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Logistics Management of COVID-19 Personal Protective Equipment and its Challenges at Public Hospitals of Southwest Ethiopia: An Integrated Quantitative and Qualitative Study

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ABSTRACT

Background: *Personal Protective Equipment (PPE) is currently a very important topic, probably the most overlooked and emotive subject, for front-line healthcare staff working with Coronavirus Disease (COVID-19) patients. With these regards, there are two main problems: shortages, and inappropriate utilization. Therefore, the purpose of this study was to assess the logistics management of COVID-19 PPEs and its challenges at public hospitals of Benchi-sheko, Kafa, and Sheka zones, southwest Ethiopia.* ***Method:*** *Hospital-based descriptive cross-sectional quantitative and qualitative study was conducted using a checklist, structured and semi-structured questionnaire, and interview guide. Quantitative data were analyzed by Microsoft Excel spreadsheets. Qualitative data were analyzed manually, using thematic analysis techniques.* ***Results:*** *All hospitals had Bin cards, reporting and resupply forms, and model 19 (receiving models), and model 21 (issue model). But they were not utilizing the majority of these forms for logistics management of PPEs. All the assessed hospitals had N-95 respirator masks, surgical masks, gowns, surgical gloves, and aprons in their inventory. But the quantities were not sufficient for available human power, especially since both N-95 respirator and surgical masks were below emergency order points. All hospitals were not used logistics record-keeping tools (bin cards) for PPEs, except for surgical gloves and disposable gloves. Among the expected 44 bin cards only seven (16%) items had Bin cards and only 6 (13.75%) bin cards were updated. None of them had submitted a report to the supplier and put an order for personal protective equipment. Shortage at supplier source, budget constraint, and complexity of the procurement process, overconsumption, and transportation restrictions was challenged contributed to a shortage of these items.* ***Conclusion:*** *Even though personal protective equipment is very important during this crisis, all assessed hospitals had an insufficient quantity of personal protective equipment and poorly managing the inventory of available equipment.*

Keywords: Personal protective equipment, Logistics management, COVID-19

INTRODUCTION

Prevention of the widespread of the Coronavirus Disease (COVID-19) pandemic is only possible with healthy and effective Health Care Workers (HCW) teams. It is urgent and necessary to protect HCWs since the pandemic's transmission speed is very high. For this reason, health authorities should give attention to the safety of the HCWs and take urgent measures. These measures include, but are not limited to, support in terms of logistics, providing Personal Protective Equipment (PPE), and giving guidance on how to use PPE [1].

Personal Protective Equipment (PPE) is currently an important topic, probably the most overlooked and emotive subject, for front-line healthcare staff working with COVID-19 patients. With these regards, there are two main problems: shortages and inappropriate utilization of PPE [2].

The global COVID-19 pandemic is leading to an acute and drastic shortage of essential supplies; including personal protective equipment, diagnostics, and clinical management. High demand for Personal Protective Equipment (PPE) affected not only low-income countries but also European countries. It caused a paradigm shift of these countries from acting as donors to becoming recipients of COVID-19 PPEs [3]. In addition to increased demand, supply shortfalls, and the increased price of PPEs by intermediaries caused this supply disruption [4]. Health supply chains are essential elements of a well-functioning health system. To respond to infectious disease pandemics effectively, logistics systems should be designed to promptly and reliably source and deliver essential health commodities, including; vaccines, medicines, and PPE for health care workers [5].

World Health Organization (WHO) estimated that 89 million medical masks, 76 million examination gloves, and 1.6 million medical goggles are required for the COVID-19 response each month. It has so far supplied about five hundred thousand sets of personal protective equipment for 47 countries, but supplies are draining rapidly. To respond to these rising global demands, WHO estimates that industry must increase manufacturing by 40% and recommends governments to take measures quickly to improve supply [6]. Low-income countries with weak health systems and work-forces to cope with COVID-19 need attention and support. Because, they are heavily reliant on the support of donors, the United Nations (UN), and Non-Governmental Organizations (NGO) partners [7].

Even though there was a serious shortage of personal protective equipment in Ethiopia, there is no research conducted on the issue. So this research addresses the magnitude of PPE shortage at public hospitals which serve large communities and challenges contributing to these shortfalls of PPEs. The purpose of this study was to assess the logistics management of COVID-19 PPEs and its challenges at public hospitals of Benchi-sheko, Kafa, and Sheka zones, southwest Ethiopia. It addressed the stock out of PPEs at hospitals, why it occurred, and recommended concerned bodies the way to resolve. It can be a baseline for researchers, government, and non-governmental organizations.

METHODS

Study Area, Period, and Design

The study was conducted in all hospitals found in Bench-Sheko, Kafa, and Sheka zones. In these three zones, there were four (2 general, 1 teaching, and 1 primary) hospitals. Three of the selected hospitals were serving as a COVID-19 treatment center. The study was conducted from 1st June to 30th June 2020. A hospital-based descriptive cross-sectional study was conducted. A quantitative study design supported with a qualitative study was employed.

Populations

The source populations were all hospitals found in southwest Ethiopia and all COVID-19 PPEs and the study populations were all hospitals of Bench-sheko, Kafa, and Sheka zones and available COVID-19 PPEs during the study period. All hospitals and all PPEs in the study area were included.

Data Collection Tool and Technique

Data collection tool was adopted from Logistics Indicator Assessment Tool (LIAT) and Logistics System Assessment Tool (LSAT). Investigators gave two days of training for data collectors on how to use the tool [8,9]. Data were collected through data collector-administered structured and semi-structured questionnaires, checklists, and KIs interview guide. The interview guide was adapted from the LSAT with flexible and probing questions. It was prepared in English and translated into Amharic, the region's working language. The interview was tape-recorded and three investigators repeatedly listened to recorded data. Then, they transcribed it into a Microsoft word document. Another group of three investigators again repeatedly heard the recorded data and checked the transcribed document. The transcribed data were rechecked and themes were selected. Finally, the results were narrated under each theme.

Data Quality Control and Analysis

Principal investigators closely supervised data collectors throughout the data collection period and each collected datum was checked for completeness and consistency. Incomplete and inconsistent data were sent back to the data

collectors and collected again. The collected data were checked and entered Microsoft excel version 16 and analyzed. The qualitative data were summarized in a Microsoft word table and narrated under each selected theme.

Ethical Considerations

The proposal was reviewed by Mizan-Tepi University Ethical review committee and a letter of approval was granted. The letter was written to respective hospitals from Mizan-Tepi University, and respective hospitals managers to each unit under hospitals.

RESULTS

Socio-Demographic Characteristics

Different professionals are involved in the logistics management of pharmaceuticals in health facilities. But the most involved individuals are those who are working in the pharmacy unit. In the assessed hospital's majority (47.4%) of individuals in the pharmacy units are druggists (pharmacy professionals with diplomas), and the majority (75%) of the store managers had a service year of >5 years (Table 1).

Table 1 Socio-demographic characteristics of health professionals involved in logistics activities at public hospitals of south-west Ethiopia, SNNP region, Ethiopia, June 2020

S. No.	Variables		Frequency	Percentage	p-value
1	Professionals under pharmacy unit	Pharmacist	14	36.80%	0.000
		Druggist	18	47.40%	
		Nurse	6	15.80%	
		Total	38	100%	
2	Service year (store manager)	1-5 year	1	25%	0.000
		>5 year	3	75%	
		Total	4	100%	
3	Education qualification	Degree (B. Pharm)	14	36.80%	0.000
		Diploma (Pharmacy)	18	47.40%	
		Diploma (Nurse)	5	13.20%	
		Degree(nurse)	1	2.60%	
		Total	38	100%	
B. Pharm: Bachelor in Pharmacy, Significant at p<0.05					

All hospitals had Bin cards. Reporting and resupply forms and model 19 (receiving models), and model 21 (issue model). But they were not utilizing the majority of these forms for logistics management of PPEs (Table 2).

Table 2 Availability and utilization of LMIS tools in public hospitals of south-west Ethiopia, SNNP region, Ethiopia, June 2020 (N=4)

S. No		LMIS format available		LMIS format utilized	
		Frequency	Percentage	Frequency	Percentage
1	Bin cards	4	100%	0	75%
2	Stock card	4	100%	0	0%
3	Issuing voucher	4	100%	4	4%
4	Receiving voucher	4	100%	4	4%
5	IFRR	4	100%	2	50%

6	RRF	4	100%	0	0%

All the assessed hospitals had N-95 respirator masks, surgical masks, gowns, surgical gloves, and aprons in their inventory. But the quantities were not sufficient for available human power; especially both N-95 respirator and surgical masks were very limited in quantity and were below emergency order point. Regarding logistics record-keeping performance, all hospitals were not used logistics record-keeping tools (bin cards) for PPEs, except for surgical gloves and disposable gloves. Among the expected 44 bin cards only seven (16%) items had Bin cards and only 6 (13.75%) bin cards were updated (Table 3).

Table 3 Availability of PPE, Bin card utilization and updating practice at hospitals of south-west Ethiopia, SNNP Region, South-west Ethiopia, June, 2020

S. No	Name of PPE	Available	Below EOP	Bin card utilized	Bin card Updated
1	N-95 Respirator mask	4 (100%)	4 (100%)	0 (0%)	0 (0%)
2	Surgical Mask	4 (100%)	4 (100%)	0 (0%)	0 (0%)
3	Gown	4 (100%)	0 (0%)	1 (25%)	1 (25%)
4	Surgical Gloves	4 (100%)	2 (50%)	3 (75%)	2 (50%)
5	Disposable gloves	3 (75%)	1 (25%)	3 (75%)	3 (75%)
6	Apron	4 (100%)	0 (0%)	0 (0%)	0 (0%)
7	Shoe cover	1 (25%)	0 (0%)	0 (0%)	0 (0%)
8	Boots	3 (75%)	1 (25%)	0 (0%)	0 (0%)
9	Hair cover	1 (75%)	3 (75%)	0 (0%)	0 (0%)
10	Eye Google	3 (75%)	1 (25%)	0 (0%)	0 (0%)
11	Face shield	2 (50%)	2 (50%)	0 (0%)	0 (0%)
	Average	**3 (75%)**	**1.54(38.5%)**	**0.63(16%)**	**0.55(13.75%)**

All the assessed hospitals did not submit Report and Resupply Forms (RRFs) to PSA and the dispensaries were not submitted Internal Facility Report and Resupply Forms (IFRRs) to the stores.

Qualitative Result

The logistics management system of COVID-19 PPEs and challenges were assessed by interviewing relevant KIs and the results were summarized into the following themes.

The Supply of COVID-19 PPE

Most of the KIs explained, COVID-19 PPEs were supplied by the regional health bureau and PSA. But the quantity is not sufficient and interrupted. This is explained by one of the KIs as follows

“As far as the supply of COVID-19 PPE is concerned PSA, southern nations, nationalities, and people’s regional health bureau through zonal health department were involved in supplying us. For instance, surgical masks were supplied from southern nations, nationalities, and the people’s regional health bureau. But there is a shortage of surgical masks as the staff number practicing at this hospital daily is higher than the supplied quantity. For this, we prepared masks made of clothes for support staff.”

And another KI also elaborated the supply of PPEs by the following statement;

“I describe the supply of COVID-19 PPEs as the provision of equipment that is used to prevent transmission of the virus from one person to another. Those equipment are hand rub sanitizers, alcohols, various face masks, gloves, etc. But I cannot say the supply of these COVID-19 PPE is sustainable enough which is reflected by shortages that occur at our hospital as the total supply of a PPE is insufficient to meet current demands at the individual level.”

Barriers for Availability of COVID-19 PPEs

Regarding barriers to the availability of COVID-19 PPEs, KIs informants identified several factors that can contribute to stock out and under the stock of PPEs. These factors are irregular supply, overconsumption at the end-user level, budget constraint, unavailability at supplier source, complex procurement process to purchase from private suppliers.

Shortage at supplier source: Shortage at PSA, the sole government facilities' supplier, was one reason repeatedly raised by the majority of the KIs, and one KI explained as;

"Hospital did not have the ready-made budget for coronavirus pandemics to procure such types of equipment as per hospital request and demand from a private wholesaler. Besides supply, there is also the problem of continuous and sustainable supply from public supply sources like PFSA."

Irregular supply and overconsumption: Another challenge was Irregular supply and overconsumption of PPEs. These can be exemplified by explanations given by two of the KIs as stated;

"Irregular supply schedule from RHB, supplies and equipment's were pushed to us disregarding our quantity of demand. For instance, RHB supplies us once in the last three months resulting in stock out and unavailability of most of the PPEs for one use only. Additionally, there is a problem of fair distribution of PPE towards units in the hospital resulting in overconsumption of PPEs in some units."

Budget constraint and complex procurement process: Budget constraint and complex procurement process to purchase from private suppliers is also, another challenge raised by most of the KIs. This is explained by one of KIs as;

"Truth to be told, there are budget constraints at our facilities. Even if we want to buy such items with a budget at hand, those products are not available for purchase from public supply sources. While product purchase from private sources involves long and complex procurement process which consume much time and money we don't have."

Another KI also elaborated by saying the following;

"The problem of the low availability of PPEs at PSA, major challenge to place and move product downwards, in my opinion, is due to the legal status of the organization which is a public institution. The status of the PFSA requires abiding by public procurement laws which are claimed to be non-flexible, as it does not give special consideration to the procurement of the PPEs and thus results in shortage at PSA, stock out at health facilities."

Challenges toward COVID-19 PPE Logistics Management and Rational Utilization

The main challenges regarding COVID-19 PPEs logistics management were identified by KIs as the task is new and complex, which was complicated with transportation restrictions, unavailability of timely training about COVID-19 PPEs utilization, and their logistics management. This was explained by one of the KI as:

"…During the pandemic, PPE is late delivery and short supply due to logistics interruption and supply schedule disruptions. Affected by the pandemic, a shortage of COVID-19 supplies and protective materials has drawn public attention. Again, due to the nature of the pandemics, there was no time for giving training. Our hospital received COVID-19 supplies and protective materials, such as masks, protective clothing, and medicine through PSA, RHB, and the zonal health department. Therefore, the management of COVID-19 supplies and protective materials is a bit a new task."

Another KI also stated the challenge as follows:

"In this hospital as far as the use of facemask and gloves are concerned, I can say there is rational utilization. But peoples show irrational behavior toward utilizing N-95 in our compound. Sometimes there is demonstrable irrational utilization behavior from people in our compound usually emanated from a shortage of PPE; there is a tendency to repeatedly use PPE that is intended to be used for a limited period. For example, in our hospital, people use a surgical face mask in this manner."

DISCUSSION

Health supply systems should swiftly and reliably source and deliver essential health commodities, including, PPEs for health care workers, during outbreaks, epidemics, and pandemics [5]. In the present study, the average availability

of COVID-19 PPEs was 3 (75%). This finding is slightly greater than studies done in Uganda and India, which indicated the average availability of medicines in the public sectors to be 41% and 51.1% respectively [10,11]. The difference may be because of the nature of the product and the number of facilities. Even though the availability seems high the quantities were not sufficient for most of the items. Especially, masks (both surgical and N-95 respirator), which are recommended to be used routinely by health professionals, are found to be below emergency order points in all hospitals. The underlying challenges for the unavailability of those COVID-19 PPEs were irregular supply, overconsumption at the end-user level, budget constraint, unavailability at supplier source, complex procurement process to purchase from private suppliers as identified by the qualitative method.

The heart of the logistics system is information. Without complete, timely, and accurate information, the logistics system would not run smoothly [12]. To keep this information up to date, LMIS forms (either manual or computerized) are critical because a lack of LMIS tools (forms) can lead to poor LMIS data quality [13]. In the current study manual LMIS forms (Bin cards, IFRRs, RRFs, issuing and receiving vouchers) were available in all hospitals assessed, which is in line with the study conducted in Addis Ababa, which stated 96.2% of the assessed facilities had LMIS forms (Bin cards, IFRR, RRF) [14].

Keeping accurate and timely records of stocks warns the logistics personnel about the stock status of the facility and helps to take corrective measures. In the current study, only 7 (16%) Bin cards were used from the expected 44 Bin cards, and only 6 (13.75%) Bin cards were updated. This is lower than the result of a study conducted in Nigeria, which reported less than 50% of facilities completing records correctly, and about 50% of the stores maintaining accurate stock cards [13]. The difference may be because the current study was conducted on COVID-19 PPEs which were not popular in those assessed hospitals. In addition to poor record-keeping practice, the assessed hospitals were not reporting the stock status of PPEs to the supplier and the dispensaries were not submitted IFRRs to the store. This is a very alarming result regarding the logistics management information system and opposite to the study conducted in east Wollega [15]. The challenge that contributed to poor logistics management is new and complex the task, which was complicated with transportation restrictions, unavailability of timely training about COVID-19 PPEs utilization, and their logistics management.

Limitation of the Study

Because COVID-19 personal protective equipment logistics and availability are frequently disregarded, the outcomes of this study are expected to shed light on the current status and gaps for enhancing the system. Despite these facts, the following limitations must be considered. First, the study only investigated personal protective equipment in four public hospitals in southwest Ethiopia. As a result, the product categories investigated for comparison lacked diversity. It also ignores the possibility of regional differences in logistics management and product availability. As a result, the investigators advocate a larger number of health facilities to be assessed, as well as a broader range of outcomes.

CONCLUSION AND RECOMMENDATIONS

From this study, it can be concluded that logistics management of COVID-19 PPEs in the assessed hospitals is poor as indicated by insufficient availability of COVID-19 PPEs, poor logistics record-keeping, interrupted supply, and overutilization at the end-user. The main challenges identified as barriers to these poor logistics management performances were: irregular supply, overconsumption at end-user level, budget constraint, unavailability at supplier source, complex procurement process to purchase from private suppliers. Ethiopian Pharmaceuticals Supply Agency should avail all PPEs in sufficient quantities for these hospitals. SNNPs regional health bureau should give attention to the procurement process and should prepare special procurement guidelines for COVID-19 PPEs during this crisis. Hospital management staff should supervise the utilization of COVID-19 PPEs, encourage staff to accurately record the COVID-19 PPEs inventory, and promote rational utilization of PPEs.

DECLARATIONS

Conflicts of Interest

The authors declared no potential conflicts of interest concerning the research, authorship, and/or publication of this article.

Ethics Approval and Consent to Participate

The investigators received ethical approval of the research from the ethics committee of Mizan-Tepi University, college of medicine and health science. Letter of permission was also received from each hospital's administration offices. Data collectors clarified the objectives, benefits, and risks of the study to the participants and continued with the data collection after obtaining consent from participants. We excluded the name of participants to keep confidentiality.

Consent for Publication

Not applicable.

Availability of Data and Materials

The data sets generated and/or analyzed during the present study are available from the corresponding author on reasonable request.

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Mizan-Tepi University covered the data collection fees.

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