

Landscape Analysis

Analysis of VMAT Indicators

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Immunization systems and technologies for tomorrow



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Executive summary

The original work on the vaccine management assessment tool (VMAT) was carried out by the World Health Organization (WHO) Regional Office for Africa (AFRO) in 2001. The current version of the VMAT was substantially revised by WHO Geneva and officially published in 2005.¹ The purpose of a vaccine management assessment (VMA) is to help countries improve the quality of their vaccine management from the national stores to the service-delivery level. The data used for the analysis presented in this report was taken from assessments that used the second-generation version of the tool. The original AFRO version used a somewhat different set of indicators. A comparison of results obtained using the two versions was not considered to be valid.

Twenty-two vaccine management assessments from 18 countries were analyzed by Andrew Garnett, an Optimize consultant. These covered a total of 16 national stores, 152 subnational stores, and 223 service points. More than half of the assessments are from WHO AFRO. These assessments were selected for detailed analysis in the accompanying report.

An analysis of the 37 critical indicators shows a generally declining standard of performance from the center to the periphery. This general observation is also true for the noncritical indicators.

Of the 32 critical indicators that apply to the national level, only 12 indicators were satisfactorily met (i.e., had a mean score of 80% or greater) across the AFRO countries (n=12). At the subnational level (n=130), only 6 out of 29 applicable indicators were satisfactorily met, and at the service-point level (n=183) only 7 out of 31 applicable indicators were satisfactorily met.

In the case of the noncritical indicators the following observations are of note:

- Vaccine arrival procedures at the national level are well observed.
- Temperature monitoring and recording is generally weak at all levels.
- Cold storage capacity is generally adequate.
- Only 47% of the indicators were satisfactorily met for buildings, cold chain equipment, and transport at the national level, and only 19% and 18%, respectively, were satisfactorily met at the subnational and service point-levels.
- Scores against the stock management and distribution indicators are generally weak.

Readers are referred to the companion documents *Landscape Analysis: Analysis of EVSM Indicators* and *Supply Chain & Logistics for Immunization: Main Findings From the Landscape Analyses*.

¹ World Health Organization (WHO) Access to Technologies Team. *Vaccine Management Assessment*. WHO/IVB/05.02. Geneva: WHO; 2005. Available at: http://whqlibdoc.who.int/hq/2005/WHO_IVB_05.02_eng.pdf.

Methodology

The VMAT enables assessors to review vaccine management over a representative sample of the entire cold chain in a systematic manner, from the national store down to the service-point level. The output of the tool is a spider (radar) chart that gives a percentage score against 11 principal vaccine management criteria. As with the national-level Effective Vaccine Stores Management (EVSM) assessment tool, these criteria percentages combine the scores from a number of indicators.

This document provides a cross-country analysis of the scores given against all the individual indicators. Many of the indicators are common to all levels, but some are level dependent—the “Indicators” worksheet in the VMAT shows which ones apply to which level.

Although the VMAT national-level indicators are derived from the EVSM tool and are often similarly worded, there are fewer of them,² with a higher proportion of critical indicators. Consequently, results obtained from the two methods are not directly comparable. Individual indicators can sometimes be compared between the two assessments, but it is not valid to compare the overall VMAT scores at the national level in one country with EVSM scores in the same or another country.

Sample

A total of 43 countries have conducted VMAs or have one planned for completion by the end of 2008 (A.G., unpublished data, 2007).³ Eighteen countries have data suitable for analysis. Of these 18, three countries have more than one assessment workbook, with each covering a different part of the country (Somalia [2], Turkey [2], and Vietnam [3]) for a total of 22 useable VMATs. Uganda also carried out a 2004 assessment using the current tool, but the spreadsheet has been password protected and cannot be analyzed. For a further three countries (Madagascar, Tanzania/Tanzania-Zanzibar, and Zimbabwe) there have been assessments using the “old” version of VMAT. These were excluded from the sample because of the different scoring methodology. Finally, the Optimize database contained VMA narrative reports for four countries, but no companion VMAT workbook; these countries are excluded from the analysis. The workbooks for the remaining countries were not available on the Optimize database and could not be located by WHO Headquarters in the time available. The chosen assessments cover the countries shown in Table 1.

² VMAT has a total of 109 sub-indicators, of which 39 (36%) are weighted “critical indicators,” compared with 118 sub-indicators in EVSM, of which 17 (14%) are weighted “critical indicators.” Indicators are also level-dependent, with fewer at the two lower levels.

³ A.G., Unpublished data, WHO IVB: EVSM&VM_Assessment_Global_Summary-0804.xls.

Table 1. VMAT spreadsheets analyzed

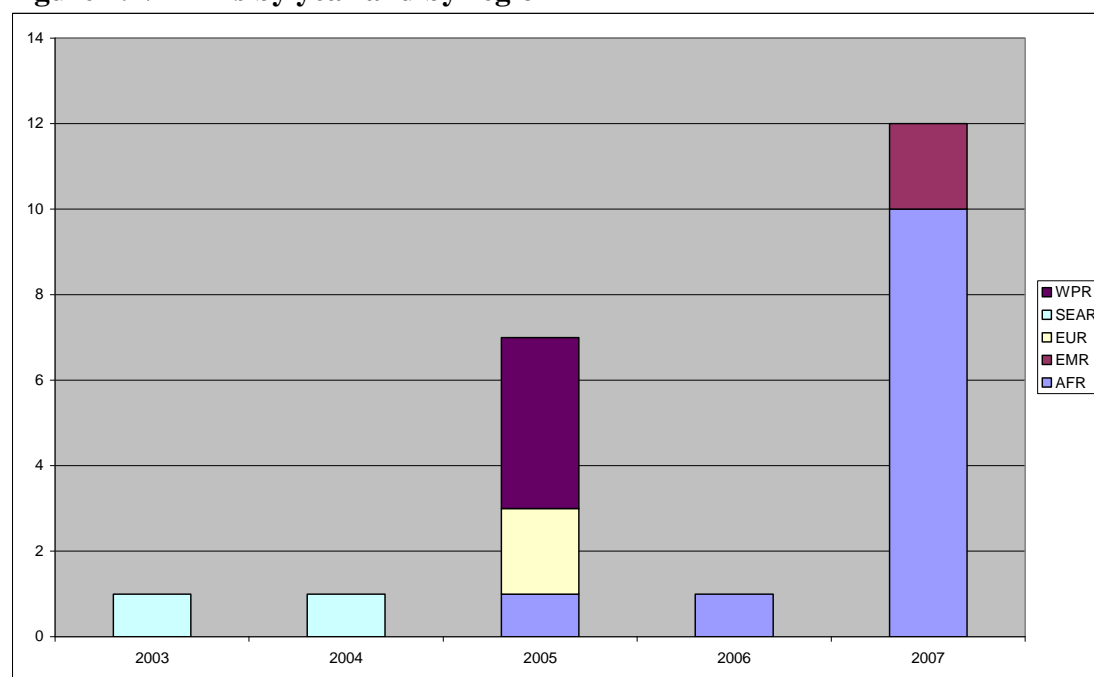
Country	Region	Year	Country	Region	Year	Country	Region	Year
Bangladesh	SEAR	2004	Niger	AFR	2007	Turkey: Zonguldak	EUR	2005
Botswana	AFR	2007	Papua New Guinea (self-assessment)	WPR	2005	Uganda	AFR	2007
Comoros	AFR	2005	Sierra Leone	AFR	2007	Vietnam: Regional	WPR	2005
Cote d'Ivoire	AFR	2007	Somalia: Puntland	EMR	2007	Vietnam: Province	WPR	2005
Liberia	AFR	2007	Somalia: Somaliland	EMR	2007	Vietnam: District	WPR	2005
Mali	AFR	2007	Swaziland	AFR	2006	Zambia	AFR	2007
Mauritania	AFR	2007	Tanzania	AFR	2007			
Nepal	SEAR	2003	Turkey: Kastamonu	EUR	2005			

Note: Countries highlighted in yellow have also received an EVSM assessment.

Abbreviations used: **AFR:** African Region; **EMR:** Eastern Mediterranean Region; **EUR:** European Region; **SEAR:** South-East Asia Region; **WPR:** Western Pacific Region.

Figure 1 shows how these assessments were distributed by year and by WHO region.

Figure 1. VMATs by year and by region



Abbreviations used: **AFR:** African Region; **EMR:** Eastern Mediterranean Region; **EUR:** European Region; **SEAR:** South-East Asia Region; **WPR:** Western Pacific Region.

Table 2 shows how the sample is distributed among the four WHO regions.

Table 2. Sample distribution

Level	AFR	EMR	EUR	SEAR
National	12	2	0	1
Subnational	130	4	2	3
Service point	183	20	6	5

Note: Of the 12 AFR national stores that were assessed, 5 have also had an EVSM assessment.

Abbreviations used: **AFR:** African Region; **EMR:** Eastern Mediterranean Region; **EUR:** European Region; **SEAR:** South-East Asia Region.

It is evident from this table that the commitment to vaccine management assessment in the Africa region has been substantially higher than in any of the other regions. Not only have more countries been covered, but the number of facilities visited during each assessment has been far higher. For this reason, our discussions of individual indicators rely solely on the AFR data.⁴ Note that, of the 12 AFR national stores that were assessed, five have also had an EVSM assessment.

Analytical approach

The latest development version of the VMAT (v2.2) was used as a basis for setting up the analysis (A.G., unpublished data, 2007).⁵ The score for each indicator from all 22 VMAT assessments was transferred to a table attached to the right side of each of the three data entry worksheets (national, subnational, and service point). The consolidated data for each criterion in each of the worksheets were then analyzed.

The scoring system in VMAT is entirely numerical, and a high score always means good performance against the indicator.⁶ The only exception is the use of “n/a” in a scoring cell to switch off an indicator where it is not universally applicable to a specific facility or a specific level (e.g., Q4.J refers to refrigerated vehicles). For this reason, the denominator used to establish mean scores at each level is often substantially lower for some indicators than for others and lower than the total number of facilities visited at any particular level.

- *Yes/no responses:* Scores are either 0 or 1.
- *Continuous scoring:* Scores are calculated on a context-dependent continuous basis between 0 and 4.

Each score is then normalized by a “weighting factor.” General indicators have a weighting factor of 1. Critical indicators generally have a higher weighting—2, 4, or 5, but there are a few exceptions. For example, the eight critical sub-indicators in Q6.A, which together characterize the features of best stock record-keeping practice, are arranged so that the perfect score for the complete group is 5.

⁴ The only other reasonably sized sample is from EMR. However the two available assessments both relate to Somalia (Somaliland and Puntland). Both assessments show an understandably low performance and are not likely to be representative of EMR as a whole.

⁵ A.G., Unpublished data, 206-VMAT-landscape-D1.xls complete analysis.

⁶ So, for example, a score of 100% against the indicator description in Table 3 shortened to: *Transport failure caused vaccine loss in past six months* means that no loss has occurred.

Revision history of the VMAT tool

The preliminary version of the VMAT tool had a different set of indicators and sub-indicators than the current one, which was officially released in early 2004 (v1.0), and earlier drafts were used before that. It is consequently not possible to carry out a useful comparative analysis of data gathered using the two versions; this analysis only uses assessments carried out using the 2004 version and subsequent releases.

A number of minor changes have been made since v1.0 was issued, mostly dealing with wording clarifications. The current release is v2.1. A new release allowing for a much larger number of subnational- and service-level facilities is in preparation (v2.2). There are also English- and French- language versions in circulation in AFRO that have been extended to allow a larger number of subnational and service point facilities.⁷ It should be noted that a few small formula errors exist in some versions of the spreadsheet. Where these errors have been detected, the data have been corrected.

Indicator types

In the following tables, each indicator in the analysis has been assigned an alpha type code to identify the principal focus of the indicator. The five indicator types are: B= buildings, E=equipment, M=management, R=repairs/maintenance (buildings and equipment), and T=training.

Critical indicator analysis

This section focuses on the 37 VMAT “critical indicators.” These are highlighted in pale green in the tool. Because their scores are weighted, these indicators have the most significant effect on the final overall results of an assessment.

Results

Table 3 shows the scores achieved against each of the critical indicators, broken down by WHO region.

The tables that follow (Figures 2 to 7) show the AFR data for criteria 2 to 11 arranged both by criteria group and by level. One clearly evident and unsurprising observation is that the mean scores achieved against each of the critical indicators tend to be highest at the center and lowest at the periphery. This is not universally true, but occurs in 23 of the 26 cases where an indicator applies at both national and lower levels (88%). The exceptions to this general rule are discussed below.

Another general observation is that only 12 of the 32 national-level critical indicators (38%) achieve or exceed the 80% score required for EVSM certification.⁸ If we take all 101 national-level indicators, only 37 meet or exceed the 80% certification level.

⁷ vD5-extended has a formula error in the subnational worksheet which has been corrected for this analysis.

⁸ The VMAT indicators are essentially a subset of the EVSM ones so this is a legitimate comparison.

Table 3. VMAT critical indicators: mean score distribution

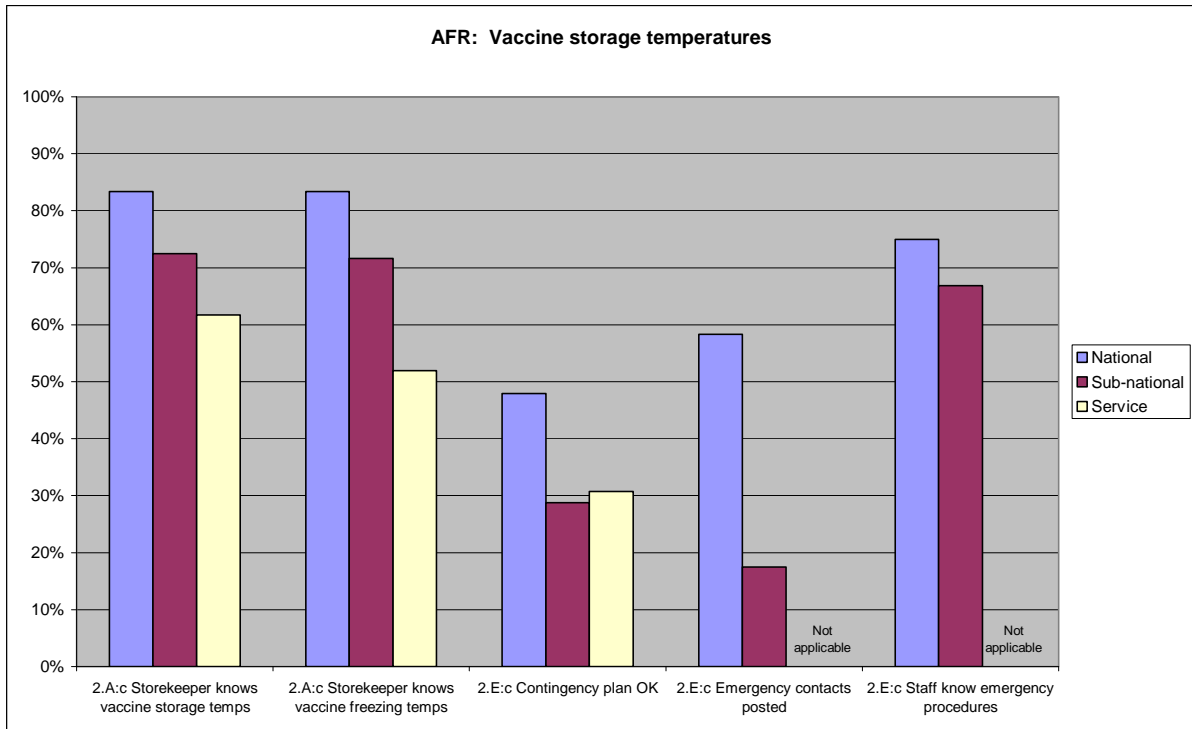
Criteria	Category	Table of mean scores										Subnational										Service																					
		WHO region:										AFR		EMR		EUR		SEAR		WPR		AFR		EMR		EUR		SEAR		WPR													
		Number of facilities assessed:										12		2		0		1		1		130		4		2		3		13		183		20		6		5		9			
Indicator description:										n=		n=		n=		n=		n=		n=		n=		n=		n=		n=		n=		n=		n=		n=		n=					
1	M	1.A:c VAR as UNICEF content.										12	92%	2	0%	0	nd	1	0%	1	100%																						
1	M	1.A:c VARs correct.										12	83%	2	100%	0	nd	1	24%	1	100%																						
2	T	2.A:c Storekeeper knows vaccine storage temps.										12	83%	2	100%	0	nd	1	100%	1	100%	120	73%	4	100%	2	100%	3	100%	13	98%	183	62%	20	90%	6	100%	5	80%	9	100%		
2	T	2.A:c Storekeeper knows vaccine freezing temps.										12	83%	2	0%	0	nd	1	100%	1	100%	120	72%	4	0%	2	100%	3	100%	13	100%	183	52%	20	0%	6	17%	5	80%	9	91%		
2	M	2.E:c Contingency plan acceptable.										12	48%	2	0%	0	nd	1	0%	1	50%	120	29%	4	0%	2	25%	3	50%	13	33%	183	31%	20	0%	6	71%	5	35%	5	25%		
2	M	2.E:c Emergency contacts posted.										12	58%	2	0%	0	nd	1	0%	1	0%	120	18%	4	0%	2	0%	3	67%	13	38%												
2	M	2.E:c Staff know emergency procedures.										12	75%	2	75%	0	nd	1	50%	1	0%	120	67%	4	50%	2	50%	3	75%	13	81%												
5	R	5.A:c CC replacement plan exists and is followed.										11	86%	2	0%	0	nd	1	0%	1	100%	120	64%	4	0%	2	0%	3	17%	13	32%	179	87%	20	0%	6	0%	5	30%	7	29%		
5	R	5.B:c Equipment PPM plan exists and is followed.										12	46%	2	0%	0	nd	1	0%	1	75%	120	27%	4	0%	2	0%	3	58%	13	38%	182	22%	20	0%	6	0%	5	40%	7	11%		
5	R	5.C:c CC failure caused no vaccine loss in past 6 months.										12	100%	2	100%	0	nd	1	100%	1	100%	120	91%	4	100%	2	100%	3	100%	13	100%	182	83%	20	75%	6	100%	5	100%	7	100%		
5	R	5.C:c Transport failure caused no vaccine loss in past 6 months.										12	100%	0	nd	0	nd	1	100%	1	0%	117	88%	0	nd	0	nd	0	nd	10	100%	140	82%	0	nd	3	100%	2	100%	5	100%		
6	M	6.A:c Vaccine and diluent quantities recorded.										12	67%	2	0%	0	nd	1	0%	1	100%	120	42%	4	0%	2	0%	3	0%	13	68%	182	23%	20	0%	6	0%	5	0%	9	61%		
6	M	6.A:c Vaccine and diluent type recorded.										12	67%	2	0%	0	nd	1	0%	1	100%	120	51%	4	0%	2	0%	3	0%	13	61%	182	29%	20	0%	6	0%	5	0%	9	56%		
6	M	6.A:c Vaccine and diluent manufacturer recorded.										12	58%	2	0%	0	nd	1	0%	1	100%	120	13%	4	0%	2	0%	3	0%	13	49%	182	5%	20	0%	6	0%	5	0%	9	39%		
6	M	6.A:c Vaccine and diluent size recorded.										12	58%	2	0%	0	nd	1	0%	1	100%	120	30%	4	0%	2	0%	3	0%	13	38%	182	16%	20	0%	6	0%	5	0%	9	39%		
6	M	6.A:c Vaccine and diluent batch/lot recorded.										12	75%	2	0%	0	nd	1	0%	1	100%	120	46%	4	0%	2	0%	3	0%	13	65%	182	29%	20	0%	6	0%	5	0%	9	50%		
6	M	6.A:c Vaccine and diluent expiry recorded.										12	75%	2	0%	0	nd	1	0%	1	100%	120	49%	4	0%	2	0%	3	0%	13	65%	182	32%	20	0%	6	0%	5	0%	9	61%		
6	M	6.A:c VVM status recorded.										12	33%	2	0%	0	nd	1	0%	1	100%	119	11%	4	0%	2	0%	3	0%	13	15%	182	3%	20	0%	6	0%	5	0%	9	33%		
6	M	6.A:c Freeze indicator status recorded.										12	0%	2	0%	0	nd	1	0%	1	100%	119	8%	4	0%	2	0%	3	0%	13	15%	181	2%	20	0%	6	0%	5	0%	9	33%		
6	M	6.C:c Physical count check matches stock records.										12	31%	2	25%	0	nd	1	0%	1	100%	120	34%	4	44%	2	0%	3	83%	13	69%	182	34%	20	23%	6	8%	5	50%	5	60%		
7	M	7.C:c No stock outs have occurred.										12	42%	2	100%	0	nd	1	100%	1	100%	120	34%	4	100%	2	100%	3	100%	13	69%	181	34%	20	50%	6	67%	5	100%	5	80%		
7	M	7.C:c Low stock has not affected deliveries.										12	33%	2	50%	0	nd	1	100%	1	100%	120	38%	4	75%	2	100%	3	100%	13	69%												

Criteria	Category	Table of mean scores		National								Subnational								Service													
		WHO region:		AFR		EMR		EUR		SEAR		WPR		AFR		EMR		EUR		SEAR		WPR		AFR		EMR		EUR		SEAR		WPR	
		Number of facilities assessed:		12		2		0		1		1		130		4		2		3		13		183		20		6		5		9	
Indicator description:		n=		n=		n=		n=		n=		n=		n=		n=		n=		n=		n=		n=		n=		n=		n=			
7	M	7.C:c Safety stock not breached.		12	33%	2	0%	0	nd	1	100%	1	100%	120	31%	4	0%	2	100%	3	100%	13	50%	181	33%	20	5%	6	67%	5	100%	5	40%
7	M	7.H:c <1% vaccine lost during distribution.		12	100%	2	100%	0	nd	1	100%	1	0%	121	77%	4	100%	2	100%	3	100%	13	92%	181	75%	20	100%	6	100%	5	100%	7	86%
8	M	8.A:c Diluents and vaccines match in distributions.		12	58%	2	0%	0	nd	1	0%	1	100%	119	47%	4	0%	2	0%	3	67%	13	73%	182	46%	20	0%	6	0%	5	100%	7	79%
8	M	8.B:c Diluent and vaccine quantities match.		12	25%	2	50%	0	nd	1	0%	1	0%	119	40%	4	0%	2	0%	3	33%	13	77%	181	40%	20	0%	6	0%	5	80%	7	64%
8	M	8.C:c Health workers use matching diluent and vaccine.																						183	69%	20	0%	6	0%	5	60%	9	89%
8	M	8.D:c Diluents kept cold at service level.																						183	87%	20	100%	6	100%	5	100%	8	75%
9	T	9.A:c VVM knowledge acceptable.		12	92%	2	100%	0	nd	1	100%	1	100%	119	89%	4	75%	2	100%	3	100%	13	96%	182	72%	20	100%	6	83%	5	100%	9	56%
9	M	9.A:c VVM use in outreach acceptable.																						142	60%	20	0%	6	33%	5	70%	7	4%
9	M	9.A:c VVMs used correctly for vaccine management.		12	92%	2	0%	0	nd	1	100%	1	0%	119	90%	4	0%	2	0%	3	100%	13	85%	182	76%	20	0%	6	50%	5	100%	1	0%
10	M	10.A:c MDVP adopted.		12	100%	2	0%	0	nd	1	0%	1	100%	119	92%	4	0%	2	100%	3	33%	10	10%	183	88%	20	0%	6	100%	5	0%	5	20%
10	M	10.A:c Reconstituted vaccine discarded within 6 hours.																						183	86%	20	100%	6	83%	5	80%	5	20%
10	M	10.A:c Opened liquid vials kept for the next session.																						183	88%	20	10%	6	100%	5	0%	5	20%
10	T	10.A:c MDVP knowledge acceptable.		12	92%	2	100%	0	nd	1	100%	1	0%	119	82%	4	25%	2	50%	3	100%	10	10%	182	76%	20	0%	6	67%	5	40%	1	100%
11	T	11.B:c Staff understand wastage calculations.		12	73%	2	0%	0	nd	1	25%	1	25%	119	58%	4	0%	2	25%	3	17%	13	67%	182	42%	20	0%	6	8%	5	0%	9	36%
11	M	11.C:c Wastage data used to estimate vaccine need.		11	23%	2	50%	0	nd	1	25%	1	100%																				

Note: Green highlighting shows “critical indicators.” Blank grey cells show indicators that are not applicable. The criteria column lists the relevant criteria numbers used in the VMAT spreadsheet. Indicator numbers preceding the indicator description refer to the numbers used in the VMAT spreadsheet.

Abbreviations used: **AFR:** African Region; **CC:** cold chain; **EMR:** Eastern Mediterranean Region; **EUR:** European Region; **M:** management, **MDVP:** multi-dose vial policy; **nd:** no data; **PPM:** planned preventive maintenance; **R:** repairs/maintenance (buildings and equipment); **SEAR:** South-East Asia Region; **T:** training; **UNICEF:** United Nations Children's Fund; **VAR:** vaccine arrival report; **VVM:** vaccine vial monitor; **WPR:** Western Pacific Region.

Figure 2. C2: Vaccine storage temperatures

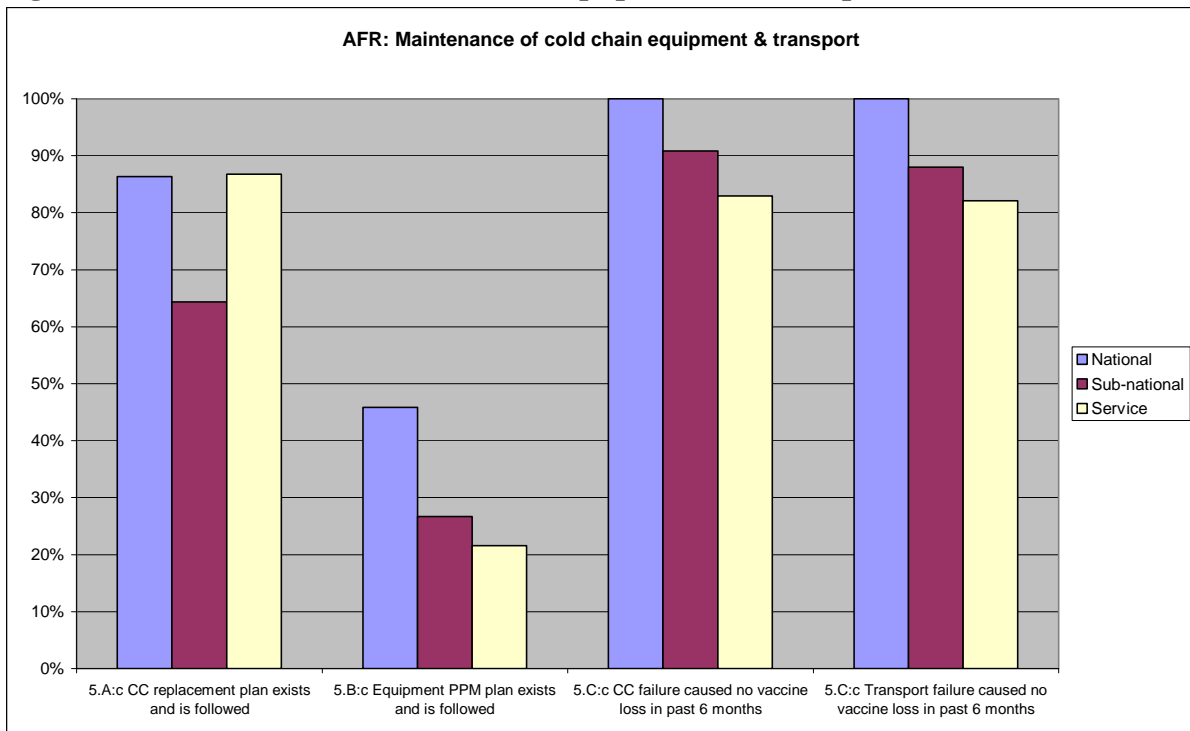


Abbreviations used: AFR: African Region,

Storekeeper knowledge: Knowledge of vaccine storage and freezing temperatures is rather low.

- *Contingency planning:* Very poor at all the levels.

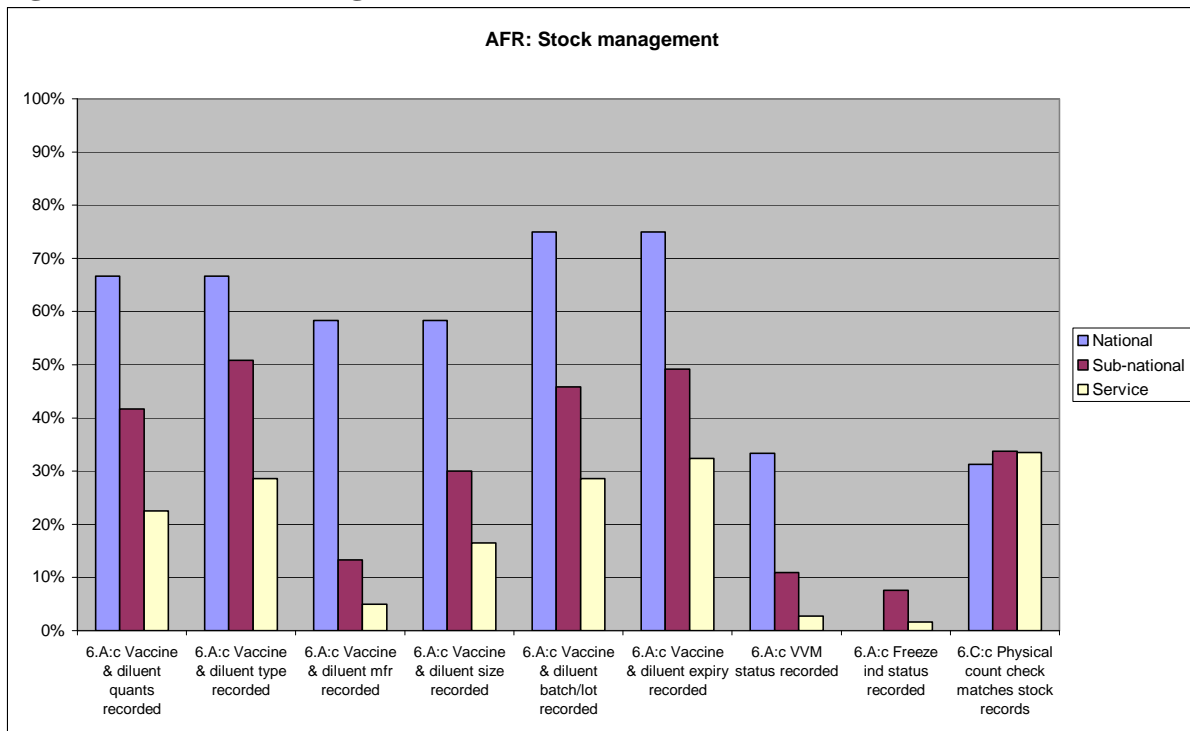
Figure 3. C5: Maintenance of cold chain equipment and transport



Abbreviations used: AFR: African Region; CC: cold chain; PPM: planned preventive maintenance.

- *Cold chain replacement plan:* A surprisingly high score at national and service point levels with an anomalous score at the subnational level.
- *Planned preventive maintenance:* Very low scores at all levels.
- *Vaccine losses:* The reported incidence of vaccine loss is surprisingly low but may simply reflect a lack of systematic investigation of vaccine distribution.

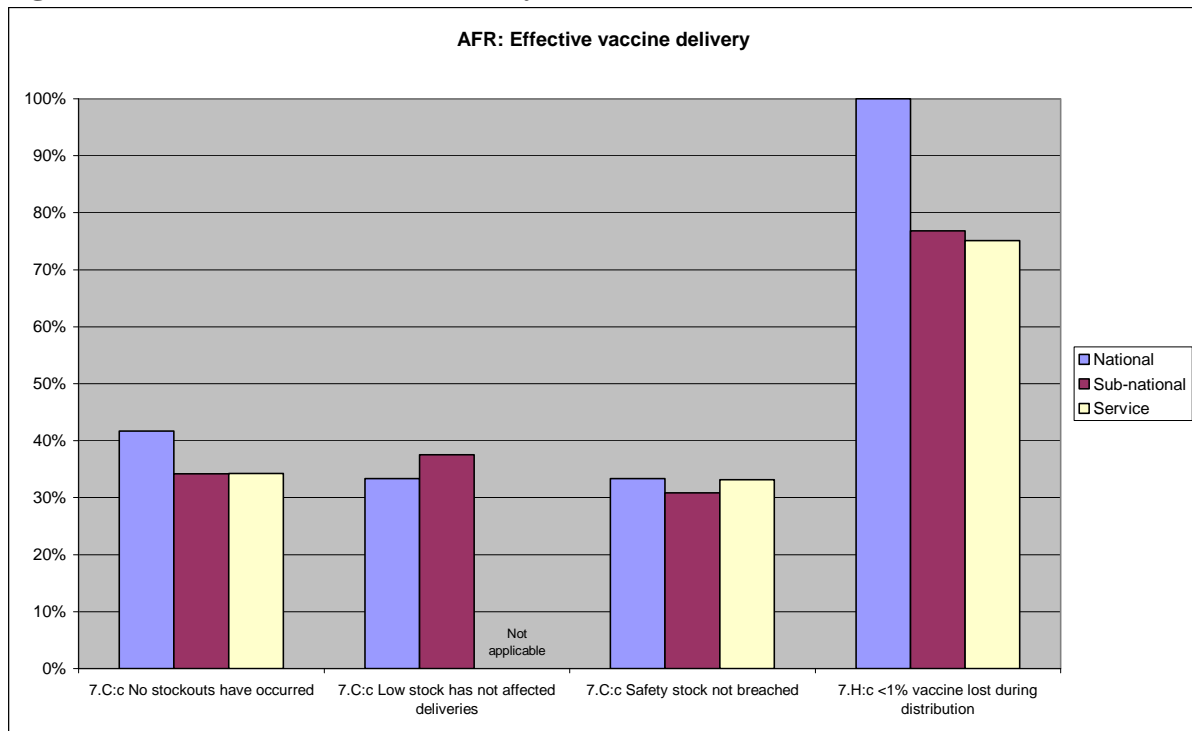
Figure 4. C6: Stock management



Abbreviations used: AFR: African Region; CC: cold chain; ind: indicator; mfr: manufacturer; quants: quantities; VVM: vaccine vial monitor.

- *Stock management:* Compliance with WHO-recommended practice for recording diluent and vaccine, lot/batch numbers, vaccine vial monitor (VVM), and freeze indicator status is not good at the national level and extremely poor at the lower levels.
- *Physical stock checks:* When physical stock checks of a sample vaccine were conducted at the 12 national stores, the checked item matched the stock records in only 31% of the countries assessed. Compliance appears to be marginally better at the subnational and service point level, but this level of performance is worryingly low. An unsatisfactory level of performance against this indicator is also noted in the EVSM analysis report.

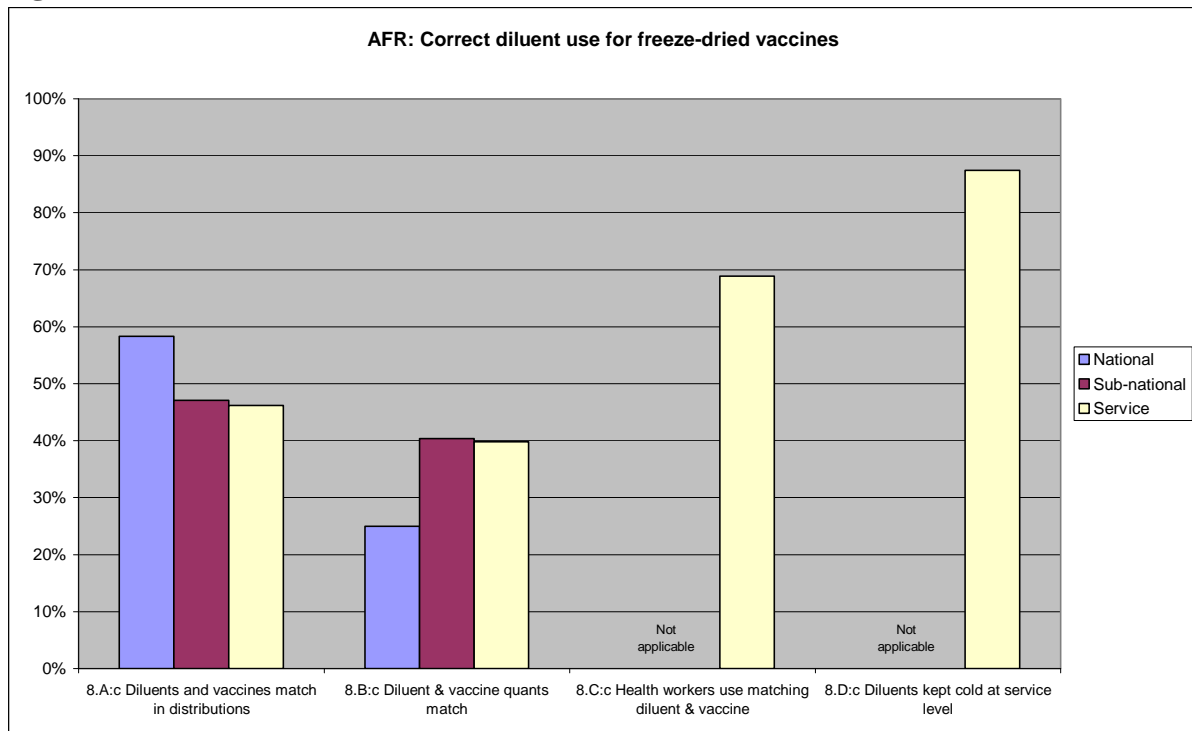
Figure 5. C7: Effective vaccine delivery



Abbreviations used: AFR: African Region.

- *Stockouts:* At the national level, only 42% of countries reported no stockouts, only 33% said that low stock levels had not affected deliveries to the subnational stores, and only 33% reported that safety stock levels had not been breached. The situation is similarly poor at the two lower levels.
- *Vaccine loss during distribution:* Reported incidence of vaccine loss is surprisingly low, but, again, may simply reflect a lack of systematic investigation. Interestingly, the reported situation at the subnational and service point level is not as good as reported under Q5C—a similar indicator.

Figure 6. C8: Correct diluent use for freeze-dried vaccines



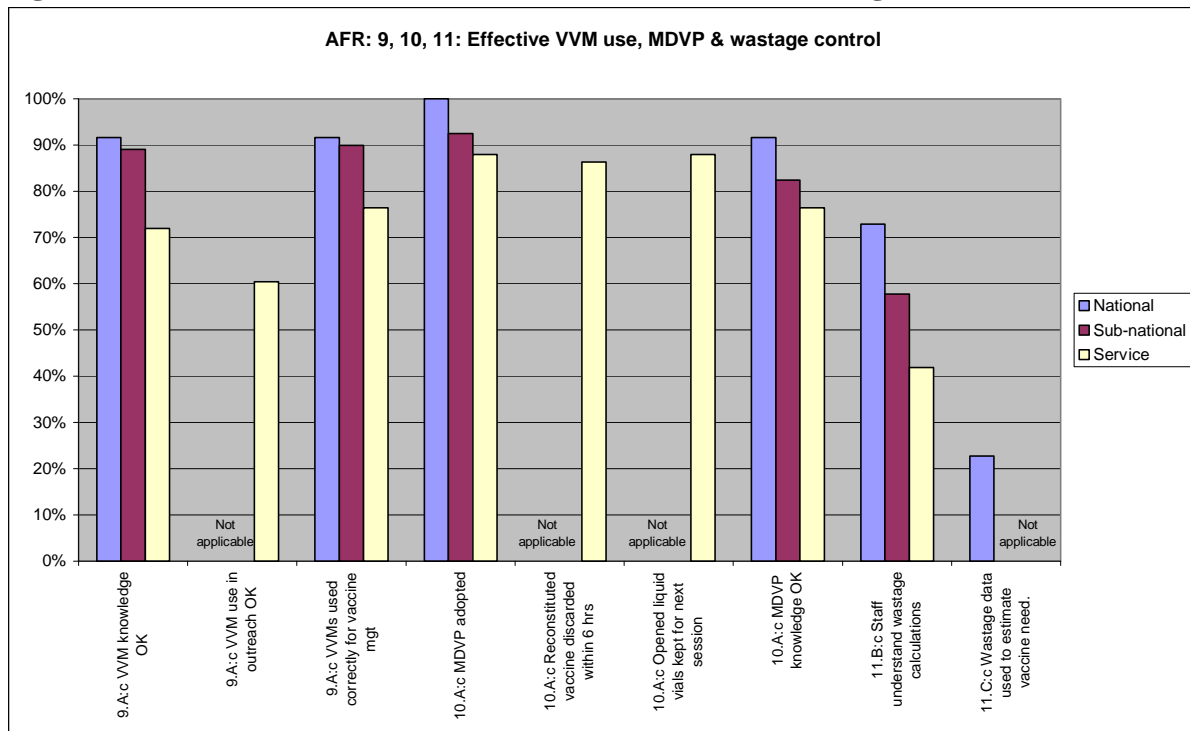
Abbreviations used: AFR: African Region; quants: quantities.

Some of the data on this chart are anomalous:

- *Freeze-dried vaccines are always ordered, received, and distributed with their original diluent:* Indicator 8.A shows a low but fairly consistent level of performance across facilities at all three levels.
- *The stock of diluent corresponds with the stock of freeze-dried vaccine:* The 58% response at the national level with indicator 8.A is difficult to reconcile with the 25% response to indicator 8.B. Similarly, it is difficult to see how 69% of service level facilities can accurately be matching diluent and vaccine if the apparent level of compliance higher up the supply chain is so low.
- *Diluents kept cold at service level:* The data suggest that 12% of health facilities are giving reconstituted vaccines without cooling the diluent first.

Mismanagement of diluents is a long-standing and frequently observed phenomenon, and it appears that this problem continues.

Figure 7. C9, 10, and 11: Effective VVM use, MDVP, and wastage control



Abbreviations used: AFR: African Region; hrs: hours; MDVP: multi-dose vial policy; mgt: management; mfr: manufacturer; quants: quantities; VVM: vaccine vial monitor.

- *VVM knowledge:* Knowledge of the VVM appears to be strong at the national and subnational level—less so at service points (Q9.A). Over 60% of peripheral facilities appear to be using VVMs for outreach correctly (Q9.B), and all three levels appear to be using the technology for vaccine management.
- *Reconstituted vials discarded within 6 hours:* 14% of the 183 health facilities visited (n=26) apparently keep reconstituted vaccine beyond the 6-hour discard point.
- *MDVP knowledge:* Knowledge of the multi-dose vial policy (MDVP) appears to be reasonable at all levels and nearly 90% of 182 health facilities were keeping opened vials of liquid vaccine for subsequent use in accordance with the policy.
- *Wastage rate calculation knowledge:* While 70% of national-level interviewees appear to understand vaccine wastage calculations, the 11 national stores that responded to Q11.C only achieved a 23% score for using this knowledge to estimate future vaccine need.

Discussion

Management and training issues predominate among the critical indicators where scoring is low. However, there do appear to be some strengths in this category. For example, the assessments suggest a good degree of success in training health workers in the use of VVMs and MDVP.

The very poor level of achievement against the stock control indicators shows that this long-standing problem is not being solved, despite the widespread introduction of computerized stock control in the African region over the past few years, and the support given by AFRO staff.

General indicator analysis

This section reviews performance against the general (noncritical) indicators. The critical indicators are still shown on the tables that follow, but they are not discussed further.

C1: Vaccine arrival procedures

This criterion only applies at the national level. There are a total of five indicators, only two of which are critical.

Table 4 shows the distribution of scores achieved against each of the indicators. In this case only, the results for the other four regions are also shown for the sake of comparison.

Table 4. C1 indicators

Category	Table of mean scores	National									
	WHO region:	AFR		EMR		EUR		SEAR		WPR	
	Number of facilities assessed:	12		2		0		1		1	
Indicator description:	n=		n=		n=		n=		n=		
M	1.A:c VAR as UNICEF content.	12	92%	2	0%	0	nd	1	0%	1	100%
M	1.A:c VARs correct.	12	83%	2	100%	0	nd	1	24%	1	100%
M	1.A: Shipments acceptable or problems followed up.	12	92%	2	38%	0	nd	1	25%	1	0%
M	1.B: Customs/MoU acceptable.	12	81%	2	88%	0	nd	1	75%	1	100%
M	1.C: Clearing agent acceptable or n/a.	11	75%	1	100%	0	nd	0	nd	0	nd

Note: Green highlighting shows “critical indicators.” Indicator numbers preceding the indicator description refer to the numbers used in the VMAT spreadsheet.

Abbreviations used: **AFR:** African Region; **EMR:** Eastern Mediterranean Region; **EUR:** European Region; **M:** management; **MoU:** memorandum of understanding; **n/a:** not applicable; **SEAR:** South-East Asia Region; **UNICEF:** United Nations Children’s Fund; **VAR:** vaccine arrival report; **WPR:** Western Pacific Region.

The table shows a high average level of compliance against all five indicators across the AFR stores—generally above the 80% EVSM certification level. Looking at the data in detail, only Comoros and Swaziland failed to get a 100% score against one or more of the critical indicators. Eleven of the 12 AFR countries apparently use an agent to facilitate customs clearance (Q1.C).

C2: Vaccine storage temperatures

Table 5 shows the distribution of scores achieved against each of the indicators.

Table 5. C2 indicators

Category	Table of mean scores	National		Subnational		Service	
	WHO region:	AFR		AFR		AFR	
	Number of facilities assessed:	12		130		183	
	Indicator description:	n=		n=		n=	
T	2.A:c Storekeeper knows vaccine storage temps.	12	83%	120	73%	183	62%
T	2.A:c Storekeeper knows vaccine freezing temps.	12	83%	120	72%	183	52%
M	2.B: Twice-daily temp records exist for CRs and FRs.	12	58%	20	50%		
M	2.B: Recorder traces exist in CRs and FRs.	12	17%	18	33%		
M	2.B: Recorder traces match manual records.	9	11%	20	35%		
M	2.C: Twice-daily temp records exist for each refrig/freezer.	8	75%	116	59%	181	62%
M	2.D: Stock/disposal records tally.	11	82%	118	62%	183	67%
M	2.E:c Contingency plan acceptable.	12	48%	120	29%	183	31%
M	2.E:c Emergency contacts posted.	12	58%	120	18%		
M	2.E:c Staff know emergency procedures.	12	75%	120	67%		

Note: Green highlighting shows “critical indicators.” Blank grey cells show indicators that are not applicable. Indicator numbers preceding the indicator description refer to the numbers used in the VMAT spreadsheet.

Abbreviations used: **AFR:** African Region; **CR:** cold room; **FR:** freezer room; **M:** management; **n/a:** not applicable; **refrig:** refrigerator; **T:** training.

- *Twice-daily temperature records for cold/freezer rooms* Q2.B: Compliance with the requirement to maintain twice-daily temperature records for cold rooms and freezer rooms is very poor: only 58% of stores at the national level achieved compliance and 50% at the subnational level (of the 20 subnational facilities with cold rooms and/or freezer rooms).
- *Recorder traces* Q2.B: Compliance with the requirement to keep temperature recorder traces is even lower: only 17% of stores reached compliance at the national level and 33% at subnational levels. It is not clear why the score is better at the subnational level. One hypothesis is that subnational cold rooms are likely to be newer and better equipped than those at the national level, which are likely to have been installed as part of an earlier cold chain rollout.
- *Recorder traces match manual records* Q2.B: The failure of recorder traces (where they exist) to match manual records is alarming in these critical, higher-level stores.
- *Twice-daily temperature records for refrigerators and freezers* Q2.C: Only 75% of national-level stores with refrigerators or freezers were able to produce a complete, six-month set of temperature records for every appliance. This figure falls to 59% at the subnational level and 62% at the service point level.
- *Stock/disposal records* Q2.D: This indicator assesses record keeping of vaccine discards due to incorrect storage temperatures. Of records tallied in the 10 national stores, 82% were satisfactory. This figure falls to 62% and 67% at subnational and service point stores.

C3: Cold storage capacity

Table 6 shows the distribution of scores achieved against each of the indicators.

Table 6. C3 indicators

Category	Table of mean scores	National		Subnational		Service	
	WHO region:	AFR		AFR		AFR	
	Number of facilities assessed:	12		130		183	
	Indicator description:	n=		n=		n=	
E	3.A: Routine storage capacity adequate.	12	83%	119	80%	183	85%
E	3.B: Campaign storage capacity adequate.	7	100%	66	76%	101	77%
T	3.C: Staff know how to adjust supply to storage capacity.	12	83%	120	66%		

Note: Blank grey cells show indicators that are not applicable. Indicator numbers preceding the indicator description refer to the numbers used in the VMAT spreadsheet.

Abbreviations used: **AFR:** African Region; **E:** equipment; **T:** training.

- *Routine storage capacity C3.A:* Routine storage capacity appears to be largely sufficient to accommodate existing vaccines across the spectrum of facilities.
- *Campaign storage capacity C3.B:* Campaign storage capacity appears to be acceptable at the national level (although only 7 of the 12 countries were assessed) and somewhat less satisfactory at the lower levels. Again, only about half the facilities were assessed.
- *Adjusting supply to storage capacity C3.C:* National-level staff appear to have a reasonable level of understanding of adjusting supply intervals to storage capacity. Competence in this area seems to be lower at the subnational stores, but it is likely that the ability to control events at this level is lower, especially with “push” distribution systems.

C4: Buildings, cold chain equipment, and transport

Table 7 shows the distribution of scores achieved against each of the indicators.

Table 7. C4 indicators

Category	Table of mean scores	National		Subnational		Service	
	WHO region:	AFR		AFR		AFR	
	Number of facilities assessed:	12		130		183	
	Indicator description:	n=		n=		n=	
B	4.A: Cold store space adequate.	12	63%				
B	4.A: Packing area adequate.	12	54%				
B	4.A: Storekeeper office acceptable.	12	73%				
B	4.A: Dry store adequate.	12	56%				
B	4.B: Cold store space adequate.			120	63%		
B	4.B: Dry store adequate.			120	62%		
E	4.C: Refrigeration units working.	12	75%	9	56%		
E	4.C: Temp recorders exist.	12	50%	8	63%		
E	4.C: CR temps acceptable.	12	100%	9	67%		
E	4.C: FR temps acceptable.	10	80%	7	43%		
E	4.C: CR/FR have dual units.	12	75%	7	43%		
E	4.C: CR/FR shelving adequate.	12	100%	7	71%		
E	4.C: CR/FR alarms exist.	12	25%	7	14%		
E	4.C: CR/FR have voltage regs.	6	67%	5	20%		
E	4.C: CR have low temp protection.	0	nd	1	0%		
E	4.D: CC equipment WHO compliant.	0	78%	118	90%	181	90%
E	4.D: All refrigerators operational.	9	89%	119	84%	183	89%
E	4.D: All refrigerators have thermometers.	9	100%	117	88%	182	86%
E	4.D: All refrigerators maintain 2° to 8°C.	8	63%	114	82%	180	76%
E	4.D: All freezers maintain -15° to -25°C.	9	67%	102	70%	47	64%
M	4.D: Adequate kerosene/gas.			32	56%	88	68%
E	4.D: Refrigerators have voltage regs.	5	20%	65	32%	59	36%
E	4.D: Refrigerator in heated rooms.	0	nd	3	67%	3	0%
E	4.E: Sufficient IP freezing cap.	12	92%	120	88%	181	75%
E	4.E: Sufficient IP storage cap.	12	92%	120	88%	182	73%
E	4.F: Sufficient CBs and VCs.	12	83%	120	75%	183	74%
T	4.F: Staff know IP conditioning.	12	67%	120	48%	183	45%
T	4.F: Staff know freeze prevention.	1	100%	10	60%		
E	4.G: Generator working.	12	92%	119	43%		
E	4.G: Generator large enough.	12	100%	119	43%		
E	4.G: Fuel tank large enough.	12	92%	119	32%		
M	4.G: Fuel supply adequate.	11	82%	119	31%		
E	4.H: Vehicles operational.	11	64%	115	69%	135	56%
E	4.H: Vehicle fuel sufficient.	11	91%	111	77%	133	58%
T	4.J: Drivers know refrigerator vehicle operating procedures.	3	100%	4	50%		

Note: Blank grey cells show indicators that are not applicable. Indicator numbers preceding the indicator description refer to the numbers used in the VMAT spreadsheet.

Abbreviations used: **AFR:** African Region; **B:** buildings; **CB:** cold box; **CC:** cold chain; **CR:** cold room; **E:** equipment; **FR:** freezer room; **M:** management; **nd:** no data; **IP:** ice pack; **R:** repairs/maintenance (buildings and equipment); **refrig:** refrigerator; **reg:** regulators; **T:** training; **temp:** temperature; **VC:** vaccine carrier.

- *National-level accommodation Q4.A:* Many national stores seem to have inadequate space in the store building(s) when assessed against the four Q4.A indicators.
- *Subnational accommodation Q4.B:* The situation is similarly unsatisfactory at the subnational level.

- *Refrigeration units* Q4.C: Compliance with the requirement to have all cold room/freezer room refrigeration units working is only 75% at the national level and a worryingly low 56% at the subnational level (n=9).
- *Temperature recorders* Q4.C: Only half of national-level cold rooms appear to have temperature recorders. This is identical to the EVSM compliance level for this indicator. At subnational stores with cold/freezer rooms, the percentage is higher (63%, n=8).
- *Cold room temperature control* Q4.C: Of national cold rooms, 100% appear to maintain 2° to 8°C, but only 67% do at the subnational level (n=9).
- *Freezer temperature control* Q4.C: Only 80% of national-level freezer rooms (n=10) and 43% of subnational freezer rooms (n=7) apparently maintain -15° to -25°C.
- *Alarms* Q4.C: Cold room and freezer room alarms are absent from many national and subnational stores.
- *Cold chain equipment standards* Q4.D: Cold chain equipment compliance with WHO standards is generally higher at the peripheral level (90%) than at the center (78%). This may reflect the greater age of national-level equipment compared with that distributed to the outlying stores and facilities.
- *Functioning refrigerators and freezers* Q4.D: Most national and service point stores have functioning refrigerators and freezers, while slightly fewer do at the subnational level (89%, 84%, 89%).
- *Thermometers* Q4.D: There are still refrigerators and freezers at the subnational and service point facilities that do not have thermometers.
- *Refrigerator temperature control* Q4.D: If the assessments are correct, a substantial numbers of refrigerators at the national level are not capable of maintaining 2° to 8°C.
- *Freezer temperature control* Q4.D: There appears to be a similar problem with freezer temperature control.
- *Kerosene and gas* Q4.D: A total of 32 of 130 subnational stores and 88 of 183 service point facilities apparently rely on gas or kerosene. Fuel availability seems to be a problem in many of these areas.
- *Generator indicators* Q4.G: Standby generator provisions at the national level seem, in general, to be good. This is not the case at the subnational level, where scores against all four indicators are low.
- *Vehicle indicators* Q4.H: Scores against the two vehicle indicators decline from the center to the periphery.

C5: Maintenance of cold chain equipment and transport

Table 8 shows the distribution of scores achieved against each of the indicators.

Table 8. C5 indicators

Category	Table of mean scores	National		Subnational		Service	
	WHO region:	AFR		AFR		AFR	
	Number of facilities assessed:	12		130		183	
	Indicator description:	n=		n=		n=	
R	5.A:c CC replacement plan exists and is followed.	11	86%	120	64%	179	87%
R	5.A: Vehicle replacement plan exists and is followed.	11	59%	108	68%	134	85%
R	5.B:c Equipment PPM plan exists and is followed.	12	46%	120	27%	182	22%
R	5.B: Transport PPM plan exists and is followed.	11	39%	114	79%	141	28%
R	5.C:c CC failure caused no vaccine loss in past 6 months.	12	100%	120	91%	182	83%
R	5.C:c Transport failure caused no vaccine loss in past 6 months.	12	100%	117	88%	140	82%
R	5.D: Spare parts shortage caused no CC failure > 7 days.	12	83%	120	66%	181	72%
R	5.D: Spare parts shortage caused no transport failure > 7 days.	12	67%	115	66%	133	65%

Note: Green highlighting shows “critical indicators.” Indicator numbers preceding the indicator description refer to the numbers used in the VMAT spreadsheet.

Abbreviations used: **AFR:** African Region; **CC:** cold chain; **PPM:** planned preventive maintenance;

R: repairs/maintenance (buildings and equipment).

Vehicle replacement plan Q5.A: Curiously the score against this indicator improves towards the periphery. This is counter-intuitive and difficult to explain because this type of long-term planning is more likely to occur at the national level.

- *Transport PPM Q5.B:* Transport planned preventive maintenance scores best at the subnational level—it is unclear why this should be so.

C6: Stock management

Table 9 shows the distribution of scores achieved against each of the indicators.

Table 9. C6 indicators

Category	Table of mean scores		National		Subnational		Service	
	WHO region:		AFR		AFR		AFR	
	Number of facilities assessed:		12		130		183	
	Indicator description:		n=		n=		n=	
M	6.A: Receipts and dispatches recorded and updated.	12	92%	120	71%	182	52%	
M	6.A:c Vaccine and diluent quantities recorded.	12	67%	120	42%	182	23%	
M	6.A:c Vaccine and diluent type recorded.	12	67%	120	51%	182	29%	
M	6.A:c Vaccine and diluent manufacturer recorded.	12	58%	120	13%	182	5%	
M	6.A:c Vaccine and diluent size recorded.	12	58%	120	30%	182	16%	
M	6.A:c Vaccine and diluent batch/lot recorded.	12	75%	120	46%	182	29%	
M	6.A:c Vaccine and diluent expiry recorded.	12	75%	120	49%	182	32%	
M	6.A:c VVM status recorded.	12	33%	119	11%	182	3%	
M	6.A:c Freeze indicator status recorded.	12	0%	119	8%	181	2%	
M	6.A: Vaccine distribution reports acceptable.	12	50%	120	27%			
M	6.A: Vaccine requisition forms used.	12	92%	120	81%	181	62%	
M	6.B: EEFO used.	12	58%	120	92%	182	79%	
M	6.B: Max/min stock levels used.	11	55%	120	56%			
M	6.B: Managers have freedom to make exceptions.	12	92%	120	88%	182	74%	
M	6.C: Physical counts in past 6 months.	12	58%	120	60%	183	43%	
M	6.C:c Physical count check matches stock records.	12	31%	120	34%	182	34%	
M	6.D: Vaccine store clean.	12	67%	120	81%	183	82%	
M	6.D: Vaccine store secure.	12	100%	120	89%			
M	6.D: Data secure.	12	75%	120	78%			
M	6.D: Stock orderly.	12	67%	117	74%			
M	6.D: Contents list on cabinets.	12	33%	120	14%			
M	6.D: Vaccine stored correctly.	12	100%	119	83%	183	80%	

Note: Green highlighting shows “critical indicators.” Blank grey cells show indicators that are not applicable. Indicator numbers preceding the indicator description refer to the numbers used in the VMAT spreadsheet.

Abbreviations used: **AFR:** African Region; **CC:** cold chain; **EEFO:** earliest-expiry-first-out; **M:** management; **VVM:** vaccine vial monitor.

The discussion on critical indicator scores has already highlighted stock management as a major problem. Continuing this discussion we can see that the scores against the general indicators do reveal some strengths, and also several weaknesses.

- *Receipts and dispatches recorded* Q6.A: The 92% score at the national level is encouraging, but performance against this indicator declines markedly towards the periphery.
- *Is a vaccine distribution report regularly made and circulated?* Q6.A: Compliance against this indicator is low.
- *Are vaccine requisition forms used for ordering and receiving vaccine?* Q6.A: Compliance is good at the national and subnational level, less so at the service point level.
- *Earliest-expiry-first-out (EEFO).* Q6.B: EEFO compliance appears to be best at the subnational and health facility level, but poor at the national level. The 58% figure compares with a 60% compliance level in the EVSM analysis.
- *Are maximum and minimum stock levels established for each vaccine?* Q6.B: Compliance is rather poor at both the national and subnational levels.

- *Physical counts* Q6.C: Only 58% of 11 national stores had carried out a physical count in the six months preceding the assessment. The EVSM assessment showed an even lower figure (32% in 3 months). Similarly inadequate compliance with this requirement is found at the lower levels.
- *Housekeeping standards* Q6.D: There is a reasonable level of compliance against these six indicators at the subnational level and in the health facilities (where only two of them apply). Performance at the national level appears to be significantly lower. Only a small proportion of facilities attach contents lists to cold chain equipment cabinets.

C7: Effective vaccine delivery

Table 10 shows the distribution of scores achieved against each of the indicators.

Table 10. C7 indicators

Category	Table of mean scores	National		Subnational		Service	
	WHO region:	AFR		AFR		AFR	
	Number of facilities assessed:	12		130		183	
	Indicator description:	n=		n=		n=	
M	7.A: Vaccine distribution plan exists and is followed.	12	67%	121	29%		
M	7.B: Stocks sufficient.	12	36%	120	58%	182	51%
M	7.C:c No stock-outs have occurred.	12	42%	120	34%	181	34%
M	7.C:c Low stock has not affected deliveries.	12	33%	120	38%		
M	7.D: Staff know how to calculate vaccine need.	12	67%	119	64%	181	37%
M	7.E: Short shipment system exists.	12	88%	121	68%		
T	7.F: Staff can read freeze indicators.	12	50%	120	23%	180	14%
E	7.G: Freeze indicators used on all deliveries.	11	36%	107	19%		
M	7.H:C <1% vaccine lost during distribution.	12	100%	121	77%	181	75%

Note: Green highlighting shows “critical indicators.” Blank grey cells show indicators that are not applicable. Indicator numbers preceding the indicator description refer to the numbers used in the VMAT spreadsheet.

Abbreviations used: AFR: African Region; E: equipment; M: management; T: training.

- *Is a plan for vaccine receipt/distribution established and followed?* Question 7.A: Only 67% of national and 29% of subnational stores follow a vaccine distribution plan. Compare the national figure with the 48% score against a similar indicator in the EVSM analysis.
- *The stock of vaccine is sufficient until the next delivery arrives* Q7.B: Only 36% of 12 national stores showed compliance with this requirement indicating that stock-outs are likely to occur. The situation is somewhat better at the lower levels, but not satisfactory.
- *The person responsible for ordering vaccine knows how to estimate the vaccine needs for one supply period* Q7.D: This basic management requirement was met in 67% of 12 national stores, 64% of subnational, and 37% of health facilities.
- *Staff can read freeze indicators* Q7.F: Knowledge of freeze indicators appears to be very low (50%, 23%, and 14%). Contrast this with the good understanding of VVMs.
- *Over a selected one-month period, were freeze indicators used on all deliveries of freeze-sensitive vaccines?* Q7.G: Compliance with this indicator was achieved by only 36% of 11 national and 19% of 107 subnational stores.

C8: Correct diluent use for freeze dried vaccines

These are all critical indicators which have been discussed above.

Table 11. C8 indicators

Category	Table of mean scores	National		Subnational		Service	
	WHO region:	AFR		AFR		AFR	
	Number of facilities assessed:	12		130		183	
	Indicator description:	n=		n=		n=	
M	8.A:c Diluents and vaccines match in distributions.	12	58%	119	47%	182	46%
M	8.B:c Diluent and vaccine quantities match.	12	25%	119	40%	181	40%
M	8.C:c Health workers use matching diluent and vaccine.					183	69%
M	8.D:c Diluents kept cold at service level.					183	87%

Note: Green highlighting shows “critical indicators.” Blank grey cells show indicators that are not applicable. Indicator numbers preceding the indicator description refer to the numbers used in the VMAT spreadsheet.

Abbreviations used: AFR: African Region; M: management.

C9: Effective VVM use

An analysis of the distribution of scores achieved against each of the indicators is given in Table 12.

Table 12. C9 indicators

Category	Table of mean scores	National		Subnational		Service	
	WHO region:	AFR		AFR		AFR	
	Number of facilities assessed:	12		130		183	
	Indicator description:	n=		n=		n=	
M	9.A: VVM poster exists.	12	50%	119	36%	182	44%
M	9.A:c VVM knowledge acceptable.	12	92%	119	89%	182	72%
M	9.A:c VVM use in outreach acceptable.					142	60%
M	9.A:c VVM used correctly for vaccine management.	12	92%	119	90%	182	76%

Note: Green highlighting shows “critical indicators.” Blank grey cells show indicators that are not applicable. Indicator numbers preceding the indicator description refer to the numbers used in the VMAT spreadsheet.

Abbreviations used: AFR: African Region; M: management; VVM: vaccine vial monitor.

As already noted, knowledge of VVMs appears to be good at all levels despite the rather low use of VVM posters.

C10: Multi-dose vial policy

These are all critical indicators and have already been discussed.

Table 13. C10 indicators

Category	Table of mean scores	National		Subnational		Service	
	WHO region:	AFR		AFR		AFR	
	Number of facilities assessed:	12		130		183	
	Indicator description:	n=		n=		n=	
M	10.A:c MDVP adopted.	12	100%	119	92%	183	88%
M	10.A:c Reconstituted vaccine discarded within 6 hours.					183	86%
M	10.A:c Opened liquid vials kept for next session.					183	88%
T	10.A:c MDVP knowledge acceptable.	12	92%	119	82%	182	76%

Note: Green highlighting shows “critical indicators.” Blank grey cells show indicators that are not applicable. Indicator numbers preceding the indicator description refer to the numbers used in the VMAT spreadsheet.

Abbreviations used: AFR: African Region; M: management; MDVP: multi-dose vial policy; T: training.

C11: Vaccine wastage control

Table 14 shows the distribution of scores achieved against each of the indicators.

Table 14. C11 indicators

Category	Table of mean scores	National		Subnational		Service	
	WHO region:	AFR		AFR		AFR	
	Number of facilities assessed:	12		130		183	
	Indicator description:	n=		n=		n=	
M	11.A: Wastage monitoring system exists.	12	52%	119	45%	182	38%
T	11.B:c Staff understand wastage calculations.	12	73%	119	58%	182	42%
M	11.C:c Wastage data used to estimate vaccine need.	11	23%				
T	11.D: Review of docs where wastage data used.	11	25%	119	28%	182	19%

Note: Green highlighting shows “critical indicators.” Blank grey cells show indicators that are not applicable. Indicator numbers preceding the indicator description refer to the numbers used in the VMAT spreadsheet.

Abbreviations used: AFR: African Region; docs: documents; M: management; T: training.

Wastage monitoring appears to need strengthening at all levels (Q11.A), and the data needs to be much more fully used as a vaccine management tool than appears to be the case at present (Q11.D).

VMAT - some conclusions and recommendations

As a result of this analysis, there are a number of general conclusions and recommendations to make concerning the future development of the VMAT:

- The tool should be expanded to allow for a larger number of subnational and service points. Unofficial versions already exist with this feature, and the formalization of this upgrade has already been put in hand.
- The status of the current “critical indicators” should be reviewed. As with the EVSM tool, there may be a case for changing the number of such indicators, or adjusting their weightings in the light of past experience with the tool and to take account of anticipated future developments (e.g., new vaccine introduction).
- A better system of update control is needed to ensure that all future assessments are carried out using the latest version. Possibly this could be accomplished via an EVSM/VMA website.
- A cross-sectional analysis of the type described in this paper can draw out common “longitudinal” problems and themes between countries. In addition it may be useful to do a detailed “vertical” analysis of the sequential assessments carried out within an individual country. The updated spreadsheet should therefore include a “results summary” worksheet so that the full data set can conveniently be exported to a related tool to create these types of analyses on a routine basis.⁹ The type of analysis required needs to be carefully considered before this work is put in hand.

⁹ The work done for this analysis and the spreadsheet WHO IVB: EVSM&VM_Assessment_Global_Summary-0804.xls represents a starting point.