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Mobile reporting of vaccine stock-levels in primary health care facilities in the Eastern Cape Province of South Africa: perceptions and experiences of health care workers

Chinwe Juliana Iwu [a,b], Ntombenhle Ngcobo [b,c], Sara Cooper [b], Lindi Mathebula [b], Hlokoma Mangqalaza[d], Abongile Magwaca[e], Usuf Chikte [a], and Charles S. Wiysonge [b,f]

aDivision of Health Systems and Public Health, Department of Global Health, Faculty of Medicine and Health Sciences, Stellenbosch University, Cape Town, South Africa; bCochrane South Africa, South African Medical Research Council, Cape Town, South Africa; cIndependent consultant, Pretoria, South Africa; dSchool of Public Leadership, Stellenbosch University, Cape Town, South Africa; eIkhwezi Township, Mthatha, South Africa; fDivision of Epidemiology and Biostatistics, School of Public Health and Family Medicine, Faculty of Health Sciences, University of Cape Town, Cape Town, South Africa

ABSTRACT

The use of mobile and wireless digital technologies – mobile health (mhealth)- is increasingly been adopted in low- and middle-income countries (LMICs) to improve data visibility, improve decision-making, and consequently help ensure availability of health commodities in health facilities. In a bid to improve availability of medicines in primary health care facilities, the South African department of Health launched the Stock Visibility Solution (SVS), a mobile application developed for the purpose of capturing and monitoring stock levels of medicines including vaccines using mobile phones. The stock levels of medicines in facilities are usually uploaded to the central stock management system so that managers can act promptly to address stock-out situations. Pilot studies show that the SVS has the potential to reduce stock-outs from occurring.

This study aimed to explore the perceptions and experiences of the SVS system amongst healthcare workers (HCWs) who are involved with managing stock levels of medicines in primary health care facilities in the Eastern Cape Province. This will help identify potential barriers and facilitators to implementation of the system and contribute to the development of strategies to improve its efficiency and effectiveness.

A qualitative research design was employed, including semi-structured interviews with 64 HCWs working in primary health care facilities in the OR Tambo district, Eastern Cape Province in South Africa. Data was transcribed verbatim and analyzed using thematic analysis.

Most HCWs understood the SVS as a system for reporting stock levels to managers and conveyed commitment to ensuring the system works. However, they highlighted a number of factors that demotivated efficient usage of the system: inadequate training, staff shortages and high staff turnover, lack of responses from the managers, the extra workload that comes with the system, amongst others. HCWs made various suggestions for how the system might be improved, most pertinently the need for more pharmacists and pharmacy assistants and for these cadres to be primarily in-charge of stock management and the use of the SVS.

While HCWs are committed to addressing vaccine stock-outs, they face various barriers to an effective and efficient implementation of the SVS system. We make various recommendations for how these barriers might be addressed.

Introduction

The use of mobile and wireless digital devices to improve access to healthcare information (mhealth), is increasingly been adopted in low and middle-income countries (LMICs).[1,2] These devices are being used to improve data visibility, enhance decision-making, and consequently help ensure availability of medicines in health facilities.[3,4] The use of these mobile devices has the potential to tackle the challenges of stock-outs of vaccines and other health commodities in health settings.[1,2] Especially in rural and resource-constrained areas.[2]

The absence of vaccines in primary health care facilities (vaccine stock-outs) is one of the challenges faced by the immunization programme in South Africa.[5,6] This is felt more in rural areas which are sometimes hard to reach.[7] South Africa has made significant progress with the introduction and self-financing of new and underutilized vaccines. However, there have been reports that point to shortages of vaccines in many parts of the country.[8,9] In a bid to reduce the rate of stock of stock-outs of medicines, the department of health in South Africa developed the 'stock visibility solution' (SVS), the South African department of health, launched a mobile application, the stock visibility system (SVS) for monitoring the availability of medicines in primary health facilities level.[10–12] The SVS is designed to capture vaccine stocks through mobile phones.[13] At

the health facilities, the health worker in charge of stock management by reporting vaccine stock levels and other medicines to managers at district, provincial, and national levels. Stock reporting is expected to be done weekly by the staff in charge. During this time, the quantity of each stock item is counted, updated on the device and sent. The data is automatically uploaded to an online stock management system, whereby all managers can access the stock-levels of all the facilities in real-time. This central stock management system can detect stock-outs reported at the facilities, including details of the item and duration of stock-out. Warning signals are then sent to the managers prompting them to respond.

In most cases, it is sub-district managers or other persons who are responsible for overseeing facilities within their region that respond.[10,13] When the managers receive the reports, they are meant to call facilities with low stock levels to confirm whether the item has been ordered from the depot. The manager can also attempt to source the item from other facilities where it is in stock. This stock redistribution helps to ensure that medicines are always available in the facilities and patients are not turned away due to stock-outs.

Pilot studies conducted in Kwazulu-Natal and Limpopo[14] provinces in the country showed that the SVS is capable of reducing stock-outs of medicines in primary health care settings.[15] However, it is known that the success of a technological intervention such as the SVS will be impacted by the human element,[10] including the staff at the facilities as well as the managers. The aim of this study was therefore to explore the perceptions and experiences of the SVS system amongst healthcare workers (HCWs) who are involved with managing stock levels of medicines in primary health care facilities in the Eastern Cape Province. This will help identify potential barriers and facilitators to implementation of the system and contribute to the development of strategies to improve its efficiency and effectiveness.

Methods

Study setting

Our study was conducted in the OR Tambo district in the Eastern Cape Province of South Africa. The OR Tambo district is the largest district in the Province with a population of 1,382,399, which is 20% of the population of Eastern Cape Province. [16] It is a rural district comprising of four sub-districts- Nyandeni, KSD, Mthlontlo and Quakeni. The district was chosen as one of the National Health Insurance (NHI) pilot districts in South Africa, where various initiatives have been implemented to improve the quality of care. Some of these initiatives include the e-health strategy, supply chain management reforms, amongst others. The OR Tambo district also has high neonatal and child mortality, coupled with a high burden of HIV/AIDS and TB epidemic.

Research design

We employed a qualitative research design, including semi-structured in-depth interviews with HCWs in primary health care facilities across the four sub-districts of the OR Tambo district. This study forms part of a broader, quantitative study which is assessing the occurrence of vaccine stock-outs and vaccine stock management status of the health facilities within the OR Tambo district.

Sampling and recruitment

We employed a purposive sampling approach. For the broader quantitative study, we visited facilities across the four sub-districts to capture data related to vaccine stock management. Sampling was done using proportional random sampling. While visiting the facilities, we used the opportunity to conduct interviews with HCWs who are involved with capturing, monitoring and reporting stock levels of medicines. These HCWs were pharmacists, pharmacy assistants and nurses. On the days we visited the health facilities, most of the people we approached were willing and happy to participate in the study despite their busy schedules.

Data collection and management

In-depth interviews were conducted with participants between 25th February to 15th March 2019. Our study was conducted with the intention of uncovering in-depth details of interviewee's experience and perspective on the use of the SVS.

The interviews were based on a semi-structured interview guide which explored the following topics: knowledge of the SVS, the impact of SVS on the occurrence of vaccine stock-outs challenges faced by the HCWs using SVS and the HCWs' recommendations to the challenges (See Appendix 1). The guide was flexible to ensure that participants could express what was important to them, and so learnings from previous interviews could be clarified and probed further in subsequent interviews.

Before each interview, we explained to the participants the purpose of the study, sought for their consent and assured them of confidentiality. With the permission of participants, each session was recorded using a digital recorder. Also, notes of both verbal and non-verbal responses were taken during the interviews. Interviews were conducted at a convenient place chosen by each respondent. For example, interviews were conducted in the medicines storeroom or their offices. All interviews were conducted in English language and lasted between 30 and 60 minutes. All interviews went smoothly, and only one participant pulled out in the middle of the interview for health reasons.

At the end of the interviews, the recorded sessions were transcribed verbatim and saved in a passworded computer, in a file bearing the date the interview was conducted, the place where it was conducted, and the questions the interview addressed. Field assistants were employed to assist with the transcribing. However, each transcribed interview was verified by the principal investigator (CJI) to check for accuracy.

Analytic process

The transcribed data was analyzed using thematic analysis.[17] Thematic analysis is a useful method for identifying and describing recurring patterns that are present in datainterview.[17] Three authors (CJI, LM and SC) participated in the analysis. The analysis of these interviews began before

data collection. We had meetings to deliberate and agreed on the analytic method to use based on the data that will be collected. Notes were made during the interviews and summaries were written after each interview to guide us through the analytical process. We shared the transcripts amongst ourselves for independent coding and then met to agree on common codes and emerging themes. During this process, each author read the transcripts for adequate immersion in the data and notes were taken. We then developed themes which were used to code the data. We tested some of the identified themes against the interviews to be sure the information was well captured, bearing in mind the aims and objectives of the study.

Ethical consideration

Ethics approval was obtained from the Health Research Ethics Committee, Stellenbosch University (S18/08/154), the provincial department of health (EC_201810_009) and the OR Tambo district. All participants were assured of anonymity during the interviews. A consent form was provided to each interviewee before the onset of the interview. In the consent form, it was clearly stated that the interview would be recorded, and the discussion with the participants will be kept confidential. The participants were also informed verbally about how their confidentiality will be kept and that they are free to withdraw from the interview at any time. The data collected was kept safe and protected. Also, identifiers were removed from transcripts, and sound files were destroyed after the interviews were transcribed.

Results

A total of 64 participants were interviewed, from all the sub-districts within the OR Tambo district; 23 from Nyandeni 21 from KSD, 13 from Mthlontlo and seven from Quakeni. Each participant represented each of the 64 facilities. Table 1 below contains a list of participants.

Six main themes were derived from the data namely; knowledge of the purpose and functioning of the SVS system; frustration about the ineffectiveness of the SVS system; challenges encountered when using the SVS, (with its sub-themes) , novel alternatives to the SVS system. Finally, a theme on recommendations made by the HCWS, for addressing identified challenges. The sub-themes that emerged from the challenges encountered by the HCWs include staff shortages and high staff turnover, inadequate training of HCWs, lack of response from the managers, increased workload, SVS reporting being time consuming, the inability of HCWs to meet up

with sending reports. The major themes are written in bold, while minor themes are italicized in bold. Each of the themes is described below.

Widespread knowledge of the purpose and functioning of the SVS system

Most of the HCWs we spoke to conveyed considerable knowledge about the SVS, including its purpose and how it functions. Most participants described the SVS as a tool used for reporting the stock levels of vaccines and other medicines. Some even highlighted details the categories of medicines that are reported using the SVS, namely; vaccines, antiretrovirals, anti-tuberculosis (TB) drugs, and other tracer medicines:

> with I SVS ke, we've got a phone here to where we were being asked about the TB drugs the vaccines, ARV, TB, the vaccines back since, we … we., with the I SVS we have to balance first the Medication and before you sent to you balance first in the medications and you … you send according to the balance of the bin cards yes and we do it on Tuesdays, if not done on Tuesday then early on (HF5).

Many of the HCWs we spoke to also knew that the SVS helps to monitor stock availability and expiry dates of medicines, in addition to using the SVS to report medications:

> .with vaccines we are able to check how many do we have at the moment, which one is about to expire and trying to get finished so if they're short we are able to place a special order, so it reminds us if we haven't placed an order it will say place an order for that because its running short (HF1).

They also described the SVS as a system that enables them to redistribute stock levels as well as a reminder for when stock levels are running low:

> Yes, definitely maybe there is somebody who is looking at the stock levels but the way I understood it is that we will share this stock (HF35).

> I thought that with SVS, those facilities who have enough stock or access will transfer to us (HF11).

> so if they're short we are able to place a special order, so it reminds us if we haven't placed an order it will say place an order for that because its running short (HF18).

Frustration about the ineffectiveness of the SVS system

We asked participants directly whether they felt the SVS had been an effective system in reducing stock-outs since it was introduced. Here, the overwhelming majority of the HCWs we spoke to felt the system had been ineffective. The widespread perception was that stock-levels had remained more or less the same since its introduction:

> there is no difference, without this SVS and with SVS, no difference. I am saying so because we were having the problem with the immunizations before and even now we still have the same problem so no difference, so you we just like, we just send the stock numbers weekly, but we don't know what is happening (HF46).

Another participant expressed similar sentiments:

> It is not helping at all, we are suffering my dear, we are suffering here at the communities, maybe SVS is working in the suburbs,

Table 1. Profile of respondents.

Sub-district	Pharmacist	Pharmacy assistant	Vaccinator	Facility manager
Sub-District 1	1	6	12	2
Sub-District 2	0	9	8	6
Sub-District 3	0	4	1	2
Sub-District 4	1	5	4	3
Overall facilities	2	24	25	13

but here it is not working at all, in our areas, it is not working (HF28).

Some of the participants exhibited uncertainties, whether it has an impact or not:

I cannot say if it is decreasing or increasing,". the point is that, let's see what I've just talked to you that when you are in the dispensary, and you always see that something's out of stock, you think of it even before SVS and you make a way of getting that drug" but then SVS has helped us a lot because now we always have to update (HF17)

otherwise, it is a reliable model; it' is fine, but I do not know as to we are the ones who are failing as nurses to share the stock amongst ourselves (HF54).

The ineffectiveness of the system appears to be a source of considerable frustration for many of the participants we spoke. However, we were indeed struck by the level of commitment many of the staff appear to have, and their wish to ensure that vaccines are available.

it is very bad to always not have when the client comes to not have this drug (HF5).

..because it is not nice to tell the patient we don't have that go and ask somewhere (H18).

……. that is not for the patient, it is for me to make sure that the treatment we have but at least (HF54).

One participant recounted that they had to travel to other facilities to pick up vaccines. Another said that if she had to refer them to other facilities, she would ask the patients to return to the clinics to show proof that they had received the vaccines.

Ultimately, the ineffectiveness of the system was perceived by some of the HCWs as demotivating, as expressed by this participant:

People are not motivated to report because we do not see the results (HF25).

Challenges to effective SVS implementation

Most of these challenges were faced by facilities that were mainly run by nurses only, without the pharmacist's assistants

Lack of training on the use of the SVS and adaptation

When the participants were asked if they had received any formal training on how to use the SVS device, most of them expressed that they had not been well trained. Knowledge was mostly passed down to them from their operational managers. In some cases, they were taught by their predecessors or colleagues. Many of them did not find this style of training useful, and hence, adaptation to the tool was a bit challenging:

Noo, only our OM (operational manager), she was trained. Yes, she was trained, and she came to train us (HF16).

so, another one just phones you there and ask, hey how is the SVS thing going, ok. You see. You just go to the phone. You tick what and you click there then you do you your stock, and then you do what … so you see, that is not a training? (HF60).

Staff shortages and high staff turnover

Also, there is understandably, a frequent migration of health workers in this region. That is, the health workers, especially the pharmacy assistants are not stable. The next person who comes after may not be able to operate the system.

our challenges are adapting. At times we are having a new staff so like I say now the one who was doing ilanto I medication she has just left for the study leave so I SVS is easy when you know it but if you do not know it you feel like it is a difficult thing but when you are used to it is not that difficult. You must be used to it (HF35).

Lack of responses from the managers

Most participants recounted how lack of response from the managers is a huge challenge to the implementation of the SVS. They try to meet up with their reporting hoping that their managers will respond to the stock-out situations:

I really don't know because you are the first person who is asking me that question. I thought our pharmacist would be active enough to phone and check do you have enough of this in this because maybe another clinic has got so much, so that is what I was expecting (HF44).

We just send the stock numbers weekly, but we do not know what is happening (HF38).

SVS contributing to heavy workload amongst the HCWs

Firstly, most of the participants felt that the SVS poses as an extra burden for them, especially as there are a lot of medicines on the system to be reported weekly:

So, there are so many programs and it does make it difficult even now I'm alone so you see (HF10).

Ok, Uhm, we do not only put immunizations ones only, there are other medicines from this, like TB medicines, everything in here, so it is too much, sooo … yaa, before it was only immunizations, ARVs, TB medicine soo … but now everything. So, it was fine when it was only immunizations, ARVs, and TB (HF19).

Reporting with the SVS is time-consuming

Secondly, the participants felt that sending of reports is time-consuming. They spend much time capturing each item and sometimes stay beyond work hours in order to meet up with the days set for reporting weekly:

it's time, we don't have time (HF34).

yah so I have to stay back at half past 4 and do it and complete it (HF37).

so we've got a lot of work, we are few at the clinic so at times I do stay here when others knock off at half-past 4 and do the SVS, yes because of I shortage of staff (HF28).

Failure to send their reports

Furthermore, due to their busy schedules, they sometimes fail or delay in sending their reports.

But sometimes we do not enter the medicines that we are supposed to enter, because we will be busy. At times we do not have time to do this really well, we need someone on our service (HF35).

yah we have to order and sometimes our orders go late because we are busy, and when you order you do not need one day (**HF62**).

Novel alternatives to the SVS system?

As described earlier, the HCWs conveyed a high level of commitment to ensuring that vaccines are available for patients. This was revealed further by the descriptions various participants gave about the strategies they developed to facilitate sharing of vaccines among themselves. One of these strategies was the creation of online groups on 'WhatsApp'. On the 'Whatsapp groups, when one facility needs an item, the HCW in charge of that facility creates a post requesting if another facility could assist. Since other facilities have access to this group, whoever is willing to share, responds to the request. They also use their mobile phones to call neighboring facilities and, in some cases, use their cars to pick up these items from other facilities. Driving to borrow vaccines from other facilities, asides being daunting also has financial implications:

> yes, my dear, even with the WhatsApp thing, we are using our own data to rotate the medication, there is a group here, pharmaceutical group, but it's not helping us … we use our own data, but somebody there is using official data, if there is an official data, I'm sure there is. Because even the cell phone is official, but here we are using our own data (**HF10**).

However, many participants expressed displeasure in using their personal resources for health service delivery, and felt that these novel strategies require more official support:

> So, it's like you have to do this using your own transport and what are they going to say, they are going to say, we do not replace for the transport (**HF15**).

Recommendations for addressing identified challenges

Participants provided two main suggestions for how the challenges they identified might be addressed. Firstly, most participants suggested that there should be pharmacists or pharmacy assistant in each facility who will be in charge of managing vaccines and of course, other medicines in general. They felt that having a dedicated staff for these purposes will enable other staff like the nurses to focus their attention on their primary duties.

> They must help with a Pharmacy assistant; we are nurses not pharmacy assistants (**HF5**).

> there should be pharmacist., to do all the work for 'I medication'(the medications) (**HF8**).

> So, the main issue is getting someone if these, if all the medicines will remain on the device, then they must get somebody that will manage (**HF15**).

> so it helps a lot but if we can have a pharmacist is will real help a lot. because now you are doing this and then this one of the sisters will come and say we do not have this we have to stop doing your admin and then to concentrate on this and phone all these clinics to find out do you have this (**HF18**).

> mm, yes, Pharmacy assistant, it would be nice, Because we have to, we see the patient and then you have dispense for them And then I have to do my admin and I have to order the medication,

there are things, like this stuff and HR things that I have to attend the meetings, I can say to my manager, no I have to do pharmacy things when she when there's a meeting. So, "I have to be at all places, you understand. So, if at least we can have a pharmacist I will be pleased" (**HF5**).

Secondly, many participants suggested that their managers at the sub-district and even district levels should endeavor and respond promptly and offer support to them, especially regarding the redistribution of stocks between facilities. Even if there are no vaccines available, they still would like to receive feedback from the managers to show that they are aware of the situations in the facilities.

> I think we have to involve all facilities in sub-district and then the district, we have to support each other, we are not being supported by our superiors (**HF16**).

> If our supervisors can be involved at least it can help, move a little faster but it is not working, it's slow (**HF18**).

> what I think can be done is for whoever is receiving the information can check as to who is out of stock not necessarily on weekly basis if she checks once because at the end we are also waiting for our stocks from the depot as I said we are ordering every month because of unreliability of our storage and electricity,; yes, because if you phone us, and we are supposed to receive stock today, and we have the circle, the SVS circle yesterday and he looks today and see that we don't have for example BCG and other meds and then he sends to the health centers, or the other clinics that are close to us, if they have let's say 50, at least 10 for a week then it is shared amongst us if he phones and we say we have not received stock then a facility can send us 10 and when we receive the 50 then we send it back to the clinic" (**HF25**).

Thirdly, the HCWs suggested that the bin cards be phased out. In these facilities, the bin cards have been used for a long time for recording stock levels of vaccines, and also other information like name of the vaccine, quantity, vial size, expiry dates and others. The bin cards are meant to help them monitor their stock levels in the facilities. While the information on the bin cards which is supposed to match with the physical quantities are also recorded on the SVS and sent to the managers, who can see the stock levels in the facilities. The HCWs would prefer to work only with the electronic device and not both. Updating both the stock cards, and the SVS is really much work to do, considering that they have to attend to their patients:

> I would be happy if they would do away with the bin cards (**HF10**)

Lastly, they would also want to have access to the data on stock levels of other facilities so that they can know which facility to call when they are in need. Although this is meant to be done by the managers themselves.

> If they can give everyone access to other facilities' information …
> If it can also show the stock visibility at the depot (**HF10**).

Discussion

In this study, we have explored how HCWs involved with stock management in primary health care facilities in the OR Tambo district perceive and experience the use of the SVS for monitoring and reporting vaccine stock levels.

The HCWs (both nurses and pharmacy assistants) are extremely knowledgeable about the purpose of SVS and how it works.

They understand that it is meant to assist them in monitoring the stock levels of vaccines in the facilities, prompt them when stock is about to expire and mostly how it is used for reporting stock levels to the managers. They also do acknowledge that the system was created to help them reduce the level of stock-outs that occur in the facilities. Since they are meant to report every week, most of the participants reported that they hardly missed the chance to submit their reports. Also, they are extremely motivated to reduce stock-outs and its impact on the patients.

Despite the commitment to consistent reporting using the SVS, they are concerned and frustrated that the SVS system is currently ineffective. They identified all sorts of challenges contributing to its effectiveness. Firstly, the lack of response from the managers. Ideally, when the managers receive the reports, they are expected to respond to the facilities with low stocks of vaccines, by assisting in redistributing vaccines between facilities. The reasons for the lack of response from the managers is not clear in this study as we could not interview them. However, this lack of response from the managers may be due to failure on their part to monitor stock levels of medicines in the facilities assigned to them. Also, one may want to ask questions around the exact format in which these reports are received on the managers' side. In other words, how do these managers make sense of these reports received from the facilities?. Are they properly trained?. Also, do they face similar challenges as the staff in the facilities where they may be overburdened and may not be able to respond promptly?. Getting answers to these questions may assist in understanding the reasons for the lack of response from them.

Furthermore, the lack of support from managers is a factor responsible for low motivation amongst health workers in developing countries. This was shown in a systematic review where the majority of studies (85%) reported that lack of support or proper supervisory roles from the superiors demotivated the health workers.[18] Also, the availability of health commodities has been identified in the same review[18] and another study,[19] as one of the motivating factors for health workers, while the lack thereof, can be a strong demotivating factor.[18] The recurring stock-outs of vaccines probably explains the frustration felt by the participants in this study.

Another demotivating factor identified from this study is that the health workers felt that the SVS is an extra burden on them, considering that they have other primary health care services to deliver. Mounting workload, in rural facilities, is a factor responsible for low motivation among health workers.[19] This is especially in facilities that are run by only nurses. The extra burden that is being experienced from using the SVS, the delay in receiving responses from the managers, delay in receiving orders from the depot, and the urgent need to send reports of stock levels of vaccines and other medicines every week, could explain the frustration and anxiety among these health care workers.

The HCWS are also developing novel, ground-up alternative strategies for managing and reducing stock-outs. They use their phones to make calls; they formed 'WhatsApp' groups where they share items and sometimes use their vehicles to fetch vaccines from neighboring facilities. Situations, where health workers use their personal resources to assist in health care delivery, are common in developing countries and have been reported in other studies.[20,21] Some studies have also shown that health workers use online communities like WhatsApp' 'Facebook' to respond to stock-outs and to share knowledge among themselves.[2,20] The use of alternative strategies holds great potential for the development of interventions which are contextually appropriate and acceptable to those who are tasked with managing stocks. However, if these are to be harnessed, they need support.

Recommendations

Staff shortages as reported by the participants in this study have been shown to be among the challenges of the health system the OR Tambo district[16] and other low and middle-income settings, especially the rural areas.[2,19] If this problem is not tackled, the realization of the full impact of interventions like the SVS may be threatened.[19] It is, therefore, important for policymakers to seek ways of addressing staff shortages at the health facilities and the sub-district levels. Health workers need to have the right emotions toward their work as low motivation has an undesirable impact on the performance of individual health workers, facilities and the entire health system. It could also contribute to the migration of health workers from rural areas to the cities.[19]

Finally, if the managers are too busy to look at the reports sent from the facilities, then there may be a need to adopt specific strategies to prompt them into responding on time. For example, a study conducted in India reported that digital screens were mounted at strategic positions on the offices of the managers.[22] These screens were meant to project only abnormal levels of medicines such that the managers can quickly identify facilities who need help and assist them without necessarily checking their systems.

Study limitation

Not being able to interview the managers at the sub-district and district levels was a limitation to this study. Their voices would have provided a balanced view of the study. Another limitation maybe associated with the thematic analysis used in this study. While the thematic analysis is known to be useful for this kind of study, it's flexibility could lead to inconsistency and incoherence when developing the themes derived from the data[23]

Even though this is a qualitative study, our findings are somewhat generalizable to the OR Tambo district and probably settings with similar characteristics as our study area.

Conclusion

The SVS has the potential to minimize the occurrence of stock-outs of vaccines and other health commodities in the health facilities. However, it may contribute to the extra workload being experienced by health workers in rural areas, coupled with the current shortage of staff. There is a strong commitment on the side of health workers, ensuring that vaccines and other health commodities are continuously available for their clients. However, their zeal is reduced by the unavailability of health commodities at the facilities, delay in deliveries from the depot, and the slow response from the managers. There is a need for policymakers to seek ways of addressing stock-outs, addressing issues around the health workforce and providing adequate training for the health workers.

Author contributions

CJI and CSW conceptualized the study. CJI and NN conducted the interviews, with assistance from HM and AM. CJI, HM and SC transcribed the data. CJI, SC and LM analysed the data. CSW and UC supervised the study and made contributions to the contents of the manuscript. NN and CSW provided technical advice and support. CJI drafted the manuscript and received inputs from all co-authors and edited subsequent drafts. All authors read and approved this manuscript.

ORCID

Chinwe Juliana Iwu http://orcid.org/0000-0003-0765-7497
Ntombenhle Ngcobo http://orcid.org/0000-0002-9666-6127
Sara Cooper http://orcid.org/0000-0001-9894-236X
Lindi Mathebula http://orcid.org/0000-0002-4213-7318
Usuf Chikte http://orcid.org/0000-0002-7985-2278
Charles S. Wiysonge http://orcid.org/0000-0002-1273-4779

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Appendix 1: Interview guide used for the study on mobile reporting of vaccine stock-levels in primary health care facilities in the Eastern Cape Province of South Africa: perceptions and experiences of health care workers

1. Brief introduction of the participant
2. Knowledge of the SVS and how the system works
3. The effectiveness of the SVS in reducing occurrence of vaccine stock-outs
4. Any challenges with using the SVS?
5. If yes, what are the challenges?
6. What is most challenging amongst them?
7. Suggestions/recommendations for improvement