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Knowledge, attitudes and practices of healthcare professionals on the use of an electronic stock visibility and management tool in a middle-income country: Implications for access to medicines

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ABSTRACT

Background: The Stock Visibility System (SVS) is a mobile application and web-based management tool used at public primary health care (PHC) facilities in South Africa to capture and monitor medicines availability, providing visibility at national level. Medicine stock-outs are prevalent despite the implementation of SVS, compromising patient care. This study aimed to assess the knowledge, attitudes and practices (KAP) of healthcare professionals (HCPs) on the use of the SVS at PHC level to provide future guidance.

Method: A cross-sectional study using a structured self-administered questionnaire among 206 HCPs at 21 randomly selected PHC facilities located in a health district in KwaZulu-Natal Province, South Africa. Closed-ended questions were used to collect data on socio-demographic characteristics, knowledge on the SVS and practices on its use. A Likert scale was used to determine attitudes towards the SVS. Cronbach's alpha (α) was used to assess the internal consistency of the questionnaire and independent samples *t*-test and one-way analysis of variance (ANOVA) was used to test statistical difference in the mean scores for KAP and socio-demographic variables. Association between knowledge and practices, and attitude and practices was determined using odds ratios (OR) and Chi-square.

Results: The majority (99.5%) of HCPs had previous training on SVS. Nearly two thirds (62.1%; 128/206) generally had good knowledge about the SVS and 76.7% (158/206) had positive attitudes towards the SVS while only 17.0% had a good practice score. There was no statistically significant association between KAP of HCPs on the use of the SVS, and sociodemographic variables (HCP qualification, age and sex). There was a significant association between the knowledge and practice scores (aOR: 5.44; 95% CI: 1.92–15.4; $p = 0.001$). Although positive attitudes, was associated with good practices, it was not statistically significant (OR: 1.21; 95% CI: 0.46–3.22; $p = 0.702$).

Conclusions: HCPs in this district had poor practices when using SVS despite good knowledge and positive attitudes towards SVS and the higher the HCPs knowledge of SVS, the more desirable the practices on SVS. This underscores the need for continuous training of HCPs to ensure a constant and efficient supply of medicines to meet the health needs of the population.

1. Background

The United Nations' (UN) Sustainable Development Goal 3 (SDG 3) is an important element of Universal Health Coverage, with Target 3.8 providing for the promotion of healthy lives, access to quality, effective, safe and affordable essential medicines and vaccines for all.[1,2] This is especially important given the catastrophic impact that poor health can have on families when members become ill in countries with high patient co-payment levels.[2–4] The goal of the essential medicines concept is to advance health equity by identifying cost-effective medicines for priority conditions and making these routinely available for all patients, with established goals including medicines for non-communicable diseases (NCDs).[5–7] However, this goal remains unmet when there is poor availability of medicines, prices are unaffordable to patients without universal healthcare or access schemes and stock-outs.[7–10]

The shortage of medicines has been a challenge to the effective delivery of quality healthcare services worldwide, including South Africa.[11–15] This

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adds to concerns with adherence to robust guidelines to improve future care.[11,12,16] Stock-outs of essential medicines, particularly at primary healthcare (PHC) level, is an important and widely acknowledged public health problem across sub-Saharan Africa, with a recognized negative impact on morbidity and mortality.[17] This is especially important given rising rates of NCDs across sub-Saharan Africa, including cardiovascular diseases and diabetes.[18–21]

In many low- and middle-income countries (LMICs), PHC facilities are typically the first level of contact for patients bringing healthcare closer to where people reside.[10,22–24] Because medicines availability is critically important in ensuring access to prescribed medicines to improve patient outcomes,[25] the availability of medicines is often taken as a proxy for the evaluation of access to essential medicines.[26,27] However, in resource constrained LMICs, poor availability of essential medicines and concerns with facility management is still experienced at many PHC facilities.[17,28] For example, a study conducted in Kenya by the Health Action International Africa in 2010 revealed that essential medicines are available in only 50% of PHC facilities.[10] Furthermore, there can be concerns with medicine stock-outs when nurses manage and dispense medicines, as opposed to dedicated pharmaceutical personnel.[10] There is a critical shortage of pharmacists in many parts of South Africa resulting in nurses and pharmacist's assistants (under the indirect supervision of a pharmacist) having to carry out medicines supply and distribution functions in many PHC facilities.[29,30] A study conducted in Zambia found that the main cause of medicine stock-outs and inefficient stock levels were the methods used in calculating current minimum-maximum stock levels, which are considered important for forecasting future demands.[31]

The Stop Stock Outs Project (SSP) is a partnership of several private-sector organisations who are committed to ensuring access to essential medicines in South Africa. It was established in 2013 following a crisis at the Mthatha pharmaceutical depot in the Eastern Cape of South Africa.[32,33] The lack of availability of essential medicines in clinics and pharmacies can be due to a variety of reasons, and the challenges experienced with medicine shortages are often the same among the different levels of care across South Africa.[15] Factors contributing to stock-outs include delayed or non-payment of suppliers, shortages of active pharmaceutical ingredients, drug shortages generally, problems with stock levels among suppliers and challenges with stock management.[13–15,34,35] Supply chains during the current coronavirus disease 2019 (COVID-19) pandemic have also been an issue, leading to calls for increased local production of medicines across continents including Africa.[36,37]

In an attempt to monitor medicines availability, the South African National Department of Health (NDoH) introduced a wide variety of communication and information technologies during the last decade. These include the RxSolution and the Stock Visibility System (SVS) to assist supply chain management and improve the speed and visibility of data at national level.[15,38,39] The SVS was implemented specifically for surveillance and visibility of medicines among PHC facilities as there have been continued concerns with stock-outs.[40] SVS enables a proactive response to improve future medicine supplies based on stock-outs and low stock holdings,[38] and by July 2016, this surveillance system covered all 3400 PHC facilities in South Africa. By mid-October 2021, 3826 facilities were reporting their medicine stock levels into the system.[32,41]

Integrating patient and medicine data into one system will empower managers to observe and mitigate stock-out risks more effectively.[15,30,31,42] In addition, integrating patient and medicine data will help issue early warnings for key priority disease areas. For example, reducing HIV drug resistance among patients with human immunodeficiency virus (HIV)[43] as well as ensure appropriate antibiotics are routinely available to limit cost considerations and resistance when recommended antibiotics are not available.[44] Good information systems are essential to support policy makers and leaders working towards improved management of patients, in line with the targets of SDG 3.[45–47] Going forward, healthcare facilities must conduct medicine shortage impact analyses to understand the effects of shortages and identify available resources to manage the situation where possible.[48–50] Furthermore, access to mobile and wireless connectivity is increasing globally and these trends are reshaping the possibilities for improved stock management, with supply chain managers moving away from paper-based systems and looking into robust technology solutions to meet supply chain data management demands.[42]

Since SVS has been introduced into the public health sector in South Africa and is widely in use, it is important that PHC facilities and other key stakeholder groups monitor and evaluate its usability among staff. Consequently, this study sought to assess the knowledge, attitudes and practices (KAP) of healthcare professionals (HCPs) on the use of the SVS for reporting medicines availability within one province in South Africa. The findings can be used to develop recommendations on how to optimise the system to benefit future patient care if pertinent.

2. Methods

2.1. Study design and setting

This was a cross-sectional study using a self-administered questionnaire among HCPs at PHC facilities in a health district in KwaZulu-Natal Province, South Africa. The district comprises seven municipalities, with 51 PHC facilities distributed across the municipalities. This health district was purposively selected due to its proximity to the main author's (HM) place of work with ease of access to the study sites. From this health district, 21 facilities were subsequently selected as this represented a realistic number that could be reached during the planned data collection period, given COVID-19 restrictions. A numbered list of all the clinics in the health district (per municipality) was compiled and 21 facilities (three PHC facilities per municipality) were selected through multi-stage random sampling, using Research Randomizer (https://www.randomizer.org/).

2.2. Study population and sample

The target population and eligibility for the study included all HCPs employed in the PHC setting in the health district who had been trained on using the SVS (i.e., mostly nurses and pharmacist's assistants) and who had experience (past or present) with working with the SVS. At the time of the study, a total of 294 HCPs were working with the SVS in the 21 selected PHC facilities. A minimum sample size of 167 healthcare professionals was calculated using Epi Info™ 7 (Centres for Disease Control and Prevention, USA) at 5% error and 95% confidence level, assuming a 50% response distribution. All eligible HCPs present at the PHC facility on the day of data collection were invited to participate in the study.

2.3. Questionnaire

The self-administered questionnaire was available in English, the official language of communication in the workplace. The questionnaire was developed specifically for the purpose of this study, following an extensive review of the literature and using similar studies with research questions aimed at assessing KAP of participants regarding a new technology or intervention.[10,25,33,39,43] The reliability or internal consistency of the questionnaire was assessed using Cronbach's alpha (α), where $\alpha \geq 0.7$ indicates good reliability. The internal consistency showed $\alpha = 0.79$ for the knowledge questions, $\alpha = 0.82$ for the attitude questions and $\alpha = 0.71$ for practice questions.

Prior to data collection, the questionnaire was pre-tested among four HCPs at one PHC facility in the health district, which was not part of the study sample. The four HCPs provided feedback on the interpretation of the questions and the overall contents of the questionnaire which further enhanced the questionnaires robustness and validity. Subsequently, minor changes were made to the questionnaire before full implementation.

The first section of the finalised questionnaire collected socio-demographic information of the HCPs pertaining to their age, sex, medical qualifications, race, work experience and whether they had undergone any formal training on the SVS (available as an Appendix). Participants' knowledge was assessed by posing questions related to the SVS and operation of

the system as outlined in the SVS technical brief.[45] An example of a knowledge question read, "*SVS allows for the redistribution of stock between facilities during times of shortages*". A 5-point Likert scale was used to determine attitudes towards the SVS in line with other studies.[26,51] HCPs indicated their attitudes towards the SVS using responses ranging from "Strongly agree" to "Strongly disagree" to each attitude statement. An example of an attitude statement was "*I would recommend SVS to be used even in community health centres and hospitals*". Practices were determined by requesting participants to report on how they carried out tasks using SVS. Two key questions were used as 'proxies' to determine HCPs practices regarding SVS, namely *'How often do you submit a report of SVS'* and *'How do you arrange stock lists for SVS reporting?'*

2.4. Data collection

Data collection took place over a two-week period during October 2020 and was undertaken by the lead author (HM). Selected clinics were contacted in advance via telephone or email, to request permission to conduct the study and secure a date for data collection. All HCPs present at the facility on the day of data collection, and who met the inclusion criteria, were individually approached and invited to participate in the study. Those who were willing to participate, reported individually to a private area within the facility. They were verbally provided with more detailed information about the study's aims and objectives and given an opportunity to ask questions.

On agreement to participate in the study, each participant provided written informed consent, prior to completing the questionnaire. The questionnaire was completed anonymously, with no personal details recorded e.g., participant's name or identity number. The questionnaire was also de-coupled from the signed consent form so that the completed questionnaire could not be traced back to a particular participant. After completing the questionnaire, it was placed in a sealed envelope provided with the questionnaire and subsequently placed in a sealed box, easily accessible in the facility. All questionnaires at a particular facility were completed within a single day and COVID-19 regulations and precautions were adhered to during data collection.

2.5. Data analysis

Data from the questionnaires were captured electronically into a Microsoft Excel® spreadsheet using double entry by lead author (HM) and a research assistant. Following this, the two data sets were cross-checked and corrections were made as necessary to create a single final data set. Data were exported to IBM SPSS Statistics (Version 26) predictive analytics software, for statistical analysis. Continuous variables were summarised using mean with standard deviation (SD), median with interquartile range (IQR), and minimum and maximum values. Categorical variables were summarised by frequency counts and percentage calculations with a 95% confidence interval (CI).

For knowledge, attitude and practice questions, continuous data were converted to categorical data. Knowledge questions had the possibility of 'True/False/Do not know' answers. Each correct answer scored one point while incorrect and 'Do not know' answers received a zero score, after which a total for all correct answers was calculated. In total, there were 20 knowledge questions with a maximum possible score of 20. Knowledge was judged to be poor if the score was between 0 and 9, average knowledge if the score was 10 and good knowledge if the score was >10.

In total, there were 11 attitude questions, measured with a 5-point Likert scale, and scores ranged from −2 (Strongly disagree) to +2 (Strongly agree). Attitude was judged to be poor if the score ranged from −22 to 0, and good if the score ranged from +1 to 22. For practices, each response indicative of good practice was assigned a score of one (maximum score of 2 for the two practice questions). Practices were judged to be good if both practice questions were answered correctly, average if either one of the two questions was answered correctly and poor if both practice questions were answered incorrectly.

The Pearson's Chi-square test was performed to assess the association of socio-demographic variables with knowledge, attitudes and practice scores towards SVS. Independent sample *t*-test and one-way analysis of variance (ANOVA) was used to test statistical difference in the mean scores for knowledge, attitude and practice scores with socio-demographic variables. Knowledge and practice scores were further re-categorised into good knowledge and poor knowledge (score > 10 and scores ≤10 respectively), and into good and poor practices (score = 2 and scores <2 respectively). Odds ratios (OR) were calculated to determine associations between knowledge and practices, and attitude and practices were determined by calculating odds ratios (OR) and adjusted OR (aOR) for HCPs' qualification, age, sex and work experience. Chi-square *p*-values ≤0.05 (2-tailed) were considered statistically significant.

2.6. Ethical considerations

Ethical approval for the study was obtained from the Sefako Makgatho University Research Ethics Committee (SMUREC/P/139/2020: PG) prior to the commencement of the study. Permission to conduct the study at PHC facilities was obtained from the KwaZulu-Natal Department of Health. All respondents in the study provided written informed consent and remained anonymous. Data were handled confidentially with only the authors having access to the raw data. The results of this study were made available to the KwaZulu-Natal Department of Health after completion of the study.

3. Results

3.1. Final sample

Of the 294 HCPs in the 21 facilities who were present at the facility on the day of data collection and who had experience with the SVS, 206 agreed to participate in the study and completed the questionnaire. This gave a response rate of 70.1%.

3.2. Socio-demographic characteristics of HCPs and experience with the SVS

The mean age of the participants was 35.0 ± 4.4 years and the majority of participants in this study were nurses (89.8%; 185/206) and had >3 years' work experience (87.4%; 180/206). In terms of training, 99.5% (205/206) had received training on the SVS from the NDoH whilst only one person indicated having received training from colleagues. More than half of those who attended NDoH training on the use of the SVS (60.7%; 125/205), indicated that they had attended two training workshops. Further details about the socio-demographic characteristics are presented in Table 1 and Table 2.

3.3. Knowledge about SVS as a tool for monitoring medicines availability

The mean knowledge score among all the participants was 11.3 ± 2.0 and the median was 11.0 (IQR: 2), with knowledge scores ranging from minimum 6 to maximum 17. Table 1 shows the mean knowledge scores stratified according to demographic characteristics. Of the 128 (62.1%) participants with good knowledge, 43.8% (56/128; $p = 0.281$) were professional nurses, 50.0% (64/128; $p = 0.316$) were in the 30–34 years age group and 44.5% (57/128; $p = 0.182$) had 3–5 years of work experience. There was no statistically significant difference between HCPs with good knowledge and those with average and poor knowledge in terms of profession, age group and years of work experience.

Table 3 provides more detailed information on HCPs' knowledge about the SVS. Among the 206 HCPs, 91.7% knew that the SVS is an electronic-networked tool for monitoring medicines availability at PHC facilities and 80.1% of participants knew that data on stock levels, batches and expiry dates is required when completing reports. More than two thirds (71.4%) knew that SVS was introduced as part of the phased-in National Health Insurance and that SVS is essential for stock surveillance by the NDoH

Table 1
Mean SVS knowledge, attitudes and practice scores of HCPs stratified by socio-demographic characteristics ($n = 206$).

Variable	n (%)*	Knowledge			Attitudes			Practices		
		Mean score	SD	p-value**	Mean score	SD	*p*-value**	Mean score	SD	p-value**
Qualification				0.281			0.150			0.828
Nurses	185 (89.8)	11.22	2.06		8.13	7.03		0.98	0.61	
Registered nurse	95 (46.1)	11.20	2.12		9.08	6.57		0.96	0.582	
Enrolled/staff nurse	90 (43.7)	11.23	1.94		7.12	7.38		1.01	0.627	
Pharmacist's assistants	21 (10.2)	11.95	1.75		8.95	7.75		1.00	0.548	
Age				0.647			0.476			0.308
25–29	16 (7.8)	11.75	1.84		8.18	7.48		0.75	0.57	
30–34	99 (48.1)	11.43	2.06		8.74	7.08		1.02	0.61	
35–39	52 (25.2)	10.90	2.10		8.38	6.64		1.04	0.63	
>40***	39 (18.9)	11.26	1.78		6.64	7.57		0.92	0.53	
Sex				0.451			0.142			0.420
Male	106 (51.5)	11.19	1.96		7.51	7.09		0.95	0.58	
Female	100 (48.5)	11.40	2.06		8.96	7.05		1.02	0.619	
Work experience				0.182			0.294			0.642
≤1	2 (1.0)	14.50	0.707		15.00	1.41		1.00	1.41	
>1–3	24 (11.7)	10.92	2.17		10.25	5.57		1.00	0.66	
>3–5	89 (43.2)	11.25	1.88		8.31	7.14		1.04	0.60	
>5–10	64 (31.1)	11.31	2.13		7.42	7.21		0.89	0.508	
>10	27(13.1)	11.48	1.93		7.44	7.78		1.00	0.679	
TOTAL	206 (100)									

* Calculated as column percentages.
** Group comparisons for mean score were performed by independent samples t-test/One-way ANOVA analysis.
*** Most (36) HCPs >40 years were within the range 40–44.

(68.0%). However, only 35.0% knew SVS was initially piloted at all PHC facilities in KwaZulu-Natal in 2014 and only 41.3% of the participants knew that SVS reports cannot be submitted without a network connection.

3.4. Attitudes towards SVS as a tool for monitoring medicines availability

HCPs showed slightly positive attitudes towards SVS with a mean score of 8.2 ± 7.1 and a median of 11 (IQR: 13), with participants' attitude scores ranging from −11 to 22. There was no significant association observed between professional group, age and attitudes towards SVS (see Tables 1 and 2). Of the 158 (76.7%) participants with positive attitudes, 49.4% (78/158; $p = 0.150$) were professional nurses, Participants between 30 and 34 years (47.4%; 75/158; $p = 0.649$) and with work experience between 3 and 5 years (42.4%; 67/158; $p = 0.294$) had the highest attitude scores.

Table 4 provides HCPs' attitudes towards SVS in more detail. Among the 206 HCPs, nearly three quarters (74.3%) were positive that SVS improves stock management at their facilities, were positive that SVS results in quick resolution of stock challenges (73.8%) and were positive that SVS assists with reducing expiry and expenditure losses (74.3%). Only 33.5% of participants were positive that SVS is effective in improving stock redistribution and most (70.9%) believed that the introduction of SVS had increased their workload.

3.5. Practices on SVS as a tool for monitoring medicines availability

There was no significant association observed between the professional group, age, sex, work experience and practices on the SVS (see Tables 1 and 2). Of the 17.0% (35/206) of participants with good SVS practices, only

Table 2
Socio-demographic characteristics of HCPs by SVS knowledge, attitudes and practices ($n = 206$).

Variable	Number (%)* of HCPs			P-value**	Number (%)* of HCPs		P-value**	Number (%)* of HCPs			P-value**
	Good Knowledge	Average Knowledge	Poor Knowledge		Positive Attitudes	Negative Attitudes		Good Practices	Average Practices	Poor Practices	
Qualification				0.468			0.209				0.838
Nurses	40 (21.6)	112 (59.5)	33 (17.8)		142 (76.8)	7.03 (23.2)		118 (63.8)	32 (17.3)	35 (18.9)	
Registered nurse	23 (24.2)	56 (58.9)	16 (16.8)		78 (82.1)	17 (17.9)		63 (66.3)	14 (14.7)	18 (18.9)	
Enrolled/staff nurse	17 (18.9)	56 (62.2)	17 (18.9)		64 (71.1)	26 (28.9)		55 (61.1)	18 (20.0)	17 (18.9)	
Pharmacist's assistants	4 (19.0)	6 (76.2)	1 (4.8)		16 (76.2)	5 (23.8)		15 (71.4)	3 (14.3)	3 (14.3)	
Age				0.316			0.649				0.556
25–29	2 (12.5)	13 (81.3)	1 (6.3)		12 (75.0)	4 (25.0)		10 (62.5)	1 (6.3)	5 (31.3)	
30–34	20 (20.2)	64 (64.6)	15 (15.2)		75 (75.8)	24 (24.2)		63 (63.6)	19 (19.2)	17 (17.2)	
35–39	13 (25.0)	26 (50.0)	13 (25.0)		43 (82.7)	9 (17.3)		32 (61.5)	11 (21.2)	9 (17.3)	
>40***	9 (23.1)	25 (64.1)	5 (12.8)		28 (71.8)	11 (28.2)		28 (71.8)	4 (10.3)	7 (17.9)	
Sex				0.896			0.156				0.534
Male	24 (22.6)	65 (61.3)	17 (16.0)		77 (72.6)	29 (27.40		71 (67.0)	15 (14.2)	20 (18.9)	
Female	20 (20.0)	63 (63.0)	17 (17.0)		81 (81.0)	19 (19.0)		62 (62.0)	20 (20.0)	18 (18.0)	
Work experience				0.877			**0.042**				0.270
≤1	0 (0.0)	2 (100.0)	0 (0.0)		2 (100.0)	0 (0.0)		0 (0.0)	1 (50.0)	1 (50.0)	
>1–3	4 (16.7)	15 (62.5)	5 (20.8)		24 (100.0)	0 (0.0)		14 (58.3)	5 (20.8)	5 (20.8)	
>3–5	17 (19.1)	57 (64.0)	15 (16.9)		67 (75.3)	22 (24.7)		57 (64.0)	18 (20.2)	14 (15.7)	
>5–10	17 (26.6)	36 (56.3)	11 (17.2)		47 (73.4)	17 (26.6)		47 (73.4)	5 (7.8)	12 (18.8)	
>10	6 (22.2)	18 (66.7)	3 (11.1)		18 (76.7)	9 (23.3)		15 (55.6)	6 (22.2)	6 (22.2)	

* Calculated as row percentages.
** Most (36) HCPs >40 years were within the range 40–44.
*** Comparisons were performed by Pearson Chi-square analysis.

Table 3
Knowledge about SVS as reported by HCPs ($n = 206$).

Knowledge items	Correct answer n (%)
SVS is an electronic-networked tool for monitoring medicines availability at PHC	189 (91.7%)
SVS allows for the redistribution of stock between facilities during times of shortages	189 (91.7%)
Reports are generated for all tracer medicines including ARVs*, anti-TB** medicines and vaccines	185 (89.8%)
The SVS report content is flagged at the National Department of Health	183 (88.8%)
This system is beneficial for identifying items soon to expire	170 (82.5%)
Data on current stock levels, batch numbers and expiry dates is required when reporting	165 (80.1%)
SVS is being implemented as part of the phased National Health Insurance	147 (71.4%)
SVS reports are essential for national stock surveillance purposes	140 (68.0%)
A red stock status color means a stock-out of one or more items	138 (67.0%)
Stock issued and stock received data is required when completing the reports	101 (49.0%)
A purple stock status color represents a facility that has not updated their reports for 2 weeks or more	87 (42.2%)
The SVS application can submit reports instantly even if mobile device has no network connection	85 (41.3%)
SVS is also used to report adverse drug reactions at PHC level	84 (40.8%)
PHC staff are able to amend the medicines catalogue on which to report	84 (40.8%)
The Department of Health worked closely with Telkom in developing SVS	76 (36.9%)
SVS was initially piloted at all PHC facilities in KwaZulu-Natal in the year 2014	72 (35.0%)
Only the pharmacist can have access to SVS reports	62 (30.1%)
A barcode cannot be scanned onto the application to identify items	49 (23.8%)
Facility details can be updated on the SVS application	43 (20.9%)
SVS has been rolled-out in all PHC facilities in eight provinces (except the Western Cape)	35 (17.0%)

* *ARV = Antiretroviral medicines.*
** *TB = tuberculosis.*

three were pharmacist's assistants (8.6%) while the remainder were professional and enrolled nurses ($p = 0.828$). The 30–34 years age group had the highest proportion (54.3%; 19/35; $p = 0.436$) of participants with good practices. Participants with work experience between 3 and 5 years also had higher practice scores (51.4%; 18/35; $p = 0.642$).

The majority of participants had less than ≤3 years' experience in working with the SVS (90.3%; 186) and indicated that they use the SVS on a weekly basis (99.0%; 204). When considered as two separate items, nearly three quarters of participants had good practices when using the SVS in terms of submitting weekly reports and arrangement of stock lists for reporting (see Table 5).

Table 4
Attitudes towards SVS as reported by HCPs ($n = 206$).

Attitude items	Positive attitude n (%)
The onus is on the system users to enter correct information to ensure accurate reporting	201 (97.6%)
Increased access to information results in improved demand planning	168 (81.6%)
SVS improves stock management at PHC	153 (74.3%)
SVS ultimately leads to a reduction of stock-loss through expiry and curbs related expenditure losses	153 (74.3%)
SVS allows for quick resolution of stock challenges	152 (73.8%)
The system is user friendly	150 (72.8%)
I find SVS useful in my job	143 (69.4%)
I would recommend SVS to be used even in Community Health Centers and Hospitals	130 (63.1%)
I believe the system is essential for improving communication between different hierarchal levels in supply chain management	126 (61.2%)
Stock redistribution has improved with the introduction of SVS	69 (33.5%)
SVS has not increased my workload	60 (29.1%)

3.6. Association between knowledge, attitudes and practice scores

Overall, 62.1% (128/206; 95%CI: 55.1–68.8) of participants had good knowledge, while 21.4% (44/206; 95%CI: 16.0–27.6) had average knowledge and 16.5% (34/206; 95% CI: 11.7–22.3) had poor knowledge. Regarding attitudes, 76.7% (158/206; 95% CI: 70.3–82.3) had positive attitudes, while the remainder (23.3%; 48/206; 95% CI: 23.3–29.7) had negative attitudes towards the SVS. When compliance to both items were considered as good practice, only 17.0% (35; 95% CI: 12.1–22.8) of participants were considered as having good overall practice, 64.6% (133; 95% CI: 57.6–71.1) as average (complying with one of the two items) and 18.4% (38; 95% CI: 13.4–24.4) as poor practices (not complying with any of the two items).

Table 6 shows the association between SVS knowledge, attitudes and practice scores among HCPs with ORs and aORs for HCPs' qualification, age, sex and work experience. There was a statistically significant positive association between the knowledge and practice scores ($p = 0.001$). Healthcare professionals with good knowledge scores were 5.44 times more likely to have good practices. Although there was a positive association between positive attitudes and good practices, it was not statistically significant (aOR: 1.21; 95% CI: 0.46–3.2; $p = 0.702$).

4. Discussion

We believe this is the first comprehensive study conducted in KwaZulu-Natal to explore HCPs knowledge, attitudes as well as practices since SVS was introduced in 2014. The main findings highlighted the good understanding that HCPs have about SVS, the good attitudes they have towards the system and their ability to demonstrate sound information about the use of SVS. These findings were similar to a recent study conducted in the USA which found that good knowledge would contribute to a positive attitude which in turn increases appropriate practice.[52] This should prove beneficial for the maintenance of good systems put in place like the SVS.

Whilst the most of the participants in our study had good knowledge and attitudes, these findings were not exceptional suggesting a need for additional training for HCPs to improve their practices in terms of use of the SVS system and its subsequent impact on patient care. This is different to a recent South African study regarding vaccine availability where participants showed considerable knowledge about SVS, including its purpose and how it functioned.[39]

Our study also highlighted the challenges with the use of SVS in PHC facilities. However, this was not universal as some HCPs felt that the system improved stock management among PHC facilities. These findings are similar to those of a recent South African study where challenges with the use of the integrated computerized inventory management system (Rx Solution) were highlighted.[26] Whilst SVS reports are supposed to be submitted on a weekly basis, this was not always the case as some HCPs reported that they did not know that the system could submit reports even if there is no network connection, which had a negative impact on their reporting status on the national dashboard. To compound the situation, 25.2% of the participants did not submit reports on a weekly basis, which would further cause them to be marked as non-compliant on the dashboard affecting their chances of getting assistance with stock during redistribution. This needs to be addressed going forward.

The results of this study also suggested that in addition to extra training of HCPs to encourage them to have a positive attitude and even better

Table 5
Practices on SVS as reported by HCPs ($n = 206$).

Practice items	Correct practice n (%)
Submitting an SVS report on a weekly basis	154 (74.8%)
Arrange stock lists for SVS reporting according to categories (e.g., ARV, vaccines, TB)	171 (71.4%)

Table 6
Association between SVS knowledge, attitudes and practice scores among HCPs using unadjusted and adjusted odds ratios ($n = 206$).

		Good practices n (%)*	Average & poor practices n (%)*	OR	95% CI	*p*-value	aOR**	95% CI	p-value
Knowledge	Good	30 (23.4)	98 (76.6)	4.47	1.65–12.08	0.00159	5.44	1.92–15.40	0.001
	Average & poor	5 (6.4)	73 (93.6)						
Attitudes	Positive	28 (17.7)	130 (82.3)	1.26	0.513–3.101	0.612	1.21	0.46–3.2	0.702
	Negative	7 (14.6)	41 (85.4)						
Totals		**35 (17.0)**	**171 (83.0)**						

HCP: Healthcare professional; OR: Odds ratio: aOR: Adjusted odds ratio.
* Calculated as row percentages.
** Adjusted ORs for the following HCP variables: qualification, age, sex and work experience.

practices towards SVS, the introduction of penalties for facilities who do not report on time could help ensure good practices are implemented and sustained similar to other situations.[53–56] From these results, it was also evident that HCPs knowledge, attitude and practices towards SVS are interdependent. The higher the HCPs knowledge of SVS, the more likely practices on SVS will be desirable. This is because this study found that good knowledge regarding SVS is over four times more likely to lead to good stock management practices. This underscores the need to increase the knowledge of HCPs regarding the SVS through education of new employees and continuing training of current workers. On the other hand, there was a positive association between good attitudes and good practices towards SVS, even though the association was not statistically significant. This needs to be addressed going forward.

Of concern is that the majority of participants felt that SVS was not effective in improving stock redistribution and that it had practical implications, in terms of increasing their workload. This though is in-line with a recent study where the overwhelming majority of HCPs in South Africa felt that the SVS system had been ineffective; however, stock levels remained more or less the same since its introduction.[46] Overall, a more proactive approach is needed when implementing change with introducing a new system such as SVS, and that those responsible for change need to understand "how" to implement change, not just "what" needs to be changed, to enhance the utility of such measures.[57] Persistent stock outs may result in patients having to make repeated costly trips to health facilities potentially resulting in some defaulting treatment.[58] The study results also highlight that a large number of participants expressed knowledge that SVS reporting is essential for NDoH stock surveillance purposes. This points out the effect that good knowledge has on positive attitudes towards the system and its success, which bodes well for the future.

This study also found that the majority of HCPs have at some point received training on SVS from the NDoH, with only the number of times training was received varying among the respondents. Consequently, adequate training of system's users is essential to the success of its implementation. SVS can also help assist with distributing stock that is about to expire rather than waste valuable resources.[39]

Another highlighted concern was that the majority of participants felt that the introduction of the system had increased their workload, similar to other studies.[39] This also needs to be addressed, potentially with more staff, to enhance the benefits from the SVS system, reduce future stockouts, and improve patient care.

5. Study limitations

We are aware that there are a number of limitations with this study, which mainly related to the design. The findings of this study are not generalizable to the whole of South Africa due to the fact that the study was conducted in the PHC level in the public health sector and in only one district in KwaZulu-Natal Province. Logistic regression model for analysis to identify predictors and barriers to knowledge, attitudes and practices of HCPs on the SVS could not be carried out for variables that were statistically significant due to the limited sample size and disproportionate number of participants from a different number of variables such as HCPs profession, sex, age, race and work experience. Furthermore, it would have been valuable to assess the perceptions of HCPs on SVS as a tool for monitoring and reporting medicine availability.

There is also a need to explore and understand other factors such as the nature and extent of the training on SVS, post-training support as well as the availability of documented standard operating procedures for SVS, and the number and availability of staff who work on the SVS and quantify the possible role, if any, on the knowledge, attitudes and practices towards the system. Nurses and pharmacist's assistants form the majority of HCPs responsible for drug supply and management in South African clinics and a limitation of this study was the total lack of participation by pharmacists. Ascertaining knowledge, attitudes and practices of pharmacists towards the SVS would have given an interesting perspective to this research.

Despite these limitations, we consider the findings robust, providing direction for the future including increased education of HCPs regarding the SVS.

6. Conclusions and next steps

HCPs in this health district of KwaZulu-Natal had had poor practices when using SVS despite good knowledge and positive attitudes towards SVS and there was a positive correlation between HCPs knowledge of SVS and practices. This may underscore the need for continuous and/or additional training in order to ensure a constant and efficient supply of medicines to meet the health needs of the population.

A number of recommendations are offered based on the results of the study. Due to staff shortages and some clinics not being able to submit their reports on a weekly basis, it is recommended that the SA NDoH facilitates the employment of post-basic pharmacist's assistants in all clinics within the district to assist with stock control. Because SVS is relatively a newer system and more developments may be made to improve the system, it is essential that HCPs are trained extensively on these as this will result in good implementation of the system. Health care managers are most important in the whole process as they are responsible for viewing reports and providing interventions, it is also recommended that the NDoH ensures that managers are held to account for action or non-action taken to address stock shortages as reported on the SVS. The fact that most respondents stated that SVS has not been effective in improving stock redistribution and that SVS had increased their workload, needs to be interrogated further, possibly through in-depth interviews with study participants. Lastly, it is important for all stakeholders involved to ensure that SVS implementation becomes a success and provides positive outcomes in terms of improving medicine availability in our PHC facilities. We will continue to follow this up.

Ethics approval and consent to participate

Ethical approval for the study was obtained from the Sefako Makgatho University Research Ethics Committee (SMUREC) prior to the commencement of the study. Permission to conduct the study at PHC facilities was obtained from the KwaZulu-Natal Department of Health. All respondents in the study remained anonymous. Data were handled confidentially, with only the authors having access to the raw data. The results of this study were made available to the KwaZulu-Natal Department of Health. All

participants provided written informed consent prior to completing the questionnaire.

Consent for publication

Not Applicable.

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Author's contributions

HM wrote the research protocol, conducted the data collection and wrote the first draft of the manuscript under supervision of MS and MM. MS assisted HM with the data analysis. BG and JCM provided extensive input on the literature review, methodology, interpretation of the results and discussion. All authors take equal responsibility for the contents of the manuscript.

Data availability

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declaration of Competing Interest

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References

1. GBD 2016 SDG Collaborators. Measuring progress and projecting attainment on the basis of past trends of the health-related Sustainable Development Goals in 188 countries: an analysis from the Global Burden of Disease Study 2016. Lancet 2017;390 (10100).1423–59.
2. Acharya S, Lin V, Dhingra N. The role of health in achieving the sustainable development goals. Bull World Health Organ 2018;96(9).591-A.
3. Aregbeshola BS, Khan SM. Out-of-pocket payments, catastrophic health expenditure and poverty among households in Nigeria 2010. Int J Health Policy Manag 2018;7(9):798–806.
4. Konduri N, Aboagye-Nyame F, Mabirizi D, et al. Digital health technologies to support access to medicines and pharmaceutical services in the achievement of sustainable development goals. Digital Health, 4; 2018.2055207618771407.
5. Mahmić-Kaknjo M, Jeličić-Kadić A, Utrobičić A, Chan K, Bero L, Marušić A. Essential medicines availability is still suboptimal in many countries: a scoping review. J Clin Epidemiol 2018;98:41–52.
6. Mukundiyukuri JP, Irakiza JJ, Nyirahabimana N, et al. Availability, costs and stock-outs of essential NCD drugs in three rural Rwandan districts. Ann Glob Health 2020;86(1): 123.
7. Saeed A, Saeed H, Saleem Z, Fang Y, Babar ZU. Evaluation of prices, availability and affordability of essential medicines in Lahore division, Pakistan: a cross-sectional survey using WHO/HAI methodology. PLoS One 2019;14(4), e0216122.
8. Mbui JM, Oluka MN, Guantai EM, et al. Prescription patterns and adequacy of blood pressure control among adult hypertensive patients in Kenya; findings and implications. Expert Rev Clin Pharmacol 2017;10(11):1263–1271.
9. Godman B, Leong T, Abubakar AR, et al. Availability and use of long-acting insulin analogues including their Biosimilars across Africa: findings and implications. J Intern Med 2021;11:343.
10. Olubumni MO, Maria SM, Mabunda J. Nurses perceptions about stock-outs of essential medicines at primary health care facilities in Vhembe District, South Africa. Open J Public Health 2019;12:550–557.
11. Kredo T, Cooper S, Abrams AL, et al. "Building on shaky ground"-challenges to and solutions for primary care guideline implementation in four provinces in South Africa: a qualitative study. BMJ Open 2020;10(5), e031468.
12. Niaz Q, Godman B, Massele A, et al. Validity of World Health Organisation prescribing indicators in Namibia's primary healthcare: findings and implications. Int J Quality Health Care 2019;31(5):338–345.
13. Acosta A, Vanegas EP, Rovira J, Godman B, Bochenek T. Medicine shortages: gaps between countries and global perspectives. Front Pharmacol 2019;10:763.
14. Bochenek T, Abilova V, Alkan A, et al. Systemic measures and legislative and organizational frameworks aimed at preventing or mitigating drug shortages in 28 European and Western Asian countries. Front Pharmacol 2017;8:942.
15. Modikaseng C, Matlala M, Godman B, Meyer JC. Medicine shortages and challenges with the procurement process among public sector hospitals in South Africa; findings and implications. BMC Health Serv Res 2020;20(1):234.
16. Campbell SM, Meyer J, Godman B. Why compliance to National Prescribing Guidelines is important especially across sub-Saharan Africa and suggestions for the future. J Biomed Pharm Sci 2021;4(316):1–7.
17. Droti B, O'Neill KP, Mathai M, Yao Tsidi Dovlo D, Robertson J. Poor availability of essential medicines for women and children threatens progress towards sustainable development goal 3 in Africa. BMJ Glob Health 2019;4(suppl 9), e001306.
18. Gouda HN, Charlson F, Sorsdahl K, et al. Burden of non-communicable diseases in sub-Saharan Africa, 1990-2017: results from the global burden of disease study 2017. Lancet Glob Health 2019;7(10).e1375-e87.
19. Godman B, Basu D, Pillay Y, et al. Review of ongoing activities and challenges to improve the care of patients with type 2 diabetes across Africa and the implications for the future. Front Pharmacol 2020;11(108).
20. Cappuccio FP, Miller MA. Cardiovascular disease and hypertension in sub-Saharan Africa: burden, risk and interventions. Intern Emerg Med 2016;11(3):299–305.
21. Hamid S, Groot W, Pavlova M. Trends in cardiovascular diseases and associated risks in sub-Saharan Africa: a review of the evidence for Ghana, Nigeria, South Africa, Sudan and Tanzania. Aging Male 2019:1–8.
22. Rampamba EM, Meyer JC, Godman B, Kurdi A, Helberg E. Evaluation of antihypertensive adherence and its determinants at primary healthcare facilities in rural South Africa. J Comp Eff Res 2018 Jul;7(7):661–672. https://doi.org/10.2217/cer-2018-0004.
23. Ofori-Asenso R, Brhlikova P, Pollock AM. Prescribing indicators at primary health care centers within the WHO African region: a systematic analysis (1995-2015). BMC Public Health 2016;16:724.
24. Bitton A, Ratcliffe HL, Veillard JH, et al. Primary health care as a Foundation for Strengthening Health Systems in low- and middle-income countries. J Gen Intern Med 2017;32(5):566–571.
25. Munedzimwe FE. Medicine stock Management at primary health care facilities in one South African province. Masters Dissertation. University of Cape Town, Available online at: https://open.uct.ac.za/bitstream/handle/11427/27822/thesis_hsf_2018_munedzimwe_fadzai_eunice.pdf?sequence=1 2018.
26. Garcia MM, Barbosa MM, Silva RM, et al. Indicator of access to medicines in relation to the multiple dimensions of access. J Comp Eff Res 2019;8(12):1027–1041.
27. Barbosa MM, Moreira TA, Nascimento RC, et al. Access to medicines in the Brazilian unified health System's primary health care: assessment of a public policy. J Comp Eff Res 2021;10(10):869–879.
28. Macarayan EK, Ratcliffe HL, Otupiri E, et al. Facility management associated with improved primary health care outcomes in Ghana. PLoS One 2019;14(7), e0218662.
29. Gray A, Riddin J, Jugathpal J. Health care and pharmacy practice in South Africa. Can J Hosp Pharm 2016 Jan-Feb;69(1):36–41. https://doi.org/10.4212/cjhp.v69i1.1521.
30. Dube EM, Zuma SM. Professional nurses' challenges regarding drug supply management in the primary health care clinics. Int J Afr Nurs Sci 2022;16, 100398.
31. Leung NH, Chen A, Yadav P, Gallien J. The impact of inventory management on stock-outs of essential drugs in sub-Saharan Africa: secondary analysis of a field experiment in Zambia. PLoS One 2016;11(5), e0156026.
32. The Stop Stockouts Project. 4th National Survey Report - The Fragile System. Available from URL: https://sahivsoc.org/FileUpload/Stop%20Stockouts%20National%20Report%20Oct%202018.pdf 2017. (Accessed 23 March 2022).
33. Mckenzie A, Mccann T. Evaluation of the Stop Stock Outs Project (SSP), South Africa. Available at URL: https://lakareutangranser106.sharepoint.com/Departments/OE/Documents/Evaluation%20Unit/02.%20Evaluations/SEU%20Dossiers%202016/14.%20SSOSA_Stop%20Stock%20Outs%20South%20Africa%20COMPLETE/1.%20Final%20Report/Final%20Version%20(pdf%20%26%20doc)/SEU_Evaluation_SSP_Final_2016_SHORT%20VERSION.pdf 2016.
34. World Health Organization. Addressing the Global Shortage of, and Access to, Medicines and Vaccines: Report by the Director-General. Available at: http://apps.who.int/gb/ebwha/pdf_files/EB142/B142_13-en.pdf 2018. (Accessed 23 March 2022).
35. Miljković N, Godman B, Kovačević M, et al. Prospective risk assessment of medicine shortages in Europe and Israel: findings and implications. Front Pharmacol 2020;11(357).
36. Ogunleye OO, Basu D, Mueller D, et al. Response to the novel Corona virus (COVID-19) pandemic across Africa: successes, challenges, and implications for the future. Front Pharmacol 2020;11(1205).
37. EAC Secretariat. East African Community COVID-19 Response Plan. Available at URL: https://www.eac.int/coronavirus 2020. (Accessed 23 March 2022).
38. United States Agency for International Development (USAID). Global Health Supply Chain Program - Technical Assistance. Technical Brief: Stock Visibility System - USAID. Available from URL: https://www.ghsupplychain.org/sites/default/files/2020-12/GHSC-TA%20Technical%20Brief_Stock%20Visibility%20System_2019.09.16%20V.F_508%20compliant.pdf 2019. (Accessed 23 March 2022).
39. Iwu CJ, Ngcobo N, Cooper S, et al. 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. Hum Vaccin Immunother 2020;16(8):1911–1917.[38].
40. The Stop Stockouts Project. Third National Survey Report. Available at URL: https://slidelegend.com/queue/2015-stock-outs-national-survey-stop-stockouts_5ae9bb247f8b9ab5468b456e.html 2015. (Accessed 23 March 2022).
41. Republic of South Africa National Department of Health. Supply Chain Medicine Availability. Available at URL: https://medssc.co.za/#/views/MedicineAvailabilityIntegratedDashboard_16225367095030/SupplyChainMedicineAvailability?:iid=2 2021. (Accessed 23 March 2022).

42. Meyer JC, Schellack N, Stokes J, et al. Ongoing initiatives to improve the quality and efficiency of medicine use within the public healthcare system in South Africa. Prelim Study Front Pharmacol 2017;8:751.
43. Mabirizi D, Phulu B, Churfo W, et al. Implementing an integrated pharmaceutical management information system for Antiretrovirals and other medicines: lessons from Namibia. Global Health Sci Pract 2018;6(4):723–735.
44. Chigome AK, Matlala M, Godman B, Meyer JC. Availability and use of therapeutic interchange policies in managing antimicrobial shortages among south African public sector hospitals; findings and implications. Antibiotics 2019;9(1).
45. Gustafsson LL, Wettermark B, Godman B, et al. The "wise list"- a comprehensive concept to select, communicate and achieve adherence to recommendations of essential drugs in ambulatory care in Stockholm. J Basic Clin Pharmacol Toxicol 2011;108(4):224–233.
46. Eriksen J, Gustafsson LL, Ateva K, et al. High adherence to the "Wise List" treatment recommendations in Stockholm: a 15-year retrospective review of a multifaceted approach promoting rational use of medicines. BMJ Open 2017;7(4).
47. MacBride-Stewart S, McTaggart S, Kurdi A, et al. Initiatives and reforms across Scotland in recent years to improve prescribing; findings and global implications of drug prescriptions. Int J Clin Exp Med 2021;14(12):2563–2586.
48. Barraclough A, Clark M. Managing Procurement. Chapter 12 in Managing Access to Medicines and Health Technologies. Management Sciences for Health. Available at URL: https://apps.who.int/medicinedocs/documents/s19577en/s19577en.pdf 2012.
49. Miljković N, van Overbeeke E, Godman B, et al. Practical implications from European hospital pharmacists on prospective risk assessment for medicine shortages. Front Med 2020;7(407).
50. Miljković N, Godman B, Bochenek T, Huys I. Managing Medicine Shortages Toolkit. Available at URL: https://drive.google.com/file/d/1QmtCn9I-SYxkxzL4SglntpsBSrCTKHeR/view 2021.
51. Držaić M, Kummer I, Mucalo I, Bruno A, Ortner Hadžiabdić M. Identifying self-assessed competencies and areas for improvement within community pharmacist-preceptors support during pre-registration training. BMC Med Educ 2018;18(1):303.
52. Prochaska JJ, Prochaska JO. A review of multiple health behavior change interventions for primary prevention. Am J Lifestyle Med 2011;5(3).
53. Fischer KE, Koch T, Kostev K, Stargardt T. The impact of physician-level drug budgets on prescribing behavior. Eur J Health Econ 2018;19(2):213–222.
54. Godman B, Fadare J, Kwon HY, et al. Evidence-based public policy making for medicines across countries: findings and implications for the future. J Comp Eff Res 2021;10(12):1019–1052.
55. Alrasheedy AA, Alsalloum MA, Almuqbil FA, et al. The impact of law enforcement on dispensing antibiotics without prescription: a multi-methods study from Saudi Arabia. Expert Rev Anti Infect Ther 2020;18(1):87–97.
56. Van Nhu H, Tuyet-Hanh TT, Van NTA, Linh TNQ, Tien TQ. Knowledge, attitudes, and practices of the Vietnamese as key factors in controlling COVID-19. J Community Health 2020;45(6):1263–1269.
57. Kho J, Gillespie N, Martin-Khan M. A systematic scoping review of change management practices used for telemedicine service implementations. BMC Health Serv Res 2020;20(1):815.
58. Prinja S, Bahuguna P, Tripathy JP, Kumar R. Availability of medicines in public sector health facilities of two north Indian states. BMC Pharmacol Toxicol 2015;16(1):43.