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ARAŞTIRMA / RESEARCH

Inventory management performance of key essential medicines in health facilities of East Shewa Zone, Oromia Regional State, Ethiopia

Oromia Bölgesel Devleti Doğu Shewa, Etiyopya'daki sağlık tesislerinde en önemli temel ilaçların envanter yönetimi performansı

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Abstract

Purpose: Appropriate management of medicines at the different stages of supply chain is important. Failure to do so will result in stock-out, wastage of medicines and financial loss which in turn affects the health care services. The aim of this study was to assess the inventory management performance of key essential medicines.

Material and Methods: Health facility based descriptive cross- sectional study using both quantitative and qualitative method was employed on 20 public health facilities. Data was gathered using checklists, structured and sem-structured questionnaires from March 29 to April 29, 2016.

Result: The inventory management performance of key essential medicines in-terms of measuring indicators revealed that out of 400 bin-cards selected 162(40.50%) of them were not updated. Only 28.50% of bin-cards were accurately filled. The mean stock out rate of key essential medicines was around 27.25% with average stock out duration of 35.31 days. On average around 10.43% of medicines were wasted resulting in loss of 174,366.98 Ethiopian birr (ETB) of which the value of medroxy progestrone accounted around 65.74% of the loss. Concerning storage condition only 5(25%) of the health facility have full filled good storage condition criteria. Budget constraints, human resource inadequacy, & over supply of near expiry date medicines were identified as major in inventory management challenges.

Conclusion: The inventory management practice of the study facilities was found to be weak which was confirmed by poor bin-card updating practice, storage condition below the standard and poor stock record accuracy. There were also high stock out rates, and medicines wastage with loss of money.

Key words: inventory management, performance, key essential medicines, health facilities, East Shewa Zone

Öz

Amaç: Tedarik zincirinin farklı evrelerinde ilaçların uygun yönetimi önemlidir. Bunun yapılmaması, stok kaybına, ilaçların israfına maddi kayıplara ve sonuçta sağlık hizmetlerinin olumsuz etkilenmesine neden olacaktır. Bu çalışmanın amacı ilaçların envanter yönetimi performansını değerlendirmektir.

Gereç ve Yöntem: 20 sağlık ocağı üzerinde nicel ve nitel yöntem kullanılarak yapılan sağlık taramasına dayalı açıklayıcı kesitsel tipte çalışma yapılmıştır. Veriler, kontrol listeleri, yapılandırılmış ve yarı yapılandırılmış anketler kullanılarak 29 Mart - 29 Nisan 2016 tarihleri arasında toplanmıştır.

Bulgular: Göstergeleri ölçmek açısından önemli olan temel ilaçların envanter yönetimi performansı için seçilen 400 kutu kartından 162'sinin (% 40.50) güncel olmadığı gösterilmiştir. Depo kartlarının sadece% 28.50'i doğru bir şekilde doldurulmuştu. Temel ilaçların ortalama stok çıkarma oranı yaklaşık %27.25 ve ortalama stok süresi 35.31 gündü. Ortalama olarak ilaçların yaklaşık %10,43'ü harcanarak 174,366,98 Etiyopya bir (ETB) değerinde para kaybedildi ve medroks progesteronun değeri, kaybın %65,74'ünü oluşturuyordu. Depolama koşuluyla ilgili olarak, sağlık tesisinin sadece 5'i (% 25) tam doldurulmuş ve iyi saklama koşulları kriterlerine sahipti. Bütçe kısıtlamaları, insan kaynakları yetersizliği ve yakın bitiş tarihli ilaçların arz fazlası, envanter yönetimi zorluklarında büyük sorunlar olarak tespit edildi.

Sonuç: Çalışma tesislerinin envanter yönetimi uygulaması zayıf bin kart güncelleme uygulaması, standartların altında saklama koşulları ve zayıf stok kayıt doğruluğu ile doğrulanmıştır. Aynı zamanda yüksek stok kayıpları ve ilaç kaybına bağlı para kaybı olduğu görülmüştür.

Anahtar kelimeler: Envanter yönetimi, performans, önemli temel ilaçlar, sağlık tesisleri, Doğu Shewa Bölgesi

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INTRODUCTION

Health systems are complex mechanisms through which pharmaceuticals, services and care are delivered to patients. There is a growing recognition that many aspects of health care are connected to each other and that without consideration of these interrelated parts and how they affect one another, policies cannot act effectively in improving health outcomes because they will be unable to face barriers imposed across levels of the health system. Medicines are part of the systems for the improvement of health of individuals[1].

World health organization defines essential medicines as products that should appear all times with sufficient quantities for the management of common diseases that can affect majority of populations[2]. There are several factors which deny access by the populations of low-income countries to effective medicines for the treatment of the diseases to which they are subject. Wastage and inefficiencies in managing logistics and other problems of supply chain management add to low availability of medicines[3].

Inventory management refers to all the activities involved in developing and managing the inventory levels of raw materials, semi-finished materials (work-in-progress) and finished good so that adequate supplies are available and the costs of over or under stocks are low[4]. The principal goal of inventory management involves having to balance the conflicting economics of not wanting to hold too much stock[5]. The inventory management can bring out significant improvement not only in patient care but also in the optimal use of resources. Continuous management can provide the value added services to the patients[6].

A good inventory system means that organization have an up to date inventory count at all times, giving good customer service, giving accurate information to customer and improve image of the organizations[5]. It is a vital that inventory management system allows managers to receive real time information on inventory. This will assist management to accurately made informed decisions, anywhere, anytime and save time and cost used for labor and thus working on inventory management properly[6].

Pharmacy inventory management is a complex but critical process within the healthcare delivery system. Without adequate pharmacy inventory management practices, hospitals run the risk of not being able to provide patients with the most appropriate medication when it is most needed[7]. The medicines management practice has different components which are organized in the logistic cycle form however the present study focused on the inventory management part.

Although medicines are powerful weapons that can help society to prevent, alleviate and cure diseases, more than one third of the World population lacks reliable access to essential medicines, a situation that directly contradicts the fundamental principle of health as a human right[8,9].

Every year globally infectious diseases deprive the life of 13 million people; the prevalence is higher in developing countries[7]. For instance study conducted in Ghana in 2008 indicated that malaria followed by HIV/AIDS, diarrheal diseases; lower respiratory infections and prenatal conditions accounted for 50% of all deaths[10]. Most of early deaths and complications associated to the diseases can be overcome if the needy had access to essential medicines through proper management of medicines with appropriate inventory control[7]. In addition medicines account the highest health care budget around 50% to 90% of non-personnel costs, hence it is not difficult to imagine how much dollar we can lose because of inventory management malpractices11.

In Ethiopia limited studies have been conducted regarding inventory management performance of essential medicines. Hence the aim of this study was to assess the inventory management performance of key essential medicines in public health facilities using various indicators like stock out rate, inventory accuracy rate, logistic record updating practices, medicines wastage rate, value of unusable stock, storage condition of health facilities and the major inventory management challenges.

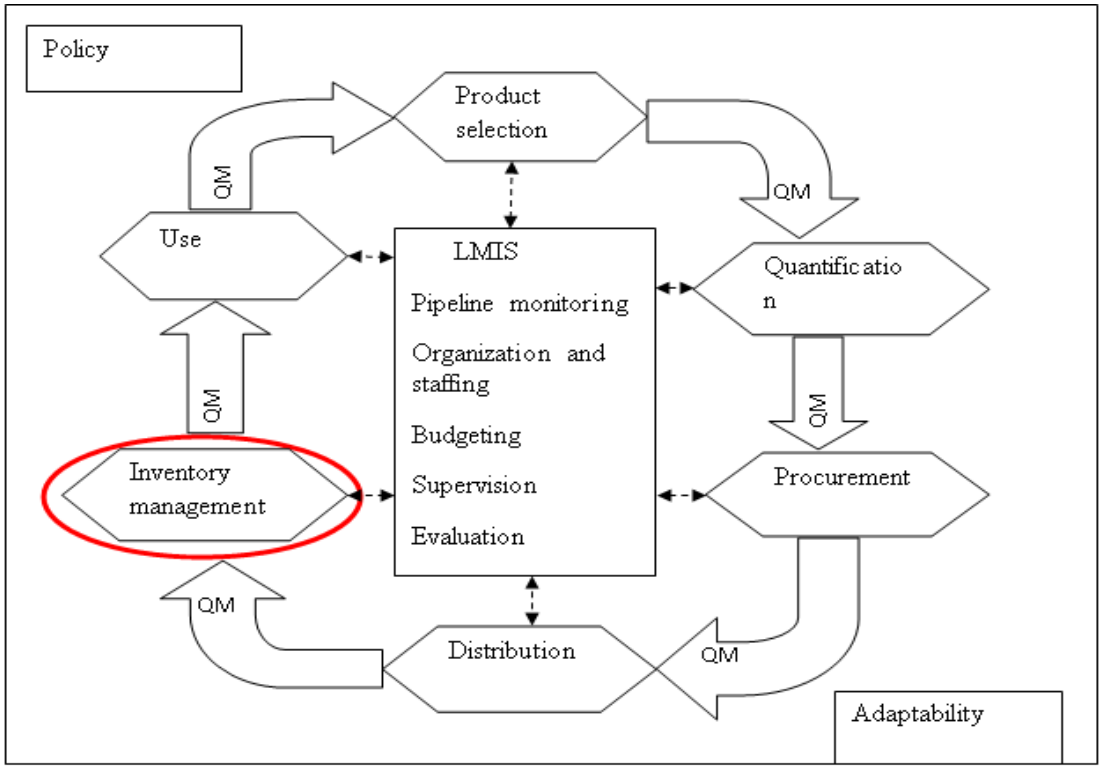

Figure 1. Drug supply management cycle (Source: USAID deliver, 2006)
QM=quality monitoring

METHODS AND MATERIALS

The study was conducted in selected public health facilities of East Shewa zone, Oromia Regional state. It is located in the middle of Oromia, connecting the western regions to the eastern ones. East Shewa zone undertakes its administrative duties and responsibility in 10 districts (Fantalle, Boset, Adama, Lume, Bora, Dugda, AdamiTulluJidoKombolcha, Ade'a, Liben and Gimbichu) and 4 urban centers namely; Matehara, Mojo and Batu (Ziway) and Dukem. The were about 382 public health facilities (i.e. 4 hospitals,52 health centers & 326 health posts) and 14 clinics in the Zone with a total of 1217 health professionals (i.e.15 doctors, 45 health officers, 386 nurses, 42 Pharmacists, 45 Lab technicians, 30 Pharmacy attendants, 44 Environmental health science and 617 health extension workers)[12]. The study was conducted from March 29 to April 29, 2016.

Ethical clearance & approval was obtained from Institutional Review Board (IRB) of Jimma University and submitted to Oromia regional health bureau along with one hard copy of the proposal. Then authorization letter was received from Oromia regional health bureau, East Shewa zone health department and from each Wereda health office sequentially. At the health facilities, before data collection started permission was obtained from the health facility Medical director and store manager of the pharmacy department by submitting the latter of cooperation obtained from the respective Wereda health office and Oromia health regional bureau (in case of hospitals). For qualitative study a verbal consent was obtained from key informants and confidentiality of the information was re-assured to them.

The determination of the sample size of the health facilities was based on the USAID delivery project logistics indicators assessment tool (LIAT) where a minimum of 15% of the total health facilities are recommended[13]. Accordingly 20 public health

facilities beyond the minimum requirement were taken from the total of 56 public health facilities.

In the study area about 56 public health facilities i.e. 4 hospitals and 52 health centers were giving service to the community. The health centers were clustered based on the Wereda of the Zone and simple random sampling techniques was used to select the study health facilities from each Wereda. The four hospitals were included since they were found in different Wereda, and the health centers were randomly selected by using lottery method.

With regard to type and amount of essential medicines included from each facility for the study were based on the tracer medicines plus the top ten diseases of the health facilities. These drugs were obtained by referring to standard treatment guidelines for general hospital and health centers. Twenty bin-cards from each health facilities for the 20 key essential medicines were reviewed, for medicines having more than one strength and dosage form; one bin-card was randomly selected. The data was gathered using structured and sem-structured questionnaires from the health facility Medical directors, pharmacy head and health facility store managers through administering the questionnaires and in depth face to face interview. For the in-depth interview 2 store persons (pharmacist and Nurse), 2 pharmacy head (pharmacists) and 2 Medical directors (Medical doctor and Health officer) were participated. In addition review of relevant documents with a maximum of six month duration, observation using check lists, & physical counts of the products have been done. The data was collected by trained data collectors (whose back ground was pharmacy profession) with close supervision by the principal investigator. The data was checked for completeness of information and entered into the Statistical package for Social Science (SPSS) programs version 20 and Excel spread sheet for analysis. Spearman correlation & chi-square tests were used to determine the association between dependent and independent variables. Variables with critical value $P<0.05$ was considered as statistically significant. Content analysis (thematic analysis) technique was used to analyze qualitative data.

Table 1.The socio-demography of the selected health facilities of East Shewa zone, Oromia regional state, May 19, 2016

Socio-demography					
S.№	**Variables**			**Frequency (%)**	**Total**
1.	Professionals under pharmacy unit	Pharmacy		58 (78.4)	74(100)
		Nurse		16 (27.6)	
2.	Service year(store man and pharmacy head)	<1		4 (10)	40(100)
		1-5		26 (65)	
		>5		10 (25)	
3	Education qualification (staff of pharmacy unit)	Degree (pharmacy)		42 (56.8)	74(100)
		Diploma(Nurse+Pharmacy)		32 (43,2)	
4	Supervision received (for store man and pharmacy head)				20(100)
		Within the last month		10 (50)	
		1 - 3 months ago		9(45)	
		3 - 6 months ago		1(5)	
5	Trainings taken by pharmacy units	IPLS	received	70 (94.6)	74(100)
			not received	4 (5.4)	
		Pre-service	received	6 (8.1)	74(100)
			not received	68 (91.9)	
		On-job training	received	4(5.4)	74(100)
			not received	70(94.6)	
		Others	received	4 (5.4)	74(100)
			not received	70 (94.6)	

Others=DTC training, medical eqpt, supplies and reagents

RESULTS

This chapter reports on the quantitative and qualitative findings of inventory management performances of key essential medicines in selected 20 health facilities of East Shewa Zone. Sixteen of the facilities were health centers and the rest 4 facilities were hospitals. For the qualitative part 2 store persons (pharmacist and Nurse), 2 pharmacy head (pharmacists) and 2 Medical directors (Medical doctor and Health officer) were participated for the in-depth face to face interview.

The socio-demography, logistic facilities and infrastructure of the study health facilities. The facilities constituted 74 staffs under pharmacy units; of which 42 (56.8%) were pharmacy degree holders and 16 (21.6 %) were pharmacy diploma holders. About 16 (21.6%) Nurse diploma holders were serving as store person in health centers. Almost all of the staffs (94.6%) have taken integrated pharmaceuticals logistics system (IPLS) training and few of them have taken pre-service training 6 (8.1%) and on job training like computer maintenance and HMIS4 (5.4%).

Most of the health facilities have received supervision within the last month just prior to the day of data collection time, 10 (50%) and 9(45%) of them received in the past 1 to 3 months ago (Table 1).All of the surveyed health facilities had bin-cards, IFRR, RRF and they were using them at OPD, ART, MCH and TB clinics. But only 4 (%) of the health facilities had automated recoding systems (Table 2).The finding of the study also indicated that most of the facilities were medium volume 10 (50%) where the rest 6 (30%) and 4(20%) of the facilities were low volume and high volume respectively. Most of the study facilities had stock taking at any time during issue 16 (47.0 %) and bi-annually11 (32.4%). (Table3).

Inventory management performances of key essential medicines in terms of quality

The quality of inventory management practices were measured by stock record accuracy, stock out rate and stock wastage due to expiration/damage/loss.

Stock record updating practices and record accuracy rate

As indicated on the table below 162 (40.50%) of the 400 bin-cards selected for the twenty key essential medicines were not updated and 238 (59.50%) bin-cards were updated. The average record accuracy rate was found to be 28.5 with the range of 15 for ORS and Medroxyprogestrone to 65 for RHZE (Table 4)

Table 2.Availability and utilization of logistic tools in the selected health facilities of East Shewa, May 19, 2016

S.№	Tools	Availability		Utilization at			
		Available (%)	Not available (%)	OPD (%)	ART (%)	MCH (%)	TB (%)
1	Bin card	20 (100)	0 (0)	20 (100)	20 (100)	20 (100)	20 (100)
2	IFRR	20 (100)	0 (0)	20 (100)	20 (100)	20 (100)	20 (100)
3	RRF	20 (100)	0 (0)	20 (100)	20 (100)	20 (100)	20 (100)
4	SOP manual	20 (100)	0 (0)	20 (100)	20 (100)	20 (100)	20 (100)
5	Automated record	4(20)	16(80)	1(5)	3 (15)	0 (0)	0 (0)

Table 3.Stock taking practices and the capacity of the selected health facilities of East Shewa, May 19, 2016

S.№	Variables		Frequency (%)	Total (%)
1	Volume of health facilities	Low Volume	6 (30)	20 (100)
		Medium Volume	10 (50)	
		High Volume	4(20)	
2	Stocking practices	Every week	0(0)	34(100)
		Every two week	3(8.8)	
		Any time during issue	16 (47.0)	
		Monthly	0 (0)	
		Annually	4(11.8)	
		Bi-annually	11(32.4)	

Table 4.Health facilities stock record updating practices and record accuracy rate in selected facilities of East Shewa Zone, Oromia regional state May 19, 2016

S. №	List of products	Bin card/automated		Accuracy rate		
		Updated Freq (%)	Not updated Freq (%)	accurate (%)	Near Accurate (+/-10%)	Not accurate (%)
	Amoxicillin	11(55)	9(45)	25	70	5
	ORS	8(40)	12(60)	15	75	10
	Mebendazole	12(60)	8(40)	35	65	0
	TTC eye ointment	15(75)	5(25)	45	50	5
	Paracetamol	10(50)	10(50)	20	70	10
	RHZE	18(90)	2(10)	65	25	10
	Medroxyprogestrone	11(55)	9(45)	15	75	10
	Ergometrin	14(70)	6(30)	20	75	5
	Ferrous +folic acid	16(80)	4(20)	25	75	0
	Pent.DPT vaccine	10(50)	10(50)	30	65	5
	Zink	8(40)	12(60)	20	70	10
	Gentamycin	20(100)	0(0)	50	50	0
	Arthmether/lumefantrin	15(75)	5(25)	25	65	20
	Ampicillin	12(60)	8(40)	45	50	5
	Antacid	12(60)	8(40)	20	75	5
	Omeprazole	8(40)	12(60)	20	60	20
	Doxy cycline	12(60)	8(40)	20	55	25
	Ciprofloxacin	13(65)	7(35)	30	60	10
	Cloxacillin	14(70)	6(30)	25	75	0
	Cotrimoxazole	11(55)	9(45)	20	70	10
Average				28.5	63.75	8.25

The associations of bin-card updating practices and contributing factors were performed as follows using non-parametric analysis (distribution free analysis) called spearman's correlations.

Bin-card updating practices had significant association with IPLS training($p<0.05$), service year of less than one year ($p<0.05$) and greater than five ($p<0.05$), the employees responsible to manage inventory ($p<0.05$), number of staffs under pharmacy units ($p<0.05$), stock taking at any time during issue ($p<0.05$), job satisfaction of the personnel who were involved in managing inventory ($p<0.05$) , automated recording system ($p<0.05$) and the low volume health facilities ($p<0.05$) and had positive relationship except for Nurses involved managing inventory and service year less than one year where their relationship with bin-card updating practice was negative. (Table 5).

Table 5. Association of bin-card updating practices and contributing factors in selected health facilities of East Shewa zone, Oromia regional state. May 24, 2016

	Correlations (Spearman's rho)			
S.№	Variables		Bin-card updating practices	
1	Types of profession	Pharmacy	R=0.741 ,	P=0.000
		Nurse	R= -0.547 ,	P=0.013
2	Service year	Less one year	R= -0.458 ,	P= 0.042
		Greater than five year	R= 0.415 ,	P=0.021
3	Low volume health facilities		R=0.567	P=0.009
4	Number of staffs		R=0.625	P=0.003
5	Automated recording systems		R=.519	P=0.019
6	IPLS training		R=0.641,	P=0.002

R =correlation coefficient

Stock out rate of key essential medicines (N=20 health facilities)

Among the selected 20 key essential medicines 14 (70%) of them were stocked out at least once within the last six months with a different duration of times. Within the last six months about 12 (60%) of the health facility had stock out of Ergometrin maleate and Zink with stock out duration of 170.92 and 61.25days respectively, half of them 10 (50%) were stocked out of artemether/lumefantrine with stock out duration of 38.70 days and oral rehydration salt with stock out duration of 22 days. Nine (45%) of the facility were stocked out of Medroxyprogestrone (Depo-Provera) with stock out duration of 19.44 days, Gentamycin and Antacid with stock out duration of 19.44,50.89and 56.67 days respectively. While 6(30%) of the facility had stock out of Amoxicillin and Ampicillin with stock out duration of 42.33 & 109.67 days respectively. Six medicines such as Mebendazole, Paracetamol, RHPE-kit, Pentavalent DPT-Hep-Hip Vaccine, cloxacilline and cotrimoxazole were not stocked out in all of the study facilities within the last 6 months (Table 6).

The reasons for stock out of key essential medicines as reported by the health facilities includes inadequate supply of medicines (27.7%), stock out at re-supply point (30.9),because of medicines expiration (26.8%) and order changed at the re-supply point (18.9%). Stock out at the re-supply point was raised as the most common reason for stock out of Ergometrin maleate (60%), Zink (60%), ORS (50%) and Gentamycin (45%).In adequate supply of medicines from the re-supply point was also mentioned as the main reason for stock out of ORS (50), Gentamycin (45%), Ampicillin (40%) and Antacid (40%) and others (Table 6)

The stock out of medicines had significant association with inadequate supply of medicines from the supplier ($P<0.05$), medicines expiration in health facilities ($P<0.05$), stock out of medicines at resupply point ($P<0.05$), change of orders at resupply point ($P<0.05$), which was evidenced by Pearson chi-square (Table 7).

Stock wastage due to expiration/ damage/ loss of key essential medicines

The amounts of medicines received and wasted within the last six months were taken to calculate the wastage rate of medicines. Thus in the study health facilities on average 10.43 % of the selected key essential medicines were found to be wasted; specifically of the total (i.e. usable and unusable medicines) Medroxy progesterone 9450 vial (26.64 %),oral rehydration salt 6100 sacket (16.64%), Ampicillin 2000 strip (11.29%),Gentamycin 2800 Ampoule (10.81%),Cotrimoxazole 2338 strip (3.76%),Zink 69strip (8.18%),artemether/lumefantrine 42 strip (7.09%),cloxacillin 240 bottle (3.15%) and Amoxicillin 3000 strip (6.38%) (Fig 2).

As displayed in the table below medicines wastage in the study facility was the result of different factors of which receiving near expiry medicines (55%), inadequate store room (75%), failed to apply first-expire first out principle (25%), poor protection from direct sun light (40%) had significant association ($p <0.05$) which was revealed by fisher's exact test (Table 8).

Costs associated with medicines wastage as a result of damage or expiration

Value of unusable key essential medicines

The monetary value of the medicines were calculated based on the current unit price obtained from PFSA.Accordingly a total of 174,366.98 ETB was lost because of medicines wastage especially the value of medroxy progesterone was found to be higher 114,628.50 ETB (65.74%) followed by ampicillin 17,600 ETB (10.09%), Cotrimoxazole 11690 ETB (6.70%), ORS 11,025 ETB(6.32%) and others (Table 9).

Storage conditions of health facilities

The storage condition of the health facilities was assessed based on visual inspection using indicators as per good pharmacy practice standards for storage condition stipulated in logistic indicators assessment tool (LIAT)[14].

With respect to drugs storage condition of the health facilities as per the good pharmacy practice standards for medicines storage condition, about 16 (80%) of the health facilities arranged and organized medicines according to a logical categorization e.g. zoning. Twelve (60%) of them updated their bin-cards regularly, 17(85%) of the facilities separated unwanted (damaged or expired) medicines in the store room from the usable medicines. Seventeen (85%) of them have properly arranged medicines.

Fourteen (70%) of the facilities stored and organized in manner which facilitates use of first to expire, first out (FEFO).All of the surveyed facilities 20(100%) had storage area which was visually free from harmful insects and rodents. However only 8 (40%) of the facilities had relatively sufficient space for medicines storage and free space for future expansion (Table10).

Table 6. Stock out rate for specific key essential medicines and reasons for stock out in the last six months in selected health facilities of East Shewa Zone, Oromia regional state (N=20 health facilities)

							Reasons for stock out			
S. №	**List of key essential medicines**	**The mean stock out for the last 6 mo**	**The $\bar{x}$freq of SO**	**The $\bar{x}$durat n of SO**	**Std deviation**	**%age of SO**	**Inadequate supply (%)**	**Stock out at re-supply pt (%)**	**Expiration (%)**	**Order changed (%)**
	Amoxicillin	.30	1	42.33	.470	30	25	20	15	25
	ORS	.50	1	22.00	.513	50	50	50	45	-
	Mebendazole	-	-	-	-	-	-	-	-	-
	TTC eye ointment	.25	1	56	.224	25.0	5	-	-	35
	Paracetamol	-	-	-	-	-	-	-	-	-
	RHZE	-	-	-	-	-	-	-	-	-
	Medroxyprogestrone	.45	1	19.44	.510	45.0	-	-	50	-
	Ergometrin maleate	.60	1.08	170.92	.503	60.0	-	60	-	-
	Ferrous salt+Folic acid	.20	1.00	28.50	.410	20.0	10	15	-	5
	Zinc	.60	1.00	61.25	.503	60.0	-	60	-	-
	Gentamycin	.45	1.33	50.89	.510	45.0	45	45	45	10
	Pentavalent DPT-Hep-Hip Vaccine	-	-	-	-	-	-	-	-	-
	Artemether/lumefantrine	.50	1.00	38.70	.513	50.0	15	35	20	20
	Ampicillin	.30	1.17	109.67	.470	30.0	40	15	35	35
	Antacid	.45	1.00	56.67	.510	45.0	40	35	25	30
	Omeprazole	.25	1.00	31.80	.444	25.0	25	25	-	5
	Doxycycline	.25	1.00	3	.334	25.0	5	-	25	-
	Ciprofloxacin	.35	1.00	15	.334	35.0	5	-	-	5
	Cloxacilline	-	-	-	-	-	-	-	-	-
	Cotrimoxazole	-	-	-	-	-	-	-	-	-
The aggregate mean stock out rate and duration				35.31		27.25	27.7	30.9	26.8	18.9

Table 7. The association of stock out rate and contributing factors in the selected health facilities of East Shewa Zone, Oromia regional state. May 24, 2016

Variables	**Stock out rate**		
	Pearson chi-square		
	Value	Df	Asymp. Sig. (2-sided)
No adequate supply	128.260a	1	.020
Expiry	95.223a	1	.045
Stock out at resupply point	202.985a	1	.015
Order changed at resupply point	78.701a	1	.042

Table 8.The reasons for wastage of key essential medicines & associated factors as reported by personnel undertaking inventory management activities in selected health facilities of East Shewa zone, Oromia regional state. May 19, 2016 (N=20)

S.№	Reasons for wastage	Yes (%)	No (%)	Fisher's Exact Test	
				Exact Sig. (2-sided)	Exact Sig. (1-sided)
1	Received near expiry medicines	11(55)	9(45)	.010	.009
2	store room not sufficient	15(75)	5(25)	.038	.030
3	Fail to practice FEFO	5(25)	15(75)	.002	.002
4	Protection from sun light	12(60)	8(40)	.028	.025
5	Over supply of medicines	9(45)	11(55)	.653	.342

Table 9. Value of unusable stock for key essential medicines in selected health facilities of East Shewa zone, Oromia regional state. May 27, 2016.

S.№	List of wasted Medicines	Quantity	Unit price (in ETB)	Total cost (in ETB)	Percentage of costs (%)
	Medroxy progesterone	9450vial	12.13	114,628.50	65.74
	Gentamycin	2800 Ampoule	0.48	1344	0.77
	Cotrimoxazole	2338 strip	5	11690	6.70
	Ampicillin	2000 strip	11	17600	10.09
	ORS	6100 Sacket	3.25	11,025	6.32
	Zink	69strip	0.80	7.20	0.0041
	artemether/lumefantrine	42 strip	37.34	1568.28	0.90
	Cloxacillin	240 bottle	22.25	6504	3.73
	Amoxicillin	3000 strip	10	10,000	5.74
Total cost (in ETB)				174,366.98	100

Table 10. HFs adherence to Good Pharmacy Practice Standards for the storage of key essential medicine in selected health facilities of East Shewa Zone, Oromia regional state. May 19, 2016 (N=20 health facilities)

S.№	Descriptions	No	Yes	Adherence % (n)
1	Pharmaceuticals are arranged & organized according to a logical categorization, e.g. zoning	4	16	16(80)
2	Bin Cards are used & updated regularly? (Observe by Checking a five or more sample BCs.)	8	12	12(60)
3	Are unwanted items (damaged or expired drugs, non-pharmaceutical items, etc.) in the store room separated from the usable stock?	3	17	17(85)
4	Products are arranged so that ID labels, expiry dates, and/or manufacturing dates are visible.	3	17	85(17)
5	Products are stored & organized in a manner which facilitates use of First-to-expire, first-out (FEFO).	15	5	5(25)
6	Products are protected from direct sunlight and high heat at all times of the day/during all seasons.	2	18	18(90)
7	The storeroom is maintained in good condition (clean, no trash, sturdy shelves, and boxes well-organized).	4	16	16(80)
8	The current space and organization is sufficient for existing products and reasonable expansion (i.e., receipt of expected product deliveries for foreseeable future).	12	8	8(40)
9	Storage area is secured with a lock and key, but is accessible during normal working hours; access is limited to authorized personnel.	5	15	15(75)
10	Storage area is visually free from harmful insects and rodents. (Check the storage area for traces of bats and/or rodents [droppings or insects].)	0	20	20(100)
11	Cartons and products are in good condition, not crushed due to mishandling. If cartons are open, determine if products are wet or cracked due to heat/radiation	4	16	16(80)

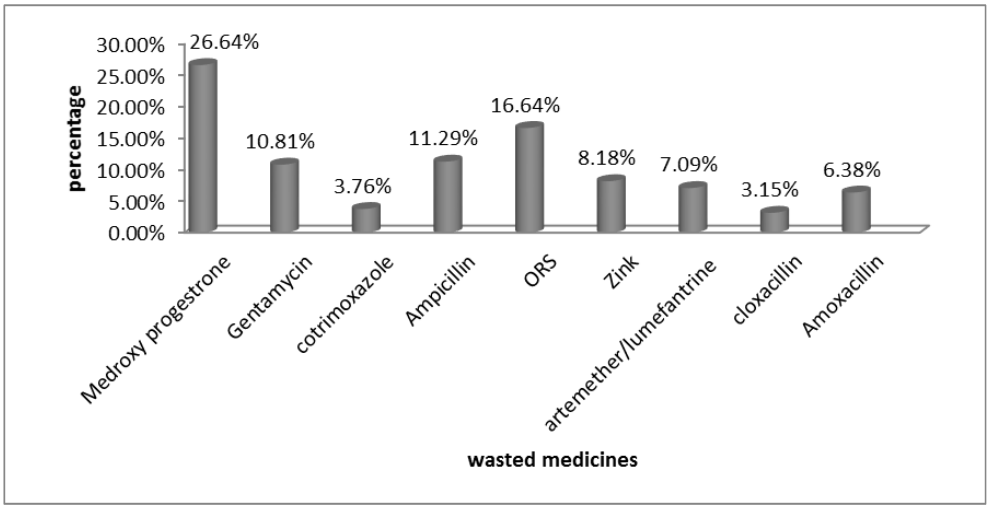

Figure 2.Percentage of key essential medicines that expired in selected health facilities of East Shewa zone, Oromia regional state, May 27, 2016

As indicated on the figure 3 below, only 5 (25%) of the study facility have fulfilled good storage condition criterion (>80% positive response to the indicators).Compared to health centers, hospitals had good storage condition /75% of the hospitals/ (Fig 3). The fisher's exact test revealed that the storage conditions of medicines had significant association with the capacity of store (P<0.05), types of profession (P<0.05) (Table 11).

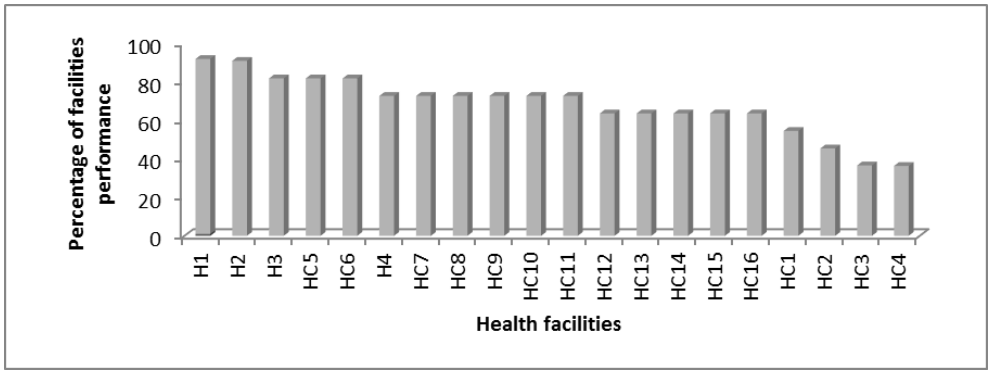

Figure 3. The performance of each study facility with regard to good storage practices (≥80% to positive response criterion) in East Shewa Zone, Oromia regional state, May 19, 2016.

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Table 11 .Association of HFs adherence to Good Pharmacy Practice Standards for the storage of key essential medicine and contributing factors in selected HFs of East Shewa Zone, Oromia regional state. May 27, 2016.

Variables	Storage condition	
	Fisher's Exact Test	
	Exact Sig. (2-sided)	Exact Sig. (1-sided)
capacity of store	.004	.004
type of profession	.001	.001

The qualitative results

The qualitative data was collected through in-depth face to face interview of key informants (i.e. medical directors, pharmacy head and store persons).The data was analyzed by categorizing in to three thematic areas based on the characteristics of the result. The areas include financial and information related problems, the human resource & capacity building related problems and store room and logistics management challenges.

Inventory management challenges

Financial and information related problems

Many facilities reported that they had budget constraints to avail products on demand based because of interruption from regional health office and insufficient internal budget that can be obtained from the reselling of medicines. This can be exemplified by one of the respondent replying that,

"we do not obtain medicines based on our demand since the regional health office (Oromia regional health office) have started funding and thus the budget is directly credited to PFSA account, hence without being notified medicines are pushed to us, among the supplied medicines most of them might be the one that we have in our stock, or irrelevant medicines".

Some of the facilities were also complaining that there was poor communication between Wereda health office and health facilities especially with regard to medicines demand and quantification. Since most often non-pharmacy professionals were visiting health facilities they were not well recognizing the actual need of the facilities and decide based on their perception. One of the respondents said that,

" we are told to receive medicines we did not order after it arrives at wereda health office and even there is a time when we are not able to accommodate the whole quantity thus we simply lay down one product over the other on the floor".

The human resource, capacity building related problems

Almost in all of the facilities there was limited human resource under pharmacy units. It was found that in all of the health centers there was one druggist in the dispensary and one nurse as store person. One of the respondents reported that

"this insufficient human resource exists because of limited pharmacy professionals in the market, high staff turnover and the limitation imposed from the Oromia regional health bureau not to employee more than the recommended number of employees".

Because of this human resource shortage in some facilities one individual may have double even triple tasks. For instance one person reported that,

"in my facility I am serving as store man and also dispense medicines at OPD and ART clinic when my colleague gets off day after duty".

Despite shortage of human resource there was still less incentives for staffs, there was very limited opportunity for available staffs to upgrade themselves through further education and even trainings were allowed on preference of the managers as reported from some individuals under pharmacy units.

With regard to store room and logistics management,

Most of the store persons were nurses that did not have pharmacy background. Hence majority of them were being challenged and even lack interest to act as store person. One respondent explained that,

"My profession is nurse and I am here to manage the store which is not my right position, am pushed to act as store person because of shortage of pharmacy professionals. I do not even know most of pharmacy terminologies so I get help from the druggist serving in the dispensary for the majority of the store activities".

The others also reported that acting as store man was the undermined activity before many people and has significant risk where no risk allowance was there. With regard to logistics some facilities were receiving over supply of medicines with near expiration dates so that most of them expired. One of the interviewee reported that,

"There was an event that I tried to reverse back huge number of cloxacillin syrup which was sent to the facility without our demand and request but the wereda health office did not accept my suggestion, so the products expired in the health facility"

DISCUSSION

The ultimate goal of inventory management is to balance the stock out and over stock of essential medicines which are the cause for decline in the quality of patient care, medicines wastage and

financial loss[15]. Hence there should be proper inventory management of medicines. The findings of this study emphasized on the inventory management performance using indicators including stock record accuracy, stock out rate of key essential medicines, Stock wastage due to expiration/damage/loss, value of unusable stock & storage condition of medicines and challenges associated with inventory management at health facility level.

The study revealed that all of the surveyed health facility had logistic recording tools and reporting forms like bin-cards 20 (100%), report and requisition forms 20 (100%), internal facility report and requisition forms 20(100%) which is in line with the study conducted by Mezid Mudzteba on pharmaceuticals logistics system in health centers of Addis Ababa where bin-cards, report and requisition forms and internal facility report and requisition forms were found to be 100% available[16].Those documents are very crucial for the proper management of inventory, to track and control the quantity of medicines to be ordered and issued.

Regarding the inventory accuracy rate or logistic recording accuracy, this indicator is vitally important in the management of medicines which helps to produce reliable information for determination of appropriate quantity and types of medicines. With the failure of updating bin cards or logistic records the follow of information will be distorted and bullwhip effect will happen where the information arose from the health facilities would be magnified along the supply chain which finally results in over stock or under stock and expiration of medicines. The findings of this study indicated that among the bin-cards reviewed about 40.50% were not updated and the average accuracy rate was found to be 28.5 which is slightly higher than the study conducted in South Sudan and lower than Uganda health facilities where only 27% and 36 % respectively were not accurate[17,18]. This difference could be because of the type and quantity of medicines selected for study as well as the type of facility involved in the study.

The present study identified that factors, such as the fewer number of staffs where 80% of the health facility had 2 employees under pharmacy units, the unsatisfied staffs with current job around (40%), only less facilities having automated recording system (20%) were negatively affecting the inventory accuracy rates for key essential medicines in the study facilities. The same problems were reported by the study conducted in Kenya Nairobi where inventory record accuracy was being affected by in adequate human resource, paper based activities and etc.[19].

Identifying the underlying causes of poor documentation or recording practices is crucial to timely intervene the problem and encouraging if positive practice toward recording accuracy is there. For instance with regard to staff adequacy some of the respondents reported that the inadequate number of staffs responsible to manage the inventory increased errors due to volume of work and fatigue. The frequent stock taking is also important to check on surplus, from the store to assist in matching the physical and record balances for efficient working condition and also in harmonizing the discrepancies to reflect the actual position in the store. The automated recording systems also minimize errors and improve recording accuracy, save time and can easily retrieve the long lasting key essential data[19,20].

The finding of this study indicated that about 27.25% of the health facilities were stocked out at least one of the key essential medicines with an average stock out duration of 35.31 days. However this finding is lower than the study conducted in Tanzania but higher than the national survey of the integrated pharmaceutical logistics system of Ethiopia where the average stock out rate was reported to be 69% and 21.9% respectively[21,22]. This significant difference between the result of this study and that of Tanzania might be the geographical coverage where that of Tanzania was national survey involving around 923 public and private health facilities where as this study was conducted in a single zone involving only 20 public health facilities. The other possible reason could be the number of medicines selected for the study. The present study involved 20 key essential medicines where the significant stock out rate of specific medicines can be masked by the product with no stock out rate. Only 14 tracer medicines were selected to be studied in 923 health facilities in case of the Tanzania survey. The difference in result between this study and the national survey of the IPLS of Ethiopia could be because of the quantity and types of medicines involved in the survey. For the national survey the data was collected on 27 essential pharmaceuticals.

The major reasons identified for stock out rate in the present study were inadequate supply of

medicines (27.7%), stock out at re-supply point (30.9%), because of medicines expiration (26.8%) and order changed at the re-supply point (18.9%).Similar reasons were identified by the study done in south Africa which indicated that receiving in near expiry date was the main reason (61.1%) and the survey done by Yasmin Chandani et.al on factors affecting availability of essential medicines in Ethiopia, Malawi and Rwanda identified that stock out at resupply point in the three countries was one of the cause for stock out at health facilities and also one of the study conducted in Malawi to assess the deficient supplies of drugs for life threatening diseases in an African community reported that the main reason for the shortage of drugs at the health centers was insufficient deliveries from the regional medical store[23-25].

With respect to medication wastage this study revealed that on average about 10.43%of the key essential medicines selected for the study were expired, this finding is almost nearly similar with the national survey done by Federal ministry of health of Ethiopia on pharmaceuticals sectors where the average presence of expired medicines in health facilities accounted (8%) and the baseline survey done in public health facilities of Kenya that revealed a mean of (13.3%) expired medicines in public health facilities[26,27].

This study identified some of the possible reasons for medicines wastage across the study health facilities. Thus receiving near expiry products (55%), over supply of medicines (45%), insufficiency of store rooms (75%) and failure to apply FEFO principles in some facilities (25%) were found to be the common problems leading to medicines wastage. Although the magnitude of the cause differs similar reasons were identified in the study conducted by Josephine K.et.al on expiry of medicines in health facilities of Uganda where the minimum shelf life not specified in orders(23.7%), use neither FIFO nor FEFO in stock management (5.3%),overstocking of medicines (32.4%) were mentioned as a possible reasons for medicines expiration and the study done in Tanzanian health facilities also raised that receiving near expiry date (61.1%) & over stocking of the items as the main cause of product expiration[23,28].

This present study revealed that a total of 174,366.98 Ethiopian birr was lost in health facilities because of expired medicines of which around 65% of this value was as a result of medroxy progesterone expiration which accounted about 114,628.50 ETB. This figure is higher than the study conducted in six facilities of Gondar town where a total of 26,760ETB was lost due to expiration[29]. This difference could be because of sample size difference; in present study the data was gathered from 20 health facilities from hospitals and health centers where as the previous study in Gondar was conducted on only six health centers which excluded hospitals. The other reason could be because of the type of medicines expired where their values make difference.

Concerning storage condition this study revealed that75% of the study facilities did not fulfill the criteria of good storage condition (≥80 positive response).Most of them did not apply first-to-expire, first-out (FEFO) principle. However this principle might be one of the possible causes for expiration of medicines in these facilities. The study also identified 60% of the facilities did not have sufficient space for medicines storage which made picking, cleaning difficult and also enforced the store persons to stack medicines over one another without any space till it touched the roof which in turn limited air circulation within the store. About 40% of the facilities were not updating their bin-cards even the bin-cards were not along with the respective medicines. This finding is almost similar with study conducted in health facilities of Addis Ababa where only 35% of the facilities had fulfilled the criteria of good pharmacy practice standards for the storage of medicines and most of them had storage space limitations and also the study done in six stores of Hararge health facilities also reported space limitations in 80% of the facilities[16,30]. Medicines should be stored in a specially designed secure area or space of a building in order to avoid contamination or deterioration, avoid disfiguration of labels, maintain integrity of packaging and so guarantee quality and potency of drugs during shelf life, prevent or reduce pilferage, theft or losses, prevent infestation of pests and vermin and the storage environment should possess Adequate temperature, sufficient lighting, clean conditions, humidity control, adequate shelving to ensure integrity of the stored drugs. Generally, poor storage conditions put the quality of drugs at risk and cause wastage and the quality of care patients receive[31].

The present study also identified the major challenges associated with inventory management practices of the study facilities by the qualitative

method. Accordingly most of the surveyed health facilities were experiencing budget constraints to avail the required medicines for the needy, and as result they were facing stock out of essential medicines that led to service compromisation. Some respondents were trying to explain the reason behind this challenge. For example one of the respondents said that,

"We began to encounter a big challenge since the last few years after the budget allocation for medicines have started to be undertaken by the regional health bureau that is not directly handover to the health facilities rather credited to PFSA account. Therefore we are not able to procure medicines relevant to our setting as a result we are facing frequent stock out that jeopardizes our service delivery".

Concerning human resource and capacity building, the present study revealed that in all of the surveyed health facilities there was not adequate human resource under pharmacy unit. Some of the respondents stated that this problem happened, one for limited pharmacy professionals in the market and the other because of the limitation levied by the Oromia regional health bureau not to recruit more than the recommended number. Thus staffs that undertook the inventory management activities had job burden where one individual had more than one task and responsibility within a given facility. This can affect the quality of inventory management practice and lead to unnecessary cost and resource wastage. With respect to capacity building most of the staffs were complaining that there was not promotion for them to upgrade their education and even trainings given at different times were not allowed fairly among the staffs.One of the respondent said that,

"I am really discouraged with the unfair practice in my setting where one prefer over the other for benefit. Once up on a time I was told to attend training to be held in Adama however in mean while I heard news that the training was cancelled but they attended themselves."

The other inventory management challenge identified in this study was associated with the storage condition and logistics activities. In most of the study health facilities the store persons were a non-pharmacy professional i.e. Nurses and reported that they were not in their right position and need help from the druggist at dispensary but clients were waiting for medicines over the window. In association with the logistic challenges, massive near expire date medicines were delivered to the health facilities within this year especially medroxy progesterone where most of them expired.

From this study we can conclude that the inventory management performance of key essential medicines using different measuring indicators showed that the logistic record updating practices and inventory accuracy rate was found to be poor. The main cause of this problem was identified to be the type of professionals undertaking the tasks, staffs job dissatisfactions associated with different incentives, undermining of being store man, inadequate human resources that led burden of tasks to staffs not to properly record and update the records. The stock out rate of medicines were also high most probably because of receiving near expiry medicines, budget constraints as reported by respondents, stock out at resupply point and inadequate supply of medicines. The magnitude of expired medicines in the study facility was also high that resulted in significant loss of money especially by receiving the near expire date medicines. Concerning storage condition only few of them have full filled good pharmacy practice standards for the storage set by USAID deliver/LIAT tool (≥ 80% positive response to the criteria for good storage).The major challenges associated with inventory managements were found to be budget constraints, human resource inadequacy and weak capacity building practice, poor coordination between wereda health offices and health facilities and supply of near expiry date medicines.

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