Landscape Analysis

Analysis of EVSM Indicators

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Executive summary

The Effective Vaccine Stores Management (EVSM) assessment tool was created by the World Health Organization (WHO) in 2003 and revised in 2004 to help countries and agencies evaluate critical components of the country's primary vaccine store. To date, 57 countries have completed the EVSM assessment. Optimize evaluated a total of 42 EVSM assessment spreadsheets for this report.

Against the 17 critical indicators, the principal shortcomings drawn from this analysis (poor vaccine arrival management, lack of contingency planning, poor equipment maintenance planning, transport failure, and poor stock control) are familiar recurring themes, most of which are predominantly management rather than equipment-related.

Against the noncritical indicators, the following picture emerges:

- The overall level of compliance with vaccine arrival procedures is rather poor.
- Management of temperature records and compliance with temperature monitoring procedures is poor.
- There is a woeful lack of current data on vaccine storage needs and an apparent absence of sufficient routine storage capacity in around 25% of countries. This shortfall may be due to a real lack of capacity, or poor delivery and arrival management, or a combination of factors.
- A worryingly larger number of stores have nonoperational refrigeration units, lack temperature recording equipment, and/or do not have dual refrigeration units on all their cold rooms or freezer rooms.
- Stock management and distribution management is generally weak.

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

Methodology

The EVSM assessment tool enables assessors to review the equipment and management in a country's primary vaccine store in a systematic manner. The output of the tool is a spider (radar) chart that gives a percentage score against the eight principal EVSM indicators. These indicator percentages are built up from the combined scores of a number of sub-indicators.

Some indicators are common to all primary stores, but some are context-dependant: if the sub-indicator is not relevant, the EVSM assessor enters "n/a" and the tool automatically adjusts the percentage denominator to allow for its exclusion. Because the denominator varies, it is meaningless to average overall scores between countries. Nevertheless, it is legitimate to carry out a cross-country analysis of the scores against the individual sub-indicators. This is the purpose of the exercise set out in this document.

Sample

A total of 42 of 57 EVSM assessment spreadsheets were analyzed. The chosen assessments are the ones that were made available to the team and cover the countries shown in Table 1.

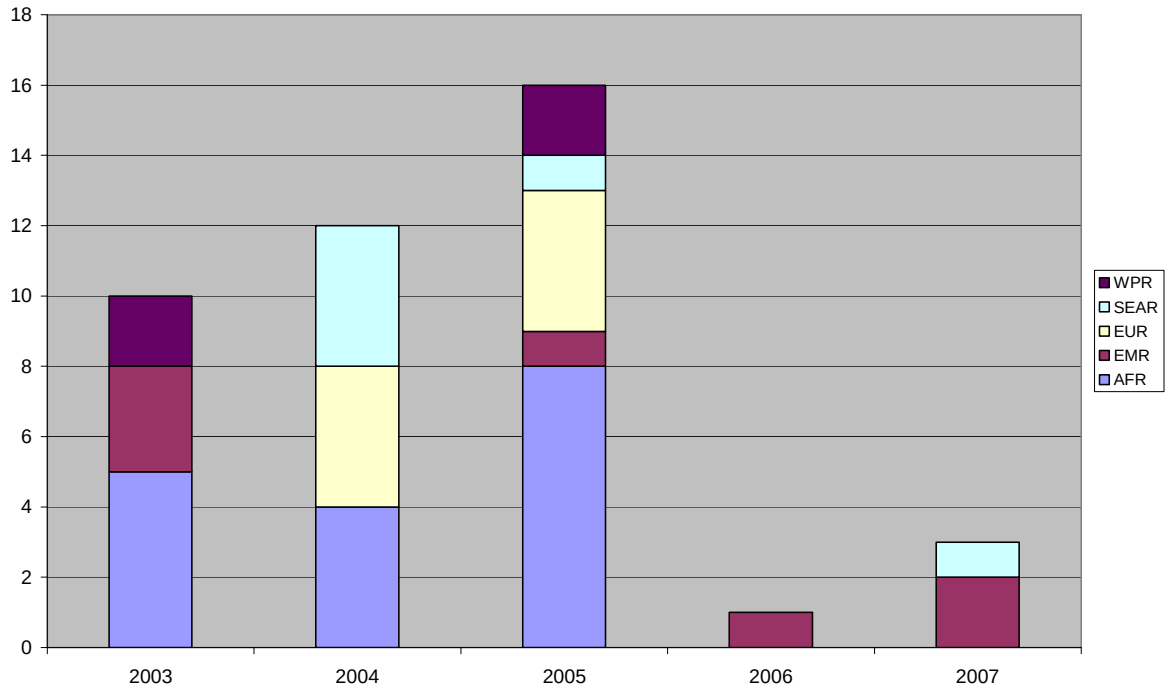
Table 1. EVSM spreadsheets analyzed

Country	Region	Year	Country	Region	Year	Country	Region	Year
Afghanistan	EMR	2007	Georgia	EUR	2005	Oman	EMR	2003
Azerbaijan	EUR	2004	India–AP	SEAR	2004	Pakistan	EMR	2003
Bangladesh	SEAR	2004	Indonesia Central Java	SEAR	2004	Senegal (self-assessment)	AFR	2004
Benin	AFR	2005	Iran (self-assessment)	EMR	2005	Sri Lanka (self-assessment)	SEAR	2005
Bulgaria	EUR	2005	Kenya	AFR	2003	Sudan	EMR	2007
Burkina Faso	AFR	2005	Kyrgyzstan	EUR	2004	Tanzania	AFR	2004
Cambodia	WPR	2003	Lao PDR	WPR	2005	Tanzania - Zanzibar	AFR	2004
Cameroon	AFR	2005	Malawi	AFR	2003	Turkey	EUR	2005
Chad	AFR	2005	Mali	AFR	2005	Turkmenistan	EUR	2004
Congo	AFR	2005	Moldova	EUR	2004	Uganda	AFR	2004
Cote d'Ivoire	AFR	2005	Myanmar	SEAR	2004	Uzbekistan	EUR	2005
Egypt	EMR	2006	Nepal	SEAR	2007	Vietnam	WPR	2005
Ethiopia	AFR	2003	Niger	AFR	2005	Yemen	EMR	2003
Fiji	WPR	2003	Nigeria	AFR	2003	Zambia	AFR	2003

Abbreviations used: AP: Andrah Pradesh; **AFR:** African Region; **EMR:** Eastern Mediterranean Region; **EUR:** European Region; **PDR:** People's Democratic Republic **SEAR:** South-East Asia Region; **WPR:** Western Pacific Region.

Figure 1 shows how these assessments were distributed by year and by WHO region. Only four of the sample assessments were conducted in 2006 and 2007.

Figure 1. EVSM assessments 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.

Analytical approach

The published version of the EVSM tool (v1.11) was used as a basis for setting up the analysis. The score for each indicator from all 42 assessments was transferred to a table attached to the right hand side of each of the eight worksheets. The indicators are numerically scored (C1 to C8).

The consolidated data for each of the eight criteria were then analyzed. Invalid data points have been filtered out, which is the reason why "n" varies in the tables below. Some of these invalid data points arise from the version changes described below. The majority of invalid data points are due to context-dependent answers—for example, countries that do not use refrigerated transport are not included in the analysis for that indicator.

Several different indicator scoring systems are used by the EVSM tool:

Critical indicators

1. *Yes/no responses:* Scores are either 0 or 5. Example: C1:Q1.
2. *Integer scoring:* Scores are 0, 1, 2, 3, 4, or 5. Example: C2:Q10.
3. *Continuous scoring:* Scores are calculated on a context-dependent continuous basis between 0 and 5. The analysis has grouped these responses into 5 bands: 0-1, 1-2, 2-3, 3-4, and 4-5. Example: C1:Q2.

General indicators

1. *Yes/no response:* Scores are either 0 or 1. Example: C2:Q11. In one case only the score must be either 0 or 2.

2. *Continuous scoring:* Scores are calculated on a context-dependent continuous basis between 0 and 1. The analysis groups these answers into 5 bands: 0-0.2, 0.2-0.4, 0.4-0.6, 0.6-0.8, and 0.8-1.0. Example: C1:Q5, where the score is the ratio between the number of vaccine lots received and the number of lot release certificates issued by the NRA in the country of origin.
3. *Interval scoring:* A few indicators are scored as 0, 0.25, 0.5, 0.75, or 1.0. Example: C1:Q16.

Indicator types

In the tables that follow, each of the indicators 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), T=training.

Revision history of the EVSM tool

The EVSM tool was field-tested before its official publication in 2004 and many of the analyses included in this study date from the prepublication period in 2003-2004. Based on feedback from assessments conducted in the prepublication stage, a series of changes were made to account for program-specific observations. In addition the wording of some indicators was clarified and a couple of new indicators were included. In the 42 assessments analyzed there are examples of eight different versions of the tool, plus a French and Russian language version. Only 10 out of the 42 assessments used the final version (v1.11). Unfortunately, the French and Russian language tools have not been updated since they were originally translated.

Critical indicator analysis

This section focuses on the 17 EVSM "critical indicators". These are highlighted in turquoise in the tool. Because scores are weighted, these indicators have the most significant affect on the final results of an assessment.

Results

An analysis of the distribution of scores achieved against each of the critical indicators is given in Table 2.

Table 2. EVSM critical indicators: score distribution

EVSM ref.	Indicator summary	n=	Type	Integer scoring						Continuous scoring				
				Score 0	Score 1	Score 2	Score 3	Score 4	Score 5	Score 0-1	Score 1-2	Score 2-3	Score 3-4	Score 4-5
C1:Q1	Does the local VAR form include all key procedures from UNICEF VAR Parts I to VII?	42	M	69%		31%								
C1:Q2	VAR completeness.	42	M							24%	2%	14%	10%	50%
C2:Q1	Does the storekeeper know correct storage temperature range for each vaccine on the schedule?	42	T	7%					93%					
C2:Q2	Does the storekeeper know which vaccines are freeze-sensitive?	42	T	2%					98%					
C2:Q5	Was OPV percentage loss ≤1% during the review period?	42	M	5%					95%					
C2:Q6	Was selected freeze-sensitive vaccine percentage loss ≤1% during review period?	37	M	3%					97%					
C2:Q10	Contingency plan assessment.	42	M	14%	5%	36%	24%	10%	12%					
C4:Q13	Assess CFC-free refrigeration units in place.	42	E							21%	10%	5%	14%	50%
C4:Q14	CFC-free purchase policy in place.	42	E	12%					88%					
C5:Q2	Assess effectiveness of equipment maintenance planning.	42	R							40%	19%	10%	14%	17%
C5:Q5	Did cold chain equipment failure caused vaccine	42	R	2%					98%					

EVSM ref.	Indicator summary	n=	Type	Integer scoring						Continuous scoring				
				Score 0	Score 1	Score 2	Score 3	Score 4	Score 5	Score 0-1	Score 1-2	Score 2-3	Score 3-4	Score 4-5
	damage during review period.													
C5:Q6	Did vehicle failure cause vaccine damage during review period?	31	R	16%					84%					
C6:Q1	Assess stock recording system for freeze-dried vaccines against 8 sub-indicators.	42	M							36%	14%	5%	24%	21%
C6:Q2	Assess stock recording system for liquid vaccines against 9 sub-indicators.	42	M							2%	14%	26%	36%	21%
C6:Q17	Assess the incidence of stock-outs and related events during the review period arising as a result of program failure.	42	M	40%	2%	19%	2%	19%	17%					
C6:Q19	Physical count check for vaccines.	42	M	21%	2%	24%	19%	19%	14%					
C8:Q5	Did vaccine loss occur during transport?	42	M	17%					83%					

Abbreviations used: CFC: chlorofluorocarbon; **OPV:** oral polio vaccine; **UNICEF:** United Nations Children's Fund; **VAR**: vaccine arrival report.

Note: Grey shading represents scoring combinations that do not apply to a specific indicator. Blue shading represents critical indicators.

Discussion

The following points summarize some conclusions that can be drawn from the analysis:

1. *VAR form:* Only 31% of countries had a VAR form that closely matches the recommended UNICEF version.
2. *VAR completeness:* Only 50% of countries produced VARs that were substantially complete and accurate. Nearly one quarter of countries substantially failed to complete accurate vaccine arrival records.
3. *Knowledge of storage temperatures:* Over 93% of storekeepers interviewed understood the correct storage temperatures for each of the vaccines in their care, and 98% knew which vaccines are susceptible to freeze damage.
4. *Vaccine loss in storage:* Reported loss of vaccine due to incorrect storage temperatures in the primary store appears to be low. Nevertheless, 2 of the 42 countries reported loss of OPV in excess of 1%, and one out of 37 lost more than 1% of their stock of at least one freeze-sensitive vaccine.

5. *Contingency plan:* 14% of countries had no form of contingency plan. Only 12% had fully effective arrangements in place.

6. *Refrigeration equipment:* The refrigeration equipment in 50% of countries was completely CFC-free, and 88% of countries had a policy only to purchase CFC-free equipment.

7. *Equipment maintenance:* The effectiveness of equipment maintenance planning was poor, with only 17% of countries having effective arrangements in place and 40% having largely ineffective provisions.

8. *Equipment failure:* Despite the widespread absence of effective maintenance planning, only one country reported losing vaccine due to the failure of fixed cold chain equipment.

9. *Transport losses:* Four countries acknowledged losses due to vehicle failure (C5:Q6). Six countries reported losses against the related indicator (C8:Q5), which deals with "incorrect transport conditions". Interestingly, only one of the countries providing these answers overlapped, which suggests that transport-related losses probably affect closer to 20% of countries.

10. *Stock recording system:* Only 21% of countries scored 4 to 5 points against stock record system indicators for freeze-dried vaccines and their diluents (C6:Q1) and for liquid vaccines (C6:Q2). Another 24% and 36%, respectively, scored 3-4 points. A worrying 36% scored 0-1 points against stock record system indicators for freeze-dried vaccines and their diluents (C6:Q1). The reason for this is almost certainly the widespread failure to keep separate stock records for diluents, because the sub-indicators specifically require these records.

11. *Stockouts:* 40% of countries scored zero against the stockout indicator (C6:Q17), indicating a significant incidence of stockouts, whereas only 17% controlled their stocks so that they never breached safety stock levels.

12. *Physical counts:* Only 14% of countries (6) scored 5 out of 5 on the physical count check (C6:Q19), with 21% (9) scoring zero. Coupled with the previous observation, this tends to confirm the frequently-reported weakness in stock control that affects many programs.

The issues highlighted by this analysis (poor vaccine arrival management, lack of contingency planning, poor equipment maintenance planning, transport failure, and poor stock control) are familiar recurring themes, most of which are predominantly management rather than equipment-related.

C1: Preshipment and arrival procedures

The full wording of the C1 criterion is as follows: *Over a period of 12 months, preshipment and arrival procedures have ensured that all shipments were in satisfactory condition when received by the primary stores.*

Results

Table 3 shows the distribution of scores achieved against each of the indicators.

Table 3. C1 indicators: score distribution

EVSM ref.	Indicator summary	n=	Type	Score 0	Score 1	Score 0	Score 2	Score 0-0.2	Score 0.2-0.4	Score 0.4-0.6	Score 0.6-0.8	Score 0.8-1.0
C1:Q1	VAR checklist - **see critical indicators.**		M									
C1:Q2	VAR completeness - **see critical indicators.**		M									
C1:Q3	Vaccine arrival follow-up: condition.	12	M	42%	58%							
C1:Q4	Vaccine arrival follow-up: paperwork.	38	M	24%	76%							
C1:Q5	United Nations vaccine: international lot release compliance.	40	M					33%	8%	5%	10%	45%
C1:Q6	Non-United Nations national lot release compliance.	28	M					79%	0%	0%	0%	21%
C1:Q9	Are customs staff trained to look after vaccine?	41	T	59%	41%							
C1:Q10	Is a customs contingency plan in place?	40	M	50%	50%							
C1:Q11	Does customs clearance take more than 24 hours?	42	M	74%	26%							
C1:Q12	A: Is a 2°C to 8°C cold room available to hold vaccine during customs clearance?	11	E	18%	82%							

EVSM ref.	Indicator summary	n=	Type	Score 0	Score 1	Score 0	Score 2	Score 0-0.2	Score 0.2-0.4	Score 0.4-0.6	Score 0.6-0.8	Score 0.8-1.0
C1:Q12	B: Is the cold room large enough to accommodate the largest anticipated vaccine shipment?	11	E	18%	82%							
	C: Does the cold room have a continuous temperature recording device?	11	E	73%	27%							
	D: Does the cold room have a secure lock?	11	E	27%	73%							
	E: Is the temperature monitored twice within a 24 hour period, 7 days a week?	11	M	73%	27%							
C1:Q13	Are vehicles for transporting vaccine from customs in good condition?	39	R	5%	92%							
C1:Q14	Have staff received effective training in vaccine transport?	41	T	51%	49%							
C1:Q15	Do staff protect shipping containers against extreme temperatures (hot or cold)?	41	M	20%	80%							
C1:Q16	Is the contract agreement with the clearing agent satisfactory? (if applicable)	23	M					22%	9%	9%	22%	39%

Abbreviations used: OPV: oral polio vaccine; **VAR**: vaccine arrival report.

Note: Grey shading represents scoring combinations that do not apply to a specific indicator. Blue shading represents critical indicators.

Discussion

The following conclusions can be drawn from the analysis:

1. 12 of the 42 countries had received vaccine in unsatisfactory condition. Of these defective arrivals, only 58% were apparently followed up with the supplier within 14 days.
2. 38 of the 42 countries appear to have received incomplete paperwork. Of these, only 76% followed up within 14 days.
3. Only 45% of countries receiving United Nations (UN)-supplied vaccines achieved substantially complete compliance against the lot release certificate indicator. This figure drops to 21% for vaccines from non-UN sources, with 79% receiving a score of zero.[1]
4. Only 41% of 40 countries have ensured that customs staff at the arrival airport has been trained to look after vaccine, and only 50% have ensured that a contingency plan is in place in the event of flight delays and other eventualities.
5. Of the 42 countries, 11 (26%) expected customs clearance to take longer than 24 hours. In these 11 countries, where vaccine has to be held under temperature-controlled conditions during clearance, 18% (3) did not have a cold room at the airport. Of those with cold rooms, 27% (3) had cold rooms with continuous temperature monitoring and 3 had a system for monitoring cold room temperatures twice a day.
6. 92% of 39 responding countries claimed that the vehicles used to transport vaccine from airport to primary store were in good condition.
7. Only 49% of 41 countries had trained drivers in vaccine transport.
8. 80% of 41 countries claim to protect vaccines against extreme temperatures during transport from the airport to the primary store.
9. Finally, in the 23 countries where a clearing agent is used to deal with customs formalities, only 39% had a fully satisfactory written contract agreement with the agent, and 22% (5) had no formal agreement of any kind.

Taken in conjunction with the results of the two C1 critical indicators, the overall level of compliance with vaccine arrival procedures is rather poor.

[1] Strangely, although this is a “continuous” indicator, only 0 and 1 scores are recorded.

C2: Vaccine storage temperatures

The full wording of the C2 criterion is as follows: *Over a period of 12 months, all vaccines have been stored within WHO recommended temperature ranges.*

Results

Table 4 shows the distribution of scores achieved against each of the indicators.

Table 4. C2 indicators: score distribution

EVSM ref.	Indicator summary	n =	Type	Score 0	Score 1
C2:Q1	Does storekeeper know vaccine storage temperature ranges? **See critical indicators.**		T		
C2:Q2	Does storekeeper know freeze-sensitive vaccines? **See critical indicators.**		T		
C2:Q3	Has storekeeper received formal or on-the-job training in how to look after vaccines?	42	T	17%	83%
C2:Q4	Have all other staff who are responsible for looking after vaccines received such training?	38	T	24%	76%
C2:Q5	OPV percentage loss check. **See critical indicators.**		M		
C2:Q6	Freeze-sensitive vaccine percentage loss check. **See critical indicators.**		M		
C2:Q7	Is there a complete set of manual temperature records for each and every cold room, freezer room, and freezer?	41	M	27%	73%
C2:Q8	Is there a complete set of temperature recorder traces for each and every cold room, freezer room, and freezer?	41	M	54%	46%
C2:Q9	Does a sample of temperature recorder traces for each appliance agree with the matching temperature records?	35	M	69%	31%
C2:Q10	Contingency plan assessment. **See critical indicators.**		M		
C2:Q11	Are temperature records kept for at least three years, or, if for a lesser period, since adoption of EVSM?	40	M	43%	58%
C2:Q12	Do quantities of discarded vaccine recorded on the vaccine loss and damage records match losses recorded in the stock records?	31	M	35%	65%
C2:Q13	Are records of discarded vaccine kept for at least three years, or, if for a lesser period, since adoption of EVSM.	36	M	42%	58%
C2:Q14	Are internal reviews of temperature records carried out at least once a month?	42	M	69%	31%
C2:Q15	Are internal reviews of vaccine loss/damage records carried out at least once a month?	41	M	66%	34%
C2:Q16	Are temperature review reports kept for at least three years, or, if for a lesser period, since adoption of EVSM.	40	M	73%	28%
C2:Q17	Does accuracy test for each appliance agree with the temperature recorder trace for the same time period to within ±1°C?	41	R	76%	24%

Abbreviations used: OPV: oral polio vaccine.

Note: Grey shading represents scoring combinations that do not apply to a specific indicator. Blue shading represents critical indicators.

Discussion

The following points can be drawn from the analysis:

1. Overall compliance with the first four critical indicators is rather good, at over 90% in all cases. Disappointingly, compliance with the contingency plan critical indicator C2:Q10 is very poor.
2. 83% of 42 countries had given storekeepers formal or on-the-job training, and 76% claimed to have extended this training to other staff with responsibility for looking after vaccines.
3. Only 73% of 41 countries were able to produce a complete set of manual temperature records for the review period, and only 46% had a complete set of temperature recorder traces. This may be because a number of countries did not have continuous temperature recording devices—see Section 5 below (criterion C4) where this issue is discussed further.
4. Worryingly, only 31% of 35 countries had manual temperature records that could be reconciled with the associated temperature traces. This suggests that accurate manual temperature records are not being kept.
5. Only 58% of 40 responding countries could produce temperature records for three years (or since adoption of EVSM).
6. 65% of the 31 countries that had apparently experienced vaccine loss during the review period could reconcile their vaccine loss and damage records with losses recorded in the stock records.
7. 58% of 36 countries could produce vaccine loss records for three years (or since adoption of EVSM).
8. EVSM recommends a monthly temperature record and vaccine loss review, the results of which are recorded. Only a third of countries appear to be following this recommendation (C2:Q14 to Q16).
9. There is very low compliance (24% of 41 countries) with the recommendation that annual accuracy (calibration) tests should be carried out to verify the accuracy of the temperature monitoring equipment.

C3: Storage capacity analysis

This section focuses on the C3 criterion: *Over a period of 12 months, the capacity of cold storage has been sufficient to meet the demand.* All the indicators in this section are currently "non-critical", although this should almost certainly be reviewed in the light of the anticipated future introduction of bulky new vaccines.

Results

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

Table 5. C3 indicators: score distribution

EVSM ref.	Indicator summary	n =	Type	Score 0	Score 1
C3:Q1	Has a vaccine volume calculation been carried out during the review period, and is it in a form which can be assessed?	42	M	62%	38%
C3:Q2	Has capacity of the 2° to 8°C vaccine store been sufficient throughout the review period?	42	E	26%	74%
C3:Q3	Has capacity of the -20°C vaccine store been sufficient throughout the review period.	41	E	24%	76%
C3:Q4	Has a vaccine volume calculation for campaign vaccines been carried out during the review period, and is it in a form which can be assessed?	11	M	36%	64%
C3:Q5	Has capacity of the 2° to 8°C campaign vaccine store been sufficient throughout the review period?	10	E	10%	90%
C3:Q6	Has capacity of the -20°C campaign vaccine store been sufficient throughout the review period?	11	E	27%	73%

Note: Grey shading represents scoring combinations that do not apply to a specific indicator.

Discussion

The following points can be drawn from the analysis:

1. Only 38% of the countries had carried out a recent vaccine volume calculation for routine operations.
2. 74% of countries had adequate cold room capacity and 76% adequate freezer capacity for routine use. This leaves one quarter under-provided.
3. Data on the storage capacity for campaign vaccines was apparently unavailable for nearly three quarters of the countries. Of those few who provided information, only 64% had carried out a volume assessment, 90% had sufficient cold room capacity, and only 75% had sufficient freezer capacity.

The concerns arising from this analysis include a woeful lack of current data on vaccine storage needs and the apparent absence of sufficient routine storage capacity in around 25% of countries. This shortfall may be due to a real under-capacity, poor delivery and arrival management, or a combination of factors.

C4: Buildings, equipment, and transport

The full wording of the C4 criterion is as follows: *Over a period of 12 months, the buildings, equipment, and transport available to the program have enabled the cold store to function effectively.*

Results

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

Table 6. C4 indicators: score distribution

EVSM ref.	Indicator summary	n=	Type	Score 0	Score 1	Score 0	Score 2	Score 0-0.2	Score 0.2-0.4	Score 0.4-0.6	Score 0.6-0.8	Score 0.8-1.0
C4:Q1	Site checklist.	42	B					2%	0%	0%	48%	50%
C4:Q2	Is building suitable for climate?	42	B	24%	76%							
C4:Q3	Building checklist.	42	B					2%	10%	10%	31%	48%
C4:Q4	Is there adequate space for refrigeration equipment?	42	B					14%	0%	24%	0%	62%
C4:Q5	Packing area checklist.	41	B					5%	5%	17%	34%	39%
C4:Q6	Storekeeper office checklist.	42	B					12%	19%	0%	29%	40%
C4:Q7	Storage space checklist.	42	B					7%	14%	12%	10%	57%
C4:Q8	Refrigerated vehicle checklist.	11	E					0%	0%	45%	27%	27%
C4:Q9	Cold room and freezer room checklist.	42	E					36%	0%	43%	0%	21%
C4:Q10	Checklist for working in cold rooms and freezer rooms.	42	M					36%	0%	43%	0%	21%
C4:Q11	Vaccine freezer checklist.	41	E					12%	0%	5%	22%	61%
C4:Q12	Icepack freezer/ chilled water pack cooler checklist.	42	E					12%	0%	7%	0%	81%
C4:Q13	CFC checklist- **see critical indicators.**		E									
C4:Q14	CFC checklist - **see critical indicators.**		E									
C4:Q15	Is there a standby generator (automatic or manual start-up)?	42	E	2%	98%							
C4:Q16	Standby generator checklist.	42	E					2%	0%	0%	17%	81%
C4:Q18	Voltage regulator checklist.	42	E					69%	7%	2%	5%	17%

EVSM ref.	Indicator summary	n=	Type	Score 0	Score 1	Score 0	Score 2	Score 0-0.2	Score 0.2-0.4	Score 0.4-0.6	Score 0.6-0.8	Score 0.8-1.0
C4:Q19	Temperature alarm equipment. checklist.	42	E					57%	2%	17%	12%	12%
C4:Q20	Are telecommunications links adequate?	42	E	14%	86%							
C4:Q22	Is the computer equipment and software adequate for its purpose and in working order?	25	E	12%	88%							
C4:Q23	Is transport the responsibility of the primary store?											
C4:Q24	Vehicle checklist.	42	E					43%	21%	0%	12%	24%
C4:Q25	Driver training checklist.	41	T					41%	5%	0%	22%	32%
C4:Q26	Transport fuel availability checklist.	41	E	51%	49%							
C4:Q27	A. Is icepack conditioning correct?	37	T			46%	54%					
	B. Is cold box packing correct?	41	T	29%	71%							
C4:Q28	Refrigerated vehicle training.	11	T	0%	100%							

Abbreviations used: CFC: chlorofluorocarbon; **OPV:** oral polio vaccine.

Note: Grey shading represents scoring combinations that do not apply to a specific indicator. Blue shading represents critical indicators.

Discussion

The following points can be drawn from the analysis:

1. Only 48% of buildings substantially passed the buildings checklist (score = 0.8 and above), with a further 31% achieving a score between 0.6 and 0.8.
2. There was adequate space and ventilation for refrigeration equipment in only 62% of the stores.
3. Only 40% of storekeepers' offices were generally satisfactory, with a further 29% lacking some amenities and the balance unsatisfactory.
4. 57% of stores had adequate storage space for diluents, packaging materials, cold boxes, and stationary. The remainder lacked space for some or all of these items.
5. Of the 11 countries operating refrigerated vehicles, only 27% (3) were generally satisfactory. 45% lacked half the indicator features necessary for a good refrigerated vehicle operation. All 11 countries appear to have trained the drivers of these vehicles (C4:Q28).
6. Only 21% of cold rooms and freezer rooms had most or all of the eight necessary indicator features (a ninth only applies in cold climates). 36% were largely unsatisfactory and 43% partially satisfactory. This is a worryingly poor level of compliance.

7. Only 21% of stores had the recommended warm clothing for workers and had also provided the necessary training for working under cold conditions. 43% lacked either training or clothing, and 36% had neither.
8. Only 61% of vaccine freezers substantially complied with the five checklist indicators. Compliance for icepack freezers is better, at 81%.
9. 98% of stores had standby generators and 81% substantially complied with the five-point generator checklist.
10. 14% of countries did not have adequate telecommunications links to the primary store.
11. Of the 25 countries with computerized stock control systems, 88% had adequate working computer equipment. A worrying 12% (3) apparently did not have the appropriate equipment to maintain their stock records.
12. C4:Q23 to Q25 require data correction and further analysis.
13. Only 54% of countries correctly conditioned icepacks, and 71% appeared to pack cold boxes correctly.

In addition to the above, a more detailed analysis of indicator C4:Q9 was carried out.[2] There is a strong argument made that this question should become a critical indicator in the next EVSM revision. Accordingly Table 7 shows an analysis of the responses received to each of the eight sub-indicators.[3]

[2] C4:Q9 is the eight-part cold room and freezer room checklist.

[3] There is a ninth sub-indicator covering low-temperature protection of cold rooms. This is not included in the analysis as it only applies to a very few of the countries in the sample.

Table 7. C4:Q9 score distribution

EVSM ref.	Indicator summary	n =	Type	Score 0	Score 1
C4:Q9A	Are all cold room and freezer room enclosures in good condition at time of inspection?	42	R	12%	88%
C4:Q9B	Are all refrigeration units fully operational at time of inspection?	42	R	26%	71%
C4:Q9C	Do all rooms have continuous temperature recorders?	42	E	55%	45%
C4:Q9D	Do all cold rooms maintain a temperature of 2 to 8°C?	42	R	17%	83%
C4:Q9E	Do all freezer rooms maintain a temperature of -15 to -25°C?	39	R	15%	85%
C4:Q9F	Are all cold rooms and all freezer rooms fitted with dual refrigeration units?	42	E	33%	67%
C4:Q9G	Can doors be locked from the outside but freely opened from the inside?	42	E	17%	83%
C4:Q9H	Are all rooms fitted with adequate shelving?	42	E	29%	71%

Note: Grey shading represents scoring combinations that do not apply to a specific indicator.

Notable features of this analysis are:

1. Only 71% of the 42 countries had all refrigeration units fully operational at the time of inspection. Note: the question does not establish whether some rooms were entirely without refrigeration or that they were just relying on one out of two units.
2. A worryingly high 55% of countries (23) did not have continuous temperature recording equipment on all their cold rooms and freezer rooms. This included the following large countries: Bangladesh, Ethiopia, Nigeria, and Pakistan.
3. 83% and 85% of countries respectively had cold rooms and freezer rooms all of which were able to maintain their design temperatures. It is concerning that nearly a fifth of countries had rooms that were apparently unable to meet this fundamental requirement.
4. Only 67% of countries had dual refrigeration units on all cold rooms and freezer rooms.
5. Only 71% of countries had adequate shelving.

C5: Maintenance

The full wording of the C5 criterion is as follows: *Over a period of 12 months, all buildings, equipment and transport have been correctly maintained.*

Results

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

Table 8. C5 indicators: score distribution

EVSM ref.	Indicator summary	n=	Type	Score 0	Score 1	Score 0	Score 2	Score 0 -0.2	Score 0.2-0.4	Score 0.4-0.6	Score 0.6-0.8	Score 0.8-1.0
C5:Q2	Assess effectiveness of equipment maintenance planning. **See critical indicators.**		R									
C5:Q3	Assess vehicle maintenance planning over the review period.	34	R					59%	15%	12%	3%	12%
C5:Q4	Does the condition of the buildings indicate that emergency repairs and replacements have been carried out effectively?	42	R	29%	71%							
C5:Q5	Did cold chain equipment failure caused vaccine damage during review period? **See critical indicators.**		R									
C5:Q6	Did vehicle failure caused vaccine damage during review period? **See critical indicators.**		R									
C5:Q7	*Commentary only.*											
C5:Q8	Did a shortage of spare parts or consumables cause any cold room freezer room or freezer to be removed from service for longer than 7 days?	41	R	24%	76%							
C5:Q9	Did a shortage of consumables (tires, etc.) cause any vehicle to be removed from service for longer than 7 days?	32	R	25%	75%							

Note: Grey shading represents scoring combinations that do not apply to a specific indicator. Blue shading represents critical indicators.

Discussion

The following are some conclusions that can be drawn:

1. Vehicle maintenance planning is extremely poor or absent in the majority of countries. The scoring band figures (59%, 15%, 12%, 3%, and 12%) compare unfavorably with the poor scoring band figures for the equipment maintenance critical indicator C5:Q2 (40%, 19%, 10%, 14%, and 17%).
2. 71% of countries had reasonably maintained buildings.
3. 76% of countries reported no failure of cold chain equipment exceeding seven days arising from lack of spare parts. However, this means that 10 countries (24%) did report such an event.
4. Similar figures apply to vehicle breakdowns due to shortage of spare parts.

C6: Stock management

The full wording of the C6 criterion is as follows: *Over a period of 12 months, stock management has been effective.*

Results

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

Table 9. C6 indicators: score distribution

EVSM ref.	Indicator summary	n=	Type	Score 0	Score 1	Score 0	Score 2	Score 0 -0.2	Score 0.2-0.4	Score 0.4-0.6	Score 0.6-0.8	Score 0.8-1.0
C6:Q1	Assess stock recording system for freeze-dried vaccines against 8 sub-indicators. **See critical indicators.**		M									
C6:Q2	Assess stock recording system for liquid vaccines against 9 sub-indicators. **See critical indicators.**		M									
C6:Q3	Assess requisition system.	42	M					2%	12%	0%	19%	67%
C6:Q4	Assess whether a formal pre-deliver or pre-collection notification system exists.	42	M					17%	2%	0%	21%	60%
C6:Q5	Do stock records for the review period indicate adherence to EEFO principles?	42	M	40%	60%							
C6:Q6	Assess stock keeping response to VVM and freeze indicator changes.	42	M					24%	10%	40%	7%	19%
C6:Q7	Does the primary store have a completed delivery section of the delivery/arrival form for every delivery?	42	M	10%	90%							

EVSM ref.	Indicator summary	n=	Type	Score 0	Score 1	Score 0	Score 2	Score 0 -0.2	Score 0.2-0.4	Score 0.4-0.6	Score 0.6-0.8	Score 0.8-1.0
C6:Q8	Do the vaccine quantities recorded on the delivery section of the delivery/ arrival form consistently match the relevant entries in the stock records?	42	M	14%	86%							
C6:Q9	Do the vaccine quantities recorded on the delivery section of the delivery/ arrival form consistently match the relevant entries in the stock records?	42	M	21%	79%							
C6:Q10	Does a representative sample of these completed forms indicate that arrival checks were carried out correctly?	42	M	24%	76%							
C6:Q11	Are damaged/ expired vaccines and diluents clearly labeled, packaged, and stored out of the cold chain?	36	M	31%	69%							
C6:Q12	Were damaged/ expired vaccines clearly identified in the stock recording system?	36	M	31%	69%							
C6:Q13	Are disposal facilities and procedures in accordance with WHO and/ or national norms?	40	M	38%	63%							
C6:Q14	Are computer records backed up at least once a week?	27	M	67%	33%							
C6:Q15	Assess safety stock policy during the review period.	42	M					12%	29%	0%	21%	38%
C6:Q16	Did the program for placing orders take adequate account of lead-times?	41	M	34%	66%							

EVSM ref.	Indicator summary	n=	Type	Score 0	Score 1	Score 0	Score 2	Score 0 -0.2	Score 0.2-0.4	Score 0.4-0.6	Score 0.6-0.8	Score 0.8-1.0
C6:Q17	Assess incidence of stockouts and related events as a result of program failure. **See critical indicators**.		M									
C6:Q18	How many recorded physical counts of vaccine stocks were carried out during the review period? (Min every 3 months)	41	M					27%	24%	12%	5%	32%
C6:Q19	Physical count check for vaccines. **See critical indicators.**		M									
C6:Q20	How many recorded physical counts of consumables stock were carried out during the review period? (Min every 3 months)	37	M					57%	11%	14%	0%	19%
C6:Q21	Physical count check for consumables.	37	M					43%	3%	14%	11%	30%
C6:Q22	Is the stock secure?	42	M	5%	95%							
C6:Q23	Are the records secure?	42	M	24%	76%							
C6:Q24	Is stock laid out in an orderly fashion?	41	M	44%	56%							
C6:Q25	Is the vaccine store clean and pest-free?	42	M	29%	71%							

Abbreviations used: EEFO: earliest expiry first out; **VVM:** vaccine vial monitor.

Note: Grey shading represents scoring combinations that do not apply to a specific indicator. Blue shading represents critical indicators.

Discussion

The C6 criterion has the largest number of indicators in EVSM (25). The following is a commentary on the most significant results obtained:

1. Scores against the three C6 critical indicators showed rather poor compliance with the relevant EVSM requirements.

2. Some 67% of countries have a fully effective requisition system. A further 19% have a reasonably good system.
3. Some 60% of countries have a fully effective predelivery or pre-collection notification system, with a further 21% having a reasonable system.
4. Only 60% of countries could provide evidence of EEFO compliance.
5. Only 19% of countries used VVM and freeze indicator changes fully correctly to manage stock. A further 7% performed reasonably against this indicator, but 24% appear largely to ignore such exposure in stock management at primary level.
6. There was reasonably good compliance against indicators Q7 to Q10 relating to the recording of distributions using delivery/arrival forms.
7. 69% of 36 responding countries clearly identify damaged or expired vaccine in the stock recording system.
8. 63% of 40 countries have WHO or nationally compliant disposal procedures and facilities for dealing with damaged or expired vaccine.
9. A worryingly low 33% of 27[4] countries reported backing up their computer records on a weekly or more frequent basis.
10. Only 38% of countries had a fully compliant safety stock policy. A further 21% scored reasonably well, but 41% scored poorly against this indicator.
11. Only 66% of countries placed vaccine orders taking account of delivery lead-time.
12. Only 32% of countries carried out physical stock counts every three months, or more frequently. 27% appear to have carried out no physical counts.
13. There was an even lower level of compliance for physical counts of the consumables stocks—only 19% of countries fully complying.
14. The accuracy of the consumables physical count check against stock records (C6:Q21) was very poor. Only 30% of countries were fully or substantially correct.
15. 95% of countries had their stocks rated as “secure”.
16. Only 76% of countries had secure records.
17. A concerning 56% of countries had stores that were rated as “orderly” and only 71% were pest-free.

[4] Section C4 shows 25 countries with computerized stock control systems, so it is not clear which the other 3 countries are. There is not a complete 1:1 relationship between the countries responding to C6:Q14 and C4:Q21.

C7: Deliveries

The full wording of the C7 criterion is as follows: *Over a period of 12 months, deliveries of vaccine to the next level have been timely and sufficient.*

Results

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

Table 10. C7 indicators: score distribution

EVSM ref.	Indicator summary	n=	Type	Score 0	Score 1	Score 0	Score 2	Score 0	Score 0.25	Score 0.5	Score 0.75	Score 1.0
C7:Q1	Did the primary store send a program to the intermediate stores setting out dates for the delivery and/or collection of vaccines?	42	M	52%	48%							
C7:Q2	Assess the reliability of actual delivery/collection dates against the program.	20	M	45%	55%							
C7:Q3	Assess the timeliness of a sample of actual deliveries/collections.	42	M					5%	19%	21%	26%	29%
C7:Q4	Where scheduled deliveries were made by the primary store, was transport reliably provided?	37	M	8%	92%							
C7:Q5	Was there a reporting system which monitored actual vaccine distributions and compared these with anticipated distributions?	42	M					43%	0%	2%	0%	55%
C7:Q6	If there were short shipments during the review period, were they followed up and corrected?	42	M					0%	0%	29%	21%	50%

Note: Grey shading represents scoring combinations that do not apply to a specific indicator. Blue shading represents critical indicators.

Discussion

There are no critical indicators in the C7 section of EVSM, but the results of the analysis do reveal some worrying shortcomings:

1. Only 48% of 42 countries (20) sent a program to the intermediate stores setting out a program for deliveries and collections. Of these 20, only 55% appear to have met the program in a reliable manner.
2. Only 29% of countries distributed vaccines with a high degree of timeliness. Another 26% appear to have been reasonably timely.
3. 55% of countries had a fully effective reporting system for monitoring anticipated distributions against actual distributions, but 43% had no system at all for doing this.
4. 50% of countries were assessed to have dealt effectively with “short shipments”, or had no short shipments.

C8: Damage during distribution

The full wording of the C8 criterion is as follows: *Over a period of 12 months, no damage has occurred to the vaccine during distribution.*

Results

An analysis of the distribution of scores achieved against each of the indicators is given in Table 11.

Table 11. C8 indicators: score distribution

EVSM ref.	Indicator summary	n=	Type	Score 0	Score 1	Score 0	Score 2	Score 0	Score 0.25	Score 0.5	Score 0.75	Score 1.0
C8:Q1	Were freeze indicators packed with deliveries of freeze-sensitive vaccines?	41	E					73%	2%	2%	0%	22%
C8:Q2	Was freeze indicator status recorded on all VARs returned by the intermediate stores?	39	M	77%	23%							
C8:Q3	Was VVM status recorded on all delivery/arrival forms returned by the intermediate stores?	40	M	88%	13%							
C8:Q4	Is there evidence that any suspected frozen vaccine was shake tested?	39	M	77%	23%							
C8:Q5	Was there vaccine loss during transport? **See critical indicators.**		M									

Note: Grey shading represents scoring combinations that do not apply to a specific indicator. Blue shading represents critical indicators.

Discussion

Against this final scored criterion there are again some significant shortcomings:

1. Only 22% of 41 countries used freeze indicators in all vaccine distributions. 73% of countries never used them.[5]
2. 23% of 39 countries (presumably the same countries that reported using freeze indicators) record freeze indicator status on a vaccine arrival report that is returned to the primary store.
3. VVM status was only recorded by 13% of 40 countries on a similar arrival form.
4. Only 23% of 39 countries provided evidence that they had carried out "shake tests" when they suspected a vaccine had been frozen.

[5] A 2007 questionnaire administered by PATH to program managers in the AFRO region as part of a vaccine product presentation study showed a continuing low level of uptake in the use of freeze indicators:
57% of country respondents report use of freeze indicators at some point in the storage system, and only 35% and 27% report such use at all levels. Similarly, in the distribution system, only 18% of country staff report use of freeze indicators for all vaccine distributions whilst the cumulative totals for use in "all" and "some" distributions is only 36%.

Overview

The 118 indicators and sub-indicators that were analyzed across the eight criteria have been classified under the five headings. Table 12 shows the breakdown:

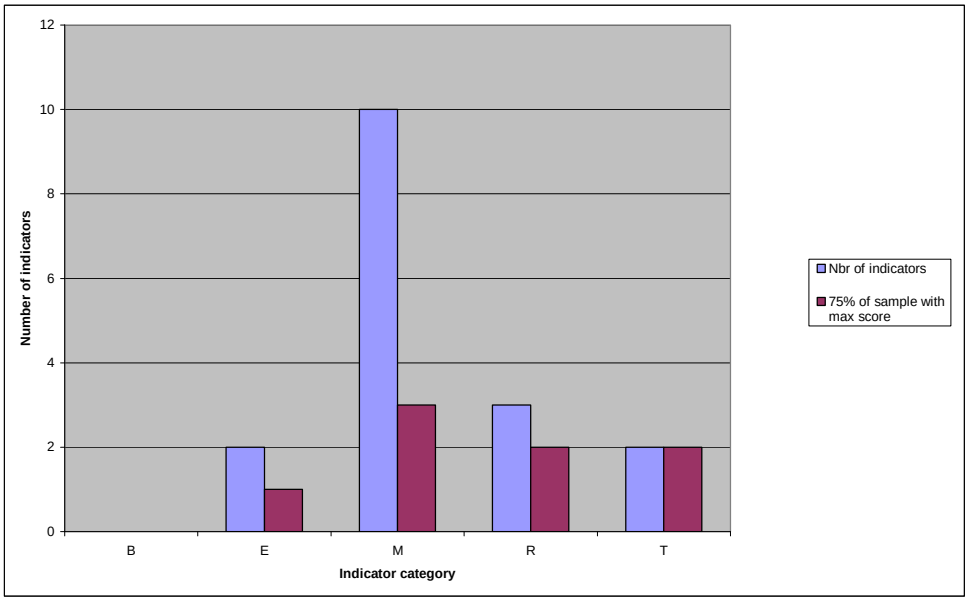
Table 12. Breakdown of indicators under five headings

Buildings	7
Equipment	27
Management	61
Repairs/maintenance	13
Training	10
Total indicators	**118**

Management-related indicators represent by far the largest category, with equipment-related indicators in second place.

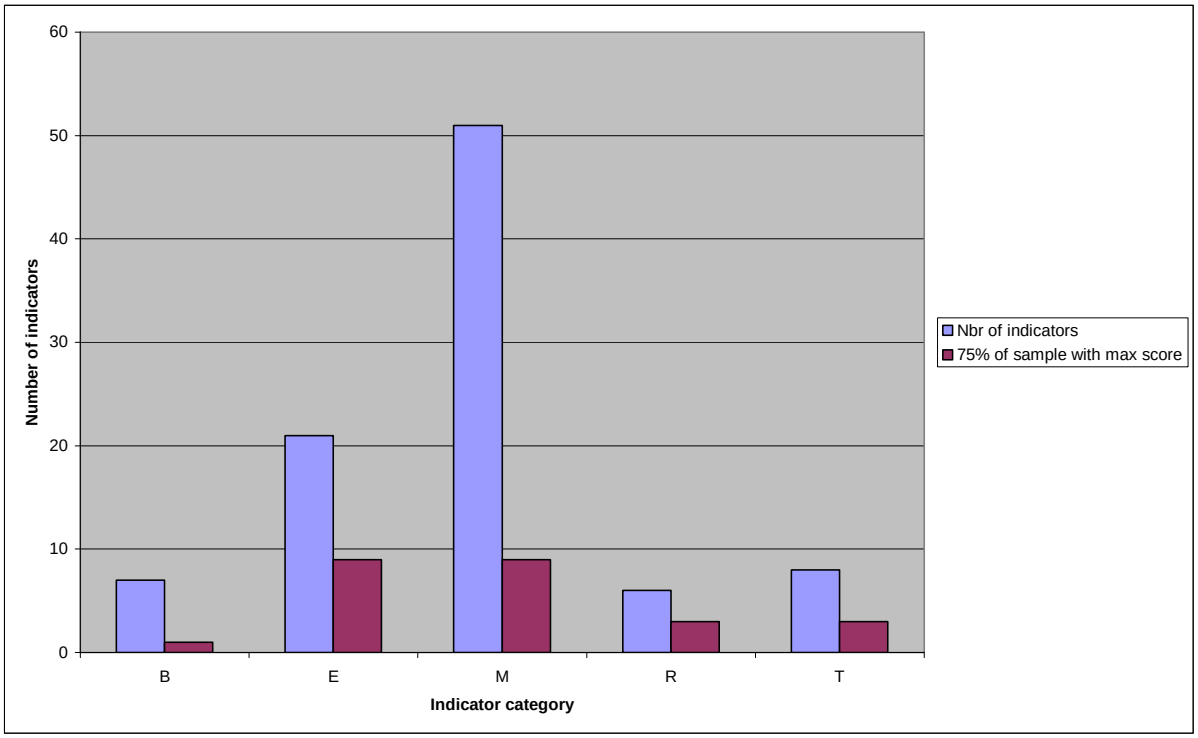
Figures 2 and 3 show in broad terms how countries have performed against each of the five indicator categories. The analysis arbitrarily assumes that we would expect 75% of all responding countries[6] to achieve a maximum score against each indicator. Figure 2 shows performance against the 17 critical indicators and Figure 3 the performance against the 93 other indicators.

Figure 2. Maximum score against 17 critical indicators: 75% cut-off



[6] "Responding countries" excludes countries from the denominator where the assessor has entered "not applicable" — for example in the case of refrigerated vehicle use.

Figure 3. Maximum score against 93 general indicators: 75% cut-off



A notable feature of both charts is the relatively poor performance against indicators in the management category as compared with the other four.

Figures 4 and 5 repeat the analysis using a 50% cut-off figure.

Figure 4. Maximum score against 17 critical indicators: 50% cut-off

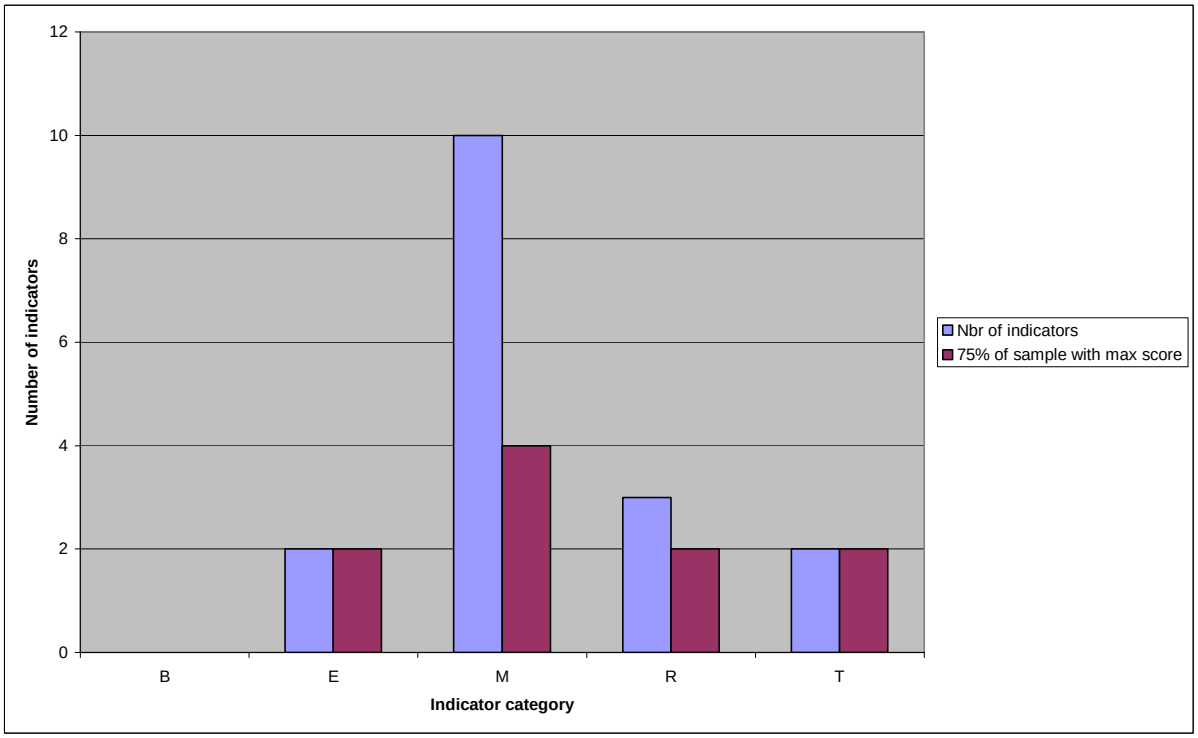
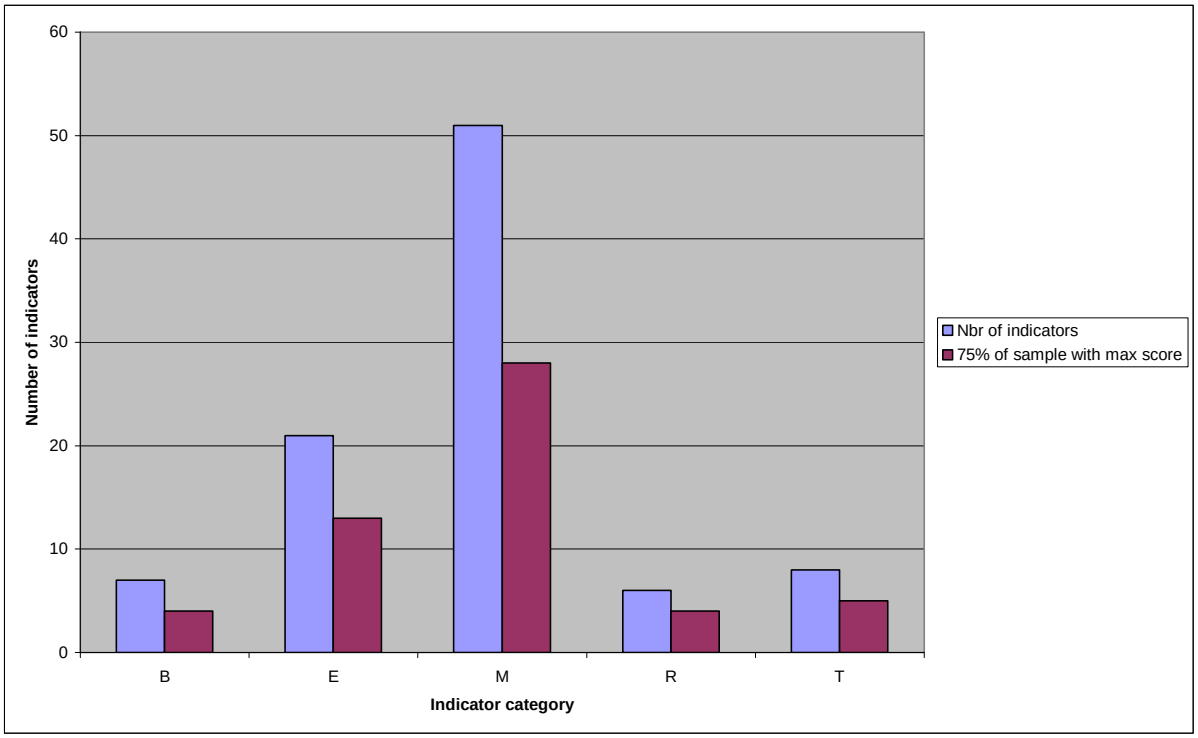


Figure 5. Maximum score against 93 general indicators: 50% cut-off



Even at this low level of expectation, relative performance against the management indicators falls short of the performance against the other indicator categories, which is also rather disappointing.

This analysis demonstrates a continuing need to focus on strengthening management skills and also indicates that there is a long way to go before the majority of countries have high-quality primary store operations.

EVSM tool — some conclusions and recommendations

As a result of this analysis, we made a number of general conclusions and recommendations concerning the future development of the EVSM tool:

- The tool merits a thorough review to eliminate overlapping and superfluous indicators, to tighten up and clarify wording, and to deal with some residual logical anomalies.
- The status of the current “critical indicators” should be reviewed. There may be a good case for changing and/or increasing the number of such indicators in the light of past experience with the tool and accounting for anticipated future developments (e.g., new vaccine introduction).
- The tool should be rewritten to simplify the production and maintenance of non-English versions. Language management should be independent of minor changes in the scoring logic.
- A better system of update control is needed to ensure that all future assessments are carried out using the latest version. This could possibly be accomplished via an EVSM 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 carry out 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 analysis on a routine basis. The type of analysis required needs to be carefully considered before this work is put in hand.