Supplemental material

Table 1.1: Details of the studies included in targeted literature review for the three UBT devices

Authors	Study design	PPH success rate	Atonic PPH success rate	Reference
Condom-UBT				
Darwish et al.	RCT	28/33 (84.8)	28/33 (84.8)	[1]
Tindell et al.	Systematic Review	186/193 (96.4)	NR	[2]
Santhanam et al.	Prospective	59/61 (96.7)	59/61 (96.7)	[3]
Rathore et al.	Prospective	17/18 (94.4)	NR	[4]
Aderoba et al.	Prospective	203/229 (88.6)	193/214 (90.2)	[5]
Mishra et al.	Prospective	59/60 (98.3)	NR	[6]
Kandeel et al.	Prospective	48/50 (96.0)	28/28 (100)	[7]
Anger et al.	RCT	56/64 (87.5)	NR	[8]
Dumont et al.	RCT	48/57 (84.2)	NR	[9]
Lohano et al.	Prospective	126/139 (90.6)	126/139 (90.6)	[10]
Hasabe et al.	Prospective	34/36 (94.4)	NR	[11]
Yadav et al.	Prospective	117/122 (95.9)	117/122 (95.9)	[12]
Bakri-UBT				
Darwish et al.	RCT	30/33 (90.9)	30/33 (90.9)	[1]
Revert et al.	Prospective	188/226 (83.2)	155/183 (84.7)	[13]
Brown et al.	Prospective	55/58 (94.8)	52/55 (94.5)	[14]
Vintejoux et al.	Retrospective	25/36 (69.4)	25/36 (69.4)	[15]
Guo et al.	Retrospective	288/305 (94.4)	131/142 (92.3)	[16]
Mathur et al.	Retrospective	40/49 (81.6)	14/17 (82.4)	[17]
Wang et al.	Prospective	373/407 (91.6)	373/407 (91.6)	[18]
Alkis et al.	Retrospective	43/47 (91.5)	NR	[19]
Kaya et al.	Prospective	34/45 (75.6)	27/34 (79.4)	[20]
Laas et al.	Before and after	37/43 (86)	37/43 (86)	[21]
Olsen et al.	Retrospective	25/37 (67.6)	17/24 (70.8)	[22]
Kong et al.	Retrospective	59/81 (72.8)	37/59 (62.7)	[23]

Cetin et al.	Retrospective	29/39 (74.4)	29/39 (74.4)	[24]
Gauchotte et al.	Before and after	35/38 (92.1)	NR	[25]
Grange et al.	Retrospective	80/108 (74.1)	26/39 (66.7)	[26]
Kadioglu et al.	Retrospective	42/50 (84)	NR	[27]
Martin et al.	Retrospective	32/49 (65.3)	28/42 (66.7)	[28]
Ogoyama et al.	Retrospective	66/71 (93)	31/32 (96.9)	[29]
Son et al.	Retrospective	239/306 (78.1)	190/241 (78.8)	[30]
ESM-UBT				
Ramanathan et al	Prospective/ Retrospective case series	189/201 (94) *	NR	[31]
Burke et al.	Prospective case series	190/201 (94.5) *	NR	[32]
Burke et al.	Prospective case series	298/306 (97.4) *	298/306 (97.4)	[33]

* - Reported survival rates

NR – Not reported

Table 1.2: Staff time allocation parameters used in costing analysis

Parameter	Value in cost analysis*	Source
Average time taken for UBT device insertion	10 minutes	Reported by senior most doctor
Average time taken for normal vaginal delivery in labour room	7.25 hours	
Average time taken for vaginal delivery with PPH complication, controlled after medical management in LR	10.25 hours	
Average time taken for UBT device retention among those controlled with UBT	24 hours	
Average time in operation theatre for a caesarean section without complications	45 minutes	
Average time in operation theatre for a caesarean section with PPH complication controlled with medical management	60 minutes	
Average time in operation theatre for a caesarean section with PPH complication requiring UBT insertion	75 minutes	
Average time for devascularization surgery after PPH	75 minutes	
Average time for hysterectomy after PPH	120 minutes	
Average time spent in out-patient department	12 hours/week	
Average time spent in indoor patient management	12 hours/week	
Average time spent in operation theatre	12 hours/week	
Average time spent in labour room	2 hours/week	
Average time spent in administration and documentation	10 hours/week	
Average time spent in teaching and training	5.15 hours/week	
Average time spent in out-patient department	12 hours/week	Reported by sister-in-charge
Average time spent in indoor patient management	12 hours/week	
Average time spent in operation theatre	6 hours/week	
Average time spent in administrative work	15 hours/week	
Average time spent in labour room by Grade 4 worker	12 hours/week	Reported by grade 4 worker
Average time spent in operation theatre by Grade 4 worker	12 hours/week	
Mean length of stay for OBGYN patients in ICU	3.47 days	[34]
Mean length of ICU stay for PPH patients	1.5 days	[5]

Table 1.3: Literature based event probabilities used for PPH utilization calculation of healthcare facilities

Input	Value	Reference
PPH incidence in vaginal delivery	3 percent	[35,36]
PPH incidence in caesarean delivery	6 percent	[35,36]
Atonic PPH incidence	80 percent	[37]
Atonic PPH controlled with medical management	90 percent	[38]
Clinical effectiveness of condom-UBT device in controlling atonic PPH	92.3 percent	Calculated from literature review of 33 studies reported in Table 1.1
Clinical effectiveness of ESM-UBT device in controlling atonic PPH	95.3 percent*	Calculated from literature review of 33 studies reported in Table 1.1
Clinical effectiveness of condom-UBT device in controlling atonic PPH	84.3 percent	Calculated from literature review of 33 studies reported in Table 1.1
Probability of stepwise devascularization procedure for uncontrolled atonic PPH cases after UBT insertion	0.85	[38]
Probability of obstetric hysterectomy for uncontrolled atonic PPH cases after UBT insertion	0.15	[38]
Probability of delivery at primary care level	0.19	[39]
Probability of delivery at secondary care level	0.33	[39]
Probability of delivery at tertiary care level	0.48	[39]

*** -** *Estimated from limited evidence from 3 case-series studies reported in Table 1.1*

PPH incidence rate in vaginal/caesarean section delivery was applied to reported number of deliveries at each health facility (Table 1.4) to estimate number of PPH and thus proportional atonic PPH cases at the facility. Proportion of these atonic PPH cases uncontrolled after medical and supportive management were eligible for UBT device insertion. Literature review based clinical effectiveness of individual UBT device determined number of patients consequently needing conservative (devascularization) or obstetric hysterectomy surgical intervention at each facility. Table 1.4 shows results of these calculations for each chosen facility.

Table 1.4: Utilization of services for atonic PPH at chosen health facilities of Maharashtra based on primary collected data and event probabilities from literature

Type of Health facility	Mode of Delivery	Annual number of deliveries	Atonic PPH cases	Atonic PPH controlled with medical management	Cases requiring UBT insertion	Controlled with UBT insertion Condom Bakri ESM	Cases requiring further intervention Condom Bakri ESM
PHC	Vaginal	494	11.86	10.67	1.18	1.09 1.00 1.13	0.09 0.19 0.06
SDH	Vaginal	1526	36.62	32.96	3.66	3.41 3.09 3.49	0.26 0.57 0.17
	Cesarean	330	15.84	14.26	1.58	1.47 1.34 1.51	0.11 0.25 0.07
DH	Vaginal	2986	71.66	64.49	7.17	6.66 6.04 6.83	0.50 1.13 0.34
	Cesarean	1045	50.16	45.14	5.02	4.66 4.23 4.78	0.35 0.79 0.24
Medical college	Vaginal	2202	52.84	47.56	5.28	4.87 4.44 5.03	0.37 0.83 0.25
	Caesarean	1141	54.76	49.29	5.47	5.05 4.61 5.21	0.42 0.85 0.25

Methodology for apportioning of unit cost estimation

Example: Unit cost for condom-UBT insertion in labour room of the district hospital

Unit cost for condom-UBT device insertion in labour room (vaginal delivery) of the district hospital was USD 2.84 (INR 182.9). This cost along with unit cost of condom-UBT insertion in operation theatre after cesarean section delivery in district hospital was weighted to get unit cost of condom-UBT insertion at district hospital. The average of weighted insertion cost at district hospital along with similar estimated unit cost for medical college was combined to report the average condom-UBT insertion cost at tertiary level (USD 6.5 (INR 422).

Annual consumption and price data for cost resource heads were obtained from respective sources as stated in Table 2 of the manuscript. Atonic PPH specific clinical data on number of services utilized at respective facilities as stated in Table 1.4 for specific PPH management components were apportioned to that of the total quantity of that particular service category provided at the facility by using time allocation parameters and following reported apportioning methods for each resource head to arrive at unit cost of a particular atonic PPH service delivery at the facility.

The following example describes methodology, apportioning factors and quantity of resources used in calculating unit cost for condom-UBT insertion in labour room (vaginal delivery) of the district hospital (DH). A similar methodology was used for calculation of each respective unit cost reported in the study.

1. Human resources (HR) - For total annual vaginal deliveries (2986) reported at DH, proportional time for annual condom-UBT insertions was obtained as a proportion of total time spent for all condom-UBT insertion (1.19 hours: 10 minutes for single UBT insertion, 7 UBT insertions) to that of total time for vaginal deliveries (21996 hours for 2986 vaginal deliveries) occurring at the facility **(Factor 1: 0.00054)**. This time allocation factor was used to calculate proportional time spent by workforce in all condom-UBT insertions to that of their respective total annual working hours (for 19 working staff of labour room including overhead workers) **(Factor 2: 0.0000023)**. For the working staff, the total annual working hours included time spent across OPD, IPD, Labour room administration, training, teaching, etc. obtained from time allocation interviews (2463 to 2934 total working hours annually). Proportion of labour room time for condom-UBT insertion to total annual working hours (in this case labour room) gave Factor 2.
2. Area - The area cost for labour room was calculated by first factoring the proportion of area used for condom-UBT insertion (labour room area-220 square feet, pharmacy-1800, blood bank-2660) to that of the total hospital area (1246881 square feet) **(Factor 1: 0.0038)**. Factor 2 was time allocation proportion of annual condom-UBT insertion time to that of the total time for all patients in the labour room **(Factor 2: 0.00054).** Unit space cost for condom-UBT insertion in labour room of DH was obtained by dividing annual area cost by number of condom-UBT insertions at DH.
3. Drug cost – Available drugs and their corresponding annually utilized quantities were used to calculate total annual cost of drugs in labour room of the DH. This was then multiplied with proportion of UBT insertion eligible cases in the labour room (**Factor 1: 0.00222)** to get annualized and thus unit cost of drugs used along with condom-UBT insertion in labour room of the DH.
4. Medical and non-medical equipment – Using the expected life time of the equipment (10/15 years), a discount rate of 3 percent and an annual maintenance rate of 0.01, annualized costs were calculated. Proportional equipment time spent on condom-UBT insertion to the total time for use of equipment in labour room **(Factor 1: 0.00054)** gave annual cost of medical and non-medical equipment. This was then divided by eligible UBT beneficiaries to calculate unit cost of equipment for condom-UBT insertion in labour room of the DH.

5. Electricity – As electricity was shared and accounted across the facility, it was first apportioned by proportional area for the labour room out of total facility area multiplied by 2 for electricity to get the first factor (**Factor 1: 0.00751**). The second factor for apportioning was based on proportional time spent for condom-UBT insertion in labour room **(Factor 2: 0.00054).**
6. Water – Water as a shared resource was first apportioned by proportional area for labour room out of the total facility area to get the first factor (**Factor 1: 0.00751**). The second apportioning factor was proportional time spent for condom-UBT insertion in labour room **(Factor 2: 0.00054).**
7. Laundry – Laundry was apportioned as proportion of eligible cases for condom-UBT insertion to the total indoor patients at the DH (22036). (**Factor 1: 0.000256).**

Similarly, for surgeries, the district hospital data reported a total of 1169 obstetric surgeries annually. This included 1045 cesarean sections, 39 major surgeries (non-specified) and 85 cases of female sterilization. We derived the number of expected atonic PPH specific surgeries from the given 1045 cesarean sections by applying literature probability estimates as reported in Table 1.1 and 1.2. Time allocation parameters for each type of surgery was then applied to get proportional time factors that was applied to relevant cost centres along with apportioning methods as stated to arrive at unit surgical costs.

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