B Medical System Total Cost of Ownership (TCO) Calculator

Solar Direct Drive (SDD) equipment 90-120L

The concept of Total Cost of Ownership (TCO) is to evaluate a purchasing decision based on the comprehensive costs of owning and operating a piece of equipment over its useful life or a set period of time - *PATH*

Key component costs of running a cold chain equipment (CCE) unit include:

1) Upfront Capital Expenditure:

- **Refrigerator**: Upfront purchase cost of the CCE, based on pricing from WHO PQS catalogue, UNICEF LTA or others
- **Installation Labour Cost**: Upfront installation labour cost levied by manufacturers to deploy CCE. Cost likely to vary by locations and manufacturers. *Same as PATH model.*

2) Operating Costs:

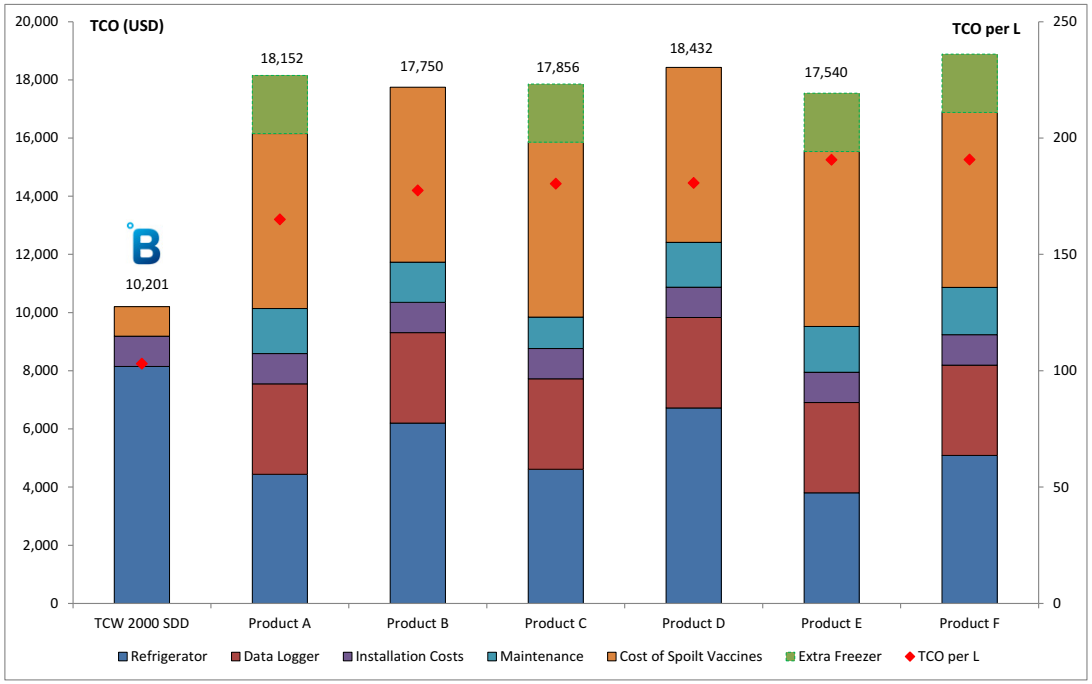
- **Maintenance Labour Cost:** Labour cost to maintain cold CCE unit, including hourly wages and travel costs. *Same as PATH model.*
- **Repair Labour Cost:** Labour cost for CCE repair, in the event of equipment breakdown. *Same as PATH model.*
- **Cost of Spare Parts:** Replacement cost of spare parts due to wear and tear or malfunction over useful life

3) Other Considerations:

- **Remote Data Logger:** To include upfront and monthly operating cost of a remote temperature monitoring device (Type 3, with enabling SMS alerts), which is one of the target product profile under the Cold Chain Equipment Optimisation Platform (CCEOP) by 2019
- **Value of Extra Freezer:** Combined refrigerator/freezer units provide additional value with the capability to freeze waterpacks. This will save a customer from needing to buy a separate freezer
- **Cost of Spoilt Vaccines:** Vaccines are very expensive and if a CCE breaks down, this will result in loss of vaccines and translate to a very high cost. The failure cost based on reliability of a CCE needs to be factored in. *Refer to Thoughts in Gear's Cold Chain Reliability Social Value Results at https://www.bmedicalsystems.com/en/2017/08/28/4-5-million-social-cost-averted-one-cold-chain-unit-2/*

Comparison of SDD equipments 90-120L (including value of freezers)

Model	Vaccine Storage (L)	Vaccine Size Category	Upfront Cost (USD)				Maintenance	Failure Cost	Useful Life (Years)	With Freezer	
			Refrigerator	Remote Data Logger	Value of Extra Freezer	Installation Labour	Maintenance / Spare Parts	Cost of Spoilt Vaccines		Total Cost of Ownership (USD)	TCO per L
TCW 2000 SDD	99.0	90-120L	8,147	Included	Included	1,042	0	1,012	10	10,201	103
Product A	110.0	90-120L	4,440	3,109	2,000	1,042	1,546	6,015	10	18,152	165
Product B	100.0	90-120L	6,200	3,109	Included	1,042	1,384	6,015	10	17,750	177
Product C	99.0	90-120L	4,615	3,109	2,000	1,042	1,075	6,015	10	17,856	180
Product D	102.0	90-120L	6,720	3,109	Included	1,042	1,546	6,015	10	18,432	181
Product E	92.0	90-120L	3,800	3,109	2,000	1,042	1,574	6,015	10	17,540	191
Product F	99.0	90-120L	5,086	3,109	2,000	1,042	1,631	6,015	10	18,883	191



Comparison of SDD equipments 90-120L (excluding value of freezers)

Model	Vaccine Storage (L)	Vaccine Size Category	Upfront Cost (USD)				Maintenance	Failure Cost	Useful Life (Years)	Excluding Freezer	
			Refrigerator	Remote Data Logger	Value of Extra Freezer	Installation Labour	Maintenance / Spare Parts	Cost of Spoilt Vaccines		Total Cost of Ownership (USD)	TCO per L
TCW 2000 SDD	99.0	90-120L	8,147	Included	Included	1,042	0	1,012	10	10,201	103
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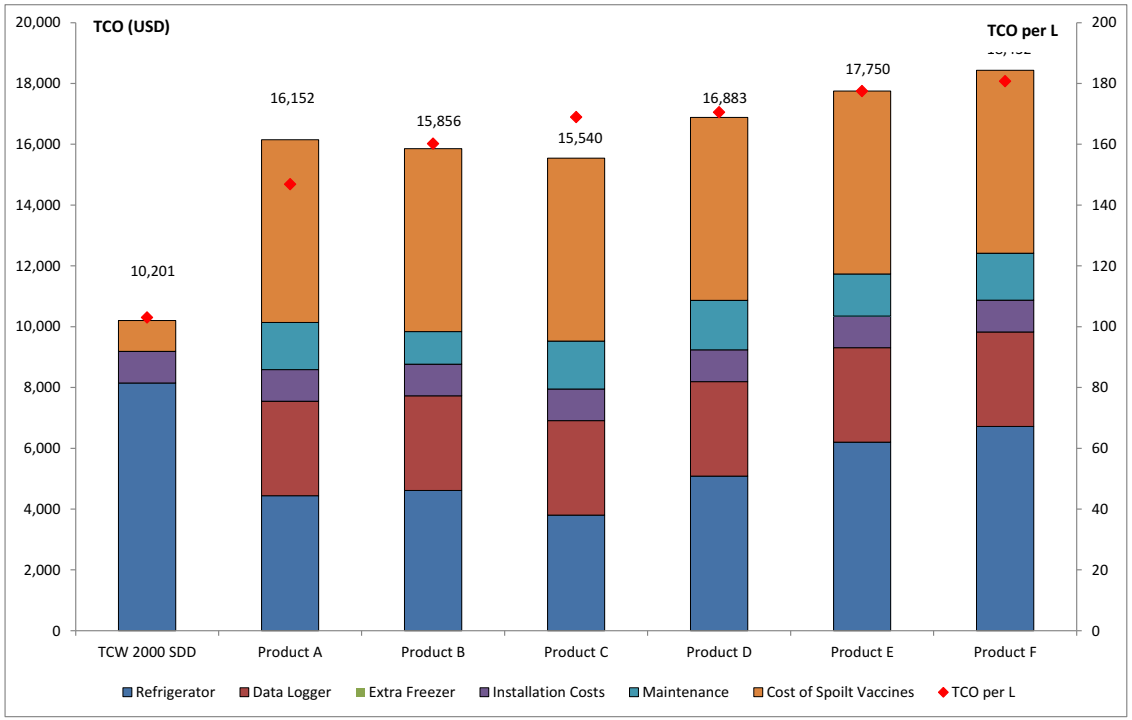

BMedical Systems TCO model compared to PATH model

BMS model **same** with PATH model

	PATH	BMS Model	Source
Equipment useful life (yrs)	10	10	Refer to PATH Total Cost of Ownership Tool for Cold Chain Equipment *http://www.path.org/publications/detail.php?i=2576*
Spare Parts replacement	1x	1x	
Installation Labour	USD 1,042	USD 1,042	
Maintenance Labour	USD 680	USD 680	
Repair labour	USD 395	USD 395	

BMS model **differences** with PATH model

	PATH	BMS Model	Comments
Refrigerator	UNICEF Catalogue	PQS	Based on WHO's PQS catalogue (E003: Refrigerators and freezers) price for more than 100 units *http://apps.who.int/immunization_standards/vaccine_quality/pqs_catalogue/*
Remote data logger	n.a.	USD 311 per year	Factored in cost of a remote data logger for all models based on WHO's PQS catalogue (E006: Temperature monitoring devices) for remote temperature monitoring devices. BMS assumption for annual cost of sim for manufacturers that do not include this cost. Refer to Appendix I *No data logger cost for Bmed products as provided free with CCE*
Value of extra freezer	n.a.	USD 2,000	Comparable for equipment with and without freezing capability (ILR freezer ~USD600 + solar panels ~USD1,400). Based on prices from WHO's PQS catalogue. Refer to Appendix II

Spare Parts Cost	All listed parts in PQS	Only 4 key parts	SDD key parts include compressor, thermostat, compressor + controller, condenser + fan. Most manufacturers do not publish all cost of other spare parts in PQS catalogue. Refer to Appendix III *No spare parts cost for Bmed products as free under 10-year warranty*
Maintenance / Repair Labour			*No labour cost for Bmed products as free under 10-year warranty*
Cost of spoilt vaccines	n.a.	Value of Vaccines	Factors in the cost of spoilt vaccines as a function of probability of breakdown; B Medical SDD breakdown assumed at 1.8% vs competitors' 10.7% based on reliability survey conducted in Nigeria of 1,632 SDD cold chain equipment Value of vaccines varies by size of CCE; assume 50% utilization of CCE. Refer to Appendix IV

Appendix I: Remote Temperature Devices

PQS #	Device	Manufacturer	Upfront Cost (USD)	Device Annual Fee (USD)	Sim Annual* (USD)	Total (USD)
E006/035	Temperature@lert	Schechter Tech	-	187	95	2,822
E006/036	Ice3-Extra-BC140	Beyond Wireless Tech	300	393	Included	4,227
E006/037	Ice3-Extra-BC440	Beyond Wireless Tech	580	480	Included	5,380
E006/039	Cold Trace 5	Nexleaf Analytics	-	77	95	1,722
E006/041	Fridge-tag 3 GSM	Berlinger & Co	199	24	95	1,391
	Average					**3,109**

**2016 Sub-Saharan Africa Mobile ARPU. Source: GSMAIntelligence*

Appendix II: Solar Panel Costs

PQS #	Cold Chain Device	Manufacturer	Vaccine Storage Size (L)	Solar Panel Costs (USD)
E003/037	ZLF 100 DC	Zero	99L	1,350
E003/052	ZLF 150 DC	Zero	128L	1,350
E003/055	ZLF 30 DC	Zero	27L	900

Appendix III: Cost of Spare Parts

Spare Parts Cost: $ 495 based on median of 31 SDD equipment for 4 key spare parts: Compressor, Thermostat, Compressor Controller/Ebox and Condensor+Fan. Example:

Manufacturer	B Medical	Zero	Dulas	Godrej	Vestfrost	Haier	Dulas
Model	TCW 2000 SDD	ZLF 100 DC	VC 150 SDD	GVR 100DC (SureChill)	VLS 094 SDD	HTCD-160	VC 110 SDD
PQS Catalogue	E003/035	E003/037	E003/048	E003/050	E003/053	E003/057	E003/058
Spare Parts (USD)	**533**	**556**	**471**	**516**	**499**	**309**	**471**
- Compressor	151	214	214	280	294	230	214
- Thermostat	141	92	61*	45	49	45	61*
- Compressor C/ Ebox	155	164	168	128*	135	30*	168
- Condensor + Fan	87	86	29	63	21	4	29*

Appendix IV: Cost of Spoilt Vaccines

Spoilt Vaccines = Value of Vaccines ($9,153) * 50% Utilization of Cold Chain * Failure Rate

Vaccine	Illness	Av. Cost per Dose	Av. Doses per Cold Chain Unit (min)	Av. Doses per Cold Chain Unit (av.)	Av. Doses per Cold Chain Unit (max)	Total Wastage per Breakdown (min)	Total Wastage per Breakdown (av.)	Total Wastage per Breakdown (max)	Cost Range (UNICEF)	Year of Costing
BCG	Tuberculosis	$0.13	723	3,171	5,787	$94	$412	$752	$0.09-0.17	2018
OPV	Polio	$0.16	2,263	9,919	18,102	$351	$1,537	$2,806	$0.12-0.19	2017
HiB	Pneumonia	PENTA								
	Meningitis									
MCV	Measles	$2.19	185	813	1,484	$406	$1,781	$3,250	$1.13-3.25	2017
TT	Tetanus	$0.09	537	2,353	4,294	$46	$200	$365	$0.05-0.12	2017
HepB	Hepatitis B	$0.30	148	648	1,183	$44	$191	$349	$0.17-0.42	2017
DTP	Diphtheria	$0.90	322	1,410	2,573	$290	$1,269	$2,316	$0.65-1.15	2018
	Pertussis									
PCV	Pneumonia	$3.18	63	275	502	$199	$873	$1,592	$3.05-3.30	2017
	Meningitis									
Rota	Diarrhoea	$2.79	167	734	1,339	$466	$2,043	$3,729	$2.07-3.50	2016
MenA	Meningitis A	$0.58	171	751	1,371	$99	$436	$795	$0.50-0.66	2017
HPV	Cervical Cancer	$4.55	NA	NA	NA				$4.50-4.60	2017
YFV	Yellow Fever	$1.01	93	407	742	$94	$411	$749	$0.84-1.18	2017
	TOTAL PER BREAKDOWN					$2,088	$9,153	$16,704		

** Min volume = 19.5L, Avg volume = 85.5L, Max volume = 156.0L.*

Source: Thoughts in Gear