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# Influence of inventory management practices on availability of medicines in public health facilities in Bungoma County, Kenya

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**Abstract**
Medicines availability is important in provision of health care. Stock outs have however been evident for a long time particularly in public health facilities in many other developing countries. This research sought to determine the influence of inventory management practices on availability of medicines. Descriptive cross sectional research design was used. All the nine sub county hospitals were sampled and census method used to sample four staff from each of the sub counties: the sub county pharmacists, medical superintendents, procurement officers and health administrative officers (36 respondents). In addition, the head of procurement department in the county, the chief officer for health and sanitation and the county pharmacist were sampled, making a total of 39 respondents. Semi structured questionnaires; in-depth interview guides and a checklist were data collection tools. Analysis of data was done using descriptive statistics while Chi square was used as appropriate. Data was presented in tables. Qualitative data was categorized into specific themes and reported in narrative form together with quantitative presentation. The average number of medicines available in the whole county was 72.22 (63.35%) out of 114 medicines, with a range of between 48.25% and 78.95% The average out of stock days for the county was 51.30 days. Main inventory management challenges identified were lack of a county central store, lack of reliable inventory management system, inadequate pharmaceutical personnel and lack of up to date inventory management guidelines and SOPs. These were noted to have a negative influence on availability of medicines. FEFO method of issuing medicines reported to be popular by 62.5% of respondents compared to 37.5% for FIFO. A majority reported irregular ordering frequencies for medicines (78.1%). Kenya Medical Supplies Authority was said to be the main supplier of medicines by 93.8% of respondents as compared to local suppliers. Proximity to the health facility was a major factor considered in supplier selection and was ranked as important by 46.9% and as extremely important by 25% of all respondents.

**Keywords:** inventory management, out of stock, stock status, FIFO (first in first out), FEFO (first expiry first out)

## 1. Introduction
Pharmaceutical advances have to a great extent transformed health care over the last several years. This has made it easier for many disease conditions to be addressed either through prevention, cure, or management by prescription and non-prescription drugs. Hospitalization as well as other expensive medical care practices such as surgeries can be avoided by using medicines [1]. Mortality and morbidity which are commonly associated with diseases can be greatly reduced when medicines are available. Public health facilities still lack essential medicines, thereby facing a major problem in delivery of health care. This is particularly evident in African countries. It is estimated that about 30 % of the world's population lacks medicines they so much need for management of several conditions [2].

Health care is so dependent on the availability of drugs and other medical supplies at the right time and quantities for the management of patients. Inventory management of medicines is thus the backbone of healthcare delivery. Having proper inventory management practices in place is required so as to avert the frequent stock outs of medicines particularly in public health institutions [3].

Generally, literature on availability of medicines is increasing as evidenced by several studies [4, 5, 6, 7, 8]. However, very little is available on availability of medicines in public health facilities and the influence of inventory management practices. All the surveys regarding the topic of medicine availability have revealed various barriers as far as medicine accessibility is concerned. These include inventory management challenges and associated health system barriers. Of particular interest is a study by Mungu in 2013 which established that poor inventory management practices were a contributing factor in unavailability of essential medicines in Bungoma East sub County, Bungoma County [9].

In the Kenyan setting, supply of medicines was mainly a role of the Kenya Medical Supplies Authority (KEMSA). However, since the adoption of the current constitution in 2010, most aspects of the public health sector were devolved and thus the supply of pharmaceuticals is a responsibility of the county governments. The national government only remained with the roles of policy making, training and regulation [10]. The recent trend in pharmaceutical procurement has been towards decentralization. The local authorities are charged with the mandate of carrying out procurement

procedures since they are best suited to do so as they better understand their unique demands [11].

A broad scope of medical supplies was out of stock in health facilities across the country. The stock out periods of essential medicines ranged from between 14 days and 46 days per year in both faith based health facilities and public health facilities respectively. It is clear that public health facilities are prone to challenges of stock outs that extend to as many as 90 consecutive days [12]. An analysis of the WHO/HAI survey found out that there was a low availability of medicines in the public health facilities when compared to the private health facilities [8].

Lack of medicines in public health facilities is common in the current devolved system in most counties in Kenya and in particular, in Bungoma County. Most health facilities are experiencing stock outs of medicines from time-to-time and thus making it extremely challenging for them to continue offering the health services they ought to. In most cases, patients are forced to buy medicines from private pharmacies which are expensive owing to the high mark ups along the supply chain. Patient treatment outcomes have therefore been affected to a great extent by unavailability of medicines as evidenced by high morbidity and mortality rates in this country. The aim of having a devolved health system as per the constitution of Kenya, 2010 was to have health services provided and managed at the lowest level which is very crucial in achieving health care for all[10]. Budgetary allocations for health care need to be done as per the Abuja declaration (2001) which states that 15% of a country's resources be allocated to health care. However, this is not being done by both the national and county governments hence the deteriorated state of affairs that is witnessed in this country as far as health care provision is concerned. The inconsistencies in the pharmaceutical supply chain and thus availability of medicines have been there for some time now and more so with devolution of health services in Kenya.

## 2. Materials and Methods

The study was conducted in Bungoma County which is one of the forty seven counties within the republic of Kenya and is approximately 3,032 $km^2$ in area. It is located in the former Western province and borders Uganda on the west. It has nine units known as sub-counties.

Descriptive cross sectional research design was used because it involves describing, recording, analyzing and reporting conditions that exist. It can therefore be used to obtain key and precise information pertaining to the existing phenomena and to draw conclusions that are valid where applicable. It is also effective in analyzing issues and topics that cannot be quantified. Cross sectional design is important when collecting data at one point in time from a sample [13]. It was chosen since the researcher sought to collect information over a short period of time.

The target population included the medical superintendents, health administrative officers, pharmacists and procurement personnel of public health facilities in Bungoma County, the head of county procurement department, the county pharmacist and the chief officer in charge of health and sanitation department.

In this study, those individuals who are involved in management of medicines were included. They were: the county pharmacist, medical superintendents, health administrative officers, pharmacists and procurement personnel of sub county hospitals, the head of county procurement department and the chief officer in charge of health and sanitation department in Bungoma County. On the other hand, those that are not involved in the activities above were excluded.

Due to the nature of this study, and small sample population, all officers involved in management of medicines in their respective sub county hospitals and at the county level participated as samples in the study. Four officers: medical superintendent, hospital health administrative officer, pharmacist and procurement officer in each of the nine sub county hospitals were sampled making a total of thirty six (36). Three other officers at the county level that is the county pharmacist, county procurement officer and chief officer in charge of health and sanitation also participated in the study, thus making the total sample to be thirty nine (39).

Census method of sampling was used. This method was considered since the entire study population is small. All the study population formed the sample. The medical superintendents, hospital health administrative officers, pharmacists and procurement officers in addition to the county pharmacist, county procurement officer and chief officer in charge of health and sanitation were visited in their respective hospitals and/or offices and data collected from them using appropriate data collection instruments.

All the nine sub county hospitals in Bungoma County were used in this study, leaving out health centers and dispensaries as there are proper and well defined structures at hospitals as far as medicines management is concerned. Therefore, meeting the desired objectives of the study was possible by having hospitals only unlike if low level health facilities were also involved.

The main instruments of this research were semi-structured questionnaires, interview guides, and a checklist. Questionnaires in general, give detailed responses to complex research questions. They are relatively easy to use and cost effective, making them a popular data collection method. Questionnaires are most effective data collection instruments as they generate relatively objective data [14]. In this study, questionnaires were the main data collection instrument. Both open ended and closed ended questions were used.

In depth interview guides were another instrument for collection of data in this study. Interviews offer high quality of responses in addition to taking advantage of the presence of the interviewer. It combines questioning, cross-examination and probing techniques, making it a multi method tool of collecting data [13]. In this study, in-depth interviews were used to collect data from the top management at the county level.

Finally, the study made use of a checklist so as to collect information concerning availability of medicines in hospitals. It consisted of a prepared list of items pertinent to the study. The checklist was adopted from the Bungoma County Essential Medicines Standard Order Form, Version 1 July 2016/17 for sub county hospitals. The absence or presence of an item was shown by marking '**yes**' or '**no**'. The checklist ensured that most aspects were considered in totality. The

above tools were pretested in a county that did not participate in the study. In this case, Kakamega County was used since it has similarities to Bungoma considering its geographic location. The data collected was analyzed by both qualitative and quantitative methods. Quantitative data was cleaned to check for completeness, coded and entered into the computer statistical package (Statistical Package for Social Sciences (SPSS version 22.0). Entered data was cleaned to check for discrepancies and errors during entry process. Descriptive statistics were used to produce frequency distribution, percentages, means and standard deviation. Chi square was also used to test for the association between variables. Analysed quantitative data was then presented in tables.

Qualitative data generated was tape recorded, translated, transcribed and categorized into themes according to the objectives under research and reported in narrative form together presentations of quantitative nature. In all the above, appropriate ethical approvals were sought from relevant institutions.

After administrative approval involving permission from post graduate School of Mount Kenya University, Institutional Research and Ethics Committee and permission from hospital administration, the study was accomplished in three phases: Phase one involved administration of semi structured questionnaires to respondents: medical superintendent, hospital health administrative officer, pharmacist and procurement officer for sub county hospitals. Phase two comprised of conducting in depth interviews with key informants at the county level: county pharmacist, county procurement officer and chief officer in charge of health and sanitation. The sessions of the interviews were recorded as well as noted. The last phase was observation by use of a checklist so as to determine availability of medicines in hospitals. Collected data was stored until the thesis has been defended since this is an academic research project. During this period, the data will be password protected to prevent unauthorized access.

## 3. Results

### Demographic characteristics of the respondents

**Table 1:** Demographic characteristics of the respondents

| Characteristic | | Frequency | Percent |
|---|---|---|---|
| Gender | Male | 26 | 81.3 |
| | Female | 6 | 18.8 |
| Cadre | Medical officers | 7 | 21.9 |
| | Pharmacists | 8 | 25.0 |
| | Hospital administrative officers | 13 | 40.6 |
| | Procurement officers | 4 | 12.5 |
| Work experience (years) | 0-5 | 14 | 43.8 |
| | 6-10 | 3 | 9.4 |
| | 11-15 | 4 | 12.5 |
| | 16-20 | 5 | 15.6 |
| | 21-25 | 3 | 9.4 |
| | Above 25 | 3 | 9.4 |
| Total | | 32 | 100 |

A total of thirty six (36) questionnaires were prepared, however, only thirty two (32) respondents could be reached, signifying a response rate of 88.89%. Out of these, 26 (81.2%) were male while 6 (18.8%) were female.

The distribution of the 32 respondents by cadre is also shown in the table above. The largest number of them was hospital administrative officers constituting, 40.6% while the least number was that of procurement officers who comprised of 12.5%. Pharmacists exceeded medical officers by only one respondent.

As it regards the respondents' work experiences, a majority of them had worked for a period of less than five years. They were 43.8% of all respondents. The least percentage had work experiences of between 6 to 10 years, 21 to 25 years and above 25 years, all contributing to 9.4% each.

### Major suppliers of medicines

**Table 2:** Major suppliers of medicine

| Supplier | Frequency | Percent |
|---|---|---|
| Local pharmacies | 2 | 6.3 |
| KEMSA | 30 | 93.8 |
| Total | 32 | 100.0 |

The Kenya Medical Supplies Authority (KEMSA) was cited as the main supplier of medicines by 93.8% of respondents. On the other hand, only 6.3% of respondents talked of local pharmacies as their main suppliers of medicines. These suppliers supply medicines direct to the health facilities. The delivery is done on time as indicated by 96.9% of respondents. Delivery outside the specified time was only reported by 3.1% of respondents. This is illustrated in the table below:

**Table 3:** Timely delivery of medicines to health facilities

| Timely delivery of medicines | Frequency | Percent | Cumulative Percent |
|---|---|---|---|
| Yes | 31 | 96.9 | 96.9 |
| No | 1 | 3.1 | 100.0 |
| Total | 32 | 100.0 | |

### Security status of the medicines store

**Table 4:** Security status of the store

| Security status of the store | Frequency | Percent |
|---|---|---|
| Good | 10 | 31.2 |
| Average | 22 | 68.8 |
| Total | 32 | 100.0 |

A majority (68.8%) of respondents rated the security status of their medicines' stores as average while 31.2% rated it as good.

**Factors considered in selecting suppliers of medicines- proximity to health facility.**

**Table 5:** Proximity to health facility and supplier selection

| Rating of proximity to health facility as a factor in supplier selection | Frequency | Percent | Cumulative Percent |
|---|---|---|---|
| Extremely important | 8 | 25.0 | 25.0 |
| Important | 15 | 46.9 | 71.9 |
| Didn't know | 9 | 28.1 | 100.0 |
| Total | 32 | 100.0 | |

Proximity of the supplier to the health facility was rated as important by 46.9% of respondents. 25% respondents rated this as extremely important while 28.1% were not in the know how.

Other factors considered in supplier choice included pre-qualification by the county government, past history of the supplier, Suppliers' prices for medicines.

**Reasons for expiry of medicines**

**Table 6:** Reasons for expiries

| Reasons for expiry | Frequency | Percent | Cumulative Percent |
|---|---|---|---|
| Reduced utilization of medicines | 27 | 84.4 | 84.4 |
| Items received as short expiry items | 5 | 15.6 | 100.0 |
| Total | 32 | 100.0 | |

84.4% of respondents cited reduced utilization of medicines as their main reason for having the said medicines expire. Only a few (15.6%) talked of items being received as short dated items as their reason for expiries.

**Status of various inventory management parameters**

**Table 7:** Status of various inventory management parameters

| Inventory management characteristic | Response | | Total |
|---|---|---|---|
| | Yes | No | |
| Presence of standard operating procedures on pharmaceutical stores management | 23 | 9 | 32 |
| Availability of records on consumption and stock status | 25 | 7 | 32 |
| Availability of medicine management system in the facility | 29 | 3 | 32 |
| Availability of standard treatment guidelines | 21 | 11 | 32 |
| Reported cases of medicines expiry | 30 | 2 | 32 |
| Health facility access to Kenya essential medicine list | 22 | 10 | 32 |
| Health facility have designated store for medicine | 17 | 15 | 32 |

The table above outlines various aspects of inventory management, stating if they were available or not.

Standard operating procedures (SOPs) on pharmaceutical management were reported to be available by 71.9% of respondents. Only 78.1% of respondents had records relating to consumption of medicines and stock status as compared to 21.9% who did not. A medicines management system (manual or electronic) was reported to be in place by 90.6% of respondents while only 9.4% said such a system was not in place. Regarding treatment guidelines, about a 34.4% of the respondents did not have them with an almost similar number 31.3% not having access to the Kenya essential medicines list. 53.1% of respondents reported that their health facilities had designated stores for medicines while 46.9% didn't have. On the same note, cases of expiry of medicines were reported by 6.3% of respondents while 93.7% recorded no such cases.

**Methods followed when issuing medicine from the store**

First Expiry First-Out (FEFO) method of issuing medicines from stores was the main method reported by a majority 62.5% of respondents while only 37.5% were in support of First in First out (FIFO). FEFO method is a preferred inventory control method as it allows for issuance of those medicines that are near to be expired, sparing those with longer expiry dates. This way, losses and wastage through expiry of medicines is prevented.

These findings are as shown in the table below.

**Table 8:** Methods/ Procedures followed when issuing medicine from the store

| Method of issuing medicines | Frequency | Percent | Cumulative Percent |
|---|---|---|---|
| First In First Out | 12 | 37.5 | 37.5 |
| First Expiry First Out | 20 | 62.5 | 100.0 |
| Total | 32 | 100.0 | |

**Relationship between having a store in the health facility and methods used when issuing medicines**

**Table 9:** Having a designated medicines store in the facility and methods/procedures used when issuing medicines

| Does the facility have a designated store for medicine? | | | | Total |
|---|---|---|---|---|
| | | Yes | No | |
| Methods/Procedures followed when issuing medicine from the store | First in first out | 6 | 6 | 12 |
| | First expiry first out | 11 | 9 | 20 |
| Total | | 17 | 15 | 32 |

50% of respondents who used FIFO method to issue medicines had designated medicines stores while the other half did not have designated stores for medicines. Among those who used FEFO, 55% had a designated store while 45% did not. On the other hand, among respondents who had designated medicines stores, 35.3% reported using FIFO while 64.7% used FEFO. In the category of those without designated stores, 40% of them used FIFO and the remaining 60% used FEFO.

**Relationship between having a designated store and reasons for expiry of medicines**

Out of the respondents who cited reduced utilization of medicines as a reason for expiry of medicines, 51.9% did not have a designated store while an almost equal number of 48.1% had designated stores. On the other hand, only 20% of

respondents who said they received short dated medicines hence their expiry, did not have a designated store. The remaining 80% of respondents had designated stores.

**Table 10:** Health facility having a designated store and reasons for expiry of medicines

| Does the facility have a designated store for medicine? | | | | Total |
|---|---|---|---|---|
| | | Yes | No | |
| Reasons for expiries | Reduced utilization of medicines | 13 | 14 | 27 |
| | Items received as short expiry items | 4 | 1 | 5 |
| Total | | 17 | 15 | 32 |

**Relationship between cadre of health care personnel and the frequency of placing orders**

78.1% of the respondents pointed out that the frequency of ordering was irregular, 15.6% talked of quarterly while 6.3% said ordering was on monthly basis. Of those who said ordering was irregular, a majority (40%) were health administrative officers with procurement officers being the least (12%). Medical officers comprised 21.9% while pharmacists were 15.6% of those respondents who said ordering was irregularly done. All the 7 medical officers indicated that ordering was irregular. Among those who said ordering was monthly, 50% were pharmacists while another 50% were health administrative officers. This compares with the category of those who said ordering was quarterly in which case, 40% of those who supported this were pharmacists, 40% were health administrative officers and only 25% were procurement officers. This is as shown in table 11 below.

**Table 11:** Cadre of the health personnel and Frequency of ordering of medicin**e**

| | | Frequency of ordering | | | Total |
|---|---|---|---|---|---|
| | | Monthly | Quarterly | Irregularly | |
| Cadre of the respondent | Medical Officers | 0 | 0 | 7 | 7 |
| | Pharmacists | 1 | 2 | 5 | 8 |
| | Hospital administrative officers | 1 | 2 | 10 | 13 |
| | Procurement officers | 0 | 1 | 3 | 4 |
| Total | | 2 | 5 | 25 | 32 |

Test ANOVA=F= 12.00; P= 0.035

According to ANOVA test, as indicated above, there was no significant difference between the means of the frequency of ordering medicines and the cadre of the health professionals involved.

**Work experience of respondents and the frequency of placing orders**

**Table 12:** Work experience of respondents and the frequency of ordering

| | | Frequency of ordering | | | Total |
|---|---|---|---|---|---|
| | | Monthly | Quarterly | Irregularly | |
| Work Experience (years) | 0-5 | 2 | 3 | 9 | 14 |
| | 6-10 | 0 | 1 | 2 | 3 |
| | 11-15 | 0 | 0 | 4 | 4 |
| | 16-20 | 0 | 0 | 5 | 5 |
| | 21-25 | 0 | 1 | 2 | 3 |
| | Above 25 | 0 | 0 | 3 | 3 |
| Total | | 2 | 5 | 25 | 32 |

F= 2.00; P= 0.035

Respondents who had the least work experience of less than five years formed a majority (36%) of those who indicated that ordering frequency was irregular with the least being those with work experience of between 6 to 10 years and 21 to 25 years who were 8% respectively of all who said ordering was irregular. All respondents (3) with more than 25 years of work experience indicated that ordering was done irregularly. Monthly ordering was only reported by 6.25% of respondents who had work experiences of less than five years. 60% of those who reported that ordering was quarterly had work experience of less than five years. The remaining 40% was shared equally between those with work experiences of between 6 to 10years and those between 21 and 25 years.

There was no significant difference between the means of the frequency of ordering medicines and the work experiences of the heath professional involved (F= 2.00; P= 0.035).

**Availability of medicines**

Medicines availability situation in the county was reported as poor considering there had been no procurement for the current financial year 2017/2018.

Average number of medicines available in the whole county was 72.22 (63.35%)

Average number of medicines that were out of stock was 41.78 (36.65%)

Average out of stock days for the county was 51.30

The facility that was well stocked on the day of visit had 78.95% availability of medicines while the least availability was reported at 48.25%. On the same note, 88.9% of visited health facilities had percent availability of above 50% while 11.1% of them had an availability of less than 50%. This is as shown in the table below.

**Table 13:** Availability of medicines – number of medicines available, number of medicines out of stock and stock out days

| Health facility | Number of medicines available on day of visit out of 114 | Per cent availability | Number of medicines not available on day of visit out of 114 | Per cent unavailability | Average out of stock days | Mode of out of stock days |
|---|---|---|---|---|---|---|
| 1 | 73 | 64.04 | 41 | 35.96 | 52.90 | 90 |
| 2 | 70 | 61.40 | 44 | 38.60 | 55.02 | 90 |
| 3 | 79 | 69.30 | 35 | 30.70 | 39.90 | 60 |
| 4 | 90 | 78.95 | 24 | 21.05 | 35.00 | 90 |
| 5 | 73 | 64.04 | 41 | 35.96 | 56.00 | 90 |
| 6 | 60 | 52.63 | 54 | 47.37 | 54.60 | 90 |
| 7 | 83 | 72.81 | 31 | 27.19 | 61.80 | 90 |
| 8 | 67 | 58.77 | 47 | 41.22 | 57.50 | 90 |
| 9 | 55 | 48.25 | 59 | 51.75 | 49.00 | 60 |

**Officers involved in management of medicines**

The county only has about forty pharmaceutical personnel which is an inadequate number. This is a very small number considering that there are so many health facilities in the county.

**Challenges in relation to medicines inventory management**

The following were identified as main challenges in relation to inventory management

**Table 14:** Challenges relating to medicines inventory management across the county's health facilities and how they can be addressed

| Challenge | How to address |
|---|---|
| Lack of a central county store for medicines | Construct one |
| Lack of a reliable inventory management system | Source for an inventory management system that is standardized across the county for medicines management |
| Lack of updated inventory management guidelines and SOPs | Develop SOPs and guidelines |
| Inadequate pharmaceutical personnel | Employ more pharmaceutical personnel |

## 4. Discussion

Proper inventory management practices of medicines are essential in ensuring availability of medicines. However, this aspect has been accorded minimal attention especially in developing countries which ironically suffer the problem of lack of medicines. For example, until as late as 2009, Kenya's national malarial strategy lacked a supply chain management component [12]. There continues to be more challenges as it regards supply chain management across the health sector-both public, private and mission health facilities. This is mainly due to linkages within the health sector supply chain that are not strong enough to sustain access to essential medicines including those for management of infectious and deadly diseases [15]. In general, inventory management for medicines is supposed to ensure availability of medicines with specific goals of sustaining the highest health services level and reducing the associated costs making orders and maintaining stock levels. In summary, it is ensuring that one has the right commodities, in adequate quantities, with respect to the right location and time at an affordable cost [16].

A majority of the respondent were health administrative officers while the least number was for procurement officers. Pharmacists only exceeded medical officers by one. The high number of health administrative officers could be due to the fact that they are involved in the day to day administrative activities of hospitals, making their presence to be required throughout. On the other hand, medical officers and pharmacists offer highly specialized care and thus many could not be reached on the day and time the researcher visited their hospitals as they could have been possibly attending to patients. Lastly, procurement officers were only four since not all hospitals in the county are procurement entities. The officers were therefore deployed to just a few hospitals which are also procurement entities as per the counties procurement regulations.

The work experience of respondents was skewed towards 0-5 years. This means that these officers had only worked for a shorter period of time and were newly employed. When assessing the experience gained in a certain field, the number of years worked should be put into consideration [17]. Those who have worked for a shorter time will be expected not to have the same competencies as those who have worked longer. However, this study found out that there was no significant difference between the means of the frequency of ordering medicines and the work experiences of the heath professional involved ($F= 2.00$; $P= 0.035$).

KEMSA was reported as the major supplier of medicines to public health facilities as compared to local suppliers. KEMSA is the preferred supplier of medicines in most public facilities since they have the advantage of affordable prices, trustworthiness as they are government owned among others. Comparing KEMSA prices with other suppliers, KEMSA's are lower since they buy medicines in bulk hence enjoying the advantages of economies of scale [18].They in addition, supply direct to the health facility, avoiding any transportation costs to be incurred. Since devolution of health care in 2013, the mandate to procure medicines shifted to the counties who have the discretion to either buy from KEMSA or any other supplier.

A majority of respondents reported that FEFO method was preferred when issuing medicines from the stores than FIFO. This allows use of medicines which are about to expire, sparing long expiry ones for future use. This finding is consistent with what Shadrack M *et al*. found in Meru County, Kenya [19]. Designated Storage facilities were not available in close to half of the reported cases. This means that still many health facilities were storing medicines in places that were not fit for storage hence possibly interfering with the potency of the said medicines. From these findings, a significant number of respondents without designated stores were for FIFO method which is not preferred as it has high chances of

causing expiry of stock and stock outs in the long run. Probably, they chose this method as they were unable to properly arrange their medicines as a result of not having stores. Slightly more than half of respondents, who cited reduced utilization of medicines as a reason for expiry of medicines, did not have a designated store. Lack of designated stores has a direct relationship with expiry of medicines. This is because it is likely to lead to underutilization as health workers may not have an idea where the said medicines were stored. This may explain why most of those without stores indicated that they had expiries due to underutilization.

From these findings, it is evident that the frequency of ordering for medicines is irregular. For instance, at the time of data collection, the last time an order was ever made was almost eight months. This irregularity is however, only experienced in this post devolution era. Before devolution of health services to the county level, health facilities could order medicines from KEMSA quarterly. A standard order form designed by KEMSA was available at the health facilities which made their orders in accordance to the budgetary allocations referred to as drawing rights. The order value would not exceed the allocated quarterly drawing rights for a given health facility [20].

Lack of medicines in public health facilities in Bungoma County was found to be in agreement with findings from a study by Muungu that has focused on one of the sub counties in Bungoma County with a bias on essential medicines. Proper inventory management practices were mentioned as a way of improving the availability of medicines in this study [9]. On average, the availability of medicines in the county was lower than that reported in other studies. On the same note, the average out of stock days were higher compared to those reported in several other studies [21, 22]. This low medicine availability is detrimental to provision of adequate health care since it is likely that patients miss medicines prescribed for them. They therefore go home without getting treated appropriately which could cause worse health outcomes

The study found out that the county only has about forty pharmaceutical personnel which is an inadequate number. This is a very small number considering that there are so many health facilities in the county. From this finding, most of the health facilities operate without pharmaceutical staff, a fact which contravenes the legal provisions for the operation of pharmacy business in Kenya.

Proximity of the supplier to the health facility was rated as important by a majority of respondents. A quarter of them rated this as extremely important. Supplier proximity is very important in a hospital set up since sometimes hospitals are faced with emergencies which need to be addressed immediately. It is thus prudent that the supplier is located within a close range to the health facility or if located far away, should make arrangements to have the medicines delivered in good time. Other factors considered in supplier choice included pre-qualification by the county government, past history of the supplier, Suppliers' prices for medicines.

All the four challenges relating to inventory management as identified in this study: lack of proper storage, lack of a good inventory management system, inadequate staff and lack of inventory management SOPs are similar to those identified by other studies [23, 24].

## 5. Conclusion

Inventory management practices were found to have direct effects on the availability of medicines in Bungoma county's public health facilities. Proper inventory management practices are thus important in ensuring continuous availability of medicines particularly in public health facilities. This in turn reduces frequent stock outs and possibility of expiry of medicines. Various challenges relating to inventory management of medicines were also identified. These, when adequately addressed, will guarantee proper inventory management practices and hence assure availability of medicines. There is also a need to have pharmaceutical personnel to be in charge of the core aspect of medicines management as they are trained on handling medicines better as compared to other health care workers.

## 6. Authors' contributions

Nicholas Barasa, Sherry Oluchina and Wilberforce Cholo contributed equally to this work.

## 7. Acknowledgements

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