The effects of Jazia prime vendor system in complementing the existing pharmaceutical supply chain across public healthcare facilities in Tanzania

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Summary

Background: The availability of quality medicines in the provision of healthcare services is an integral part of universal health coverage (UHC). In low and middle-income countries (LMIC) the accessibility to essential medicines is often limited especially in peripheral healthcare facilities. The reasons for this situation include: - limited resources, weak transparency and poor accountability mechanisms in the pharmaceutical supply chain. These challenges have received substantial attention by health system researchers and health system strengthening initiatives. The focus has often been on interventions to establish public-private partnerships (PPP). The United Republic of Tanzania in 2014 started implementing a unique PPP, the Jazia prime vendor system (Jazia PVS), as a contracted private wholesaler supplier to complement the existing medicines supply chains in public facilities. The aim of this doctoral thesis was to analyse the Jazia prime vendor system.

Methods: A mixed-method research design was used to analyse the effect of the prime vendor system, in improving access to healthcare commodities in public healthcare facilities in Tanzania. The research combined household and health facility quantitative surveys with the qualitative research methods. Specifically, the thesis first assessed the effects of medicines availability and stock-outs on household's utilisation of health care services. Second, it examined the role of accountability in the performance of the Jazia PVS. Third, it analysed how acceptability factors of the Jazia PVS affected shortages of essential medicines. Lastly, it estimated the costs and costs drivers of setting up a prime vendor system in the pilot regions and the predicted costs of national scale-up.

A cross-sectional study that combined information from 1,237 households along a survey covering 89 public healthcare facilities was used for assessing the effects of medicines availability and stock-outs on household's utilisation of health care services in Dodoma region. The household survey captured information on healthcare access and utilization, ownership of different assets, insurance and health promotion activities. On the other hand, the facility survey included observation of actual healthcare commodities available, record review over a three-month period before survey date, and interviews with key staff. Descriptive analysis and multivariate logistic regressions models were estimated to assess the effects of medicine availability and stock-outs on utilization patterns and to identify additional household-level factors associated with health service utilization. Framework analysis was adopted to summarise the results of accountability and acceptability experiences of Jazia PVS

implementers using a deductive and inductive approaches. Data were drawn from, 14 focus group discussions (FGDs), 7 group discussion (GD) and 30 in-depth interviews (IDIs) with a range of persons involved in Jazia PVS. Lastly, a micro-costing approach was used to estimate costs and costs drivers for setting up a prime vendor system in the regions and model the national scale-up costs of the Jazia PVS in other regions.

Results: The results showed that household's healthcare utilization was positively and significantly associated with continuous availability of essential medicines (odds ratio (OR): 3.49; 95% CI: 1.02-12.04; p~0.047). Healthcare utilization was positively associated with household membership in the community health insurance funds (OR, 1.97; 95% CI: 1.23-3.17; p~0.005) and exposure to health promotion (OR: 2.75; 95% CI: 1.84-4.08; p~0.000).

Qualitative findings revealed that some accountability mechanisms implemented in conjunction with Jazia PVS contributed to the performance of Jazia PVS. These include inventory and financial auditing conducted by district pharmacists and the internal auditors, close monitoring of standard operating procedures by the prime vendor regional coordinating office and peer cascade coaching. Besides, the auditing activities allowed identifying challenges of delayed payment to the vendor and possible approaches for mitigation while peer cascade coaching played a crucial role in enabling staff at the primary facilities to improve skills to oversee and manage the medicines supply chain. The most critical factor contributing to the acceptability of the Jazia PVS was the perceived effectiveness of the system in achieving its intended purpose. Participants' acceptability of Jazia PVS was influenced by the increased availability of essential medicines at the facilities, higher-order fulfilment rates, and timely delivery of the consignment. Furthermore, acceptability was also influenced by the good reputation of the prime vendor, close collaborations with district managers and participants' understanding that prime vendor was meant to complement the existing supply chain.

The estimated Jazia PVS start-up financial costs amounted to US$ 2,170,989.74. Training of the staff and healthcare workers accounted for 27.9% (US$ 605,060.13) while the health facility baseline assessment and the official launch of the Jazia PVS amounted to 5.4% (US$ 117,406.86) and 3.7% (US$ 79,951.42) respectively. The economic start-up costs accounted for about 52.2% (US$ 1,209,573.47) of the total economic costs and the largest share 32.0% (US$ 741,836.55) was for staff and healthcare workers training. The Jazia PVS national roll-out costs amount to US$ 8,031,335.3 with the largest share going to the training of the staff and healthcare workers 45.8% (US$ 3,618,682.96).

The current study provides evidence on the potentiality of the Jazia PVS in complementing existing pharmaceutical supply chain, indicating that such a model can be used to increase efficiency in the provision of services. LMICs interested in establishing PPP within the intension of improving healthcare delivery may adopt good lessons from the Jazia PVS in Tanzania. Nonetheless, strong capacity of various bodies to exercise oversight and sanctions in the implementation of the PPP is important in ensuring accountability linkages for the public and private entities.

In conclusion, these results highlight the importance of medicine availability in promoting access to health services in low-income settings. Effective planning and medicine supply management from national to health facility level is an important component of quality health services. In terms of accountability, it revealed that there is a need for capacity building linked to financial and supply management at lower-level health facilities, including health facility governing committees, which are responsible for priority-setting and decision-making at the facility level. PPP has the potential to improve service delivery; however, it is crucial to select a reputable and competent vendor, together with being loyal to the contractual agreement. Short-term experts, staff and health workers training comprised the largest component of Jazia PVS start-up costs. Integration of Jazia PVS into the existing regional and district administrative structures result in decreased implementation costs as no new structures were established and new staff deployed.

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List of abbreviations

ADDOs	Accredited of Drug Dispensing Outlets
ALU	Arthemeter/Lumefantrine
CHF	Community Health Fund
CHMT	Council Health Management Team
CHSB	Council Health Service Board
CI	Confidence interval
CMSs	Central Medical Stores
DED	District Executive Director
DHFF	Direct Health Facility Financing
DHIS	District Health Information Systems
DMO	District Medical Officer
DPharm	District Pharmacists
DTP	Diphtheria, tetanus, and pertussis vaccine
EC	Evaluation Committee
ELCT	Evangelical Lutheran Church
eLMIS	Electronic logistics management information system
FGDs	Focus group Discussions
GD	Group Discussion
GPS	Global Positioning System
HFGC	Health Facility Governing Committee
HPSS	Health Promotion and System Strengthening
HSSP	Health Sector Strategic Plan

IDIs	In-depth Interviews
IHI	Ifakara Health Institute
ILS	Integrated Logistic Supply
IMIS	Insurance Management Information System
IRB	Institutional Review Board
Jazia-PVS	Jazia Prime Vendor System
LMIC	Low and Middle-Income Countries
MEMS	Mission for Essential Medical Supplies
MoFEA	Ministry of Finance and Economic Affairs
MoHCDGEC	Ministry of Health, Community Development, Gender, Elderly, and Children
MSD	Medical Store Department
MUHAS	Muhimbili University of Health and Allied Sciences
NBS	National Bureau of Statistics
NHIF	National health insurance fund
NIMR	Tanzanian National Institute for Medical Research
ODK	Open Data Kit
OR	Odds ratio
OTC	Over-the-counter
PEPFAR	President's Emergency Plan for AIDS Relief
PHSDP	Primary health services development programme
PO-RALG	President Office Regional Administration and Local Government
PPP	Public-Private Partnership
PPS	Probability Proportional to Size

R&R	Request and Reporting
RA	Research Assistants
RFPs	Revolving Fund Pharmacies
RHMT	Regional Health Management Team
RPVTB	Regional Prime Vendor Tender Board
RPVTC	Regional Prime Vendor Technical Committee
SCIH	Swiss Centre for International Health
SDC	Swiss Agency for Development and Cooperation
SDGs	Sustainable Development Goals
SMS	Short Message Service
SOPs	Standard Operating Procedures
SPHSS	School of Public Health and Social Sciences
SSA	Sub-Saharan Africa
Swiss-TPH	Swiss Tropical and Public Health Institute
TASAF	Tanzania Social Action Fund
TFA	Theoretical Framework of Acceptability
TFDA	Tanzania Food and Drug Authority
TZS	Tanzanian shillings
UHC	Universal Health Coverage
URT	United Republic of Tanzania
US$	United State of America dollars
WHO	World Health Organization

1. Introduction

1.1 The availability of medicines in Tanzania

The Health Sector Strategic Plan (HSSP VI) July 2015 – June 2020 set a government target to reach 100 percent availability of essential medicines (URT, 2015). The initiatives to achieve this goal, listed in the HSSP VI, include those aimed to improve governance and accountability in the healthcare commodity supply chain; eliminating stock-outs and pilferages; strengthening working capital; and engagement with the private sector (URT, 2015). Furthermore, some health system reforms have been undertaken in Tanzania, such as the introduction of facility bank accounts in all public primary healthcare facilities (Kuwawenaruwa et al., 2019); the implementation of direct health facility financing (DHFF) (Kapologwe et al., 2019); the re-designing of the community health insurance (Lee, Tarimo, & Dutta, 2018) and strengthening public-private partnership (PPP) (Maluka et al., 2018; Wiedenmayer et al., 2019). Initially, most of the health centres and dispensaries had no bank accounts. All the cost-sharing funds (user fees, basket funds, and insurance reimbursements) were managed and controlled at the district level, and facilities had no direct access to funds or control of financial resources (Kapologwe et al., 2019). In 2011/12, all public primary facilities were directed to open a bank account with a local/nearby bank that was approved by the Bank of Tanzania and cost sharing funds are deposited in the accounts. In 2017/18, the government allowed for fiscal decentralization, and health basket funds are transferred directly to each healthcare facility bank account (See Kapologwe et al. 2019). The re-design of the community health insurance would improve access to health for the households as well as revenue to the healthcare facilities. These reforms are expected to increase health facility autonomy, improve purchasing arrangements for essential medicines, and facilitate operational costs at the facility level (Kapologwe et al., 2019; Kuwawenaruwa et al., 2019). Implementation of DHFF is expected to improve accountability and governance, increasing health system responsiveness and improving health-seeking behaviour and service utilisation at the primary health facility level (Kapologwe et al., 2019).

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governance has been deemed important, if not integral, to systems strengthening. However, governance in health systems design is rarely studied and governance interventions rarely tested. Some research focus on accountability mechanisms and processes at community level, in holding governments accountable and improving the implementation of programs and policies or to encourage communities to be more involved with the public health service provision and to hold their local health providers to account for performance. Nevertheless, the evidence available is still limited. In general, little is known on how governance and accountability mechanisms can be improved for supporting progress toward universal health coverage by ensuring access to quality health services to all and financial risk protection. The r4d project intended to address the challenges of how governance and accountability mechanisms can improve health system governance to support the implementation of inclusive and sustainable social health protection systems.

1.2 Rationale of the Study

Universal health coverage (UHC) embraces equitable access to quality essential healthcare services, including medicines, with financial protection (Bhatt & Bathija, 2018; WHO, 2017b). Estimates show that nearly two billion people have no access to essential medicines in Low and Middle-Income Countries (LMIC) (WHO, 2017a). According to the World Health Organization (WHO), in the South-East Asia Region, at least 65 million people spend an enormous amount of money on medicines to the extent that they have been impoverished. In light of the sustainable development goal three (SDG-3), target 3.8 indicates that there is a need for providing access to affordable medicines and vaccination to all by 2030 (Beran, Pedersen, & Robertson, 2019; UN, 2015).

In most of the LMIC, Central Medical Stores (CMSs) are responsible for the in-country supply chain, including drug selection, quantification, purchase, storage and delivery to the public and some of the non-governmental healthcare facilities such as private not for profit (Bornbusch & Bates, 2013; Khuluza & Haefele-Abah, 2019; Inez Mikkelsen-Lopez et al., 2014). CMSs in different countries have been found to have inefficiencies which can be attributed to a monopolistic position protected by law (Bornbusch & Bates, 2013), underfunding and low resources availability, weak transparency, and weak accountability mechanisms (Maryam Bigdeli et al., 2013; Bornbusch & Bates, 2013; Govindaraj & Herbst, 2010; Sonak, Benson, & Tran, 2018), poor staff ability to forecast needs and requisitioning of medical commodities (Walker & Ozawa, 2011). Inefficiencies within the CMSs have led to low availability of essential medicines in the facilities. The average availability of medicine in LMIC ranges from

35 percent to 70 percent in public and private facilities respectively, and prices for medicines tend to be high in the private sector (Bazargani, Ewen, de Boer, Leufkens, & Mantel-Teeuwisse, 2014; A. Cameron, Ewen, Ross-Degnan, Ball, & Laing, 2009; Khuluza & Haefele-Abah, 2019; Masters et al., 2014; Sado & Sufa, 2016; Vledder, Friedman, Sjöblom, Brown, & Yadav, 2019).

WHO advocates for the strengthening of the national pharmaceutical supply system in critical areas including governance and accountability; manufacturing and trade; medicine financing; quality assurance and regulation; procurement and supply management; appropriate and responsible use; pharmaceutical workforce, and surveillance system to achieve the 2030 target (WHO, 2017b). A framework for action has been endorsed in different countries to improve access to essential medicines (WHO, 2017b). The framework highlights the need to secure sufficient financial resources for essential drugs and vaccines within the country and globally. Advocates have also been on innovative financing mechanisms from the central government, the extension of health insurance coverage to reduce out-of-pocket spending, especially catastrophic expenditure on medicines (WHO, 2017b; Yadav, 2015). In addition to that, adequate regulatory controls have been advocated for quality assurance of the drugs. Also, leveraging regional regulatory capacities, strategic procurement mechanisms to improve efficiency, maintain comprehensive electronic information systems, and enhancement of the last-mile delivery systems to ensure physical accessibility to the people in low resource settings (Inez Mikkelsen-Lopez et al., 2014; Shieshia et al., 2014; WHO, 2017b).

Countries have implemented several initiatives to improve the availability of essential medicines in the public health care facilities by pooled medicines procurement, which allows the purchase of such commodities in uniform prices and terms (Dubois, Lefouili, & Straub, 2019). Such strategic purchasing with longer-term contracts and bargaining practices lower costs of the products and leads to fewer stock-outs (WHO, 2018) and increase drug availability for populations (Seidman & Atun, 2017). Barbosa and Fiuza (2011), found that a pooled procurement of pharmaceutical supplies in Brazil in public institutions, lead to the reduction in the acquisition prices of the commodities, increases bargaining power and allowed for economies of scale compared to when institutions purchased individually (Barbosa & Fiuza, 2011). Arney *et al*., (2014) argues that strengthening technical capacity and improvement in the legislation develop and implement long-term contracts through strategic contracting practices in public procurement in Sub Saharan Africa would improve pharmaceutical supply security and ensure cost savings (Arney, Yadav, Miller, & Wilkerson, 2014).

1.3 The Pharmaceutical Supply Chain in Tanzania

In Tanzania, the Medical Stores Department (MSD) is responsible for the supply of medical commodities (medicines, medical supplies and medical equipment) to all the public facilities in the country (Inez Mikkelsen-Lopez et al., 2014; Wande et al., 2019b). MSD is the autonomous department under the Ministry of Health, Community Development, Gender, Elderly, and Children (MoHCDGEC) with the obligation to procure medicines, medical supplies and laboratory reagents, store and distribute via nine MSD zones to over 6,000 public healthcare facilities (Inez Mikkelsen-Lopez et al., 2014). Private healthcare facilities get their medical commodities from registered private distributors in the country. Private distributors are mainly located in urban and major cities, and very rarely they supply in hard to reach areas (Wande et al., 2019b). All the items procured by MSD are registered with Tanzania Food and Drug Authority (TFDA) based on quality, safety and effectiveness. MSD receives and manages medical commodities supplied by various programs and development partners which focus on specific diseases or groups of diseases within the vertical programs. MSD is responsible for the management and coordination of the cold chain for deliveries of vaccines together with other related cold chain products across the country (Beran et al., 2019; Inez Mikkelsen-Lopez et al., 2014).

Public healthcare facilities have accounts within MSD, and the accounts are credited quarterly by the Ministry of Finance and Economic Affairs (MoFEA) via the MoHCDGEC. MoFEA allocates funds to the facilities based on the service population (Manji et al., 2016; Inez Mikkelsen-Lopez et al., 2014). This is an initiative to increase the availability of essential medicines which was introduced in the 1980s within Sub-Saharan Africa (SSA) as part of Bamako Initiative (Garner, 1989; Manji et al., 2016; Inez Mikkelsen-Lopez et al., 2014). Healthcare facilities order medicines from the MSD on a quarterly basis through an integrated logistics system (ILS). Funds are released from the healthcare facility accounts and transferred to the MSD as working capital (Inez Mikkelsen-Lopez et al., 2014). MSD charges about 17.4% mark-up on medical commodities supplied to the facilities (excluding those provided within the vertical programs) to finance its operating costs (Inez Mikkelsen-Lopez et al., 2014). MSD uses both the ‘push' and ‘pull' system to supply facilities with the medicines (Inez Mikkelsen-Lopez et al., 2014).

In the last few years the government of Tanzania increased the amount of funding going to the health sector with a rise from Tanzanian shillings (TZS) 1,821 billion in 2015/16 to TZS 2,055 billion in 2016/17, and TZS 2,222 billion in 2017/18 (Lee, Dutta, & Lyimo, 2016; Lee &

Tarimo, 2018). The increase in the financial resources to the health sector was also reflected with an increase in the allocation of funding to the MSD. For example, in the fiscal years 2016/17 and 2017/18, TZS 251.5 billion and TZS 260 billion respectively were given to MSD for procurement and supply chain strengthening (Lee & Tarimo, 2018; Lee, Tarimo K., & Dutta, 2017). Nonetheless, such amounts did not translate into the improvements in medicines supply chain as a substantial amount of the funds (amounting to TZS 70 billion) were allocated for the debt owed by the government of Tanzania to the MSD, hence virtual. In the financial year 2015/16, the amount owed to the MSD was estimated to be TZS 114.2 billion (Deloitte, 2015). MSD remains under-resourced and under-funded, resulting in constant stock-outs of essential medicines across health facilities (Wiedenmayer et al., 2019). Order fulfilment rates by the MSD has been low, around 60 percent compared to its targeted level of 100% (URT, 2015). There has also been an increase in demand for medical commodities from the healthcare facilities in Tanzania. The MSD faced several additional challenges, including delays in disbursement of funding from MoFEA; and insufficient governance and accountability structures; shortage of staff together with operational inefficiencies leading to stock-outs at health facilities (Inez Mikkelsen-Lopez et al., 2014; Wiedenmayer et al., 2019).

1.4 Complementary Pharmaceutical Supply in Tanzania

In Tanzania, public healthcare facilities have earmarked funding for the purchase of essential medicines from private suppliers (retailers and/or wholesalers) to supplement MSD (EHG, 2007; HPSS, 2014). However, the purchase of complementary medicines has reportedly been fragmented, uncoordinated, inefficient and characterized by poor transparency (HPSS, 2014). A number of initiatives have been initiated to compensate for these shortfalls. Among them, it is worth mentioning the Evangelical Lutheran Church (ELCT) of Tanzania implemented a prime vendor system, under the Mission for Essential Medical Supplies (MEMS), launched in 2001 to complement the existing medical supply chain (Häfele-Abah & Neuhann, 2010; World_Bank, 2013). MEMS coordinates the procurement of medicines, health workers training on stock management, quality assurance and rational use of medicine for church healthcare facilities (the majority of which are located in rural areas) and other not-for-profit organizations in Tanzania. However, MEMS failed to meet the contractual terms as it underestimated the program complexity, had low coverage and high reliance of the program on donor funding (Häfele-Abah & Neuhann, 2010).

In 2003, another public-private partnership initiative was launched in Tanzania to improve access to medicines in peripheral areas through the accreditation of drug dispensing outlets

(ADDOs) program (Embrey et al., 2016). ADDOs have been found to increase access to quality pharmaceutical products and services in under-served areas. Its implementation has been accompanied by training, supervision and regulation from Tanzania Food and Drugs Authority (TFDA) and the Pharmacy Council (Embrey et al., 2016). ADDOs have been found to face some challenges in terms of overuse of antibiotics especially for clients with acute respiratory infections and diarrhoea (Chalker et al., 2015; Dillip et al., 2015). In few cases, clients receiving medicines from the ADDO had not being referred to formal providers as a result of poor adherence to referral procedures or sheer preference to increase drugs sales to boost income (Chalker et al., 2015; Dillip et al., 2015).

In 2014, the United States President's Emergency Plan for acquired immune deficiency syndrome Relief (PEPFAR) launched a prime vendor model in collaboration with the government of Tanzania (USAID, 2016). This model relied on the existing local pre-selected pharmaceutical vendors to address gaps for 45 opportunistic infection drugs which were needed in the country (USAID, 2016). PEPFAR program focussed mainly on the fight against AIDS, malaria and tuberculosis, together with strengthening health systems, providers training and providing support for quality improvement (El-Sadr et al., 2012; PEPFAR, 2018).

In 2014, the Dodoma Regional Administration and Local Government (RALG) started implementing an innovative PPP, referred to as the Jazia prime vendor system (Jazia PVS) to complement MSD on medical supplies to all the public facilities (Wiedenmayer et al., 2019). All orders of medical commodities from public hospitals, health centres and dispensaries are pooled at the district level and then purchased at agreed prices from a preferred and contracted private wholesaler supplier, the prime vendor. Framework contracts with prime vendors at the regional level are established for two years. A recent study conducted in the Jazia PVS pilot regions showed that Jazia PVS has been effective in increasing the availability of essential medicines in public health facilities (Wiedenmayer et al., 2019). Consequently, in 2018 the government decided to roll out the Jazia PVS to twenty-six regions of Tanzania mainland.

Accountability within pharmaceutical supply chain interventions (such as PPP) is of paramount importance as an enormous amount of resources are invested to achieve the targeted goal (Karwa et al., 2017). Accountability not only involves all parties (such government/private institutions) within a certain agreement to account for their performance in addressing the needs of the public but also requires parties involved to justify their decisions (Vian, Kohler, Forte, & Dimancesco, 2017). Dimancesco and Paschke, argue that individuals and institutions

comply to standards and commitments; they are answerable for their actions; and they face consequences whenever rules or commitments are observed (Dimancesco & Paschke, 2018). Accountability has been found to reduce inefficiencies in supply management (Karwa et al., 2017; Paschke, Dimancesco, Vian, Kohlerd, & Forteb, 2018; Walkowiak, Hafner, & Putter, 2018), corruption, unethical practices, maintaining the availability of essential medicines and containing drug costs (Govindaraj & Herbst, 2010; Paschke et al., 2018; Yadav, 2015). In low-income settings, there is little evidence on how accountability contributes to the performance of such complementary pharmaceutical supply systems.

The successful performance of pharmaceutical supply chain such as PPP, Jazia PVS relies crucially on the degree of beneficiary's and implementers' acceptance (Diepeveen, Ling, Suhrcke, Roland, & Marteau, 2013; Mandeep Sekhon, Cartwright, & Francis, 2017; M. Sekhon, Cartwright, & Francis, 2018; Shieshia et al., 2014). The extent to which beneficiaries and implementers accept an intervention affects both the implementation and the effectiveness of the intervention (Bos, Van der Lans, Van Rijnsoever, & Van Trijp, 2013). Most empirical studies have explored the acceptability of health system interventions (Maryam Bigdeli et al., 2013; Diepeveen et al., 2013; Mandeep Sekhon et al., 2017), whilst only a few studies have explored the acceptability of interventions such as public-private partnerships in the pharmaceutical supply chain (Guillermet et al., 2015; Shieshia et al., 2014).

The availability of essential medicines has been shown to influence health care utilization (Anselmi, Lagarde, & Hanson, 2015; Mwabu, Ainsworth, & Nyamete, 1993). Medicine stock-outs in facilities contribute to low utilization of the formal healthcare system (Mkoka, Goicolea, Kiwara, Mwangu, & Hurtig, 2014). There are other factors affecting household utilization including: trust in health care providers (Brennan et al., 2013), distances to reach a formal healthcare provider (Tran, Nguyen, Nong, & Nguyen, 2016), and affordability of healthcare services (Ahmed et al., 2018; Atnafu, Tilahun, & Alemu, 2018; Chomi, Mujinja, Enemark, Hansen, & Kiwara, 2014; Saksena, Antunes, Xu, Musango, & Carrin, 2011) have been found to influence healthcare utilization.

Supply chain management interventions have been effective in reducing health commodities stock-outs and improve the availability of medicines to the population (Nunan & Duke, 2011; Seidman & Atun, 2017; Wiedenmayer et al., 2019). Economic analyses of the resources needed to design and implement such interventions is important in informing the policy-makers of the resources required in maintaining and scaling up such interventions into different settings

taking into consideration economies of scale (Dang, Likhar, & Alok, 2016; Johns, Baltussen, & Hutubessy, 2003a).

Access and affordability of essential medicines are crucial for the health of the population and attainment of universal health coverage. However, little is known on the effects of the regional complementary pharmaceutical supply system on improving availability and healthcare utilisation to the population; accountability mechanisms within such contracting mechanisms; their acceptability by the beneficiaries and implementers of the intervention as well as their costs and cost drivers for implementing of the prime vendor systems in low-income settings.

2. Aim and Objectives

2.1 Aim

The overall aim of this thesis was to analyse the effect of the Jazia PVS in complementing the existing pharmaceutical supply chain across public health facilities in Tanzania.

2.2 Objectives

The following specific objectives were defined:

i) To analyse the effects of medicines availability and stock-outs on household's utilisation of health care services in Dodoma region, Tanzania.

ii) To examine the role of accountability in the performance of Jazia prime vendor system in Tanzania

iii) To explore the acceptability of prime vendor system in public healthcare facilities in Tanzania.

iv) To estimate costs and costs drivers for setting up Jazia prime vendor system and model the costs of the roll-out of the Jazia-PVS in other regions of Tanzania.

3. Methods and Study Settings

3.1 Methods

A mixed-method research design was adopted to assess the Jazia PVS, we combined the analysis of a household and a health facility quantitative survey data with qualitative research based on 14 focus group discussions (FGDs), 7 group discussion (GD) and 30 in-depth interviews (IDIs) with a range of persons involved in the Jazia PVS (Table 1). In addition, a micro-costing approach was used to estimate costs and costs drivers for setting up a prime vendor system in the regions and model the national scale-up costs of the Jazia-PVS in other regions.

Table 1: Study method adopted in this thesis by objective

Approach adopted	Objective 1	Objective 2	Objective 3	Objective 4
Descriptive statistics [1]	X			
'Pearson's correlation' analysis [1]	X			
Univariate and Multivariate logistic regression model [1]	X			
In-depth interviews (IDIs) [1,2]		X	X	X
Group discussion (GDs) [2]		X	X	
Focus group discussion (FGDs) [2]		X	X	
Micro-costing [1]				X
Document review[1,3]	X	X	X	X

Note: 1, indicates quantitative methods, 3, secondary data (review and extraction of data from financial, meetings, monitoring and evaluation reports) and 2 qualitative data.

Household and health facility cross-sectional survey data was collected from a random sample of 1,237 households and a survey covering 89 public primary health care facilities. The household survey captured information on healthcare access and utilization, ownership of different assets, insurance and health promotion activities. On the other hand, the facility surveys included observation, record review over a three-month period prior to survey date, and interviews with key staff. Data from facility surveys were linked with data from household surveys conducted in the same geographical location. Qualitative data were collected from four districts which were purposively selected; Bahi and Kondoa districts in Dodoma region, and Kilosa and Ulanga districts in Morogoro region. Districts selection was based on the high/low use of the prime vendor and distance from the regional Jazia PVS coordinating office. We

included two districts with high use of the prime vendor and two districts with low use of the prime vendor. Monitoring and evaluation reports showed that, over 18 months of Jazia PVS implementation, Kondoa and Kilosa districts had a high use of prime vendor while Bahi and Ulanga had low use of prime vendor. In each region, we selected a district located far [more than 100 kilometres] from regional Jazia PVS coordinating office and another located in proximity of the regional office [less than 100 kilometres]. Out of the four districts, twenty-seven facilities (three district hospitals, eight health centres and sixteen dispensaries) were selected in collaboration with the district and regional managers based on high/low use of prime vendor and proximity to the district headquarter. Qualitative analytical methods were used to explore accountability and acceptability experiences of Jazia PVS implementers' in four districts in mid-2018.

Descriptive statistics were generated for the health facility and household survey data. We then used '*t-tests*' to assess whether the difference in proportions between districts for each variable was statistically significant. The descriptive statistics informed the variables (covariates) included in the multivariate logistic regression model, to assess the effects of medicines availability and stock-outs on health care utilization. The regression analysis was clustered at the facility level. We hypothesised that household healthcare utilization would be affected by a continuous availability of medicine and stock-outs.

During the analysis of qualitative data open coding was used, in labelling, defining as well as developing categories based on dimensions of the participant's description using NVivo 12.0 (QSR International Pty Ltd). Subsequently, both inductive and deductive approaches were used to group the codes into themes reflecting the three dimensions of accountability (Bovens, 2007) and seven dimensions of acceptability (Mandeep Sekhon et al., 2017). The first author and a senior social scientist performed inter-coder reliability to improve the codes. The whole analysis focused on emerging themes, patterns, similarities, and differences. Framework analysis was adopted to summarise the results using a deductive and inductive approach. (N.K. Gale, G. Heath, E. Cameron, S. Rashid, & S. Redwood, 2013). The selected verbatim key quotations were translated into English and incorporated in the manuscript. We based the analysis on so-called data source triangulation which allows for data validation and comprehensive understanding of the Jazia PVS (Carter, Bryant-Lukosius, DiCenso, Blythe, & Neville, 2014; Heath, 2001; Salkind, 2010).

Finally, we used a micro-costing (ingredients) approach to address our fourth objective and capture the Jazia PVS programme costs. Our approach targeted all financial costs deployed in the establishment and maintenance of the Jazia PVS. Implementation costs were collected retrospectively adopting a societal perspective. A total of 30 IDIs were conducted between July and September 2018. We estimated both financial and economic costs for the Jazia start-up costs and recurrent costs for Jazia PVS implementation phase, January 2014 to July 2019.

3.2 Study Settings

The study was done in three regions, Dodoma, Morogoro and Shinyanga. The regions were implementing the Health Promotion and Systems Strengthening (HPSS) project (Phase I) which was funded by the Swiss Agency for Development and Cooperation (SDC) from 2010 up to July 2019. The HPSS project was a people-centred project that follows a comprehensive systems approach and intended to improve community health, both demand and supply side. The HPSS project supported four main components including: - the health promotion, health financing, technology management and pharmaceutical component. It is within the management of healthcare commodities component where the Jazia PVS was conceptualized. The Jazia PVS was piloted across seven districts of Dodoma region in 2014. Later on, the pilot was extended to fifteen districts, nine of Morogoro region and six of Shinyanga region in 2016 (Figure 1). This thesis analysed the effect of the Jazia PVS in complementing the existing pharmaceutical supply chain in Tanzania. Morogoro had the highest population, 2,218,492 followed by Dodoma region with 2,083,588 and Shinyanga 1,534,808 (NBS, 2012). The number of primary care facilities per 10,000 population was 1.8, 1.7 and 1.4 for Morogoro, Dodoma and Shinyanga respectively. About 770 public facilities participated in the Jazia PVS, including 17 hospitals, 83 health centres and 670 dispensaries.

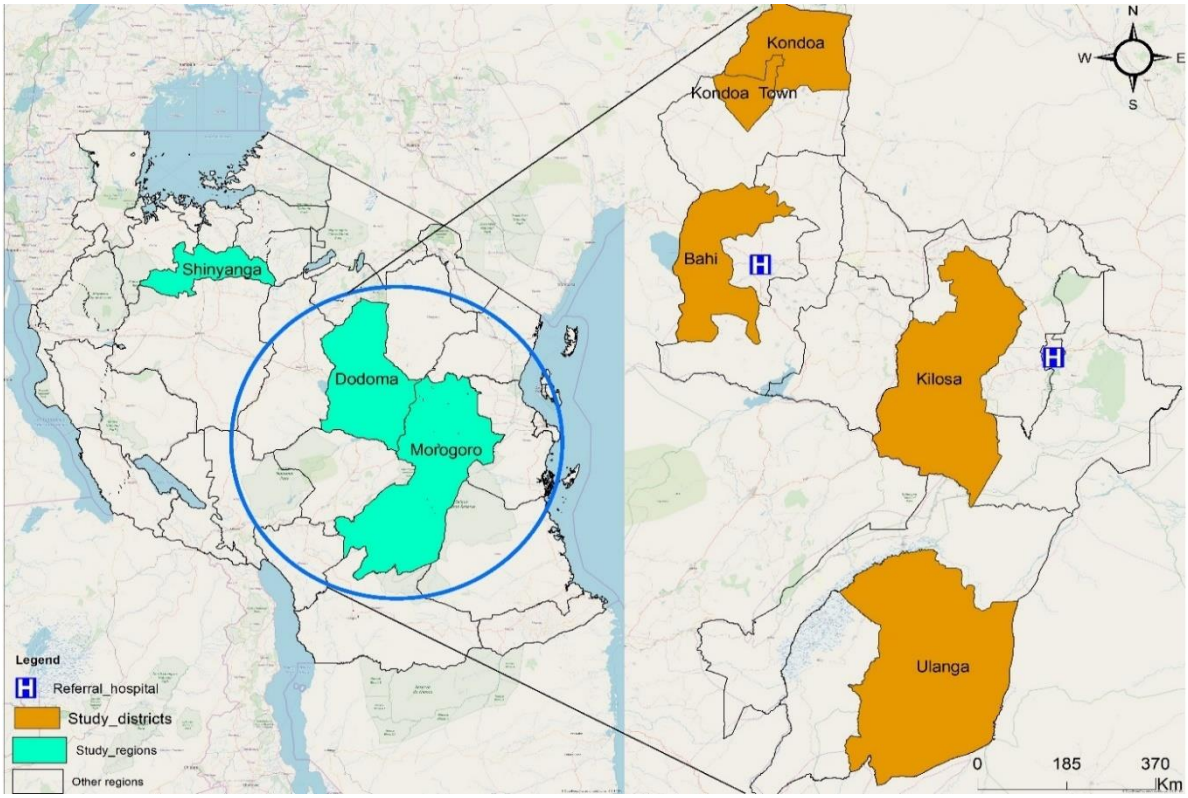

Figure 1. Jazia PVS pilot Regions

Figure 1, represents the map of the United Republic of Tanzania, with the regions where Jazia PVS was implemented. The study sites are shown in orange colour. Bahi and Kilosa districts are close to the Jazia PVS coordination office located at the regional referral hospital (H). Instead Kondoa and Ulanga districts are located more than 100 kilometres away from the regional referral hospital.

3.3 Ethical Considerations

Ethical clearance for this study was obtained from the Ifakara Health Institute Institutional Review Board (IHI/IRB/No. 21-2017) and the Tanzanian National Institute for Medical Research (NIMR/HQ/R.8a/Vol. IX/2720). All district managers and health facility in-charges involved were informed about the study and written informed consent was obtained from household heads or his /her representatives as long as the participant was aged 18 years and above.

4. The effects of medicines availability and stock-outs on household's utilization of health care services in Dodoma region, Tanzania [1]

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4.1 Abstract

Low and middle-income countries have been undertaking health finance reforms to address shortages of medicines. However, data are lacking on how medicine availability and stock-outs influence access to health services in Tanzania. The current study assesses the effects of medicine availability and stock-outs on healthcare utilization in Dodoma region, Tanzania. We conducted a cross-sectional study that combined information from households and healthcare facility surveys. A total of 4 hospitals and 89 public primary health facilities were surveyed. The facility surveys included observation, record review over a three-month period prior to survey date, and interviews with key staff. In addition, 1,237 households within the health facility catchment areas were interviewed. Data from the facility survey were linked with data from the household survey. Descriptive analysis and multivariate logistic regressions models were used to assess the effects of medicine availability and stock-outs on utilization patterns and to identify additional household-level factors associated with health service utilization. Eighteen medicines were selected as 'tracers' to assess availability more generally, and these were continuously available in approximately 70% of the time in facilities across all districts over three months of review. The main analysis showed that household's healthcare utilization was positively and significant associated with continuous availability of all essential medicines for the surveyed facilities (odds ratio (OR): 3.49; 95%CI: 1.02-12.04; p~0.047). Healthcare utilization was positively associated with household membership in the community health insurance funds (OR, 1.97; 95%CI: 1.23-3.17; p~0.005) and exposure to healthcare education (OR: 2.75; 95%CI: 1.84-4.08; p~0.000). These results highlight the importance of medicine availability in promoting access to health services in low-income settings. Effective planning and medicine supply management from national to health facility level is an important component of quality health services.

Keywords: medicines availability, health care utilization, Dodoma, Tanzania

4.2 Introduction

The availability of quality medicines in the provision of healthcare service is an integral part of universal health coverage (UHC) (Prinja, Bahuguna, Tripathy, & Kumar, 2015). Evidence suggests that the availability of medicines is essential for healthcare service delivery (M. Bigdeli, Laing, Tomson, & Babar, 2015; Obare, Brolan, & Hill, 2014). In low and middle income (LMIC) countries the availability of essential medicines in public health facilities ranges from 17.9% to 87.1% (WHO, 2014). The proportion of total health expenditure (THE) spent on medicines in low-income countries ranges widely: from 7.7% to 67.6% (Lu, Hernandez, Abegunde, & Edejer, 2011). Additionally, a limited proportion of funds for medicines is allocated to primary health facilities in these countries (Kusemererwa, Alban, Obua, & Trap, 2016). Coupled with frequent supply chain management problems (A. Cameron et al., 2009; Yale, 2011), access to quality medicines is often limited, contributing to inequalities and deficits in access to health services and ultimately influencing health outcomes (Chen, Blank, & Cheng, 2014; Masters et al., 2014). The lack of medicines in health facilities fosters the use of over-the-counter (OTC) medicines or products from unqualified sources, exposing consumers to the risks of using counterfeit or substandard products (Jia, Lou, Guo, Leung, & Zeng, 2016). In addition, a large proportion of medicines are paid for out-of-pocket, potentially exposing households to financial hardship (Lu et al., 2011; Luiza et al., 2016; Prinja et al., 2015).

Several LMICs have undertaken or are undertaking health finance reforms (Fenny, Yates, & Thompson, 2018; Mtei G. et al., 2007) aimed at increasing the availability of medicines at an affordable cost. The emphasis of some reforms has been on expansion of social health insurance schemes (Fenny et al., 2018; McIntyre, Ranson, Aulakh, & Honda, 2013) and direct health facility financing (Kapologwe et al., 2019) as a means of generating more revenue to purchase medicines and to protect citizens from the risk of catastrophic health expenditure (Ataguba & Ingabire, 2016; Kusi, Hansen, Asante, & Enemark, 2015; Saksena et al., 2011). Furthermore, other initiatives undertaken include the strengthening of public-private partnerships as a means of ensuring healthcare facilities have sufficient medicines to carter for the population needs throughout the year (Embrey et al., 2016; Rutta et al., 2015; WHO, 2000).

The continuous availability of essential medicines within primary healthcare facilities plays an important role in promoting access to and utilization of health services. On the other hand, frequent stock-outs of medicines have been shown to influence health care utilization (Anselmi et al., 2015). In Uganda, the continued absence of medicines in public health facilities was

found to influence health care utilization and individual decisions to consult health service providers (Musoke, Boynton, Butler, & Musoke, 2014; B. T. Shaikh & J. Hatcher, 2005). The availability of medicines positively affects patient trust in health care providers (Shan et al., 2016), while medicine stock-outs in facilities foster distrust in health care providers and contributes to low utilization of the formal health care system (Mkoka et al., 2014). Trust in health care providers is important; it shapes household health care utilization patterns, it influences medication adherence (Brennan et al., 2013) and it fosters communication with service providers (Al-Mandhary, Al-Zakwani, & Afifi, 2007). A number of other factors have also been found to influence household healthcare-seeking behaviour. In rural areas, long distances to reach a formal healthcare provider results in the underuse of health services (Tran et al., 2016). The availability of sufficient transport systems and close geographic proximity to healthcare facilities positively influences healthcare service utilization (Feikin et al., 2009; B. Shaikh & J. Hatcher, 2005). In addition, affordability of healthcare services influences household's healthcare seeking behaviour; evidence suggest that health insurance increases the probability of households seeking care (Ahmed et al., 2018; Atnafu et al., 2018; Chomi et al., 2014; Saksena et al., 2011) and protects them against impoverishment from out-of-pocket expenditures (Saksena et al., 2011; Spaan et al., 2012).

To our knowledge, most studies assessing how medicine availability influences health care utilization in Tanzania have focused on specific diseases such as diarrhoea, fever/malaria, tuberculosis, chronic diseases and acute respiratory infection (Kante et al., 2015; I. Mikkelsen-Lopez et al., 2013; Nnko et al., 2015; Senkoro et al., 2015); on special vulnerable populations such as people who inject drugs; or on the influence of health insurance systems overall (Chomi et al., 2014; Mlunde et al., 2016). However, no study investigated how medicine availability and stock-outs influence health care utilization in the general population by integrating information from the healthcare facility and households. This study assesses the effects of medicine availability and stock-outs on health care utilization in Dodoma region, Tanzania by combining data of households and health facilities survey. We aimed to assess the effects of medicine availability and stock-outs on health care utilization in Dodoma region, Tanzania by combining data of households and health facilities survey

4.3 Methods

Study Setting

Tanzania has a decentralized health system which gives district councils authority to manage available resources district healthcare facilities. The central government, in turn, allocates funds to the Medical Store Department (MSD), the main supplier of medicines, medical equipment and medical supplies to public healthcare facilities. However, several barriers challenge MSD's effectiveness in supplying medicines to the health facilities, including inadequate funds for medicines, delays in disbursement of allocated funds, inaccurate forecasting of medicines at the facility and national level, thefts, stock-outs at the national MSD warehouse, and ineffective systems for fulfilling back-ordered items (Yale, 2011). Nevertheless, health facilities and districts have funds available that are earmarked for purchasing supplementary medicines from the private sector when MSD is out-of-stock (HPSS, 2014), Funding for complementary medicines and supplies are closely linked with fiscal decentralization of public financial management and the community health fund (CHF "*iliyoboreshwa"*) system. These medicines are paid from the regular sources of complementary funds available such as those of the CHF, of the national health insurance fund (NHIF), of user fees, and the basket funds provided by the government, donors and the private sector. However, the availability of medicines within the public sector in district-level facilities tends to be insufficient, in turn affecting the quality of services. A survey conducted in 2012 in Dodoma region reported a stock-out rate of 46% and an order fulfilment rate of 59% from MSD (HPSS, 2011). The purchase of supplementary medicines has been reported to be fragmented, uncoordinated, inefficient and lacking transparency (HPSS, 2014). In 2014 regional authority and district councils started implementing a complementary pharmaceutical supply system funded by Swiss Agency for Development and Cooperation (SDC) through the Health Promotion and Systems Strengthening (HPSS) project known as Jazia Prime Vendor system (Jazia-PVS). The aim of Jazia-PVS is to improve the availability of medicines in the Dodoma Region by complementing MSD supply. Jazia-PV system is a unique public-private partnership between the health authorities of the Dodoma region and a private supplier (HPSS, 2014). The Jazia PVS consolidates and pools orders for supplementary medicines from all public health care facilities at the district level and purchases from one contracted supplier, the Prime Vendor. Medicines are paid for using the funds collected through national insurance schemes (CHF and NHIF), user fees and basket funds (Mushi, 2014). Jazia PVS was designed to address shortages of medicines in primary-level public health facilities by pooling the

limited resources available from districts councils. Health care decision-makers require information on the effectiveness of the Jazia PV system, including the effect on medicines availability and stock-outs and on household healthcare utilization.

This study was carried out in six districts in the Dodoma region where the Jazia PVS was implemented: Kondoa, Kongwa, Dodoma City Council, Bahi, Mpwapwa and Chemba. Table 2 presents information about the included districts in Dodoma region. The region has a population of 2,083,588. Of the six district councils, Dodoma municipal has the largest population (410,956) while Bahi district council has the smallest population (221,645). Bahi has the largest average number of primary health care facilities per 10,000 population (1.8), followed by Chemba and Kongwa district councils (1.4) and Dodoma city council has the fewest (0.8).

Table 2: Key characteristics of the study settings

District Council / Variable	Kondoa	Kongwa	Dodoma City	Bahi	Mpwapwa	Chemba
Population[2]	269,704	309,973	410,956	221,645	305,056	235,711
Area coverage in square kilometres	5,921	4,041	2,576	5,948	7,479	7,289
Number of public health centres[3]	2	4	7	6	2	4
Number of public dispensaries[2]	27	40	27	35	39	30
Number of private health facilities[2]	11	8	29	2	5	4
Number of primary care facilities per 10,000 population	1.1	1.4	0.8	1.8	1.3	1.4
Number of primary health facilities surveyed						
Hospital	1	1	1	0	1	0
Health Centres	2	1	1	3	1	3
Dispensaries	6	16	13	12	18	13
Total staffing in the surveyed Health Centre						
Clinical Cadre[4]	3	2	2	9	2	2
Nurse Cadre[5]	14	4	0	39	4	4
Pharmacists cadre[6]	0	0	0	1	0	0
Total staffing in the surveyed Dispensary Clinical Cadre	1	7	8	4	5	3
Nurse Cadre	15	18	29	45	27	22
Pharmacists cadre	0	0	0	0	0	0
Household Interviews						
Household selected (N=1,264)	194	223	296	160	221	170
Household interviewed (n=1,237)	195	220	281	168	201	172
Household response rate, % (98.5)[7]	100.5	98.7	94.9	105	91.0	101.2

[2] NBS, Tanzania National Bureau of Statistics; Population and Housing Census 2013

[3] http://hfrportal.ehealth.go.tz/ (Accessed on 15th January 2018; Only operating facilities)

[4] Composed of Medical Doctor (MD); Assistant Medical Officer (AMO) and Clinical Officer (CO)

[5] Composed of Medical attendant (Nurse assistant); Nurse midwife and Nurse officer

[6] Composed of Pharmacist; Pharmaceutical assistant and Pharmaceutical technician

[7] Variation of household response rates by district was due to the fact that some of sampled iCHF households members have permanently/temporarily migrated out of the sampled villages as it was a harvesting time and some villages had changed their administrative boundaries hence the names of households do not appear in the sampled villages therefore there was a need to sample extra households.

Study design

Two cross-sectional surveys were conducted in May 2017 in Dodoma Region; (1) a household survey and (2) a health care facility survey. The two surveys covered the same areas and were then combined to assess the effects of medicines availability and stock-outs on household health care utilization.

Health facility survey

The sample size for the healthcare facilities was 50% of all government health facilities (267) covered by the Health Promotion and System Strengthening (HPSS) project in Dodoma region. The health facilities were stratified into three categories, namely hospitals, health centres and dispensaries. A Probability Proportional to Size (PPS) sampling design was utilized, whereby the number of health facilities selected was adjusted based on the number of healthcare facilities in the district. Thus districts with larger numbers of health facilities had a greater number of health facilities included in the sample. A total of 4 hospitals and 89 public primary health care facilities (11 health centres and 78 dispensaries) were randomly selected and surveyed in May 2017 across the seven districts. Surveys included observation, record review, and interview with key staff at each health facility selected. Health care facility staff was interviewed to collect data on medicine availability, frequency and duration of medication stock-outs, reasons for stock-outs and facility staffing levels (Appendix 1: Sample of Health facility assessment tool). The survey addressed the previous three-month period of February – April 2017.

The availability of eighteen tracer medicines were examined from existing health facility records (Supplementary material 1, Table S1). The eighteen tracer medicines were selected to align with the medications targeted by the HPSS-Jazia PVS. A pharmacist and an enumerator verified the availability and stock-outs of medications using a review of facility records from the previous three months (90 days) prior to the survey. The average number of days a facility had experienced stock-outs for each of eighteen medicines was recorded (Supplementary material 1, Table S2). We categorised health facilities as those with and without any stock-outs over the observation period of three months prior to the survey date and this variable was included in the final regression model.

Household survey

A multi-stage sampling approach was used in the selection of wards and villages from the councils. In the first stage, a list of wards was obtained and three wards from each district were randomly selected. The second stage of selection involved the random selection of 2 villages from each ward. In total 42 villages were chosen across the district councils. The sample size was obtained by adopting a formula from Cochran with consideration of households who had enrolled in CHF and those who are not enrolled (Cochran, 1977). A random sample of 1,237 households was interviewed from the villages. At the village level, households were categorised into two categories, the first group consisted of those who were previously enrolled in the CHF "*iliyoboreshwa*" scheme (415 households) that were randomly selected for interview from the Insurance Management Information System (IMIS) database. While the second group were non-CHF members (822 households) that were randomly selected from a list of all households in the village, obtained from a village chairperson. At each household, the head of the household or his /her representative were interviewed to collect information on household demographic and economic characteristics, health care access and utilization. Demographic and economic characteristics included ownership of assets, household income and expenditure, and health insurance status. Recent health care utilization, illness episodes and health problems, reasons for not consulting health services; waiting times at healthcare facilities where care was sought, distance from the closest healthcare facility, trust to health care providers and exposure to health education were also assessed. Potential respondents aged 18 years and above were eligible to participate. In this study health education has been conceptualized as one of the strategies of health promotion intended to raise community awareness of relevant health issues and enhance knowledge in improving health such as preventing illness and seeking timely and appropriate health assistance.

Data collection and management

A team of six experienced supervisors, five district pharmacists and twenty-one enumerators were recruited for field data collection. In each district, a pharmacist and one enumerator conducted the health facility survey. Four enumerators implemented the household's survey. All supervisors, pharmacists and enumerators together with research scientists underwent a three days training session. Health facility and household survey tools were pre-tested villages in Dodoma rural district council that were included in the study sample. Open Data Kit (ODK)

technologies on Android mobile devices were used for data collection and management in both surveys. Data from both surveys were exported and analysed in STATA version 13.0. The household and healthcare facility response rate across all the district councils was 98.5 percent and 100 percent respectively.

Data from facility surveys were linked with data from household surveys conducted in the same geographical location. To this end, we first used the household information on place of residence (such as village and ward/street) to match households with facilities in the same village or area. Secondly, we then matched the two surveys using positioning system (GPS) coordinates of both health facilities and households' village to visualize the spatial distribution of households and health facilities using the ArcGIS software v10.5 (ESRI, Redland, CA, USA). The shapefiles of Dodoma region were obtained from the National Bureau of Statistics (http://www.nbs.go.tz/) and geo-processing was used to dissolve to the district level. The results for the second stage are presented in Figure 2: Map of Dodoma showing the distribution of healthcare facilities and households surveyed. 577 households out of 1,237 (47percent) surveyed households were successfully linked across six out of the seven district councils. We could not include one district, Chamwino, in the study due to the fact that none of the 20 facilities surveyed was in the catchment area of the households surveyed (232).

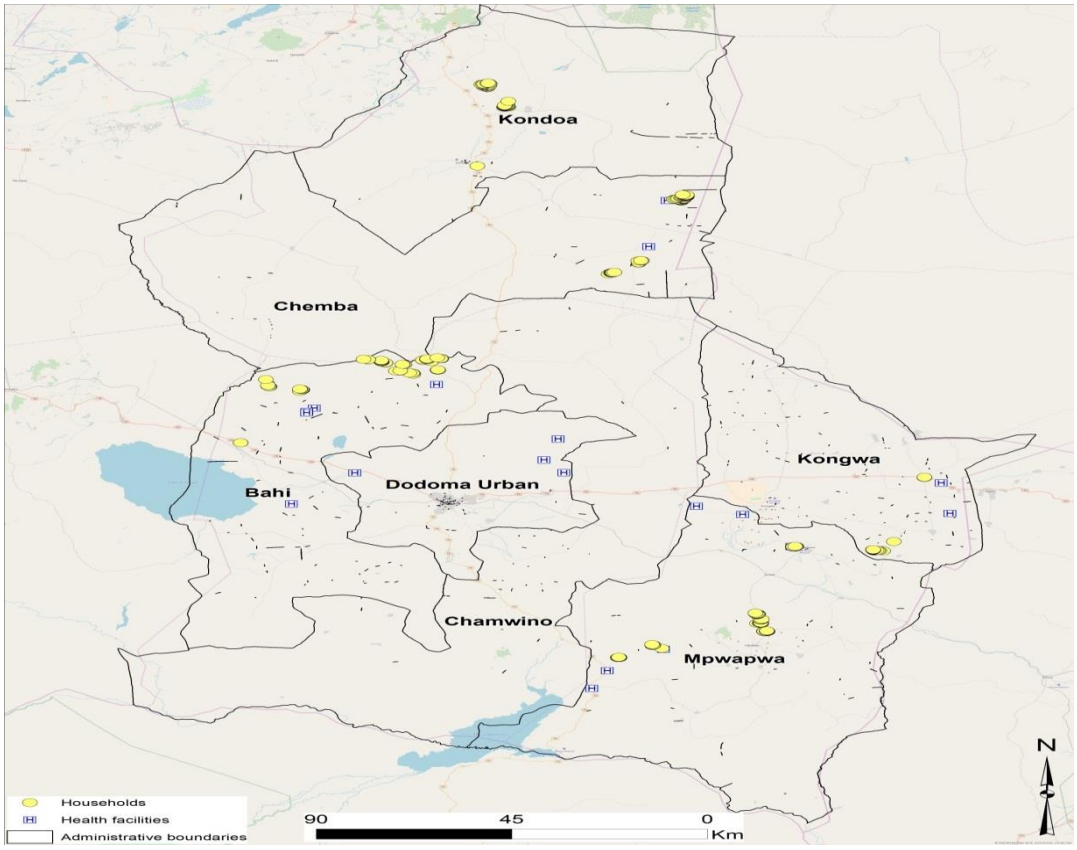


Figure 2: Map of Dodoma showing facility and households surveyed

Figure 2 showing visualization of the spatial distribution of households and health facilities the ArcGIS software v10.5 (ESRI, Redland, CA, USA) was applied. The image visualization of household and health facilities was enhanced by the background image from Open-Street-Map (© Open-Street-Map.

Analysis

Descriptive statistics

Descriptive statistics were generated for the health facility and household survey data. We computed frequencies and percentages of reported medicine availability/stock-outs considering facilities with and without any stock-out of medicines within the observation period of ninety days (three months). The mean value of medicines availability in the surveyed facilities was 0.73 with the minimum-maximum value of [0.22-1.00] (Supplementary material 1: Table S3).

Descriptive statistics were used to summarize household economic and demographic characteristics and healthcare utilization. We then used '*t-tests*' to assess whether the difference in proportions between districts for each variable was statistically significant. The descriptive statistics informed the variables (covariates) included in the multivariate logistic regression model, to assess the effects of medicines availability and stock-outs on health care utilization.

Empirical strategy

A 'Pearson's correlation' analysis was used to examine the strength and direction of the linear relationship between facilities without any stock-outs and household use of public health care facilities. We hypothesised that household healthcare utilization would be affected by a continuous availability of medicine and stock-outs. Other variables which could affect healthcare utilization included socio-demographic variables, CHF insurance coverage, level of trust in facility staff, receiving health care education, waiting time at the health facility, distance to the facility, chronic illness in at least one household member, and household income (Supplementary material 1: Table S6). Backward elimination was used to arrive at the final model, a technique in which variables with the highest p-values were eliminated one by one, conditional on the p-value being bigger than some pre-determined level ($p>0.60$). Furthermore, the models were subjected to a diagnostic test to ensure the model was correctly specified; we used the link test for model specification (Long & Freese, 2006). The regression analysis has been clustered at the facility level, relaxing the assumption of independence (C. Cameron & Miller, 2015).

We created a household wealth index including indicators relating to housing characteristics (water source, toilet type, nature of the flooring, nature of roof) and assets (electricity, radio, TV, mobile phone, car, refrigerator, bicycle) using polychoric principal component analysis (PCA) (Vyas & Kumaranayake, 2006). The constructed wealth index was used as a proxy measure of the household living standard; households were ranked according to the wealth index score and generated wealth quintiles of each household, five equally sized groups. Sampled households were classified according to the five wealth quintiles.

4.4 Results

Descriptive statistics

Availability of medicines in healthcare facilities

Table 3 presents results on the availability of eighteen tracer medicines in the sampled facilities along with the mean days of medicine stock-outs in the three months prior to the survey (Supplementary material 1: Table S5). Availability of ALU was generally high in all facilities in all districts above 85.7%. Availability of amoxicillin caps or cotrimoxazole tabs was above 70.0% in five districts, except Chemba district where availability was 57.8%. Availability of Amoxicillin syrup and cotrimoxazole suspension in all facilities in all districts was below 65%, with 73.3%, 70.6% and 68.4% of facilities in Kongwa, Bahi and Mpwapwa respectively experiencing stock-outs for more than fourteen days. We found that availability of Ceftriaxone 1g injection /250g injection in all facilities in all districts was above 85.0% in Chemba and Kondoa districts.

Availability of paracetamol 500mg tabs was generally high in all facilities in Kondoa and Chemba reaching 100.0%. However, it was lower in Bahi and Mpwapwa, below 50.0%, with several facilities reporting stock-out for more than fourteen days (53.3% and 31.6% respectively). Availability of oxytocin injection was generally high in all facilities in all districts above 85.6%. A hundred per cent availability of DTP vaccine was reported in Kondoa, Kongwa and Chemba district councils.

Table 3: Availability of medicine for the last three months prior to the date of the survey

District name	Kondoa	Kongwa	Dodoma City	Bahi	Mpwapwa	Chemba	Total
n = number of facilities	n=8	n=17	n=14	n=15	n=19	n=16	N=89
No stock-out was observed for 90 days,%							
Artemether/Lumefantrine (ALU) oral, **	100.0	100.0	85.7	100.0	94.7	100.0	96.6
Quinine injection or Artesunate injection, *	62.5	70.6	64.3	93.3	89.5	93.7	80.9
Amoxicillin caps or Cotrimoxazole tabs, **	87.5	70.6	85.7	93.3	57.8	93.1	79.8
Amoxicillin syrup or Cotrimoxazole suspension,	62.5	29.4	42.9	20.0	31.6	56.3	38.2
Benzyl Penicillin 5MU injection, **	87.5	41.2	35.7	80.0	73.7	93.6	67.4
Ceftriaxone 1g injection /250g injection, ***	87.5	52.9	64.3	53.3	52.6	93.6	65.2
Mebendazole or Albendazole tabs, **	87.5	64.7	78.6	86.7	52.6	81.3	73.0
Griseofulvin oral or Clotrimoxazole cream, ***	87.5	17.6	64.3	60.0	73.7	75.0	60.7
Metronidazole tabs, **	100.0	76.5	78.6	100.0	63.2	100.0	84.3
ORS sachet, **	87.5	64.7	64.3	73.3	57.8	93.7	71.9
Paracetamol 500mg tabs, ***	100.0	64.7	71.4	33.3	47.4	100.0	66.3
Medroxyprogesterone acetate (depo) injection, **	100.0	94.1	100.0	93.3	73.7	100.0	92.1
Oxytocin injection, **	100.0	100.0	85.7	100.0	100.0	100.0	97.8
Ferrous salt and folic acid, ***	50.0	11.8	50.0	26.7	31.6	0.0	25.8
Vaccine e.g. DTP vaccine, **	100.0	100.0	78.6	93.3	89.4	100.0	93.3
Ophthalmologic drops or cream, **	87.5	58.8	71.4	53.3	84.2	100.0	75.3
Dextrose 5% or DNS or Ringer solution, ***	87.5	64.7	64.3	93.3	42.1	100.0	73.0
Adrenaline Injection, ***	87.5	52.9	57.1	80.0	100.0	93.6	78.6

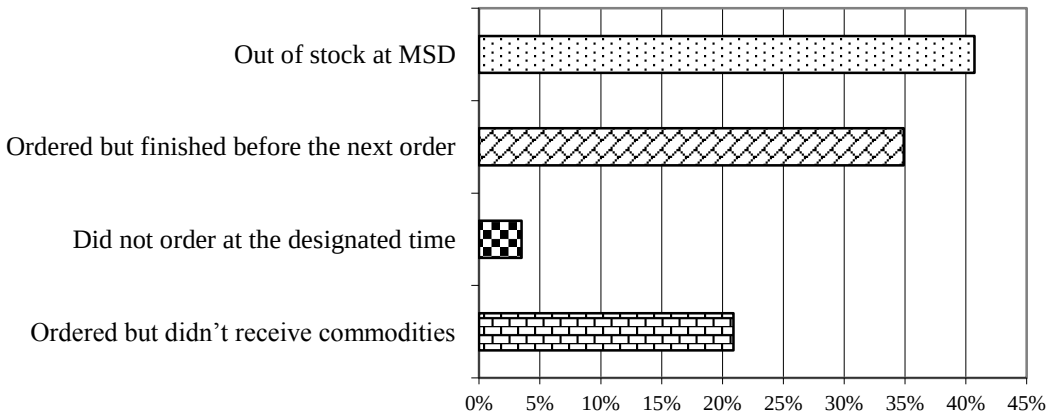
Note: *** denotes significance at 1%, ** at 5%, and * at 10% level

Availability of ferrous salt and folic acid was below 52.0% across all the facilities in all the districts, and most facilities reported stock-outs of more than fourteen days. About 41.2% and 35.7% of facilities in Kongwa and Dodoma City, respectively experienced stock-out of adrenaline injection that lasted more than fourteen days.

Availability of individual medicines by facility-level over the observed period of three months is presented in supplementary material 1, Table S1. The availability of most medications varied substantially across facility levels. All health centres had 100.0% availability of ALU, while 96.2% of the dispensaries had ALU. Mebendazole was available in 72.7% of health centres and 73.1% of dispensaries. All health centres had a 63.5% availability of paracetamol, compared with 66.7% of dispensaries. Only 28.2 % of dispensaries and 9.1% of the health centre had ferrous salt in stock.

Out of 89 healthcare facility surveyed the most commonly reported reasons for the medicines stock-out were lack of availability of medication at MSD (40.7%), use of all stocked medicines before the next order arrived (34.9%), failure to receive medicines that had been ordered (20.9%), and failure of the facility to send orders at the designated time (3.5%) (Figure 3).

Figure 3: Reasons for the out of stock for the past three months



Household's demographic and socio-economic characteristics

Table 4 presents information on the participant's demographic and socioeconomic characteristics. The majority of the surveyed households were male-headed (68.6%). The average age of respondents was 49.6 years [standard deviation, SD: 16.2]. Most heads of the households were aged between 46-64 (31.3%) years, or between 36 – 45 years (26.2%). Few households were headed by someone below 25 years of age (5.2%). Most of the heads of households (68.3%) had attended primary school up to grade five while few (5.7%), had secondary education and above, and 26.0% had not attended formal education. About half (48.9%) heads of households were farmers, 24.3% were not employed and very few (2.4%) were employed in a formal sector position. The majority (58.4%) of respondents were not married. 75.6% of respondents reported their health as "good" while few (1.9%) reported "bad" health status. The average household size across all the district councils was 4.5 people [SD: 1.9] (Table 4).

Table 4: Demographic and Socio-Economic Characteristics of the Respondents.

Variable	Kondoa N= 79	Kongwa N=24	Dodoma City N=200	Bahi N=65	Mpwapwa N=129	Chemba N=80	Total N=577
Gender of head of household	n (%)	n (%)	n (%)	n(%)	n (%)	n (%)	n(%)
Male	45(56.0)	8(33.3)	123(61.5)	53(81.5)	93(72.1)	66(82.5)	396(68.6)
Female	34(43.9)	16(66.7)	77(38.5)	12(18.5)	36(27.9)	14(17.5)	181(31.4)
Age Categories of head of household							
< = 25	0(0.0)	3(12.5)	13(6.5)	5(7.7)	5(3.9)	4(5.0)	30(5.2)
26 – 35	5(6.3)	3(12.5)	39(19.5)	14(21.5)	23(17.8)	15(18.7)	99(17.2)
36 – 45	17(21.5)	6(25.0)	47(23.5)	18(27.7)	40(31.0)	23(28.7)	151(26.2)
46 – 64	27(34.2)	12(50.0)	58(29.0)	21(32.3)	34(26.4)	29(26.3)	181(31.4)
> =65	30(38.0)	0(0.0)	43(21.5)	7(10.8)	27(20.9)	9(11.3)	116(20.0)
Mean (years)[sd]	60[17.9]	45[10.4]	49[16.2]	45[14.0]	48[115.8]	46[13.3]	49.6[16.2]
Education Level of head of household							
No education	35(44.3)	5(20.8)	42(21.0)	24(36.9)	32(24.8)	12(15.0)	150(26.0)
Primary up to grade five	43(54.4)	18(75.0)	133(66.5)	41(63.1)	95(73.6)	64(80.0)	394(68.3)
Secondary and Above	1(1.3)	1(4.2)	25(12.5)	0(0.0)	2(1.6)	4(5.0)	33(5.7)
Occupation of head of household							
Formal employed	0(0.0)	0(0.0)	7(3.5)	1(1.5)	3(2.3)	3(3.7)	14(2.4)
Farmer	39(49.4)	21(87.5)	39(19.5)	57(87.7)	73(56.6)	53(66.3)	282(48.9)
Self-Business	8(10.1)	0(0.0)	94(47.0)	1(1.5)	27(20.9)	11(13.7)	141(24.4)
Not employed	32(40.5)	3(12.5)	60(30.0)	6(9.2)	26(20.2)	13(16.3)	140(24.3)
Marital status							
Married	57(72.2)	13(54.2)	74(37.0)	39(60.0)	43(33.3)	51(63.7)	240(41.6)
Not married	22(27.8)	11(45.8)	126(63.0)	26(40.0)	86(66.7)	29(36.3)	337(58.4)

Health status of head of household							
Good	53(67.1)	19(79.2)	143(71.5)	53(81.5)	105(79.1)	66(82.5)	436(75.6)
Average	25(31.6)	5(20.8)	50(25.0)	11(16.9)	25(19.4)	14(17.5)	130(22.5)
Bad	1(1.3)	0(0.0)	7(3.5)	1(1.5)	2(1.5)	0(0.0)	11(1.9)
Number of people in the household							
<=2	17(21.5)	1(4.2)	33(16.5)	4(6.2)	17(13.2)	14(17.5)	86(14.9)
3 – 4	30(38.0)	6(25.0)	75(37.5)	18(27.7)	66(51.2)	30(37.5)	225(38.9)
5 – 6	23(29.1)	13(54.2)	55(27.5)	32(49.2)	31(24.0)	27(33.7)	181(31.4)
>=7	9(11.4)	4(16.6)	37(18.5)	11(16.9)	15(11.6)	9(11.3)	85(14.7)
Average House Hold size [SD]	4.2[1.8]	5.0[1.4]	4.6[2.0]	5.0[1.7]	4.2[1.7]	4.4[2.1]	4.5[1.9]
CHF Insurance Status							
CHF insured	72(91.1)	9(37.5)	41(20.5)	8(12.3)	25(19.4)	2(2.5)	157(27.2)
Not insured	7(8.9)	15(62.5)	159(79.5)	57(87.7)	104(80.6)	78(97.5)	420(72.8)
Social Economic Status							
S1 (Poorest), (%)	35(44.3)	1(4.2)	48(24.0)	5(7.7)	24(18.6)	12(15.0)	125(21.7)
S2, (%)	13(16.5)	7(29.2)	21(10.5)	25(38.5)	7(5.4)	22(27.5)	95(16.5)
S3, (%)	10(12.7)	9(37.5)	30(15.0)	24(36.9)	44(34.1)	31(38.7)	148(25.6)
S4, (%)	9(11.4)	5(20.8)	38(19.0)	7(10.8)	34(26.4)	8(10.0)	101(17.5)
S5 (Non-poor), (%)	12(15.1)	2(8.3)	63(31.5)	4(6.2)	20(15.5)	7(8.8)	108(18.7)

Household health care utilization

Among the households which were successfully linked with the health facility providing services in their region, 255 (44.2%) reported an illness episode of a household member in the last three months before the survey. The reported causes of illness were: chest and related diseases (20.3%), malaria (18.0%), and typhoid and stomach-related diseases (12.9%). Out of 255 households, about 7.8% reported a member with non-communicable diseases (NCDs – point prevalence) such as cancer, hypertension and diabetes (7.8%), fever (5.5%), illness related to eyes and ears (3.9%), urinary tract infection (3.1%), while the health problem could not be specified for 12.2% (Table 5).

Of the 255 who reported illness, 200 (78.4%) sought care from a health care provider. 52.0% of them sought health care from public dispensary or health centre, while 17.0% from a public hospital, 14.0% sought care from pharmacy/drugstore, 8.0% from a private hospital, 6.0% sought care from private doctor/clinic, 2.0% sought care from local doctor, and 1% sought care from traditional healer (Table 5).

The reasons given for not seeking care were: the health problem was not considered serious (5.5%); no drugs were available in the area (5.5%); participant perceived that consultation and drugs were too expensive (5.5%); participant expected to recover without treatment (1.8%); individual had knowledge on how to deal with the health problem and took self-treatment (23.6), and the remaining 58.2% did not report a reason for not seeking care with illness (Table 5).

Table 5: Health Care Utilization

Illness episode last three months	**Kondoa 79**	**Kongwa 24**	**Dodoma City 200**	**Bahi 65**	**Mpwapwa 129**	**Chemba 80**	**Total 577**
	n(%)	n(%)	n(%)	n(%)	n(%)	n(%)	n(%)
Household reported any illness case	44(55.7)	10(41.7)	78(39.0)	33(50.8)	55(42.6)	35(43.7)	255(44.2)
Type of Illness episode reported							
Malaria	10(22.7)	3(30.0)	9(11.5)	3(9.1)	12(21.8)	9(25.7)	46(18.0)
Urinary tract infection	1(2.3)	1(10.0)	3(3.8)	0(0.0)	1(1.8)	2(5.7)	8(3.1)
Eyes and Ears	3(6.8)	0(0.0)	4(5.1)	1(3.0)	2(3.6)	0(0.0)	10(3.9)
Fever	5(11.4)	0(0.0)	3(3.8)	3(9.1)	1(1.8)	2(5.7)	14(5.5)
Typhoid and stomach related diseases	6(13.6)	1(10.0)	14(17.9)	4(12.1)	2(3.6)	6(17.1)	33(12.9)
Chest related diseases	13(29.6)	3(30.0)	12(15.4)	4(12.1)	10(18.2)	11(31.4)	53(20.3)
Cancer, Pressure and Diabetes (NCDs)	1(2.3)	0(0.0)	15(19.2)	0(0.0)	3(5.5)	1(2.8)	20(7.8)
Others	5(11.4)	2(0.0)	17(21.8)	2(6.1)	10(18.2)	4(11.4)	40(15.7)
No information on the type of illness	0(0.0)	0(0.0)	1(1.3)	16(48.5)	14(25.5)	0(0.0)	31(12.2)
Household sought help	36(81.8)	10(100)	70(89.7)	15(45.5)	37(67.3)	32(91.4)	200(78.4)
Where did s/he go for treatment							
Public Dispensary or Health Centre	30(81.1)	8(80.0)	16(22.9)	9(60.0)	22(61.1)	19(59.4)	104(52.0)
Private Doctor/clinic	0(0.0)	0(0.0)	7(10.0)	0(0.0)	5(13.9)	0(0.0)	12(6.0)
Public hospital	2(5.41)	0(0.0)	20(28.6)	3(20.0)	5(13.9)	4(12.5)	34(17.0)
NGO or Trust hospital/clinic	0(0.0)	0(0.0)	1(1.4)	0(0.0)	0(0.0)	0(0.0)	1(0.5)
Private Hospital	0(0.0)	0(0.0)	10(14.3)	1(6.7)	0(0.0)	1(3.1)	15(7.5)
Traditional healer	0(0.0)	0(0.0)	1(1.4)	1(6.7)	3(8.3)	0(0.0)	2(1.0)
Pharmacy/drugstore	5(13.5)	2(20.0)	14(20.0)	1(6.7)	0(0.0)	6(18.7)	28(14.0)
Home treatment	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
Local Doctor	0(0.0)	0(0.0)	1(1.4)	0(0.0)	1(2.8)	2(6.3)	4(2.0)
The reason that the sufferer not sought care							

Ailment not considered serious	1(14.3)	0(0.0)	0(0.0)	1(5.6)	1(5.6)	0(0.0)	3(5.5)
Expected to become better without treatment	0(0.0)	0(0.0)	0(0.0)	0(0.0)	1(5.6)	0(0.0)	1(1.8)
No drugs available in the area	1(14.3)	0(0.0)	0(0.0)	0(0.0)	2(11.1)	0(0.0)	3(5.5)
Did not believe it would help	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
Consultation &drugs too expensive	0(0.0)	0(0.0)	3(37.5)	0(0.0)	0(0.0)	0(0.0)	3(5.5)
Took self-treatment	4(57.1)	0(0.0)	4(50.0)	1(5.6)	1(5.6)	3(100)	13(23.6)
No reason given	2(14.3)	0(0.0)	1(12.5)	16(88.8)	13(72.2)	0(0.0)	32(58.2)

Multivariate logistic regression

The link-test showed that the model was correctly specified (supplementary material 1: Table S5). Table 6 presents a multivariate logistic regression analysis on the effects of medicine availability on the household's health care utilization. Results show that households with self-reported good health status were two times (odds ratio – OR 1.80; 95% CI: 1.06-3.05; p~0.029) as likely to seek care from formal healthcare providers compared to respondents that reported bad health status. Households that had received health education interventions were more than 2.7 times as likely (OR, 2.75 CI: 1.84-4.08; p ~ 0.000) to seek health care services as were those who had not received health education. Results on pairwise correlation matrix showed a positive and significant association between the health care utilization and with facilities without any stock-outs (0.197) together with less waiting time at the facility (0.136), while a negative association was observed with minutes taken to reach at the healthcare facility when accessing healthcare services (-0.040) (supplementary material 1: Table S4). Regression results showed that households that reported less than sixty minutes of wait time during the previous health care facility visit were more likely to have sought care than those that waited more than sixty minutes (OR, 2.02, 95% CI, 0.75-5.44; p ~ 0.167). In addition, households that were member of a community health insurance fund (CHF) were two times as likely to seek care from a formal provider than those not registered (OR, 1.97; 95% CI, 1.23-3.17; p ~ 0.000).

Distance to the healthcare facility was found to influence the likelihood of seeking health care services: households residing less than 5 kilometres from a facility were 1.6 times more likely to seek care than those residing more than five kilometres from the healthcare facility though not statistically significant (OR 1.62, 95% CI: 0.74-5.44; p ~ 0.225). Lastly, household healthcare utilization was positively and significantly associated with continuous availability of all essential medicines for the surveyed facilities (OR 3.49, 95% CI: 1.02-12.04; p ~ 0.047).

Table 6: Multivariate logistic regression on the effects of medicines availability on health care utilization

Variable	Univariate Analysis (255)		Multivariate Analysis (255)	
Odds Ratio (Confidence interval)	OR (95% CI)	p-value	OR (95% CI)	p-value
Age of Respondents	0.998(0.98-1.02)	0.869	0.992(0.97-1.01)	0.441
Household head being male	1.185(0.69-2.03)	0.538	1.365(0.43-4.25)	0.591
Household head being married	0.629(0.33-1.20)	0.161	0.532(0.24-1.15)	0.107
Household self-reported good health status, **	1.737(1.08-2.78)	0.021	1.801(1.06-3.05)	0.029
Household being a CHF membership, **	2.212(1.11-4.42)	0.024	1.974(1.23-3.17)	0.005
Level of trust to facility staffs being great	1.359(0.82-2.25)	0.234	1.307(0.76-2.24)	0.338
Household head received health care education, ***	1.912(1.23-2.98)	0.004	2.745(1.84-4.08)	0.000
Waiting time at the health facility less than 60 minute	1.783(0.85-3.74)	0.126	2.015(0.75-5.44)	0.167
Distance to the facility less than 5 kilometres	1.107(0.56-2.19)	0.769	1.624(0.74-3.54)	0.225
Minutes to the closest facility	0.998(0.99-1.00)	0.558		
Household with at least one person with chronic illness	0.856(0.60-1.22)	0.397	0.872(0.54-1.40)	0.575
Facilities without any stock-outs for the past 3 months, **	4.869(1.75-20.18)	0.029	3.496(1.02-12.04)	0.047
Household size	0.994(0.89-1.11)	0.909	0.986(0.77-1.26)	0.908
Wealth index value (proxy of income)	0.868(0.76-0.99)	0.043	0.908(0.80-1.02)	0.116
Total number of staffs	1.089(0.79-1.49)	0.596		
TASAF beneficiary	1.856(0.79-4.35)	0.154	0.991(0.50-1.95)	0.978
Waiver/Exemption of any household member	1.117 (0.56-2.21)	0.751	1.056(0.49-2.28)	0.889
Constant			0.131(0.03-0.59)	0.010
Number of observations			251	
Wald chi2(14)			1596.77	
Prob > chi2			0.000	
Pseudo R2			0.1117	

Note, *** denotes significance at 1%, ** at 5%, and * at 10% level (corresponds to the multivariate results)

4.5 Discussion

This study assessed medicine availability and stock-outs in public health facilities and examined the effects of medicines availability on health care utilization in six districts of Dodoma region in Tanzania. We found that the availability of most tracer medicines was relatively good, with continuous availability of approximately 70% of the medicines assessed over a three months period, much higher compared to the findings in Malawi where overall availability of medicines in public facilities was less than fifty per cent (Khuluza & Haefele-Abah, 2019). Frequent stock-outs (5/18) were found for a few medicines, such as amoxicillin syrup or cotrimoxazole suspension, paracetamol tabs and ferrous salt and folic acid. This trend varied across facility types and across the districts. Medicine stock-outs at facilities were frequently due to the failure of the health facility to plan for needed refills and to stock-outs at the central medical store department.

Medicines such as paracetamol, ferrous salt and folic acid availability were low compared to the reported estimated in low and middle-income countries such as Nigeria (Sun et al., 2018), Malawi (Khuluza & Haefele-Abah, 2019) and Ethiopia (Sado & Sufa, 2016). The reported causes for regular stock-outs at health facility level were related to procurement inefficiencies, staff ability to forecast needs and requisitioning of medical commodities (Walker & Ozawa, 2011). Therefore, improvements in communication, forecasting and ordering procedures at healthcare facilities are necessary for addressing such inefficiencies (Soyiri & Reidpath, 2013).

We found that the majority of households reported having sought care from public healthcare facilities, similarly to the findings of other studies (Basu, Andrews, Kishore, Panjabi, & Stuckler, 2012; Ngugi et al., 2017). This finding shows the importance of the public sector in the provision of healthcare services, especially for the marginalized population. Among the prerequisites for universal health coverage include ensuring availability of high-quality medicines in the public facilities, rational prescribing, strengthening the community and peripheral health facility level (WHO, 2012). The results of these studies indicated that the continued availability of essential medicines at the facility may influence the use of public health facility services.

The association between distance from a health facility and the use of health services was not statistically significant. Other recent studies found that living in the proximity (less than one hour walking time) of a health facility increases the probability of household health care utilization (Anselmi et al., 2015; Khuluza & Haefele-Abah, 2019), whereas in Vietnam those

living less than one kilometre were three times likely to utilize healthcare services compared to those residing more than one kilometre from the facility (Tran et al., 2016). Waiting time was found to influence health care utilization as reported in other settings (Afolabi, Daropale, Irinoye, & Adegoke, 2013; Sado & Sufa, 2016). In our analysis, we assessed waiting time as measured in terms of how long a client normally wait until s/he gets treatment contrary to that of Nigeria which was measured in terms of a four point's Likert-scale (Afolabi et al., 2013) and Laos which participants rated long clinic waiting time as one of the barriers in seeking treatment at the facilities (Phrasisombath, Thomsen, Sychareun, & Faxelid, 2012). Irrespective of the methodology used to assess the effect of waiting time on health care utilization, findings tend to be similar. In contrast, easy access, shorter waiting time and longer or flexible opening hours have been demonstrated to increase the use of formal health care services (Sado & Sufa, 2016; B. Shaikh & J. Hatcher, 2005).

We could not find an association between trust in health care providers and use of health services as it was found by other studies (Dawson-Rose et al., 2016; Trachtenberg, Dugan, & Hall, 2005). Trust in providers influences both healthcare-seeking, and influences patient engagement, participation in care, and treatment adherence (Mkoka et al., 2014). A high level of trust between the client and the provider induces people to utilize healthcare services from a given facility (Russell, 2005). Trust is defined as the household's perceived technical competence of the healthcare provider (face-to-face interaction) (Dawson-Rose et al., 2016; Russell, 2005) as well as inter-personal dimensions of quality of care (Russell, 2005). Stock-outs of medicines at the healthcare facility affects the quality of healthcare services which in turn undermine the trust which the population has in the health services influencing health-seeking behaviour (Mkoka et al., 2014).

We found an association between health education and healthcare utilization from the study area. As documented elsewhere, health education impacts household knowledge and willingness to seek healthcare services from formal health care providers (Jibril et al., 2017; Oladipo, 2014). Raising community awareness of health issues, illness prevention and encouragement of timely care-seeking, in turn, improve health outcomes.

Similar to the findings of other studies (Ahmed et al., 2018; Atnafu et al., 2018), we have found that community health fund beneficiaries were more likely to seek healthcare in formal settings as compared to non-insured households. Financial protection is crucial in achieving universal health coverage, implying the absence of (substantial) out-of-pocket payments when accessing

healthcare services (Abiiro, Mbera, & De Allegri, 2014; Ataguba & Ingabire, 2016). Insured households are less likely to delay care-seeking, borrow or sell their valuable assets, or incur income loss when accessing care (Abiiro et al., 2014). The government of Tanzania within its Health Sector Strategic Plan for 2015–2020 made commitments towards universal healthcare through social health insurance (URT, 2015). The health financing strategy includes the scale-up the coverage of redesigned community health funds (the so-called "CHF iliyoboreshwa") with the aim of reaching all households. It is anticipated that the uptake of "CHF iliyoboreshwa" will improve household access to care as well as facility revenue. In turn, facilities could use the CHFs revenue, together with other cost-sharing mechanisms, to improve quality-of-care through procurement of medical commodities (medicines, medical equipment, and medical supplies) (Wiedenmayer et al., 2019).

The results presented here should be considered alongside a few important limitations. First, we were unable to link data from many of the households with facility-level data. This might lead to potential selection bias if the households we were able to link are systematically different from households we were unable to link. It could also influence the generalizability of the findings across the region. Additionally, our study focused specifically on facilities in the public sector although households may seek care and services from the private sector too. The study focused only on the availability of medicines, as medical supplies and equipment data was limited. Lastly, respondents provided responses based on their past experiences and it is possible that responses were subject to some recall errors.

4.6 Conclusion

This study showed that the availability of most tracer medicines was relatively good (compared to other studies in the region), although there were frequent stock-outs of a few medicines and wide variation across health facilities and district councils. Medicine availability was associated with higher use of health care services indicating it may play an important role in influencing household utilization of health care services in Tanzania. The results of this study highlight the importance of efficient coordination, planning and medicine supply management between the facility and the national supply chain. A better understanding of factors contributing to the performance of the Jazia-PVS is crucial for improvement in medicines availability at the facilities. In addition, providers should also consider the availability of healthcare services within a reasonable time as a way of shortening waiting time at the point of service. Moreover, healthcare providers should continue to provide healthcare education to the community to raise community awareness of relevant health issues and enhance knowledge in seeking timely and appropriate health assistance, along with community sensitization on the importance of health insurance in accessing health care services and avoiding health-related financial hardship.

4.7 Acknowledgement

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Supplementary Tables

Table S1: Proportions of medicine availability by facility level

Medicine Availability	**Facility-level**		
No stock-out was observed for 90 days,%	Dispensary (78)	Health Centre (11)	Total (89)
Artemether/Lumefantrine (ALU) oral	96.2	100.0	96.6
Quinine injection or Artesunate injection.	79.5	90.9	80.9
Amoxicillin caps or Cotrimoxazole tabs	79.5	81.8	79.8
Amoxicillin syrup or Cotrimoxazole suspension,	37.2	45.5	38.2
Benzyl Penicillin 5MU injection, *	64.1	90.9	67.4
Ceftriaxone 1g injection /250g injection	64.1	72.7	65.2
Mebendazole or Albendazole tabs	73.1	72.7	73.0
Griseofulvin oral or Clotrimoxazole cream	60.3	63.6	60.7
Metronidazole tabs	82.1	100.0	84.3
ORS sachet	71.8	72.7	71.9
Paracetamol 500mg tabs	66.7	63.6	66.3
Medroxyprogesterone acetate (depo) injection,	91.0	100.0	92.1
Oxytocin injection	98.7	90.9	97.8
Ferrous salt and folic acid	28.2	9.1	25.8
Vaccine e.g. DTP vaccine	92.3	100.0	93.3
Ophthalmologic drops or cream	74.4	81.8	75.3
Dextrose 5% or DNS or Ringer solution	73.1	72.7	73.0
Adrenaline Injection, *	75.6	100.0	78.7

Note: *** denotes significance at 1%, ** at 5%, and * at 10% leve

Table S2: Average number of days experienced stock-out

Medicine and medical supplies District Council (n)	Kondoa (8)	Kongwa (17)	Dodoma City (14)	Bahi (15)	Mpwapwa (19)	Chemba (16)	Total (89)
Days ALU stock-out , mean [sd]	0.0[0.0]	0.0[0.0]	0.1[0.4]	0.0[0.0]	4.6[20.2]	0.0[0.0]	1.0[9.3]
Days Quinine/ Arthsunate inj stock-out , mean [sd]	29.4[42.0]	22.8[39.0]	15.1[31.4]	6.0[23.2]	4.7[20.2]	1.5[6.0]	11.7[28.7]
Days Amoxicillin caps stock-out , mean [sd]	3.8[10.6]	13.1[24.7]	5.8[15.3]	5.0[19.4]	9.0[15.7]	0.3[1.0]	6.6[16.8]
Days Amoxicillin syrup or Cotrimoxazole stock-out , mean [sd]	13.0[27.6]	63.5[42.3]	19.8[23.4]	40.9[31.5]	44.7[40.1]	15.6[26.8]	35.7[37.5]
Days Benzyl Penicillin stock-out , mean [sd]	0.9[2.5]	38.4[40.4]	23.027.8 [ ]	8.0[17.8]	4.2[8.5]	5.0[20.0]	14.2[27.0]
Days Ceftriaxone stock-out , mean [sd]	11.3[31.8]	33.5 [42.6]	12.6[24.7]	31.5[40.1]	36.5[41.0]	5.6[22.5]	23.5[36.7]
Days Mebendazole stock-out , mean [sd]	0.1[0.4]	28.2[41.7]	13.7 [32.1]	3.4[9.1]	36.3[42.9]	13.1[30.9]	18.2[34.4]
Days Griseofulvin stock-out , mean [sd]	0.9[2.5]	67.1[37.5]	15.9[28.5]	15.4[26.1]	19.1[34.5]	18.6[36.1]	25.4[37.3]
Days Metronidazole stock-out , mean [sd]	0.0[0.0]	7.2[22.0]	8.8[19.6]	0.0 [0.0]	14.9[24.4]	0.0[0.0]	6.0[17.4]
Days ORS stock-out , mean [sd]	0.9[2.5]	18.4[34.7]	9.3[20.0]	9.3[20.5]	33.7[41.6]	0.3[1.3]	13.9[29.1]
Days Paracetamol stock-out , mean [sd]	0.0[0.0]	8.2[16.8]	6.3[15.4]	22.7[23.8]	13.9[20.5]	0.0[0.0]	9.3[18.0]
Days Medroxyprogesterone stock-out , mean [sd]	0.0[0.0]	5.3[21.8]	0.0[0.0]	1.3 [5.2]	5.9[12.6]	0.0[0.0]	2.5[11.4]
Days Oxytocin stock-out , mean [sd]	0.0[0.0]	0.0[0.0]	5.6[15.7]	0.0[0.0]	0.0[0.0]	0.0[0.0]	0.9 [6.4]
Days Ferrous salt stock-out , mean [sd]	21.4[34.4]	64.1[35.0]	20.5[30.3]	41.1[37.4]	53.3[40.3]	68.1[23.0]	47.9[37.7]
Days Vaccine stock-out , mean [sd]	0.0[0.0]	0.0[0.0]	2.9[5.9]	0.9[3.4]	1.1[4.4]	0.0[0.0]	0.8[3.4]
Days Ophthalmologic stock-out , mean [sd]	11.3[31.8]	32.4[43.5]	15.6[31.9]	25.7[36.3]	13.9[33.0]	0.0[0.0]	16.9[33.5]
Days Dextrose stock-out , mean [sd]	11.3 [31.8]	30.0[42.4]	15.0[32.3]	2.0[7.7]	38.2[38.1]	0.0[0.0]	17.6[33.1]
Days Adrenaline stock-out , mean [sd]	11.3[31.8]	32.4[41.3]	32.5[43.9]	8.7[23.9]	0.0[0.0]	3.9[15.5]	14.5[31.5]

Note: *** denotes significance at 1%, ** at 5%, and * at 10% level

Table S3: The distribution of the index by facility level

Medicine Availability	Facility-level		
	Dispensary	Health Centre	Total
No stock-out was observed for 90 days	0.730[0.22-1.00]	0.783 [0.55-0.94]	0.735[0.22-1.00]

Table S4: Correlation Matrix

Variable	A	B	C	D
Health care utilization (A)	1			
Medicine availability (no stock-outs) (B)	0.197*	1		
Less waiting time at the health care facility (C)	0.136*	0.049	1	
Minutes taken by the household to reach a health care facility (D)	-0.040	0.153	0.178	1

Pair-wise correlations test - * Significant at 10%; ** significant at 5%; *** significant at 1%

Table S5: Linktest results (main results in Table 5)

	OR (95% CI)	p-value
_hat	0.984(0.56-1.40)	0.000
_hatsq	0.023(-0.36-0.31)	0.894
_constant	0.011(-0.32-0.34)	0.950
Number of observations	251	
LR Chi^2	37.91	
Prob > chi^2	0.000	
Pseudo R2	0.112	

Table S6: Description of independent variables hypothesized to explain health care utilization

Variable	Measurement	Hypothesis
Household health care utilization	1= if household reported having sought care to any formal healthcare facility, 0 otherwise	
Age of Respondents	Household age in years	No prior hypothesis
The household head being male	1= if the head of the household was male, 0 otherwise	Male-headed households are more likely to utilize health care services
The household head being married	1= if the head of household reported being married, 0 otherwise	Married headed households are more likely to utilize health care services
Household self-reported good health status	1= if the head of household reported his/her health status was good, 0 otherwise	Households reporting good health care services are less likely to utilize health care services
Household being a CHF membership	1= if the household is insured by community health fund CHF, 0 otherwise	Married headed households are more likely to utilize health care services
Level of trust to facility staffs being great	1= if the household reported greater trust to the health care staffs, 0 otherwise	An individual who trusts providers is more likely to utilize health care services
Household head received health care education	1= if the household received health care education, 0 otherwise	People receiving health care educations are likely to utilize health services because they are more aware of the importance of health care.
Waiting time at the health facility less than 60 minutes	1= if the household reported less than 60 minutes before entering doctors' room, 0 otherwise	Households reporting less waiting time are more likely to utilize health care services
Distance to the facility less than 5 kilometres	1= if the household reported less than 5 km from a healthcare facility, 0 otherwise	Households reporting less little distance to the healthcare facility are more likely to utilize health care services
A household with at least one person with a chronic illness	1= if the household reported having at least one person with any chronic illness, 0 otherwise	Households with any person with chronic illness are more likely to utilize health care services

Medicine availability (no stock-outs)	Measured as continuous [mean scores across eighteen tracer medicines for each health facility surveyed]	Came from health facility level measured as the continuous availability of medicines at the healthcare facility increases healthcare utilization
Household size	Number of people who eat and sleep within the house	No prior hypothesis
Total number of staffs	Total number of staffs with any medical training working in a given facility	No prior hypothesis
TASAF beneficiary	1= if a household receives social support from Tanzania Social Action Fund (TASAF), 0 otherwise	No prior hypothesis
Waiver/Exemption of any household member	1= if a household has been exempted/waived from paying out of pocket payment when accessing health care based on Tanzanian health policy, 0 otherwise	Households with waiver/exemption are more likely to utilize health care services
Wealth index value (a proxy of income)	Measured as continuous based on the principal component analysis	Households with income are more likely to utilize health care services

5. The role of accountability in the performance of Jazia prime vendor system in Tanzania[8]

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5.1 Abstract

Access to safe, effective, quality and affordable essential medicines for all is a central component of Universal Health Coverage (UHC). However, the availability of quality medicines in peripheral healthcare facilities is often limited. Several countries have developed integrated complementary pharmaceutical supply systems to address the shortage of medicines. Nevertheless, there is little evidence on how accountability contributes to the performance of such complementary pharmaceutical supply systems in low-income settings. The current study analyses how accountability mechanisms contributed to the performance of Jazia Prime Vendor System (Jazia PVS) in Tanzania.

Methods

The study analysed financial, performance and procedure accountability as defined in Boven's accountability framework. We conducted thirty in-depth interviews (IDIs), seven group discussions (GD) and fourteen focus group discussions (FGDs) in 2018 in four districts that implemented Jazia PVS. We used a deductive and inductive approach to develop the themes and framework analysis to summarize the data.

Results

The study findings revealed that a number of accountability mechanisms implemented in conjunction with Jazia PVS contributed to the performance of Jazia PVS. These include inventory and financial auditing conducted by district pharmacists and the internal auditors, close monitoring of standard operating procedures by the prime vendor regional coordinating office and peer cascade coaching. Furthermore, the auditing activities allowed identifying challenges of delayed payment to the vendor and possible approaches for mitigation while peer cascade coaching played a crucial role in enabling staff at the primary facilities to improve skills to oversee and manage the medicines supply chain.

Conclusion

Financial, performance and procedure accountability measures played an important role for the successful performance of Jazia PVS in Tanzania. The study highlights the need for capacity building linked to financial and supply management at lower-level health facilities, including health facility governing committees, which are responsible for priority-setting and decision-making at the facility level.

Keywords: accountability, medicines, performance, prime vendor system, Tanzania

5.2 Introduction

Access to safe, effective, quality and affordable essential medicines for all is a central component of Universal Health Coverage (UHC) (Wirtz et al., 2017). Yet the availability of quality medicines in low and middle-income countries (LMICs) is often limited especially in peripheral healthcare facilities (Ahmadiani & Nikfar, 2016; Bukuluki et al., 2013; Karwa et al., 2017; Paschke et al., 2018; Stevens & Huys, 2017). Central Medical Stores (CMSs) are the main supplier of healthcare commodities to public healthcare facilities. However, CMSs are faced with several challenges, including inadequate resources, insufficient transparency, weak accountability mechanisms, inaccurate forecasting of medicines at the facility and national level, thefts, and ineffective systems for fulfilling back-ordered items (Maryam Bigdeli et al., 2013; Govindaraj & Herbst, 2010; Sonak et al., 2018). Wirtz *et al*. highlighted other challenges such as the existence of substandard and falsified medicines, affordability, and inefficiencies in medical prescriptions to the patients (leading to overuse, underuse, and incorrect use) (Johnston & Holt, 2014; Wirtz et al., 2017).

Several countries have implemented initiatives to strengthen the medical supply systems through collaborations between the public, non-governmental, and commercial sectors (Embrey et al., 2016; Rutta et al., 2015; WHO, 2000). For instance, in some countries governments contracted private companies as a prime vendor under public-private partnership (PPP). Health facilities (or districts) purchase medical commodities from the prime vendor, usually a single local wholesaler, at agreed prices, rather than purchasing directly from the various manufacturers (May & Herrick, 1984; Olson, Hammel, & Liegel, 1985). Weaver *et al* (1994) found an increase in drug availability after implementation of the prime vendor system within the Department of Veterans Affairs (VA) hospitals in the United States of America (USA) (Patterson, Pierce, & Powell, 1995). Furthermore, the prime vendor system was associated with faster turnaround, higher-order fulfilment rates, costs reduction and increased satisfaction among program users (Johnson & Herrick, 1984). For example, in Zambia, such contractual agreements between the government and the vendors lead to higher flexibility in quantities ordered as well as delivery schedules, together with improved availability of medicines, and decreased stock-outs (Arney et al., 2014).

In 2001, the Evangelical Lutheran Church (ELCT) of Tanzania implemented a prime vendor system, under the Mission for Essential Medical Supplies (MEMS), to complement the existing medical supply chain (Häfele-Abah & Neuhann, 2010; World_Bank, 2013). The MEMS failed

to meet the contractual terms as it underestimated the program complexity, leading to low coverage and over-reliance of the program on donor funding. (Häfele-Abah & Neuhann, 2010). Two years later, another PPP was launched in Tanzania to improve access to medicines in peripheral areas through the accreditation of drug dispensing outlets (ADDOs) program (Embrey et al., 2016). In 2011 the Tanzanian government, with funding from the United States President's Emergency Plan for acquired immune deficiency syndrome Relief (PEPFAR) (USAID, 2016), launched a prime vendor model. This model relied on the existing local pre-selected pharmaceutical vendors for the purpose of addressing gaps for 45 opportunistic infection medicines (USAID, 2016).

In 2014, the regional authorities in Dodoma, Morogoro and Shinyanga regions started implementing a complementary pharmaceutical supply system, the Jazia Prime Vendor system (Jazia PVS) (Box 1, Figure 4), with the support of the Health Promotion and Systems Strengthening (HPSS) Project (HPSS, 2014). The Jazia PVS is a PPP that complements national Medical Stores Department (MSD) with supplies from a single private contracted vendor, in a pooled regional approach. Jazia PVS is anchored in the structures of the regional health administration and it is overseen, supported and managed by mandated administrative structures such as regional administrative secretary, regional prime vendor coordinating office, regional health management teams and council health management teams.

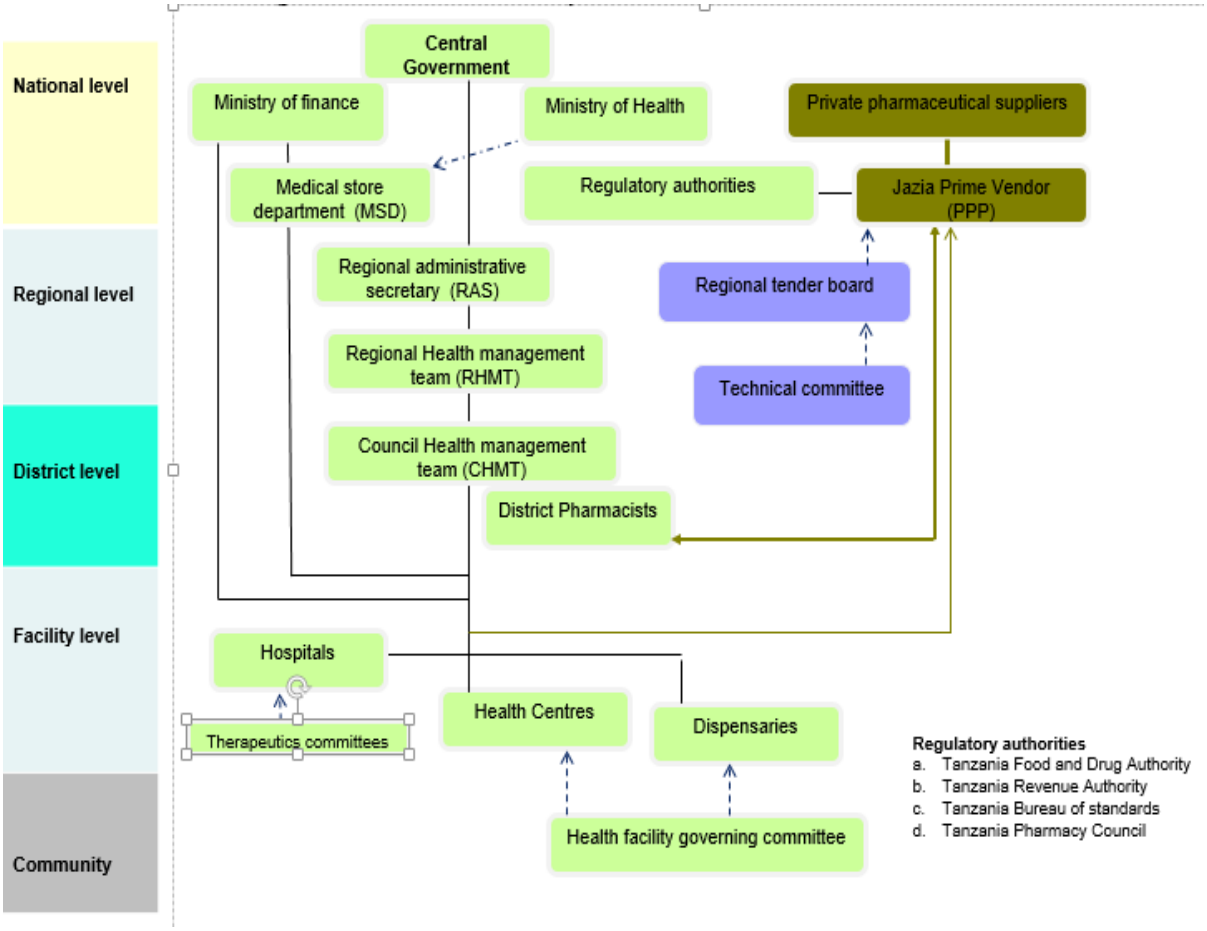
Box 1: Jazia Prime Vendor System (Jazia-PVS)

	Description
Jazia –PVS	• Jazia PVS is a public-private partnership (PPP) initiative between the regional health authorities and a private supplier that aims at improving availability of medicines, equipment and supplies by consolidating and pooling orders for supplementary medicines from all public healthcare facilities at the district level and then, purchase them from one contracted single whole supplier '*the Prime Vendor*' (HPSS, 2014) for two calendar years (Figure, 2). Furthermore, along with the implementation of Jazia-PVS, capacity buildings, peer coaching, and auditing interventions were strengthened to improve accountability (Wiedenmayer et al., 2019). Moreover, public financial management was reviewed and revised to standardize and simplify procedures and transactions. Additionally, the system is anchored in the structures of the regional health administration and being overseen, supported and managed by mandated administrative structures
Mandated administrative structures	• Each region has a Prime Vendor coordinating office responsible for supportive supervision, training (on the rational use of medicines, ordering and reporting); monitoring of system performance and overseeing the implementation of the system standard operating procedures (SOPs). The coordination office works closely with the Health Promotion and System Strengthening (HPSS), President Office Regional Administration and Local Government (PORALG), Regional Health Management Teams (RHMT), Council Health Management Teams (CHMT), prime vendor and healthcare providers. • Regional Prime Vendor Technical Committee (RPVTC). This is responsible with the provision of advice to all the technical and administrative issues including identification of the prime vendor, review of system performance and actors compliance with the

	contractual agreement. Meetings are held twice a year, though if the need for a meeting arises then the secretary call for a meeting. The technical team is answerable to the tender board and to the regional administrative secretary (contract holder) • Regional Prime Vendor Tender Board (RPVTB). This oversees the operations of the system, links to the technical committee, more important oversee transparency in the selection of the prime vendor, regular meetings are held twice a year, but in case of anything, the board secretary may call for a meeting. After the rollout tender board has been anchored within the government structures to ensure compliance with the public procurement act.
Other supporting mechanisms	• Ad hoc Regional Bids Evaluation Committee (EC). This is usually established whenever a need arise for the purpose of undertaking evaluation of the proposals from prequalification of suppliers and during the bidding evaluation process to identify the prime vendor
Operating procedures (6)	• Jazia-PVS has standard operating procedures guiding the process and the purchase of medicines from the prime vendor when these are either out of stock, in short supply or not stocked by medical store department. 1. In each quarter health facility staffs order commodities from CMS, upon delivery of the order, a list of missing items has to be presented to the facility. In turn, facilities review the list of missing items and prepare commodities (quantification) to be purchased from a prime vendor, conditioned on available funds at the facility bank account. 2. The order is shared with the district pharmacist, who consolidates with the list from other facilities and then forward the consolidated order(s) to the vendor. 3. The prime vendor delivers the consignments at the district headquarter, for inspection by district pharmacists and members of council health management team (CHMT).

	4. Each facility is informed to come and collect its consignment at the district level. At the facility, consignment is then being inspected by the health facility governing committee (HFGC) 5. The facility in charge and the committee issues a cheque to pay the vendor, and it's being reviewed by district executive director (DED) or district medical office (DMO) before being deposited into the vendor's bank account. 6. All communications for the procurement, problems with the consignment and related issues are directed to the district pharmacists (DPharm). DPharm is responsible in all communication with the vendor and is answerable to the CHMT, technical committee and tender board. In the process of communication, DPharm has to inform the regional Jazia-PVS coordination office.

Figure 4: Prime Vendor Operation Structures



On-going monitoring and evaluation reports show that Jazia PVS has been successful in improving the availability of medicines, equipment and supplies at the peripheral healthcare facilities within the pilot regions (HPSS, 2014; Wiedenmayer, 2017; Wiedenmayer et al., 2019). Jazia PVS has reportedly improved the availability of essential medicines in primary health facilities from an average of 69 percent in 2014 to 94 percent in 2018 (Wiedenmayer et al., 2019). Improved availability of medicines at peripheral healthcare facilities is closely associated with a better quality of healthcare services (as perceived by patients), which in turn creates trust in public institutions (Prinja et al., 2015). As a consequence, the government of Tanzania decided to roll out Jazia PVS in other regions since October 2018 (Myscience, 2018; Wiedenmayer et al., 2019). However, key accountability aspects that contributed to Jazia PVS performance have not been assessed yet.

Accountability mechanisms are important for maintaining high availability of essential medicines while at the same time containing drug costs (Govindaraj & Herbst, 2010; Paschke et al., 2018; Yadav, 2015). Effective accountability in the medicines supply chain has been shown to reduce inefficiencies in supply management, corruption, unethical practices [fraud and abuse], and rate of falsified and substandard medicines in the system (Karwa et al., 2017; Paschke et al., 2018; Walkowiak et al., 2018). This manuscript analyses accountability mechanisms contributing to the performance of Jazia PVS in Tanzania. Understanding such accountability mechanisms provides evidence to inform policy decisions on how to boost the performance of the system in general.

5.3 Methods

Theoretical framework

Accountability has been conceptualized in different ways (Bovens, 2007; Brinkerhoff, 2003; Uzochukwu et al., 2018) and it is often related to several concepts such as responsiveness, responsibility, and effectiveness (Bovens, 2007). Accountability refers to the obligation to explain and justify conduct (Bovens, 2007; Brinkerhoff, 2003; Uzochukwu et al., 2018). In this study, we adapted the concept of accountability used by Boven to analyse the accountability of transnational institutions such as the European Union (Bovens, 2007). According to this conceptualization, accountability is described as *"a relationship between an actor and a forum, in which the actor has an obligation to explain and to justify his or her conduct, the forum can pose questions and pass judgment, and the actor may face consequences"* (Bovens, 2007). Such relationships between the actor and a forum give rise to a number of accountability classifications which are linked in some way (Bovens, 2007; Brinkerhoff, 2003, 2004). Following Boven's framework, we explored three of these accountability dimensions: financial, performance, and procedure accountability (Table 7). Financial accountability entails an actor's compliance with various rules, laws and regulations concerning financial control and management. It is related to the responsibility for tracking and reporting on resource allocations, disbursements, and decisions on the utilization of financial resources in accordance with laws, rules, and regulations on financial control and management. Performance accountability refers to the accomplishment of an agreed-upon set of performance indicators and targets. We focused on district managers', vendors', and providers' efforts in achieving performance targets set within the Jazia PVS. Procedure accountability finally refers to the processes used to arrive at pre-determined performance targets (Siegel-Jacobs & Yates, 1996). The focus here was on the strategies taken by facility and district managers to arrive at desired program targets.

Table 7: The Accountability Dimensions Adapted from Boven's, 2007 Framework

The accountability dimension	Codes/sub-themes
Financial accountability	• Revenue tracking and reporting • Tracking and reporting on fund utilization • Financial and inventory auditing
Performance accountability	• Medicines availability • Delivery time of consignment
Procedure accountability	• Adherence to standard operating procedures • Payment terms of the vendor • Peer cascade coaching • Redistribution of medicines

Table 7, Presents the accountability dimensions adapted from Boven's, 2007 Accountability Framework

Study Settings

The study was conducted by a team of independent researchers in four districts that implemented Jazia PVS: Kondoa and Bahi district (of Dodoma region) and Ulanga and Kilosa districts (of Morogoro region). Districts selection was based on documented prime vendor volume use and distance from the regional Jazia PVS coordinating office. Two districts with high volume use of the Jazia PVS and two other districts with low volume use of the prime vendor were included in the study. Jazia PVS monitoring and evaluation reports showed that over 18 months of implementation Kilosa and Kondoa districts had high volume use of the prime vendor while Bahi and Ulanga had low volume use of Jazia PVS. The study districts counted a total population of 1,194,727, with Ulanga having the largest population (438,175, 36.7%) while Bahi had the smallest population (221,645, 18.6%). The study included a total of 27 purposively-selected health facilities (Table 8), roughly 20 percent of all public health facilities in these districts. The facilities were selected in collaboration with the regional and district managers based on documented Jazia PVS use by facilities and proximity to the district headquarters.

Table 8: Key characteristics of the study settings

District Council Variable	Kondoa	Bahi	Ulanga	Kilosa
Population[1]	269,704	221,645	265,203	438,175
Area coverage in square kilometres	5,921	5,948	24,460	14,918
Number of hospitals[2]	1	0	1	1
Number of public health centre[s2]	2	6	2	6
Number of public dispensaries[2]	27	35	43	19
Number of private facilities	12	2	6	25
Number of primary care facilities per 10,000 population	1.6	1.9	1.9	1.2
Facility sampled	7	6	7	7
Wards	28	20	24	35
Villages	107	57	68	143

1. NBS, Tanzania National Bureau of Statistics; Population and Housing Census 2013

2. http://hfrportal.ehealth.go.tz/ (Accessed on 15th January 2018; only operating facilities)

Study Design and population

This was a qualitative exploratory study. Data were collected via 30 in-depth interviews (IDIs), 7 group discussions (GDs) and 14 focus group discussions (FGDs) between July and September 2018. The FGDs lasted between one hour and a half to two hours, while GD and IDI lasted between forty-five minutes to one hour. FGDs participants had a median age of 40.5 years, and the majority (59/80) had attended lower level schools (primary and secondary). While GD participants had a median age of 43.5 years, and the majority (13/18) had attained education above the secondary level.

IDIs were used to explore accountability mechanisms in-depth with purposively selected study participants, namely Council Health Management Team (CHMT) members, district internal auditors, procurement managers; healthcare providers; council health service board (CHSB) members; regional health management team (RHMT) members; representatives from the President's Office for Regional Administration and Local Government (PO-RALG); personnel

of the Jazia PVS regional coordination office; a representative of the Prime Vendor; Jazia PVS Consultant and HPSS regional managers.

To capture diverse experiences and discuss controversial issues at the healthcare facility and community interface we conducted FGDs with six – eight participants with the healthcare facility governing committee (HFGC). During fieldwork, we repeatedly faced the situation where the suggested number of participants could not be enrolled in a focus group discussion. Accordingly, in those instances where only less than 5 persons participated, renamed the discussion a group discussion given the discrepancy to the outlined size and interactions within a focus group. GD participants included purposefully selected healthcare workers, members of CHMT and the district HPSS project officers/assistants. See table S7 and S8 in supplementary materials for further details on study participants.

Data collection

To achieve consistency and accuracy in translation of tools and data, two research assistants with a social science background and extensive training on qualitative methods at a postgraduate level assisted during translation of data collection tools, pilot, data collection and transcription of audio. The interview guides were developed in English and translated into the local language, Swahili. All discussions and interviews were conducted in Swahili and were audio recorded with the permission of the participants. Thereafter the first author reviewed all the translated documents. Translated documents were also reviewed by a senior social scientist to ensure the text is error-free and the content is the same based on the original document (s). All tools were piloted in two different study sites and modified where appropriate before the commencement of the actual data collection.

Data management and analysis

Data were transcribed verbatim 48 hours after being generated. This allowed for easy follow-up and clarification of issues as they emerged during data collection till we achieved data saturation. All electronic transcribed documents alongside the audio records were cross-checked for their quality assurance. The transcribed data from voice recordings were read and re-read to gain an initial impression of the data and an in-depth understanding of participants' descriptions before developing the codebook and data analysis. All analyses were conducted on the Swahili language transcripts and only the verbatim key quotations incorporated in this

manuscript were translated into English. The analysis was facilitated by the qualitative data management software NVivo 12.0 (QSR International Pty Ltd).

The analysis was conducted by first author and done on two levels. The first level entailed the development of inductive (ideas originating from the data itself) and deductive codes (theoretical understanding, empirical literature review together with several researchers' experiences) (Table 7). Both inductive and deductive codes were developed by the first author in collaboration with the co-author EM; any discrepancies were reconciled among the two. The 1st author coded the data, analysed and drafted the manuscript. However, throughout the process received feedback and support from the senior scientists who are also co-authors on this manuscript. The second level of analysis involved classification and categorizing the codes at abstract level according to key concepts and emergent patterns. Different themes representing the accountability constructs of Boven's framework have included both inductive and deductive categories. Framework analysis was adapted for summarizing the data to address the research questions (Bradley, Curry, & Devers, 2007; Nicola K. Gale, Gemma Heath, Elaine Cameron, Sabina Rashid, & Sabi Redwood, 2013). Validation of the study findings was done by triangulating and synthesizing data across respondent groups. Triangulation of data collection methods allowed for the observation of similarities and differences among and across different levels of the informants and in the districts. The approach allowed for an in-depth, multi-faceted exploration of complex issues in the participants' real-life settings (Crowe et al., 2011). The results have been organized according to the Boven's accountability framework (see Table 7). The themes include (i) financial, (ii) performance and (iii) procedure accountability.

5.4 Results

Financial accountability

Revenue tracking and reporting

We found that the Jazia PVS implementation was supported by health financing policy reforms that were underway in the study districts. First, these districts implemented the so-called direct health facility financing (DHFF[9]), whereby each healthcare facility has its own bank account. The implementation of DHFF was an important prerequisite for Jazia PVS to be successfully implemented because facilities have financial autonomy and flexibility in the use of funds held in their bank accounts. Second, the Community Health Fund (CHF) premium and the related government matching funds, along with the financial flows coming from the 'health basket fund' fed by various donors, and the National Health Insurance Fund (NHIF) facilitated Jazia PVS implementation. The health worker in-charge (the in-charge) of the facility mentioned the importance of receiving timely and regularly funds. They said that the health facility accounts are directly credited with funds from the basket fund on a quarterly basis, from the NHIF reimbursements on monthly basis, and from the CHF reimbursements on monthly basis. On monitoring the basket fund allocations one of the health facility in-charges noted the following:

> "…..*each year as we prepare our facility budget there is an amount of basket fund that is allocated for us, so each quarter it is credited into our account and we are informed, we ask for the bank statement for verification and then we use the funds*….." IDI, Facility in-charge, Dodoma.

The health facility in-charges and their assistants are responsible for depositing the user fees into the health facility bank accounts on a monthly basis. The facility in-charges said that for the purpose of financial accountability they were supposed to present a banking slip to the HFGC when the funds had been deposited into the bank accounts. This is an important accountability mechanism whereby after receiving the bank slip the HFGC members conduct validation by checking whether the amount deposited into the account equals the amount collected in the receipts book. HFGC validates the amount on the deposit slip by reviewing information from monthly bank statements as well as from the financial books available at the facility. Facility in-charges reported maintaining records of all the clients visiting the facility, categorising them by different payments options (such as insured, waived and those paying

[9] In Tanzania, primary healthcare facilities have no financial autonomy; cost-sharing funds (user fees, basket funds, insurance reimbursements) are managed and controlled at the district level. In 2018, the government undertook some initiatives, allowing for fiscal decentralization. All public primary facilities were directed to open a bank account with a local/nearby bank and were approved by the Bank of Tanzania and cost sharing funds are deposited in the accounts (See Kapologwe *et al.* 2019).

out-of-pocket). During the HFGC meetings, they reviewed all the records in the book, deposit slip and bank statements. During the discussion some of the HFGC members felt that they do not have much knowledge on issues related to health commodities and financial reports. This issue was also attested during the FGDs with the HFGC when they mentioned that they can see whether the amount deposited in the health facility accounts equals the account collected:

> "…..*the person who deposited the money at the bank, must come with a bank slip which shows on a certain date the money was deposited and we observe whether the amount deposited is equal to the amount collected*…" FGD, HFGC, Dodoma.

Tracking and reporting on funds utilization

The decisions on how to allocate financial resources to purchase medical commodities are left to the HFGC and should be approved by the district manager. This committee sits and discusses the health facility needs, and it then makes the necessary decisions. As a way of accounting for the financial resources utilized at the facility, the health facility in-charge share the minutes of the HFGC meetings with the district manager for their approval. The HFGC involves in their decisions district pharmacists and the district medical officer (DMO), as explained by the district manager when elaborating on the process of financial accountability

> "…..*they (HFGC members) sit in their meetings and identify what they need to purchase, then they bring the needs to the pharmacist who reviews facility needs and then shares with the DMO. The DMO review the money which the facility wants to use and compares the amount with revenue available in the facility bank account. Our role is to review and approve* ...." IDI, District Manager, Morogoro

The importance of the role of the HFGC was confirmed by health workers at the healthcare facility, reporting that health workers cannot authorise the use of funds without HFGC approval. However, it is important to highlight that HFGC members do not have strong financial management skills such as budgeting, clear record accounting, monitoring, and reporting. Before the HFGC meeting, the health facility in-charge in collaboration with other staff identifies and shortlists all the medical commodities to be purchased from the prime vendor and their respective monetary value. This process emerged clearly during the HFGC discussions:

> "…..…*together with colleagues (other staff) at the facility, we review the availability of medicines, we compare medicines received against the quantity we ordered from (MSD). For example, if in the order we did not receive ten tins of Amoxicillin, we*

document for each item missed from MSD, together with their respective (vendor) prices. I then inform the HFGC. Once they authorise, I submit the meeting minutes, the request and the reporting form for the vendor to the district pharmacist….." FGD, HFGC, Morogoro

Financial and Inventory audits

Financial and inventory audits are key to strengthening management and implementation capacity of healthcare intervention and are supposed to be done quarterly for each health facility. Financial and inventory audits are done both as regular and unannounced activity as part of supportive supervision. District internal auditor leads financial audit, accompanied by other CHMT members, using standardized auditing tools. They review all the documents used for authorising procurement and payments to the vendor, whether they were procured from the contracted prime vendor. They also examine whether approval documents were submitted to the district managers and whether the prices paid for the purchases were in line with the contractual agreement. When discussing audits, the district managers said:

"….. *As an internal auditor, we conduct financial audits for the user fees, we audit the way in which medicines equipment and medical supplies were purchased from the vendor.....*" IDI, District Manager, Morogoro

After auditing, health facility staffs are given feedback by auditors and reports are shared with other district managers for close follow-up. In the case of inconsistencies and unethical practices, facility in-charges are instructed to reimburse funds which have been identified to be misused and the in-charges are given warnings.

District pharmacists lead the inventory audits with the support from other CHMT members. Pharmacists reported that a basket of 24 essential medicines and related transactions are audited using a uniform tool which was prepared for the monitoring of the prime vendor system across the region. Together they review ledgers, bin cards, dispensing registers, issued vouchers and purchase requisition documents for the previous three months before the visit date. Also, they reported that review teams interviewed the staff responsible for the medicine supply chain at each health facility. According to the health workers, medical commodities procured through the prime vendor are audited more regularly than those supplied via MSD. This is because medical commodities procured via the vendor were not labelled compared to those from MSD labelled with "*GOT (Government of Tanzania) and MSD logo*". Labelling is intended to differentiate MSD supplies from other medicines found in the private hospitals and

pharmacies (MSD, 2016), to mitigate the risk of unethical practices such as fraud, abuse and sale to the local drug dispenser outlets. Document review also ensures that facilities are using the prime vendor system. CHMT members use a drug-tracking tool to review ledgers, bin cards as well as dispensing registers to reconcile stock and funds. When explaining how medicine auditing is conducted, the district managers said:

> "…..*as CHMT we have a team for conducting medicine audit, the team visits the facilities to observe whether the medicine received were prescribed to the patients or there are some medicine which entered into unsafe pockets, we go through dispensing registers and compare with the existing stock level at the facility. At the end of the day, we make reconciliation and realize if they are smart or there is misappropriation*…." IDI, CHMT, Dodoma.

Another form of medicine auditing reported by the district managers are unannounced (special) audits. Unannounced audits happen infrequently in the districts and were only mentioned in two out of the four districts visited. The district managers reported that they conduct special auditing to assess the existing medical stock or under suspicion of medicine fraud in the healthcare facilities. Unannounced auditing was done to identify shortcomings facing the facilities so that district managers may make a decision, offer advice, or take appropriate action.

Performance accountability

Among the key performance indicators of Jazia PVS are increased availability of essential medicines at the facility and product delivery time at the district headquarter. The contracted vendor has to deliver the consignment at the district headquarters, while staff at the facilities are responsible for the pick-up of the consignment. Jazia prime vendor technical committee and regional programme managers monitor closely the performance of the vendor. In case of failure to meet the contractual agreements, regional authorities initiate a discussion with the vendor to remedy the situation. Continued disrespect of contractual obligations can lead to suspension or termination of the contract. During fieldwork it was noted that participants' experience on the vendor and healthcare facility performance was based on feedback information given to them during quarterly monitoring and evaluation activities coordinated by the regional prime vendor coordination office.

Medicine Availability

The regional prime vendor coordination office reported that medicines availability and stock adequacy at health facilities were assessed quarterly each year as part of Jazia PVS performance assessment. Across facilities and districts in the two regions, the study participants felt that the prime vendor system has increased the availability of medicines at the facilities. The regional and district managers reported that the availability of tracer medicines for some facilities was ninety to a hundred percent. One of the district officials elaborated:

> "….. *in the last financial year 2017/2018, I participated in the stocktaking exercise for the whole district, I visited all the healthcare facilities, dispensary, health centre and district hospital, I found availability of medicines was satisfactory, like ninety percent*….." IDI, District Manager, Morogoro.

Another district officer explicitly mentioned the upward trend in tracer medicines availability after the introduction of the Jazia prime vendor system;

> "….. *after implementation of the system, availability of medicines increased up to seventy-five percent, then it reached eighty percent, from there up to eighty-five percent, then ninety, and right now the availability of essential medicines within the district is ninety-seven percent*….." IDI, CHMT, Dodoma.

Delivery time of consignment

Regional and district managers reported that, the average delivery time was in most cases fourteen days, with some hospital purchases delivered even within five working days. However, some delays were observed in moving the consignment from the district headquarter to the health facility level. Delays were linked to the lack of transport, communication challenges related to poor mobile phone signals, shortage of staff at the healthcare facility, and facility delays in processing orders to the districts.

Procedure accountability

Adherence to standard operating procedures (SOPs)

Standard operating procedures were established to guide providers and district managers on procurement of commodities from the prime vendor (see supplementary material Box: 1). In the SPOs it is stipulated that facility staffs are to consult the list of missing items 'stock-out'

from MSD before placing orders to prime vendor. In addition to that, they should ensure that they have sufficient funds in their bank accounts to pay for the medicines and that HFGC approves the use of available funds to procure required medicines. Moreover, SOPs indicate the obligation of the HFGC to inspect delivered commodities from the vendor, while the CHMT is responsible for inspection of the consignment at the district level. Lastly according to the SOPs, all communication with the vendor should be channelled through the district pharmacists. It emerged from the interviews that there were six different SOPs. In all healthcare facilities surveyed, it was reported that they do comply with the SOPs. This process is illustrated by the facility in-charge who said:

> "….*we have a list of medicine stock-outs from MSD, we take the copy and request from the vendor. So we look at our facility bank account, how much is available, we call for HFGC meeting. We sit with them and prepare meeting minutes. Later on, I prepare a proposal for purchasing medicines from the vendor, and submit to the district pharmacist* ...." IDI, Health Facility In-charge, Morogoro.

In a discussion with the district pharmacists, they reported that they are responsible for consolidating and forwarding orders to the prime vendor. One of the district officials explained:

> "…*we consolidate facility requests, we enter all requests from our facilities in an excel sheet and forward it to the vendor. It may happen that eight facilities have brought their order out of quarterly schedule, we just request for them……*" IDI, CHMT, Dodoma.

Payment terms of the vendor

The contractual agreement specifies that the vendor should be paid within twenty-two days by the respective healthcare facility. District and regional managers reported that initially there were some delays in paying the vendor. In some cases, it took more than thirty working days to pay the vendor after delivering the consignment at the district headquarter. Initiatives were in place to address the problem of delayed payments including regular reminders to subordinates and order placement by facilities after reviewing available funds in their bank accounts. The main reasons for delayed payments mentioned were weak financial management skills and knowledge on rules and regulations pertaining to bank transfers, lack of cash flow, system closure to allow financial audits at the end of the fiscal year, and the unfamiliar bureaucracy regarding transactions with the private sector. In fact, although reported vendor

payment delays were rather short, they were particularly critical at the end of the fiscal year (30th of June in Tanzania) when facility bank accounts were usually frozen to allow a financial audit. One of the district officials when elaborating on the number of days it takes to pay the vendor said:

> "……*there are payments which got stuck due to the government financial system. One consignment from 30the June has not yet been paid after entering a new financial year. The financial systems were still closed, till now they have not been opened [13th August 2018 date of interview], so we have delayed paying the vendor, we will finalize the payment once the systems are in operation…"* IDI, CHMT, Morogoro

The representatives from the prime vendor confirmed that payment delays were sometimes a critical issue, at times payment delays could persist beyond three months.

> "……*at the time we were in a meeting, it was observed that there are some districts which had gone up to a hundred and eighty days without making payments, that is one of the challenges we faced, of course in some places payments were not made according to the contract …"* IDI, vendor representative, Dar es Salaam.

Peer cascade coaching

In each district, well-performing healthcare workers are identified during supportive supervision and are offered responsibility for peer coaching (mutual learning partnership among healthcare facility staffs to help them unfold best practices and capabilities/creativity to address health facility challenges in order to improve service delivery). These coaches are selected based on their experience as well as knowledge of commodities management. They are further trained on integrated logistic supply at the district level and provided with tools to assist them when performing coaching in the assigned facilities. Coaches are assigned three to four dispensaries for peer coaching, ensuring that respective facility orders are well prepared and filled correctly in the so-called 'request and reporting forms". When discussing the role of the cascade coaching in the district they mentioned for instance:

> "*...after the establishment of prime vendor system, I think a lot of energy was directed to the coaches whom I have mentioned, ensuring that they identify/raise any challenges at the facility related to the prime vendor, for those which require district pharmacist to respond, then they communicate with the pharmacist ...*" IDI25, CHMT, Morogoro.

Theoretically, peer coaches are required to visit the dispensaries quarterly. However, during discussions with district managers, lack of transportation, lack of regional ownership as well as recognition of its importance and limited financial resources were reported as the main challenges for the efficient operation of cascade coaching. A few health facilities reported having not received any cascade coaching during the last financial year.

> "…..*regarding cascade coaching, I think ownership by the district has been minimal, you may find that the district manager considers it to be the idea of HPSS. The support was given for the first two years, the following years it was left to the district to supervise themselves as part of their work ……*" GD1, Regional implementers, Dodoma

Redistribution of Medicines

Reallocation of commodities to meet health facility needs was mentioned several times. Medicine reallocations at the facility are done whenever there is excess stock of certain medicines, close expiry dates and when there is an emergency need in any facility. For accountability purposes, each healthcare facility has a local issue voucher, which is used whenever commodities are transferred from one facility to the other. Facilities receiving the medicines do not make cash payment for the consignment received from another facility, rather, they return the medicines after purchasing. Supportive supervision are essential for medicines redistribution. Discussions with the district managers revealed that during supportive supervision, district managers take note of the facility with excess supplies or medicines close to the expiry date. In discussing this issue, district managers said:

> "…*as I said in the beginning, during supportive supervision you may find one facility has excess and the other one has none, we re-distribute, for example from facility A to facility B, from facility B to facility C*……." IDI7, CHMT, Dodoma.

5.5 Discussion

The study aimed to analyse the role of accountability in the implementation of Jazia PVS in Tanzania. The findings show that several accountability mechanisms were of relevance for the successful implementation and operations of Jazia PVS. Financial accountability was positively influenced by the establishment of health facility bank accounts that were part of the DHFF mechanism. Successful operations of the Jazia PVS were possible as facilities had funds in their bank accounts and used the funds to purchase medical commodities from the prime vendor. Financial and inventory audits conducted at the facilities also contributed to the performance of the Jazia PVS. The team conducting the audits reviewed all the documents used to purchase complementary medicines, ensured that facilities use the prime vendor and instructed those which had not ordered from the dedicated vendor to purchase from the prime vendor. Good performance of the Jazia PVS was also attributed to adherence of standard operating procedures by health facilities and the vendor, assuring continued contractual obligations. Cascade coaching on the other hand contributed to the well-functioning of the Jazia PVS as healthcare staff had the opportunity to learn from colleagues on issues related to the complementary pharmaceutical supply system. Through such peer learning staff confidence increased, knowledge improved leading to better understanding of and compliance with Jazia PVS operation.

Regional, district, and healthcare facility staffs complied with the standard inventory and financial auditing procedures. It was, therefore, possible to track resource allocations, disbursements, and decisions on the utilization of financial resources during the implementation of Jazia-PVS. Findings of this study on inventory and medicine audits are consistent with those of other studies of the pharmaceutical supply system, which underlined the importance of financial accountability in ensuring high performance of the system (Karwa et al., 2017; Paschke et al., 2018; Vian et al., 2017). For example, a study undertaken in Kenya revealed that accountability and transparency were key to the successful implementation of revolving fund pharmacies (Karwa et al., 2017). RFPs financial and medicines' documents were audited on a weekly basis within the first two months of implementation and later on, audits were done on a monthly or bi-monthly basis (Karwa et al., 2017). Quarterly audits allow for transparency and close monitoring of the cash collected at the facility and procurement of medical supplies leading to improved availability of medicines. Auditing requires the use of standardized tools and systems for tracking products and financial information (Bovens, 2007; Uzochukwu et al., 2018; Vian et al., 2017). Tools should be designed in such a way that they capture relevant information in the supply chain ensuring medicines reach targeted clients

without any leakage or misappropriation (Mensa, Ayele, & Wogayehu, 2018; SIAPS, 2017; Uzochukwu et al., 2018). In the department of Veterans Affairs (VA) programme audits were conducted to examine whether prices paid for the purchases from the prime vendor were similar to those presented within the contractual agreement, and changes in the contract terms were effectively communicated to the right authorities (VA, 1998). In most cases whenever there were any inefficiencies or misconducts identified during auditing, measures were taken to improve the system (VA, 1998; Wiedenmayer, 2014). Regular audits and feedback to those being audited result in positive outcomes (Ivers et al., 2012; Vasan, Mabey, Chaudhri, Brown Epstein, & Lawn, 2017; Wiedenmayer, 2014). In Tanzania, audits conducted in the prime vendor pilot region resulted in significantly increased facility reporting rates to the district managers, whereas funds collected on user fees increased, and facility in-charges had to repay funds which were identified to be miss-used (Wiedenmayer, 2014).

The findings on performance accountability show that prime vendor was typically able to meet performance targets, including the delivery of the consignment to the health facility within fourteen days. However, there were some drawbacks in terms of timely payment to the vendor. Similar to a study undertaken in a hospital setting in Tanzania to assess the performance of the private suppliers, the private vendors were able to meet contractual agreements, the order fulfilment rate was ninety percent and the mean lead time of private suppliers' to deliver pharmaceuticals to the health facilities was ten days (Jairo, 2013). In the United States, prime vendor implementation leads to a faster turnaround, higher-order fulfilment rates, costs reduction, and increased satisfaction among program users (Johnson & Herrick, 1984). Comparing the prime vendor system applied in Tanzania and the prime vendor implemented by the VA in the USA, Jazia PVS is largely paper-based, while the other entails considerable computerised record-keeping. It is envisioned that overtime Jazia PVS will be linked with the national electronic integrated logistics system, thus improving efficiency reducing the paper-based work. In addition, comparing the maturity of the US health system and supply chain, the VA prime vendor benefits from strong governance and accountability mechanisms. Procurement and contracting agreements between the government and the prime vendors have also been found to decrease the stock-outs of medicines in Zambia (Arney et al., 2014). Close performance monitoring and evaluation of the prime vendor system itself is equally important for the observation of contractual obligations by both contracted vendor and contracting regional authority. Non-adherence to contractual obligations by the private vendor may lead to contract termination. Non-adherence to contractual obligations by facilities, councils and the region may lead to loss of reputation and to loss of complementary supplies. In most cases, the

Jazia PVS vendor and the respective regional authority adhered to the contractual agreement. The noteworthy exceptions were sporadic delays of consignments to councils, delivery from district level to health facility and payment of the vendor, implying both contract partners.

We have identified a number of procedure accountability activities undertaken in conjunction with the implementation of the Jazia PVS, including supportive supervision done by district managers and cascade coaching done by peer health facility personnel. Trap *et al* argue that adequate oversight and support to the healthcare facilities in-store management, inventory controls, and record-keeping is essential for the effectiveness of any supply chain (Trap, Todd, Moore, & Laing, 2001). Evidence suggests that close oversight of the medical commodities at the healthcare facilities helps in curtailing wastage of medicines which are about to expire, misappropriations or any incidence of pilferage; in turn, these measures improve efficiency and effectiveness of the pharmaceutical management as well as service delivery (SIAPS, 2017; Trap et al., 2001; Vian et al., 2017). Close monitoring of activities during supervision increases accountability and problem-solving skills especially into primary healthcare facilities (Bailey et al., 2016; Stinson, Malianga, Marquez, & Madubuike, 1998; Vasan et al., 2017). The content of supervision and provision of constructive feedback to those being supervised is crucial in strengthening the system as it improves professional practices (Bailey et al., 2016; Ivers et al., 2012; Molyneux, Atela, Angwenyi, & Goodman, 2012).

Content and frequency of peer cascade coaching also contributed to the successful implementation of Jazia PVS. Ajeani *et al.* argue that cascade coaching done by frontline health workers has not only been found to improve medicine availability at the facilities but also teamwork and innovative local problem-solving approaches (Ajeani et al., 2017). In Swaziland, close mentorship provided to the frontline staff at primary health facilities contributed to the improvement in stock management as well as reporting (SIAPS, 2014). Both supervision and peer coaching face some challenges including lack of managerial training, shortage of time, official work responsibilities, and costs associated with travels (Bailey et al., 2016; Manzi et al., 2017; Penfold et al., 2013).

Compared to previous vendor programs undertaken in Tanzania, accountability activities of Jazia PVS are anchored within the structures of the regional and district health administration for sustainability purposes and no new or parallel structures were created for implementation (Wiedenmayer et al., 2019). This decision was made to promote the sustainability of Jazia PVS. Implementation of Jazia PVS is in line with the Tanzania Health Sector Strategic Plans (HSSP) three (July 2009 – June 2015) and four (July 2015 – June 2020), which aim at ensuring

a hundred percent availability of essential medicines in all primary health facilities in the country (URT, 2015). HSSP advocates for close collaboration with the private sector for effective delivery of healthcare services. HSSP also clearly stipulates that access to medicines could be achieved through new innovative approaches such as new contracting arrangements with the private sector (URT, 2015).

The results of this study should be interpreted in the context of its limitations. The qualitative approach used cannot establish causality between implementation success and procedure and performance accountability. It rather offers a plausible overview on how accountability measures contributed to good performance. The number of analysts looking at the qualitative data analysis was limited, which may increase the potential for misinterpretation. A higher number of scientists analysing the phenomenon under investigation with multiple viewpoints has been found to be effective in producing more accurate results and lessening the chance of individual bias. Moreover, the present results and analysis cannot be generalized to parallel broader health reforms happening in Tanzania, such as direct health facility financing, scale-up of improved community health funds, as well as improved facility financial accounting and reporting system. Boven's accountability framework selected has not broadly been applied in the pharmaceutical supply chain and was not specifically tailored to this management area. Lastly, we cannot weigh the contribution of the different elements examined in this study. For example, it is not possible to assess whether auditing is more important than shifting the decision power to healthcare facility level, which allows for financial autonomy and flexibility in the use of financial resources. Future studies could be designed to compare health facility data with the existing set of indicators used within the district health information systems (DHIS). Cascade coaching seems to improve knowledge and skills on medicine management, but more research on this approach is needed, especially on the selection of the coaches and content of the coaching materials as well as on its effect on accountability.

5.6 Conclusion

This study shows that accountability mechanisms contributed to the successful implementation of Jazia PVS in Tanzania. Specifically, auditing, well-structured financial reporting mechanisms on revenue and expenditure, standard operating procedures and cascade coaching accounted for the success of the system. However, sustained improvement in the availability of medicines at the primary healthcare facilities will also depend on correct quantification, timely delivery of consignments to the facility level and prompt payment to the contracted vendor. HFGCs have a crucial role in decision making regarding health facility commodity needs and fund use. Therefore capacity building for their members is important in strengthening financial management capacity. In this regard, one could argue that strong accountability and transparency in any intervention targeting the pharmaceutical supply chain is crucial. In conclusion, this study provides some evidence that financial, performance, and procedure accountability measures play an important role for the successful performance of Jazia PVS in Tanzania, a complementary supply chain intervention.

5.7 Acknowledgement

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Supplementary Material

Table S7: Categories of respondents at the regional, district and facility level

Region	Dodoma Region					Morogoro Region				
Council	Kondoa DC		Bahi DC			Ulanga DC			Kilosa DC	
Category of Respondent	FGD	IDI	FGD	IDI	GD	FGD	IDI	GD	FGD	IDI
Council health management team (CHMT)		2		1	1		1			2
District accountants/ auditors		1					1			1
District procurement managers							1			1
Health service providers		1		1	1		2	3		3
Health facility governing committee (HFGC)	5		3			2			4	
Council health service board (CHSB)		1								
Total	5	5	3	2	2	2	5	3	4	7

Table S8: Categories of respondents at the national, regional, and district level

National and regional level key informants	IDI	GD
Health Promotion System Strengthening (HPSS)	3	2
President's Office for Regional Administration and Local Government –PO-RALG (Jazia coordinating office)	1	
President's Office for Regional Administration and Local Government –PO-RALG (Procurement department)	1	
Jazia PVS Regional Coordination office	2	
RHMT members (Regional Pharmacists /Regional medical officer)	2	
Bahari pharmacy representative	1	
Jazia PVS Consultant	1	
Total	11	2

6. Acceptability of a prime vendor system in public healthcare facilities in Tanzania[10]

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6.1 Abstract

Introduction: Pharmaceutical supply chain management in low and middle-income countries (LMIC) has received substantial attention to address the shortage of medicines at peripheral facilities. The focus has been on health system interventions, including the establishment of public-private partnerships (PPP). In 2014, the United Republic of Tanzania began implementing the Jazia prime vendor system (Jazia PVS) with a contracted private wholesale supplier to complement the national medicines supply chain in public facilities. Few studies have investigated the acceptability of such a prime vendor system. This study analyses factors that contributed to the acceptability of Jazia PVS introduced in Tanzania. We used qualitative analytical methods to study experiences of Jazia PVS implementers in four districts in mid-2018.

Methods: Data were drawn from fourteen focus group discussions (FGDs), seven group discussion (GD) and thirty in-depth interviews (IDIs) with a range of actors involved in Jazia PVS. The study analysed seven acceptability dimensions as defined in the acceptability framework by Sekhon *et al.* Framework analysis was adopted to summarise the results using a deductive and an inductive approach.

Results: The findings show that participants' acceptability of Jazia PVS was influenced by the increased availability of essential medicines at the facilities, higher-order fulfilment rates, and timely delivery of the consignment. Furthermore, acceptability was also influenced by the good reputation of the prime vendor, close collaboration with district managers, and participants' understanding that the prime vendor was meant to complement the existing supply chain. Intervention coherence, experienced opportunity cost and intervention burden, affective attitude and self-efficacy were also important in explaining the acceptability of the Jazia PVS.

Conclusion: In conclusion, the most critical factor contributing to the acceptability of the Jazia PVS was the perceived effectiveness of the system in achieving its intended purpose. Districts purchasing directly from the prime vendor have a policy based on the possibility to increase the availability of essential medicines at peripheral facilities in a low-income setting; however, it is crucial to select a reputable and competent vendor, as well as to abide by the contractual agreements.

Keywords: Acceptability, medicine supply chain, public-private partnerships, prime vendor, Tanzania.

6.2 Introduction

The pharmaceutical supply chain in low and middle-income countries (LMIC) faces multiple challenges, such as the existence of falsified medicines, underfunding, affordability, weak transparency, weak mechanisms of accountability, and inefficiencies in medical prescriptions to the patients(M. Bigdeli et al., 2015; Sonak et al., 2018; Wirtz et al., 2017). Consequently, pharmaceutical supply chains have received substantial attention (Vledder et al., 2019), focusing on health system interventions such as those for redesigning and optimising the public sector pharmaceutical supply chain (Kumar, Ozdamar, & Zhang, 2008; Mokrini, Loubna, & Abdelaziz, 2018; Vledder et al., 2019; Yadav, 2015), including increasing financial resources allocated to the supply chain, introduction of incentives for staff to act effectively (Bastani, Doshmangir, Samadbeik, & Dinarvand, 2017; Lee et al., 2016; Wande et al., 2019a), staff training to improve pharmaceutical supply chain management skills (Konduri, Rauscher, Wang, & Malpica-Llanos, 2017; Leung, Chen, Yadav, & Gallien, 2016), improvement of the supply chain process and procurement procedure such as centralising/decentralising purchasing of drugs, improvement of health information management systems to monitor and inform purchases, as well as infrastructure improvement and communication (Kokilam, Joshi, & Kamath, 2016; Seidman & Atun, 2017; Shieshia et al., 2014). Another policy introduced in several countries is the establishment of public-private partnerships (PPP) (Mokrini et al., 2018; Seidman & Atun, 2017) to complement existing medicines supply chain systems (Fadlallah, El-Jardali, Annan, Azzam, & Akl, 2016; Matowe et al., 2008; Vledder et al., 2019). PPPs have been reported to increase the availability of essential medicines in peripheral areas in low-income settings (Arney et al., 2014; Manji et al., 2016; Patterson et al., 1995; Wiedenmayer et al., 2019) to improve order fulfilment rates, to control drug costs, and to increase satisfaction among programme users (Arney et al., 2014).

The successful deployment of new devices, interventions, or PPPs within the health system usually requires high acceptability by both implementers and beneficiaries of the intervention (Diepeveen et al., 2013; Mandeep Sekhon et al., 2017; M. Sekhon et al., 2018; Shieshia et al., 2014). The degree of acceptance by beneficiaries affects not only the successful implementation of the PPP, but also the effectiveness of the intervention (Bos et al., 2013). In any intervention, low acceptability implies that the intervention may not be delivered as intended, thus impeding the overall effectiveness of the intervention (Borrelli et al., 2005). Several studies have explored the acceptability of health system interventions (Maryam Bigdeli

et al., 2013; Diepeveen et al., 2013; Mandeep Sekhon et al., 2017). However, few studies have been conducted to assess the acceptability of interventions in the health supply chain (Guillermet et al., 2015; Shieshia et al., 2014). For example, Shieshia *et al*. that, found after the adoption of technology within the pharmaceutical supply chain in Malawi, there was a reduction of time spent in attaining medicines from collection points, and there was improved drug availability and accountability (Shieshia et al., 2014). Furthermore, individual affective attitude and intervention coherence in terms of ease of use, safety and reliability contribute to the acceptability of an intervention (Glenton, Khanna, Morgan, & Nilsen, 2013; Guillermet et al., 2015).

In Tanzania, the Medical Store Department (MSD) is the main supplier of medical commodities (drugs, medical equipment, and medical supplies) to all public healthcare facilities and some of the private non-profit facilities. MSD receives funds from the Ministry of Finance to supply the facilities with the medical commodities based on facility quantification, and then MSD delivers the consignment directly to the respective facility. In recent years, MSD has been facing difficulties which hinder its efficiency in supplying all facilities, including delays in accessing funds from the Ministry of Finance, inaccurate forecasting of drug needs at facility levels, thefts, as well as ineffective systems for fulfilling back-ordered items(Yale, 2011). Districts and healthcare facilities have complementary funds that are earmarked for purchasing medical commodities from private pharmaceutical suppliers (retailers or wholesalers) when MSD is out-of-stock (HPSS, 2014). Still, the purchase of complementary medical commodities has been reported to be poorly managed (HPSS, 2014). In 2012, a survey was conducted to assess the availability of medicines in all the public healthcare facilities in Dodoma region, where it was found that order fulfilment rate from the MSD was about 60 percent, with facilities experiencing an average stock-out rate of 40 percent in essential medicines (HPSS, 2011).

In 2014, the United Republic of Tanzania started implementing a PPP programme in three pilot regions (Dodoma, Morogoro and Shinyanga) in which all public healthcare facility orders for missing healthcare commodities at the MSD are pooled at the district level, and then purchased from one contracted supplier, the prime vendor. The system was named '*Jazia prime vendor system – Jazia PVS*' as it complements in situations where the MSD has failed to supply needed healthcare commodities. There is only one prime vendor for each region, contracted for two years. Jazia PVS is anchored in the structures of the regional health administration and it is overseen, supported and managed by mandated administrative structures such as the regional administrative secretary, the regional prime vendor coordinating office, regional health management teams,

and council health management teams. The concept and set-up of the Jazia PVS was funded by the Swiss Agency for Development and Cooperation (SDC) through the Health Promotion and Systems Strengthening (HPSS) project in the period from January 2014 to July 2019. HPSS project staff oversee the operations of the Jazia PVS together with government officers. Selection of the prime vendor followed a tender process where all private retailers and wholesalers in Tanzania were invited to bid. They were evaluated and assessed, based on various criteria such as prices of commodities, financial capacity, staff, vehicles, quality assurance, systems in place for the procurement, and storage facility. After evaluation, the successful vendor was contracted to supply commodities for a given region. Orders for medical commodities from public hospitals, health centres and dispensaries are consolidated and purchased at previously agreed prices from the preferred and contracted private wholesale supplier, the prime vendor. After accounting for missing items from MSD each quarter, facility in-charges quantify the remaining needs and share with the district pharmacist who consolidates a list of needs across facilities and submits them to the vendor. In turn, the vendor delivers the consignment at the district headquarters where facilities are responsible for picking-up their consignment. Framework contracts with prime vendors at the regional level are established for two years. The contractual agreement specifies that the vendor deliver consignments at the district headquarters within fourteen (14) working days from confirmed date of receipt of an order from the respective districts. Emergency order(s) should be delivered within five (5) working days. In addition, the contracts specify that the prime vendor be paid within twenty-two days by the respective healthcare facility. Medical commodities purchased from the prime vendor are financed with funds from national insurance schemes (Community Health Fund and National Health Insurance Fund), out-of-pocket payments, and basket funds (Wiedenmayer et al., 2019). Jazia PVS pools financial resources available to districts to address shortages of essential medicines at public facilities. Continuous monitoring in the Jazia PVS pilot regions showed that this complementary prime vendor system has been effective in increasing the availability of essential medicines in public health facilities (Wiedenmayer et al., 2019). Consequently, in 2018 the government decided to roll out the Jazia PVS to all twenty-six regions of Tanzania's mainland.

This study analyses factors that contributed to the acceptability of the Jazia PVS introduced in Tanzania. It is part of a broader assessment of Jazia PVS that include other studies: one study analysed how accountability mechanisms contributed to the performance of Jazia PVS in Tanzania (Kuwawenaruwa, Tediosi, et al., 2020), and another study looked at the cost and

cost-drivers of setting up Jazia PVS in public healthcare facilities in Tanzania (Kuwawenaruwa, Wyss, Wiedenmayer, & Tediosi, 2020).

6.3 Methods

Conceptual Framework

The concept of acceptability has several definitions (Maryam Bigdeli et al., 2013; Penchansky & Thomas, 1981; Mandeep Sekhon et al., 2017). In general, it refers to the degree to which the intended programme beneficiaries, as well as those involved in implementing a given intervention, consider it to be congruent with cultural beliefs, and values (Bowen et al., 2009; Diepeveen et al., 2013; Mandeep Sekhon et al., 2017). In this study we adopt a definition of acceptability as defined by Sekhon *et al., 'a multi-faceted construct that reflects the extent to which individuals, as well as institutions affected by an intervention directly or indirectly, consider it to be suitable, based on their expectations, or experienced reasoning and emotional reactions to such intervention* (Mandeep Sekhon et al., 2017). Sekhon *et al.* gave specific dimensions to be considered when analysing the acceptability of interventions in the context of health systems (Mandeep Sekhon et al., 2017; M. Sekhon et al., 2018). Table 1 highlights the seven dimensions of acceptability and their definitions; (i) perceived effectiveness, (ii) affective attitude, (iii) intervention coherence, (iv) ethicality, (v) self-efficacy, (vi) opportunity costs, and (vii) experienced intervention burden (Mandeep Sekhon et al., 2017). The '*perceived effectiveness*' corresponds to the degree to which an intervention successfully reaches the desired beneficiaries and produces the expected or desired output. '*Affective attitude*' refers to the emotional reaction or feeling of an individual towards the object of the attitude (Abun, Magallanes, & Incarnacion, 2019). An individual makes a judgment about, or has feelings toward, the Jazia PVS before or after taking part in it; such a judgment can be positive or negative (like or dislike of the attitudinal object). *'Intervention coherence'* denotes a personal belief that the intervention is logical, consistent, and makes sense. '*Intervention ethicality*' represents the notion that the intervention is in accordance with the rules/values concerning the right practices or conduct, particularly the standards of a profession. '*Self-efficacy*' has been defined by Bandura as an individual's self-belief in his/her capacity to execute behaviours necessary to produce specific performance attainments(Bandura, 1997). Individual confidence and self-assessment influence the level of effort that is executed in achieving the goals, together with the likelihood of achieving a particular level of behaviour performance(Bandura, 1997). '*Opportunity costs*' indicates the value of the next best alternative foregone because of the intervention. Lastly, '*experienced intervention burden*' stands for the amount of effort that is required to participate in the intervention". Acceptability usually looks at the introduction of a new device/technology (Al-Taee, Kapoor, Garrett, & Choudhary, 2016; Shieshia et al., 2014; van der Meer et al., 2019) or innovative ways to improve service delivery (Mukunya et al.,

2018; Murphy & Gardner, 2019; M. Sekhon, Cartwright, & Francis, 2016; Strait et al.). Acceptability assessment can take place '*before*' the implementation of the healthcare intervention; during the intervention period, '*concurrent assessment*', or after the implementation, '*post-intervention*' (Mandeep Sekhon et al., 2017; M. Sekhon et al., 2018). The present study has been done after implementation of Jazia PVS as a '*post-intervention* assessment'.

Table 1: Theoretical Framework of Acceptability (TFA), Sekhon *et al.*, 2017

TFA	Definition
Perceived effectiveness	Experienced effectiveness: the extent to which the intervention is seen to have achieved its intended purpose
Affective attitude	Experienced Affective Attitude: How an individual feels about the intervention, after taking part
Intervention coherence	The extent to which the participant understands the intervention, how it addresses their condition, and how it works
Ethicality	The extent to which the intervention has a good fit with an individual's value system
Self-efficacy	The participants' confidence that they can perform the behaviour(s) required to participate in the intervention
Opportunity costs and	Experienced opportunity cost: the extent to which benefits, profits or values were forfeited to engage in the intervention
Experienced burden	Experienced burden: the amount of effort that was required to participate in the intervention (e.g. participation requires too much time or expense, or too much cognitive effort)

Study Area

We purposively selected four districts (Bahi and Kondoa districts in Dodoma region, and Kilosa and Ulanga districts in Morogoro region) out of thirteen districts where the Jazia PVS pilot has been implemented since 2014 and 2016, respectively. Districts selection was based on the high/low use of the prime vendor and distance from the regional Jazia PVS coordinating office. We included two districts with high use of the prime vendor and two districts with low use of the prime vendor. Monitoring and evaluation reports showed that over 18 months of Jazia PVS implementation, Kondoa and Kilosa districts had high use of the prime vendor while Bahi and Ulanga had low use of the prime vendor. In each region, we selected a district far away [more than 100 kilometres] from the regional Jazia PVS coordinating office, while the other was located proximal to the regional office [less than 100 kilometres] (Figure 1). Out of

the four districts, twenty-seven facilities (three district hospitals, eight health centres and sixteen dispensaries) were selected in collaboration with district and regional managers, based on documented prime vendor use of facilities and proximity to the district headquarters.

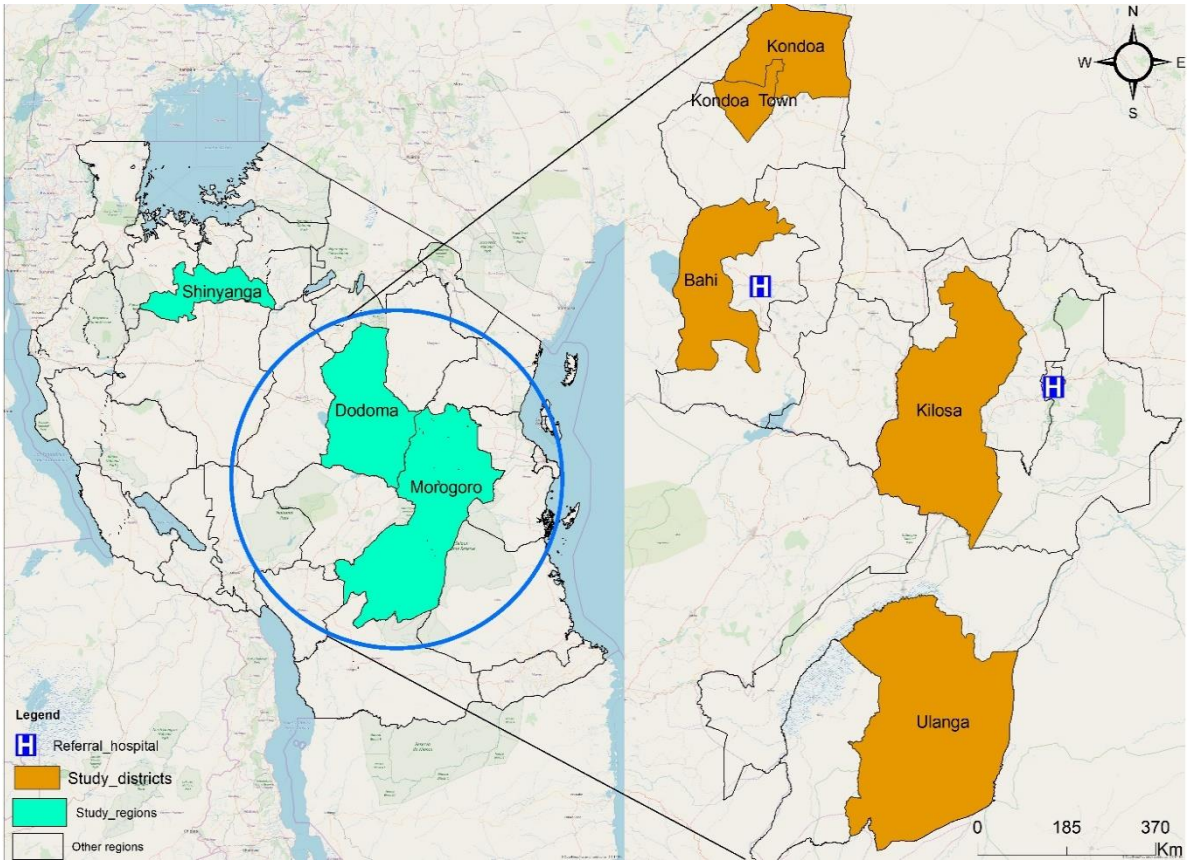

Figure 5: Study Region and Districts

Figure 5 shows the study regions and districts, Bahi and Kilosa districts are close to the Jazia PVS coordination office, located at the Regional referral hospital (H) while Ulanga and Kondoa districts are located far away from the regional referral hospital.

Study design

Between July and September 2018, we conducted 30 qualitative in-depth interviews (IDIs), 7 group discussions (GDs) and 14 focus group discussions (FGDs). The FGDs included between five and eight participants, while GDs had two to four participants. The length of the FGDs session was one and a half to two hours, while that of GDs and IDIs lasted forty-five to sixty minutes. IDIs participants were purposively selected to represent the range of different actors involved in Jazia PVS implementation from the regional level, including the President's Office for Regional Administration and Local Government (PO-RALG) (IDI 2); members of regional

health management teams (RHMT, IDI, 2); regional level health promotional and system strengthening (HPSS) project managers (IDI 3 and GD 2); Jazia PVS Regional Coordination Office (IDI 2); Council Health Management Team (CHMT) members (IDI 6 and GD 1); Council Health Service Board (IDI 1); district accountants, auditors and procurement managers (IDI 5); healthcare facility in-charges (IDI 7 and GD 4); prime vendor representative (1); Jazia PVS consultant (1) and Health Facility Governing Committee (HFGC, FGD 14) (see supplementary material, table S8 and S9). In IDIs and GDs, we assessed the participants' in-depth understanding of Jazia PVS and its acceptability after participating in the intervention. In the FGDs we explored participants' general opinion of the acceptability of Jazia PVS as compared to the previous system of procuring complementary pharmaceutical supplies from different private suppliers.

Data collection

We collected information on the acceptability of Jazia PVS based on the acceptability dimensions (Table 1). The IDI, GD and FGD guides were developed in English and later translated into the local language, Swahili. The Swahili version of the guides was piloted in two healthcare facilities (a dispensary and a health centre). The pilot results were used to refine the final data collection guides before use in the actual data collection activities. The first author and two research assistants, experienced in qualitative data collection activities, conducted the interviews. The first author took responsibility for organising the interview, welcomed the participants, moderated the discussion, and probed for additional information, while one of the research assistants asked questions and the other took field notes. We tape-recorded all the conversations during the fieldwork.

Data management and analysis

FGDs, GDs and IDIs were transcribed verbatim within forty-eight hours of the time they were conducted to allow follow-ups on emerging issues and points of clarification during the subsequent interviews. The transcribed data were reviewed and crosschecked for quality before they were imported into NVivo 12.0 (QSR International Pty Ltd). All the transcripts were analysed in their original language. Open coding was used in labelling, defining as well as developing categories based on dimensions of the participants' descriptions. Subsequently, inductive as well as deductive approaches were used to group the codes into themes reflecting the acceptability dimensions (Mandeep Sekhon et al., 2017; M. Sekhon et al., 2018; Strauss, 1998). The first author and a senior social scientist performed intercoder reliability to improve

the codes. The whole analysis focused on emerging themes, patterns, similarities, and differences. Framework analysis was used to summarise the results (Bradley et al., 2007; Nicola K. Gale et al., 2013) (Figure 2). The selected verbatim key quotations were translated into English and incorporated in the manuscript. We base the analysis on so-called data source triangulation which allows for data validation and comprehensive understanding of the Jazia PVS (Carter et al., 2014; Heath, 2001; Salkind, 2010). In addition, it allows for exploration of the similarities and differences in terms of participants' prior-expectations of Jazia PVS, or experienced and emotional reactions during and after implementation of the intervention (Carter et al., 2014).

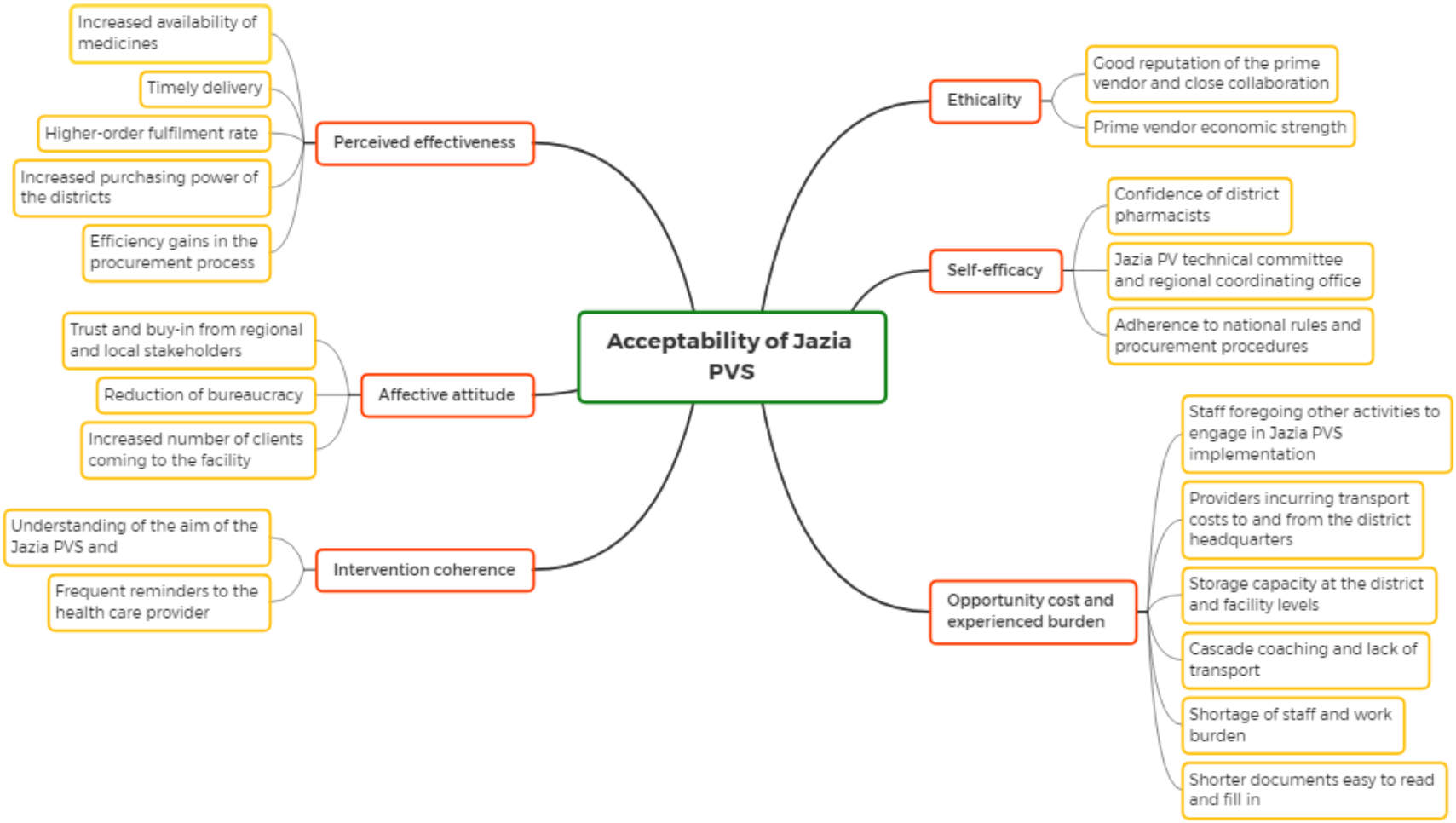

Figure 6: Acceptability of Jazia PVS, Deductive and Inductive Codes

6.4 Results

Perceived effectiveness

The 'perceived effectiveness' corresponds to the extent to which a given intervention has achieved its envisioned purpose. Sub-themes include increased availability of medicines, timely delivery and higher-order fulfilment rate, increased purchasing power of the districts, and efficiency gains in the procurement process.

Increased availability of medicines, timely delivery, and higher-order fulfilment rate

The study participants felt that the availability of essential medicines improved after implementation of Jazia PVS in the pilot regions. During the discussions with the regional and district managers, it was reported that, at the time of data collection (mid-2018), the average availability of essential medicines for some facilities was ninety to a hundred percent. One of the district officials elaborated:

> "…*before the Jazia PVS, availability of medicines at the health facilities was so low. The average availability was between sixty to seventy percent, and could even be below sixty percent. After the introduction of Jazia PVS, the average availability of essential medicines increased up to eighty-ninety percent within the district*…." IDI7, CHMT, Dodoma.

Regional implementers highlighted that among the reasons for the establishment of Jazia PVS was the failure of the MSD to supply all the facility needs in each quarter. District managers felt that the ability of the prime vendor to supply medicines that matched the facility's needs contributed to the acceptability of Jazia PVS. When a regional implementer was elaborating on this, she said:

> "…*Jazia PVS has an order fulfilment rate of a ninety-nine percent to a hundred, in case if a facility request ten tins, the vendor delivers them as required. Though, at times out of three hundred medicines ordered, two may be missing, but the vendor supplies them within two weeks*…." IDI 2, regional implementer, Dodoma.

In a follow-up discussion at the facility level, the HFGC members were of the opinion that Jazia PVS was effective in ensuring timely delivery of the consignments. When explaining this, participants made a comparison with the previous system, noting that they used to experience delays of sometimes more than two months in receiving medicines at the facility level. They further noted that the Jazia PVS has resulted in timely delivery of the consignment

at the facility together with a reduction in the lead time. In one of the FGDs with HFGC, the following was reported:

> "…*Jazia PVS has helped us; we get medicines on time; in the past, there were some delays. At the moment, whenever you press an order for medicines, they are delivered on time, different from the past where one had to wait for some time*…." FGD16, HFGC, Morogoro.

The purchasing power of the districts and price of medicines

District managers reported that the process of pooling facility orders at the district level to purchase from the prime vendor was seen as an efficient way to purchase medicines at lower than private market prices. They also felt that prices are fair, and at times they could negotiate commodity prices, and request the inclusion of additional items which are not listed in the contract. In discussion with the Jazia PVS implementers, it was further reported that, prior to the Jazia PVS, facilities purchased medicines from different suppliers at various price levels in each procurement cycle. District managers felt that increased transparency, pooling of all facility orders, and purchasing in bulk from the prime vendor with uniform medicine prices across facilities contributed to the acceptability of the Jazia PVS. This was detailed in the discussions with the district managers as follows:

> "….*I can say the system has increased the purchasing power of the districts, the prices are fixed all over for the customers. The notion of a certain health facility to purchase a tin of Paracetamol for eighty thousand, while another facility purchases the same tin for fifty thousand is no more, and we are all treated the same, this has increased the purchasing power of the districts*…." IDI10, CHMT, Kondoa, Dodoma.

At the district level, managers confirmed that within the Jazia PVS, prices for the commodities supplied to the facilities are fixed, based on a contractual agreement with the vendor. In a follow-up discussion with the in-charges, they reported that facilities were paying high prices for the commodities before the implementation of the Jazia PVS. They further highlighted that in the previous system, suppliers used to inflate the price of the commodities each quarter to their benefit. When discussing cost savings with the in-charge, this was said:

> "….*prices for medicines are within the contract, different from the previous system. The list of all the items with which the vendor was awarded the contract was brought to us, and we use the prices through the contract duration which is two years*…." IDI13, Facility in-charge, Dodoma.

Efficiency gains in the procurement process

Jazia PVS regional implementers described that, before its implementation, the staff at the districts spent an enormous amount of time in the process of purchasing complementary supplies. They further explained that, in each quarter, district officials travelled to Dar es Salaam or other regions looking for quotes from different suppliers which could take up to three weeks. The regional implementers highlighted that Jazia PVS rendered travelling in search of quarterly quotations and meetings unnecessary. This was reported in discussions with the regional implementers. For instance, one of them said:

> "*….in 2011-2012 we had a shortage of medicines, the pharmacist travelled to Dar es Salaam for like three weeks. The pharmacist just came back with quotations and had been paid per-diem. Documents would then enter into the procurement cycle, and the facility could get medicines after a month. Jazia PVS has helped us a lot, and as implementers, we have seen its success*...." IDI2, Regional Implementer, Dodoma.

In one of the districts, managers felt that the prime vendor is cost-conscious when delivering consignments to the respective districts. Besides, the manager noted that the vendor tended to combine orders for districts which are close to one another to control the operational costs. In explaining the vendor's control of operational costs, this was said:

> "*At the beginning, districts were not ordering medicines together. Each district orders at its own time. To reduce operational costs, the vendor could tell us… 'I will bring your consignment after few days' or 'I will bring it after three to four days because I want to combine and deliver orders for district A, district B and C which are close to each other'...."* IDI14, CHMT, Dodoma.

Affective Attitude

'Affective attitude' refers to an individual's feeling after taking part in the intervention. Sub-themes include trust and buy-in from regional and local stakeholders, reduction of bureaucracy, and increased number of clients coming to the facility.

Trust and buy-in from regional and local stakeholders

In discussions with representatives from PORALG, they felt that Jazia PVS has improved medicine availability at the facilities, and that is why the government decided to scale it up to other regions of Tanzania. They further highlighted that the decision was informed by its perceived effectiveness, including improved medicines availability at the facilities, reduction

in the lead time [time from the facility ordering to the time of receipt of the consignment at the facility], reduction in opportunities for fraud, and improved transparency in the whole system of procuring complimentary supplies for the facilities. The buy-in from the government to institutionalise the Jazia PVS idea was also reported by district managers. They mentioned that the government recognized the achievement made by the system which is why it decided to roll it out.

> "….*based on the achievement resulting from the Jazia PVS, the government felt that Jazia PVS is a good system and should be adopted in all the regions of Tanzania*…." IDI19, CHMT, Morogoro.

Trust in the Jazia PVS was also related to its private status and its clear rules on price adjustments. Some district managers felt that the prime vendor is profit-oriented and therefore able to obtain lower prices. District managers were of the opinion that the prime vendor was able to purchase directly from the manufacturers, offering the opportunity to bargain prices which, in turn, allowed the prime vendor to sell medical commodities to facilities at a lower price while still making a profit. In addition, it was reported that price adjustments were only allowed to offset inflation, based on the evaluation of a technical committee. While elaborating on price adjustment, one of the district officials explained:

> *"...In the year 2015, there was inflation; the vendor requested for price adjustment. The contract allows for a price adjustment of the items whenever there is inflation. The vendor wrote a letter to request for a price adjustment on some of the items within the contract."* IDI14, CHMT, Dodoma

Felt reduction in the bureaucratic process during the procurement

Regional and local stakeholders felt positive that the implementation of the Jazia PVS had resulted in a substantial reduction of bureaucratic procedures in the procurement process of complementary pharmaceutical supplies in the districts and at facilities. They reported that before the implementation of Jazia PVS, in each quarter it required more than fifteen signatures for authorising documents, and so the approval of documents took a long time. To clarify this point, a district manager explained:

> "….*Jazia PVS has reduced bureaucracy because in the past, once the facility received out of stock items from MSD, the facility in-charge had to write a letter to the district executive director, which took some time. Within the Jazia PVS, once you have documentation from MSD on missing items, the in-charge prepares the order and*

shares with the prime vendor through the district pharmacist…." IDI25, CHMT, Morogoro.

Increased number of clients coming to the facility

In most of the facilities visited, it was reported that before the implementation of Jazia PVS, the number of clients accessing care in the facilities had been low. Healthcare providers felt that the prime vendor has led to an increased number of clients coming to their healthcare facility due to improved availability of essential medicines. Providers noted that clients are also coming from distant villages seeking care from their facilities because of improvement in service delivery and because clients could get all essential medicines prescribed to them. HFGC were of the opinion that there had been an improvement in the availability of essential medicines, causing more clients to seek care. In discussion with the HFGC members, this issue was mentioned as follows:

"….*Many clients are coming to seek healthcare services because the facility has enough medicine and staff's language is good compared to the past*…." FGD5, HFGC, Dodoma.

Interventions coherence

'Intervention coherence' implies how individual participants comprehend the intervention and how it works. Two sub-themes emerged: understanding of the aim of the Jazia PVS and frequent reminders to the health care provider.

Understanding of the aim of the Jazia PVS

When asked about Jazia PVS coherence, regional and district managers showed a clear understanding of Jazia PVS's purpose in strengthening the health system. They described that Jazia PVS was not a parallel system, rather it was meant to complement whatever was missing (out-of-stock) from MSD. Regional implementers highlighted that the MSD could not fulfil all facility needs each quarter; therefore, they felt that the Jazia PVS would complement the remaining facility needs. In discussing this issue, a regional manager said:

"The purpose of the Jazia PVS was not to replace the MSD, as it could supply over half of the facility needs. So the prime vendor was designed to complement MSD, that's

why it was named 'Jazia', meaning that it fills the gap of out of stock from MSD…." GD1, Regional implementer, Dodoma

Conversely, the majority of the health facility in-charges were able to demonstrate how Jazia PVS operates, rather than stating its purpose. In describing the process of procurement of the commodities from the vendor, facility in-charges reported that the foremost task was to review the list of missing items (out of stock) from the MSD and funds available in the facility bank account. Facility in-charges explained that they first quantify the commodities to be purchased from the prime vendor, then they discuss with the HFGC for approval and share this with the district pharmacist. This process is explained by the facility in-charge, who said:

"*…once we have received a list of missing items from MSD, we discuss with the members of the health facility governing the committee. Then we prepare meeting minutes based on the facility needs, and submit to the district pharmacist, who reviews and shares directly with the prime vendor…."* IDI26, Facility in-charge, Morogoro

Frequent reminders to the health care provider

District managers reported that, at the beginning of the Jazia PVS, they spent a substantial amount of the time reminding providers about the quantification process and the need to prepare a list of their facility's need just after receiving the notification of out-of-stocks items from the MSD. They went further and described that not all the facilities submitted their facility's need list on time, so they had to remind the facility staff of the deadline to submit the needs because they had a lot of work to do at the facilities, including outreach services. It was noted that they have been using the 'WhatsApp' application platform in which they have formed a group for all the facility in-charges with smartphones to remind them on matters related to Jazia PVS. In clarifying about the frequent reminders and communication process with the facility in-charges, the manager had this to say:

"*…majority were delaying in quantifying facility needs at the beginning after receiving out of stocks from MSD, so we kept on pursuing them and reminding them that once you receive missing items, you should immediately start the process of ordering from the prime vendor….*" GD2, CHMT, Dodoma.

Ethicality

'Intervention ethicality' indicates the extent to which the intervention has a good fit with an individual's value system. Sub-themes include the good reputation of, and close collaboration with, the prime vendor, and the prime vendor's economic strength.

The good reputation of the prime vendor and collaboration

Regional and district level stakeholders mentioned the good reputation of the prime vendor as a factor that promoted acceptability of the new system. They also felt that as a private supplier, the vendor supplies products of high quality, and the commodities are handled properly to protect the health of the consumers. District officials further highlighted the vendor's commitment to observe the contractual agreement with the region. In discussing the good reputation of the prime vendor, a district official said:

> "*Professionally, I am a procurement person, and I know challenges associated with the procurement process. The prime vendor is committed and has the ability to meet the deadline, and has uniform prices."* IDI16, District official, Morogoro.

District managers commended the Jazia PVS for its close cooperation with district officials, to the extent that, at times, they received support with regard to medical commodities from the vendor. Even the prime vendor's marketing strategies were perceived as collaborative in nature by the district managers. For instance, they highlighted that on two occasions, the vendor had supported the district by sponsoring some medicines and medical equipment during community outreach activities and public gatherings. When explaining how close collaboration with the vendor works, the district manager said:

> "*Sometimes they provide free of charge some of the equipment, for example, haemoglobin test strips, with the expectation that districts and healthcare facilities will then purchase reagents because these are distributed by the vendor. At times, a vendor decides that, instead of selling the strip, he provides it for free.*" IDI10, CHMT, Dodoma

Prime vendor economic strength

In one of the districts, the officials thought that the system is effective because the vendor has sufficient capital to run the business, compared to the previous system where suppliers had little capital. The district manager noted that before the implementation of Jazia PVS, it had

been challenging to find a supplier who could supply complementary medicines for the whole district at once. In discussing the ability of the prime vendor, this was said:

> *"…the district is so large, and previous suppliers had low capital, so it was difficult to get one supplier who could supply for all districts. The prime vendor has enough capital that is the advantage; hence, the district can purchase as a whole, and receive most of the items as ordered."* IDI28, CHMT, Morogoro

Self-efficacy

'Self-efficacy' refers to the participants' self-confidence that they can perform the behaviour(s) required to participate in the intervention. Three sub-themes emerged, including the confidence of district pharmacists, of the Jazia PVS technical committee and regional coordinating office, and adherence to national rules and procurement procedures

View of district pharmacists

District pharmacists believed they could perform all procedures needed to ensure that the Jazia PVS attains the intended objectives. Pharmacists in the study districts reported communicating with the facility in-charges to make sure that they prepare their orders correctly and on time, and to ensure proper documentation of commodity usage at the facility. They confirmed that timely consolidation of requests from the facilities and prompt communication with the vendor is necessary for the system to function well. Pharmacists were responsible for the inspection of the consignment at the district level, before informing facility in-charges to collect their consignment. When a pharmacist was asked about his role, he reported that:

> "…*as a district pharmacist my role is to ensure the system works properly, first making sure that facilities including district hospital, health centres and dispensaries prepare their orders on time. I communicate with a healthcare facility to get feedback on the quality of commodities procured from the vendor*……." IDI25, CHMT, Morogoro.

Jazia PVS technical committee and regional coordinating office

Regional implementers at the regional Jazia PVS coordinating office expressed confidence in their ability to organise, monitor, and advise to ensure that the system performs as expected. Also, they reported that the regional coordinating office conducts quarterly monitoring and evaluates the vendor's performance; reports are shared with the Jazia regional technical committee, the board, and regional administrative secretary (contract holder) for review during semi-annual meetings. A regional implementer stated:

> "*…the first role of regional coordination office is to inform contract holder day-to-day operations of the system if the system is performing well or not. It is also responsible for solving any conflicts emerging between the vendor and the districts, also responsible for compiling data coming from the districts…is also involved in monitoring and evaluation…prepare the report and submit to the technical committee*…." IDI1, Regional implementer, Dodoma

Adherence to national rules and procurement procedures

Regional and district managers felt that the prime vendor was effective as it followed all the procurement rules and regulations within the country. They further highlighted that during the selection of the vendor, stipulated procurement guidelines were followed, whereby all the potential retail and wholesale suppliers were invited and participated in the tendering process. Prime vendor technical committee members highlighted that they managed to review documents from the bidders and make sure that the selected prime vendor was licenced and registered with Tanzania's pharmacy council, paid all the necessary charges (including taxes) to the government and that the medicines supplied were registered by the Tanzania Food and Drug Authority (TFDA). When discussing procurement laws and regulations with the district procurement managers, one of them said:

> "…..*the law directs us that to award any tenderer/vendor any work in which public funds are used, they must adhere to procurement rules and regulations, that is the work that we have been doing: ensuring they follow the rules and regulations*….." IDI3, Regional implementer, Dodoma.

Opportunity costs and experienced burden

'Opportunity costs' connotes the benefits, profits, or values that were forfeited to engage in the intervention. 'Experienced intervention burden' refers to the amount of effort required to participate in the intervention. The section has the following sub-themes: staff foregoing other activities to engage in Jazia PVS implementation; providers incurring transport costs to and from the district headquarters; storage capacity at the district and facility levels; cascade coaching and lack of transport; shortage of staff and work burden, and shorter documents easy to read and fill in.

Staff foregoing other activities to engage in Jazia PVS implementation

As described earlier, efficiency gains were perceived as relevant for the acceptability of Jazia PVS. However, the burden of Jazia PVS implementation on health personnel was mentioned as a challenge. In one of the regions, the manager reported that some of the staff who have been participating in the technical meetings have multiple tasks, and at times they have to forego other activities to participate in the implementation of Jazia PVS activities. Besides, the manager highlighted that having staff who are specifically employed for the Jazia PVS could improve the performance of the system, even beyond what people expect. In discussing the implications for other activities, the manager said:

> "…*I am a specialised doctor, and at times I am supposed to go and provide treatment to the clients while, at the same time, I should participate in Jazia PVS monitoring and evaluation activities. If there were staff who were employed specifically for Jazia PVS activities, perhaps the efficiency of the system could go beyond what we expect*…." IDI2, Regional implementer, Dodoma

Providers incurring transport costs to and from the district headquarter

In a few health facilities, in-charges reported incurring transport costs when submitting their order to the district pharmacists as well as when collecting the facility consignment. They reported spending a whole day for travelling to the district headquarters and submitting an order as well as for picking up the facility consignment. A few facility in-charges reported that incurring costs are not refunded when using a motorcycle to pick up the consignment at the district headquarters. A facility in-charge stated:

> "…*we are supposed to receive medicines on time, in case of delays it becomes a problem, there comes a time as in-charge you are supposed to use your common sense if you have a motorcycle you go and collect facility consignment* …." IDI26, Facility in-charge, Morogoro.

Storage capacity at the district and facility levels

In one of the districts, the manager reported that with the bulk purchases from the vendor, they faced a challenge with the storage facility. The manager noted that the vendor delivers the whole consignment to the district level, and one of the problems is low storage capacity because all the medicines should be stored appropriately before distribution to the respective health facilities. One of the district officials explained:

"…*one of the challenges is that our building is small and is not enough for the storage of the medicines. They are supposed to be kept in a standard form, and there is not enough storage space in our building*…." IDI25, CHMT, Morogoro.

In a follow-up discussion at the facility level, in two of the facilities surveyed staff reported experiencing challenges with the storage capacity, in terms of room size as well as the nature of the shelves. The in-charge described that the facility had been built many years ago and that the size of the store and shelves were small compared to the volume of the consignments. In-charges highlighted that they have been receiving more drugs at the moment compared to the time before the implementation of the Jazia PVS. To clarify this point at the facility level, the in-charge said:

"…*At this time we have been receiving many drugs. However, the facility was constructed during the colonial period, and the room for the storage of medicines is small, so storage capacity has become a problem*…." IDI26, Facility in-charge, Morogoro.

Cascade coaching and lack of transport

In discussions with district managers, it was reported that, during supportive supervision, staff who had experience and knowledge of commodity management were identified from health centres and dispensaries. They were trained in integrated logistic supply and offered the responsibility of peer coaching (mutual learning partnership among healthcare workers within the Jazia PVS pilot region to help identify best practices and creativity for improving healthcare service delivery). District managers highlighted that coaches were assigned at least three dispensaries for peer coaching on pharmaceutical supply chains to ensure that staff at the facility properly prepared a list of healthcare commodity needs and saved appropriate records. Besides, the manager highlighted that the coaches were facing a challenge as some dispensaries were located far away and that there were no funds apportioned to undertake coaching. In discussing cascade coaching and the burden that coaches from the health centre were facing, the following was said:

"…*at the beginning we had staff from the health centre to coach staff at the dispensaries, it became difficult, for a person to serve about ten facilities which are in distant places. So, we looked at the performance of other facilities and re-distributed into three to four facilities. This helped and reduced the work burden*…." IDI14, CHMT, Dodoma.

Shortage of staff and work burden

In two of the study districts, it was reported that there was a shortage of staff. District managers highlighted that the existing staff are assigned a lot of work which they have to complete and, at the same time, perform Jazia PVS activities. The district manager reported that they are responsible for the management of hospital medicine supplies. Additionally, receiving and reviewing most of the health facility reports was challenging for just one person to oversee the whole process. In explaining the shortage of workforce, and in view of other assigned duties such as reviewing store ledgers, voucher books, and bank balance, the manager had this to say:

> "*…there is a shortage of staff at the district, and at times I am forced to work till five p.m. in the evening and may extend up to eight p.m. At the hospital, I am responsible in overseeing medicines for the hospital and at the same time receiving and reviewing reports from the facilities, so it becomes a challenge for someone to perform all the assigned tasks on time ….*" IDI25, CHMT, Morogoro.

Shorter documents easy to read and fill in

District managers felt that the implementation of the Jazia PVS came with additional paperwork at the facility level during quantification and inspection of the commodities. However, they maintained that the forms were not complicated and easy to fill in. They reported that facility in-charges were using the forms, which were easy to read and fill in during quantification and inspection of the consignment. The district official explained this process:

> "*…to a greater extent, procedures at the facilities have been simplified so that staff at the facilities may follow easily. During the inspection of the consignment, there is a form that they fill in after receiving medicines which has simplified the process. Also, when quantifying the medicines to be procured from the vendor, there is a particular form facility in-charges have to fill in, it's easy to read and fill in….*" IDI14, CHMT, Dodoma.

6.5 Discussion

This study analysed the acceptability of Jazia PVS in Tanzania among stakeholders involved in its implementation. Among the factors named most frequently as contributing to the acceptability of the Jazia PVS is the perceived effectiveness of the system. Participants felt Jazia PVS has been effective in increasing the availability of essential medicines at the facilities, in timely delivery of the consignment together with higher-order fulfilment rates. Intervention coherence, a reduction in experienced opportunity cost, and low intervention burden were also important in explaining the acceptability of the Jazia PVS. Other factors included affective attitude and self-efficacy.

The study findings on the perceived effectiveness reflect the extent to which Jazia PVS has achieved the intended purpose of improving the availability of essential medicines in public healthcare facilities. The results are consistent with other studies which have found perceived effectiveness of an intervention in solving a problem or making improvements to be among the factors explaining acceptability of the intervention (Maryam Bigdeli et al., 2013; M. Sekhon et al., 2016; Shieshia et al., 2014). In Malawi, perceived effectiveness of short message service (SMS), web-based reporting and a resupply system resulted in reducing stock-outs of healthcare commodities, thus influencing the acceptability of the intervention (Shieshia et al., 2014). In South Africa a prime vendor system resulted in improved availability of medicines at the facilities, increased reliability, and cheaper distribution; however, acceptability of the system was not assessed(Velásquez, Madrid, & Quick, 1998).

Similarly, other studies conducted in different settings found that pooling of healthcare facility orders increased the purchasing power of health providers, and district and regional managers were able to negotiate prices for the commodities due to economies of scale (Banda, Ombaka, Logez, & Everard, 2006; MSH, 2012; Waning et al., 2009; WHO, 1998) (Banda et al., 2006; MSH, 2012; Waning et al., 2009; WHO, 1998). Similarly, in Thailand, a collective provincial bargaining system across district hospitals and health centres resulted in a twelve to twenty percent reduction in drug prices (WHO, 1998). In Cameroon, pooled procurement of pharmaceutical supplies was considered the best option for increasing the volume and purchasing power of drug supply organizations, hence lowering the price of the medicines (Banda et al., 2006). Proper management of pooled procurement increases pharmaceutical procurement efficiency and in most cases actually does reduce transaction costs (Kim & Skordis-Worrall, 2017; Waning et al., 2009).

We found that experienced intervention burden and lower opportunity costs related to the previous system influenced the acceptability of the Jazia PVS. The findings of this study are similar to those of an innovative programme which was conducted in Senegal and Vietnam to integrate the medical product supply chain for all public-sector vaccines, drugs, and other health products (Guillermet et al., 2015; WHO, 2013b). After integration, vaccines and other medical commodities were allocated from the national level to the regional level. Acceptability of the intervention was influenced by time-savings for healthcare staff and caretakers in administering vaccination; the reduction in workload for staff involved the supply chain and improved the availability of vaccination and health products (Guillermet et al., 2015; Shieshia et al., 2014; WHO, 2013b). In Malawi, Shieshia *et al.* noted that the reduction in effort, time, and money spent in travelling to the districts to follow up the facilities' needs contributed to the acceptance of the m-Health technology ("medical and public health practice supported by mobile devices") in strengthening the community health supply chain (Shieshia et al., 2014).

Self-efficacy within the context of the intervention contributes to effective implementation (Guillermet et al., 2015). Pharmacists and Jazia PVS technical committee members expressed their ability to manage day-to-day Jazia PVS activities, ensuring that the vendor complies with the contractual agreement and other laws/regulations. In Tanzania, various institutions are in place to oversee the operations of prime vendors for safety purposes, including the pharmacy board and the TFDA (C. Goodman, Kachur, Abdulla, Bloland, & Mills, 2007). Close monitoring of the prime vendor remains crucial to the supply chain; there were cases of regulatory infringements which were linked to the failure to implement sanctions by respective institutions, staff malpractices, and concealment of regulatory violations (C. Goodman et al., 2007).

Findings on the affective attitude and ethicality of the intervention show that participants had a positive feeling towards Jazia PVS. Murphy and Gardner (2019) assessed pharmacists' acceptability of a men's mental health promotion programme using the framework of Sekhon *et al.* and found that participants' acceptability of the intervention was influenced by their positive feeling that the programme would improve men's mental health (Murphy & Gardner, 2019). In this study, regional and district managers felt that the programme resulted in a substantial reduction in bureaucratic procedures in the procurement process. Similarly, in Thailand, acceptability of the collective provincial bargaining system was influenced by the active involvement of the district hospitals, by the reduction of bureaucratic steps in the procurement process and by the absence of conflicts of interest (WHO, 1998).

To the best of our knowledge, this was the first study to apply a theoretical framework of acceptability to assess the implementation of a pharmaceutical supply chain PPP intervention in a low-income setting. Nevertheless, the study contends with a few minor limitations. Not all acceptability dimensions could easily be analysed, such as affective attitude and ethicality of intervention. There could be some overlap with regard to some dimensions; for example, there is no clear demarcation between the opportunity cost experienced during the intervention and the intervention burden conferred by the intervention. In this study, as we assessed acceptability using self-reported experience with the Jazia PVS, there could be some social desirability recall bias (Steene-Johannessen et al., 2016). However, this was minimised by the purposive selection of participants and data triangulation (Carter et al., 2014; Heath, 2001).

The field would benefit from future studies that use objective measures and individual self-reported measures to assess acceptability and compare the findings. Similarly, the methodological assessment of acceptability depends on the nature of the intervention being implemented. Several methods have been used to assess acceptability, including objective measures of behaviour (such as all-cause discontinuation, dropout rates or withdrawal rates), individual self-reported measures (such as satisfaction measures, attitudinal measures, personal experiences with the intervention), and both objective measures and individual self-reported measures (Mandeep Sekhon et al., 2017). There is no established convention concerning the time for an assessment of acceptability, and one could conduct a study pre-intervention, post-intervention, or during the intervention. Future studies targeting the pharmaceutical supply chain could choose different time points for the purpose of comparison. Ongoing monitoring activities would enable identifying problems with acceptability over time and would facilitate comparisons of acceptability between alternative or competing interventions (M. Sekhon et al., 2018). In terms of the quality of medicine, the Jazia PVS programme has measures in place to ensure that the selected prime vendors deliver healthcare commodities of high quality to facilities. However, this study did not capture and track changes in the quality of medicines supplied by the prime vendor. Furthermore, this study did not explore the perceived effectiveness on the part of the staff and executive management of the MSD, the institution mandated with the supply and distribution of essential medicines in the public sector in Tanzania. Their opinion and experience of the effectiveness of the Jazia PVS would have enriched the findings of this study and strengthened policy recommendations.

6.6 Conclusion

The findings of this study indicate that the perceived effectiveness of the Jazia PVS was mentioned most frequently by the participants in explaining its acceptability. Jazia PVS was perceived to be effective in improving the availability of essential medicines at public healthcare facilities, a key determinant of access to health care. Districts purchasing directly from the prime vendor have the well-structured and institutionalized possibility to increase availability of essential medicines in peripheral areas in a low-income setting. However, when implementing this strategy, it is crucial to select a reputable and competent vendor that abides by contractual agreements. As in any PPP, these contractual obligations need to be followed by both parties. In addition, it is important to establish and maintain a routine monitoring system which will allow tracking the effects and results of innovation such as Jazia PVS on the pharmaceutical supply. Furthermore, it is important to strengthen coordination between the entities responsible for managing the supply chain of healthcare commodities at different levels to ensure timely availability and proper use of health commodities at the facilities.

6.7 Acknowledgement

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Supplementary Material

Table S8: Categories of respondents at the regional, district and facility level

Region / Council / Category of Respondent	Dodoma Region					Morogoro Region				
	Kondoa DC		Bahi DC			Ulanga DC			Kilosa DC	
	FGD	IDI	FGD	IDI	GD	FGD	IDI	GD	FGD	IDI
Council health management team (CHMT)		2		1	1		1			2
District accountants/ auditors		1					1			1
District procurement managers							1			1
Health service providers		1		1	1		2	3		3
Health facility governing committee (HFGC)	5		3			2			4	
Council health service board (CHSB)		1								
Total	5	5	3	2	2	2	5	3	4	7

Table S9: Categories of respondents at the national, regional, and district level

National and regional level key informants	IDI	GD
Health Promotion System Strengthening (HPSS)	3	2
President's Office for Regional Administration and Local Government –PO-RALG (Jazia coordinating office)	1	
President's Office for Regional Administration and Local Government –PO-RALG (Procurement department)	1	
Jazia PVS Regional Coordination office	2	
RHMT members (Regional Pharmacists /Regional medical officer)	2	
Bahari pharmacy representative	1	
Jazia PVS Consultant	1	
Total	11	2

7. Cost and Cost Drivers Associated with Setting-up a Prime Vendor System to Complement the National Medicines Supply Chain in Tanzania[11]

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7.1 Abstract

Introduction

Economic analysis of supply chain management interventions to improve the availability of health commodities at the primary healthcare level is important in generating evidence for decision-makers. The current study assesses the cost and cost drivers for setting-up a public-private-partnership programme in Tanzania in which all public healthcare facility orders for complementary medicines are pooled at the district level, and then purchased from one contracted supplier, the prime vendor, (referred to as 'Jazia Prime Vendor System – Jazia PVS').

Methods

Financial and economic costs of Jazia PVS were collected retrospectively and using the ingredients approach. The financial costs were spread over the implementation period of January 2014 – July 2019. In addition, we estimated the financial rollout costs of Jazia PVS to the other 23 regions in the country over two years (2018-2019). A multivariate sensitivity analysis was conducted on the estimates.

Results

Jazia PVS start-up and recurrent financial costs amounted to US$2,170,989.74 and US$ 709,302.32 respectively. The main cost drivers were costs for short term experts, training of staff and healthcare workers and the Jazia PVS technical and board management activities. The start–up financial cost per facility was US$2,819.47 and cost per capita was US$0.37.

Conclusion

In conclusion, the study provides useful information on the cost and cost drivers for setting-up a complementary pharmaceutical supply system to complement an existing system in low-income settings. Despite the substantial costs incurred in the initial investment and operations of the Jazia PVS, the new framework is effective in achieving the desired purpose of improving availability of healthcare commodities.

Keywords: Cost analysis, Jazia Prime Vendor, Public Private Partnership, Tanzania

7.2 Introduction

Access to essential medicines of good quality, affordable, at the right time and place is essential for the attainment of universal health coverage (Rankin, Quickand, & Muziki, 1999). Access to medicines has been on the global agenda towards Sustainable Development Goal(s) in goal number three, specifically target eight (Beran et al., 2019; UN, 2015). Achieving this target relies on the complex interactions between various actors in the pharmaceutical supply chain such as manufacturers, central medical stores, sector ministries, distributors (retailers and wholesalers), vendors, healthcare providers and the community (Bhakoo & Chan, 2011; Chung & Kwon, 2016).

There has been an increase in the number of health system interventions to improve service delivery, targeting either supply or demand side or both (Garchitorena et al., 2018; Jannati, Sadeghi, Imani, & Saadati, 2018; Kokilam et al., 2016; Senkubuge, Modisenyane, & Bishaw, 2014; Sylim, Liu, Marcelo, & Fontelo, 2018; Vledder et al., 2019). A recent systematic review conducted to assess whether in-country changes in the pharmaceutical supply chain models yield cost savings and improve the availability of health commodities found that both centralised tendering and procurement bring cost savings and improve efficiency (Seidman & Atun, 2017). In addition, supply chain management interventions have been effective in reducing health commodities stock-outs and improve the availability of medicines for the population (Nunan & Duke, 2011; Seidman & Atun, 2017). For example, in Thailand, the transition from the conventional vaccine supply and logistics systems to the vendor managed inventory resulted in a reduction of the cost of immunization due to the reduction of vaccine wastage (Riewpaiboon et al., 2015). Reduction of vaccine wastage resulted in a lower number of doses procured and the vendor system led to the elimination of vaccine storage at intermediate warehouses. Furthermore, information technology was improved alongside the vendor system, hence reducing the number of supply chain operators (regional and provincial levels) distributing directly to the hospitals, health centres or immunization clinics (Riewpaiboon et al., 2015). Likewise, in Jordan, a joint procurement bidding process for medical commodities achieved 5.2–17.0 percent cost savings on drugs procured from the vendors (Alabbadi, 2011). Other studies have found that medicines procurement through a formal tendering process reduces prices of the commodities and results in cost savings when compared to drugs purchased in the free-market (Danzon, Mulcahy, & Towse, 2015; Milovanovic, Pavlovic, Folic, & Jankovic, 2004). Pharmaceutical procurement arrangements

operating under framework agreements have been shown to significantly reduce the cost of the procurement process and shorten lead times (Arney & Yadav, 2014). Economic analysis of a health system intervention is important for informing policy-makers of the resources required in implementing and scaling up such interventions into different settings, taking into consideration economies of scale (Dang et al., 2016; Johns et al., 2003a).

The United Republic of Tanzania piloted a supply chain intervention in three regions namely Dodoma, Morogoro and Shinyanga to complement the existing national pharmaceutical supply chain from 2014 to July 2019. The complementary procurement system in the regions has been successful in improving the availability of medicines at public healthcare facilities (HPSS, 2014; Kiologwe, 2016; Wiedenmayer, 2017; Wiedenmayer et al., 2019). Hence, the government decided to implement the Jazia Prime Vendor System (Jazia PVS) to all the twenty-six regions in 2018 (Wiedenmayer et al., 2019). The current study assesses the cost and cost drivers for setting up Jazia PVS in public healthcare facilities within the pilot regions in Tanzania. In addition, we also estimated the financial costs for the Jazia PVS rollout to the remaining twenty-three regions in Tanzania. Economic analysis of interventions for improving the availability of essential medicines at the periphery is important to generate evidence for decision-makers when allocating limited resources. In addition, knowledge of the amount of resources needed for planning purposes and for informing decision-makers is critical when implementing effective and efficient complementary supply chains such as the Jazia PVS to improve public welfare.

The Jazia Prime Vendor System (Jazia PVS)

In Tanzania, the Medical Store Department (MSD) is an independent department under the Ministry of Health, Community Development, Elderly and Children (MoHCDGEC) that is responsible for the supply of healthcare commodities to the public healthcare facilities and some of the faith-based organization hospitals that serve as District Designated Hospitals (DDHs). MSD delivers consignments directly to the respective facility based on a quarterly facility quantification of health commoditiy needs. However, a number of challenges hinder MSD efficiency, leading to low order fulfilment rates for supplies by MSD, such as inaccurate forecasting of pharmaceutical needs at facility levels, ineffective systems for fulfilling back-ordered items and weak supply chain (Yale, 2011). Healthcare facilities have resources earmarked for purchasing healthcare commodities from private pharmaceutical suppliers when MSD is out-of-stock (HPSS, 2014). Initially, procurement from private pharmaceutical suppliers was reported to be poorly managed (HPSS, 2014). A survey conducted in 2012

revealed that order fulfilment rate from the MSD was about 60 percent (HPSS, 2011), but facilities with resources could procure complementary supplies from private pharmacies. However, procurement was done from multiple private sources within and outside their district and region; incurring high opportunity costs (travel and fuel, per diems, high prices of medicines they purchase) in the process. The procedure was reported to be poorly managed (HPSS, 2014).

In 2014, the United Republic of Tanzania began implementing the Jazia PVS to supplement the MSD. The Jazia PVS is a unique public-private partnership (PPP) programme in which all the public healthcare facility orders for missing medicines at the MSD are pooled at the district level, and then purchased from one contracted prime vendor per region. The set-up of the Jazia PVS was funded by the Swiss Agency for Development and Cooperation (SDC) and implemented by the Health Promotion and System Strengthening (HPSS) project. Both international and local experts were responsible for conceptualizing, supporting and providing technical expertise. HPSS project staff supported the operations of the Jazia PVS in collaboration with government officers.

Jazia PVS was implemented alongside several activities, including capacity-building to healthcare staff, inventory and financial audits conducted at the facilities, monitoring and evaluation and peer cascade coaching. To ensure the sustainability of the system, Jazia PVS was anchored within the government structures and overseen by the regional administrative secretary, regional health management teams and council health management teams.

The Jazia PVS intervention pilot phase started in Dodoma region in 2014 and was later extended to Morogoro and Shinyanga regions in 2016. After the government decided to integrate the successful pilot into national policy, the Jazia PVS was rolled-out and implemented in all regions of mainland Tanzania in 2019. Of the three pilot regions, the Morogoro region has the highest population, 2,218,492 followed by Dodoma with 2,083,588 and Shinyanga 1,534,808 (Table 10). A total of 770 public facilities are covered by Jazia PVS, including 17 hospitals, 83 health centres and 670 dispensaries (Table 1). Morogoro region has the largest number of public dispensaries (251) while Shinyanga has the least number of dispensaries (186). The number of primary care facilities per 10,000 population is 1.7, 1.8 and 1.4 for Dodoma, Morogoro and Shinyanga respectively (Table 10).

Table 10: Regional information

Variable	Dodoma	Morogoro	Shinyanga
Population [12]	2,083,588	2,218,492	1,534,808
Population growth rates	2.1	2.4	2.1
Area coverage in square kilometres	41,311	70,624	50,781
Hospitals[2]	5	6	6
Number of public health centres[13]	29	32	22
Number of public dispensaries[2]	251	233	186
Number of private health facilities[2]	62	128	55
Number of primary care facilities[14]	1.7	1.8	1.4
Assistant medical officers[3]	0.37	0.64	0.26
Medical doctors[3]	0.52	0.4	0.11
Assistant medical officers and medical doctor[3]	0.89	1.04	0.37
Nurse/Midwives[3]	4.57	5.13	3.82
Pharmacy staff[3]	0.28	0.19	0.15
Laboratory staff[3]	0.27	0.45	0.19
Total staffing per [3]	6.9	7.85	4.9

Jazia PVS had a number of performance targets which were set out during its establishment (PO-RALG, 2016). Table 11 presents Jazia PVS monitoring and evaluation performance results from 2015 to 2019 in terms of the availability of essential medicines in the pilot regions, with Dodoma reaching above 90 percent, Shinyanga 87 percent and Morogoro 78 percent. In addition, medicines, medical equipments and medical supplies worth US$ 9,172,726.21 have been procured from the prime vendor during the pilot phase. Other performance indicators showed that satisfaction with the prime vendor was good; medicines order fulfilment rates were high; and medicines were delivered within 4 to 15 days (Wiedenmayer et al., 2019).

[12] NBS, Tanzania National Bureau of Statistics; Population and Housing Census 2013
[13] http://hfrportal.ehealth.go.tz/ (Accessed on 15th January 2018)
[14] per 10,000 population 2013/14

Table 11: Jazia PVS performance and purchases

Year	2015	2016	2017	2018	2019	Total
Variable						
Mean availability of essential medicines to the facilities						
Dodoma, %	69	75	83	81	94	83.25
Morogoro, %		72	70	77	78	74.25
Shinyanga, %		83	79	86	87	83.75
Value of commodities purchased from the prime vendor in US $						
Dodoma, US$	732,319.09	512,999.11	1,731,510.89	1,442,258.84	864,620.81	5,283,708.73
Morogoro, US$			1,060,317.92	951,708.14	242,320.18	2,254,346.24
Shinyanga, US$			621,419.95	679,861.81	333,389.48	1,634,671.23
Total, US$	732,319.09	512,999.11	3,413,248.76	3,073,828.79	1,440,330,47	9,172,726.21

Note 1) Health facility baseline assessment in Dodoma was conducted prior to 2015, by the first quarter of 2015 facilities had purchased and received the consignment from the prime vendor

2) Health facility baseline assessment for Morogoro and Shinyanga was conducted in 2016, facilities started purchasing and receiving commodities from the prime vendor first quarter of 2017

7.3 Methods

Costing approach

Cost analyses can be implemented adopting a 'bottom-up' (micro-costing or ingredients approach), a 'top-down' (macro-costing or activity-based) approach or a combination of the two approaches (Cunnama et al., 2016; Vassall et al., 2017; Xu, Grossetta Nardini, & Ruger, 2014). Ingredients approach disaggregates the costs of a given output, linking them to specific items being assessed within the intervention. It measures quantities of resources used at the activity level (Xu et al., 2014). Bottom-up costing comprehensively captures information on the resources used, and whether the data required for conducting analysis is available and easier to access (Cunnama et al., 2016; Hendriks et al., 2014). In contrast, a 'top-down' approach divides intervention expenditures by a given number of outputs in order to calculate a unit cost (Vassall et al., 2017). A top-down analysis of the economic costs, on the other hand, takes consideration of all the expenditure items at the central level and allocates the costs using formulae based on a number of factors such as office space usage in a building, number of staff and staff time spent on various activities (Cunnama et al., 2016; Flessa, Moeller, Ensor, & Hornetz, 2011). Economic costing using any of the approaches above can be captured retrospectively, prospectively or using both (Vassall et al., 2017; WHO, 2003). The prospective approach allows analysts to directly observe resource use and avoids/minimises recall bias. Nevertheless, the use of such approach may influence resource use in the implementation process of intervention (Evans & Crawford, 2000; Vassall et al., 2017). In this study, the cost assessment of Jazia PVS was conducted when it was already implemented in the three pilot regions and as such, implementation costs were collected retrospectively. The retrospective approach is reliable and usually works well if relevant financial and implementation reports are available to track resources used (Vassall et al., 2017). The current study has adopted an ingredients approach.

We considered public healthcare facilities as Jazia PVS caters for public healthcare facilities only, with no private healthcare facilities participating in the programme. Data collection was conducted between July and September 2018 based on the range of activities performed in the implementation of the Jazia PVS (Supplementary Material, Table S12). Using the ingredients approach, we captured information on the quantities of time and other resources, together with their unit cost (Supplementary Material, Table S13). Unit costs were multiplied by the respective quantities of inputs used to obtain total cost (M. Drummond, Sculpher, Torrance,

O'Brien, & Stoddart, 2002; Johns, Baltussen, & Hutubessy, 2003b; Vassall et al., 2017) (Supplementary Material, Table S14). A checklist for Consolidated Health Economic Evaluation Reporting Standards (CHEERS) was completed to ensure that all recommended sections in reporting economic evaluation were covered (Supplementary Material, Table S17).

Data sources

Several sources of information were used to estimate the costs to implement Jazia PVS. These included Jazia PVS financial reports and coordination office reports, government salary scales, HPSS planning meeting reports, and semi-structured interviews (Table 12). A total of 30 semi-structured in-depth interviews were conducted to capture information on resources used to implement Jazia PV, such as staff time. A costing survey tool was used to capture information for different activities undertaken with the Jazia PVS (Supplementary Material Table S12). In addition, we conducted a document review of the intervention design, implementation monitoring and evaluation reports, and of the HPSS financial reports. We extracted expenditure information on staff allowances, training, meetings, and schedules for auditing as well as monitoring and evaluation activities. All information for the economic cost at the district and facility level were later on extrapolated to the regional level. We used the government salary scale based on the position of the staff and self-reported salary. This was also supplemented with salary information for health and non-health staff obtained from salary explorer website (SalaryExplorer, 2019), and health and medical average salaries in Tanzania 2018.

Table 12: Data sources used for costing

Data sources / Activities	Jazia PVS financial reports	Government salary scales	Meeting minutes and reports	Semi-structured interviews	Jazia coordination office reports
Start-up costs					
Baseline data	X			X	X
Advocacy and buy-in	X		X	X	X
Vendor forum	X	X		X	
Administrative structures	X		X	X	X
Launch of the Jazia PVS	X	X	X	X	
Jazia PVS training	X	X		X	X
Consultancy	X		X	X	
Office purchases	X				
Recurrent costs					
Staff remuneration	X				
Quantification				X	
Pick-up of consignment				X	
medicines and financial audits	X			X	
Coaching				X	
Supervision	X			X	
Monitoring and Evaluation (M&E)	X			X	X

Financial analysis

Jazia PVS financial cost represents the real expenditure incurred ('paid for') (Vassall et al., 2017) in the process of conceptualisation and supporting the implementation of the intervention (Frick, 2009; Vassall et al., 2017). Jazia PVS financial costs are grouped into start-up and recurrent costs. We estimated the Jazia PVS financial start-up costs from January to December 2014 for Dodoma and January to December 2016 for Morogoro and Shinyanga regions. Jazia PVS start-up costs included all the expenses incurred between the conceptualisation of the idea and actual operation (the time when healthcare facilities and districts started procuring and receiving medicines from the prime vendor). Some of the start-up costs included payment to short-term pharmaceutical experts, baseline healthcare facility assessment, advocacy and orientation to stakeholders, suppliers/vendors pre-qualification and tendering for short-listed/prequalified vendors, the official launch of the Jazia PVS in the pilot regions, preparation of Jazia PVS official documents as well as training of trainers and health workers. At least one staff from each dispensary, two from each health centre and three from hospitals participated in the Jazia PVS training.

Financial costs were also incurred for the purchase of capital equipment such as computers, furniture, signposts, water dispensers and printing machines. These costs were included within the establishment of Jazia PVS office. We consider capital cost as any equipment with a lifespan of greater than one year and its purchase price worth more than US$100. Three computers were bought and installed at the regional coordinating offices in Dodoma, Morogoro and Shinyanga and were only used for Jazia PVS activities.

Recurrent financial costs comprised of expenses incurred during the actual operation of the Jazia PVS from January 2015 to July 2019 for Dodoma and January 2018 to July 2019 for Morogoro and Shinyanga regions. Such costs included Jazia PVS regional coordinating office personnel allowances, monitoring and evaluation, medicine and financial audits at the facility level, Jazia PVS technical and board meeting management activities, and allowances for various trainings and meetings. Each of the three regional Jazia PVS coordination offices operated with three staff: a senior staff/pharmacist, a pharmacy technician and one junior staff who were responsible for overseeing the Jazia PVS activities. These costs were captured up to 31st July 2019 at the closure of Jazia PVS pilot phase, and have also been spread over the Jazia PVS implementation period. In the financial analysis we excluded the costs for experts based in Switzerland together with HPSS project overall costs and we only considered the direct costs for the implementation of Jazia PVS. Jazia PVS activities in Morogoro and Shinyanga were implemented concurrently. Separation of the financial costs for both regions was based on a share of the total public healthcare facilities in the region (56% for Morogoro and 44% for Shinyanga). We used the share of healthcare facilities for separation of costs as Jazia PVS was intended to improve availability of healthcare commodities at the facility level. At least one staff from each of the 271 facilities in Morogoro and at least one staff from each of the 214 facilities in Shinyanga participated in Jazia PVS capacity building.

Economic analysis

We estimated economic cost for the Jazia PVS start-up from January - December 2014 for Dodoma and January - December 2016 for Morogoro and Shinyanga regions. Jazia PVS initial implementation started in Dodoma 2014 where most of Jazia PVS start-up activities took place. Jazia PVS start-up cost has been considered as a capital investment and has been discounted and annualised over the life of the intervention (M. F. Drummond, Sculpher, Claxton, Stoddart, & Torrance, 2015; Vassall et al., 2017). We estimated economic costs of staff and healthcare workers who reported participating in any of the Jazia PVS activities. The Jazia PVS

coordination offices were located within the regional hospitals, therefore no costs were incurred for utilities and rent. However, for estimating the economic cost of the Jazia PVS office in the three pilot regions, we have used the market value per square meter inclusive of the utilities (US$ 17.5 per square metre per month). Equipment supplied to the Jazia PVS offices were annualised using a discount rate of 3% and a useful life of 5 years, consistent with economic analysis guidelines where a minimum of three percent discount rate is recommended for international comparison purpose (M. F. Drummond et al., 2015; Vassall et al., 2017). Initial healthcare worker training followed a step-down approach and assumed to have a useful life of 3 years. We had no baseline assessment of the costs for the previous system of procuring complementary healthcare commodities from private supplies, therefore the comparator was 'do-nothing'.

Financial Costs for the national roll-out of Jazia PVS

We estimated the Jazia PVS financial rollout costs to the other 23 regions of Tanzania covering 112 hospitals, 464 health centres and 4,318 dispensaries over two years (2018-2019). Jazia PVS scale-up costs are modelled based on the estimated cost from the pilot regions and costs are estimated based on a number of assumptions (Appendix 1: Table 6). Assumptions include: a prime vendor for a given region is contracted for two years and re-evaluated, a prime vendor continues to deliver consignments at the district level and facilities pick/retrieve their consignment at the district level, start-up activities include a baseline health facility assessment, advocacy and orientation of stakeholders, pre-qualification and tender for the prequalified vendors is performed once after every three years, an official event launches the Jazia PVS, training of trainers and health workers is conducted once and each region provides a Jazia PVS coordination office. For Jazia PVS recurrent activities, we assumed that each region constitutes a prime vendor technical commission and a tender board team which meets at least twice a year. In addition, Jazia PVS monitoring and evaluation together with inventory and financial audits at the facility level are conducted twice a year. Each facility is visited at least once during the contract duration of two years. We considered scale-up cost with 30 percent technical support from national and international pharmaceutical consultants and without technical support. The assumption is that resources to finance and run the Jazia PVS are covered by respective regional authorities. Jazia PVS is assumed to be fully integrated into the government regional and district administrative structures, with some financial resources from the government required to support the training of health workers, monitoring and evaluation, and establishment of regional coordination offices.

Sensitivity Analysis

Cost estimates for interventions are surrounded by uncertainty arising from the unit cost used in the valuation of resources inputs; the efficacy of an intervention; choice of the discount rate and inflation rate and the need to extrapolate the results (Vassall et al., 2017; WHO, 2003). To account for uncertainty, varying individual input into the model '*one way*' or varying two or more inputs at the same time (multivariate sensitivity analysis), while observing the changes in the outcomes is usually advised (Briggs & Gray, 1999; Vassall et al., 2017; WHO, 2003). We performed a multivariate sensitivity analysis to account for varying useful life of capital items (3, 5 and 10 years) and discount rate (3%, 5% and 10%). The base year for analysis is 2018. Cost data are adjusted for inflation using the local currency, Tanzania Shillings (TZS) and the local inflation rates (Tanzania gross domestic product deflator) and subsequently converted to the United States of America dollars (US$) for international comparison (Kumaranayake, 2000; Turner, Lauer, Tran, Teerawattananon, & Jit, 2019; Vassall et al., 2017). Kumaranayake argues that the appropriate measure for adjusting costs should be the one that is closely related to the general price level of the resources used to implement the intervention (Kumaranayake, 2000). Results of the study are expressed in 2018 US$, where the conversion rate was 2,230 TZS per US$ (BoT).

Patient and Public Involvement

Patients or the public were not involved in the design, conduct, reporting, or dissemination plans of our research. The study findings will be shared with the regional and district healthcare managers of the different sites where the study was conducted and at policy level.

Consent and ethical approval

The study was approved respective institutional board, the Tanzanian National Institute for Medical Research (NIMR/HQ/R.8a/Vol. IX/2720) and Ifakara Health Institute review board (IHI/IRB/No. 21-2017). Written informed consent was obtained from all study participants and confidentiality of the information was guaranteed during data collection, cleaning, and analysis.

7.4 Results

The financial cost of the Jazia PVS intervention

Table 14 presents the Jazia PVS start-up financial costs, where the total cost amounted to US$ 2,170,989.74. Of the total start-up costs, 57.1% (US$ 1,239,868.87) was for the payment of the short-term international and national pharmaceutical experts, US$ 427,683.15 for Dodoma region and US$ 454,824.01 and US$ 357,361.72 for Morogoro and Shinyanga regions respectively. When these costs are spread over the pilot phase, they amount to US$ 76,645.73 for Dodoma and US$ 127,045.81 for Morogoro and US$ 99,821.71 for Shinyanga. Training of the staff and healthcare workers accounted for 27.9% (US$ 605,060.13). When these costs were spread over the pilot phase, they amounted to US$ 49,042.47 per year in Dodoma and US$ 51,839.60 for Morogoro and US$ 40,731.11 for Shinyanga regions. The health facility baseline assessment and the official launch of the Jazia PVS amounted to US$ 117,406.86 and US$ 79,951.42 respectively. Further analysis showed that the cost per facility was US$ 2,819.47 (US$ 2,857.19 for Dodoma and US$ 2,854.29 for Morogoro and US$ 2,840 for Shinyanga regions). Cost per capita was US$ 0.39 for Dodoma and US$ 0.35 for Morogoro and US$ 0.40 for Shinyanga (Table 13).

The total recurrent financial cost for Jazia PVS was US$ 709,302.32 (Table 14). The largest share (80.2%) of the recurrent financial costs was used for the payment of the Jazia PVS technical and board management meetings and allowances. About 8.5% (US$ 60,485.50) was for the payment of allowances and operational costs for the Jazia regional coordination office while 6.3% (US$ 44,530.93) was for Jazia PVS specific monitoring and evaluation activities. Cost per facility amounted to US$ 1,114.57 in Dodoma and US$ 809.31 for Morogoro and US$635.89 for Shinyanga. Recurrent cost per capita was US$ 0.15 for Dodoma and US$ 0.10 for Morogoro and US$ 0.08 for Shinyanga (Table 14).

Table 13: Jazia PVS financial start-up costs in US$

Expenditure item, US$	Dodoma, 2014	Per year	Morogoro 2016	Per year	Shinyanga, 2016	Per year	Total, US$	**Proportion**
Short-term pharmaceutical experts national and international	427,683.15	76,645.73	454,824.01	127,045.81	357,361.72	99,821.71	1,239,868.87	57.1
Health facility baseline assessment	32,160.58	5,763.54	47,737.91	13,334.61	37,508.36	10,477.20	117,406.86	5.4
Advocacy and buy-in to stakeholders	5,312.92	952.14	5,608.12	1,566.51	4,406.38	1,230.83	15,327.42	0.7
Administrative structures	6,145.33	1,101.31	6,882.77	1,922.56	5,407.89	1,510.58	18,435.99	0.8
Vendor forum	8,359.16	1,498.06	6,921.13	1,933.28	5,438.03	1,519.00	20,718.32	1.0
Vendor prequalification and Tendering	12,290.66	2,202.63	13,765.54	3,845.12	10,815.78	3,021.17	36,871.98	1.7
Prime vendor contracting	6,145.33	1,101.31	4,642.77	1296.86	3,647.89	1,018.96	14,435.99	0.7
Jazia PVS production of tools and documents (SOPs, M&E)	4,504.77	807.31	2,522.67	704.66	1,982.10	553.66	9,009.54	0.4
Trainings to the staff and health facility workers	273,656.96	49,042.47	185,585.77	51839.60	145,817.39	40,731.11	605,060.13	27.9
Launch of the Jazia PVS	31,980.57	5,731.28	26,863.68	7503.82	21,107.17	5,895.86	79,951.42	3.7
Establishment of Jazia PVS office	6,060.17	1,086.05	4,392.11	1226.85	3,450.94	963.95	13,903.22	0.6
Total	814,299.60	145,931.83	773,512.01	216064.81	607,759.44	169,765.21	2,170,989.74	100
Cost per facility	2,857.19		2,854.29		2,840.00		2,819.47	
Costs per capita	0.39		0.35		0.40		0.37	

Table 14: Recurrent financial costs for Jazia PVS in US$

Expenditure item	Dodoma, January 2015 – July 2019		Morogoro, January 2017– July 2019		Morogoro, January 2017– July 2019		Total US$	Proportion
Jazia PVS recurrent activities	Total US$	Per year	Total US$	Per year	Total US$	Per year		
Monitoring and evaluation	33,788.88	7,372.12	6,015.55	2,328.60	4,726.50	1,829.61	44,530.93	6.3
Medicine and financial audits at facility level	15,890.68	3,467.06	7,208.01	2,790.20	5,663.44	2,192.30	28,762.13	4.1
Cascade coaching	6,611.27	1,442.46	-	-	-	-	6,611.27	0.9
Technical and Board management activities	237,608.35	51,841.82	185,530.32	71,818.19	145,773.82	56,428.58	568,912.50	80.2
Jazia Coordination office (Allowances and operation costs)	23,754.37	5,182.77	20,569.43	7,962.36	16,161.70	6,256.14	60,485.50	8.5
Total	317,653.54	69,306.23	219,323.32	84,899.35	172,325.46	66,706.63	709,302.32	100
Cost per facility	1,114.57	243.18	809.31	312.59	635.89		921.17	
Costs per capita	0.15	0.03	0.10	0.04	0.08		0.12	

Note 1) Costs have been spread out throughout the pilot phase, Dodoma, 2014 – July 2019, 5 years and 7 months

2) Morogoro and Shinyanga, 2016 – July 2019, 3 years and 7 months

The economic cost of the Jazia PVS intervention

Table 15 presents the economic costs of Jazia PVS start-up and recurrent costs in US$. Results show that Jazia PVS start-up costs accounted for about 52.2% (US$ 1,209,573.47) of the total economic costs. Of the economic costs, 6.0% (US$ 138,567.99) was for the official launch of the Jazia PVS, 6.3% (US$ 146,684.21) was for the healthcare facility baseline assessment and the largest share 32.0% (US$ 741,836.55) was for training of staff and healthcare workers (Table 15).

Recurrent cost accounted for 47.8% (US$ 1,106,440.94), whereas 27% (US$ 634,056.57) was for the technical and board management meetings and allowances, 7.0% (US$ 161,164.20) was for the ongoing Jazia PVS activities (including quantification, submission of documents at the district headquarter, inspection and picking-up consignment), 4.6% (US$ 106,644.94) for monitoring and evaluation activities, while 2.7% (US$ 61,694.07) was for inventory and financial audits conducted at the healthcare facilities (Table 15).

Table 15: Economic costs of Jazia PVS in US$, 2014 – July 2019

	Dodoma				Morogoro and Shinyanga					
Expenditure Item	FC US$	OP US$	Total EC	Cost per year	FC US$	OP US$	Total EC	Cost per year	Total EC	%
Jazia PVS start-up costs										
Health facility baseline assessment	32,160.58	9,834.68	41,995.27	7,526.03	85,246.27	19204.87	104,451.14	29,176.30	146,446.41	6.3
Advocacy and buy-in to stakeholders	5,312.92	3,006.48	8,319.40	1,490.93	10,014.51	6012.97	16,027.48	4,476.95	24,346.88	1.1
Administrative structures	6,145.33	1,441.93	7,587.26	1,359.72	12,290.66	0.00	12,290.66	3,433.15	19,877.92	0.9
Vendor forum	8,359.16	6,772.65	15,131.81	2,711.79	12,359.16	3640.64	15,999.80	4,469.22	31,131.61	1.3
Vendor prequalification and Tendering	12,290.66	8,212.67	20,503.33	3,674.43	24,581.32	15,084.19	39.665.51	11,079.75	60,168.85	2.6
Prime vendor contracting	6,145.33	1,162.17	7,307.50	1,309.59	8,290.66	2324.33	10,614.99	2,965.08	17,922.49	0.8
Jazia PVS production of the materials (SOPs)	4,504.77	6,346.11	10,850.88	1,944.60	4,504.77	0.00	4,504.77	1,258.32	15,355.65	0.
Trainings to the staff and health facility workers	273,656.96	45,997.84	319,654.81	57,285.81	331,403.16	90778.57	422,181.74	117,927.86	741,836.55	32.0
Launch of the Jazia PVS	31,980.57	19,538.86	51,519.42	9,232.87	47,970.85	39077.71	87,048.56	24,315.24	138,567.99	6.0
Establishment of Jazia PVS office	6,060.17	-	6,060.17	1,086.05	7,843.05	0.00	7,843.05	2,190.80	13,903.22	0.6
Sub-total	386,616.46	102,313.40	488,929.86	87,621.84	544,504.41	176123.29	720,627.70	201,292.65	1,209,557.56	52.22
Jazia PVS recurrent activities				-				-		
Monitoring and evaluation	33,788.88	25,994.84	59,783.72	10,713.93	10,742.06	36119.17	46,861.22	13,089.73	106,644.94	4.6
Medicine and financial audits at facility level	15,890.68	18,931.53	34,822.21	6,240.54	12,871.45	14000.41	26,871.86	7,506.11	61,694.07	2.7
Cascade coaching	6,611.27	3,544.40	10,155.66	1,820.01	-	0.00	-	-	10,155.66	0.4
Technical and Board meetings	237,608.35	44,632.43	282,240.78	50,580.78	331,304.15	20511.64	351,815.79	98,272.57	634,056.57	27.4
Jazia Coordination office (Allowances and operation costs)	23,754.37	42,000.00	65,754.37	11,783.94	36,731.13	30240.00	66,971.13	18,707.02	132,725.50	5.7
Jazia PVS activities (Quantification, picking consignment and inspection)	-	103,323.17	103,323.17	18,516.70	-	57841.03	57,841.03	16,156.71	161,164.20	7.0
Sub-total	317,653.54	238,426.37	556,079.91	99,655.90	391,648.78	158712.25	550,361.03	153,732.13	1,106,440.94	47.8
Total economic costs	704,269.99	340,739.77	1,045,009.76	187,277.74	936,153.19	334,835.54	1,270,988.73	355,024.79	2,315,998.50	100.0
Cost per facility	2,471.12	1,195.58	3,666.70	657.11	1,930.21	690.38	2,620.60	732.01	3,007.79	
Costs per capita	0.34	0.16	0.50	0.09	0.25	0.09	0.34	0.09	0.40	

Note 1) FC- financial costs; OP – opportunity costs and EC economic costs

Table 16: Estimates for the Jazia PVS national rollout financial costs, 2019 - 2020

Expenditure item	No technical assistance US$	Proportion	30% technical assistance US$	%
Jazia PVS start-up costs				
Health facility baseline assessment	670,487.78	8.5	680,965.00	8.5
Advocacy and buy-in to stakeholders	89,218.22	1.1	90,612.36	1.1
Administrative structures	106,941.74	1.4	108,612.84	1.4
Vendor forum	122,379.68	1.5	124,292.01	1.5
Vendor prequalification and Tendering	213,883.48	2.8	217,225.69	2.8
Prime vendor contracting	85,756.56	1.1	87,096.61	1.1
Jazia PVS production of the materials (SOPs)	54,533.92	0.7	55,386.09	0.7
Training to the staff and health facility workers	3,618,682.96	45.8	3,675,229.46	45.8
Launch of the Jazia PVS	471,840.28	6.0	479,213.38	6.0
Establishment of Jazia PVS office	82,806.02	1.0	84,099.97	1.0
Sub-total	5,516,530.65	69.8	5,602,733.42	69.8
Jazia PVS recurrent activities				
Monitoring and evaluation	573,958.55	7.3	582,927.38	7.3
Medicine and financial audits at facility level	352,757.90	4.5	358,270.19	4.5
Cascade coaching	270,117.47	3.4	274,338.40	3.4
Technical and Board management activities	481,812.09	6.1	489,341.01	6.1
Jazia Coordination office (Allowances and operation costs)	712,589.74	9.0	723,724.86	9.0
Sub-total	2,391,235.76	30.2	2,428,601.84	30.2
Total	**7,907,766.41**	**100.0**	**8,031,335.3**	**100.0**
Cost per facility	1,615.81		1,641.06	
Costs per capita	0.16		0.16	

Note: Cost per facility = Total cost divided by the number of public facilities in Tanzania

Cost per capita = Total cost divide by the population of Tanzania

Table 16 presents information on the Jazia PVS rollout costs to 23 more regions with and without technical assistance. Training of the staff and healthcare workers accounted for 45.8% (US$ 3,618,682.96) of the costs, 8.5% (US$ 670,487.78) for healthcare facility baseline assessment, and 6.0% (US$ 471,840.28) for the official launch of the Jazia PVS for each region without technical assistance. Of the Jazia PVS recurrent costs, 9.0% (US$, 712,589.74) was for the Jazia PVS regional coordination offices, 7.3% (US$ 573,958.55) for monitoring and evaluation, while 4.5% (US$ 352,757.90) was used for the inventory and financial audits without technical assistance (Table 5). The national rollout cost per region amounts to US$ 343,815.93 (~US$ 171,907.97 per year).

Sensitivity analysis

The sensitivity analysis results show that the values are sensitive to the capital asset useful life and discount rate. When varying the capital assets' useful life and the discount rates, total economic start-up cost ranged between US$ 1,441.71 and US$ 12,667.06 (Supplementary Material Table S16).

7.5 Discussion

The study aimed to assess the cost and cost drivers for setting up a complementary pharmaceutical supply system in public healthcare facilities in Tanzania to supplement the supply gap by the national MSD. We found that for the financial start-up costs, the largest share of the costs incurred was for the payment of short-term pharmaceutical consultants both national and international and for training of the healthcare workers. The largest share of the Jazia PVS financial recurrent costs was for the Jazia PVS technical and board management activities. Similar trends were observed for the Jazia PVS economic costs, where the highest start-up costs were for the staff and healthcare workers training while Jazia PVS technical and board meetings accounted for the largest share of the recurrent economic costs. Jazia PVS rollout costs show that a high proportion of the costs were for the training of staff and health facility workers.

In this study, a significant share of the initial costs was for staff training, which is similar to a study conducted in Zambia to assess the cost-effectiveness of supply-chain interventions. The study found that training costs for the district personnel were higher compared to other costs such as staff recruitment, salaries and transport (Vledder et al., 2019). Though costly, such training and mentorship programmes have been found to improve staff skills as well as the overall quality of service delivery (Hamel et al., 2015). With the Jazia PVS, a step-down cascading approach was used for training of staff at various levels, to control costs. This approach is validated by findings from a study conducted in Nigeria including training of staff involved in laboratory systems. They found that utilisation of training-of-trainers and step-down training methods was a cost-effective system in the provision of the training to laboratory staff and allowed for a broader sharing of the training across laboratory staff (Hamel et al., 2015). Equally important, staff training on supply chain management across cadres and levels helped maintain the sustainability of the intervention. Similarly to this study, Goodman *et al* conducted an economic analysis of replicating training for drug retailers in Kenya to improve the management of malaria (C. A. Goodman, Mutemi, Baya, Willetts, & Marsh, 2006). They found that training of trainers and the drug retailers accounted for the largest share of the implementation costs, while community advocacy and monitoring and evaluation activities accounted for the smallest of the implementation costs (C. A. Goodman et al., 2006). A study conducted in a different setting in Tanzania showed that staff training on the web-based electronic logistics management information system (eLMIS) intervention accounted for more

than fifty percent of the investment costs, however, there were enormous cost savings after upgrading the eLMIS (Mwencha et al., 2017).

The Jazia PVS received significant technical assistance from both in-country and external, from the conception of the idea to the completion of the pilot phase. Our findings are similar to a costing study conducted in Malawi, where they found that technical assistance accounted for the largest share of the costs, followed by the installation of the software and training of the staff responsible for the supply chain (Joy & Stewart, 2013).

In Nepal, a new model for the distribution of vitamin-A capsules to children of 6 to 60 months of age carried out by using female community health workers showed that community advocacy activity accounted for about 27.4 percent of the initial cost, while health worker's training and monitoring accounted for 12.7 percent and 9.6 percent respectively (Fiedler, 2000). Despite this investment in the advocacy and training activities, the new model for the distribution of vitamin-A capsules was found to be highly cost-effective (Fiedler, 2000). A different programme conducted in the same country as a collaborative training programme between the government and private (retailers and wholesalers) suppliers of drugs showed that training cost accounted for about 39.1 percent of the financial cost (Kafle et al., 1992).

With regards to pooled procurement, Chaudhury *et al.,* assessed a policy intervention which aimed to improve the rational use of drugs in Delhi, India and found that a pooled procurement system offers added advantage in terms of quality drugs and reduction of the procurement cost but also leads to the improved healthcare commodities' availability of more than eighty percent at health facilities. However, financial or economic costs were not assessed and reported for the implementation of the programme (Chaudhury et al., 2005).

In this study, we found that the financial start-up and recurrent costs of pilot phase for the three regions amounted to US$ 2.8 million, covering a population of 5,836,888 (NBS, 2012) (this is equivalent to US$ 0.49 per capita). The rollout financial cost amounted to about US$ 8,038,150.50, covering a population of 37,788,466 (NBS, 2012) (US$ 0.213 per capita). A recent statistic from the Bank of Tanzania shows that the gross domestic product per capita (current US$) for the fiscal year 2018/2019 was US$1,090 (BOT). The costs of introducing the Jazia PVS are minimal compared to the country per capita income. Hence the investment in a complementary supply chain system supporting national supply of health commodities and improving availability of medicines at the public healthcare facilities seems appropriate.

From the beginning, Jazia PVS was integrated into government structures. Similarly, Sorensen, Codjia, Hoorelbeke *et al.*, argue that an intervention should be fully or partially integrated into the existing medicines supply chain structures, as in most cases creating a parallel supply chain tends to escalate overall management and operational costs (Sorensen, Codjia, Hoorelbeke, E., & Jille-Traas, 2016). A study conducted in Kenya showed that integration of complementary commodity supply chains into a national supply chain resulted in forty-two percent savings in overall recurrent costs and improved effectiveness of the supply chain (Eby, Daniel, Agutu, Gonzalez Cortijo, & Moloney, 2019).

Nonetheless, the study suffers from some limitations. We collected primary data from different levels of implementation retrospectively to estimate the economic costs, which have a potential limitation of recall bias. Participants tend to forget some of the initial activities if the recall period is more than a year. A mix of prospective and retrospective approaches could be of potential value in capturing all resources used from the start of the intervention. Furthermore, we did not have a baseline assessment on the costs incurred for the purchase of complementary pharmaceutical supplies in the pilot regions previous to the Jazia PVS introduction. This would have been of added value in conducting a cost-benefit analysis of the Jazia PVS. Future studies could assess the cost-effectiveness of such complementary pharmaceutical supply chain. Finally, we could not find any published studies focusing on the costing and cost drivers of interventions targeting at complementary supply chain in low-income settings for comparison with our findings. Most studies assessed the whole supply chain system or components of the supply chain such as vertical (vaccination distribution) programmes (Fiedler, 2000). Therefore, the settings and design of available studies do not allow for meaningful comparison. Furthermore, the identified published studies were not related to a prime vendor system.

7.6 Conclusion

To our knowledge, this has been the first study exploring start-up and recurrent costs of an intervention in the pharmaceutical sector to complement and enhance a national supply system. Our findings show cost and cost drivers for setting up a complementary pharmaceutical supply system for public healthcare facilities in a low-income setting. The main cost drivers for the start-up of the Jazia PVS system were costs for short term experts, training of staff and healthcare workers and the Jazia PVS technical and board management activities. The recurrent costs were lower compared to the start-up cost and the largest share of the recurrent financial costs was used for the payment of the Jazia PVS technical and board management activities. Despite the substantial costs incurred in the initial investment and operations of the Jazia PVS, the new framework for procurement of complementary medicines is effective in achieving the desired purpose of improving availability of essential medicines in the public healthcare facilities. The study provides useful financial information for other countries intending to adopt such an innovative public-private partnership for improvement of the in-country pharmaceutical supply chain. The start-up costs were higher than recurrent costs, indicating the need for front loading a significant amount of resources. Policy adoption and anchoring in existing government structures rather than parallel systems resulted in decreased implementation and recurrent costs and ensured sustainability. Governments aiming at fostering efficiency and cost improvements of health supply chains could consider implementing integrated prime vendor systems.

7.7 Acknowledgement

We would like to acknowledge the assistance of the Health Promotion and System Strengthening (HPSS) project in Dodoma Tanzania. Grateful thanks are extended to Patrick Hanlon for his support and advice during data analysis. We would like to thank regional and district managers together with the facility-in-charges within the sampled facilities for their support during the study. We also acknowledge the Swiss Programme for Research on Global Issues for Development (r4d); Swiss Agency for Development and Cooperation (SDC); Swiss National Science Foundation (SNF) for funding the study.

Supplementary Material

Table S12: Description of Jazia PVS activities in the pilot regions

Expenditure item	Description	Resources
Jazia PVS start-up costs		
Short-term experts	Consultants were contracted to provide technical advice at various stages including conceptualization, advocacy and buy-in, the establishment of administrative structures, vendor selection, and training of staff and healthcare workers.	Transport costs, perdiem/allowances, consultancy fee
Health facility baseline assessment	Jazia implementation team(s) from the regional level conducted a baseline assessment of the availability of essential medicines at all the facilities in each district within the pilot regions Activities included the review of medicine availability, the procurement process for complementary medicines from private suppliers, and assessment of financial management at the facility	Transport costs, perdiem/allowances, stationaries
Advocacy and buy-in to stakeholders	A one-day advocacy seminar was conducted with stakeholders from the national level, regional, district, healthcare providers together with private suppliers. They were invited to discuss and share findings from the baseline facility assessment. During the meeting(s), a concept of the prime vendor system was presented and its potential benefit in improving service delivery.	Transport costs, perdiem/allowances, cost of the training venue, media announcement costs, mobilization material
Administrative structures	A task force was formed during the conceptualization of the Jazia PVS and later on, the following structures were formed A Regional Prime Vendor Technical Committee(RPVTC); A Regional Prime Vendor Tender Board (RPVTB); A Regional Prime Vendor Coordination Office and Ad hoc Regional Bids Evaluation Committee (EC)	Transport costs, perdiem/allowances, stationaries
Vendor forum	All interested private suppliers (wholesalers and retailers) in the pilot regions were informed of the new system being developed (public-private partnerships, PPP). Thereafter, interested private suppliers were informed of a whole process of identifying and contracting a prime vendor.	Transport costs, perdiem/allowances, cost of training venue, media announcement costs, stationaries
Vendor prequalification and Tendering	Selection of the vendor followed stipulated procedures which were aligned with the Tanzanian public procurement act, of 2013. Activities of the 1st stage included the development of a prequalification questionnaire (PQQ), advertisement of the bids, evaluation of the submitted bids and notification to unsuccessful as well as successful private suppliers	Transport costs, perdiem/allowances, stationaries
	In the 2nd stage, all the private suppliers who were successful in the 1st stage participated in the second stage. Activities included a request for proposal (technical proposal(s) and pricing proposal (s)); evaluation of the proposals; physical visits to potential vendors for inspection; final decision to select the prime vendor, as well as notification to the unsuccessful vendor(s)	Transport costs, perdiem/allowances, stationaries

Prime vendor contracting and Launch of the Jazia PVS	The official signing of the contract was done with the regional administrative secretary (RAS), various government officials from the ministries, regions and districts were invited to witness the official launch of the Jazia PVS. In additional health care providers and other stakeholders were also invited.	Transport costs, perdiem/allowances, cost of the venue, media announcement costs, stationaries
Jazia PVS production of the materials (SOPs)	A number of documents were prepared to guide the operation of the Jazia PVS at the regional, district and facility level. Such documents included together with quantification and inspection forms, standard operation procedures (SOPs), monitoring and evaluation (M&E) tools, medicines and financial auditing tools, staff training manuals, and contract document.	Transport costs, perdiem/allowances, stationaries
Training to the staff and health facility workers	Three days training of trainers (district pharmacists, procurement personnel, and district medical officers) was conducted at the regional level, these were responsible for leading the training of the healthcare workers at their respective districts. Two days of training of staff from the facilities was conducted at the district level. At least one staff from the dispensary, two from the health centre and three from the hospital participated in the training. Staff were trained on the Jazia PVS SOPs (such as quantification of facility medicine needs, review of financial resources, an inspection of the consignment, payment to the vendor and communication channel)	Transport costs, perdiem/allowances, cost of the training venue, stationaries
Establishment of Jazia PVS office	Coordination offices were located within the regional referral hospital. The offices were renovated, supplies with furniture, a computer and a printer as well as other office supplies.	Costs of capital equipment (computers, furniture, signposts, water dispenser and printing machines)
Jazia PVS recurrent activities		
Monitoring and evaluation	Regional implementers sample some facilities each quarter for monitoring performance of the Jazia PVS (monitoring and evaluation, cascade coaching, medicines and financial audits).	Transport costs, perdiem/allowances, stationaries
Medicine and financial audits at the facility level	Regional and district managers visited a sample of facilities for medicine and financial audits each quarter	Transport costs, perdiem/allowances, stationaries
Cascade coaching	Health workers from the health centre and some of the dispensaries were identified and allocated a number of dispensaries to visit each quarter	Transport costs, allowances
Technical management activities	Jazia PVS technical committee conducts quarterly meetings to review the operations of the Jazia PVS Jazia PVS technical team is composed of consultants, representatives from Health Promotion System Strengthening (HPSS) project (component advisor as well as monitoring and evaluation focal person), DMO (1); regional pharmacist (1); district pharmacists (4); regional hospital in-charge (1); district procurement officer (1); laboratory representative (1) and a pharmaceutical technologist.	Transport costs, perdiem/allowances, cost of venue, stationaries
Board management activities	Jazia PVS tender board usually meets twice a year to review progress and approve the documents shared from the Jazia PVS technical committee. The board is composed of a regional medical officer (RMO); a regional pharmacist (1); DMO (1); members of the tender board (3); regional procurement unit (1); district pharmacists (2); and district internal auditor (2)	Transport costs, perdiem/allowances, cost of venue, stationaries

Jazia Coordination office (Allowances and operation costs)	Three staffs were identified and appointed to work within the Jazia PVS regional coordination offices. Staff were government employees including the regional pharmacist, a pharmaceutical technician and administrator.	Transport costs, perdiem/allowances, monthly allowances, office supplies
Jazia PVS, supply chain activities		
Quantification of facility needs	Health facility staff (at dispensaries, health centres and hospitals) are responsible for placing medicines and medical supplies orders each quarter after receiving stock-outs from medical store department (MSD).	Staff time, transport to the district, and allowance
Quantification of facility needs	Health facility staff (at dispensaries, health centres and hospitals) are responsible for placing medicines and medical supplies orders each quarter after receiving stock-outs from medical store department (MSD).	Staff time, transport to the district, and allowance.
Consolidation and inspection at the district level	District Pharmacists or relevant pharmaceutical staff are responsible for compilation of all facility orders and communicates with the vendor. District pharmacist and two-three members of the council health management team (CHMT) participate in the inspection of the consignment at the district level once delivered by the prime vendor.	Staff time.
Pick-up of consignment from the district by health facility staff	Health facility staff are responsible for picking up consignment once inspected by the CHMT members at the district level. Other activities include inspection of the consignment.	Staff time, transport to the district, and allowance.
Payment to the prime vendor	Health facility in-charge together with the health facility governing committee (HFGC) prepare the payments and share the documents with the district level officials for authorisation Participants include facility in-charge, at least two members of the HFGC, DMO, financial auditors; and district pharmacist.	Staff time, transport to the district, and allowance.

Source: Jazia PVS program reports; and interviews with various stakeholders carried out during fieldwork in 2018

Table S13: Average unity cost for some of the resources in Tanzania Shilling, TZS and US$

Item	Unit cost (TZS)	Unit cost (US$)
Currency conversion rate	2,230	1.000
Cost per km using private car	3,568	1.600
Cost per km using public transport (less than 200 kms)	10,000	4.484
The Health facility governance seating allowance	10,000	4.484
Per–diem district level managers	65,000	29.150
Per–diem regional level managers	80,000	35.874
Per–diem national level managers	120,000	53.812
Economic unit cost per hour in US$ (CHMT/CHSB)	16,234/h	7.270
Economic unit cost per hour in US$ (Procurement officers)	9,624/h	4.316
Economic unit cost per hour in US$ (district medical officer - DMOs)	24,717/h	11.084
Economic unit cost per hour in US$ (Pharmacists)	16,234/h	7.280
Economic unit cost per hour in US$ (Jazia PVS technical and board members)	17,460/h	7.830
Economic unit cost per hour in US$ (health centre – AMO/clinical officer - CO	11,699 /h	5.250
Economic unit cost per hour in US$ (dispensary – CO/Nurse cadre)	10,460 /h	5.141
Transport allowance for facility in-charge	10,000	4.484
Health facility governing committee meeting allowance	10,000	4.484
Cost of refreshments (short meeting per person)	16,000	7.175
Cost of venue (per person per day)	32,000	14.350

Note: AMO = assistant medical officer, kms = kilometres, CHMT = council health management team, CHSB = council health service board

Note: a) Hourly economic unit costs per participant for each activity was computed based on a staff cadre using the government salary scale.

b) To compute hourly unit costs of a participant we had to deduct number of statutory holidays in a year (13 days), leave entitlement (28 days), and weekends (105) from number of days in a year (365) to obtain average working days per year (219 days) [2017]. 219 days per year divide by 12 months ~ 20 days per month. We assumed 8 working hours per day (= 160 hours per month). We used the government average monthly salary earning and was inflated by 25% to incorporate workers' fringe benefits. The monthly earning was divided by working hours (monthly earning/working hours in a month) and subsequently converted to US dollar for a given year to obtain the economic unit cost per hour in US$.

Table S14: Estimation of total economic costs

Cost item	**Financial Cost**	**Opportunity cost**	**Computation of opportunity costs**	**Economic costs (=Financial Opportunity)**
Jazia PVS start-up costs				
Short-term experts	Costs for resources per project			
Health facility baseline assessment	Costs for resources per activity	Opportunity cost per staff/hour	Number of days (30 days)* Number of facilities in a region * Number of participants (4 pharmacists) * Unit cost per hour (US$ 7.9857)	Economic
Advocacy and buy-in to stakeholders	Costs for resources per activity	Opportunity cost per staff/hour	One day * number of hours (8 hours) * Unit cost per hour for each respective clinical cadre/participant	Economic
Administrative structures	Costs for resources per activity	Opportunity cost per staff/hour	One day * number of hours * Unit cost per hour for each respective clinical cadre/participant	Economic
Vendor forum	Costs for resources per forum	Opportunity cost per staff/hour	One day * number of hours (8 hours) * Unit cost per hour for each respective clinical cadre/participant	Economic
Vendor prequalification and Tendering	Costs for resources per event	Opportunity cost per staff/hour	One day * number of hours * Unit cost per hour for each respective clinical cadre/participant	Economic
Prime vendor contracting	Costs for resources per event	Opportunity cost per staff/hour	One day * number of hours * Unit cost per hour for each respective clinical cadre/participant	Economic
Jazia PVS production of the materials (SOPs)	Costs for resources per activity	Opportunity cost per staff/hour	One day * number of hours * Unit cost per hour for each respective clinical cadre/participant	Economic
Training to the staff and health facility workers	Costs for resources per activity	Opportunity cost per staff/hour	Days (3- 5 days) * number of hours * Unit cost per hour for each respective clinical cadre/participant	Economic
Launch of the Jazia PVS	Costs for resources per activity	Opportunity cost per staff/hour	One day * number of hours (8 hours) * Unit cost per hour for each respective clinical cadre/participant	Economic
Establishment of Jazia PVS office	Costs for resources per coordination office	Equipment costs	Annualized	Economic
Jazia PVS recurrent activities				
Monitoring and evaluation	Costs for resources per activity	Opportunity cost per staff/hour	Days (3–5 days) * number of hours * Unit cost per hour for each respective clinical cadre/participant	Economic
Medicine and financial audits at the facility level	Costs for resources per activity	Opportunity cost per staff/hour	Days (3-5 days) * number of hours * Unit cost per hour for each respective clinical cadre/participant	Economic

Cascade coaching			Number of facilities visited * number of hours spent in a particular facility* Unit cost per hour for each respective clinical cadre/participant	Economic
Technical and Board management activities	Costs for resources per activity	Opportunity cost per staff/hour	One day * number of hours * Unit cost per hour for each respective clinical cadre/participant	Economic
Jazia PVS, supply chain activities				
Quantification of facility needs		Opportunity cost per staff/hour	Number of hours spent each quarter * Unit cost per hour for each respective clinical cadre/participant	Economic
Quantification of facility needs		Opportunity cost per staff/hour	Number of hours spent each quarter * Unit cost per hour for each respective clinical cadre/participant	Economic
Consolidation and inspection at the district level		Opportunity cost per staff/hour	Number of hours spent each quarter * Unit cost per hour for each respective clinical cadre/participant	Economic
Pick-up of consignment from the district by health facility staff		Opportunity cost per staff/hour	Number of hours spent each quarter * Unit cost per hour for each respective clinical cadre/participant	Economic
Payment to the prime vendor		Opportunity cost per staff/hour	Number of hours spent each quarter * Unit cost per hour for each respective clinical cadre/participant	Economic

Note a) Information on the number of days/hours for each activity was extracted from Jazia PVS reports (financial, monitoring and evaluation reports) and additional information was obtained from interviews.

Table S15: Roll out assumptions

Jazia PVS activities	Assumption
Start-up	
Health facility baseline assessment	To all the health care facilities within the region
Advocacy and buy-in to stakeholders	Conducted once at the beginning of the Jazia PVS
Administrative structures	Conducted once at the beginning of the Jazia PVS
Vendor forum	Conducted once after every two years
Vendor prequalification and Tendering	Conducted once after every two years
Prime vendor contracting	Conducted once after every two years
Jazia PVS production of the materials (SOPs)	Once at the start of the programme
Training to the staff and health facility workers	Conducted once at the beginning of the Jazia PVS
Launch of the Jazia PVS	Conducted once at the beginning of the Jazia PVS
Establishment of Jazia PVS office	Conducted once at the beginning of the Jazia PVS
Recurrent	
Cascade coaching	All the facilities should be visited at least once per year
Training on monitoring and evaluation	Conducted once at the start of the Jazia PVS and on-job training be conducted for each facility
Monitoring and Evaluation activities	Conducted twice a year, at least each facility be visited once during the contract duration
Medicine and financial audits at the facility level	Conducted twice a year, at least each facility be visited once during the contract duration
Post ILS assessment	Conducted twice a year, at least each facility be visited once during the contract duration
Prime vendor board management activities	Board will meet at least twice a year
Prime vendor technical management activities	The technical team will meet at least twice a year
Jazia Coordination allowances	Assuming these are government employees
Jazia PVS supply chain	Prime vendors will continue to deliver consignments at the district level and facilities continue to pick their consignment at the district level

Table S 16: Sensitivity analysis of Jazia PVS financial capital costs

		Furniture	Computer	Signposts	Water dispenser	Printing machine	Total
Financial costs	Non- annualized	5,581.83	3,566.16	2,017.94	672.65	828.48	12,667.06
Economic costs	*3% discount rate*	1,915.87	1,224.03	692.62	230.87	284.36	4,347.76
	3% discount rate, 3 years useful life	1,183.32	756.01	427.79	142.60	175.63	2,685.35
	3% discount rate, 5 years useful life	635.30	405.89	229.67	76.56	94.29	1,441.71
	3% discount rate, 10 years useful life	5,581.83	3,566.16	2,017.94	672.65	828.48	12,667.06
	5% discount rate, 3 years useful life	1,952.09	1,247.17	705.72	235.24	289.74	4,429.95
	5% discount rate, 5 years useful life	1,227.87	784.47	443.90	147.97	182.25	2,786.45
	5% discount rate, 10 years useful life	688.45	439.84	248.89	82.96	102.18	1,562.33
	10% discount rate, 3 years useful life	2,040.49	1,303.64	737.67	245.89	302.86	4,630.55
	10% discount rate, 5 years useful life	1,338.61	855.22	483.93	161.31	198.68	3,037.76
	10% discount rate, 10 years useful life	825.83	527.61	298.55	99.52	122.57	1,874.10

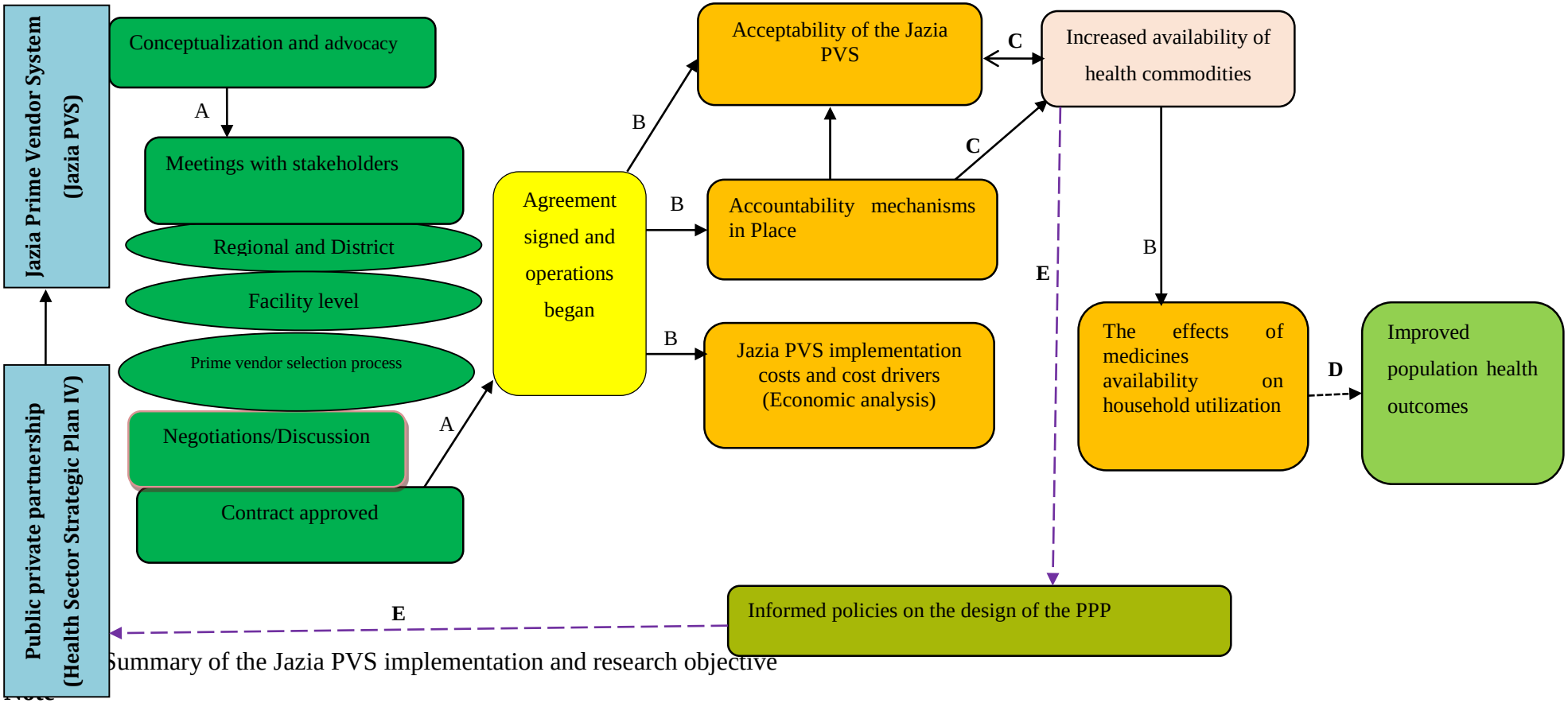
Table S 17: CHEERS – Jazia PVS checklist

Item No	Section/item	Reported on page No/line No
1	Title	1
2	Abstract	4
3	Background and objectives	5 - 8
4	Target population and subgroups	10
5	Setting and location	10
6	Study perspective	10
7	Comparators	12
8	Time horizon	10 - 11
9	Discount rate	11 -12
10	Choice of health outcome	8
11	Measurement of effectiveness	Appendix 1: Table 2
12	Measurement and valuation of preference based outcomes	-
13	Estimating resources and costs	10-13
14	Currency, price date, and conversion	13
15	Choice of model	9
16	Assumptions	13
17	Analytical methods	10-13
18	Study parameters	10
19	Incremental costs and outcomes	14-15
20	Characterising uncertainty	13
21	Characterising heterogeneity	
22	Study findings, limitations, generalizability, and current knowledge	14-15
23	Source of funding	3
24	Conflicts of interest	3

8. Discussion

8.1 Summary of the Key Findings

This thesis assessed the effects of the Jazia prime vendor system in complementing the existing pharmaceutical supply chain in public health facilities in Tanzania. Figure 6 summarises the research conducted within the Jazia PVS. The Tanzanian health sector strategic plan IV, encouraged innovative approaches towards a public-private partnership to improve service delivery. Jazia PVS is an innovative approach of bringing different stakeholders including government, private whole sale and retail pharmaceutical suppliers, district and regional healthcare managers, healthcare providers and donors in addressing shortage of healthcare commodities in public facilities. The Jazia PVS has also been found to be effective in addressing the critical shortage of health workforce in Tanzania (Sirili, Kiwara, Gasto, Goicolea, & Hurtig, 2017). The establishment of the Jazia PVS followed a step-wise implementation starting from conceptualization and advocacy, later continuing to meeting with various stakeholders, prime vendor selection, contract negotiations, and actual operation after signing of the agreement.



Summary of the Jazia PVS implementation and research objective

A: Jazia process, B: Study objectives, C: Direct effect (outcomes) D: Long term effects/impact, E: Feedback on the design of PPP

Availability of most tracer medicines was relatively good, with frequent stock-outs of a few medicines and variation across the facility and districts level. Household's healthcare utilization was positively and significantly associated with continuous availability of all essential medicines for the surveyed facilities. In addition, household's healthcare utilization was positively associated with household membership in the community health insurance funds.

Performance of the Jazia PVS was mainly influenced by the existence of strong accountability measures including inventory and financial auditing conducted by district pharmacists and the internal auditors, close monitoring of standard operating procedures by the prime vendor regional coordinating office and peer cascade coaching. Furthermore, the auditing activities allowed identifying challenges of delayed payment to the vendor and possible approaches for mitigation while peer cascade coaching played a crucial role in enabling staff at the primary facilities to improve skills to oversee and manage the medicines supply chain.

We found that the perceived effectiveness of the system (increased availability of essential medicines at the facilities, higher-order fulfilment rates, and timely delivery of the consignment) was mentioned more frequently in influencing the acceptability of the Jazia PVS. Whereas intervention coherence, experienced opportunity and intervention burden were not frequently mentioned in influencing the acceptability of the Jazia PVS.

Results on cost and cost drivers associated with setting up a prime vendor system for complementing the existing medicines supply chains in low-income settings showed that financial start-up costs were higher than the recurrent costs with the largest share of the costs incurred for the payment of short-term technical advisors and training for the healthcare workers. The largest share of the Jazia PVS financial recurrent costs was for the Jazia PVS technical and board management activities. Similar trends were observed for the Jazia PVS economic costs whereas the highest start-up costs were associated to training of staff and healthcare workers while Jazia PVS technical and board meetings accounted for the largest share of the recurrent economic costs.

A transparent contractual agreement between public and private entities creates a powerful tool in addressing healthcare delivery challenges including staffing, healthcare commodities and other facility infrastructure by leveraging innovative ideas, staff expertise and technology. Therefore, the current study provides evidence on the potentiality of the Jazia PVS in complementing existing pharmaceutical supply chain, indicating that such a model can be used to increase efficiency in the provision of various sectors including:- joint diagnose and

treatment of diseases, infrastructure, education/ capacity building, planning process to avoid misuse of resources and duplication of efforts. Other LMICs interested in establishing PPP within the intension of improving healthcare delivery can learn useful lessons from the Jazia PVS in Tanzania. Strong capacity of various bodies to exercise oversight and sanctions in the implementation of the PPP is important in ensuring accountability linkages for the public and private entities (Kamugumya & Olivier, 2016).

In the subsequent section, we discuss the contribution of the regional complementary pharmaceutical supply system in improving access to medical commodities. The section is followed by a critical review of the methodological approaches explored in the study. Lastly, based on the main results of the study policy implications and recommendations are made.

8.2 Jazia PVS and Improved Access to Health Commodities

The public-private partnership (PPP) has the potential to contribute to the achievement of universal health coverage. Sustainable Development Goal 17, particularly calls for close collaboration and partnerships between the private sector and the governments (Clarke et al., 2019). In essence, both the public and private sectors need to work together to achieve health-related SDG 3. Initiatives undertaken by any country cannot ignore the role of the private sector. Involvement of the private sector cuts across several health-related activities including the provision of healthcare services; medicines and medical products, training for the health workforce, infrastructure, and information technology and support services (Clarke et al., 2019). PPP is the best option to solve some of the challenges (such as medicines availability, shortage of staff, government failure to construct facilities in some places) in the provision of healthcare services to the population as it combines efficiency management and use of incentives from the private sector and the regulatory actions together with the protection of the public interest from the public sector (Phua, 2017). This has the potential of harnessing the best from the public and private sector to achieve the desired goals.

The regional prime vendor approach had a direct effect on the availability of healthcare commodities in the public healthcare facilities. Availability of healthcare commodities was relatively good (Chapter 4), with frequent stock-outs of a few medicines and variation across the facility and districts level. Compared to the baseline evaluation which showed mean availability of essential medicines was 60 percent, the survey undertaken in 2017 showed improvement in the mean availability to above 80 percent (Chapter 4). Improved availability of medicines is closely associated with a better quality of healthcare services (as perceived by

patients), which in turn increases the utilization of formal healthcare facilities (Prinja et al., 2015).

The Jazia PVS as a part of the pharmaceutical supply chain of healthcare commodities is not a new concept as countries have adopted different modalities in the implementation (Arney et al., 2014; Häfele-Abah & Neuhann, 2010; May & Herrick, 1984; Olson et al., 1985; Patterson et al., 1995). The uniqueness of the prime vendor system implemented in Tanzania relies on the nature of the framework agreement between the regional administration and the prime vendor; order for healthcare commodities are pooled at the regional level; the system is anchored in the structures of the regional health administration and it is overseen, supported and managed by mandated administrative structures such as regional administrative secretary, and regional prime vendor coordinating office (Kuwawenaruwa, Wyss, Wiedenmayer, Metta, & Tediosi, 2020). In the context of Tanzania, pooling the resources at the regional level makes it easier to operate and increases purchasing power. A prime vendor should operate at the regional level rather than at the council level as there are many councils and it may become difficult for councils to exercise oversight and sanctions in the implementation of the Jazia PVS. Each region has a Regional Jazia PVS coordination office, responsible for making efficient use of limited resources, compared to having Jazia PVS offices in each district where more resources will be needed for investment. The system was implemented along with the existing government structures, thus, through accountability mechanism such as financial and medicine audits as well as routine supportive supervision it could ensure that envisioned improvement of healthcare commodities throughout the region was happening. Besides that, cascade coaching done along the Jazia PVS was strengthened based on the already existing system, where in most cases government hospitals oversee the health centres and in turn, the health centres oversee the dispensaries (MoHSW, 2010). Champions who were knowledgeable on the supply chain were appointed from the health centres and dispensaries to train the staff at the dispensaries on the operations of the supply chain. Therefore, accountability approaches within the Jazia PVS can be considered as an effective way in managing health system interventions. Nevertheless, Jazia PVS accountability and auditing could also be externalized to ensure governments and healthcare providers are held accountable for the implementation of programs. One approach is to encourage the community to participate in various activities linked to the health service delivery and provide their concern. Moreover, independent institutions such as civil society organizations may also help in holding governments and healthcare providers accountable for performance.

Evidence suggests that effective supportive supervision of healthcare providers is vital for maintaining and improving the quality of healthcare services (Renggli et al., 2018). The findings on the role of accountability in the performance of the Jazia PVS shed some light on the accountability and transparency challenges within the existing pharmaceutical supply chain in Low and Middle-Income countries (Karwa et al., 2017; Paschke et al., 2018; Walkowiak et al., 2018). The Tanzania experience is useful in informing and guiding initiatives to strengthen accountability in such settings and therewith enhanced availability of healthcare commodities in low resource settings. Accountability measures contributed to the improved availability of healthcare commodities, however, it is important to ensure equitable distribution of essential healthcare commodities in achieving universal health coverage (M. Bigdeli, Peters, & Wagner, 2014).

The analysis of the Jazia PVS acceptability components indicated that the perceived effectiveness of the prime vendor system in improving the availability of the health commodities was more frequent than the other components (Chapter 5). The successful implementation of the healthcare intervention relies on the degree of acceptability by the beneficiaries (Bos et al., 2013). Low acceptability impedes the overall effectiveness of the intervention in achieving its intended purpose (Borrelli et al., 2005). Our analysis highlighted how the Jazia PVS has been widely well received by the implementers and has achieved the intended purpose of complementing the existing healthcare commodities supply chain. Existing literature shows that in most cases implementers tend to accept an intervention whenever they realize that an intervention has more benefits (positive effects) compared to the efforts required to take part in the intervention (Shieshia et al., 2014). In the case of the Jazia PVS, implementers and healthcare providers were satisfied with the intervention as it met their needs in addressing the shortage of essential medicines. Acceptability of intervention within the pharmaceutical supply chain has also been influenced by the time, ability to do work effectively, efficiency, overall supply chain management and costs (WHO, 2013a).

The analysis of the costs associated to the implementation of the Jazia PVS suggested that the path toward improved availability of the healthcare commodities requires relevant resources (financial and human resources) (Chapter 7). The analysis highlighted the importance of people who are committed to performing all the tasks required to achieve performance targets. The results presented in this chapter shed some light on how the limited financial resources held by the facilities and districts can be used to complement the existing supply chain. Our economic

analysis has also provided some evidence on the resources invested in the implementation of the Jazia PVS and the associated improvements in the availability of healthcare commodities. Therefore, chapter 7 calls for a realistic consideration of the role of the government, the donor(s), prime vendor and healthcare managers in planning the approach taken to address the shortage of healthcare commodities in Tanzania. To this end, our study aligns with other studies from LMIC, which confirmed the importance of the PPP in improving availability of healthcare commodities across public and private healthcare providers (Arney et al., 2014; Wiedenmayer et al., 2019). Pursuing this road could have a positive impact for the broader improvement in the healthcare provision and population health outcomes. Some of the studies raised the question of the cost savings as a result of the implementation of a health care intervention (Seidman & Atun, 2017). Both centralised tendering and procurement do yield cost savings and improve the availability of health commodities and efficiency (Danzon et al., 2015; Milovanovic et al., 2004; Seidman & Atun, 2017). In many countries supply chain improvement operations have focused on strategic ways to contain costs and gain efficiencies of scale (Mehralian, Rajabzadeh Gatari, Morakabati, & Vatanpour, 2012). There is an opportunity of saving enormous resources which could be invested in improving health service provision. Nevertheless, there is no single solution in improving the management of healthcare commodities in low-income settings, and a comprehensive understanding of all the existing mechanisms (human resource, financial, accountability mechanisms, etc) within a country is equally important.

8.3 Methodological Considerations

In order to quantitatively assess the effects of medicine availability on household's healthcare utilization, we had to link data from households' survey with facility-level data from the facility survey. This process generated a potential for selection bias and also could influence the generalizability of the findings. Household members responded to the survey questions based on their past experiences and it is possible that their responses were subject to some recall errors. To this extent, a better approach to assess healthcare utilization would have been linking clients exit interview data with the respective facility data, which would have reduced the bias. Data used for the analysis was collected for a different purpose, namely assessing the achievement of Health Promotion and System Strengthening project goals, nevertheless enabled to fruitfully use the data in our analysis. The frameworks adopted in organizing the qualitative data, the accountability (Bovens, 2007) and acceptability framework (M. Sekhon et

al., 2016), can be simple yet complicated if not properly considered from the initial designing phase of the qualitative study. The experience gained in this research emphasized the importance of considering the context where the framework is applied and think critically about how the data collection guide is formulated, how data are analysed, and how the results and policy recommendations are presented. With regards to the analysis conducted in chapter 7, the use of ingredient approach, and retrospectively collection of data for the costs analysis showed some limitations related to recall bias. Data collection took place 4 years after the onset of the Jazia PVS in Dodoma, while in Morogoro data collection was after 3 years. Many participants had already forgotten some of the activities conducted during the early phases of the program. However, information from the primary data was supplemented with secondary data from the financial reports as well as monitoring and evaluation reports.

To account for the recall bias we triangulated information from document reviews, and interviews at various levels including regional, districts and community level. In addition, the research assistants with a social science background at a postgraduate level, with extensive skills in qualitative research and in-depth interviews, conducted the interviews together with the first author. The research assistants were well trained on probing skills. Furthermore, to control for the recall bias we had to verify all the information from the document review with the regional and district level implementers. Financial reports were of good quality as all the information was kept in an accounting software, however, at times we faced challenges as some of the costs were aggregated and there were no itemized costs for some activities. To account for the cost categorization we used information from in-depth interviews and the share of the facilities participating in the Jazia PVS in each region.

Ensuring data quality at all the steps in research activity is important and at times very challenging. Enormous resources (time and financial resources) are devoted to the collection of primary data. The whole process is time-consuming, from preparation, training, piloting, actual data collection to the analysis and report writing. Transcription of the interviews and checking the audio together with the transcribed word document was tedious work. Research assistants were asked to transcribe and revise some transcripts. The quality of qualitative data largely depends on the person conducting the research and the role of the researcher should be carefully considered (Bergman & Coxon, 2005; Malterud, 2001). Quality has to be ensured through data management, analysis and interpretation (Bergman & Coxon, 2005). In the course of data collection, two research assistants with social science background (one leading the discussion and the other one taking notes) assisted in data collection while the lead researcher

moderated the interviews and group discussions to ensure good quality data. During interviews and discussions maintenance of the empathy with participants, giving participants ample time to ask, listening and responding was important in ensuring quality data (Mack, Woodsong, Macqueen, Guest, & Namey, 2005). Settings of the interviews, note-taking, daily debriefing, and transcription of the audio within 48 hours, helped in maintaining quality data and following up with new concepts arising from the previous discussion. Special attention should be put on the quality of data collected in the field when conducting the interviews and focus group discussions when exploring an intervention in which several months had passed since the implementation started (Bergman & Coxon, 2005).

8.4 Policy Implications and Recommendations for Research

Decision-makers need evidence derived from well-planned research to inform their decision making (Peters, Adam, Alonge, Agyepong, & Tran, 2013). Experience in undertaking this thesis has come up with good evidence on the accountability mechanisms in place for the successful performance of the Jazia PVS, its acceptability, as well as costs, cost drivers and roll-out costs for Jazia PVS in all the regions in Tanzania. There are other methodological approaches such as case-control and mixed-method approach that could be used in evaluating the effects of such complementary pharmaceutical supply chain in improving access to essential medicines. Never-the-less the current study has some relevant policy and future research recommendations.

First, the findings presented in this thesis offer some insights on policy and practice. Recommendations have been organized according to the research objectives. The availability of quality medicines in the provision of health care service is an integral part of universal health coverage (UHC), shapes health service delivery as well as household healthcare utilization. Although the availability of most tracer medicines was relatively good, there is a need for using an existing electronic system to monitor health commodity availability and healthcare utilization. Better forecasting of upcoming medicine needs and timely ordering at health facilities, along with the improved availability of medicines at the medical store department, could help prevent stock-outs and improve availability. Expansion of insurance coverage would guarantee the household's healthcare utilization, in turn, the revenue generated by the healthcare facilities would be invested in procuring medicines to ensure continuous availability of medicines through the year.

Financial, performance and procedure accountability enhancement contributed to the performance of Jazia PVS. It remains important to identify a scalable accountability structure, which helps to maintain the levels of medicines availability achieved and leading to further improvements in the availability of healthcare commodities at the healthcare facilities. Capacity building at the primary facility level is vital to strengthen governance and accountability of the pharmaceutical supply chain. Correct quantification, timely delivery of consignments to the facility level are crucial in ensuring the availability of medicines. Integration of any pharmaceutical supply chain intervention into existing government structures is equally important for sustainability purpose. The government decided to scale-up the intervention to all the regions, this shows strong political will to support the public health systems and supply chains to overcome bottlenecks faced by the existing supply chain. However, there is a need to ensure the medical commodities are affordable, of good quality and safe.

Establishing and maintaining a routine monitoring system, for example through the district health information system which allows tracking effects and results of innovation such as Jazia PVS on the pharmaceutical supply. Establish and communicate to relevant stakeholders, namely district authorities, health workers and the private sector, a transparent and well understandable framework guiding supply chain improvements. Emphasis the confidence and compliance of district pharmacists, healthcare providers, district and regional managers adhere to the rules and procedures guiding the public-private partnerships. Strengthening coordination between the entities responsible for managing quantification, forecasting, procurement and distribution of the health commodities at the regional, district, facility level to ensure timely availability and properly used of health commodities at the facilities

Potential areas for further research

Future research on pharmaceutical supply chain could focus on the following areas: - analysis of the intensity of healthcare utilization by different population groups across facilities, districts and linking such trend with broader health policy such as social protection, exemption and waiver and others. Another area could be linking improvement in the healthcare commodity availability with enrolment into the community health fund, to investigate trend in the enrolment and retention into the scheme. In this study, we only focused on the availability of medicines in the surveyed healthcare facilities, future studies could look at the effect of

different conditions at the facility such as medical supplies and equipment, facility environment and infrastructure on household utilization of healthcare services.

Qualitative data has been used to assess acceptability of the Jazia PVS, future studies could consider combining some of the perceived effectiveness and other metrics with observational data from surveys and other methods to make the findings more robust. The Jazia PVS has been effective in improving availability of essential healthcare commodities at the public healthcare facilities, there is a need of exploring its potentiality in improving the availability of healthcare commodities that target unmet disease burden in peripheral areas. Future studies should consider the inclusion of the clients seeking care in the respective healthcare facilities, their perception of the availability of medicines and compare with the existing records at the facility.

We estimated cost and cost drivers associated with setting-up the Jazia PVS in low resource settings, future analysis could look at the cost savings associated with Jazia PVS for complementary existing supply chain in Tanzania. Analyse options for financing healthcare commodities from the prime vendor and their sustainability with the healthcare system during health sector planning and budgeting.

9. Conclusion

This thesis is among the few to analyse effects of the continued availability of essential medicines on household's healthcare utilization, accountability and acceptability of prime vendor system within the pharmaceutical supply chain as well as costs and costs drivers for setting-up and scaling up such interventions in low resource settings in Tanzania. We found that continuous availability of essential medicines was a positive and significant association with the household's healthcare utilization. Financial, performance and procedure accountability measures played an important role in the successful performance of the Jazia PVS in Tanzania. The most critical factor contributing to the acceptability of the Jazia PVS was the perceived effectiveness of the system in achieving its intended purpose of complementing the medical store department. Financial start-up costs were higher than the recurrent costs with the largest share of the costs incurred for the payment of short-term technical advisors and training for the healthcare workers. Given the importance of medicines availability in achieving universal health coverage, and the movement towards achieving sustainable development goals by end of 2030, PPP has the potential to improve service delivery however, it is crucial to select a reputable and competent vendor, together with being loyal to the contractual agreement.

10. References

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11. Appendices

11.1 Appendix 1: Sample of Health facility assessment tool

SURVEY TEAM ID NO:

DATE_____ START TIME _____ FACILITY NAME _____ TYPE OF FACILITY_____DISTRICT_____WARD_____ VILLAGE_____

Instructions before commencing the survey:

Introduce all members of the survey team to the HF staff. Using the script below, inform each respondent of the nature of the survey and project: *The HPSS (Health Promotion and System Strengthening) project, supported by the Swiss Agency for Development and Cooperation in partnership with the Government of Tanzania aims at improving access to, quality and utilization of health resources and services in Dodoma, Morogoro and Shinyanga Region. Within the framework of this project, we are conducting an assessment of all health facilities in the region to better understand the situation and perceptions of health professionals on the following four components: 1) Medicines 2) Health financing 3) Facility maintenance and 4) Health promotion.*

We will thus ask you questions pertaining to these four areas. Feel free to make any additional comment you think useful for this assessment. This survey should last approximately two hours. You do not have to give your name to be written on this form. The first part of the survey on medicines will be asked by ……..(name). The other parts on Health promotion, Health financing and Facility maintenance may be conducted by another member of our team.

Thank you for your time and goodwill in helping our survey of health facilities throughout your/_____(name of respective region) region.

Part 1. Supply of medicines

If there are multiple respondents then enter details for a person who is responsible for medicine management in the health facility

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1. Which of the following medicines is available today

Name	Available	
	Yes	**No**
a. Arthemeter/Lumefantrine (ALU) oral	1☐	0☐
b. Quinine inj or Arthsunate inj.	1☐	0☐
c. Amoxicillin caps or Cotrimoxazole tabs	1☐	0☐
d. Amoxicillin syrup or Cotrimoxazole suspension	1☐	0☐
e. Benzyl Penicillin 5MU inj	1☐	0☐
f. Ceftriaxone 1g inj /250g inj	1☐	0☐
g. Mebendazole or Albendazole tabs	1☐	0☐
h. Griseofulvin oral or Clotrimoxazole cream	1☐	0☐
i. Metronidazole tabs	1☐	0☐
j. ORS sachet	1☐	0☐
k. Paracetamol 500mg tabs	1☐	0☐
l. Medroxyprogesterone acetate (depo) inj	1☐	0☐
m. Oxytocin inj	1☐	0☐
n. Ferrous salt and folic acid	1☐	0☐
o. Condoms	1☐	0☐
p. Vaccine e.g. DTP vaccine	1☐	0☐
q. Bendrofluazide tabs	1☐	0☐
r. Glibenclamide tabs	1☐	0☐
s. Ophthalmologic drops or cream	1☐	0☐
t. Dextrose 5% or DNS or Ringer solution	1☐	0☐
u. Surgical gloves	1☐	0☐
v. Adrenaline Injection	1☐	0☐

2. Is the following cadre working at this health facility?

Name	Present at HF	
	Yes	**No**
a. Pharmacist	1☐	0☐
b. Pharmaceutical technician	1☐	0☐
c. Pharmaceutical assistant	1☐	0☐

3. Staffing status and status of received supply (ILS) training in the last two years?

Staff to be mentioned as per facility staff list irrespective of who is currently not in the facility at the time of the interview.

Cadre	Number of staff at facility a.	ILS training b. (N/A when a cadre is not present)		
		Yes	**No**	**N/A**
1. a. Medical Doctor (MD)		1☐	0☐	2☐
2. b. Assistant Medical Officer (AMO)		1☐	0☐	2☐
3. c. Clinical Officer (CO)		1☐	0☐	2☐
4. d. Medical attendant (Nurse assistant)		1☐	0☐	2☐
5. e. Nurse midwife		1☐	0☐	2☐
6. f. Nurse officer		1☐	0☐	2☐
7. d. Pharmacist		1☐	0☐	2☐
8. e. Pharmaceutical assistant		1☐	0☐	2☐
9. f. Pharmaceutical technician		1☐	0☐	2☐

4. Do you know how to access and use complementary funds from cost sharing, CHF and NHIF for the procurement of medicines and other health commodities? *(verify through health facility plan expenditure report)*

1☐ Yes 0☐ No

5. Do you know the guidelines and SOPs for requesting and accessing complementary funds for the procurement of medicines and other health commodities?

a. 1☐ Yes 0☐ No

If yes, are they

1 = Yes and 0 = No

b. Used by responsible staff	1☐	0☐
c. Considered useful by staff	1☐	0☐
d. Considered difficult to use by staff	1☐	0☐

Please show these guidelines

6. When did you last use funds from cost sharing, CHF and NHIF for the procurement of medicines and other health commodities?

1☐ This month 2☐ Last month 3☐ 3 months ago 4☐ 6 months ago 5☐ Never

7. When has your health facility last had a medicine audit?

1☐ Within last 3 months 2☐ within last 6 months 3☐ In the last year 4☐ Never

Please show available reports

8. Is supportive supervision on medicine supply management …

	Yes	No	Don't know
a. Integrated in supervision checklist	1☐	0☐	2☐
b. Conducted in this health facility	1☐	0☐	2☐
c. Conducted at least quarterly in this health facility	1☐	0☐	2☐
d. Followed up with feedback to the HF staff (Ilani)	1☐	0☐	2☐
e. Documented (reports with actions taken are available)	1☐	0☐	2☐
f. Conducted by whom?			
g. When did you receive the last supportive supervision visit?	_____		

9. Is the national Essential Medicine List (NEDLIT) and national Standard Treatment Guidelines (STG)…

	Yes	No
a. Available at the Health Facility	1☐	0☐
If yes, are they:		
b. Used by responsible staff	1☐	0☐
c. Considered by staff as: 0. not useful 1. Somewhat useful 2. Very useful		
d. Please indicate the edition (year) of the available STG	2013☐	2007☐

10. Is medicine supply management integrated and discussed in HFGC?

	Yes	No	Can't Verify
a. MM always on meeting agenda of HFGC	1☐	0☐	2☐
b. Minutes on MM available from HFGC meeting minutes	1☐	0☐	2☐

Please show minutes

11. Can stock out situation be verified from existing registers/records?

1☐ Yes 0☐ No

If yes then, What was the stock-out duration of each medicine during last three months?

Name and unit	Out of stocks		
	# of stock outs last 3 months a.	Total # days of stock out b.	Reasons for stock out* c.
1. Arthemeter/Lumefantrine (ALU) oral			
2. Quinine inj or Arthsunate inj.			
3. Amoxicillin caps or Cotrimoxazole tabs			
4. Amoxicillin syrup or Cotrimoxazole suspension			
5. Benzyl Penicillin 5MU inj			
6. Ceftriaxone 1g inj/250 inj			

7. Mebendazole or Albendazole tabs			
8. Griseofulvin oral or Clotrimoxazole cream			
9. Metronidazole tabs			
10. ORS sachet			
11. Paracetamol 500mg tabs			
12. Medroxyprogesterone acetate (depo) inj			
13. Oxytocin inj			
14. Ferrous salt and folic acid			
15. Condoms			
16. Vaccine e.g. DTP vaccine			
17. Bendrofluazide tabs			
18. Glibenclamide tabs			
19. Ophthalmologic drops or cream			
20. Dextrose 5% or DNS or Ringer solution			
21. Surgical gloves			
22. Adrenaline Injection			

* Reasons

1. Did not order
2. Don't know how to order
3. Ordered but didn't receive commodities
4. Did not order at the designated time
5. Ordered but finished before the next order
6. Out of stock at MSD
7. Did not stock-out .
8. Others (Specify) …….

12. Please indicate the number of each medicines in the ledger book and the physical inventory

Name and unit	Number of medicines	
	# in ledger book a.	# by physical inventory b.
1. Arthemeter/Lumefantrine ALU oral		
2. Quinine inj or Arthsunate inj.		
3. Amoxicillin 250mg caps		
4. Amoxicillin syrup		
5. Albendazole or Mebendazole tabs		
6. ORS sachet		
7. Paracetamol 500mg tabs		
8. Medroxyprogesterone acetate (depo) inj 9. Dextrose 5% or Sodium Chloride+Dextrose IV solution		
10. Malaria Rapid Diagnostic Test MRDT		

13. Expired medicines

Expired medicines	Yes	No
a. Are there expired medicines?	1☐	0☐
b. Are expiries recorded in ledger for expired medicines?	1☐	0☐

14. During the last ordering cycle, did your HF receive all medicines ordered from MSD on time?

1☐ Yes 0☐ No

15. Order and receipt of consignment from MSD (timeliness of delivery): Is the last MSD delivery order and receipt information available?

1☐ Yes 0☐ No

Please fill in the date of order and receipt of the last delivery from MSD

a. Date of order submitted to MSD	
b. Date of receipt of consignment from MSD	

16. Are details available for a previous MSD order against the drugs that where actually received?

1☐ Yes 0☐ No

If yes, then during the last ordering cycle, how many of the ordered medicines were received from MSD and how many were out of stock? Please calculate from your last MSD invoice.

a. _____ # of types of medicines received **b.*** _____ # (type) of medicines listed as missing items **c.*** _____ # (type) out of stock at MSD

**Enter -9 if this is not mentioned* on the invoice

11.2 Appendix 2: Sample of Qualitative guide

In-depth interview guide for Jazia-Prime Vendor System

This interview should be conducted with the facility in-charges, health facility governing committee, Pharmacists other relevant people in Dodoma and Morogoro. Depending on availability, may do a group interview or a single interview with the most relevant person. For each interview, say this information at the start of digital recording and write this information at the top of the transcript.

District: _____ and interview location _____

Date: _____/_____/_____ Tarehe _____/_____/_____

Time start: __ __:___ __ Time Finish: __ __:__ __

Name of Interviewer: _____

Name of Recorder: _____

SECTION A: Basic Information

Question	**Respondent/Mhojiwa**
DO NOT ASK. Indicate the sex of the respondent	
What is your current job title?	
Work place	
How many years have you been working in this position	
What is your level of education	
What is your Age	

Section B: Management and financing systems of Jazia-PV system

Supply chain management in the Jazia-PV system refers to the set of activities involved in moving a product (in this case medicine, diagnostics and other health supplies) and its associated services from the ultimate supplier to the health care facility. These include selection, quantification/ forecasting, procurement, inventory management, storage, and distribution.

Management

1. Could you please describe to me how Jazia-PV system was developed and implemented in Dodoma and Morogoro regions

2. Explain how is the flow of information and communication system from health care facilities to the regional level in terms of availability or shortage of drugs and medical supplies?
3. Performance management of the Jazia-PV system
    a. Probe on the pharmaceutical capacity to forecast, reporting on the drugs and other medical supplies, training, staffs retention and motivation strategies in the districts
    b. Probe Data management issues, rate of stock-outs, stock on hand and how products are managed in a facility
    c. Supportive supervision linked to drugs and medical supplies under Jazia-PV system
4. What is your opinion as frequent resupply leads to higher transport costs, it also results in a shorter forecast horizon for the health facilities, thereby allowing for better stock management and a lower chance of stock-outs
5. Think about the need for effective management of drugs and medical supplies at each level of health care service
    a. What are the benefits of effective management of drugs and medical supplies?
    b. What are the challenges faced by providers with regards to drugs and medical supplies?
    c. What are the strategies employed by providers to deal with drugs and medical supplies management?

Financing

Finance is a key component of the supply chain, as the availability of funding determines what supplies can be procured, where and when supplies can be distributed.

6. How are the drugs and medical supplies being financed on Jazia-PV system?
    a. Probe on sources of funds and how the funds are pooled together
    b. Probe on pooling and coordination of the available financial resources to ensure optimal performance of the Jazia-PV system
    c. Probe on the sustainability of each financing mechanism needed to build and maintain adequate supply chains under Jazia-PV system
    d. Probe on timely disbursement of the funds to the supplier
    e. Equity and cross-subsidisation of pooled funds taking into consideration some facilities have more resources than others
7. Describe sources and amount of resources to finance the operating costs of Jazia-PV system (e.g., fuel expenses, car rental, vehicle maintenance, and per diems of drivers)?
8. What are the management and financing challenges impeding the smooth operation of the Jazia-PV system in Dodoma and Morogoro Regions?
9. In your opinion what are the management and financing changes which need to be done to improve operations of Jazia-PV system?

Section C: Governance and Accountability of medical supplies under Jazia-PV system

Governance

Governance represents the structures and processes by which supply chain constituents share power, also shapes individual and collective actions

10. Describe existing systems for procurement, distribution, storage, dispensing, reporting, investigating, and misallocation or misuse of drugs and medical supplies at the health care facility. Probe on
    a. Whether facility managers ensure that health workers follow protocols, standards and codes of conduct during procurement, storage and dispensing of drugs and medical supplies.
    b. The health facilities receive regular external supervision from CHMT/RHMT teams to ensure that the protocols and standards are followed
    c. There is a mechanism for correcting those not complying with standards and code of conduct at a different level of health care management
11. Explain whether the public has regular opportunities to meet with managers of the health facility to raise issues about drugs, medical supplies, efficiency or quality of health care services. Probe also on whether
    a. The public and concerned stakeholders can advocate and participate effectively with the health facility officials in making plans
    b. The allocation and utilization of resources are regularly tracked and information on results is available for review by the local communities/stakeholder.
12. Is there a service or committee responsible for monitoring and enforcing the provisions on drugs and medical supplies at each point of the supply chain under Jazia-PV system?
13. Who decides how much stock of each product to go to each facility and based on what information?
14. In your opinion, what types of unethical behaviour are common with regards to procurement of medical commodities via Jazia_PV system?
15. How transparent are the Jazia-PV system activities? Are there written procedures for the operation of the PV system?
    a. Are there clear and comprehensive guidelines for the committee's decision-making process?
16. Think about community participation
    a. Probe on local organisations and health service users whether they influence what services are offered at the health facility
    b. Probe on the existence of forums and procedures that give the public, technical experts, and local communities' opportunities to provide input on Jazia-PV system

c. Probe whether health facility use evidence on program results, patient satisfaction, and other health-related information to improve the services they deliver

17. If you were in a position of the highest authority, what would be the first action that you would take to improve the medicine availability in the health care facilities?

Accountability

18. In Jazia-PV system we consider accountability as "……one group being responsible for something or to another group, and being able to explain their actions…..".
    a. Could you describe to me actors involved in the Jazia-PV system (Such as Ministry of Health, Local government authorities, RHMT, CHMT, CHSB, health care providers, Suppliers, private suppliers, HFGC, WADC, etc)
    b. What is the role of each actor in the Jazia-PV system with regards to accountability? Which actors in the health system are answerable for their actions and behaviours on Jazia-PV system and to whom are they accountable?
    c. Internal accountability: Probe on the content and frequency of supervision: Financial accountability and transparency? Processes surrounding the allocation of the funds in the facility and district level? Resource prioritisation to meet district targets?
    d. External accountability: Probe on enhancing provider responsiveness to users and improve the relationship with the local community? Role of health facility governing committees on smooth operations of Jazia-PV system?
19. Accountability and health system in the operations of Jazia-PV system
    a. Accountability issues
        i. Determination of quarterly order quantities to be purchased from Jazia-PV system and whether health facilities orders consolidation at District HQ and forwarding to Jazia-PV system Receiving and inspection of consignments from Jazia-PV system
        ii. Inspection of supplies, funds transfer & payment to Jazia-PV system
        iii. Lines of communication within Jazia-PV system
    b. Financial accountability concerns tracking and reporting on allocation, disbursement, and utilization of financial resources, using the tools of auditing, budgeting and accounting. Probe on compliance with laws, rules, and regulations regarding financial control and management? Misuse of resources devoted to procuring of medical commodities in the facility, district or region?
    c. Performance accountability refers to demonstrating and accounting for performance in light of agreed-upon Jazia-PV system performance targets. Probe on the assurance that available resources devoted for purchase of medical commodities are used and authority is exercised according to appropriate and legal procedures, professional standards, and societal values?

20. Probe on the following issues
    a. The allocation and utilization of resources are regularly tracked and information on results is available for review by the local communities/ any other stakeholder
    b. Do the public/concerned stakeholders have regular opportunities to meet with managers of the health facility to raise issues about Jazia-PV system in terms of efficiency or quality?
    c. Overall openness of the Jazia-PV system?
21. What are the challenges in achieving accountability in the Jazia-PV system
    a. Probe on asymmetries among service providers, users, and oversight bodies in terms of information, expertise and access to services?
    b. Probe on the inability of health facilities to track and report on budgets, collection of fees, pharmaceutical purchases and supply inventories, vehicles and equipment?
22. Consider accountability-enhancing strategies which can be applied to improve medical supplies through Jazia-PV system in facilities:
    a. Probe on how can facility reduce over description/abuse of drugs in the facility? Assuring compliance with procedures and standards of the supply chain through the PV system? and improving the performance of the Jazia-PV system?
    b. Probe on possible ways to strengthen the linkages among accountability actors? How can accountability be improved? What strategies lead to which outcomes? What are the targets for accountability strategies?

Thank you for taking part in this interview, do you have any questions?

11.3 Appendix 3: Sample of Costing guide

Date of Interview	
Interviewer name	
Interviewee	
Interviewee position (if possible try to get official cadre title)	
Interviewee institution	
District	
Time of interview start	
Time interview end	
Observations	

General

What is your role in the Jazia-PVS system /In which PVSS activities have you been involved? (List answers; use probes below to ascertain that interviewee has not forgotten any aspect of his involvement in PVSS)

Probe on Procurement cycle management; Bidding documents; Pre- and post-qualification of suppliers; Advertisement and sale of bid document; Communication during the bidding process; Receipt of bids and bid opening; Bid evaluation; Contract award; Contract administration, data collection etc, administrative body assignments with TORs, M&E and SOP development, M&E activities, lobbying and advocacy, communication with supplier, support of HFs and HFGCs, training and capacity building, auditing,

1. **Were you involved in any Jazia-PVSS preparatory start-up activities:**
   1.1. *Describe the activities which you were involved*
   1.2. *What is your role in Jazia-PVSS*
   1.3. **Development of any Jazia-PVSS training materials?** If yes:
      1.3.1. Can you describe what aspect of Jazia-PVSS was covered in these materials and who was targeted by this training? (ie training of trainers, health workers, CHMT e.t.c)?
      1.3.2. Approximately how long did it take in total to develop the training materials? (estimate approximate start date of development and end date if this is known to the respondent, otherwise skip to next question)
      1.3.3. How long did you spend developing the materials? (it can be for the whole duration of the development of the material or a share of it) (estimate full-time hours/days/weeks as appropriate, or % of a month/week/day etc

1.3.4. Who else was involved?

1.3.5. What other resources if any did you use (list all resources, and quantities used)

1.3.6. List of Participants (meetings/training and their cadre)

2. **Conducting training?** If yes:

2.1. Can you describe the aim of the training?

2.2. Who was being trained? (is there a participant list that we can obtain? If yes, from who?)

2.3. How many other trainers were involved? (and from which institutions did trainers come from?)

2.4. How long did the training last? (number of days, hours)

2.5. How long did you participate in the training? (it can be for the whole duration of the training of a part of it)

2.6. Which other resources were involved? (computers, communications, transport)

3. **Development of Jazia-PVS contracts?** If yes:

3.1. Can you indicate which contracts?

3.2. Typically, how long did it take to develop the contract(s)? (note: not have it signed etc just development of the paperwork) (estimate approximate start date and end date if this is known to the respondent, otherwise skip to next question)

3.3. Who else was involved?

3.4. How long did you work for on the development of each contract? (it can be the whole duration of the development, or just participation of the review process, i.e. 1-2 hours) (estimate full-time hours/days/weeks as appropriate, or % of a month/week/day etc)

3.5. Which other resources were involved? (computers, communications, transport)

4. Distribution/sign-up of each contract? If yes:

4.1.1. Can you indicate which contracts?

4.1.2. For each contract, who was involved in this process?

4.1.3. How long did the process take? (estimate approximate start date and end date if this is known to the respondent, otherwise skip to next question)

4.1.4. How long did you spend on this activity? (estimate full-time hours/days/weeks as appropriate, or % of a month/week/day etc)

4.1.5. Who else was involved?

4.1.6. Which other resources were used (transport, supplies, communication etc.) try to list and quantify each?

5. Development of Jazia-PVS guidelines? If yes:

5.1.1. Describe which guidelines you participated in the development of?

5.1.2. Describe the tasks that you performed when developing each guideline

5.1.3. How did the whole process take? (estimate approximate start date and end date if this is known to the respondent, otherwise skip to next question)

5.1.4. How long did you spend on each task? (estimate full-time hours/days/weeks as appropriate, or % of a month/week/day etc)

5.1.5. Who else was involved? (i.e. secretary, printing agency, editor..)

5.1.6. Which other resources were involved? (transport to printing agency, communications, transport)

6. Distribution of Jazia-PVS guidelines? If yes:

6.1.1. Were you involved in the distribution of any guideline (including those you did not develop)? If yes, which guideline?

6.1.2. How did the whole distribution process take for each guideline? (estimate approximate start date and end date if this is known to the respondent, otherwise skip to next question)

6.1.3. Describe the tasks you perform for distributing each guideline

6.1.4. How long did you spend on each task? (estimate full-time hours/days/weeks as appropriate, or % of a month/week/day etc)

6.1.5. How many guidelines were distributed?

6.1.6. Who else was involved?

6.1.7. Which other resources were involved? (transport, communications, supplies)

7. Participation in Jazia-PVS preparatory meetings

7.1.1. Did you participate in any preparatory meetings? If yes, which ones?

7.1.2. How long was each meeting? (estimate approximate start date and end date if this is known to the respondent, otherwise skip to next question)

7.1.3. Who else was involved? (possible to collect participant list?)

7.1.4. Other resources involved?

7.1.5. **Were you involved in any other Jazia-PVS related activities?** If yes, please describe; (Interviewer record for each activity approximate start date and end date if this is known to the respondent; interviewee's time spent in the activity; who else was involved, and whether other resources were used)

8. **Jazia-PVS ongoing activities**

8.1. **Jazia-PVS Data processing and capture? If Yes:**

8.2. Can you describe your involvement in this activity? (i.e. the tasks that you perform)

8.2.1. How long did this whole activity take? (if there are several tasks, try to ask duration of each task) (estimate approximate start date and end date if this is known to the respondent, otherwise skip to next question)

8.2.2. How long did you spend on this activity? (estimate full-time hours/days/weeks as appropriate, or % of a month/week/day etc) (if there are several tasks, try to ask time spent on each task)

8.2.3. Who else was involved?

8.2.4. Which other resources were involved? (computers, communications, transport)

8.2.5. *For every individual involved in data processing and capture, please could you tell us the following:*

Nature of data collected and for what purse

How long did it take

Who was involved and list resources used

9. Strategies employed by facilities to meet targets? If yes:

9.1. Describe which strategies

9.1.1. Can you describe your involvement in each strategy (i.e. the tasks that you perform)

9.1.2. How long did this whole activity take? (if there are several tasks, try to ask duration of each task) (estimate approximate start date and end date if this is known to the respondent, otherwise skip to next question)

9.1.3. How long did you spend on this activity? (estimate full-time hours/days/weeks as appropriate, or % of a month/week/day etc) (if there are several tasks, try to ask time spent on each task)

9.1.4. Who else was involved?

9.1.5. Which other resources were involved? (computers, communications, transport)

10. Verification: supervision/audits by CHMT and RHMT, RCC? If yes:

10.1. Which verification/supervision?

10.1.1. Can you describe your involvement in this activity? (i.e. the tasks that you perform)

10.1.2. How long did this each verification/supervision take? (if there are several tasks, try to ask duration of each task) (estimate approximate start date and end date if this is known to the respondent, otherwise skip to next question)

10.1.3. How long did you spend on this activity? (estimate full-time hours/days/weeks as appropriate, or % of a month/week/day etc) (if there are several tasks, try to ask time spent on each task)

10.1.4. Who else was involved?

10.1.5. Which other resources were involved? (computers, communications, transport)

11. Performance assessment? If yes:

11.1. Describe the kind of performance assessment?

11.1.1. Can you describe your involvement in this activity? (i.e. the tasks that you perform)

11.1.2. How long did each assessment take? (if there are several tasks, try to ask duration of each task) (estimate approximate start date and end date if this is known to the respondent, otherwise skip to next question)

11.1.3. How long did you spend on this activity? (estimate full-time hours/days/weeks as appropriate, or % of a month/week/day etc) (if there are several tasks, try to ask time spent on each task)

11.1.4. Who else was involved?

11.1.5. Which other resources were involved? (computers, communications, transport)

12. Any other PVS system related activities? If yes

12.1.1. If yes, please describe; (Interviewer record for each activity approximate start date and end date if this is known to the respondent; interviewee's time spent in the activity; who else was involved, and whether other resources were used**)**

Please could you tell us the following?

How many hours a day do you work?

How many days a week do you work?

What is your annual leave entitlement?

Your job title?

Your Grade?

Thank you for taking part in this interview, do you have any questions?

12. Curriculum Vitae

AUGUST J. KUWAWENARUWA

_____PERSONAL INFORMATION

Box 65131, Dar es Saalam, Tanzania

ajoachim@ihi.or.tz; kuwawenaruwa@gmail.com

Mobile phone +255754975025; Skype august_joachim

_____SHOORT PERSONAL PROFILE

Excellent writing, analytical, communication, coordination, and organizational skills

Over 7 years' experience in working within the health system programs in Tanzania

Committed and team spirit owning to experience gained at work and other social activities

_____EDUCATION

2016-2020 University of Basel, Basel, Switzerland

Swiss Tropical and Public Health Institute, Basel, Switzerland & Ifakara Health Institute, Dar es Salaam, Tanzania

PhD in Epidemiology/Public Health

Relevant course: Mixed methods approach; implementation research; Quantitative Economic Data Analysis (e.g. analysis of household survey data; econometric analysis); economic and impact evaluation; micro-economic costing

2007-2009 University of Dar es Salaam, Tanzania

Master of Arts Degree in Economics

Relevant course: Health Economics, Econometrics, Environmental Economics

2004-2007 University of Dar es Salaam

Bachelor of Arts Degree in Economics

TRAININGS, SEMINARS AND WORKSHOPS

2015 Summer School in Public Health Policy, Economics and Management (Short course on Health care financing and Non-communicable diseases control (NCDs))

2015 Applied Economic Evaluation of Health care Interventions, University of Bergen, Norway

2014 AfHEA Universal Health Coverage Course, Nairobi, Kenya

2013 I attended a workshop on qualitative data analysis, Dar es Salaam, Tanzania

2013 Equity Case Study Methodology Workshop, Maryland, USA, Sept 2013

2009 Workshop presentation of the preliminary results from the project named "Strategies for Health Insurance and Equity in Less Developed Counties" (SHIELD) Presented at the University of Cape Town – Health Economics Unity, South Africa

WORK AND TEACHING EXPERIENCE

March 2009 to Date Ifakara Health Institute

March 2004 to September 2004: Employee of Muhimbili University College of Health Sciences, Department of Community Health. MUCHS – Harvard Collaborative Research Projects

Teaching Introduction to Macroeconomics, University of Dar es Salaam School of Business, Dar es Salaam, Tanzania, 2015

CONSULTANCIES UNDERTAKEN

2017 Consultant in a consultancy team that has been assigned a task to undertake financing analytical review of the health sector strategic plan three

(HSSP III). The task has been commissioned by the World Health Organization and the Ministry of Health in Tanzania

2017 Consultant in a consultancy team that has been assigned a task to undertake holistic review and costing of supply chain of medical commodities in Tanzania. The task has been commissioned by the Ministry of Health and Medical Store Department of Tanzania (MSD)

2014 Health financing consultant in a consultancy team that was assigned a task to undertake Situational Analysis and Feasibility Study of Options for Harmonization of Social Health Protection Systems towards Universal Health Coverage in the East African Community States. The task was commissioned by East African Community.

_____LANGUAGES

Swahili Native Language

English Second Language

_____KNOWLEDGE

Skills Statistical software for data analysis (STATA, SPSS, Eviews)

Qualitative data analysis (NViVO - 12)

Microsoft Office Application

Competencies costing and cost-effective analysis

Impact evaluation of health care interventions

Complementary Pharmaceutical supply system

_____VOLUNTEERING

Teaching Health Systems and Health Financing, to Masters Student, IHI-Kingani-Bagamoyo, 2019

Lectures in Economic Evaluation, to Masters Student, IHI-Kingani-Bagamoyo, 2019

Teaching introduction to Statistical Package for Social Science (SPSS), at the Hubert Kairuki Memorial University, Dar es Salaam, Tanzania, 2015

PUBLICATIONS

2019 Kuwawenaruwa A., Ramsey K., Binyaruka P., Baraka J., Manzi F. and Borghi J. (2019) Implementation and effectiveness of free health insurance for the poor pregnant women in Tanzania: a mixed methods evaluation, Social Science & Medicine, Volume 225, Pages 17-25

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2011 Kuwawenaruwa, A., Macha J., and Borghi J., (2011): Willingness to pay for Voluntary Health Insurance in Tanzania, East African Medical Journal Vol. 88 N0. 4 April 2011

2012 Mtei, G., Makawia, S., Ally, M., Kuwawenaruwa, A., Meheus, F., Borghi, J., (2012), Who pays and who benefits from health care? An assessment of equity in health care financing and benefit distribution in Tanzania. Health Policy and Planning, 2012. 27(suppl 1): p. i23-i34.

2012 Macha, J., Harris, B., Garshong, B., Ataguba, J., Akazili, J., Kuwawenaruwa, A., Borghi J., (2012), Factors influencing the burden of health care financing

and the distribution of health care benefits in Ghana, Tanzania and South Africa. Health Policy and Planning, Vol. 27(suppl 1): p. i46-i54.

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REFERENCES

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Kaspar Wyss University of Basel, Swiss Centre for International Health (SCIH), Basel - Switzerland

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