Web Annex D: Tracking health commodity inventory and notifying stock levels via mobile devices (unpublished review)

Link to published protocol:

https://www.cochranelibrary.com/cdsr/doi/10.1002/14651858.CD012907/full

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Abstract

Background

Timely and reliable availability of essential medicines and health commodities is foundational to a responsive health system, and an area that is of much interest to governments, especially in low and middle income countries. The rapid expansion of mobile technologies offers potential low-cost solutions to the challenge of drug distribution and commodity availability in primary health care settings. However, the evidence on the use of mobile devices to address commodity shortages is sparse, and offers no clear way forward. To respond to this need, the World Health Organization (WHO) is establishing guidelines that aim to inform investments of digital health applications for strengthening tracking of health commodity inventory and stock notification.

Objectives

Primary objective

- To assess the effects of strategies for notifying stock levels and digital tracking of healthcare-related commodities and inventory via mobile devices.

Secondary objectives

- To describe what mobile strategies are currently being used to improve reporting and digital tracking of health commodities
- To identify factors influencing the implementation of mobile interventions targeted at reducing stock-outs of health commodities

Search methods

We searched Cochrane Central Register of Controlled Trials; (CENTRAL) in the Cochrane Library; MEDLINE Ovid; Embase Ovid; Global Health Library WHO; and POPLINE K4Heath on August 15, 2017. We searched the World Health Organization International Clinical Trials Registry Platform; and the US National Institutes of Health Ongoing Trials Register. We also searched Epistemonikos for related systematic reviews and potentially eligible primary studies. We conducted a grey literature search using mHealthevidence.org and issued a call for papers through popular digital health communities of practice. Finally, we conducted citation searches of included studies. We searched for studies published after 2000. We searched for studies in any language.

Selection criteria

Study design: For the primary objective we included individual and cluster-randomised trials; controlled before-after studies, provided they have at least two intervention sites and two control sites; and interrupted time series studies, if there is a clearly defined time point when the intervention occurred and at least three data points before and three after the intervention. For the secondary objectives: we included any study design, either quantitative, qualitative, or descriptive, that aimed to describe current strategies for commodity tracking or stock notification via mobile devices; or aimed to explore factors that influence the implementation of these strategies, including studies of acceptability or feasibility.

Types of participants: we included studies of all cadres of healthcare providers, including lay health workers and others involved in the distribution of health commodities (administrative staff, managerial and supervisory staff, dispensary staff); and all other individuals involved in stock notification who may be based in a facility or a community setting and involved with the delivery of primary healthcare services

Types of interventions: We included interventions aimed at improving the availability of health commodities using mobile devices in primary healthcare settings. By mobile devices, we mean mobile phones of any kind (but not analogue landline telephones), as well as tablets, personal digital assistants, and smartphones. Laptops are not included in this list. For the primary objectives, we included studies that compared health commodity tracking or stock notification via mobile devices with standard practice (i.e. non-digital and non-mobile, paper-based processes for stock management). For the secondary objectives, we included studies of health commodity tracking and stock notification via mobile device as long as we could extract data relevant to our secondary objectives.

Data collection and analysis

For the primary objective, two authors independently screened all records, extracted data from the included studies and assessed the risk of bias. For the analyses of the primary objective, we reported means and proportions where appropriate. We used the Grading of Recommendations Assessment, Development and Evaluation (GRADE) approach to assess the certainty of the evidence and we prepared a Summary of Findings table. For the secondary objective, two authors independently screened all records, extracted data from the included studies and assessed methodological limitations using the WEIRD tool. Results were summarized under key themes identified through a review of the data. We used the GRADE-CERQual (Confidence in the Evidence from Reviews of Qualitative research) approach to assess our confidence in the evidence and we prepared a Summary of Qualitative Findings table.

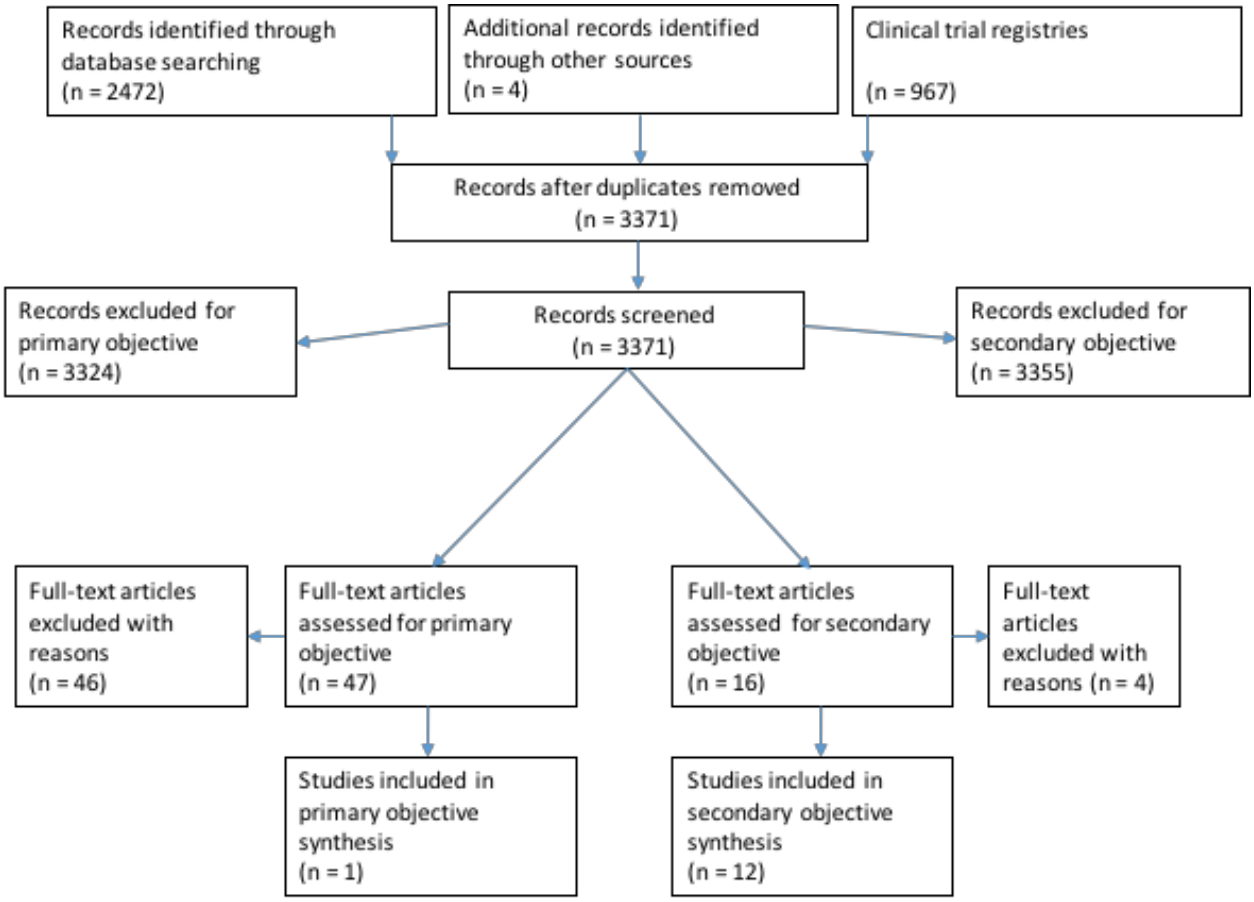
Main results

For the primary objective, we included one study, which used a controlled before-after study design and assessed the effect of a mobile system for stock notification and tracking. The study was conducted in Malawi and assessed outcomes related drug stock-outs, quality of data about stock management, time between stock level reporting and appropriate action and provider acceptability/satisfaction with the mobile system for stock notification. However, we are uncertain of the effect of the intervention on these outcomes because the certainty of this evidence was assessed as very low. The included study did not assess resource use or unintended consequences.

For the secondary objective, we included 12 studies that described a total of eight interventions. All studies were conducted in African countries (Tanzania, Kenya, Malawi, Ghana, Cameroon, Zambia, Liberia, Uganda and South Africa) and one was conducted in India. Most of the interventions aimed to make data about stock-levels and potential stock-outs visible to managers, who could then take corrective action to address it. We identified a number of factors that may influence the implementation of stock notification and tracking via mobile device. These include challenges tied to infrastructural issues such as poor access to electricity or internet (moderate confidence); and broader health systems issues such as drug shortages at the national level which cannot be mitigated by interventions at the primary health care level (low confidence). Several factors were identified as important, including availability of stock-level data at all levels of the health system

(low confidence); familiarity and training of healthcare providers in the use of the digital devices (moderate confidence); availability of technical programming expertise for initial development and ongoing maintenance (low confidence); Easy-to-use systems built with user participation (moderate confidence); data availability in a easy-to-use format such as an interactive dashboard (moderate confidence); and supportive supervision for effective adoption of the digital system (moderate confidence).

Figure 1: Study flow diagram



Authors' conclusions

We need more well-designed studies on the effect of using mobile devices for stock notification and on the factors that may influence the implementation of such interventions.

Summary of Findings A: Mobile stock notification with enhanced management

Mobile stock notification with enhanced management compared to standard care in primary healthcare settings

Patient or population: Healthcare providers and other health professionals involved in commodity/stock management
Setting: Primary healthcare setting in Malawi
Intervention: Mobile stock notification with enhanced management which involved quality improvement teams that were tasked with using the data supplied by the stock notification system
Comparison: Standard care involved routine stock management with mobile stock notification or any other digital intervention

Outcomes	**Standard care**	**Mobile stock notification with enhanced management**	Relative effect (95% CI)	№ of participants (studies)	Certainty of the evidence (GRADE)	What happens?
Availability of commodities						
Stock-out of drugs in the last 30 days - Stock-out of Cotrimoxazole (to treat bacterial infections)	167 per 1,000	**160 per 1,000** (82 to 317)*	**RR 0.96** (0.49 to 1.90)*	171 (1 non-RCT) Malawi[1]	⨁◯◯◯ VERY LOW [a,b]	**We are uncertain of the effect of this approach on stock-out of Cotrimoxazole because the certainty of this evidence was assessed as very low.**
Stock-out of drugs in the last 30 days - Stock-out of Artemether-Lumefantrine 2X6 (to treat malaria caused by Plasmodium facilparum)	189 per 1,000	**136 per 1,000** (68 to 272)*	**RR 0.72** (0.36 to 1.44)*	171 (1 non-RCT) Malawi[1]	⨁◯◯◯ VERY LOW [a,b]	**We are uncertain of the effect of this approach on stock-out of Cotrimoxazole because the certainty of this evidence was assessed as very low.**
Stock-out of drugs in the last 30 days - Stock-out of oral rehydration salts (ORS) (to treat dehydration)	256 per 1,000	**258 per 1,000** (156 to 432)*	**RR 1.01** (0.61 to 1.69)*	171 (1 non-RCT) Malawi[1]	⨁◯◯◯ VERY LOW [a,b]	**We are uncertain of the effect of this approach on stock-out of Cotrimoxazole because the certainty of this evidence was assessed as very low.**
Stock-out of drugs in the last 30 days - Stock-out of Zinc 20 mg (to treat diarrhea)	211 per 1,000	**209 per 1,000** (118 to 376)*	**RR 0.99** (0.56 to 1.78)*	171 (1 non-RCT) Malawi[1]	⨁◯◯◯ VERY LOW [a,b]	**We are uncertain of the effect of this approach on stock-out of Cotrimoxazole because the certainty of this evidence was assessed as very low.**
Quality and timeliness of stock management						
Quality of data about stock management	On average, 85% (n=393) of the intervention group participants who managed relevant medicines reported on stock-levels completely[c]. (Only intervention group assessed for this outcome thus non-comparable.)			N[2] (1 non-RCT) Malawi[1]	⨁◯◯◯ VERY LOW [a,b]	**We are uncertain of the effect of this approach on quality of data about stock management because the certainty of this evidence was assessed as very low.**

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Comparison: Standard care involved routine stock management with mobile stock notification or any other digital intervention

Outcomes	**Standard care**	**Mobile stock notification with enhanced management**	Relative effect (95% CI)	№ of participants (studies)	Certainty of the evidence (GRADE)	What happens?
Time between stock-level reporting and appropriate action	Health facilities took an average of 12.8 days to fulfil an order requested by the health surveillance assistants (lead time)[d]. (Only intervention group assessed for this outcome thus non-comparable.)			N[2] (1 non-RCT) Malawi[1]	⨁◯◯◯ VERY LOW [a,b]	**We are uncertain of the effect of this approach on quality of data about stock management because the certainty of this evidence was assessed as very low.**
Satisfaction and acceptability						
Provider acceptability/satisfaction	The proportion of intervention group participants who reported using the digital intervention (cStock) as the primary means for ordering health products was 97% (n=81). (Only intervention group assessed for this outcome thus non-comparable.)			N[2] (1 non-RCT) Malawi[1]	⨁◯◯◯ VERY LOW [e]	**We are uncertain of the effect of this approach on provider satisfaction with stock management because the certainty of this evidence was assessed as very low.**
Resource use						
Resource use	No studies were identified that reported on this outcome					**We are uncertain of the effect of this approach on resource use because no direct evidence was identified.**
Unintended consequences						
Unintended consequences	No studies were identified that reported on this outcome					**We are uncertain of the effect of this approach on unintended consequences because no direct evidence was identified.**

*The 95% confidence interval (CI); **RR:** Risk ratio; **RCT:** Randomised controlled trial

GRADE Working Group grades of evidence. **High certainty:** We are very confident that the true effect lies close to that of the estimate of the effect. **Moderate certainty:** We are moderately confident in the effect estimate: The true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different. **Low certainty:** Our confidence in the effect estimate is limited: The true effect may be substantially different from the estimate of the effect. **Very low certainty:** We have very little confidence in the effect estimate: The true effect is likely to be substantially different from the estimate of effect

Explanations

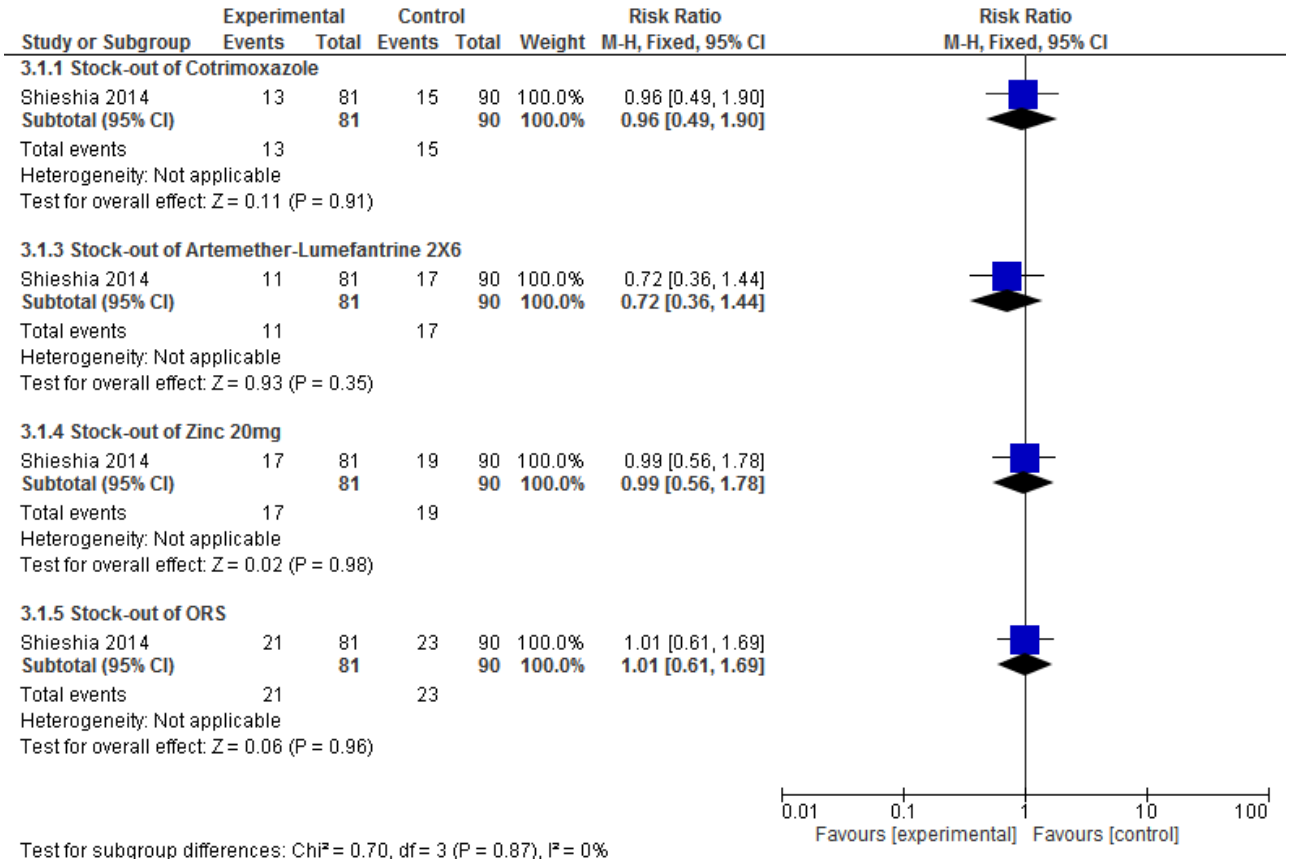
a. Downgraded two steps for very serious risk of bias concerns: Unclear random sequence generation, allocation concealment and blinding of participants not feasible given the intervention, unclear blinding of outcomes and incomplete outcome reporting
b. Downgraded one step for imprecision: Small sample size
c. Reporting completeness was assessed by the extent to which health surveillance assistants (intervention group participants) send messages about the stocks on-hand for all the products they managed.
d. Measured over a 18 month period (January 2012-June 2013)
e. Non-comparable results, thus downgraded to very low

References and notes

1. Shieshia M, Noel M, Andersson S, Felling B, Alva S, Agarwal S, Lefevre A, Misomali A, Chimphanga B, Nsona H, Chandani Y. Strengthening community health supply chain performance through an integrated approach: Using mHealth technology and multilevel teams in Malawi. Journal of global health. 2014 Dec;4(2). Published and unpublished data
2. For this outcome the number of study participants is based on another study sample than for the other outcomes. These data come from ongoing data (backend data in a digital system) and comprise of ALL the health care providers who ever reported on stock-levels

Analyses

Stock-out of drugs in the last 30 days



Summary of Findings B: Mobile stock notification with effective product transport

Mobile stock notification with effective product transport compared to standard care in primary healthcare settings

Patient or population: Healthcare providers and other health professionals involved in commodity/stock management
Setting: Primary healthcare settings in Malawi
Intervention: Mobile stock notification with effective product transport which involved providing health surveillance assistants with training and tools for bicycle maintenance
Comparison: Standard care involved routine stock management with mobile stock notification or any other digital intervention

Outcomes	**Standard care**	**Mobile stock notification with effective product transport**	Relative effect (95% CI)	№ of participants (studies)	Certainty of the evidence (GRADE)	What happens?
Availability of commodities						
Stock-out of drugs in the last 30 days - Stock-out of Cotrimoxazole (to treat bacterial infections)	167 per 1,000	**218 per 1,000** (117 to 407)*	**RR 1.31** (0.70 to 2.44)*	168 (1 non-RCT) Malawi[1]	⨁◯◯◯ VERY LOW [a,b]	**We are uncertain of the effect of this approach on stock-out of Cotrimoxazole because the certainty of this evidence was assessed as very low.**
Stock-out of drugs in the last 30 days - Stock-out of Artemether-Lumefantrine 2X6 (to treat malaria caused by Plasmodium facilparum)	189 per 1,000	**270 per 1,000** (153 to 472)*	**RR 1.43** (0.81 to 2.50)*	168 (1 non-RCT) Malawi[1]	⨁◯◯◯ VERY LOW [a,b]	**We are uncertain of the effect of this approach on stock-out of Cotrimoxazole because the certainty of this evidence was assessed as very low.**
Stock-out of drugs in the last 30 days - Stock-out of oral rehydration salts (ORS) (to treat dehydration)	211 per 1,000	**129 per 1,000** (63 to 260)*	**RR 0.61** (0.30 to 1.23)*	168 (1 non-RCT) Malawi[1]	⨁◯◯◯ VERY LOW [a,b]	**We are uncertain of the effect of this approach on stock-out of Cotrimoxazole because the certainty of this evidence was assessed as very low.**
Stock-out of drugs in the last 30 days - Stock-out of Zinc 20 mg (to treat diarrhea)	256 per 1,000	**281 per 1,000** (171 to 465)*	**RR 1.10** (0.67 to 1.82)*	168 (1 non-RCT) Malawi[1]	⨁◯◯◯ VERY LOW [a,b]	**We are uncertain of the effect of this approach on stock-out of Cotrimoxazole because the certainty of this evidence was assessed as very low.**
Quality and timeliness of stock management						

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Outcomes	**Standard care**	**Mobile stock notification with effective product transport**	Relative effect (95% CI)	№ of participants (studies)	Certainty of the evidence (GRADE)	What happens?
Quality of data about stock management	On average, 65% (n=253) of the health surveillance assistants who managed relevant medicines in the intervention group reported on stock-levels[c]. (Only intervention group assessed for this outcome thus non-comparable.)			N[2] (1 non-RCT) Malawi[1]	⨁◯◯◯ VERY LOW [a,b]	**We are uncertain of the effect of this approach on quality of data about stock management because the certainty of this evidence was assessed as very low.**
Time between stock-level reporting and appropriate action	Health facilities took an average of 26 days to fulfil an order requested by the health surveillance assistants (lead time)[d]. (Only intervention group assessed for this outcome thus non-comparable.)			N[2] (1 non-RCT) Malawi[1]	⨁◯◯◯ VERY LOW [a,b]	**We are uncertain of the effect of this approach on quality of data about stock management because the certainty of this evidence was assessed as very low..**
Satisfaction and acceptability						
Provider acceptability/satisfaction	The proportion of intervention group participants who reported using the digital intervention (cStock) as the primary means for ordering health products was 91% (n=78). (Only intervention group assessed for this outcome thus non-comparable.)			N[2] (1 non-RCT) Malawi[1]	⨁◯◯◯ VERY LOW [a,b]	**We are uncertain of the effect of this approach on provider satisfaction with stock management because the certainty of this evidence was assessed as very low.**
Resource use						
Resource use	No studies were identified that reported on this outcome					**We are uncertain of the effect of this approach on resource use because no direct evidence was identified.**
Unintended consequences						
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c. Reporting completeness was assessed by the extent to which health surveillance assistants (intervention group participants) send messages about the stocks on-hand for all the products they managed.
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2. For this outcome the number of study participants is based on another study sample than for the other outcomes. These data come from ongoing data (backend data in a digital system) and comprise of ALL the healthcare providers who ever reported on stock-levels

Analyses

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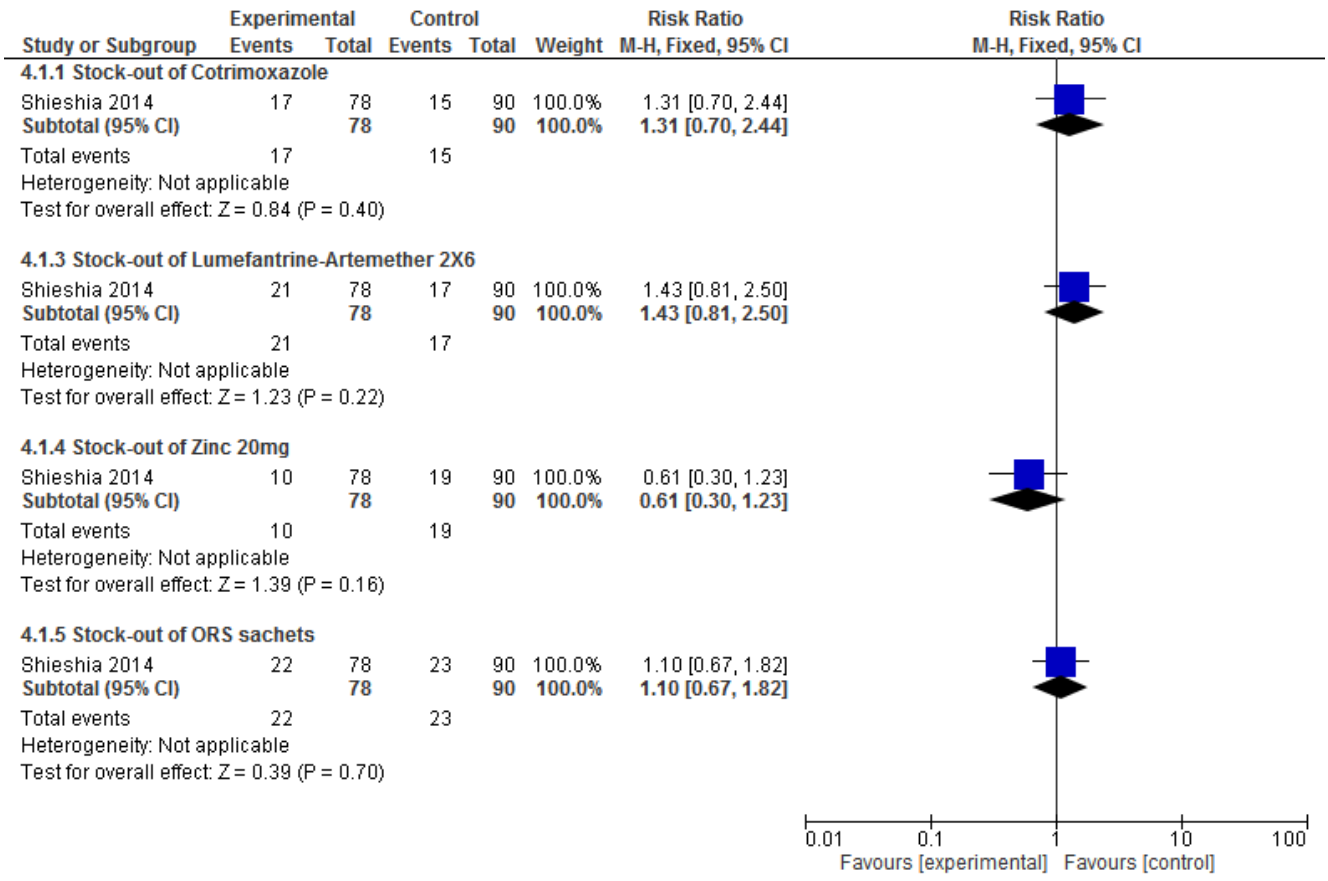

Summary of Qualitative Findings

Summary of the review finding		Studies contributing to the review finding	Overall CERQual assessment of confidence in the evidence
F1	Authors identified infrastructural issues such as challenges in charging phones, uploading and transmitting data and loss of data due to poor network as key barriers to implementation.	Negandhi 2016; Stanton 2016; Shieshia 2014; Asiimwe 2011; Sanabria 2010	**Moderate confidence** Due to methodological limitations as all source material does not include empirical data.
F2	Study authors were concerned that digital stock notification systems used at facility level cannot mitigate a number of broader health system problems, including an underlying lack of stock at national or district level, and a mismatch between national ordering routines and local needs.	Mikkelson-Lopez 2013; Githinji 2013	**Low confidence** Due to methodological limitations, and concerns about adequacy as conclusions are based on two studies.
F3	Study authors suggested that the availability and use of data on stock-levels at all levels of the health system allowed health care officials to respond to anticipated shortages.	Barron 2016; Stanton 2016; Shieshia 2014; Asiimwe 2011	**Low confidence** Due to methodological limitations and concerns about coherence of the data.
F4	The extent to which healthcare providers are familiar with smartphones and are given adequate training in using the digital system influence adoption of the system.	Stanton 2016; Shieshia 2014; Negandhi 2016; Githinji 2013; Barrington 2010; Asiimwe 2011	**Moderate confidence** Due to concerns about methodological limitations.
F5	Study authors considered the availability of technical programming expertise for initial development and ongoing maintenance of the digital system an important implementation factor.	Sanabria 2010; Asiimwe 2011	**Low confidence** Due to concerns about methodological limitations and adequacy as conclusions are based on two studies.
F6	User-friendly systems built with user participation with easy-to-use interfaces were considered important to implementation.	Negandhi 2016; Shieshia 2014; Namisango 2016	**Moderate confidence** Due to concerns about methodological limitations.
F7	Authors emphasized that mangers should have access to data in an easy-to-use format such as an interactive dashboard.	Shieshia 2014; Negandhi 2016; Sanabria 2010	**Moderate confidence** Due to concerns about methodological limitations.
F8	Authors emphasized the role of supportive supervision for effective adoption of a digital system.	Negandhi 2016; Shieshia; Barrington 2010	**Moderate confidence** Due to concerns about methodological limitations.

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