HHS Public Access
Author manuscript
Trop Med Int Health. Author manuscript; available in PMC 2015 June 24.

Published in final edited form as:
Trop Med Int Health. 2014 July ; 19(7): 791–801. doi:10.1111/tmi.12314.

Stock-outs of essential health products in Mozambique-longitudinal analyses from 2011 to 2013

Bradley H. Wagenaar[1,2], **Sarah Gimbel**[2,3], **Roxanne Hoek**[2,4], **James Pfeiffer**[2,5], **Cathy Michel**[2], **João Luis Manuel**[4], **Fatima Cuembelo**[6], **Titos Quembo**[2,4], **Pires Afonso**[2,4], **Stephen Gloyd**[2,5], and **Kenneth Sherr**[2,5]

[1]Department of Epidemiology, University of Washington School of Public Health, Seattle, WA, USA

[2]Health Alliance International, Beira, Mozambique

[3]Department of Family Child Nursing, University of Washington, Seattle, WA, USA

[4]Beira Operations Research Center, Beira, Mozambique

[5]Department of Global Health, University of Washington School of Public Health and Community Medicine, Seattle, WA, USA

[6]Community Health Department, School of Medicine, Eduardo Mondlane University, Maputo, Mozambique

Abstract

objectives—To assess the relationship between health system factors and facility-level EHP stock-outs in Mozambique.

methods—Service provisions were assessed in 26 health facilities and 13 district warehouses in Sofala Province, Mozambique, from July to August in 2011–2013. Generalised estimating equations were used to model factors associated with facility-level availability of essential drugs, supplies and equipment.

results—Stock-out rates for drugs ranged from 1.3% for oral rehydration solution to 20.5% for Depo-Provera and condoms, with a mean stock-out rate of 9.1%; mean stock-out rates were 15.4% for supplies and 4.1% for equipment. Stock-outs at the district level accounted for 27.1% (29/107) of facility-level drug stock-outs and 44.0% (37/84) of supply stock-outs. Each 10-km increase in the distance from district distribution warehouses was associated with a 31% (CI: 22–42%), 28% (CI: 17–40%) or 27% (CI: 7–50%) increase in rates of drug, supply or equipment stock-outs, respectively. The number of heath facility staff was consistently negatively associated with the occurrence of stock-outs.

conclusions—Facility-level stock-outs of EHPs in Mozambique are common and appear to disproportionately affect those living far from district capitals and near facilities with few health staff. The majority of facility-level EHP stock-outs in Mozambique occur when stock exists at the

Corresponding Author: Bradley H. Wagenaar, Department of Epidemiology, School of Public Health and Community Medicine, University of Washington, Box 358734, 1959 NE Pacific Street, Seattle, WA 98195, USA. Tel.: + 404-530-9740; Fax: 001-206-685-4184; wagenaarb@gmail.com.

district distribution centre. Innovative methods are urgently needed to improve EHP supply chains, requesting and ordering of drugs, facility and district communication, and forecasting of future EHP needs in Mozambique. Increased investments in public-sector human resources for health could potentially decrease the occurrence of EHP stock-outs.

Keywords

implementation research; health services research; health resources; health planning; pharmaceutical services; delivery of health care

Introduction

In 2012, the United Nations Millennium Development Goal (MDG) Gap Task Force called attention to the lack of progress on improving access to and availability of essential health products (EHPs) such as drugs, supplies and equipment in developing countries, highlighting that only 51.8% of EHPs were available in a sample of public facilities from 17 low- and middle-income countries (LMICs) between 2007 and 2011 (United Nations 2012). In 2008, an analysis of data collected by the World Health Organization (WHO)/Health Action International's collaboration on the availability and price of drugs found that among eight countries in the WHO African region, a mean of 29.4% of 15 essential first-line medications were available in public-sector clinics (Cameron *et al*. 2009). Consistently across national and sub-national surveys, EHP availability has been found to be higher in private-sector clinics than in public-sector clinics (Mendis *et al*. 2007; Cameron *et al*. 2011).

Stock-outs of even a small number of EHPs can have far-ranging consequences for the provision of quality health services. Stock-outs are an important measure of health service readiness, and clinics without consistent and adequate availability of EHPs are inadequately prepared to provide quality health services (World Health Organization 2012). Frequent stock-outs of artemisinin combination therapy can systematically change provider prescription behaviour for malaria, even after constraints in drug supply are overcome (Zurovac *et al*. 2008; Hensen *et al*. 2011). Unplanned interruptions of anti-retroviral medicines (ARVs) for HIV treatment increase the risk of disease progression and death for the patient and can lead to the development of ARV resistance mutations – a significant public health problem in areas with limited second- and third-line treatment regimens (Kranzer & Ford 2011; Mann *et al*. 2013).

In addition to their impact on the quality of patient care, ruptures of EHP stocks may contribute to an increased workload for already stressed healthcare staff, as patients require additional visits or referrals to access recommended services. These additional visits and/or referrals may contribute to low morale and high turnover among staff at rural health centres, further affecting service quality and hindering the scalability of health programmes (McDougal *et al*. 2012; Blanas *et al*. 2013; Penfold *et al*. 2013). The lack of medicines at public clinics often results in low patient satisfaction (Newman *et al*. 1998; Peltzer 2009), leading patients to access medical care at private clinics and pharmacies where medicines are often more expensive (Mendis *et al*. 2007); together, this undermines patient confidence in formal health services and may result in increased utilisation of health services via traditional and alternative healers (McCombie 1996; Varga & Veale 1997; Sato 2012).

Multiple factors associated with stock-outs of EHPs at the facility level have been cited, including manufacturing shortages, errors in ordering or requesting products, difficulties in transport, sudden increases in demand, inadequate funding and staffing, and lack of incentives to maintain stocks. Qualitative data from Tanzania indicate that too few supervision visits may lead to ruptures in medicine stock, as replacement medicines are often supplied by supervisors when travelling to field sites (Penfold *et al*. 2013).

Since 1998, the WHO/Health Action International collaboration has generated substantial data on the availability and prices of medicines internationally, although data are often sporadic at the country level. Household surveys in southern Africa estimate that 20% of patient visits result in patients being unable to receive a prescription due to medicines not being available (World Health Organization 2009). In Malawi, it has been estimated that only 9% of public hospitals and clinics have current availability of all drugs and supplies in the essential healthcare package (Mazengera 2012). A 2003 survey in Mozambique found that the majority of public health facilities had experienced a stock-out of essential medicines in the six months prior to the survey (Republica de Mocambique Ministerio da Saude 2012a).

To date, there are few studies that have evaluated the relationship between within-country heterogeneity in stock-outs for essential medicines, supplies and equipment, and health system factors including workforce and distribution mechanisms. The objective of this study was to identify factors associated with facility-level availability of EHPs in Mozambique. Identifying these factors is important to target efforts to improve access and availability of EHPs in resource-limited health settings in sub-Saharan Africa.

Methods

We conducted annual cross-sectional service provision assessments (SPAs) in 26 health facilities and 13 district distribution warehouses in Sofala Province from July to August in 2011, 2012 and 2013. These annual SPAs are carried out as part of the evaluation framework for a comprehensive health-systems-strengthening intervention supported by the Doris Duke Foundation’s African Health Initiative (Sherr *et al*. 2013). Each SPA was carried out in all 13 districts of Sofala Province in central Mozambique and included data collection at the facility and district levels in order to facilitate a comprehensive view of the EHP supply and distribution system. A map of study sites is presented in Figure 1.

Study setting

In Mozambique, the Center for Drugs and Medical Supplies (CMAM) is responsible for centrally distributing medicines and reagents, while the Centro de Abastecimento is responsible for procurement and distribution of equipment and medical supplies. Both groups use regional warehouses in Maputo and Beira to distribute EHPs to approximately 1300 public health facilities nationally. These regional warehouses supply medicines to 10 provincial warehouses and central hospitals, which then distribute medicines to the district level using vehicles, often ambulances. Under protocol, EHPs are then distributed quarterly to individual health facilities using a push (kit) mechanism and monthly using a pull (requisition) system (Republica de Mocambique Ministerio da Saude 2012b). To guard against stock-outs of EHPs, standard operating procedures (SOPs) in Mozambique are that health facilities should have buffer stocks of 1 month, whereas district/provincial levels should have buffer stock of 3 months. In practice, the system to deliver EHPs to facilities from district-level warehouses to health facilities relies on *adhoc* transport methods, in which health workers from small facilities often pick up stocks of EHPs from the district distribution centre when travelling for banking, shopping or work meetings.

The push (kit) system accounts for the bulk of drugs in peripheral health facilities, with the number of kits allocated for each facility determined by the previous quarter's number of outpatient consults registered through the national health information system (HIS). The pull system, known locally as the 'via classica', requires monthly requisition from the health facility to district drug warehouses. In many cases, these requests are not filled completely by the district warehouse due to lack of adequate stocks. ARVs and malaria medicines are managed separately in close collaboration with the national pharmacy system.

Study sample

We used a two-stage sampling approach to provide a broadly representative sample of public health facilities across the 13 districts of Sofala Province. For the first stage, we selected the largest facility (as determined by the number of institutional births from the national HIS in 2009) located at the district capital for 11 of the 13 districts. The two exceptions were Chibabava (where we selected the largest facility in the district – a rural hospital) and Beira City (where we selected the largest facility in the capital excluding the central hospital, which is independently managed). For the second stage, we randomly selected one additional facility for each district from a list of all facilities reporting at least 250 institutional births in 2009. This number of institutional births was chosen as a contextually relevant way to exclude very small health facilities with insufficient staff or EHPs to accurately track changes resulting from our ongoing comprehensive health-systems-strengthening intervention. This resulted in a total of 26 facilities (two per district), capturing the largest facilities in each district and a randomly selected group of smaller health centres. Together, this sample represents approximately 20% of all public facilities in the province (Figure 1). Only public health facilities were considered for inclusion in the study; mission or other private facilities and pharmacies were excluded from the sampling frame.

Data collection

The data collection tool was a paper questionnaire adapted from the SPA data collection forms used for the demographic and health surveys (Measure DHS 2013). Our surveys included a list of tracer medicines, supplies and equipment standardised across the five African Health Initiative countries (Ghana, Mozambique, Rwanda, Tanzania and Zambia) to allow for a common intervention evaluation framework (Bryce *et al*. 2013). In order to allow for standardisation and common metrics across these diverse countries, all EHP categories included in the ongoing surveys were available on the essential drug list for all five countries, although the specific medicines and compositions varied to align with the drug list in each country. Additional questions were included to provide information on management practices, human resource availability and other factors thought to reflect health system organisation and functioning.

Two data collectors and one supervisor working out of the Beira Operations Research Center (CIOB) collected data using paper questionnaires in the field. Data were reviewed and entered into Microsoft Access at the end of each day, and any discrepancies or uncertainties were clarified the next day on site. Paper questionnaires were then transported by field supervisors to the central site at the CIOB. All data were re-entered at the central site and compared for consistency, and original paper questionnaires were consulted if needed. Initial data analyses of summary and facility-level frequencies were conducted at the CIOB and disseminated to health authorities in Sofala Province. Advanced statistical analyses were conducted at the University of Washington.

The SPA collected the following information at each facility, as well as at the district-level management office and medicines warehouses: current availability of essential tracer medicines, supplies/reagents and functioning equipment (see Table 1); number of technical staff (doctors, nurses); number of pharmacy staff, laboratory staff and administrative staff; frequency of management meetings and confirmation of meeting minutes; and reported number of district and/or provincial supervisory visits as well as evidence of these visits from visit books. The availability of tracer medicines and supplies was assessed as the presence of non-expired medicines and supplies the day of the survey (both reported by facility staff and verified at the facility pharmacy and/or in service delivery rooms). The availability of functioning equipment was assessed by direct observation. Additional variables considered in the analyses were the number of outpatients seen at each health facility (from the national HIS *[Módulo Básico])*, the distance in kilometres from the district medicines warehouse to each health facility (provided by provincial health authorities) and rural/ urban status of the facility. The number of outpatient consultations for 2013 was estimated by multiplying the number seen in the first 6 months by two.

Analyses

Our primary outcomes were facility-level counts of the number of essential tracer medicines, supplies/reagents and functioning equipment not available on the day the SPA occurred for each of the 3 years – this we called ‘stock-outs for any reason’ or ‘absolute number of stock-outs’. In addition, we computed the number of facility stock-outs of drugs and supplies where there existed stock at the district drug/supply distribution point – this we called ‘stock-outs with availability at district’. As equipment is not routinely kept in stock at district distribution points, we tabulated and analysed only the absolute number of facility-level equipment stock-outs.

Generalised estimating equations (GEE) using the Poisson family, a log link function and facility as the cluster variable were used to evaluate the effect of each potential health facility or district-level covariate on each of our count outcomes separately. All analyses were conducted using an exchangeable working correlation matrix and robust standard errors. Residuals versus fitted-value plots and delta-betas were investigated to ensure proper fit of the mean model and to identify influential clusters. Multi-variable analyses were not feasible due to the number of clusters and observations. Analyses were conducted using SAS 9.3 and Stata 13; associations were evaluated for statistical significance at $\alpha = 0.05$ using two-tailed tests.

Study procedures received ethical approval from the National Ethics Review Committee of the Ministry of Health (MOH) of Mozambique and were determined to pose no risk to human subjects and therefore did not require review by the Human Subjects Division of the University of Washington.

Results

The majority of clinics surveyed were in rural areas (88.5%) and received an average of 40,260 outpatient visits a year, were located an average of 19.5 km from the district depository (range 0–64 km) and had an average of 21 technical staff (range 2–62) (Table 2). A total of 96% of clinics (n = 25) were missing at least one tracer drug or supply for any reason at any of the three data collection visits, while 57.7% (n = 15) were missing or had non-functional equipment. Every drug and supply was stocked out for at least one visit across the annual visits; stock-out rates ranged from 1.3% for oral rehydration solution (ORS) to 20.5% for Depo-Provera and condoms, with an overall mean drug stock-out rate of 9.1% (Table 1). Rates of unavailability for supplies ranged from 3.8% for malaria smears to 35.9% for syphilis tests with a mean of 15.4%, while functional equipment unavailability ranged from 0% for bag valve masks and scales for children and adults to 17.9% for autoclaves, with a mean of 4.0%. The average number of stock missing was 1.9 for drugs, 1.6 for supplies and 1.4 for equipment. A total of 79% of 107 total drug stock-outs and 56% of 84 total supply stock-outs occurred while stock was available at the district level.

Stock-outs at district depositories

Eighty-five percent of the 13 district depositories had a stock-out of an essential drug, and all had a stock-out of an essential supply during at least one of three data collection visits. Depo-Provera (15.4%), ferrous sulphate (15.4%) and oral rehydration solution (12.8%) were the most frequently stocked-out drugs; syphilis tests (35.9%) and Determine HIV tests (20.5%) were the most stocked-out supplies (Table 1).

Facility-level factors associated with drug stock-outs

Of all facility-level factors, distance from the district warehouse was most strongly related to medicine stock-outs at the facility level: for each 10-km increase in distance, the rate of stock-outs increased by 19% (95% confidence interval [CI]: 12–26%) when considering any stock-out and 31% (CI: 22–42%) when considering stock-outs with district availability. The mean distance for the 56 clinic visits with a stock-out for any reason was 25.5, contrasting with a mean distance of 4.1 for the 22 clinic visits without a stock-out (Table 3). The number of technical staff was inversely related to the rate of stock-outs with district availability: each additional staff member was associated with 4% (CI: 2–6%) lower stock-out rates. Even more significant was the ratio of technical staff to 10 000 outpatient visits, with each additional technical staff per 10 000 visits being associated with 25% (CI: 16–

33%) lower stock-out rates. Last, each additional district supervisory visit was associated with 7% (CI: 3–11%) higher stock-out rates, while provincial-level visits were associated with 4% (CI: 1–7%) lower stock-out rates.

Facility-level factors associated with supply and reagent stock-outs

Similar to drug stock-outs, each 10-km increase in distance from the distribution centre was associated with a 16% increase (CI: 8–24%) in stock-out rates when considering stock-outs for any reason and a 28% increase (CI: 17–40%) when considering supply stock-outs with district availability (Table 4). All health staff variables were significantly and negatively associated with stock-out rates for any reason, with technical, pharmacy and administrative staff being most significant. Laboratory staff was insignificant when looking at stock-outs with availability at the district supply depository. Last, district supervisory visits were associated with higher stock-out rates.

Facility-level factors associated with equipment stock-outs

As with supply and drug stock-outs, increasing distance from the distribution centre was associated with increased rates of equipment stock-outs (RR: 1.27, CI: 1.7–1.5). All health staff variables were significantly and negatively associated with stock-out rates, with laboratory and administrative staff being most significant (Table 5). District supervisory visits were associated with higher stock-out rates.

Discussion

In our sample of public health facilities in Sofala, Mozambique, the lack of availability of essential drugs and materials was common: only one clinic of 26 surveyed had availability of all 15 essential drugs in 2011, 2012 and 2013. Taken together, these clinics conducted over 3 million outpatient consultations from 2011 to 2013, representing the first line of healthcare provision for the vast majority of the population in Sofala Province, Mozambique. If we assume that these stock-out patterns reflect shortages throughout the calendar year, we can estimate that 14% of consultations did not have availability of DPT vaccines and between 4 and 18% of malaria consultations did not have rapid diagnostic tests, malaria smears or first-line antimalarials available. Furthermore, 15–20% of all consultations did not have availability of HIV tests, and over 20% did not have current availability of condoms. Even the most basic materials such as examination gloves were not available at over 11% of clinic visits.

In 2008, the Mozambique National Cause of Mortality Survey (INCAM) showed that, nationwide, 29% and 27% of all deaths were due to malaria and HIV/AIDS, respectively (Mozambique National Institute of Statistics, U.S. Census Bureau, MEASURE evaluation, and U.S. Centers for Disease Control and Prevention 2012). While the proportion of deaths attributable to the lack of essential materials at the facility level is not possible to quantify, given these data, it is likely an important factor. Frequent essential product shortages are especially concerning given that the majority of clinics surveyed were in rural areas where there are few or no private pharmacies to distribute medicines if public facilities experience stock-outs. Stock-outs of EHPs in formal systems may undermine local confidence and cause individuals to turn to informal providers with potential negative consequences (such as non-recommended treatment). For example, in one study of informal medicine shops in Nigeria, 92% sold non-recommended antimalarial medication, and only 18.4% of pharmaceuticals for other conditions followed treatment guidelines (Bloom *et al*. 2011).

The EHP distribution system in Mozambique is complex and involves a centralised ‘push’ kit system and a monthly requisition ‘pull’ system using paper forms submitted from health facilities to district warehouses, with the kit system providing the bulk of EHPs to peripheral health facilities. Currently, kits are ordered 18 months in advance by central Ministry authorities using forecasts of need and are then distributed quarterly to health facilities based on the number of outpatient consults reported through the national HIS (1 kit per 1000 outpatient consults). SOPs are for health facilities to consistently have a minimum of 1 month of buffer stock on hand. Vertical programmes (such as for HIV/AIDS, malaria and tuberculosis) often have procurement and distribution mechanisms that run in parallel to the general commodity and equipment system.

In our study, we found that the majority of facility-level drug and supply stock ruptures were not the result of central or widespread stock-outs. By contrast, they resulted because of the failure to effectively or efficiently distribute stocks existing at district warehouses to health facilities to meet real demand prior to the occurrence of a stock rupture. This is borne out by our data highlighting that only 27% of facility drug and 44% of facility supply stock-outs occurred when stock was also unavailable at district warehouses.

There was substantial clinic-level heterogeneity in the number of stock-outs over time. The variable most strongly and consistently related to stock-out rates was distance from the facility to the district warehouse. Compared to those clinics/hospitals with built-in district-level EHP warehouses, clinics that are 40 km from their distribution point had nearly three times the rate of drug stock-outs, 2.5 times the rate of supply stock-outs and over 2.5 times the rate of non-functional or missing equipment. The fact that the majority of these stock-outs occurred while EHPs existed at the district warehouse indicates that SOPs around the monthly paper requisition system ‘via classica’ and the standardised allocation of kits using the simple formula of one per 1000 outpatient consults are currently insufficient to guard against ruptures of EHP stock. Greatly increasing the number or relocating existing equipment storehouses is not immediately feasible; however, implementation research to test strategies to modify the allocation of kits based on local burdens of disease or past patterns of pharmaceutical use and around improving communication between facilities and district depositories could decrease the *effective* distance between distribution centres and health facilities.

These EHP stock-outs at the facility and district level are also related to commodity forecasting. On the national level, these EHP kits are ordered 18 months in advance to allow for production, assembly, transport, and delivery to districts – a process necessitating accurate projections of future need far in advance. High-quality data from routine health information systems are a prerequisite for accurate central-level macro-planning and facility-level micro-planning to predict trends in future pharmaceutical demands (AbouZahr & Boerma 2005; World Health Organization 2007; Mutale *et al*. 2013). Yet, these data systems are underfunded at the central Ministry level and underutilised at the health facility level, and skills for commodity forecasting are low in peripheral arms of the public healthcare delivery system.

In contrast to distance from the distribution centre, the number of health-facility staff was consistently and strongly related to lower rates of stock-outs. The larger issue of human resources for health and ‘brain drain’ in Mozambique (Sherr *et al*. 2012), and in sub-Saharan Africa as a whole, is one that deserves additional attention and requires new approaches. In Mozambique, resources to invest in public-sector human resources for health continue to be low in the aftermath of structural adjustment programmes and the persistence of IMF Poverty Reduction Strategy Papers (Pfeiffer 2003). Paired with more investment in public-sector human resources, further research should be conducted on innovative incentive structures, as well as training, management and accountability modifications for health-facility, district and provincial leadership teams. Also, approaches emphasising task shifting from technical/professional health-facility staff to lay or community health workers (CHWs) could be used to rapidly decrease the administrative and logistical burden on technical workers (Sherr *et al*. 2010). In the Mozambican context, this could take place by elevating *Serventes* (custodians), *Agentes Polivalente Elementar* (APEs) or other CHWs to handle forecasting, requesting, procurement and management of facility EHP stocks.

Our findings have a number of important limitations to consider when interpreting results. First, data collection was conducted at one point in the year (July-August) and therefore may not be representative of EHP availability year round. Second, we did not have a random sample of clinics, and our small sample size limited analyses to bivariate associations. Third, our list of essential drugs, supplies and equipment was purposefully limited to allow standardisation across African Health Initiative countries and therefore may have been less representative of other essential products in Mozambique. Fourth, we did not disaggregate stock-outs to allow analyses of which distribution system (‘kit’ versus ‘via classica’) may be more or less effective. This was due to complexity in the EHP distribution process in Mozambique whereby ‘kit’ drugs and supplies are supplemented by monthly ‘via classica’ requisition forms if lacking between quarterly kit distributions. Future implementation research and quality improvement approaches should be undertaken to streamline the supply chain and determine optimal approaches for EHP delivery in Mozambique. Last, our data were entirely from the province of Sofala and may not be generalisable to other disparate areas of Mozambique or other countries. Notwithstanding these limitations, we believe that these data accurately illustrate the magnitude of the problem of stock-outs of EHPs in rural and urban Sofala and contribute to the sparse literature on the topic of factors associated with health-facility heterogeneity in EHP stock-outs.

Conclusions

Currently, a large proportion of individuals in Sofala, Mozambique, arrive at clinics to find essential medicines and supplies unavailable. These shortages appear to disproportionately affect those living in areas far from district capitals and with few trained health-facility staff. The majority of facility-level stock-outs in Sofala, Mozambique, currently occur when appropriate stocks exist at district distribution warehouses. We urge a renewed research focus on the following: (i) improving supply-chain distribution/allocation to peripheral facilities, (ii) simple methods for central and facility-level product forecasting and EHP requesting and (iii) rapid task-shifting interventions utilising lay health workers in Mozambique and similar countries in sub-Saharan Africa. Without availability of WHO-recommended commodities, clinicians are limited to prescribing imperfect treatments or referring patients to the private or informal sector, potentially leading to poor treatment quality, low patient satisfaction and drug-resistant disease strains. Simple, effective interventions to increase EHP availability at the facility and district levels are urgently needed in Mozambique, and sub-Saharan Africa more broadly.

Acknowledgements

This work was supported by the African Health Initiative of the Doris Duke Charitable Foundation. K. Sherr was supported by the Fogarty International Center. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

References

AbouZahr C, Boerma T. Health information systems: the foundations of public health. Bulletin of the World Health Organization. 2005; 83:578–583. [PubMed: 16184276]

Blanas DA, Ndiaye Y, Nichols K, Jensen A, Siddiqui A, Hennig N. Barriers to community case management of malaria in Saraya, Senegal: training and supply-chains. Malaria Journal. 2013; 12:95. [PubMed: 23497188]

Bloom G, Standing H, Lucas H, Bhuiya A, Oladepo O, Peters D. Making health markets work better for poor people: the case of informal providers. Health Policy and Planning. 2011; 26:i45–i52. [PubMed: 21729917]

Bryce J, Requejo JH, Moulton LH, Ram M, Black RE. Population Health Implementation and Training - Africa Health Initiative Data Collaborative (2013) A common evaluation framework for the African Health Initiative. BMC Health Services Research. 13(Suppl 2):S10. [PubMed: 23819778]

Cameron A, Ewen M, Ross-Degnan D, Ball D, Laing R. Medicine prices, availability, and affordability in 36 developing and middle-income countries: a secondary analysis. The Lancet. 2009; 373:240–249.

Cameron, A.; Ewen, M.; Auton, M.; Abegunde, D. The World Medicines Situation 2011: Medicines Prices, Availability, and Affordability. Geneva: World Health Organization; 2011.

Hensen B, Paintain LS, Schretta R, Bruce J, Jones C, Webster J. Taking stock: provider prescribing practices in the presence and absence of ACT stock. Malaria Journal. 2011; 10:218. [PubMed: 21812948]

Kranzer K, Ford N. Unstructured treatment interruption of antiretroviral therapy in clinical practice: a systematic review. Tropical Medicine and International Health. 2011; 16:1297–1313. [PubMed: 21718394]

Mann M, Lurie MN, Kimaiyo S, Kantor R. Effects of political conflict-induced treatment interruptions on HIV drug resistance. AIDS Reviews. 2013; 15:15–24. [PubMed: 23449225]

Mazengera, S. Missing medicines in Malawi: campaigning against 'stock-outs' of essential drugs. van der Gaag, N.; Burbridge, C., editors. Oxford: Local Governance and Community Action Programme Insights Oxfam GB; 2012. http://policy-practice.oxfam.org. uk/publications/missing-medicines-in-malawi-campaigning-against-stock-outs-of-essential-drugs-226732 [(Accessed 27 March 2014)]

McCombie SC. Treatment seeking for malaria: a review of recent research. Social Science & Medicine. 1996; 43:933–945. [PubMed: 8888463]

McDougal L, Moteetee MM, Mohai F, et al. Lesotho's minimum PMTCT package: lessons learned for combating vertical HIV transmission using co-packaged medicines. Journal of the International AIDS Society. 2012; 15:17326. [PubMed: 23273267]

Measure DHS. Service Provision Assessments (SPA): SPA overview. 2013. http://www.measuredhs.com/What-We-Do/Survey-Types/SPA.cfm

Mendis S, Fukino K, Cameron A, et al. The availability and affordability of selected essential medicines for chronic diseases in six low- and middle-income countries. Bulletin of the World Health Organization. 2007; 85:279–288. [PubMed: 17546309]

Mozambique National Institute of Statistics, U.S. Census Bureau, MEASURE evaluation, and U.S. Centers for Disease Control and Prevention. Mortality in Mozambique: Results from a 2007–2008 Post-Census Mortality Survey. Chapel Hill, USA: MEASURE Evaluation; 2012.

Mutale W, Chintu N, Amoroso C, et al. Improving health information systems for decision making across five sub-Saharan African countries: implementation strategies from the African Health Initiative. BMC Health Services Research. 2013; 13(Suppl 2):59. [PubMed: 23402304]

Newman RD, Gloyd S, Nyangezi JM, Machobo F, Muiser J. Satisfaction with outpatient health care services in Manica Province, Mozambique. Health Policy and Planning. 1998; 13:174–180. [PubMed: 10180406]

Peltzer K. Patient experiences and health system responsiveness in South Africa. BMC Health Services Research. 2009; 9:117. [PubMed: 19602290]

Penfold S, Shamba D, Hanson C, et al. Staff experiences of providing maternity services in rural southern Tanzania: a focus on equipment, drug, and supply issues. BMC Health Services Research. 2013; 13:61. [PubMed: 23410228]

Pfeiffer J. International NGOs and primary health care in Mozambique: the need for a new model of collaboration. Social Science & Medicine. 2003; 56:725–738. [PubMed: 12560007]

Republica de Mocambique Ministerio da Saude. Piano estrategico do sector saude 2007–2012. 2012a. Accessed May 24, 2013 at: http://www.afro.who.int/index.php?option=com_doc-man&task=doc_download&gid=6811

Republica de Mocambique Ministerio da Saude. 2012b Relatorio da revisao do sector de saude, Directora National de Plani-ficacao e Cooperacao.

Sato A. Revealing the popularity of traditional medicine in light of multiple recourses and outcome measurements from a user's perspective in Ghana. Health Policy and Planning. 2012; 27:625–637. [PubMed: 22345671]

Sherr K, Micek M, Gimbel S, et al. Quality of HIV care provided by non-physician clinicians and physicians in Mozambique: a retrospective cohort study. AIDS. 2010; 24(Suppl 1):S59–S66. [PubMed: 20023441]

Sherr K, Mussa A, Chilundo B, et al. Brain drain and health workforce distortions in Mozambique. PLoS ONE. 2012; 7:e35840. [PubMed: 22558237]

Sherr K, Cuembelo F, Michel C, et al. Strengthening integrated primary health care in Sofala, Mozambique. BMC Health Services Research. 2013; 13(Suppl 2):S4. [PubMed: 23819552]

United Nations. The Global Partnership for Development: Making Rhetoric A Reality. New York: MDG gap task force; 2012.

Varga CA, Veale DJH. Isihlambezo: Utilization patterns and potential health effects of pregnancy-related traditional herbal medicine. Social Science & Medicine. 1997; 44:911–924. [PubMed: 9089914]

World Health Organization. Framework and Standards for Country Health Information Systems. Geneva: Health Metrics Network; 2007.

World Health Organization. Baseline assessment of the pharmaceutical situation in Southern African development ommunity countries. 2009. Accessed November 7, 2013 at: http://www.who.int/medicines/areas/coordination/sadc_final.pdf

World Health Organization. Service availability and readiness assessment (SARA): A methodology for measuring health systems strengthening. Geneva: 2012. Acessed November 7, 2013 from: http://www.who.int/healthinfo/systems/SARA_Overview-Presentation.pdf

Zurovac D, Tibenderana JK, Nankabirwa J, et al. Malaria case-management under artemether-lumefantrine treatment policy in Uganda. Malaria Journal. 2008; 7:181. [PubMed: 18803833]

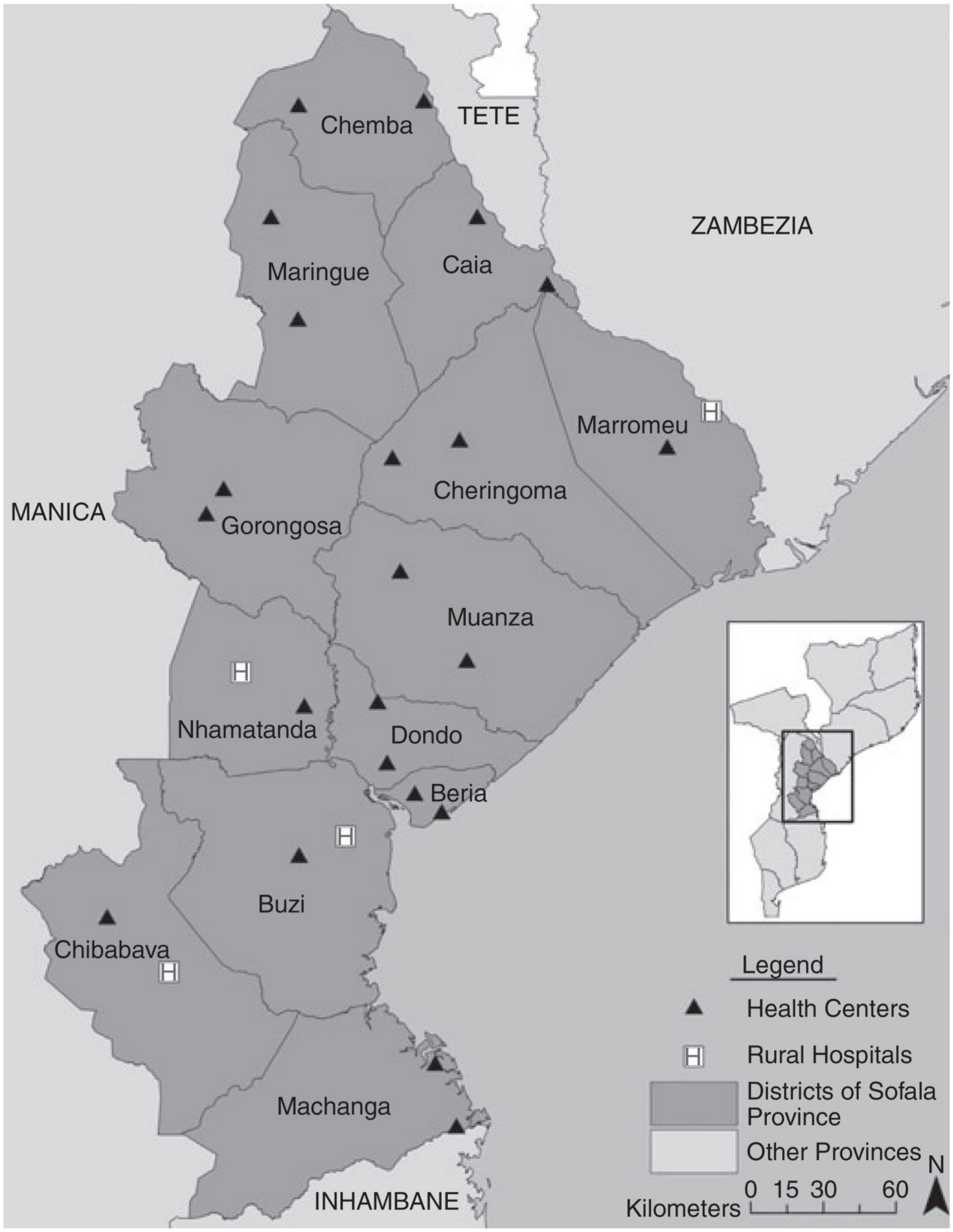

Figure 1.

Map of 22 health centres and 4 rural hospitals included in service provision assessments conducted on July–August 2011, 2012 and 2013 in Sofala Province, Mozambique.

Table 1

List and number of clinic/district depository visits stocked out and the number of facility-level stock-outs where stock was available at the district of tracer drugs, supplies/reagents and equipment assessed in service provision assessments (SPA) in 2011, 2012 and 2013 in Sofala, Mozambique

Drugs	Absolute no. of clinic visits stocked out (*N* = 78) *n* (%)	No. of district depository visits stocked out (*N* = 39) *n* (%)	No. of clinic visits stocked out with availability at district (*N* = 78) *n* (%)	Supplies and reagents	Absolute no. of clinic visits stocked out (*N* = 78) *n* (%)	No. of district depository visits stocked out (*N* = 39) *n* (%)	No. of clinic visits stocked out with availability at district (*N* = 78) *n* (%)	Equipment	Absolute no. of clinic visits stocked out (*N* = 78) *n* (%)
Erythromycin	6 (7.7)	4 (10.3)	5 (6.4)	Examination gloves	9 (11.5)	3 (7.7)	5 (6.4)	Sphygmo-manometer	1 (1.3)
Co-trimoxazole	3 (3.8)	2(5.1)	3 (3.8)	Hemocue	10 (12.8)	0(0)	10 (12.8)	Stethoscope	1 (1.3)
Coartem adult	5 (6.4)	2(5.1)	4(5.1)	Syphilis test	28 (35.9)	14 (35.9)	10 (12.8)	Autoclave	14 (17.9)
Coartem child	8 (10.3)	2(5.1)	5 (6.4)	Malaria smear	3 (3.8)	3 (7.7)	3 (3.8)	Bag valve mask	0 (0)
Co-amilozide	7 (9.0)	5 (12.8)	4(5.1)	Malaria rapid test	6 (7.7)	2(5.1)	5 (6.4)	Scale for children	0 (0)
Injectable quinine	14 (17.9)	3 (7.7)	12 (15.4)	Determine HIV test	16 (20.5)	8 (20.5)	4(5.1)	Scale for adults	0 (0)
Ferrous sulphate and folic acid	4(5.1)	6 (15.4)	1 (1.3)	Unigold HIV test	12 (15.4)	1 (2.6)	10 (12.8)	Watch/timer	8 (10.3)
Oxytocin	2 (2.6)	1 (2.6)	2 (2.6)					MUAC tape	1 (1.3)
Depo-Provera	16 (20.5)	6 (15.4)	6 (7.7)					Refrigerator	4 (5.1)
Condoms	16 (20.5)	3 (7.7)	14 (17.9)						
Oral rehydration solution	1 (1.3)	5 (12.8)	1 (1.3)						
Rifampicin, isoniazid, pyrazinamide	3 (3.8)	2(5.1)	3 (3.8)						
Triomune	3 (3.8)	0(0)	3 (3.8)						
DPT vaccine	11 (14.1)	3 (7.7)	7 (9.0)						
VAT vaccine	8 (10.3)	0(0)	8 (10.3)						

Author Manuscript

Author Manuscript

Author Manuscript

Table 2

Demographic characteristics of 26 clinics surveyed in service provision assessments; data collected in 2011, 2012 and 2013 in Sofala, Mozambique

Characteristic	**Combined (78 clinic visits) Mean (SE) unless noted**	**2011 (26 clinic visits) Mean (SE) unless noted**	**2012 (26 clinic visits) Mean (SE) unless noted**	**2013 (26 clinic visits) Mean (SE) unless noted**
Had at least one stock-out of essential medicines for any reason, *n* (%)	56 (71.8)	20 (76.9)	19 (73.1)	17 (65.4)
Average number of stock-outs among clinics experiencing	1.9 (1.2)	1.7 (1.0)	1.9 (1.1)	2.2 (1.3)
Had at least one stock-out of essential supplies for any reason, *n* (%)	S3 (67.9)	20 (74.1)	14 (53.8)	19 (73.1)
Average number of stock-outs among clinics experiencing	1.6 (0.75)	1.8 (0.72)	1.8 (0.97)	1.3 (0.45)
Had at least one stock-out of essential equipment for any reason, *n* (%)	21 (26.9)	4 (15.4)	4 (15.4)	13 (50.0)
Average number of stock-outs among clinics experiencing	1.4 (0.60)	1.0 (0)	1.5 (1.0)	1.5 (0.52)
Distance to distribution point in kilometres	19.5 (2.5)	n/a	n/a	n/a
Number of technical staff	21.0 (2.1)	19.5 (3.4)	19.1 (3.3)	24.4 (4.2)
Number of pharmacy staff	1.9 (0.20)	1.8 (0.35)	1.8 (0.31)	2.2 (0.40)
Number of laboratory staff	1.8 (0.26)	1.7 (0.43)	1.8 (0.44)	2.0 (0.49)
Number of admin staff	1.2 (0.25)	1.1 (0.43)	1.2 (0.39)	1.3 (0.49)
Number of minutes confirmed	1.4 (0.28)	0.96 (0.45)	1.5 (0.47)	1.7 (0.56)
Number of district supervisory visits	3.1 (0.36)	2.3 (0.51)	4.0 (0.74)	2.9 (0.55)
Number of provincial supervisory visits	4.6 (0.69)	3.8 (1.7)	3.8 (0.42)	6.2 (1.1)
Number of outpatients seen	40 260 (3780)	34 471 (5612)	40 082 (6648)	46 227 (7317)
Ratio of technical staff to 10,000 visits	4.9 (0.34)	5.5 (0.73)	4.4 (0.47)	4.9 (0.56)
Proportion clinics rural, *n* (%)	69 (88.5)	n/a	n/a	n/a
Frequency of meetings, *n* (%)				
Weekly (4)	7 (9.0)	2 (7.7)	3 (11.5)	2 (7.7)
Every 2 weeks (3)	16 (20.5)	5 (19.2)	8 (30.8)	3 (11.5)
Monthly (2)	43 (55.1)	12 (46.2)	15 (57.7)	16 (61.5)
Trimesterly (1)	7 (9.0)	4 (15.4)	0(0)	3 (11.5)
It depends (0)	5 (6.4)	3 (11.5)	0(0)	2 (7.7)

n/a, not applicable because values do not change over time.

Table 3

Factors associated with any drug stock-out and stock-outs where drug was present at district depository at 26 clinics visited in 2011, 2012 and 2013 in Sofala, Mozambique

Facility-level characteristics	Clinic visits with stock-out for any reason (*N* = 56)	Clinic visits without stock-out for any reason (*N* = 22)	RR (95% CI) for any stock-out	RR (95% CI) when only considering stock-outs with availability at district drug depository
Distance from distribution point in kilometres (10 km change)	25.5	4.1	1.19† (1.12–1.26)	1.31† (1.22–1.42)
Rural clinic (% rural)	83.9	100	0.74 (0.53–1.04)	1.00 (0.62–1.61)
Number of technical staff	17.9	28.9	0.98* (0.97–0.99)	0.96† (0.94–0.98)
Number of pharmacy staff	1.7	2.5	0.85 (0.72–1.00)	0.68* (0.53–0.87)
Number of laboratory staff	1.6	2.4	0.89 (0.70–1.14)	0.76 (0.50–1.18)
Number of admin staff	1.0	1.6	0.95 (0.87–1.03)	0.78* (0.61–0.99)
Number of minutes confirmed	1.4	1.2	0.96 (0.89–1.03)	0.93 (0.84–1.04)
Number of district supervisory visits	3.4	2.1	1.06* (1.02–1.11)	1.07† (1.03–1.11)
Number of provincial supervisory visits	3.6	7.0	0.95† (0.92–0.98)	0.96* (0.93–0.99)
Outpatient visits (1000 visit change)	38 368	45 076	1.00 (0.99–1.01)	0.99 (0.97–1.00)
Ratio of technical staff to 10,000 visits	4.1	6.9	0.83† (0.76–0.90)	0.75† (0.67–0.84)
Frequency of meetings (moving up one step, ordinal)	2.1	2.4	0.90 (0.73–1.10)	0.90 (0.69–1.16)

* $P < 0.05$.

† $P < 0.001$.

Table 4

Factors associated with any supply stock-out and stock-outs where supply was present at the district depository at 26 clinics visited in 2011, 2012 and 2013 in Sofala, Mozambique

Facility-level characteristics	Clinic visits with stock-out :for any reason (*N*= 53)	Clinic visits without stock-out for any reason (*N* =25)	RR (95% CI) for any stock-out	RR (95% CI) when only considering stock-outs with availability at district supply depository
Distance from distribution point in kilometres (10 km change)	24.2	9.6	1.16† (1.08–1.24)	1.28† (1.17–1.40)
Rural clinic (% rural)	92.4	80.0	1.43 (0.52–4.0)	0.89 (0.33–2.43)
Number of technical staff	18.2	27.0	0.98† (0.97–0.99)	0.97* (0.95–0.99)
Number of pharmacy staff	1.6	2.8	0.80† (0.70–0.91)	0.70* (0.52–0.94)
Number of laboratory staff	1.5	2.5	0.83* (0.72–0.96)	0.81 (0.58–1.12)
Number of admin staff	0.74	2.2	0.80† (0.73–0.89)	0.78* (0.63–0.96)
Number of minutes confirmed	1.5	2.2	0.97 (0.91–1.04)	0.94 (0.84–1.06)
Number of district supervisory visits	3.4	2.4	1.06* (1.0–1.12)	1.11* (1.04–1.18)
Number of provincial supervisory visits	3.9	6.0	0.96 (0.91–1.02)	0.96 (0.90–1.03)
Outpatient visits (1000 visit change)	36 069	49 145	0.99* (0.98–0.99)	0.99 (0.97–1.01)
Ratio of technical staff to 10,000 visits	4.6	5.6	0.93 (0.87–1.00)	0.86* (0.76–0.97)
Frequency of meetings (moving up one step, ordinal)	2.1	2.3	0.93 (0.90–1.08)	1.00 (0.80–1.26)

*$P < 0.05$.

†$P < 0.001$.

Table 5

Factors associated with equipment stock-outs at 26 clinics visited in 2011, 2012 and 2013 in Sofala, Mozambique

Facility-level characteristics	Clinic visits with a stock-out (*N* = 21)	Clinic visits without a stock-out (*N* = 57)	RR (95% CI) for any stock-out*	*P*-value
Distance from distribution point in kilometres (10 km change)	29.2	15.9	1.27 (1.07–1.5)	0.006
Rural clinic (% rural)	90.5	87.7	1.8 (0.33–9.4)	0.51
Number of technical staff	12.1	24.2	0.96 (0.93–0.99)	0.006
Number of pharmacy staff	1.2	2.2	0.71 (0.53–0.97)	0.03
Number of laboratory staff	0.67	2.3	0.59 (0.42–0.82)	0.002
Number of admin staff	0.1	1.6	0.26 (0.12–0.60)	0.002
Number of minutes confirmed	1.3	1.4	0.98 (0.86–1.11)	0.75
Number of district supervisory visits	3.9	2.8	1.10 (1.00–1.21)	0.049
Number of provincial supervisory visits	4.3	4.7	1.00 (0.97–1.03)	0.97
Outpatient visits (1000 visit change)	27 312	45 030	0.98 (0.95–1.00)	0.09
Ratio of technical staff to 10,000 visits	4.1	5.2	0.89 (0.75–1.06)	0.20
Frequency of meetings (moving up one step, ordinal)	2.0	2.2	0.76 (0.52–1.11)	0.16

*Did not analyse ruptures where stock was available at the district level for equipment because it is not kept in stock at district distribution points but instead ordered on an as-needed basis or repaired if non-functional.