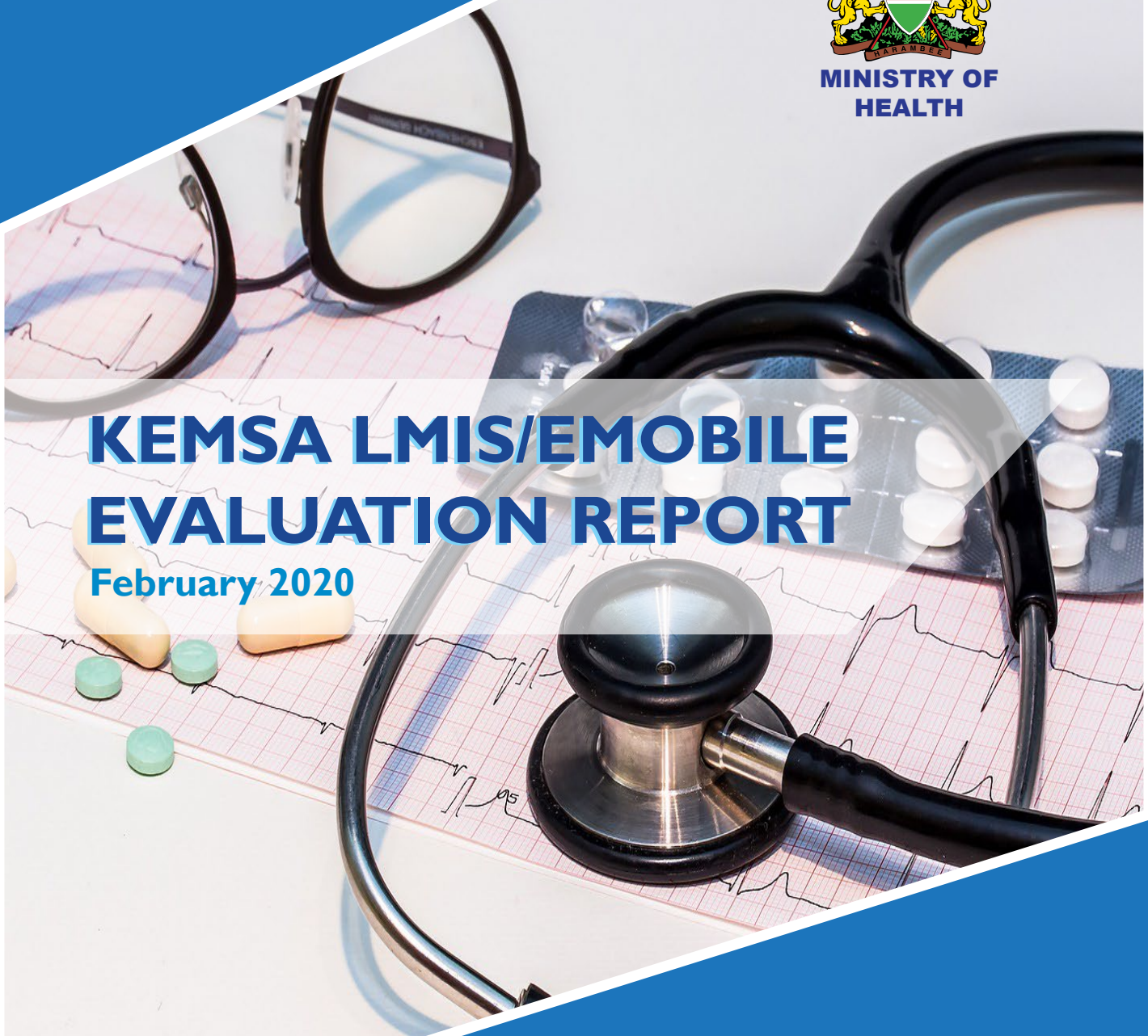
MINISTRY OF HEALTH



KEMSA LMIS/EMOBILE EVALUATION REPORT

February 2020

Disclaimer: The findings and conclusions of this report are those of the authors and do not necessarily represent the official positions of the funding agencies.

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CONTENTS

ACRONYMS

CDC	US Centers for Disease Control and Prevention
CEC	Chief Executive Committee
CHMT	County Health Management Team
EMMS	Essential Medicines and Medical Supplies
ERP	Enterprise Resource Planning
ICT	Information Communication Technology
KEMSA	Kenya Medical Supplies Authority
LMIS	Logistics Management Information System
LPO	Local Purchase order
MHEALTH	Mobile Health
MOH	Ministry of Health
MOU	Memorandum Of Understanding
ODK	Open Data Kit
OTT	Order Turnaround Time
PEPFAR	The U.S. President's Emergency Plan for AIDS Relief
PPP	Public Private Partnerships
SOP	Standard Operating Procedures
SORF	Standard Ordering and Requisition Form
TAT	Turn Around Time
TB	Tuberculosis
WMS	Warehouse Management System

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Edward Njoroge
Ag. Chief Executive Officer

EXECUTIVE SUMMARY

Introduction and background

By 2012, the medical supply chain in Kenya had major gaps which included: i) paper-based ordering of supplies by the facilities using manual Standard Ordering and Request Form (SORF) ii) SORF was sent to KEMSA via courier which resulted in additional delays iii) Incomplete SORF, prompting delays in order processing iv) Lack of demand data use to inform quantification of health commodities iv) Inability to track orders within the supply chain. The Ministry of Health (MOH) engaged Centers for Disease Control and Prevention (CDC) in Kenya for technical assistance on the above challenges. In response, CDC Foundation was awarded a Public Private Partnerships (PPP) grant by PEPFAR to address the challenges. CDC Foundation in collaboration with KEMSA and mHealth Kenya developed the KEMSA LMIS/eMobile platform to support KEMSA's and alleviate some of the challenges they experienced.

Evaluation of KEMSA LMIS/eMobile

In 2019, an evaluation was conducted by KEMSA in collaboration with mHealth Kenya and Ministry of Health (MOH) to determine the impact of the intervention. The KEMSA eMobile evaluation was aimed at conducting a comparative analysis to determine the efficiencies in time and transparency gained by implementing a new mobile system for the ordering, tracking and supply of public health commodities as well as its influence on improving the efficiency of county and KEMSA commodities order management. The evaluation question to be investigated was: "Did the introduction of mobile phone technology improve the overall turnaround time (move the process to optimal) of the commodities ordering, tracking and delivery processes between the supplier (KEMSA) and the recipient at the health facility.

Methods

The evaluation used a mixed methods approach including one arm pre-post-intervention design. The period of review was 6 months pre-intervention and 6 months post-intervention with a washout period of 3 months before and 3 months after the intervention for the purpose of measuring the influence of the KEMSA eMobile intervention. Descriptive analysis was conducted to show changes in the specific mean turnaround times. A chi-square goodness of fit test was conducted before inferential analysis using a paired sample t-test.

Comparisons were drawn on the mean turnaround times before and after the KEMSA eMobile intervention. Qualitative data were used to complement quantitative data in ascertaining the role of the intervention on the changes in turnaround times. Participants in the qualitative interviews were the pharmacists at sub-county health facilities and county pharmacists who were the main users of the system. A total of 69 facilities in 8 Counties were involved in the evaluation. These were facilities that: a) used the KEMSA eMobile system to order HIV related commodities b) were within counties that performed at least 45 facility orders 6 months pre and 6 months' post intervention c) were to be in a county that had received the KEMSA eMobile training. In total 1688 records and 64 interviews were analyzed. The process of data collection experienced a challenge in terms of obtaining all the records for the pre-intervention period. Unavailability of data was one of the challenges the KEMSA LMIS/eMobile system was solving. However, 58 health facilities had data for both periods.

Results

All the 69 health facilities were using the Logistics management information system LMIS/KEMSA eMobile. Findings show great improvements on all the turnaround times. In general, the turnaround time from facility order to county receipt reduced from 15 days to 1 day. The turnaround time (TAT) from county order to KEMSA receipt reduced from 24 days to 1 day. The turnaround time from Facility order to KEMSA receipt, which includes time of orders consolidation at county level, improved from 52 to 20 days. Overall, the turnaround time from facility order to facility receipt of the commodities improved from 64 to 32 days across all the 69 health facilities. Analysis by county shows that almost all counties had improvements on all turnaround times apart from 1 county (Homa Bay). To ascertain the significance of the changes, analysis was conducted on data from 58 facilities that had both pre-intervention and post intervention data. This excluded 11 health facilities that had only post-intervention data. There were statistically significant differences in the various turnaround times between the two time points (pre-post intervention) as follows: mean TAT from facility order to county receipt improved by 13.5 days at 95% CI (12.8-14.2); ($t57 = 38.08$, $p < .01$); mean TAT from county order to KEMSA receipt improved by 22.7 days at 95% CI (19.7-25.6); ($t57 = 15.26$, $p < .01$). Results based on the 58 facilities that had both pre- and post-intervention data show that on overall, mean TAT from facility order to facility receipt of the commodities improved by 29.4 days at 95% CI (24.1- 34.6); ($t57 = 11.26$, $p < .01$).

Qualitative data showed that there was interest in using the intervention among participants. Opinions from participants imply that the system had great impact on turnaround times leading to efficiency in managing commodities. However, there were still some bottlenecks affecting the supply chain including manual processes of order consolidation at lower facilities and delays in preparation of Local Purchase orders (LPOs) at county level.

Conclusion and Recommendations

The fact that limited records were available for the pre-intervention period implies that there was poor record keeping at facilities then. This situation calls for the need to automate most processes in public facilities to ensure availability of records in the future. Although the overall turnaround time has significantly improved, there are still some bottlenecks influenced by factors outside the system. Most of the recommendations made were on availability of KEMSA e-mobile training for new staff and refresher training for existing users. Some of the respondents cited that county governments should make timely payments to KEMSA in order to enhance the timely supply of commodities.

INTRODUCTION AND BACKGROUND

i. Introduction to implementing organizations

KEMSA is a state corporation under the Ministry of Health (MOH) established under the KEMSA Act 2013(KEMSA, 2013) and mandated to:

- Procure, warehouse and distribute drugs and medical supplies for prescribed public health programs, the national strategic stock reserve, prescribed essential health packages and national referral hospitals.
- Establish a network of storage, packaging and distribution facilities for the provision of drugs and medical supplies to health institutions.
- Enter into partnership with or establish frameworks with county Governments for purposes of providing services in procurement, warehousing, distribution of drugs and medical supplies.
- Collect information and provide regular reports to the national and county governments on the status and cost effectiveness of procurement, the distribution and value of prescribed essential medical supplies delivered to health facilities, stock status and on any other aspects of supply system status and performance which may be required by stakeholders.
- Support county Governments to establish and maintain appropriate supply chain systems for drugs and medical supplies.

mHealth Kenya is a registered limited liability company incorporated under the companies Act CAP 486 of the Laws of Kenya. mHealth Kenya provides a critical needed link between public and private entities to support, improve, optimize and sustain provision of quality health services in Kenya. mHealth Kenya is a local implementing partner working in partnership with the Ministry of Health, National, county and other stakeholders, overseeing and managing mobile technology projects in the health sector. mHealth Kenya embraces the power of Public Private Partnerships (PPP) and seeks to leverage this potential for the benefit of public health. mHealth Kenya is the pioneer of mobile health technologies and initiatives bringing together a team of experts with a diversity of knowledge, experience, and a deep understanding of the Health sector. mHealth Kenya's experience includes health information systems, health projects design and implementation, mobile and network communications technology backed by a strong experience in program fund management.

ii. Situational analysis of previous gaps and challenges

KEMSA is mandated by the Government of Kenya to manage the supply chain services of health commodities for HIV, TB, Malaria, Family planning, and Essential Medicines and Medical supplies (EMMS). In 2012, the supply chain in Kenya like many other developing countries had major gaps (Asamoah, Abor, & Opare, 2011); (Narayana, Pati, & Vrat, 2012) which had an impact on the supply of commodities. The gaps included:

- Manual paper ordering by the facilities using manual Standard Ordering and Request form (SORF).
- SORF was sent to KEMSA via courier leading to delays in receipt of the document.
- Incomplete SORF documents prompted delays in order processing.
- Lack of demand data to inform quantification of health commodities.
- Lack of visibility on orders progression within the supply chain.

iii. KEMSA and mHealth Kenya Partnership

The Ministry of Health (MOH) engaged Centers for Disease Control and Prevention (CDC) in Kenya for technical assistance on the above challenges. In response, CDC Foundation was awarded a PEPFAR Public Private Partnerships (PPP) grant to look at technological means to address the challenges. CDC Foundation in collaboration with KEMSA and mHealth Kenya identified mobile technology as the platform to support KEMSA's needs through the PEPFAR fund which is mainly on provision and supply of program commodities. Subsequently, KEMSA and CDC Foundation in partnership with mHealth Kenya signed a Memorandum of Understanding (MOU) on provision of mobile technology service to KEMSA. The technology was named the KEMSA eMobile. In the initial development of the KEMSA eMobile system, Fintech Kenya was the technological partner that was engaged in the development of the KEMSA eMobile.

The KEMSA eMobile is a mobile technological application which rides on the KEMSA Logistic Management Information System (LMIS) and is integrated in the Enterprise Resource Planning (ERP) platform. The application gives visibility to the customer once an order has been made through LMIS. The KEMSA eMobile complements the LMIS by providing visibility and information concerning the orders which are done in the LMIS.

The eMobile enables facilities to track and confirm their receipt of supplies, record turnaround time, fill rates and view order status and county statements. It targets public hospitals to ease procurement of medical supplies from KEMSA. KEMSA eMobile was developed in-house by mHealth Kenya and KEMSA technical teams and focused on the gaps identified by KEMSA and performance metrics measured by KEMSA.

iv. KEMSA eMobile Implementation

KEMSA eMobile project was implemented countrywide with emphasis on the then 27 PEPFAR focused counties which supported program commodities. The counties included those with:

- Prevalence above 15% (Hyper endemic): Kisumu, Siaya and Homa Bay.
- Prevalence between 5%-14.9%: Nairobi, Mombasa, Kiambu, Busia, Kilifi, Makueni, Kwale, Trans Nzoia, Taita Taveta, Migori and Nyamira.
- Prevalence between 1%- 4.9%: Uasin Gishu, Machakos, Murang'a, Kajiado, Vihiga, Turkana, Kitui, Kakamega, Nandi, Kisii, Nakuru, Tharaka Nithi and Kericho.

The implementation was in conjunction with the following facilitators:

i. Key members from counties including the County Health Management Teams (CHMT), County Cabinet Executive Committee Members (CECs) of health, County Directors of Health, County Pharmacists, Sub-County Pharmacists and various facilities' staff in charge of commodity management and distribution.
ii. Key members from KEMSA included the Information Communication Technology (ICT) team, both regional and headquarters sales teams and the commodity distribution team.
iii. Technical and program team from mHealth Kenya.

The implementation strategy adopted was a phased approach composition strategy which looked at all the key players in the supply chain. In the year 2012, KEMSA, CDC Kenya and CDC Foundation worked collaboratively to develop the KEMSA eMobile product specifications and system requirement document. Subsequently, Fintech Kenya was engaged in the development of the KEMSA eMobile version 1 that was eventually launched in July 2013 by the then Cabinet Secretary for health, Mr. James Macharia. Later that year, KEMSA business model changed affecting the initial design of the national and devolved system of government.

The KEMSA support to the counties took time because every county was unique and distinct. Further each county had a choice on whether to engage KEMSA or another supplier for their commodities. In 2014, KEMSA initiated the county engagements to supply commodities. At the same time, mHealth Kenya and the KEMSA team with support from CDC through CDC Foundation redesigned the KEMSA eMobile and the development of the Logistics Management Information System. In 2015, mHealth Kenya worked closely with the KEMSA technical team in the capacity building of county and facility staff and transition planning of the system.

In July 2016, the Ministry of Health teams went through training of trainers (TOT) on the entire system and in August 2016, countrywide training was launched for the counties. mHealth Kenya supported the PEPFAR focused counties and KEMSA supported the rest of the counties. The centralized training was conducted in Meru, Kisumu, Mombasa, Machakos and Eldoret.

mHealth Kenya continued to support the KEMSA technical team and build capacity within the technical team while performing routine monitoring and supervision of the project. In November 2017, mHealth Kenya fully transitioned the KEMSA eMobile/LMIS system to KEMSA. No evaluation was carried out during the implementation of the KEMSA eMobile/LMIS system.

EVALUATION OF THE KEMSA LMIS/EMOBILE PROJECT

i. Background to the Evaluation

In 2019, an evaluation of the system was funded by Cardno. Cardno is a global infrastructure, environmental and social development company based in the United States of America. The funding was through a Cooperative Agreement between PEPFAR and Cardno. The evaluation was conducted by KEMSA in collaboration with mHealth Kenya to determine the impact of the intervention. The evaluation was aimed at conducting a comparative analysis to determine the efficiencies in time and transparency gained by implementing a new mobile system for the ordering, tracking and supply of public health commodities.

Traditionally, implementation of Information Communication and Technology (ICT) systems in the health sector in Kenya has not been followed up with systematic evaluations to measure effect in health care service delivery. This evaluation endeavors to address this gap by measuring the extent to which the KEMSA LMIS/eMobile solution influenced the respective program areas and to inform future program decision making related to resource allocation and strategic planning. The implementation of KEMSA LMIS/eMobile evaluations were funded under the CoAg U2GGH001531 titled, "Public-Private Partnerships in PEPFAR countries", awarded to Cardno Emerging Markets on April 1, 2015.

ii. Objectives

The broad objective of the outcome evaluation was to estimate the effect of the of KEMSA eMobile intervention on the health care facilities commodity supply system.

The specific objective of this evaluation was to examine changes in turnaround time and transparency of ordering, delivery and tracking
commodities from KEMSA to health facilities via the use of mobile technology.

iii. Evaluation question/hypothesis

Did the introduction of mobile phone technology improve the overall turnaround time (move the process to optimal) and transparency of the commodities ordering, tracking and delivery processes between the supplier (KEMSA) and the recipient at the health facility?

iv. Evaluation assumption

The assumption for the KEMSA eMobile evaluation was that the adoption of KEMSA eMobile system would reduce the turnaround time for ordering, tracking and delivery of commodities to the facilities.

METHODS AND PROCEDURES

i. General approach

The evaluation was a quasi-experimental design (one arm pre-post- intervention) to measure the effect of the introduction of KEMSA LMIS/eMobile on specific turnaround times for ordering, tracking and delivery of commodity supplies. The review period was 6 months before and 6 months after the intervention with 3 months washout periods before and after the intervention. The intervention has been scaled and continues to be implemented countrywide. All facility heads or their representatives provided consent for their facilities to participate by signing the Participant Agreement for the Head of the health facility/implementing partner form (Appendix 4).

ii. Evaluation design

The evaluation used a mixed methods approach to assess the influence of the KEMSA eMobile intervention. Comparisons were drawn on the mean turnaround times before and after the KEMSA LMIS/eMobile intervention. Qualitative data was used to complement and verify quantitative findings and in ascertaining the effect of the intervention. Participants in the qualitative interviews were the county pharmacists at sub-county pharmacists who were the main users of the system. Both quantitative and qualitative data were collected concurrently in 2019.

iii. Sampling Strategy and sample size determination

To determine the appropriate number of facilities to sample from the eight counties with at least 45 facility orders as described above, we conducted sample size estimation. For this estimate, we assumed that for the KEMSA population we expected TAT of 45 days (SD=75 days) pre-intervention and 14 days (SD=28 days) post-intervention. The pre-intervention was arrived at based on anecdotal evidence per discussions with KEMSA regarding their average TAT prior to the introduction of KEMSA eMobile. The post intervention was based on KEMSA's goal for improvements in TAT. Based on these assumptions, we estimated a sample size of 69 health facilities allowing for 80% power.

Sample size formula: $n = DEFF\left[\left(Z_{1-\frac{\alpha}{2}} + Z_{1-\beta}\right)/\Delta\right]^2/([\sigma_1^2 + \sigma_2^2]RR)$ *which assumes 80% power (β =20%) and 0.05 level of significance (α=0.05); Z is the standard normal quantile,* Δ *is the difference in TAT between pre-and post-intervention,* σ_1^2 *and* σ_2^2 *are pre-and post-intervention variances, respectively. DEFF is the design effect and RR is the response rate. This implemented in STATA power two means.*

Table 1: Sample size calculation

Sub-study	Population Size	Effective samples	Design Effect	Response Rate	Sample Size (n)
KEMSA eMobile Study	1059	54	1.25	98%	69

All the 69 facilities had orders for post intervention period and only 58 facilities had orders for the pre-intervention period due to poor record keeping pre-intervention.

The number of facilities per County for the evaluation was as shown in table 2.

Table 2: Sample size by counties

County	Number of facilities at pre intervention	Number of facilities at post intervention
Busia	4	6
Homa Bay	13	13
Kajiado	5	6
Kiambu	9	9
Kitui	8	11
Makueni	7	11
Migori	6	7
Vihiga	6	6
Total	**58**	**69**

iv. Sampling of records

For this evaluation, a maximum of 30 records before and 30 records after KEMSA LMIS/eMobile system were to be randomly sampled per healthcare facility. This number was considered large enough for mean or median comparison. A 3-months washout period before intervention and 3-months' washout period after intervention was observed. This was to avoid interference from other factors immediately before and after KEMSA LMIS/eMobile.

v. Intended and potential use of evaluation findings

The results from this evaluation will help assess the influence of mHealth technology investments in improving the efficiency of service delivery. The results will facilitate decision making related to resource allocation and strategic planning for similar interventions in the future. The findings will also assist stakeholders and relevant agencies such as the Ministry of Health, KEMSA and its implementing partners in learning lessons from the KEMSA LMIS/eMobile project thus influencing other activities and national policies on the integration of mHealth solutions in healthcare services.

vi. Data Management and Analysis Plan

a) Data quality, security and confidentiality

A standard operating procedure (SOP) was developed to oversee data quality, verification, range checks and procedures in data collection. The evaluation used Hoji application hosted on an ODK platform with inbuilt data validation checks which ensured data integrity during abstraction. The data collection was monitored on live dashboards. Only members of the evaluation team had access to the data.

All paper forms and electronic databases used in this evaluation were protected by procedures consistent with applicable laws, directives, policies, regulations, and standards in Kenya. The paper forms were stored in locked cabinets. Electronic backups were password protected.

All the researchers underwent human subjects' protection and protocol-specific training to ensure they understood how to conduct this activity and to ensure that confidentiality of all information was maintained, and the data was managed, reviewed and corrected appropriately.

b) Data collection

KEMSA in collaboration with mHealth Kenya were responsible for overseeing the data collection and management process. mHealth Kenya facilitated the process by providing logistical support. More specifically, data collection was led by KEMSA staff and mHealth Kenya staff with necessary support from the service delivery officers at the facilities. Data for the pre-intervention were abstracted from warehouse management system (WMS) while data for post intervention was abstracted from both the Logistics Management Information System and WMC as shown on the Appendix 1.

c) Describing variables

There were four key variables as indicated in table 3.

Table 3: Definition of variables

Variables	Description
TAT facility order to County sent an order.	Date when commodities were ordered by facility and date when County sent an order to KEMSA
TAT facility order to KEMSA receipt	Date when the facility sent the order and date when the order was received by KEMSA
TAT KEMSA receipt of the order to KEMSA dispatched the order	Date when the order was received by KEMSA and date when the commodities was dispatched by KEMSA to the facility
TAT KEMSA dispatched the commodities to facility receipts of the commodities	Date when the commodities were dispatched by KEMSA and date when commodities were received by facilities

d) Data Cleaning

The raw evaluation data were extracted from the Hoji app in excel format for analysis. Cleaning began by checking any records that were within the washout period of 90 days before and 90 days after the intervention period in line with the evaluation protocol. Any record found to be within the periods was expunged from the data analysis. The next step was to derive the county order receipt dates for the eight (8) counties for pre-intervention data. For the pre-intervention data only date of receipt of the order at KEMSA was available from the KEMSA database. There was no other source of data hence to get the estimated TAT we asked the county pharmacist and sub-county pharmacists how long it would take to for orders to reach the counties from the

facilities and how long it would take for the county pharmacist to get an acknowledgement that their orders had been received at KEMSA. Using the dates of receipt of orders at KEMSA and the estimated number of days the order took between KEMSA, county and facility order date, the respective dates were calculated retrospectively.

The number of estimated TAT also factored in the time counties held the orders outside the KEMSA LMIS/eMobile to allow validation and consolidation of various facility orders in the county. Estimated times also included the period of time taken for county budget approvals, generation of LPOs and order initiation which took place outside the system before orders are sent to KEMSA. All post intervention data were available in the data abstracted from the KEMSA LMIS/eMobile database and the only date captured at facility level was when the commodities were actually received.

Other checks were conducted on records with negative values of turnaround time assumed to have wrong data entry. In cases where the actual receipt dates could be verified, the correct data was updated by the analysis team but the data was expunged for the records that could not be verified as far as the actual receipt date was concerned. Verification was done using data from the KEMSA LMIS/eMobile system which also indicates the dates when commodities were received. These dates are usually entered into the system from the copies of the delivery notes by KEMSA staff. This was also done for records that had extremely high turnaround times such as over one year to even three years. The check for these was to ascertain first, whether it was due to data entry error or second, whether the data entry was correct. Valid records were retained while invalid but verifiable data was updated accordingly.

The last check was to compare order dates and intervention dates to ascertain that all the records had been properly categorized as pre-intervention and post-intervention. Upon completion of all data quality checks data analysis began.

e) Data Analysis

We conducted descriptive and inferential analysis.

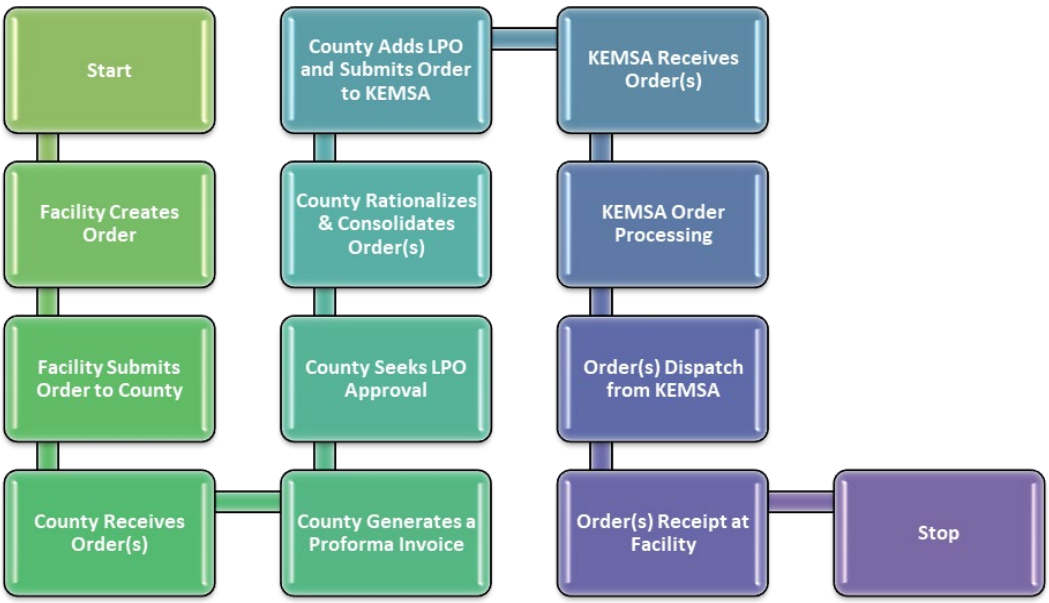
- ***Descriptive Analysis***

Based on KEMSA's business model, the LMIS/eMobile helps in supporting the ordering process up to the point where the order reaches KEMSA. From that point, in-house processing begins with the aid of different systems which are linked with the KEMSA LMIS/eMobile system while some processes like commodity picking within the warehouse, routing, loading and transportation to each facility's doorstep take place outside the system. The outcome and effect of the system cannot, therefore, be measured on the turnaround time of these other commodity delivery processes not affected by it.

The ordering process can be summarized as follows.

1. An order is made by the facility and sent to the County.
2. After receiving the order each county confirms and consolidates all orders from each facility within the County into one comprehensive County order.
3. Each County generates proforma invoices and prepares respective LPOs then sends the order to KEMSA
4. The KEMSA order processing cycle begins and ends at the point each facility receives the medical commodities they ordered. KEMSA has direct delivery of the commodities to each facility.

Figure 1: Commodities ordering process



The analysis focused on the areas the system directly affects in matters TAT, as well as the effect of the system on the overall turnaround time.

As a result, the following turnaround times were obtained:
1. Facility order to county Receipt
2. County Order to KEMSA Receipt
3. Facility Order to KEMSA Receipt
4. Overall order TAT (from facility order to actual facility receipt of commodities).

Descriptive findings are presented using graphs.

• ***Inferential statistics***
Before data analysis, a chi-square goodness of fit test was conducted to ascertain whether the data from the 58 facilities was good enough for inferential test. A paired sample two tailed t-test was used to test for significance in change.

A t-test was preferred because of the small sample size of 8 Counties that were involved in this evaluation. The key variable to determine the significance of the changes resulting from the KEMSA eMobile system was the overall turnaround time from when facilities ordered commodities to when they received them. To test for this, only the 58 facilities which had both pre-intervention data and post-intervention data were used for analysis to pair data in the periods (pre-post intervention). Paired samples correlations were used to ascertain the strength of relationships between changes in turnaround time and the specific facilities that were involved in analysis. Eleven facilities did not have data for pre-intervention period and therefore were not included in the one sample paired t-test analysis.

QUANTITATIVE FINDINGS

This section provides simple high level descriptive analysis and presentation of findings from data. Appendix 8 provides further data presentation on each of the turnaround times studied using box plots and analysis using non-parametric methods.

i. Achieved sample

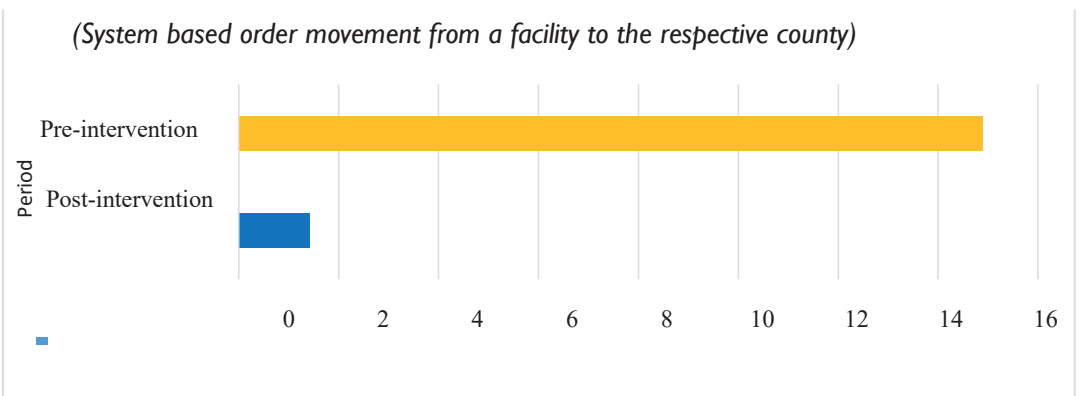
A total of 1688 records were analyzed. Out of the 1688, a total of 1236 (73.2%) were post intervention records while 452 (26.8%) were pre-intervention records.

	Frequency	Valid Percent
Post-intervention records	1236	73.2
Pre-intervention records	452	26.8
Total	1688	100.0

ii. Overall results on turnaround times

a) Turnaround time from facility order to county receipt

Figure 2: Mean TAT from facility order to county receipt



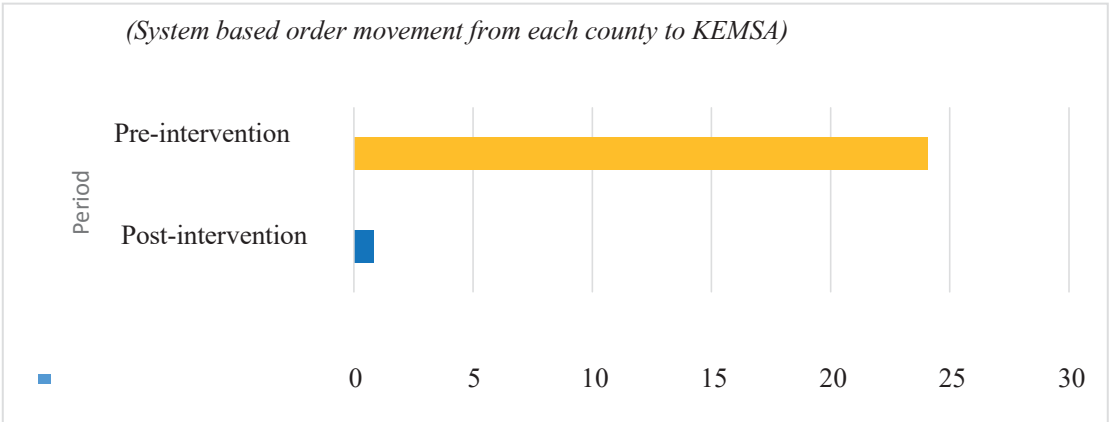
	Post-intervention	Pre-intervention
Facility to County	1	15

No. of days

Figure 2 represents the average time between order creation by a facility and receipt of the order by the county for the sampled facilities. There has been a significant improvement of 93.4% in the turnaround time from 15 days to 1 day as the facilities now create and submit their orders to counties within the system. The elimination of manual ordering and travels has resulted into almost real time order movement from facility to county.

b) Turnaround time from county order to KEMSA receipt

Figure 3: Mean TAT from county order to KEMSA receipt



	Post-intervention	Pre-intervention
County Order to KEMSA Receipt	1	24

No. of days

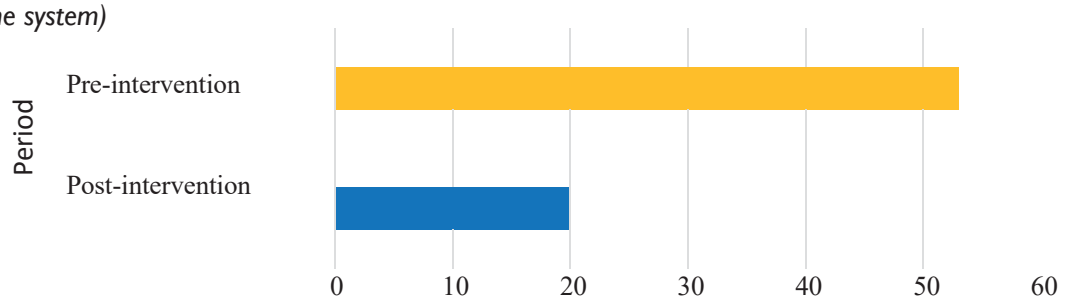
Figure 3 represents the next step in the supply chain in terms of the average time taken between order submission from the county and receipt of the order at KEMSA. This happens after individual facility orders are confirmed and consolidated into one comprehensive county order which is then sent to KEMSA. The chart shows significant reduction (95.8%) from an average of 24 days to 1 day after the intervention. This implies that on average, the orders are received at KEMSA on the same day the counties submit them.

c) Turnaround time from facility order to KEMSA receipt

This is a representation of the average time taken between order creation by a facility and order receipt at KEMSA. Figure 4 shows that through use of the system, the turnaround time was reduced by 62% (53 days before to 20 days after). This turnaround time includes days for confirmation and consolidation of orders at county level which are processes outside the KEMSA LMIS/eMobile system which constituted for 14 days before intervention and 18 days after e-Mobile system introduction.

Figure 4: Mean TAT from facility order to KEMSA receipt

(Includes time of order handling and consolidation at county level which are manual processes and are off the system)



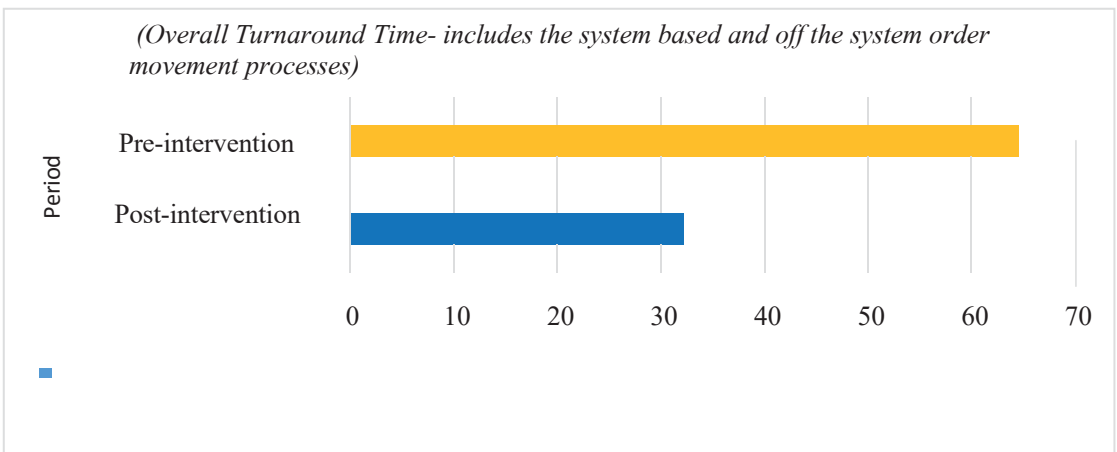
	Post-intervention	Pre-intervention
Facility Order to KEMSA Receipt	20	53

No. of days

d) Turnaround time from Facility Order to Facility receipt of the commodities

Figure 5 shows the overall turnaround time from order creation at the facility to receipt of the ordered commodities at the facility. This period covers all the steps of the order cycle including the times that orders are processed at the counties, within KEMSA, and then the physical transit of the commodities. The results show a 50% improvement from 64 to 32 days after the intervention.

Figure 5: Mean TAT from facility order to facility receipt of commodities



	Post-intervention	Pre-intervention
Facility Order to Facility Receipt	32	64

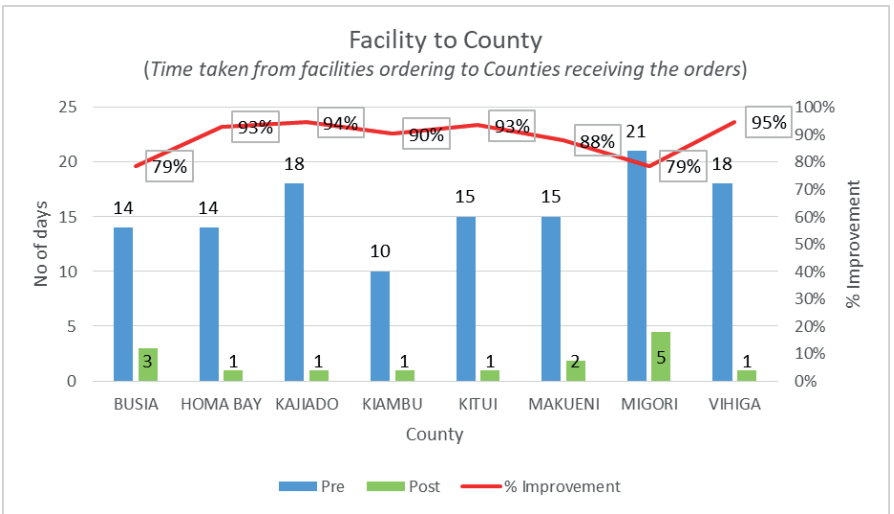
No. of days

iii. Analysis of turnaround times by county

a) Turnaround time from facility to county

Figure 6 shows that there was improvement across all the counties from facility order to county receipt. Vihiga and Kajiado Counties showed the greatest improvements of about 95% and 94% respectively. They were followed by Homa Bay and Kitui Counties which had an improvement of 93%. Kiambu county had an improvement of 90% from 10days to 1 day followed by Makueni county which had an improvement of 88%. Busia and Migori had the least improvement of 79%.

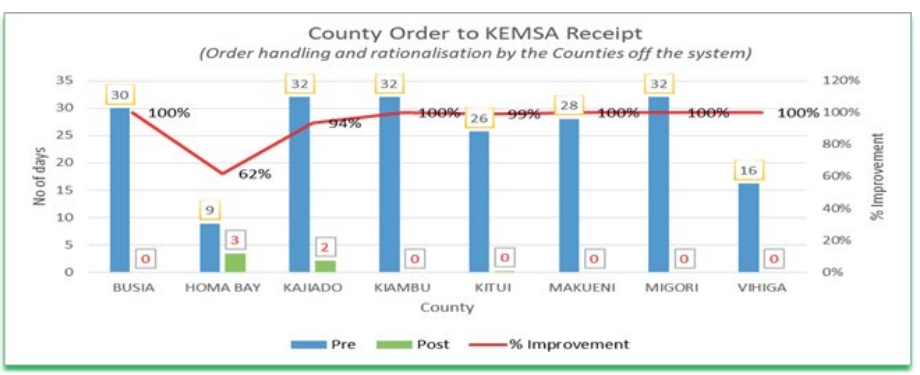
Figure 6: Mean TAT from Facility to County order receipt by County



b) Turnaround time from County order to KEMSA receipt

Figure 7 shows that a part from the two counties, Homa Bay and Kajiado, which had 62% and 94% improvement respectively, the rest of the counties had 100% improvement in the time it takes between submissions of orders by counties to receipt by KEMSA. Submission of orders had been automated and thus was expected to be real-time. It is not clear why Homa Bay and Kajiado counties did not have real-time submission of the orders to KEMSA. The evaluation did not expect that hence did not inquire.

Figure 7: Mean TAT from county order KEMSA receipt



c) Turnaround time from facility order to KEMSA receipt

The turnaround time from facility order to receipt by KEMSA varied across counties. Figure 8 shows that Kitui county had the greatest improvement of 86% (from 55 to 8 days). On the other hand, Homa Bay county had the least improvement of 5% (from 37 to 35 days). This turnaround period includes about 14-21 days of handling at the county level where order validation, consolidation, necessary approvals and LPO generation are made.

Figure 8: Mean TAT from facility order to KEMSA receipt by county

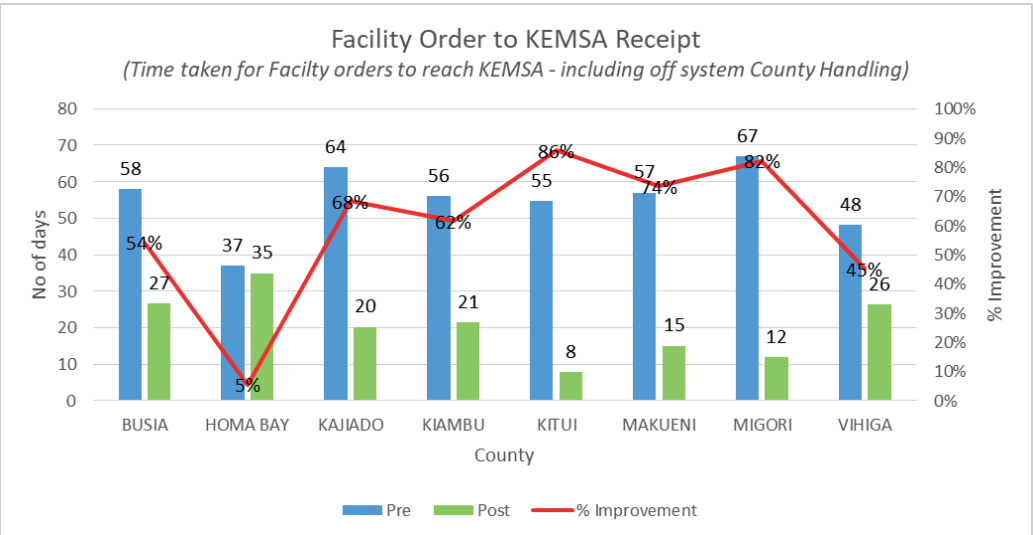
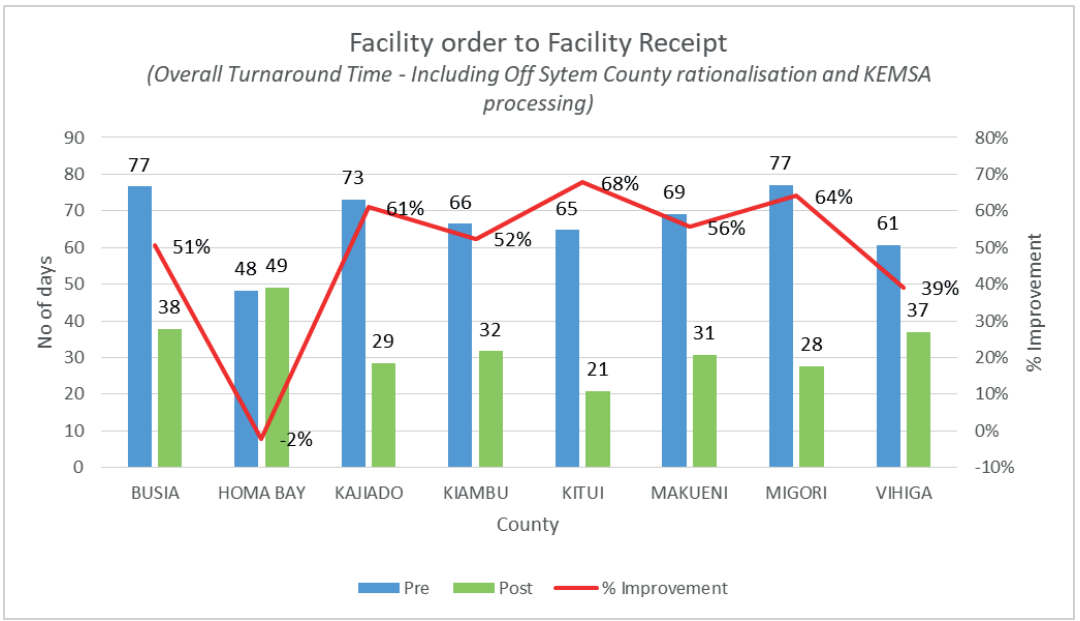


Figure 9 compares the overall turnaround times between the two periods pre- and post-intervention. As a result of the intervention, the turnaround time has significantly reduced across the 8 counties. The turnaround time reduced from an average of 64 days to 32 days. Kitui county registered the highest improvement of 68% and the lowest is Homa Bay county which appears to have a decline of 2% performance from 48 days pre intervention to 49 days for the post intervention period. The dip in performance is not indicative of system non-performance but of delays occasioned by factors outside the KEMSA LMIS/eMobile system. As far as what is done in the system is concerned, the average movement time of Homa Bay's orders from facility to county TAT was 1 day and from county Order to KEMSA receipt was 3 days totaling to 4 days. The delay was related to processes outside of the automated system: 30 days from when the county received the order to the time the order was forwarded to KEMSA, another 10 days for order processing by KEMSA and 5 days of order transit to the facility.

Figure 9: Mean TAT from facility order to receipt by County



On the overall, the 32 day average turnaround time was still high and reflects the entire supply chain process. That includes about 14- 21 days that orders are processed by the counties outside the LMIS/eMobile system, as well as another 7 days for KEMSA to process the order which involves selection, routing, loading and physical transit of commodities to the facilities.

iv. Effect of the system on turnaround times

Given that the evaluation only obtained data from 58 facilities that had both pre-intervention and post-intervention data, a chi-square goodness of fit test was conducted to ascertain whether the obtained sample from the 58 health facilities were significantly different from the expected sample from 69 health facilities. It had been expected that all the 69 facilities across the 8 counties would have data for both pre-and post-intervention. The test gave a significance of 0.785 suggesting that there was no evidence in the data that the distributions between the 69 (expected values) and 58 (observed) sites were different, though the sample size is small.

a) Facility order to county receipt

Results for the 58 facilities that were paired in the inferential statistics show that there was a change from 15.12 days, SD=3.124 pre-intervention to 1.61 days, SD=1.333 post-intervention in the mean turnaround time from facility order to county receipt of the order. Seemingly, the standard deviation figures show that there were more deviations and/or outliers in TATs pre-intervention compared to TATs in the post-intervention. This indicates that most TATs in the post-intervention period were closer to the mean than in the period before the intervention.

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair1	Facility to County pre-intervention	15.12	58	3.124	.410
	Facility to County Post-intervention	1.61	58	1.333	.175

A correlation of +.508 indicates that there was a moderate positive relationship between TAT scores pre-intervention and post-intervention.

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	Facility to County pre- & Facility to County post-intervention	58	.508	.000

In testing the significance of the change a mean TAT from facility order to county receipt improved by 13.5 days at 95% CI (12.8-14.2); ($t57 = 38.08$, $p < .01$) indicating a statistically significant change in turnaround time from facility order to county receipt.

b) County order to KEMSA receipt

As regards the turnaround time from county order to KEMSA receipt, results from the 58 paired facilities indicate that there was change in the turnaround time from 23.65 days, SD=10.183 to 0.98 days, SD=1.791 (almost real time). The standard deviation results imply that there were a lot of deviations/outliers in the TATs pre-intervention compared to the post-intervention period.

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 2	County Order to KEMSA Receipt pre-intervention	23.65	58	10.183	1.337
	County Order to KEMSA Receipt post-intervention	.98	58	1.791	.235

A correlation of -.581 indicates that there was a moderate negative relationship between TATS that were probably higher pre-intervention and those that were lower post-intervention.

Paired Samples Correlations

		N	Correlation	Sig.
Pair 2	County Order to KEMSA Receipt pre- intervention & County Order to KEMSA Receipt post-intervention	58	-.581	.000

There was statistically significant improvement in the mean TAT from county order to KEMSA receipt of 22.7 days at 95% CI (19.7-25.6); (t57 =15.257, p < .01) shows that the change was statistically significant.

Paired Differences

		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		T	df	Sig. (2-tailed)
					Lower	Upper			
Pair 2	County Order to KEMSA Receipt pre - County Order to KEMSA	22.673	11.317	1.486	19.697	25.648	15.257	57	.000

c) Facility order to facility receipt of commodities

Findings show change in the overall turnaround time from facility order to facility receipt of commodities from 64.21, SD=11.562 to 34.84 days, SD=11.352. Standard deviations for both before and after do not show huge variations.

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 3	Facility Order to Facility Receipt pre-intervention	64.21	58	11.562	1.518
	Facility Order to Facility Receipt post-intervention	34.84	58	11.352	1.491

A correlation statistic of -.505 indicates a moderate negative relationship in turnaround times before and after.

Paired Samples Correlations

		N	Correlation	Sig.
Pair 3	Facility Order to Facility Receipt before & Facility Order to Facility Receipt after	58	-.505	.000

An improvement in the mean TAT from facility order to facility receipt of the commodities of 29.4 days at 95% CI (24.1- 34.6); ($t57 = 11.25$, $p < .01$) shows a statistically significant change in the overall TAT from facility order to receipt of commodities. KEMSA LMIS/eMobile worked in reducing the various turnaround times investigated in this evaluation.

Paired Samples Test

		Paired Differences					T	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 3	Facility Order to Facility Receipt pre-Facility Order to Facility Receipt post-intervention	29.375	19.877	2.610	24.148	34.601	11.255	57	.000

QUALITATIVE ASSESSMENT

i. Background to the qualitative interview

An embedded qualitative study was conducted as part of the intervention's evaluation, consisting of one-on-one interviews with county pharmacists and sub-county pharmacists. The qualitative evaluation targeted a total of 8 county pharmacists and 69 sub-county pharmacists. However, Only 64 (7 county pharmacists and 57 sub-county pharmacists) interviews were conducted due to availability of the respondents. The above respondents were the system users from its inception to the time of the evaluation. Sub-county pharmacists place orders to the county pharmacists who then validate and send to KEMSA using the system.

ii. objectives

The specific objectives for the qualitative assessments were:

a. To assess the system adoption

b. To explore the system's use and functionality

c. To evaluate the benefits of the system

d. To explore challenges in using the system

e. To obtain recommendations about the system

iii. Methods

a) Sampling

Purposive sampling was used to recruit all the respondents who were key informants to the evaluation. The researchers recruited the county and sub-county pharmacists from all the 8 counties and 69 health facilities. Inclusion criteria included those who had been trained and were using the system.

b) Data collection methods

One on one interviews were conducted using a structured interview guide (Appendix 3). Two researchers conducted the interviews where one moderated and the other took notes. The notes were transcribed in word format for analysis. All participants signed a consent form (Appendix 2) before participating.

c) Qualitative analysis

The analytical approach to the development of the themes from the qualitative data focused on the following four key themes
(i) system adoption,
(ii) system use and functionality,
(iii) benefits,
(iv) challenges, and
(v) recommendations. Findings are presented per theme in table 4.

iv. Qualitative Findings

TABLE 4: QUALITATIVE DATA ANALYSIS			
THEME	**SUB-THEMES**	**KEY Findings**	**QUOTATIONS**
System adoption	System use	All County pharmacists reported that they had heard about the system and even interacted with it.	• "Yes, I have interacted with the system". • "Yes, the system works and can capture the order tracking and the order turnaround time." -County Pharmacist • "Yes, I have used the system for ordering, tracking, I get to know the stock status, and I am able to generate proforma invoices." -County Pharmacist • "KEMSA eMobile can be used to track orders at various levels/stages. It can be used to report order/supplies complaint. I last used the system around June -2018."- County Pharmacist
		Some Sub-County pharmacists reported that they had heard about the system and interacted with it	• "Yes. I know about the system and have interacted with it."- Sub-County Pharmacist
System Use /Functionality	Experiences using the system	County pharmacists use the system for four key functions; editing ,approval , and tracking of orders, submission to KEMSA	• "Yes, I use it to upload and approve orders for all the facilities."-County Pharmacist • "Yes, for LMIS/eMobile. I use it to update orders & submit to KEMSA, approve at facility, sub-County and County. I can also edit orders before uploading."- Sub-County Pharmacist
		Sub-County pharmacists use the system for ordering, editing ,approval and submission to the County	• "I have used KEMSA LMIS/eMobile to upload and edit orders from the facilities within my sub-County."- ."- Sub-County Pharmacist

Benefits		Some users in interviews claimed as a benefit the accessibility to the system through mobile phone;	• "The tool is convenient because one can access it using the mobile phone -Sub-County pharmacist."
Challenges	Technological	Majority of the respondents raised connectivity as a main challenge to use the system. Some respondents raised compatibility issues with IOS gadgets for the eMobile application runs on Android only.	• "The only challenge I have experienced regarding the system is network connectivity at times hence delaying the ordering time."-County Pharmacist • "Internet connectivity is an issue as there's no budget for internet."-Sub-County Pharmacist • "I find it time consuming because it takes a long time to load."-Sub-County Pharmacist • "Compatibility with iOS is a huge challenge i.e. iPhone and iPad"-Sub-County Pharmacist
	User Capacity	Most of the respondents lack enough training, especially for new staff. Some of the respondents mentioned lack of User Manual to help them navigate through the system.	• "Training was done well though not all users currently using the system were trained."-County Pharmacist • "I have experienced some user challenges- I won't blame the training so much. I would recommend refresher training. Sometimes you forget. Is there a report we can get? Can it help me track or look at historical data?"-Sub-County Pharmacist • "More health staff especially at lower level facilities need to be trained on usage especially on pack size vs what to order"-Sub-County Pharmacist

	Administrative	Some of the respondents stated that they were not given access rights to LMIS in good time. Some respondents wanted to track the order by facility name in addition to MFL code. Some respondents pointed out that the ordering tool is frequently changed by KEMSA. Some respondents complained that in order to upload orders they have to use their personal internet bundles. There is no budget provided by County for Internet.	• "I also lack user credentials to access the new system version."-Sub-County Pharmacist • "Changes on templates frequently bring challenges especially when the internet is not consistent."-Sub-County Pharmacist • "Connectivity is not guaranteed, this is because server's reachability is an issue and there is no connectivity, so the sub-County pharmacists have to use their own bundles to upload the orders."-Sub-County Pharmacist
Recommendations	Technological	Majority of respondents from facility level noted that access to commodity stock status to give them visibility of the quantities available at KEMSA would be a useful feature for the system. Some users recommended an improvement on system to accommodate multiple users at the same time.	• "Let the LMIS inform the user of the quantities that are left in stock so that they can make an informed decision. We should be able to view commodities available in KEMSA."-Sub-County Pharmacist • ""I would recommend that you incorporate inventory management into the system."-Sub-County Pharmacist • "The system should be configured in a way to accommodate many users if they log in at the same time." Sub-County Pharmacist • "Allow giving back of feedback via the LMIS – eMobile system-Sub-County Pharmacist

		A few respondents suggested the establishment of a helpdesk to get feedback and assistance for users. One respondent wanted to have expanded functionality for order analysis.	• "Add analysis of orders to show fill rates based on order value and item so that it can be at a click of a button." -Sub-County Pharmacist • "Add a field for facility name in the system instead of just MFL code." -Sub-County Pharmacist
	User Capacity	Almost all of respondents emphasized the importance of continuity of training support through conducting initial and refresher trainings for facility staff on regular basis. Many respondents made recommendations that the standard User Manual would be helpful for efficient use of the system.	• "Automate the ordering process to reduce the time taken to calculate the required quantity and to guide the user on proper quantification; Similar to the VAN tool."- County Pharmacist • "Provide manuals on how to use the system."- Sub-County Pharmacist
	Administrative	Some respondents recommended having an option to make orders directly from facilities to KEMSA. Most of the respondents strongly advised the County governments to make timely payments to KEMSA for commodities to facilitate timely order processing and delivery of commodities.	• "There is need for facilities that have not been provided with the rights to order directly to do so."- Sub-County Pharmacist • "Let the County government embrace the system and make payments promptly." –County Pharmacist

CONCLUSIONS

The lack of pre-intervention records implies poor record keeping at the facility level. This situation is a call to automate or continue using electronic systems processes in public facilities to ensure the ongoing availability of records. Quantitative results demonstrated that ordering processes done within the KEMSA LMIS/eMobile system have significantly improved. The system has resulted in near real-time TATs in ordering commodities from facilities to counties and from counties to KEMSA by eliminating manual ordering and travels as follows:

- Mean turnaround time from facility order to county order improved from 15 days to 1 day.
- Mean turnaround time from county order to KEMSA receipt improved from 24 days to 1 day.

Although the overall turnaround time has significantly improved, there are still some bottlenecks related to factors outside the system. These factors include order confirmation, consolidation and LPO generation at counties as well as KEMSA order processing including picking, loading, routing, dispatch and physical transit. These factors contribute to some delays in ordering and delivery of commodities leading to the following turnaround times:

- Facility order to KEMSA receipt of the order improved from 53 to 20 days.
- Facility order to receipt of commodities improved from 64 to 32 days.

The qualitative data sought to evaluate the KEMAS LMIS/eMobile system with a focus on:
(i) system adoption
(ii) system use and functionality,
(iii) benefits,
(iv) challenges, and
(v) recommendations

(i) System adoption

It was evident that all the county and sub-county pharmacists had heard about the system and interacted with it. The high level of awareness and interaction imply that the implementation process of the project was successful. Users were open to adoption of the system.

(ii) System use and functionality

The county pharmacists use the system for ordering, editing, approval, and, tracking of orders. However, the sub-county pharmacists can only use the system for ordering, editing and approval of orders. This was attributed to the different roles assigned to the users.

(iii) Benefits

The system was said to be beneficial to the users. The ordering process was reported to have improved as a result of using the KEMSA eMobile. This was attributed to its design and functionalities.

(iv) challenges

Despite the fast adoption and benefits of the system, some challenges were conversely raised. Some respondents reported technological gaps, user capacity and administrative challenges.

RECOMMENDATIONS

Overall, findings from both quantitative and qualitative data show that the intervention worked in reducing the turn-around time from facility order to receipt of commodities, making it a worthwhile intervention. However, there were suggestions on a number of things.

Firstly, some of the sub-county pharmacists requested for visibility of stock. Although this functionality is already in the system, it has been restricted due to administrative challenges such as users placing huge orders and types of drugs that may not be required but because they have seen that KEMSA has stocks. This suggestion requires further deliberations to look into ways of extending the rights.

Secondly, participants recommended the need for continuous or refresher training. Majority of the participants had only been trained once. It was noted that in some instances, the KEMSA regional officers were providing on job training to pharmacists. This could be leveraged to ensure that there was continuous capacity building. Several respondents expressed the need to have a user manual for the system users to be able to make references when in need.

Thirdly, although the intervention had generally reduced the turnaround time, there were still delays in the process related to factors outside the KEMSA/LMIS automated system. Delays in payment by county governments and manual procedures were reported to hamper turnaround time. For example participants identified the need to automate monthly consumption rates of supplies to support timely planning and supply requisition.

CURRENT STATUS

This evaluation analyzed data through the end of 2017. However, to get an understanding of the current status, an analysis was conducted on a country-level data abstracted from KEMSA LMIS database for the period July 2018 to March 2019. Figure 9 shows that the highest number of days is 11 in November 2018, while the least number of OTT achieved is 7 in the December 2018. Results show that KEMSA continues to work to achieve the target order turnaround time (OTT) of 7 days. This has already been achieved in the 4 counties - Kisumu, Nyeri, Machakos and Isiolo- where the Government of Kenya has launched the Universal Health Coverage pilot program.

Figure 9: Monthly Mean TAT from facility order to receipt of commodities (July 2018-March 2019)

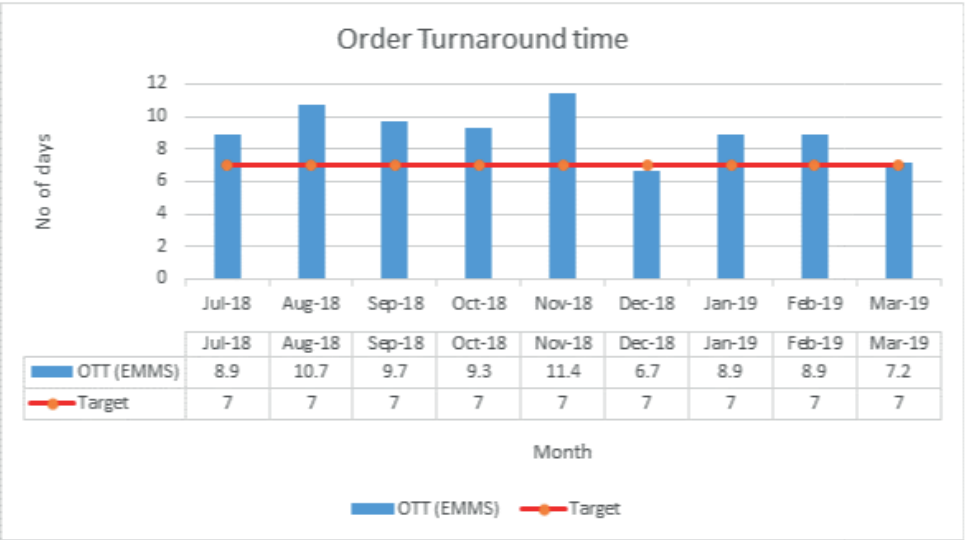


Table 5 shows that the current mean OTT stands at 18.9 days inclusive of all the off the system processes which are still being done manually.

Table 5: Current overall mean order turnaround time for the period (July 2018-March 2019)

Facility to Sub- county	Sub county To county	**County processing and validation** *(Dependent on the county processes. Off the system validation of orders before submission)*	County submission To KEMSA Receipt	**KEMSA receipt to Facility receipt** (Off the LMIS system. Includes picking, loading and transportation)	System movement	Total OTT (days)
0.10198	0.82550	8.46361	0	9.6	0.92	18.9

DISSEMINATION PLAN

The final approved evaluation version of this report will be posted on a publically accessible websites (CDC, KEMSA, mHealth Kenya websites) within 90 days of clearance. Presentations will be made to key stakeholders at the Ministry of Health and other partners.

At least one abstract will be developed for presentation at a key conference. At least one manuscript will be drafted for publication in a relevant journal.

CONFLICT OF INTEREST STATEMENT

Procedures were put in place during protocol development, the review process and monitoring of data collection activities, to ensure that the results are credible and biases were mitigated. In addition, the PI and other investigators declare that they have no conflict of interest.

APPENDICES

Appendix1: Quantitative Data collection tool

Appendix 2: Consent form for qualitative assessment

Appendix 3: KEMSA/eMobile Interview guide

Appendix 4: Participant Agreement for the Head of the health facility/implementing partner

Appendix 5: Evaluation Budget

Appendix 6: KEMSA evaluation implementation plan

Appendix 7: Qualifications of key investigators

Appendix 8: Data presentation using box plots and analysis using nonparametric methods

Appendix I: Quantitative Data collection tool

MFL Code								
County								
No	Commodity order number	Order date from Facility	Order sent Date By County	Order Receipt Date By KEMSA	Commodities Dispatch Date from KEMSA	Commodities Receipt Date at Facility	Information Source (Delivery notes)	Remarks

Appendix 2: Consent form for qualitative assessment

KEMSA eMobile evaluation Consent form

Hi, my name is …….. from the MOH/mHealth Kenya.

You are invited to participate in the KEMSA evaluation interviews.
Please read this document in full before deciding whether to participate. Feel free to ask me any questions, or contact these people for more information:

Principal investigator:
Dr Cathy Mwangi
mHealth Kenya
Mobile phone: 0712636688
Email: drcmwangi@mhealthkenya.org

Co-Principal Investigator:
Wataku, Samuel
Kenya Medical Supplies Authority (KEMSA), Ministry of Health
Mobile Phone: 0714619338
Email: samuel.wataku@kemsa.co.ke

What is the KEMSA eMobile evaluation?
The KEMSA eMobile is an innovation that included the use of mobile phone technology to help in the ordering, managing and tracking health commodities. The procedures and processes involved are tracking commodities from KEMSA warehouses to delivery at the health facilities, and facility staff to ordering commodities from KEMSA at the facility level. The objective of this evaluation will be to assess routine KEMSA MoH commodities management to gauge time-related efficiencies gained in tracking commodity supplies and orders to and from health facilities after using mobile technology.

As part of the **KEMSA eMobile intervention,** your facility or department has been using (either KEMSA eMobile or SMS printers). The partners want to find out more what worked and what did not work regarding the interventions. You have been chosen to take part in interviews because we are interested in your opinions about the systems.

What does the evaluation involve?
If you agree, we will ask you to attend an interview with a member of the study team (one-on-one).

The interviewer will ask you to share your thoughts and feelings about either (KEMSA eMobile), including:

- What you liked and didn't like about the systems;
- How you felt and acted with the system(s);
- Whether implementing the system (KEMSA eMobile) had reduced turnaround time for commodities.

The interview will last about 30 minutes. You can choose to do the interview in English or Kiswahili. It will be recorded (sound only, not video), transcribed (written down) and translated into English (if in Kiswahili).

What if you don't want to participate?
Your participation is completely voluntary. There is no penalty if you decide not to do an interview. You can still take part in other services or programs being implemented by partners.

If you want to take part, you will need to sign the consent form. This means that you understand and agree with the information here.

During the interview, you don't have to answer any questions that you don't want to. There is no right or wrong answers to the questions. You may stop the interview at any time if you don't feel comfortable.

Benefits of being in the study
You may find it enjoyable and helpful to share your opinions on the system.

You can help us understand how the systems worked or didn't work, and how we can make it better in the future. This could help in enhancing the system for future benefits to the citizens who seek medical services at Government owned health facilities

Risks of being in the study
There are no risks of participating in this study. However, if participation causes you distress, or something happens you may choose to stop the interview at any time.

Payment
You will not be paid for taking part in this study. However, your participation will be highly appreciated.

Confidentiality and privacy
The information you give will remain private. Your name and contact details will be kept separate from your answers to the interview questions. We plan to publish the results in reports and journal articles, and we may present the results at conferences. We may publish quotes from the interviews but will not use names or other identifying information. We will never publish any information that could be used to identify you or people you have told us about.

How will we store your information?
The audio recordings and documents containing your answers to the interview questions will be stored on a computer. They will only be accessible by the research team using a password. Your name will not be written on these documents. Your contact details will be kept in a private secure computer file only accessible to the members of the research team in case they need to contact you.

The paper records will be stored in locked filing cabinets mHealth Kenya. The consent form, which contains your name, will be stored separately from the other documents.

The information collected will be stored for at least 5 years. It will then be destroyed if it is no longer required.

Results
Publications from this research will be available on the MOH, CDC-PEPFAR, and KEMSA and mHealth websites.

Complaints
This research has been approved by Kenya Ministry of Health and by the Associate Director for Science at the Centers for Disease Control and Prevention (CDC). These institutions help protect study participants from harm. If you have any questions about your rights as a participant, or complaints about the study, please contact one of the following people:

Thank you
Dr. Mwangi Cathy PI

CONSENT FORM/CERTIFICATE

I have been asked to take part in the KEMSA evaluation interviews. I have read and understood the Information Sheet and I agree to participate.

Name of participant:

Name of participant: _____

Participant Signature (or thumb print)*:_____ Date: _____

*Name of witness (for participants unable to sign): _____

Witness signature: _____ Date: _____

*Name of Researcher _____

Researcher signature: _____

Appendix 3: KEMSA eMobile Interview guide

Name of Interviewee: _____ **Designation** _____

County: _____ **Sub-County:** _____

Facility Name:_____

Interview guide

1. Are you aware of the KEMSA LMIS/eMobile system? Probe LMIS, Probe KEMSA eMobile

2. Have you ever used the system? If yes probe the role (uploading, approving, editing)

3. Is the KEMSA LMIS/eMobile a suitable means of managing supplies? Probe for LMIS, Probe for KEMSA eMobile, if yes or no probe why

4. Do you think the KEMSA LMIS/eMobile helps in ordering, tracking and delivery of commodities? Probe in what ways?

5. Please rate your experience using the KEMSA LMIS/eMobile system? (Rate from 1-5 – where 1 is Very bad & 5 is Excellent) Probe why & was it easy to use/difficult/availability/connectivity?

Explain…….....

…….

…….....

6. What challenges do you experience using the KEMSA LMIS/eMobile? Probe connectivity of the App/coverage, user challenges, Training challenges, implementation process

7. What are the benefits of using the KEMSA LMIS/eMobile? Probe convenience, time saving, cost, availability, efficiency

8. What lessons have you learnt from using the KEMSA LMIS/eMobile?

9. What could be done to enhance the use of KEMSA LMIS/eMobile system?

Appendix 4: Participant Agreement for the Head of the health facility/implementing partner

Project Title: Evaluation of the US President's Emergency Plan for AIDS Relief (PEPFAR) funded mobile health (mHealth) initiatives in improving HIV/AIDS health care services in Kenya, 2012-2015

Introduction

This form contains information seeking your consent for participating in this study. The study is being funded through mHealth Kenya limited. Our plan is to review KEMSA commodities ordering records. We will also be interviewing one or more staff members at each health care facility and one or more staff members of implementing partners. Each interview will take approximately 30 minutes. There is no right or wrong answer to the questions that we will be asking. We do not believe that we are asking any sensitive questions, but you are free to not answer any question you wish or to stop the interview at any time. Refusing to take part will not have any effect on your job at the health care facility or with the implementing partner.

Your staff members do not have to agree to participate in this assessment. If they decide not to participate, their participation in this study will not disadvantage them or you as the head of this health facility/partner in any way. It will not affect your work and those of the other staff. Your taking part in this evaluation is voluntary; however, your inputs are very valuable to us. We will not be recording your name or any other personal information about you. If you agree to allow the staff to take part, we want them to share their perceptions and opinions on the KEMSA intervention and their thoughts on how it can be improved. If you or they decide to take part, the information that you provide should not harm you in any way. You are being asked to allow your staff to take part in this assessment as a supervisor at this health facility/partner site because the service providers are under your supervision

Possible Benefits and Compensation

You will not be given any money for taking part in this study; however, your input and those of the other service providers who will participate will help in improving delivery of efficient services using technology.

If you say no or change your mind

If you change your mind after saying yes, you may leave the study in between. In such a case, we will not use any information you shared for this study. This will not affect your position in your organization.

Confidentiality

We will do everything to protect the information you provide and your participation in this study. Only persons working directly on this project will have access to your interview. We will use all the information you provide only for this study. Your name will not be used or mentioned anywhere in the project report. Only project staff will have access to the non-personally-identifiable interview data.

Feedback on our findings will be provided to the implementing partner staff after the completion of the evaluation and it will be disseminated to you and other stakeholders. As stated above, your name or any other personal information about you or your staff will not be recorded. Your responses to the interviews will only be identified by a unique code which will identify the health care facility or the implementing partner. Results will be combined before reporting to others.

Possible Risks

There is a very little chance that someone else could know about your participation in this study. But we will do everything to prevent that from happening.

If you have a problem or have other questions

If you have any questions about taking part in these interviews or about the assessments, please ask them now. Your taking part in the interviews will indicate that you agree to take part in this part of the assessments. It will also indicate that you have had the opportunity to ask any questions about this and that these have been answered to your satisfaction. If you have any further questions, please contact:

Chief investigator: Dr. Cathy Mwangi
Mobile phone: 0712636688
Email: drcmwangi@mhealthkenya.org).

OR

Samwel Wataku
ICT Manager, Kenya Medical Supplies Authority (KEMSA),
Ministry of Health
Mobile phone: +254 714619338
Email: samuel.wataku@kemsa.co.ke

You will be offered a copy of this consent document for your records.

Do you agree to participate in this study? YES _____ NO _____

Please sign below if you agree to be in this study. By signing this consent form, you will not give up any of your legal rights. A copy of the signed consent form will be provided to you to keep.

Name of Subject: _____

Signature: _____

Date: _____

Interviewer:

I have read this informed consent form aloud to the interviewee and confirm that he/she agrees to take part in this interview.

Name of the interviewer: _____

Signature of the interviewer: _____

Date: _____ Facility code: _____

Complaints

This research has been approved by the ethics committee at the University of Nairobi/Kenyatta National Hospital. It was also reviewed in accordance with the Centers for Disease Control and Prevention (CDC) human research protection procedures and was determined to be research, but CDC investigators did not interact with human subjects or have access to identifiable data or specimens for research purposes. These committees help protect research participants from harm. If you have any questions about your rights as a participant, or complaints about the study, please contact one of the following people:

Professor M.L. Chindia Secretary
Kenyatta National Hospital Ethics and Research Committee
Tel. (020) 2726300 ext. 43791 or 44102

OR

Professor A.N. Guantai Chairperson
Kenyatta National Hospital Ethics and Research Committee Tel. (020) 2726300 ext. 43524

Appendix 5: Evaluation Budget

	KEMSA eMobile Evaluation Actual Expenditure		
	ROE 1USD=100KES	**Total Amount (KES)**	**Total Amount USD**
A	Salaries and Wages	1,402,529.86	14,025.30
B	Fringe Benefits	912,421.00	9,124.21
C	Supplies	110,000.00	1,100.00
D	Travel	2,480,907.20	24,809.07
E	Other	335,684.54	3,356.85
		5,241,542.60	**52,415.43**
	Projected Dissemination costs (To be done)		4,999.00
			57,414.43

Appendix 6: KEMSA evaluation implementation plan

Key activities schedule

Serial	Activity Name	Start date mm/dd/yy (Estimated)	Finish date mm/dd/yy (Estimated)	Duration in days	Status
Activities for both evaluation					
1.	Get full approval of the protocol from CDC	8/1/2018	8/16/2018	5	Done
2.	Get budget approval and disbursement of funds by Cardno	10/3/2018	11/9/2018	14	Done
3.	Preliminary/Initial sensitization meeting with key stakeholders	11/12/2018	11/16/2018	1	Done
4.	Developing electronic data abstraction tools and databases	11/12/2018	11/16/2018	5	Done
5.	Assemble equipment (recorders/data collection materials)	11/19/2018	11/23/2018	7	Done
6.	Recruit data collectors -KEMSA	1/2/2019	1/4/2019	2	Done
7.	Train KEMSA data collection team	1/7/2019	1/11/2019	3	Done
8.	Field Data Collection	1/14/2019	1/25/2019	15	Done
9.	Data Cleaning and Data analysis	1/28/2018	2/15/2019	15	Done
10.	KEMSA report writing meeting	2/25/2019	3/01/2019	5	Done
11.	Review of the report and final draft by all investigators	3/03/2019	4/1/2019	15	Done
12.	Obtain approvals	4/2/2019	6/02/2019	60	TBD
13.	Dissemination of the report				TBD

Appendix 7: Qualifications of key investigators

Principal Investigators

Bio Data

1. **Name: Dr. Cathy Mwangi**
   Email: drcmwangi@mhealthkenya.org
   Contacts: 0712636688
   Nationality: Kenyan
   Profession: Business and Health Administration
   Specialization: Public Health, Project Management and Health Information Systems Development
   Current Position: Chief Executive Officer/Principal Investigator

Key Qualifications & Experience

Cathy Mwangi is a senior business and public health executive experienced in providing business and technology solutions for organizations in the United States and Kenya, with over 20 years' experience in business management, health care management and public health.

Cathy has a PhD in Health Administration from Warren National, USA and pursuing a second one in Health Communication at Jomo Kenyatta University of Agriculture and Technology. She has a Master in Business Administration from Strayer University, USA.

Cathy has been privileged to work with some of the finest academic and health institutions, i.e. Computer Career Institute at Johns Hopkins University in Maryland; University of Maryland Medical Systems; Georgetown University Hospital, Washington, DC; NextGen Health Systems, Maryland; Aga Khan University Hospital, Nairobi; CDC Foundation and mHealth Kenya.

She is currently the Chief Executive Officer of mHealth Kenya, which was an incubation of CDC Foundation through a public private partnership with the mandate to implement mobile solutions to improve care and treatment in the public health in Kenya.

In her current appointment at mHealth Kenya, she has worked in partnership with CDC Foundation, CDC Kenya, CARDNO, UNICEF, UN Foundation, mHealth Alliance, mHELP, Bloodlink Foundation, Ministry of Health, Kenya Medical Supply Authority (KEMSA), Kenya National Blood Transfusion Services, and National AIDS and STI Control Program (NASCOP). Dr. Cathy Mwangi was the principal investigator in the evaluation.

Academic Qualifications

2018 Certificate, Scale for Success, Transformational Business Network, Kenya
2007 PhD in Health Administration Warren National, USA
2017 PhD in Health Communication JKUAT, Kenya (Ongoing)
2003 Masters in Business Administration, Strayer University, USA
1992 Bachelors of Arts, Education, Kenyatta University, Kenya

2. Name: Samuel K. Wataku
Email: skwataku@gmail.com

Technical Qualifications

PMI Certified Project Management professional (PMP)
PMI Certified Risk Management Professional (PMI-RMP)
ISACA Certified in the Governance of Enterprise IT (CGEIT)
ITIL Expert
ITIL V3 Managers Bridge
ITIL Manager Certification in IT Service Management
ITIL Foundation Certification in IT Service Management
PCI Change Management Practitioner Certification

Academic Qualifications

Masters of Arts in Project Planning and Management – University of Nairobi (2011)
Bachelor of Science (Mathematics & Computer Science): - Kenyatta University (1993)
Kenya Advanced Certificate of Education, Kirangari High School (1988)
Kenya Certificate of Education, Karai Day Secondary School (1986)

Co-investigators and Coordinators

1. Mukanya Collins Mudogo, P.O Box 9610-00100, Nairobi, Kenya
Contacts: Mobile Phone: 0726095677; E-Mail Address: mudogo@mhealthkenya.org

Academic Qualifications

2018 – Now- Ph. D. In Monitoring and Evaluation - University Of Nairobi (Ongoing)
2014 - 2016 -Master of Arts Degree in Sociology (Medical Sociology)-University of Nairobi
2007 - 2011 -Bachelor of Arts Degree (Anthropology and Human Ecology) - Moi University

Professional experience

2017 - Now - Research, Monitoring and Evaluation Officer-mHealth Kenya
2015 – 2016-Project Manager and Co-Investigator -International Centre for Reproductive Health (ICRH)
2013 - 2015 -Project Officer - University of Manitoba
2011 - 2012 -Social Science Researcher -Population Council
2010 - 2011 -Facilitator and Trainer Project Management and Proposal Writing -World Voices Positive in Kenya

2. Dennis Ndwiga Migwi
Email: dennis.ndwiga@kemsa.co.ke

Academic Qualifications

2012-2015: University of Wales
Masters of Science in Advanced Information Technology and Business Management

2004-2009: Jomo Kenyatta University of Agriculture and Technology (JKUAT)
Bachelors of Science Biomechanical and Processing Engineering

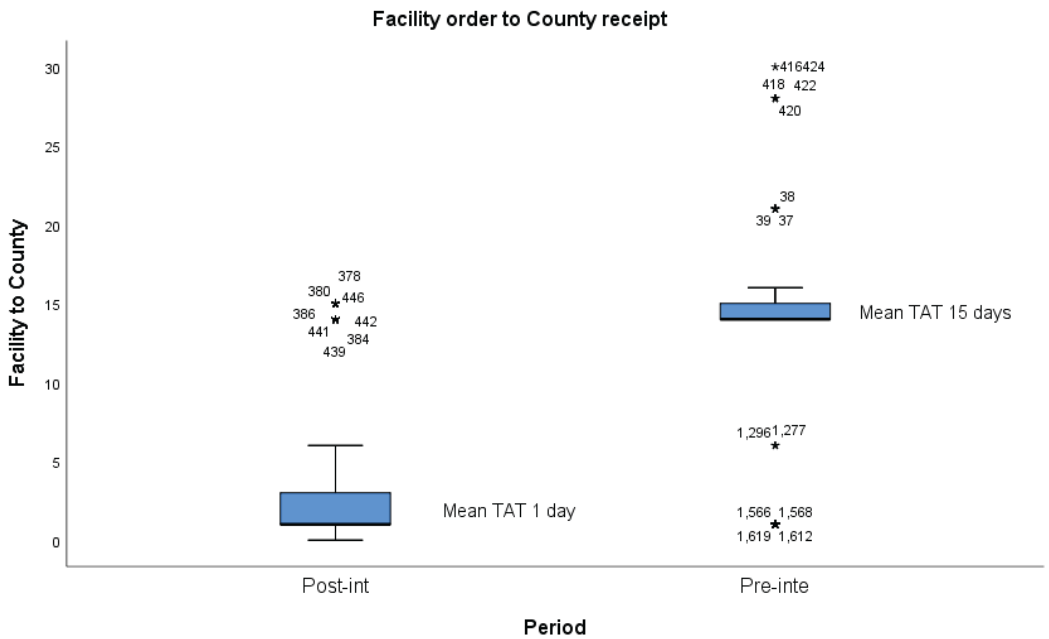
2003 – 2004: Strathmore University
Diploma in Institute for the Management of Information System (IMIS)
Professional experience

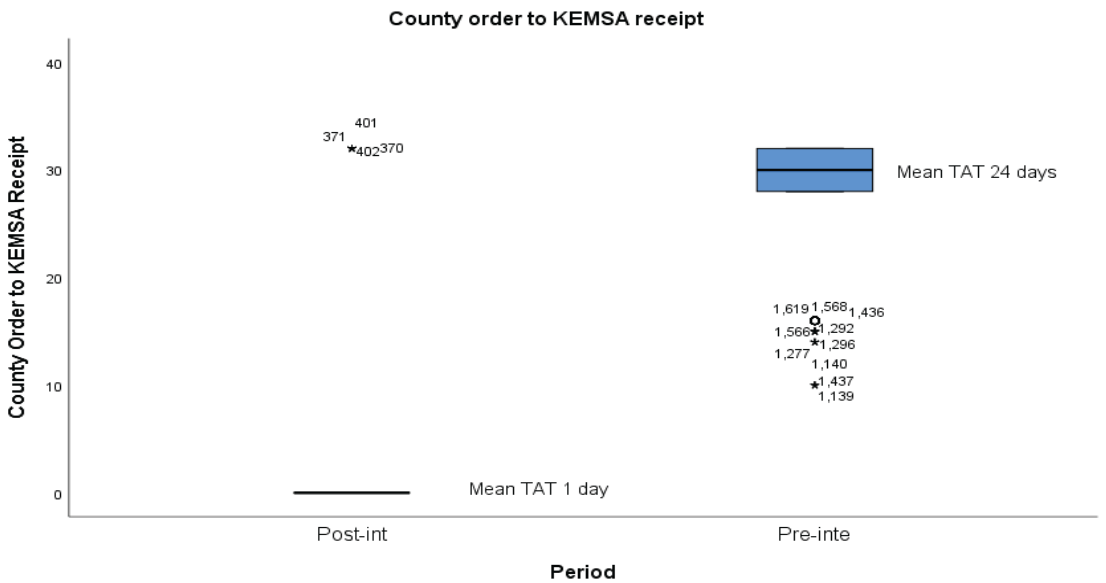
2014 – Currently at Kenya Medical Supplies Authority (KEMSA) Working as Project specialist-KEMSA LMIS/e-mobile

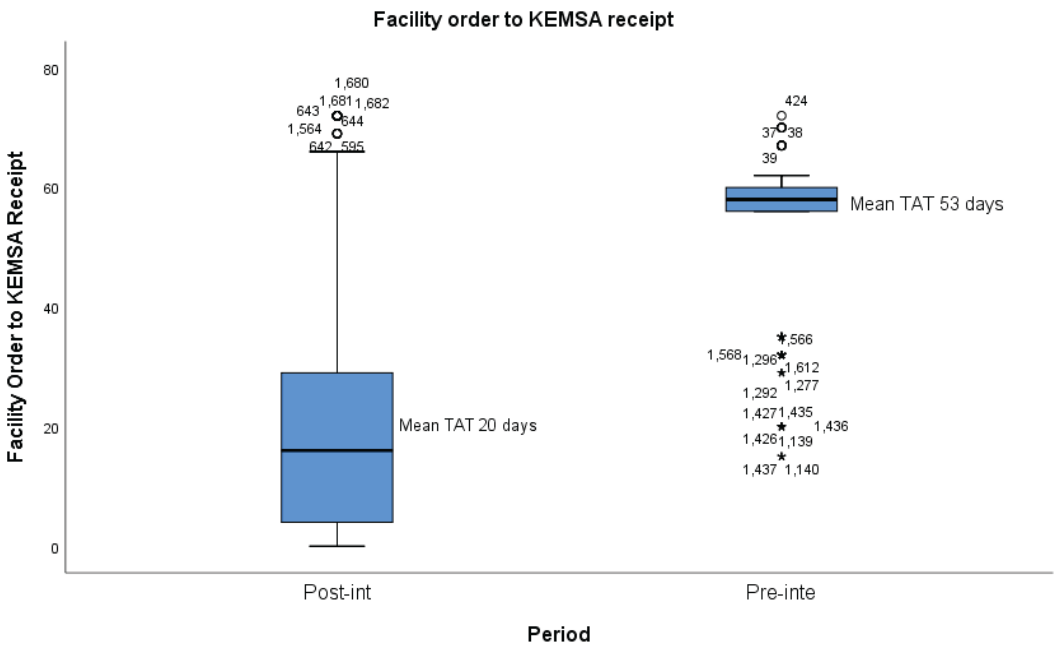
Sept 2012-2014: Kenya Medical Supplies Authority (KEMSA) working as Senior Business Analyst

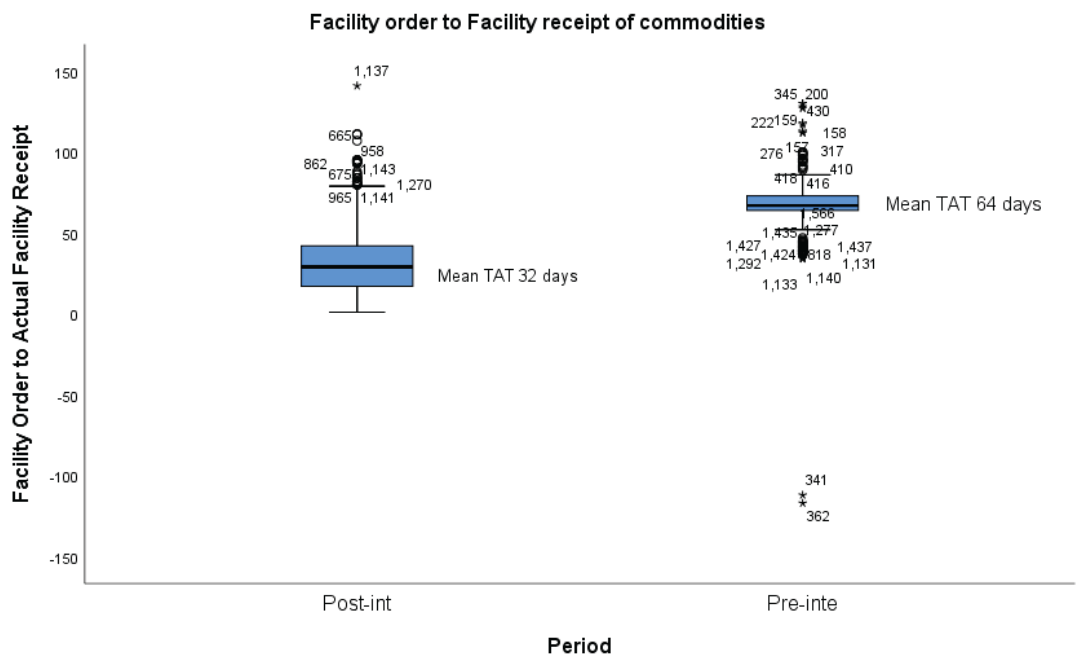
Appendix 8: Data presentation using box plots and analysis using non-parametric methods

Box plots






Facility order to KEMSA receipt
Facility Order to KEMSA Receipt
80
60
40
20
0
1,680
1,681
1,682
643
644
1,564
642
595
424
37
38
39
Mean TAT 53 days
Mean TAT 20 days
566
1,568
1,296
1,612
1,277
1,292
1,427
1,435
1,436
1,426
1,139
1,437
1,140
Post-int
Pre-inte
Period


Facility order to Facility receipt of commodities
Facility Order to Actual Facility Receipt
150
100
50
0
-50
-100
-150
1,137
665
958
862
675
1,143
1,270
965
1,141
345
200
430
222
159
158
276
317
410
416
566
1,427
1,292
1,424
818
1,437
1,131
1,133
1,140
341
362
Mean TAT 32 days
Mean TAT 64 days
Post-int
Pre-inte
Period

Non-Parametric analysis

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
facilitytocountypost - pre_facilitytocounty	Negative Ranks	452[a]	226.50	102378.00
	Positive Ranks	0[b]	.00	.00
	Ties	0[c]		
	Total	452		
countytokemsapost - pre_countytokemsa	Negative Ranks	357[d]	182.98	65323.00
	Positive Ranks	5[e]	76.00	380.00
	Ties	90[f]		
	Total	452		
facilitytikemsapost - pre_facilitytokemsareceipt	Negative Ranks	386[g]	249.06	96136.00
	Positive Ranks	64[h]	83.42	5339.00
	Ties	2[i]		
	Total	452		
facilityordertoreceiptpost - pre_facilityordertofacilityreceipt	Negative Ranks	369[j]	246.09	90808.50
	Positive Ranks	82[k]	135.58	11117.50
	Ties	1[l]		
	Total	452		

a. facilitytocountypost < pre_facilitytocounty

b. facilitytocountypost > pre_facilitytocounty

c. facilitytocountypost = pre_facilitytocounty

d. countytokemsapost < pre_countytokemsa

e. countytokemsapost > pre_countytokemsa

f. countytokemsapost = pre_countytokemsa

g. facilitytikemsapost < pre_facilitytokemsareceipt

h. facilitytikemsapost > pre_facilitytokemsareceipt

i. facilitytikemsapost = pre_facilitytokemsareceipt

j. facilityordertoreceiptpost < pre_facilityordertofacilityreceipt

k. facilityordertoreceiptpost > pre_facilityordertofacilityreceipt

l. facilityordertoreceiptpost = pre_facilityordertofacilityreceipt

Test Statistics[a]

	Facility order to County receipt post - Facility order to County receipt pre-intervention	County order to KEMSA receipt post-County order to KEMSA receipt pre-intervention	Facility order to KEMSA receipt post-Facility order to KEMSA receipt pre-intervention	Facility order to Facility receipt of commodities post-Facility order to Facility receipt of commodities pre-intervention
Z	-18.854[b]	-16.649[b]	-16.448[b]	-14.388[b]
Asymp. Sig. (2-tailed)	.000	.000	.000	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

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