

Pharmaceutical stock-out in Uganda, Kenya and Ghana

Samuel H Masters

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Committee:

Michael Hanlon

Joseph Babigumira

Emmanuela Gakidou

Santosh Kumar

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School of Public Health – Department of Global Health

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Samuel H Masters

University of Washington

Abstract

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Samuel H Masters

Chair of the Supervisory Committee:

Michael Hanlon, PhD

Department of Global Health

Abstract

In this study we utilize facility level data from three nationally representative surveys conducted in Uganda, Kenya and Ghana. We analyze the availability of pharmaceuticals and quantify the effect of various factors that affect facility stock-out of pharmaceuticals. Specifically, we use a binomial regression model to analyze stock-out of essential pharmaceuticals required to alleviate national disease burden. We find that both presence of a lab at the facility and presence of a vehicle at the facility are significantly associated with reduced stock-out.

Introduction

Millions of people worldwide die or face disability each year due to diseases that have proven pharmaceutical treatments (Lozano et al., 2012; Murray et al., 2012). In order to decrease these preventable deaths, access must increase to necessary medicines. Assuming people visit the health center when they are sick, the provision of pharmaceuticals at the health center to treat deadly disease is imperative. However, drugs are often not provided at facilities due to stock-out, or specifically, a pharmaceutical not being available due to it being out of stock. Stock-out of medicines has a profound effect on health in various ways. First, if a drug is not available then a sick patient who visits the health facility will not be able to receive the treatment they need. Patients who do not receive proper drug treatment have worse outcomes. Pasquet et al. (2010) link patients with facility level antiretroviral medicine stock-out and finds that stock-out led to higher mortality. Second, if a facility experiences stock-out a patient may be less willing to visit the health facility because they do not believe they will get the care and medicine they need to be properly treated. Nabbuye-Sekandi et al. (2011) find that patients' perceptions of a health facility and their satisfaction with health services are directly linked to the availability of pharmaceuticals at that facility. In addition, Hanson et al. (2005) find that availability of pharmaceuticals is a significant predictor of perceived quality of health facilities. These studies imply that as availability of pharmaceuticals decreases, patients reduce their positive perception of the facility. Perceived quality of a health facility can have a profound effect on a patient's choice to utilize or not (Mugisha et al., 2004). Therefore, it is important to stock medicines so people maintain confidence in the health system and continue to utilize it.

Despite the obvious need for drugs to treat patients, information on the prevalence of stock-out has been predominantly analyzed through small survey datasets and there is a dearth of

information related to the determinants of stock-out. There is a large existing literature that examines stock-out and price of essential medicines using an approach developed by the WHO and Health Alliance International in 2003 (World Health Organization and Health Action International, 2003). The approach examines the availability and affordability of up to 50 medicines that are considered essential by the WHO. The survey has been conducted in numerous countries worldwide and is still being used today as a relevant policy undertaking (Babar et al., 2007; Cheraghali and Idries, 2009; Mendis et al., 2007; Mourik et al., 2010; Yang et al., 2010). Specific results from the WHO/HAI methodology are comparable across studies. Cameron et al. (2009) have synthesized relevant data from 45 WHO/HAI surveys to generate medicine availability estimates by region. The WHO/HAI method has been widely used, however; it does little to take into account prevailing pharmaceutical norms within each country, such as different levels of care carrying different pharmaceuticals to address their relevant burden. In addition, another limitation of these studies is that they use surveys with small sample sizes that lack generalizability to the entire pharmaceutical system of a country.

Other literature has looked at pharmaceutical availability at the facility level not using the WHO/HAI methodology. Buabeng et al. (2008) explore anti-malarial drug availability in Ghana and find that fewer than half of the health facilities sampled stocked the recommended first line therapy to treat malaria. However, despite these numerous mentioned studies looking at availability, none of them examine the facility level determinants of availability.

There is some literature that examines the relationship between modifiable policies/factors and drug availability. Kangwana et al. (2009) investigate the effect of a nationwide pharmaceutical policy to stock artemisinin combination therapies (ACTs) in public facilities in Kenya. They find uptake of the policy has been widespread; however, stock-out of

artemether-lumefantrine is high, greater than 25%, two years after its introduction as a treatment for uncomplicated malaria. Davis et al. (2013) analyze availability and affordability of ACTs in five countries currently receiving Global Fund funding. They find that stock-out is higher among rural facilities than urban in Ghana and Kenya and that stock-out rates were highest in rural Kenya (87% experienced at least one stock-out occurrence in the prior 3 months) and lowest in Tanzania (20.4%). Tumwine et al. (2010) analyze pharmaceutical stock-out in a hospital in south western Uganda both before and after the hospital was put on a pull system from a push system. They find that the hospital faced significantly higher stock-out while under a push system, but note their limitation of only looking at one facility at two time points.

The need for increased access to pharmaceuticals drove the World Health Organization to publish its first essential drugs list in 1977, which later became the essential medicines list (EML) and is now on its 18th edition (Laing et al., 2003; World Health Organization, 2013). The EML is designed to highlight drugs that are essential to the care of diseases that plague individuals worldwide. The EML has become a ubiquitous concept with many countries adopting the strategy of creating national EMLs to treat their relative disease burdens in cost-effective ways. Uganda, Kenya and Ghana have all developed EMLs and the pharmaceuticals included in each vary slightly depending on the country's needs (Ghana National Drugs Program and Ministry of Health, 2010; Kenya Ministry of Medical Services and Kenya Ministry of Public Health & Sanitation, 2010; Uganda Ministry of Health, 2011). The national EMLs are designed to include the pharmaceuticals that should be available to treat disease at various levels of the public health care system. For example, a referral hospital should carry specialist medicines that are necessary for care at the national level, but at the local level, only a few select pharmaceuticals may be available to treat the most common diseases. Private facilities are not

required to carry the essential medicines laid out by the national EML guidelines, but many do given their pertinence and cost-effectiveness.

In this study we attempt to fill in the existing knowledge gap on pharmaceutical availability in sub-Saharan Africa by investigating data from three nationally representative surveys in Uganda, Kenya and Ghana. Further, we use this data to investigate the relationship between various supply chain and facility level factors that contribute to stock-out.

Methods

Data

Data was collected using a standard survey instrument in each country as part of the Access, Bottlenecks, Cost and Equity (ABCE) project. Health facilities and pharmacies were visited in each country. Data on pharmaceuticals was collected from 209 facilities in Kenya, 220 facilities in Ghana and 230 facilities in Uganda. Facilities were grouped based on their ability to provide service and their designation by the various Ministries of Health in each country. We have labeled these groups of facilities as platforms and will report on them as such. Information on the facilities and platforms is summarized in Table 1. The ABCE study was reviewed and approved by the University of Washington's Institutional Review Board and the corresponding Institutional Review Boards in each of our partner countries.

Questions on specific pharmaceuticals varied slightly in each country based on country data needs, but a core group of 50 pharmaceuticals were asked across all countries.

Pharmaceuticals were included based on their necessity for treating high-burden diseases and on

advice from our in-country partners. The vast majority of pharmaceuticals were from the EML of each country.

In addition to pharmaceutical data captured at the facility, various facility characteristics were asked about in the survey. Questions asked varied by country, but Table 2 summarizes the responses. Specifically, questions about the storekeeper were not asked in Ghana, whereas questions about where the facility regularly receives pharmaceuticals from were not asked in Kenya. Distances were calculated using straight line distance to the capital city.

The dependent variable in the regressions was the number of pharmaceuticals that were stocked-out. Each drug was categorized as stocked-out if it was not available at the time of survey administration. In order for a pharmaceutical to be considered available at the time of survey administration, the drug had to be directly observed by the surveyor. General pharmaceuticals in all facilities were considered stocked-out if the facility reported normally having the drug but it was not directly observed. Essential medicines were considered stocked-out if the facility was public—thus having to adhere to the EML guidelines—and the drug was unavailable, even if they reported not typically carrying the drug. This specification creates higher drug stock-out since drugs not reported as typically carried are considered stocked-out.

Statistical analysis

The data was structured so that each facility had a number of drugs stocked-out and a bounded number of possible drugs stocked, as well as various facility-level predictors. The data structure led us to analyze the association between facility characteristics and pharmaceutical stock-out using a generalized linear model with a binomial family. Two different dependent variables were used, 1) pharmaceutical stock-out of any drug in all facilities and 2)

pharmaceutical stock-out of essential medicines in public facilities. Independent variables were included where appropriate for each country. Specifically, whether or not the facility was on a push or pull system was included as a categorical variable coded as push, pull or both. Presences of different types of record keepers were included as binary predictors. Whether or not the facility received drug kits, whether or not the facility had a lab, and whether or not the facility had access to a vehicle were included as binary predictors. Rurality of the facility was included as a categorical variable, with rural, semi-urban and urban as the three categories. Distance to the capital was coded as a continuous variable and the unit of analysis was the decimal degree. Whether or not a facility received pharmaceuticals from the Ministry of Health or received them from a private provider were each included as binary predictors. In addition to the covariates measured at the facility level, we also controlled for platform of the facility and month that the facility survey took place—to control for potential seasonality of stock-out. Facilities were not included in the regression analysis if they reported not carrying any of the pharmaceuticals asked about in the survey. This accounted for 13 facilities (9 in Kenya, 1 in Uganda, and 3 in Ghana) when using the any drug dependent variable. No public facilities were dropped in the analysis of EML drugs since all were expected to carry the essential drugs. Regression analysis was done using the *binreg* command in Stata software version 12 and a logit link function was used to define the relationship between the independent predictors and stock-out. (StataCorp., 2011).

Results

Availability of pharmaceuticals

Table 1 summarizes the stock-out variable by country and platform. Results indicate that rates of pharmaceutical stock and stock-out varied by country and platform. In general, facilities carried more pharmaceuticals the more complex the services they offered. Hospitals tended to carry over 80% of the pharmaceuticals surveyed, while community level facilities carried less than half. CHPS compounds in Ghana carried the fewest drugs on average per facility with 16 of the 54 surveyed pharmaceuticals typically available. All three countries faced similar patterns of stock-out with the low-level community public health facilities facing the highest proportion of drugs stocked-out. Pharmacies faced very low stock-out in all three countries. In addition, private medical service providers, such as private hospitals and medical clinics, faced low stock-out compared to their public counterparts.

Certain high-profile pharmaceuticals are of significant importance to address the disease burden of these sub-Saharan African countries. Table 3 summarizes stock-out of a country's first line treatment for malaria, pneumonia, and meningitis. In general, stock-out of antimalarial drugs was lower than drugs to treat pneumonia and meningitis. Across the sample, Ghana had the lowest rate of ACT stock-out with only 2% of facilities and Kenya the highest with 7%. Amoxicillin stock-out was also much lower in Ghana, at 5% compared with over 14% in Uganda and 21% in Kenya. All countries faced stock-out rates greater or equal to 10% for ceftriaxone and chloramphenicol, the drugs necessary to treat meningitis.

Determinants of stock-out

The regression model suggests that the factors influencing stock-out differ across the three countries (Table 4). Rurality of the facility did not have a significant effect on stock-out of essential medicines. However, in Uganda rural facilities had 59% higher odds of stock-out than

urban facilities, while in Kenya rural facilities had 72% lower odds of stock-out than urban, but it was only marginally significant at the 0.1% level. In Ghana, if the facility received drugs from a private supplier they were less likely to face stock-out of any medication and essential medications. In Uganda, both facilities receiving pharmaceuticals from the MOH and from private suppliers were associated with reduced stock-out. In Uganda, presence of a vehicle was associated with lower stock-out for both any surveyed drug and essential medicines. In Ghana and Kenya the results were similar, with presence of a vehicle associated with lower stock-out, however, the effect was only significant for essential medicines. Having a lab in the facility was significantly associated with reduced essential medicine stock-out, possibly suggesting that more advanced facilities are able to test and subsequently treat only positive cases, which would drive down unnecessary use of pharmaceuticals. Where the facility received drugs from was significantly associated with stock-out.

Discussion

In this analysis of over 600 health facilities in Uganda, Kenya and Ghana we have shown that pharmaceutical stock-out is still a persistent problem despite large efforts in each country to strengthen the provision of pharmaceuticals. Availability of essential medicines was strikingly low, with over 30% of those expected to be available not at the facility. Even if availability is low, it is important to note that facility specific stock-out does not necessarily imply that a patient does not receive pharmaceuticals. A patient could go to a private pharmacy or another provider to get medication. However, this entails multiple trips from the patient and as the number of required trips increases, the likelihood a patient will visit the subsequent facility

decreases, thus decreasing their probability of getting the pharmaceuticals they need. This has the potential to have a profound impact on the health of these populations if patients are not receiving the pharmaceuticals they need. It is necessary that facilities carry the pharmaceuticals expected of them so that patients get the care they need and expect.

Regression analysis suggests the presence of vehicles at the facility is associated with reduced stock-out. One potential way to alleviate stock-out in Uganda, Kenya and Ghana is to provide vehicles to facilities so they can seek out medications when their stock is low. This intervention would give the facility more autonomy and accountability in dealing with pharmaceutical procurement. Presence of different types of pharmaceutical record keeper did not significantly affect stock-out in Uganda and Kenya which implies that facilities without experienced pharmaceutical personnel may still be capable of monitoring stock. Given this outcome, supplying vehicles to facilities, even those without a pharmacist, would be a useful intervention.

The results from our analysis on availability were consistent with those found in the existing literature. Robertson et al. (2009) found the rate of pharmaceutical availability in our surveyed countries to be lowest in Ugandan district hospitals and primary health care centers, each at 29%. We found availability to be much higher, which could be due to the Robertson study using specific formulations of the drug, rather than asking about the drug regardless of formulation, as we did. In addition, the Robertson study uses a standard 20 medicines across 14 different African countries and did not incorporate if Uganda utilizes those 20 medicines. Davis et al. (2013) find stock-out rates of ACTs among our surveyed countries to be highest in Kenya and lowest in Ghana. Although their stock-out measure is not directly comparable because it incorporates any stock-out within the past 3 months, rather than at the time of survey, their

results seem to show a similar trend. Our analysis provides more robust results because we analyzed more drugs and used directly observed availability rather than self-reported availability.

This analysis faced three specific limitations. First, in our survey we did not ask about availability of specific formulations of a pharmaceutical. If we had information on this we would be better able to assess the importance of some drugs over others. For example, a facility carrying an antibiotic for use with pediatric patients would still be considered not having stocked-out of that antibiotic even if the antibiotic for adults was stocked out. However, the likelihood that this limitation would have any real effect on the analysis is minimal since it is likely that facilities stock pharmaceutical formulations that are prescribed to them by the EML and not others. Second, we did not have outcomes at the individual patient level to assess the relationship between pharmaceutical stock-out and outcomes. Although this would have been nice to understand, we did not ask this in the survey and are therefore limited. Third, we did not measure if the drug was effective or expired. Counterfeit drugs are known to exist in Africa but very little is known about their prevalence due to lack of survey data (Cockburn et al., 2005; Kaur et al., 2008). Future analysis should focus on determining, in addition to if a facility stocks medicines, if the medicines they stock are effective and safe.

Conclusion

Very little existing literature has explored the relationship between facility level determinants and availability of pharmaceuticals. Future research should attempt to better understand the causal mechanisms that drive pharmaceutical procurement and subsequent stock-

out. In addition, countries should take a strong look at their own health systems to understand where the need exists for better pharmaceutical monitoring to improve drug availability.

In conclusion, Uganda, Kenya and Ghana still have a long road ahead before necessary essential medicines are available in the health facilities as they are mandated. Investment should be made to strengthen the monitoring system of pharmaceutical procurement and more autonomy should be given to facilities to monitor their stock. With increased availability of essential medicines the health of these countries should improve.

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Table 1. Pharmaceutical treatment guidelines by country

	Platform	All pharmaceuticals				Essential Medicines			
		Number of facilities	Mean number stocked out at time of survey	%	# of drugs available	Mean EML drugs stocked out	%	Total EML drugs expected	
Ghana	Referral hospital	11	5.2	12%	44	11.5	24%	48	
	Public hospital	18	2.3	6%	38	13.4	29%	46	
	Health center	43	2.0	9%	22	4.7	26%	18	
	Private clinic	30	2.8	10%	29				
	Community health post	65	2.4	15%	16	2.5	35%	7	
	Maternity clinic	16	2.5	11%	23				
	Pharmacy	37	2.0	8%	27				
Kenya	Referral hospital	11	3.0	7%	41	7.6	18%	42	
	District hospital	19	4.3	12%	37	10.8	26%	42	
	Private hospital	17	2.9	7%	41				
	Sub-district hospital	9	6.1	17%	35	7.8	29%	27	
	Health centre	54	6.6	23%	28	8.7	33%	26	
	Medical clinic	18	4.0	11%	38				
	Dispensary	34	5.3	22%	24	10.3	39%	26	
	Maternity clinic	20	2.6	9%	29				
	Pharmacy	16	1.9	5%	40				
	VCT center	11	0.2	5%	4				
Uganda	Referral hospital	13	5.5	12%	46	11.2	22%	51	
	District hospital	21	3.8	9%	43	12.4	25%	50	
	Private hospital	6	1.8	4%	47				
	Health center IV	39	6.8	17%	39	14.1	33%	43	
	Health center III	54	6.6	21%	31	11.1	37%	30	
	Medical clinic	14	2.8	8%	35				
	Health center II	46	5.7	24%	24	6.6	36%	18	
	Pharmacy	37	2.7	7%	38				

Table 2. Facility level covariates

Covariate	Uganda	Kenya	Ghana	Range
Order drugs and receive routine shipments	10%	19%	19%	[0,1]
Order drugs only	63%	74%	75%	[0,1]
Receive routine shipments only	26%	6%	5%	[0,1]
Receive drugs from the Ministry of Health	40%		13%	[0,1]
Receive drugs from the private market	60%		95%	[0,1]
Record keeper: admin personnel	11%	11%		[0,1]
Record keeper: medical personnel	41%	36%		[0,1]
Record keeper: pharmaceutical personnel	46%	48%		[0,1]
Record keeper: accounting personnel	10%	7%		[0,1]
Facility has a vehicle	59%	49%	67%	[0,1]
Facility has drug kits	42%	39%	0%	[0,1]
Facility has a lab	73%	84%	56%	[0,1]
Distance to the capital in decimal degrees	1.57	1.72	2.43	[0,5.7]

Table 3. Stock-out of essential medicines to treat malaria, pneumonia and meningitis

Drug	Uganda		Kenya		Ghana	
	%	Count	%	Count	%	Count
Coartem	6%	226	7%	194	6%	204
AS+AQ					14%	199
Any ACT	6%	226	7%	194	2%	214
Amoxicillin	14%	225	21%	198	5%	205
Cotrimoxizole	4%	227	6%	195	5%	200
Erthromycin	31%	207	30%	182	15%	136
Chloramphenicol	14%	216	27%	123	10%	166
Ceftriaxone	14%	149	31%	162	10%	99

Notes: Percent is rate of stock-out. Count is the number of facilities that said they typically carry the drug. AS+AQ stands for Artesunate + Amodiaquine.

Table 4. Regression results

Dependent variable	Uganda		Kenya		Ghana	
	ALL	EML	ALL	EML	ALL	EML
Both routine and order	Base	Base	Base	Base	Base	Base
Routine only	0.73 (0.16)	0.80 (0.12)	1.24 (0.26)	1.13 (0.15)	0.92 (0.17)	1.26 (0.23)
Order only	0.65* (0.16)	0.65** (0.11)	0.92 (0.30)	0.91 (0.20)	2.18** (0.73)	1.62 (0.68)
Receive drugs from the MOH	0.75* (0.13)	0.77** (0.09)			0.73 (0.19)	1.01 (0.16)
Receive drugs from private	0.71 (0.17)	0.75** (0.10)			0.50*** (0.13)	0.34*** (0.12)
Record keeper-admin	0.57 (0.23)	0.49* (0.19)	0.78 (0.28)	1.10 (0.38)		
Record keeper-medical	0.85 (0.25)	0.97 (0.25)	0.54 (0.21)	0.76 (0.29)		
Record keeper-pharmacist	0.76 (0.25)	0.85 (0.22)	0.61 (0.22)	0.89 (0.34)		
Record keeper-accountant	0.98 (0.37)	0.83 (0.31)	0.75 (0.25)	1.05 (0.53)		
Presence of a vehicle	0.74* (0.13)	0.81* (0.10)	0.75 (0.14)	0.68*** (0.09)	0.98 (0.20)	0.80 (0.14)
Facility receives drug kits	1.20 (0.17)	1.02 (0.10)	1.04 (0.22)	0.86 (0.12)		
Presence of a lab	0.81 (0.18)	0.73** (0.10)	0.76 (0.27)	0.57*** (0.11)	0.84 (0.17)	0.72** (0.10)
Urban	Base	Base	Base	Base	Base	Base
Semi-urban	1.09 (0.19)	0.94 (0.12)	1.04 (0.21)	0.87 (0.12)	1.24 (0.32)	1.22 (0.21)
Rural	1.59** (0.31)	1.07 (0.17)	0.58* (0.17)	1.15 (0.20)	0.71 (0.15)	1.08 (0.22)
Distance to capitol	1.07 (0.12)	1.00 (0.08)	1.01 (0.07)	1.12** (0.05)	1.09* (0.05)	1.03 (0.04)
N	227	150	186	114	217	137

Notes: Coefficients are odds ratios. Dependent variable ALL implies regression was run with all drugs included in the regression model. Dependent variable EML

implies the regression was only run on public facilities and only on EML drugs. *, **, and *** denote significance at the 0.1, 0.05, and 0.01 level respectively.

Regressions also controlled for facility type and the month of survey but results are not shown.