharmacies to 66.7% (IQR 57.1-500.0) at private health facilities; while for AL, this ranged from 12.5% (IQR 7.7-41.7) at private health facilities to 20.0% (IQR 15.4-38.5) at other private outlets, such as supermarkets.
- For SP, the antimalarial with the highest number of AETDs distributed, the median mid percent mark-up among all wholesalers was 22.0% (IQR 11.1-42.9), while the median percent mark-up at retail level ranged from 25.0% (IQR 19.1-53.9) at other private outlets, such as supermarkets, to 42.9% (IQR 33.3-50.0) at private health facilities.
- The wholesale median mid percent mark-up on RDTs was 40.4% (IQR 23.8-57.1).

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[8] 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]			WHOLESALER CATEGORIES								
			ALL WHOLESALERS N=136			SUPPLY WHOLESALERS N=40			SUPPLY RETAILERS N=103		
			MID	LOW	HIGH	MID	LOW	HIGH	MID	LOW	HIGH
All ACT	All	**Median**	**17.6**	**14.6**	**20.8**	**16.0**	**12.9**	**20.0**	**16.7**	**14.3**	**20.0**
		IQR	10.7-33.3	8.6-27.8	12.5-40.0	8.9-41.8	6.0-36.7	11.1-46.9	10.5-28.9	8.5-25.0	12.5-36.4
		(n)		(753)			(119)			(692)	
	Tablet	**Median**	**17.6**	**15.1**	**20.6**	**16.0**	**12.7**	**20.0**	**17.1**	**14.4**	**20.0**
		IQR	11.1-35.2	9.1-28.8	13.3-42.9	8.9-39.5	6.0-33.3	11.1-46.3	11.0-31.4	9.0-26.7	12.8-37.9
		(n)		(596)			(95)			(548)	
	Oral liquid	**Median**	**16.7**	**13.1**	**22.2**	**19.6**	**18.8**	**21.0**	**16.3**	**12.5**	**21.2**
		IQR	9.8-26.7	6.7-23.7	10.0-33.3	7.0-43.2	5.7-42.9	8.3-51.4	9.8-24.3	6.7-22.2	10.0-32.4
		(n)		(111)			(14)			(103)	
	Granule	**Median**	**17.2**	**14.7**	**20.0**	**29.4**	**25.8**	**33.0**	**15.8**	**12.8**	**17.6**
		IQR	10.9-26.7	8.5-25.0	13.7-33.6	11.0-51.0	8.0-50.0	14.0-52.0	10.0-22.7	8.0-22.2	12.8-25.0
		(n)		(44)			(10)			(39)	
WHO prequalified ACT	All products were tablets	**Median**	**18.2**	**16.7**	**21.9**	**21.3**	**20.4**	**22.3**	**18.2**	**16.7**	**21.9**
		IQR	11.1-33.3	9.0-27.4	13.3-37.1	11.5-38.7	7.7-34.2	14.1-43.7	11.2-31.1	9.0-26.5	13.1-36.4
		(n)		(106)			(12)			(96)	
Non WHO prequalified ACT	All	**Median**	**17.6**	**14.6**	**20.7**	**16.0**	**12.5**	**20.0**	**16.7**	**14.3**	**20.0**
		IQR	10.5-33.3	8.6-28.6	12.5-40.7	7.9-42.9	6.0-36.8	10.0-47.4	10.4-28.8	8.3-25.0	12.5-35.8
		(n)		(647)			(107)			(596)	
	Tablet	**Median**	**17.5**	**14.9**	**20.0**	**15.0**	**12.1**	**20.0**	**16.7**	**14.3**	**20.0**
		IQR	11.1-35.4	9.1-29.3	13.2-42.9	7.9-40.8	6.0-33.3	10.0-46.9	10.9-31.4	8.7-26.7	12.6-38.9
		(n)		(490)			(83)			(452)	
	Oral liquid	**Median**	**16.7**	**13.1**	**22.2**	**19.6**	**18.8**	**21.0**	**16.3**	**12.5**	**21.2**
		IQR	9.8-26.7	6.7-23.7	10.0-33.3	7.0-43.2	5.7-42.9	8.3-51.4	9.8-24.3	6.7-22.2	10.0-32.4
		(n)		(111)			(14)			(103)	
	Granule	**Median**	**17.2**	**14.7**	**20.0**	**29.4**	**25.8**	**33.0**	**15.8**	**12.8**	**17.6**
		IQR	10.9-26.7	8.5-25.0	13.7-33.6	11.0-51.0	8.0-50.0	14.0-52.0	10.0-22.7	8.0-22.2	12.8-25.0
		(n)		(44)			(10)			(39)	

ANTIMALARIAL TYPE[1] Formulation[2]			WHOLESALER CATEGORIES								
			ALL WHOLESALERS N=136			SUPPLY WHOLESALERS N=40			SUPPLY RETAILERS N=103		
			MID	LOW	HIGH	MID	LOW	HIGH	MID	LOW	HIGH
AMT	All	**Median**	**20.0**	**14.3**	**25.0**	**26.7**	**20.8**	**29.9**	**19.0**	**13.6**	**23.1**
		IQR	10.0-37.5	7.1-29.6	11.1-42.9	9.0-51.6	6.0-47.8	11.1-56.3	10.0-33.3	7.1-27.0	11.1-40.0
		(n)		(358)			(50)			(326)	
	Tablet	**Median**	**22.1**	**14.3**	**27.8**	**22.1**	**15.0**	**27.3**	**21.3**	**14.1**	**27.0**
		IQR	11.1-40.7	8.7-36.8	11.4-48.1	10.5-54.3	5.3-50.0	12.5-60.9	11.1-38.9	8.6-34.1	11.2-42.0
		(n)		(181)			(21)			(168)	
	Oral liquid	**Median**	**14.6**	**12.5**	**18.4**	**20.8**	**17.2**	**24.4**	**14.4**	**12.1**	**18.4**
		IQR	8.8-31.6	6.1-26.7	9.8-34.1	6.0-61.5	5.3-55.6	7.0-67.4	8.9-27.4	6.1-22.6	10.0-31.6
		(n)		(106)			(16)			(94)	
	Injectable	**Median**	**21.4**	**18.4**	**25.5**	**28.6**	**27.0**	**35.1**	**20.8**	**14.4**	**25.0**
		IQR	11.1-35.3	7.1-27.0	12.5-41.2	9.4-40.6	6.7-35.4	12.5-45.8	10.0-31.1	6.7-25.0	11.1-36.4
		(n)		(69)			(13)			(62)	
nAT	All	**Median**	**25.0**	**18.2**	**33.3**	**27.9**	**20.0**	**32.1**	**25.0**	**18.0**	**31.9**
		IQR	11.4-47.7	9.1-33.3	12.8-60.0	10.7-50.0	9.1-38.5	12.0-58.6	11.3-45.2	8.8-33.3	12.8-60.0
		(n)		(915)			(115)			(820)	
	Tablet	**Median**	**25.0**	**16.7**	**26.7**	**19.6**	**15.5**	**25.0**	**23.8**	**16.7**	**26.3**
		IQR	11.1-42.9	8.6-32.0	12.0-56.3	7.3-46.4	5.3-35.4	8.8-52.8	11.1-41.7	8.7-31.3	12.5-55.6
		(n)		(534)			(68)			(479)	
	Oral liquid	**Median**	**29.2**	**20.0**	**37.5**	**35.8**	**24.9**	**45.5**	**27.3**	**19.4**	**33.3**
		IQR	12.5-50.0	9.3-37.5	15.4-66.7	18.0-60.0	14.3-48.3	20.7-70.0	12.1-50.0	8.6-36.4	14.3-66.7
		(n)		(306)			(36)			(275)	
	Injectable	**Median**	**25.7**	**21.1**	**33.3**	**26.9**	**23.1**	**28.9**	**25.0**	**21.1**	**33.3**
		IQR	15.4-54.3	11.8-40.0	16.7-66.7	19.6-45.5	18.2-45.5	19.6-45.5	14.6-54.3	11.1-40.0	15.4-66.7
		(n)		(71)			(9)			(63)	
RDT (per unit)		**Median**	**40.4**	**32.7**	**48.2**	**23.8**	**22.5**	**25.0**	**57.1**	**42.9**	**71.4**
		IQR	23.8-57.1	22.5-42.9	25.0-71.4	23.8-23.8	22.5-22.5	25.0-25.0	57.1-57.1	42.9-42.9	71.4-71.4
		(n)		(2)			(1)			(1)	

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.

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

ANTIMALARIAL TYPE[1] Formulation[2]			RETAILER CATEGORIES[3,4]				
			PHARMACIES N=274	PRIVATE HEALTH FACILITIES N=156	PPMVs DRUG STORES N=906	OTHER PRIVATE OUTLETS N=96	PUBLIC HEALTH FACILITIES N=189
All ACT	All	**Median**	**25.0**	**41.7**	**22.2**	**29.0**	**0.0**
		IQR	16.9-31.0	12.5-66.7	13.3-40.0	18.2-42.9	0.0-0.0
		(n)	(2150)	(210)	(783)	(39)	(225)
	Tablet	**Median**	**25.0**	**41.7**	**23.8**	**29.0**	**0.0**
		IQR	16.7-37.5	8.3-66.7	14.6-40.0	16.7-42.9	0.0-0.0
		(n)	(1669)	(159)	(690)	(36)	(198)
	Oral liquid	**Median**	**16.9**	**25.0**	**15.4**	**20.0**	**0.0**
		IQR	16.9-22.2	16.7-40.0	9.0-30.4	20.0-20.0	0.0-11.1
		(n)	(333)	(31)	(71)	(3)	(24)
	Granule	**Median**	**25.0**	**33.3**	**25.0**	**-**	**150.0**
		IQR	25.0-25.0	25.0-50.0	19.0-40.0	-	150.0-150.0
		(n)	(131)	(19)	(19)	-	(3)
WHO prequalified ACT	All products were tablets	**Median**	**28.6**	**66.7**	**33.3**	**33.3**	**0.0**
		IQR	20.0-43.8	60.0-500.0	20.0-50.0	13.6-50.0	0.0-0.0
		(n)	(288)	(59)	(332)	(13)	(78)
Non WHO prequalified ACT	All	**Median**	**25.0**	**25.0**	**19.0**	**28.6**	**0.0**
		IQR	16.9-30.0	7.7-41.7	11.1-29.0	18.2-40.0	0.0-0.0
		(n)	(1862)	(151)	(451)	(26)	(147)
	Tablet	**Median**	**25.0**	**25.0**	**19.0**	**29.0**	**0.0**
		IQR	15.4-36.4	7.7-41.7	12.0-28.6	18.2-40.0	0.0-0.0
		(n)	(1381)	(100)	(358)	(23)	(120)
	Oral liquid	**Median**	**16.9**	**25.0**	**15.4**	**20.0**	**0.0**
		IQR	16.9-22.2	16.7-40.0	9.0-30.4	20.0-20.0	0.0-11.1
		(n)	(333)	(31)	(71)	(3)	(24)
	Granule	**Median**	**25.0**	**33.3**	**25.0**	**-**	**150.0**
		IQR	25.0-25.0	25.0-50.0	19.0-40.0	-	150.0-150.0
		(n)	(131)	(19)	(19)	-	(3)
AMT	All	**Median**	**29.9**	**39.5**	**22.2**	**21.7**	**4.2**
		IQR	14.3-48.9	20.0-39.5	14.3-36.4	13.6-25.0	0.0-22.2
		(n)	(809)	(135)	(760)	(34)	(87)
	Tablet	**Median**	**56.3**	**25.0**	**25.0**	**22.8**	**22.2**
		IQR	28.6-56.3	17.6-42.9	14.6-38.9	16.7-29.7	4.2-22.2
		(n)	(438)	(69)	(493)	(26)	(37)
	Oral liquid	**Median**	**28.6**	**39.5**	**17.0**	**11.1**	**30.0**
		IQR	11.1-29.9	39.5-39.5	12.5-25.0	8.3-15.4	10.0-30.0
		(n)	(223)	(25)	(213)	(8)	(11)
	Injectable	**Median**	**25.0**	**50.0**	**33.3**	**-**	**11.1**
		IQR	16.7-36.4	25.0-100.0	15.8-50.0	-	0.0-177.8
		(n)	(145)	(41)	(54)	-	(38)
nAT	All	**Median**	**36.4**	**42.9**	**40.0**	**27.3**	**19.0**
		IQR	25.0-60.0	33.3-60.0	25.0-60.0	20.0-50.0	0.0-42.9
		(n)	(2140)	(388)	(5243)	(357)	(433)
	Tablet	**Median**	**36.4**	**50.0**	**40.0**	**25.0**	**0.0**
		IQR	25.0-60.0	38.9-75.0	25.0-60.0	20.0-60.0	0.0-25.0
		(n)	(1238)	(190)	(2724)	(202)	(242)
	Oral liquid	**Median**	**33.3**	**42.9**	**38.5**	**27.3**	**33.3**
		IQR	25.0-60.0	33.3-50.0	25.0-57.9	20.0-42.9	7.1-85.7
		(n)	(781)	(121)	(2303)	(150)	(94)
	Injectable	**Median**	**42.9**	**140.0**	**50.0**	**100.0**	**33.3**
		IQR	33.3-50.0	140.0-185.7	25.0-100.0	33.3-185.7	0.0-50.0
		(n)	(121)	(77)	(211)	(5)	(97)

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 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; Other private outlets include supermarkets, kiosks, itinerant medicine sellers (hawkers) and outlet types that do not fit into any of the mentioned outlet categories; Public health facilities includes community health workers. Note: 61 of 21,031 (0.3%) purchase price observations (19 in pharmacies, 11 in private health facilities, 29 in PPMVs/drug stores, 2 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 Nigeria 2009 Outlet Survey. www.actwatch.info

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

The absolute mark-up is calculated in general terms 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 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.

- At wholesale level, median mid absolute mark-ups were highest on AMTs (US$ 0.87, IQR: 0.44-1.94), followed by ACTs (US$ 0.65, IQR: 0.39-1.29), and then nATs (US$ 0.16, IQR: 0.05-0.38), 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).
- Absolute mark-ups applied within the same antimalarial category and dosage form were not observed to vary considerably across different levels of the wholesale supply chain. However, retail absolute mark-ups tended to be higher compared to wholesale level mark-ups, which is a function of the higher purchase prices paid by retailers to their suppliers compared to wholesalers.
- At retail level, median absolute mark-ups exhibited a similar pattern to that observed among wholesalers where they were highest on AMTs, ranging from US$ 0.62 (IQR 0.51-1.03) at other private outlets, such as supermarkets, to US$ 2.57 (IQR 0.62-6.56) at private health facilities; followed by ACTs, ranging from US$ 0.64 (IQR 0.36-1.09) at PPMVs/drug stores to US$ 0.96 (IQR 0.51-1.29) at pharmacies; and then by nATs, ranging from US$ 0.16 (IQR 0.10-0.26) at other private outlets, such as supermarkets, to US$ 0.30 (IQR 0.13-0.58) at pharmacies.
- Private health facilities tended to have higher absolute mark-ups for AMTs and nATs compared to drug stores and other private outlets, such as supermarkets, because they stocked relatively more injectable antimalarials that other retailer types. In addition, more than half of all observed antimalarial products in PPMVs/drug stores and other private outlets, such as supermarkets, were produced in Nigeria, while pharmacies and public health facilities stocked relatively more products imported from Europe and China. However, this also partly accounts for the higher absolute mark-ups observed in these two retailer types.
- Regarding first-line treatments for uncomplicated *Pf* malaria, absolute mark-ups tended to be higher for AL than ASAQ among wholesalers supplying other wholesalers (median mid absolute mark-up for AL of US$ 0.69 (IQR 0.23-1.39) and US$ 0.56 (0.29-1.36) for ASAQ), while there was little difference among wholesalers supplying retailers (AL: US$ 0.67, IQR 0.36-1.26 vs. ASAQ: US$ 0.65, IQR 0.39-1.29). Across retailer types, median absolute mark-ups also tended to be higher for AL than ASAQ. In pharmacies, the median absolute mark-up was US$ 1.11 (IQR 0.96-1.71) for AL vs. US$ 0.45 (IQR 0.43-0.90) for ASAQ; in private health facilities US$ 0.64 (IQR 0.32-1.61) for AL vs. US$ 0.64 (IQR 0.51-0.64) for ASAQ; in PPMVs/drug stores US$ 0.69 (IQR 0.51-1.20) for AL vs. US$ 0.64 (IQR 0.39--1.29) for ASAQ; and in other private outlets, such as supermarkets, $0.96 (IQR 0.64-1.37) for AL vs. US$ 0.13 (IQR 0.06-0.19).
- For SP, the antimalarial with the highest number of AETDs distributed, the median absolute retail mark-up was US$ 0.19 (IQR 0.11-0.32) at pharmacies, US$ 0.19 (IQR 0.13-0.26) at private health facilities, US$ 0.16 (IQR 0.10-0.23) at PPMVs/drug stores, and US$ 0.13 (IQR 0.06-0.19) at other private outlets, such as supermarkets; at the wholesale level, median mid absolute mark-up was US$ 0.07 (IQR 0.02-0.21) among wholesaler supplying other wholesalers, and US$ 0.07 (IQR 0.03-0.16) among wholesalers supplying retailers.
- The median absolute mid mark-up on RDTs was US$ 0.32 (IQR 0.25-0.39) among all wholesalers.

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

ANTIMALARIAL TYPE[1] Formulation[2]			WHOLESALER CATEGORIES								
			ALL WHOLESALERS N=136			SUPPLY WHOLESALERS N=40			SUPPLY RETAILERS N=103		
			MID	LOW	HIGH	MID	LOW	HIGH	MID	LOW	HIGH
All ACT	All	**Median**	**0.65**	**0.58**	**0.80**	**0.65**	**0.52**	**0.77**	**0.65**	**0.52**	**0.77**
		IQR	0.39-1.29	0.32-1.15	0.45-1.53	0.26-1.36	0.19-1.16	0.32-1.55	0.39-1.29	0.32-1.03	0.45-1.45
		(n)		(753)			(119)			(692)	
	Tablet	**Median**	**0.61**	**0.52**	**0.65**	**0.52**	**0.39**	**0.65**	**0.56**	**0.45**	**0.65**
		IQR	0.32-1.19	0.26-1.02	0.39-1.29	0.23-1.29	0.19-1.10	0.32-1.48	0.32-1.03	0.26-0.90	0.39-1.23
		(n)		(596)			(95)			(548)	
	Oral liquid	**Median**	**1.45**	**1.21**	**1.72**	**1.53**	**1.38**	**1.68**	**1.38**	**1.08**	**1.72**
		IQR	0.77-2.50	0.58-2.07	0.86-3.10	0.69-3.10	0.60-3.10	0.86-3.27	0.77-2.24	0.52-1.89	0.86-2.75
		(n)		(111)			(14)			(103)	
	Granule	**Median**	**0.94**	**0.77**	**1.23**	**1.19**	**0.97**	**1.48**	**0.90**	**0.77**	**1.29**
		IQR	0.61-1.87	0.52-1.42	0.65-2.58	0.55-3.29	0.52-3.10	0.65-3.36	0.58-1.81	0.52-1.29	0.65-2.58
		(n)		(44)			(10)			(39)	
WHO prequalified ACT	All products were tablets	**Median**	**0.65**	**0.48**	**0.77**	**0.74**	**0.58**	**0.85**	**0.65**	**0.48**	**0.77**
		IQR	0.32-1.29	0.26-1.16	0.32-1.29	0.53-1.39	0.32-1.19	0.63-1.55	0.32-1.24	0.26-1.12	0.32-1.29
		(n)		(106)			(12)			(96)	
Non WHO prequalified ACT	All	**Median**	**0.68**	**0.58**	**0.84**	**0.65**	**0.52**	**0.77**	**0.65**	**0.52**	**0.77**
		IQR	0.39-1.36	0.32-1.14	0.45-1.55	0.26-1.36	0.19-1.16	0.32-1.55	0.39-1.29	0.32-1.03	0.45-1.48
		(n)		(647)			(107)			(596)	
	Tablet	**Median**	**0.58**	**0.52**	**0.65**	**0.52**	**0.39**	**0.65**	**0.55**	**0.45**	**0.65**
		IQR	0.32-1.16	0.26-0.97	0.39-1.29	0.23-1.29	0.19-1.10	0.32-1.42	0.32-0.97	0.26-0.84	0.39-1.18
		(n)		(490)			(83)			(452)	
	Oral liquid	**Median**	**1.45**	**1.21**	**1.72**	**1.53**	**1.38**	**1.68**	**1.38**	**1.08**	**1.72**
		IQR	0.77-2.50	0.58-2.07	0.86-3.10	0.69-3.10	0.60-3.10	0.86-3.27	0.77-2.24	0.52-1.89	0.86-2.75
		(n)		(111)			(14)			(103)	
	Granule	**Median**	**0.94**	**0.77**	**1.23**	**1.19**	**0.97**	**1.48**	**0.90**	**0.77**	**1.29**
		IQR	0.61-1.87	0.52-1.42	0.65-2.58	0.55-3.29	0.52-3.10	0.65-3.36	0.58-1.81	0.52-1.29	0.65-2.58
		(n)		(44)			(10)			(39)	

ANTIMALARIAL TYPE[1] Formulation[2]			WHOLESALER CATEGORIES								
			ALL WHOLESALERS N=136			SUPPLY WHOLESALERS N=40			SUPPLY RETAILERS N=103		
			MID	LOW	HIGH	MID	LOW	HIGH	MID	LOW	HIGH
AMT	All	**Median**	**0.87**	**0.72**	**1.03**	**1.03**	**0.75**	**1.25**	**0.83**	**0.68**	**0.97**
		IQR (n)	0.44-1.94	0.31-1.55 (357)	0.52-2.32	0.41-2.91	0.32-2.58 (50)	0.52-3.49	0.41-1.84	0.31-1.45 (325)	0.52-2.07
	Tablet	**Median**	**0.52**	**0.32**	**0.68**	**0.41**	**0.32**	**0.52**	**0.52**	**0.32**	**0.68**
		IQR (n)	0.23-0.83	0.20-0.72 (180)	0.26-1.03	0.24-0.93	0.13-0.72 (21)	0.31-1.14	0.23-0.77	0.19-0.72 (167)	0.26-1.03
	Oral liquid	**Median**	**1.36**	**1.16**	**1.65**	**2.18**	**1.84**	**2.57**	**1.36**	**1.16**	**1.60**
		IQR (n)	0.77-2.91	0.58-2.32 (106)	0.77-3.49	0.73-3.63	0.60-3.00 (16)	0.77-4.16	0.77-2.42	0.58-1.94 (94)	0.97-3.10
	Injectable	**Median**	**2.97**	**2.32**	**3.62**	**2.52**	**1.94**	**2.58**	**3.24**	**2.32**	**3.74**
		IQR (n)	1.74-7.23	1.23-4.13 (69)	1.94-8.26	1.08-2.91	0.70-2.58 (13)	1.47-3.87	1.39-7.75	1.03-5.16 (62)	1.55-8.65
nAT	All	**Median**	**0.16**	**0.10**	**0.19**	**0.19**	**0.15**	**0.26**	**0.15**	**0.10**	**0.19**
		IQR (n)	0.05-0.38	0.03-0.29 (874)	0.06-0.48	0.05-0.48	0.05-0.39 (110)	0.06-0.65	0.05-0.36	0.03-0.25 (783)	0.06-0.44
	Tablet	**Median**	**0.10**	**0.06**	**0.12**	**0.13**	**0.09**	**0.13**	**0.08**	**0.06**	**0.10**
		IQR (n)	0.03-0.24	0.03-0.19 (495)	0.03-0.31	0.02-0.27	0.02-0.23 (63)	0.03-0.32	0.03-0.23	0.03-0.19 (444)	0.04-0.29
	Oral liquid	**Median**	**0.25**	**0.16**	**0.32**	**0.42**	**0.29**	**0.51**	**0.24**	**0.16**	**0.32**
		IQR (n)	0.15-0.48	0.08-0.39 (306)	0.16-0.56	0.21-0.79	0.15-0.68 (36)	0.28-0.89	0.12-0.44	0.08-0.34 (275)	0.15-0.56
	Injectable	**Median**	**0.28**	**0.24**	**0.33**	**0.44**	**0.36**	**0.44**	**0.25**	**0.23**	**0.28**
		IQR (n)	0.07-1.08	0.07-1.02 (70)	0.09-1.08	0.06-1.02	0.05-1.02 (9)	0.07-1.02	0.07-1.08	0.07-0.84 (62)	0.10-1.08
RDT (per unit)		**Median**	**0.32**	**0.12**	**0.52**	**0.12**	**0.12**	**0.12**	**0.52**	**0.52**	**0.52**
		IQR (n)	0.25-0.39	0.12-0.13 (2)	0.39-0.65	0.12-0.13	0.12-0.13 (1)	0.12-0.13	0.39-0.65	0.39-0.65 (1)	0.39-0.65

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.

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

ANTIMALARIAL TYPE[1] Formulation[2]			RETAILER CATEGORIES[3,4]				
			PHARMACIES N=276	PRIVATE HEALTH FACILITIES N=155	PPMVs DRUG STORES N=904	OTHER PRIVATE OUTLETS N=96	PUBLIC HEALTH FACILITIES N=193
All ACT	All	**Median**	**0.96**	**0.64**	**0.64**	**0.90**	**0.00**
		IQR	0.51-1.29	0.43-1.29	0.36-1.09	0.64-1.29	0.00-0.00
		(n)	(2135)	(208)	(782)	(39)	(225)
	Tablet	**Median**	**0.90**	**0.64**	**0.64**	**0.77**	**0.00**
		IQR	0.64-1.29	0.32-0.96	0.35-1.03	0.64-1.29	0.00-0.00
		(n)	(1668)	(159)	(690)	(36)	(198)
	Oral liquid	**Median**	**1.11**	**2.89**	**1.20**	**1.71**	**0.00**
		IQR	1.11-2.06	1.71-4.80	0.86-1.74	1.71-1.71	0.00-0.64
		(n)	(333)	(31)	(71)	(3)	(24)
	Granule	**Median**	**0.43**	**0.69**	**0.30**	**-**	**0.51**
		IQR	0.43-0.43	0.43-2.57	0.17-0.43	-	0.51-0.51
		(n)	(117)	(17)	(18)	-	(3)
WHO prequalified ACT	All products were tablets	**Median**	**1.29**	**0.51**	**0.77**	**0.96**	**0.00**
		IQR	0.74-1.93	0.51-0.64	0.51-1.29	0.77-1.29	0.00-0.00
		(n)	(291)	(59)	(333)	(13)	(79)
Non WHO prequalified ACT	All	**Median**	**0.96**	**0.90**	**0.64**	**0.90**	**0.00**
		IQR	0.45-1.29	0.32-1.71	0.32-0.96	0.58-1.41	0.00-0.00
		(n)	(1844)	(149)	(449)	(26)	(146)
	Tablet	**Median**	**0.90**	**0.64**	**0.60**	**0.77**	**0.00**
		IQR	0.64-1.29	0.32-1.29	0.32-0.84	0.58-1.29	0.00-0.00
		(n)	(1377)	(100)	(357)	(23)	(119)
	Oral liquid	**Median**	**1.11**	**2.89**	**1.20**	**1.71**	**0.00**
		IQR	1.11-2.06	1.71-4.80	0.86-1.74	1.71-1.71	0.00-0.64
		(n)	(333)	(31)	(71)	(3)	(24)
	Granule	**Median**	**0.43**	**0.69**	**0.30**	**-**	**0.51**
		IQR	0.43-0.43	0.43-2.57	0.17-0.43	-	0.51-0.51
		(n)	(117)	(17)	(18)	-	(3)
AMT	All	**Median**	**1.54**	**2.57**	**0.72**	**0.62**	**0.10**
		IQR	0.93-2.22	0.62-6.56	0.51-1.44	0.51-1.03	0.00-2.89
		(n)	(809)	(135)	(761)	(34)	(89)
	Tablet	**Median**	**0.93**	**0.62**	**0.51**	**0.62**	**0.41**
		IQR	0.72-0.93	0.31-1.23	0.36-0.82	0.51-0.71	0.10-0.41
		(n)	(438)	(69)	(494)	(26)	(39)
	Oral liquid	**Median**	**2.22**	**6.56**	**1.93**	**1.93**	**5.79**
		IQR	1.54-2.22	5.79-6.56	1.03-2.89	1.03-2.31	1.16-5.79
		(n)	(223)	(25)	(213)	(8)	(11)
	Injectable	**Median**	**6.17**	**6.43**	**2.70**	**-**	**1.70**
		IQR	3.86-7.71	3.86-15.43	1.16-3.86	-	0.00-16.46
		(n)	(145)	(41)	(54)	-	(38)
nAT	All	**Median**	**0.30**	**0.24**	**0.19**	**0.16**	**0.06**
		IQR	0.13-0.58	0.13-0.56	0.13-0.35	0.10-0.26	0.00-0.24
		(n)	(2138)	(387)	(5213)	(357)	(431)
	Tablet	**Median**	**0.19**	**0.19**	**0.13**	**0.12**	**0.00**
		IQR	0.11-0.34	0.10-0.19	0.10-0.22	0.06-0.19	0.00-0.06
		(n)	(1236)	(190)	(2698)	(202)	(241)
	Oral liquid	**Median**	**0.48**	**0.32**	**0.32**	**0.25**	**0.24**
		IQR	0.29-0.86	0.24-0.64	0.20-0.50	0.16-0.40	0.05-0.96
		(n)	(782)	(121)	(2303)	(150)	(95)
	Injectable	**Median**	**0.34**	**0.63**	**0.22**	**0.30**	**0.16**
		IQR	0.12-0.60	0.56-1.20	0.08-0.34	0.15-0.39	0.00-0.72
		(n)	(120)	(76)	(207)	(5)	(95)

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 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; Other private outlets include supermarkets, kiosks, itinerant medicine sellers (hawkers) and outlet types that do not fit into any of the mentioned outlet categories; Public health facilities includes community health workers. Note: 61 of 21,031 (0.3%) purchase price observations (19 in pharmacies, 11 in private health facilities, 29 in PPMVs/drug stores, 2 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 Nigeria 2009 Outlet Survey. www.actwatch.info

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5. Discussion

Supply Chain Structure and Wholesaler Characteristics

Private commercial sector antimalarial wholesalers operate at 2 distinct levels: Although we observed antimalarial wholesalers to operate over 4 overlapping levels, indicating a maximum of 5 supply chain steps from manufacturer to retailer, most either sold only to other wholesalers (36.6%) or only to retailers (59.5%). Therefore, a considerable proportion of antimalarials flowing down the distribution chain likely pass through 3 steps from manufacturer to retail outlet (manufacturer → intermediate wholesaler → terminal wholesaler → retailer).

Many wholesalers in Nigeria are supplied directly by manufacturers: Nigeria has a relatively well-developed pharmaceutical manufacturing sector that produces a wide range of antimalarial products, including ACTs. It is therefore not surprising that half of wholesalers supplying retailers (or terminal wholesalers) identified a manufacturer as at least one of their top two sources of antimalarials, indicating that the number of steps between manufacturer to retailer could often be as low as 2 (manufacturer → terminal wholesaler → retailer). While manufacturers in Nigeria deliver orders directly to wholesalers, manufacturers have also adopted several different types of distribution strategies to ensure extensive geographic coverage across this large country, all of which employ the use of sales representatives. One model involves the establishment of vertically integrated distribution infrastructure, where the manufacturer will establish subsidiary distribution points across the country. This was observed in 2 instances in Nigeria. The other more common model involves the use the third-party logistics companies that have a network of warehouses throughout the country to serve as regional or state-level distribution points for a wide range of imported and domestically manufactured products, including antimalarials. [8] Among all wholesalers, 12.4% reported being supplied via one of these indirect channels.

Large commercial markets are important centres for antimalarial wholesaling: These types of markets are more important antimalarial sources for retailers than for wholesalers, as more than half (54.7%) of all suppliers mentioned by retailers were located in these markets, but just 12.8% of the suppliers mentioned by wholesalers. Similar findings were documented in a study conducted in 3 states which found that 51.9% of PPMVs procured their medicines from such markets. [21]

Low level of transactions between public, private and NGO sectors: At wholesale level, no interactions were observed between the public and private sectors. At retail level, one private outlet reported a public source distributing subsidised antimalarials (this interaction was noted in a state piloting a model where the state-level government medical stores was wholesaling to the private sector [8]), and only two public facilities mentioned a private sector source as one of their two top antimalarial suppliers. As prolonged disruptions in public sector distribution chains frequently occur [10], it is reasonable to assume that some public health facilities rely on the private sector as a supply source of medicines, including antimalarials. Observed transactions with the NGO sector were also few. Despite being an important source of first-line drugs since beginning the subsidy programme in 2008, SFH was mentioned by only one retailer and 5 wholesalers as one of their two top supply sources for antimalarials[9], and there were no mentions of SFH's civil society distribution partners. There are several factors that may make SFH less likely to be mentioned as a top supplier of antimalarials: During the subsidy programme, SFH limited the number of packages that could be

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[9] Each of the 5 wholesalers who mentioned SFH also engaged in retailing (i.e. they reported having either a retail pharmacy or PPMV license, but were also identified by an outlet as a wholesale supplier of antimalarials). This is consistent with SFH's distribution model for this particular programme where subsidised Larimal and Arsuamoon were distributed either to retailers directly or via one of their civil society partners.

purchased by retailers per transaction. Furthermore, the data collection methods only allowed supplier information to be collected about the two top suppliers; so although SFH may be a common supplier of antimalarials, they may not be among the top two. Finally, because businesses place a great deal of value on offering their customers a variety of product choice, it is common for businesses to procure antimalarials from many different suppliers. [8] As SFH only offers a few antimalarial products, top suppliers are more likely to be those who carry a wider range of products.

Wholesaler characteristics: Wholesalers operating at different levels of the supply chain did not differ greatly in terms of their number of years in operation or the number of people working in the business. Those supplying wholesalers were in operation for a median of 9.5 years with a median of 8.5 employees, while those supplying retailers were in operation for a median of 8 years with a median of 5 employees. However, among those wholesalers operating at higher levels of the supply chain, there was wide variation in the number of people working in the business (IQR 5-25 employees). Considering that these wholesalers operating at higher levels of the supply chain engage in activities ranging from pharmaceutical wholesaling to importing, and in some cases, manufacturing, it is reasonable to expect a wide range in the size of enterprise. Also, more than half (54.9%)of all wholesalers were observed to sell other products in addition to pharmaceuticals, but these tended to be related products, such as toiletries (25.5%) and bed nets (24.2%).

Business practices within the supply chain: The differences between wholesalers operating at higher and lower levels of the distribution chain in Nigeria also extend to their business practices. For example, compared to those supplying other wholesalers, a greater proportion of wholesalers supplying retailers were observed to have retail customers (80.6% vs. 25.6%), and to sell to PPMVs and drug stores (96.1% vs. 78.1%), while more of those operating at higher levels of the supply chain imported antimalarials (44.2% vs. 3.9%), had customers in other countries (28.6% vs. 10.7%), and delivered antimalarials to their customers (59.5% vs. 22.3%). This small number of terminal wholesalers delivering to their retail customers indicates that many retailers go to the physical wholesaler premises to make their purchases. This is supported by our findings noted above about the important role that markets play as supply sources for retailers. Retailers selling relatively small volumes, such as rural PPMV and kiosk operators, may prefer to go to these markets in order to take advantage of the convenience, wide product availability and competitive prices that these commercial environments engender. Further research into the supplier choices of retailers is needed. One wholesaler characteristic that did not differ considerably across supply chain levels was that most wholesalers (77.9%) reported providing credit for a median of 2 weeks to selected customers.

Licensing and Inspection
Few wholesalers possessed the required license to wholesale antimalarials: It is recognised that pharmaceutical regulatory bodies in Nigeria lack sufficient capacity to fully implement all regulations. [8, 9, 12] This is reflected in our observations that only 71.2% of wholesalers were visited by an inspector in the past 12 months, and of the very low numbers of wholesalers adhering to licensing requirements. For example, an up-to-date license from the PCN to wholesale antimalarials was observed in only 8.0% of all wholesalers interviewed.

PPMVs regularly engage in the wholesaling of antimalarials: This draws attention to our finding that 19.6% of all wholesalers reported having only a PPMV license, which highlights the role that these types of medicine distributors play, not only in retailing and dispensing [21], but also in wholesaling of antimalarials. Among these wholesaling PPMVs, we also observed that only 22.2% employed a person with a health qualification – despite being required to do so – and only 86.7% stored antimalarials in acceptable

conditions. Other studies have shown that many PPMVs belong to associations that provide information on best practices in treatment, procurement and management [8, 21]; these results may indicate that at least some of these wholesaling PPMVs could be willing participants in any effort to legitimise their wholesaling activities.

Wholesaler knowledge
Despite having changed the first-line treatment policy from chloroquine to ACT in 2004 [22], only 53.6% of all wholesalers were able to correctly identify either AL or ASAQ as the government recommended treatment for uncomplicated *Pf* malaria. This may be partially explained by our observation that only 62.8% of wholesalers employed a staff member with any kind of health qualification, and only 16.9% reported that their staff had participated in any kind of in-service training related to malaria treatment in the past 2 years. Similar proportions of wholesalers identified an ACT as the most effective treatment for malaria for either adults (43.5%) or children (45.7%), and significant proportions of wholesalers mentioned SP or chloroquine as the most effective treatments. Compared to East Africa were resistance was already widespread, a study of the therapeutic efficacy of SP in 2002 found that it was still relatively high in some regions of Northern Nigeria. [17] Although this and the continued familiarity of chloroquine as the former first-line drug may partially explain the low levels of knowledge of and preferences for ACTs, clearly more effort must go into raising awareness of their benefits – particularly in light of activities to improve affordability through the ACT subsidy programme run by SFH and the AMFm – and some of this effort could be targeted at retailers and wholesalers.

Availability
First-line drug availability is high among wholesalers, but AMT and nAT availability is equally high: Considering the high burden of malaria in Nigeria, it is not surprising that nearly all wholesalers had antimalarials in stock at the time of interview. It is encouraging to note that ACTs, and in particular the first line drugs, were available in more than 80% of wholesalers, but perhaps less encouraging that wholesalers continued to stock nATs and oral AMTs at levels comparable to ACT. High levels of nAT and AMT availability may be due, at least in part, to the fact that SP is used for IPTp programmes, and that injectable AMTs are recommended in the national treatment guidelines for cases of severe malaria; however, 80% of all AMT products stocked by wholesalers were in oral dosage form. Furthermore, while it is likely that high levels of nAT availability among wholesalers are partly driven by domestic capacity to manufacture these products, this does not appear to be the case for the high availability of ACT. For example, although there are several domestic manufacturers producing a number of AL and ASAQ products, only 18.7% of audited first-line drugs among wholesalers were manufactured in Nigeria, while 55.0% of all audited nATs were manufactured domestically. In addition, none of the domestically produced first-line ACTs are WHO prequalified, making them ineligible for procurement for most Global Fund-supported programmes or for receipt of subsidies under the AMFm – both major sources of financing for malaria treatment in Nigeria. So although there may be some capacity in-country to meet domestic need for first-line treatment, it is unlikely that this capacity will be used to its full potential. It is also unlikely that domestic manufacturers will begin to produce WHO prequalified ACTs in the near future because of the large investment that would be required to raise their ACT production line standards to meet WHO prequalification requirements and because of the competitive pressure from the large number of relatively cheap imported ACTs from counties such as China and India that keep margins low.

First-line drug availability is high among wholesalers, but not among retailers: It is interesting to note that the second round of the Outlet Survey in Nigeria (conducted concurrently with the Supply Chain Survey in 2009) found that nATs were available in over 90% of private outlets, and oral AMTs were available in 46% of

private outlets; but with respect to ACTs, availability was 37% across all private outlets, and 26% stocked a quality assured first-line drug. [11] If ACTs, and particularly first-line drugs, are generally available among wholesalers, why are they not being stocked by more retailers? Issues around first-line drug affordability are certainly key, as a number of studies looking at the impact of interventions to reduce consumer prices show. [23, 24] Two programmes currently operating in Nigeria that aim to improve first-line drug affordability, the private sector subsidy programme run by SFH and funded by the Global Fund operating in 18 states, and the AMFm which applies subsidies when quality-assured ACTs leave the factory gate, will likely have a notable impact on retail level availability.

RDT availability among wholesalers is very low: RDTs were available in less than 5% of all wholesalers. Although the national treatment policy for children under 5 years of age recommends presumptive treatment, the treatment guidelines endorse parasitological confirmation for all other suspected cases of uncomplicated malaria. While there is debate about the usefulness of RDTs in contexts with high transmission, as is the case in some parts of Nigeria, economic analyses have shown that use of RDTs can be cost-effective at all but the highest levels of malarial prevalence. [25, 26] RDTs may have a particularly key role to play in improving diagnostic capabilities in public and private health facilities where microscopy is limited. For example, the ACTwatch Outlet Survey conducted in 2009 found that only 27.5% of public facilities and 36.1% of private for-profit facilities had microscopy available. [11]

Sales Volumes

ACTs are being sold, but in smaller quantities than nATs: Although the typical volumes of ACT being sold by wholesalers were lower than for nATs overall, the magnitude of this difference was greater among wholesalers operating at lower levels of the supply chain (medians for ACT: 114.8 AETDs vs. nAT: 555.5) than among those operating at higher levels of the supply chain (medians for ACT: 787.4 AETDs vs. nAT: 1207.3). These figures reflect the fact that 70.9% wholesalers operating at lower levels of the supply chain reported their top selling antimalarial to be either SP or chloroquine, compared to 48.7% of wholesalers operating at higher levels of the supply chain. A greater proportion of wholesalers operating at higher levels of the supply chain also reported their top selling antimalarial to be one of the government recommended first-line treatments, AL or ASAQ (33.3%) compared to wholesalers at lower levels of the supply chain (14.6%). Chloroquine was the former first line drug prior to the adoption of ACTs in 2004, so familiarity with this particular nAT may be an important driver of demand. [22] As noted above, SP still has high treatment efficacy rates in some parts of the country. [17] This may be reflected in our finding that 20.3% of wholesalers believed SP to be the most effective treatment for adults. In these areas, continued treatment success using SP combined with its very affordable price may be important factors behind the observed sales volumes.

Non WHO-prequalified ACTs are being sold in greater quantities than WHO prequalified ACTs: At all wholesaler levels of distribution chain, the typical volumes of WHO prequalified ACTs being sold were many times smaller than the typical sales volumes for non-prequalified ACTs. Part of this discrepancy may be due to the small number of WHO-prequalified products (all of which must be imported) in comparison to the total number of ACT products on the market that are both imported and locally produced. In 2008, there were 7 WHO-prequalified ACTs compared to 37 ACTs registered for sale in Nigeria with NAFDAC, nearly a fifth of which were domestically produced. [27]

AMTs are not being sold in large quantities: The typical volumes of AMT being sold by wholesalers at different levels of the supply chain were smaller than those for ACTs and nATs, ranging from a median of 165.8 AETDs among wholesalers supplying other wholesalers to 38.7 AETDs among wholesalers supplying

retailers. While artesunate and artemether injections are included in the national guidelines for treatment of severe malaria, AMT sales were dominated by AMT tablets, and less so by oral liquid preparations. This is of particular concern as oral AMTs have been banned in Nigeria since 2006. When AMTs were stocked by wholesalers, observed sales volumes of tablets were considerable. For example, among those wholesalers supplying other wholesalers that stocked AMT tablets, the median of 309.5 AETDs sold during the week preceding the survey was more than double the median volume sold of WHO prequalified ACTs (138.0 AETDs).

Volumes of RDTs sold are low: Among the very few wholesalers that were observed to have them in stock, the median number of tests sold during the week preceding the interview was low: 40 tests (IQR 30-50).

Price and Mark-ups

Purchase prices for nAT were much lower than for ACT and AMT: At both wholesale and retail levels of the distribution chain, median purchase prices for nATs were 6-10 times lower than median purchase prices for ACTs or AMTs. Because percent mark-ups are fairly consistent across antimalarial drug categories, these differences in purchase prices persist as products flow down the supply chain and are reflected in end-user prices in the private sector, thus affecting end-user affordability and demand.

Percent mark-ups were relatively low overall, but wholesaler mark-ups were lower than retailer mark-ups: At wholesale level, the median mid percent mark-ups ranged from 18% on ACTs to 25% on nATs, and did not vary considerably across dosage forms. Although higher than at wholesale level, median percent mark-ups among retailers were still not that high, ranging between 22% for ACTs at PPMVs to 43% for nATs at private health facilities, and this was consistent across dosage forms. In addition, retail mark-ups of 100% or higher were infrequently observed. These relatively low percentage mark-ups and observed consistency across business types and dosage forms could be a reflection of intense competition in the wholesale and retail markets in Nigeria. At the lower levels of the wholesale supply chain, this may also be reflected in our finding that many terminal wholesalers tended to be located in the large open markets in major commercial centres throughout the country; at higher levels of the wholesale chain, competition may be enhanced by the extensive geographic coverage achieved by manufacturers, importers and large wholesalers through various distribution strategies (as described above). At retail level, the wide range of outlets stocking antimalarials, from public health facilities to informal street hawkers, and the sheer number of outlets stocking antimalarial contributes to a competitive environment.

ASAQ purchase price lower than AL, but both are still much more expensive than SP: Among all wholesalers, the median purchase price for SP (US$ 0.29, IQR 0.21-0.61) was at least 10 times lower than the median purchase price for AL (US$ 4.13, IQR 3.10-6.89) or ASAQ (US$ 2.91, IQR 1.94-4.65), and a similar pattern was observed at retail level. However, at private health facilities, the median purchase price for ASAQ (US$ 0.26, IQR 0.13-0.77) was comparable to that of SP. This was due to the high proportion of lower-priced ASAQ branded as Larimal observed among this outlet type, compared to the other private sector retailer types. To demonstrate, although subsidised Larimal is also targeted at PPMVs and pharmacies, less than 10% of the Larimal observed in PPMVs was purchased at a price lower than US$ 0.25 per AETD (approximately US$ 0.06 per paediatric dose), and even less in pharmacies and other private outlets, such as supermarkets. This may also reflect our observation that out of the 150 antimalarial supplier mentions collected from retailers during the ACTwatch Outlet Survey, the one mention of SFH was made by a private health facility, which may suggest that private health facilities are more likely to be supplied by SFH than any of the other outlet types, and therefore, may also be more likely to stock the subsidised ASAQ products distributed by SFH. In

addition, the typical price of Larimal was also lower in retail outlets located in the states participating in the subsidy programme run by SFH than in those retail outlets located in non-participating states; and compared to all other retail outlet types, the median purchase price for Larimal among private health facilities in participating states was particularly low (US$0.13 per AETD in private health facilities vs. US$ 2.44 in pharmacies vs. US$ 1.29in PPMVs), again, potentially reflecting the greater likelihood of private health facilities to be supplied with subsidised products from SFH. However, more than 80% of the observed Larimal among private retailers located in states participating in the subsidy programme was purchased above the target subsidised wholesale price of 5 NGN (US$ 0.03) per paediatric dose (or approximately US$ 0.12 per AETD). This is because non-subsidised versions of Larimal and Arsuamoon were being sold concurrently in all states and were widely available in the private sector distribution chain, as reflected in our observation that 41% of all wholesalers stocked ASAQ products branded as either Larimal or Asuamoon.

Public facilities sometimes purchased drugs from private wholesalers and sold them to patients: Most antimalarial drugs used for the treatment and prevention of malaria (i.e. ACTs for uncomplicated malaria, SP for IPT) that are available in public facilities are procured using external aid money, and should be supplied to public facilities at no cost. This is consistent with our observation that many of these types of antimalarials had a purchase price of US$ 0.00 in public facilities. However, it is common for drugs in public facilities to be financed through revolving drug funds (meaning that patients purchase most drugs consumed at public facilities and the revenue raised goes toward procuring future stock). This is also consistent with our observation that public facilities paid to purchase some antimalarials, particularly for those that are not included in the national treatment policy, such as AMTs and nATs. This is of particular concern as this result indicates that some public facilities may be failing to treat some patients according to the antimalarial policy, and that some patients in public facilities are paying to be treated with ineffective antimalarials.

RDT purchase prices were lower than ACT purchase prices: Among the very few wholesalers who stocked RDTs, the median wholesale purchase price was US$ 0.70 per test (IQR 0.52-0.90). This was several times lower than the median purchase price for ACT.

Conclusion

This report has presented a number of important new insights into the market for antimalarial drugs in Nigeria. The distribution chain had wholesalers operating on a number of levels giving an overall pyramidal shape. However, most wholesalers either supplied only other wholesalers or only retailers, and many wholesalers were supplied by manufacturers (as one of their top two antimalarial sources), either directly or through a network of regional depots owned by the manufacturer or by a logistics company. 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 an up-to-date license permitting the wholesale of antimalarials, and a number of those engaged in antimalarial wholesaling were only permitted to retail over-the-counter medicines. Large markets are an important source of antimalarial purchasing for retailers, but regardless of wholesaler type and location, ACTs, and in particular the first-line drugs AL and ASAQ, were available in most wholesalers. However, AMTs and nATs were also available at comparable levels, and in terms of sales volumes, those of nATs far exceeded sales volumes of ACTs. At wholesale and retail levels, percent mark-ups on antimalarials were relatively low and consistent across antimalarial category and business type. This may be due to a high degree of competition among wholesalers and retailers. RDTs were not widely available at wholesale level; however, their wholesale purchase prices were low compared to ACT purchase prices.

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]			WHOLESALER CATEGORIES		
			ALL WHOLESALERS N=142[3]	SUPPLY WHOLESALERS N=46	SUPPLY RETAILERS N=103
All ACT	All	**Median**	**137.9**	**787.4**	**114.8**
		IQR	12.8-794.0	117.4-4633.1	8.4-530.8
	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	All	**Median**	**94.0**	**418.0**	**70.2**
		IQR	2.6-556.4	4.9-2266.7	2.6-374.0
	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**	**42.0**	**165.8**	**38.7**
		IQR	3.8-272.1	0.0-934.9	11.0-206.4
	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
nAT	All	**Median**	**562.9**	**1207.3**	**555.5**
		IQR	163.6-2006.6	0.0-8144.7	166.7-1635.3
	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

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 136 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, 205 wholesalers were identified, of which 137 were interviewed successfully. Of the remaining, 3 were partially interviewed, 27 refused, 33 were not screened because a respondent was not available, the business had closed or could not be found, and 5 did not stock antimalarials at the time of the survey (Table 1). These 68 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 2531 antimalarials audited, and 903 (35.7%) had missing sales volumes that were imputed using the mi impute pmm command.

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			WHOLESALER CATEGORIES[3]		
			ALL WHOLESALERS	SUPPLY WHOLESALERS	SUPPLY RETAILERS
All ACT	All	**Median**	**200.0**	**853.2**	**140.9**
		IQR	49.8-890.3	162.5-6807.9	35.1-715.5
		(n)	(118)	(36)	(89)
	Suppository	**Median**	**20.3**	**-**	**20.3**
		IQR	0.9-57.9	-	0.9-57.9
		(n)	(4)	-	(4)
	Granule	**Median**	**3.1**	**15.4**	**2.1**
		IQR	0.8-26.9	2.0-43.1	0.8-13.3
		(n)	(27)	(8)	(21)
Non-WHO prequalified ACT	All	**Median**	**193.5**	**809.7**	**136.9**
		IQR	45.4-760.4	200.0-4426.3	30.6-557.9
		(n)	(103)	(30)	(79)
	Suppository	**Median**	**20.3**	**-**	**20.3**
		IQR	0.9-57.9	-	0.9-57.9
		(n)	(4)	-	(4)
	Granule	**Median**	**3.1**	**15.4**	**2.1**
		IQR	0.8-26.9	2.0-43.1	0.8-13.3
		(n)	(27)	(8)	(21)
AMT	All	**Median**	**90.8**	**667.6**	**61.6**
		IQR	31.5-333.8	257.1-3424.3	25.0-265.4
		(n)	(107)	(23)	(88)
	Suppository	**Median**	**32.3**	**-**	**32.3**
		IQR	8.0-56.7	-	8.0-56.7
		(n)	(2)	-	(2)
	Granule	**Median**	**-**	**-**	**-**
		IQR	-	-	-
		(n)	-	-	-
nAT	All	**Median**	**840.0**	**2207.9**	**563.3**
		IQR	261.7-2149.3	1049.9-14032.1	218.7-1777.3
		(n)	(121)	(29)	(97)
	Suppository	**Median**	**58.7**	**117.9**	**80.0**
		IQR	36.5-140.0	35.7-200.0	37.4-200.0
		(n)	(4)	(2)	(3)
	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.

6.2. Range of health and non-health retail outlets selling medicines in Nigeria

Public Health Facilities	N	Description
University teaching hospital / Federal Medical Centre	29	These tertiary level public health facilities are designated as referral hospitals for the State. They have specialized clinics with qualified personnel. Federal Medical Centres (FMCs) are headed by a Chief Medical Director appointed by Federal Government, funded by and reporting to the Federal Government. They conduct postgraduate training of health providers including doctors and nurses. Unlike university teaching hospitals, FMCs are not attached to any specific university or medical school. By definition, university teaching hospitals are linked to a university or medical school. They are headed by a Chief Medical Director, and regulated by the Medical and Dental Council. Some teaching hospitals are privately owned and the distinction between government-owned and private-owned facilities has made during the survey.
General / Specialist hospital	24	These secondary public health facilities are funded by and report to State governments. General hospitals typically serve urban or peri-urban areas with a catchment area covering 200,000 to 300,000 people. They are headed by a Medical Superintendant, and have facilities for diagnosis, in-patient admission, and surgery. They include pharmacy section(s), dispensary unit(s), an ambulance, and a few residential houses for staff on emergency duties. General hospitals may host internships for doctors under supervision, but do not perform postgraduate training.
Primary Health Care Centre (PHCC)	202	These primary health facilities are managed and operated at the local government area level. They are the smallest of all government-owned health facilities and offer fewer services than those found at tertiary and secondary level facilities. Health centres are located in both urban and rural settings, and have a typical catchment area covering 10,000 to 30,000 people. They are usually manned by one or two nurses with some community health extension workers and a few auxiliary staff. However, some are operated by doctors, while others have doctors that periodically visit to make major decisions or run specialist clinics. Services provided include community IMCI; family planning; focuses ANC; routine immunization; and PMTCT.
Private, not-for-profit facilities	N	Description
Non-Governmental Organization (NGO) Hospital / Health Centre	11	These health facilities operate at different levels of the health system, depending on their size. They are funded and supported by non-governmental organizations and provide medical consultations, diagnoses, and prescription medicines at a nominal cost.

Community health workers	N	Description
Community Health Extension Worker	19	This cadre of trained health worker is found mostly at the primary health care level and provides services directly to the communities in which they work. While most of them are attached to government facilities, some of them operate at privately owned outlets, such as PPMVs, or from their residential homes.
Pharmacy	**N**	**Description**
Pharmacy	409	These outlets are registered by the Pharmacy Council of Nigeria and are authorized to sell all classes of medicines, including prescription medicines. They usually employ nurses and intern pharmacists. Pharmacies are highly regulated by the National Agency for Food and Drug Administration and Control (NAFDAC). They are privately owned, either by registered pharmacists or individuals who employ the services of a registered pharmacist. In Nigeria, pharmacies are overwhelmingly located in urban areas in commercial zones.
Drug Store	**N**	**Description**
Propriety patent medicine vendors / Drug Store	1,031	These are small to medium sized outlets, equivalent to *drug sho*ps in other *ACTwatch* countries. PPMVs may be registered by the Directorate of Pharmaceutical Services (DPS), but the majority of them are not registered. They are legally allowed to sell over the counter (OTC) medicines, however a number of them also illegally stock prescription medicines. (In 2006, NAFDAC de-classified ACTs from prescription-only to OTC; hence ACTs are legally available at PPMVs.) Some operate without a license, especially at the village level or remote areas. PPMVs are ubiquitous across Nigeria and, given the lack of pharmacies in rural settings, serve as accessible medicine outlets for consumers. Staff typically have little or no training in health service delivery, although a small proportion of PPMVs are owned by nurses or other health workers, such as community health extension workers.
Private-for-profit	**N**	**Description**
Private hospitals / clinics	405	These are non-governmental health facilities. Just as with public health facilities, private hospitals and clinics are classified in terms of their capacity— tertiary, secondary, or primary. For this study, all three levels have been grouped into one category. Hence, they can range from offering comprehensive health services to being limited in scope. Likewise, staff range in qualification and number. There is usually a dispensing section, but in some cases, the doctors may dispense medications themselves.
Retail stores	**N**	**Description**
Supermarket / Minimarket / Provision store	3,305	Small businesses which sell household products, food, and beverages. These stores may also sell medicines, usually antipyretics. They are unlicensed.

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 *Artequick* 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 (*Winthrop/Coarsucam – Sanofi Aventis*)
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 (*Artequin Adult – Mepha*)
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 (*Co-arinate – Dafra*)
Atovaquone-Proguanil	3000mg	Atovaquone		Manufacturer Guidelines (*Malanil – GSK*)
Chloroquine	1500mg			WHO Model Formulary, 2008
Chloroquine-Sulfadoxine-Pyrimethamine	1500mg	Chloroquine		WHO Model Formulary, 2008
Chlorproguanil-Dapsone	360mg	Chlorproguanil		Manufacturer Guidelines (*LapDap – GSK*)
Dihydroartemisinin	480mg			Manufacturer Guidelines (*Cotecxin – Holleypharm; MALUether – Euromedi*)

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 (*Duo-cotecxin – Holleypharm*)
Dihydroartemisinin-Piperaquine-Trimethoprim	256mg	Dihydroartemisinin		Manufacturer Guidelines (*Artecxin – Medicare Pharma; Artecom – Ctonghe*)
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 (*Dalasin – Adams Pharma*)
Dihydroartemisinin-Mefloquine	360mg	Dihydroartemisinin		Manufacturer Guidelines (*Meflodisin – Adams Pharma*)
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 (*Halfan – GSK*)

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 (*Plaquenil – Sanofi Aventis)*
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 P. falciparum.	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 (*Quinimax – Sanofi Aventis)*
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 was done according to the country's six geo-political zones: North Central, North West, North East, South West, South East and South-South. The primary sampling unit is the 'locality', also known as a village or town depending on urbanization and size. A one-stage probability proportional to size (PPS) technique was used in sample selection, with the locality population as the measure of size and 19 localities per stratum. Notably, the population sizes of localities have a big variation – from small rural villages with populations in the low hundreds to large urban state capitals in excess of 300, 000. The generic ACT Watch outlet survey study design describes the selection of a primary sampling unit as an administrative division that hosts a population of approximately 10,000-15,000 inhabitants; however, in Nigeria there are no administrative divisions with populations consistently within this range. The following approach was agreed upon and used in the survey:

i.   A census of all PHF (Public Health Facility) and POPs (Part One Pharmacy) was conducted in 20 selected locations for each stratum
ii.   A census of all private health facilities, registered pharmacies was conducted in 19 selected localities in each stratum, regardless of the population size
iii.   A census of Proprietary Patent Medicine Vendor (PPMVs) and informal sector(such as supermarkets, hawkers, CHWs, shops) was conducted ONLY in three selected EAs for 'large areas' (>50,000 inhabitants) among the 19 selected localities
iv.   A full census of PPMVs and informal sector was conducted in 'medium to small' geographical areas among the 19 selected localities

A booster sample comprised of an additional locality in each of the six geo-political zones selected on the basis of having large population size. A census of all PHFs and registered pharmacies in the booster sample was conducted.

Weighting approach

Weights were calculated differently for the different outlet categories and specific to analysis type but generally involved the inverse of the selection probability and corresponding population size. We used the locality populations for all PHFs, private health facilities, and registered pharmacies and for all analysis involving both booster and non-booster samples (including volumes analysis) and EAs populations for PPMVs and informal outlets in 'large areas'. There was no adjustment to the weights with the assumption that a full census of PHF and registered pharmacies was done in all localities. We did not have an updated list of these facilities to verify the coverage of the enumeration.

The sampling weight for the corresponding units given in above was calculated by:

i. For the PHFs (Public Health Facility) and POPs (Part One Pharmacy)

$$Weight_i = \frac{\text{stratum population}}{\text{number of localities in stratum}(20) \times \text{locality population}}$$

ii. For all the private health facilities and registered pharmacies other than PHFs & POP

$$Weight_i = \frac{\text{stratum population}}{\text{number of localities in stratum}(19) \times \text{locality population}}$$

iii. For PPMVs and informal outlets in a 'large areas' (>50,000 inhabitants)

$$Weight_i = \frac{\text{stratum population}}{\text{number of localities in stratum}(19) \times \text{EA population}}$$

iv. For PPMVs and informal outlets in a 'medium to small' geographical areas

$$Weight_i = \frac{\text{stratum population}}{\text{number of localities in stratum}(19) \times \text{locality population}}$$

7. References

1. CIA. (2011) *The World Factbook: Nigeria*. Accessed 19 September 2011; Available from: https://www.cia.gov/library/publications/the-world-factbook/geos/ni.html.
2. FMOH (2009). *Malaria Strategic Plan 2009-2013: A Road Map for Malaria Control in Nigeria*. Abuja: Federal Ministry of Health, National Malaria Control Programme.
3. Foreign & Commonwealth Office. (2011) *Nigeria - Country Information*. Accessed 4 August 2011; Available from: http://www.fco.gov.uk/en/travel-and-living-abroad/travel-advice-by-country/country-profile/sub-saharan-africa/nigeria?profile=all.
4. World Bank. (2011) *World Development Indicators Online*. Accessed 20 August 2011; Available from: http://ddp-ext.worldbank.org/ext/DDPQQ/member.do?method=getMembers&userid=1&queryId=6.
5. Transparency International. (2011) *Corruption Perception Index 2010*. Accessed 7 August 2011; Available from: http://www.transparency.org/policy_research/surveys_indices/cpi/2010/results.
6. NAFDAC. (2002-2009) *National Agency for Food and Drug Administration and Control: Safeguarding the health of the nation*. Accessed 8 August 2011; Available from: http://www.nafdacnigeria.org/.
7. PCN. (2011) *Pharmacists Council of Nigeria*. Accessed 8 August 2011; Available from: http://www.pcnng.org/.
8. Palafox B, Patouillard E, Tougher S, Goodman C and Hanson K. (2009) *The private commercial sector distribution chain for antimalarial drugs in Nigeria: Findings from a rapid survey*. London: London School of Hygiene & Tropical Medicine and Population Services International.
9. FMOH. (2011) *Nigeria Pharmaceutical Country Profile*. Abuja: Federal Ministry of Health in collaboration with the World Health Organization.
10. FMOH. (2010) *Access to and rational use of medicines at the facility level*. Abuja: Federal Ministry of Health.
11. ACTwatch Group. *Outlet Survey Report, Nigeria, 2009 Survey*: www.actwatch.info.
12. Erhun W, Babalola O and Erhun M. (2001) "Drug Regulation and Control in Nigeria: The Challenge of Counterfeit Drugs." *Journal of Health & Population in Developing Countries* 4(2): 23-34.
13. WHO. (2011) *National Health Accounts - Nigera*. Accessed 15 August 2011; Available from: http://www.who.int/nha/country/nga/en/.
14. NPC, NMCP and Macro MDI. (2011) *Nigeria Malaria Indicator Survey 2010: Preliminary Report*. Abuja: National Population Commission, National Malaria Control Programme, MEASURE DHS/ICF Macro.
15. NPC and ICF Macro. (2009) *Nigeria Demographic and Health Survey 2008*. Abuja, Nigeria: National Population Commission and ICF Macro.
16. WHO. (2008) *World Malaria Report 2008. WHO/HTM/GMP/2008.*
17. FMOH. (2005) *National antimalarial treatment policy*. Abuja: National Malaria and Vector Control Division, Federal Ministry of Health.
18. World Bank. (2011) *Malaria Control Booster Project - Nigeria*. Accessed 25 August 2011; Available from: http://web.worldbank.org/external/projects/main?pagePK=64312881&piPK=64302848&theSitePK=40941&Projectid=P097921.
19. ACTwatch Group. (2011) "Monitoring fever treatment behavior and equitable access to effective medicines in the context of initiatives to improve ACT access: baseline results and implications for programming in six African countries." *Malaria Journal* in press.
20. PMI. (2010) *Nigeria Malaria Operational Plan FY 2011*. Abuja: President's Malaria Initiative
21. Oladepo O, Salami KK, Adeoye BW, Oshiname F, Ofi B, Oladepo M, Ogunbemi O, Lawal A, Brieger WR, Bloom G and Peters DH. (2007) *Malaria treatment and policy in three regions in Nigeria: The role of patent medicine vendors*. Future Health Systems Working paper 1: Nigeria Series: Future Health Systems Research Programme Consortium.
22. Aina BA, Tayo F and Taylor O. (2008) "Cost implication of irrational prescribing of chloroquine in Lagos State general hospitals." *J Infect Dev Ctries* 2(1): 68-72.
23. Sabot OJ, Mwita A, Cohen JM, Ipuge Y, Gordon M, Bishop D, Odhiambo M, Ward L and Goodman C. (2009) "Piloting the global subsidy: the impact of subsidized artemisinin-based combination therapies distributed through private drug shops in rural Tanzania." *PLoS One* 4(9): e6857.
24. Talisuna A, Grewal P, Rwakimari JB, Mukasa S, Jagoe G and Banerji J. (2009) "Cost is killing patients: subsidising effective antimalarials." *Lancet* 374(9697): 1224-6.
25. Shillcutt S, Morel C, Goodman C, Coleman P, Bell D, Whitty CJ and Mills A. (2008) "Cost-effectiveness of malaria diagnostic methods in sub-Saharan Africa in an era of combination therapy." *Bull World Health Organ* 86(2): 101-10.
26. Drakeley C and Reyburn H. (2009) "Out with the old, in with the new: the utility of rapid diagnostic tests for malaria diagnosis in Africa." *Transactions of the Royal Society of Tropical Medicine and Hygiene* 103(4): 333-337.
27. ACTwatch Group. (2009) *Outlet Survey Report (Baseline), Federal Republic of Nigeria, 12/08*: Population Services International. www.actwatch.info.