



Cost of delivering primary healthcare services through public sector in India

Akashdeep Singh Chauhan¹, Shankar Prinja¹, Sakthivel Selvaraj², Aditi Gupta³, V.R. Muraleedharan⁴ & Thiagarajan Sundararaman⁵

¹Department of Community Medicine and School of Public Health, Postgraduate Institute of Medical Education & Research, Chandigarh, ²Department of Health Economics, Financing and Policy, Public Health Foundation of India, ³Department of Family Planning, Jhpiego India Country Office, New Delhi, ⁴Department of Humanities & Social Sciences, Indian Institute of Technology - Madras, Chennai, Tamil Nadu & ⁵School of Health Systems Studies, Tata Institute of Social Sciences, Mumbai, Maharashtra, India

Received January 14, 2019

Background & objectives: Public health spending on primary healthcare has increased by four times (in real terms) over the last decade and continues to constitute more than half of the total public health expenditure. The present study estimated the cost of providing healthcare services at sub centre (SC) and primary health centre (PHC) level in four selected States of India.

Methods: A total of 51 SCs and 33 PHCs were selected across the four States (Himachal Pradesh, Odisha, Kerala and Tamil Nadu) of India. The economic cost of delivering health services at these facilities was assessed using bottom-up costing methodology during the reference year of 2014-2015. The cost of capital items was annualized and allocation of shared resources was based on appropriate apportioning statistics.

Results: The mean annual cost of providing health services at SC and PHC was ₹ 0.69 million (US\$ 11,392) and ₹ 5.1 million (US\$ 83,837), respectively. Nearly 3/4th and 2/3rd of this cost at the level of SC (74%) and PHC (63%) were spent on salaries. In terms of unit cost, the costs per antenatal care and postnatal care visit were ₹ 221 (173-276) and ₹ 333 (244-461), respectively, at SCs. Similarly, the costs of per patient outpatient consultation and per bed day hospitalization at PHC level were ₹ 121 (91-155) and ₹ 1168 (955-1468), respectively.

Interpretation & conclusions: The cost estimates from the present study can be used in economic evaluations, assessing technical efficiency and also for providing valuable information during scale-up of health facilities.

Key words Health system cost - mean annual cost - primary healthcare - primary health centre - subcentre - unit cost

India has a vast network of subcentres (PHCs; n=25,650) for providing primary healthcare to (SCs; n=156,231) and primary health centres around 70 per cent of the population living in the rural

areas^{1,2}. The first interaction of the community and the health system is at the level of SC, which is also involved in the implementation of various health and family welfare programmes³. PHC is the first point of contact of a qualified medical doctor with the community⁴.

India's public health system has been funded through supply-side financing mechanism⁵. While the proportion of the total government health spending on secondary and tertiary care has remained almost constant during the last decade, the proportion of expenditure on primary care has increased from 41 to 51 per cent^{6,7}. However, it falls short of the expected allocation, which is envisaged to be 2/3rd of the total health expenditure⁸. With more than half of the public health funding being directed towards the provision of primary healthcare, empirical evidence on the cost of providing services becomes important to better plan and organize health services.

Several other policy developments make an assessment of the cost of primary healthcare services in India timely and useful. Firstly, as part of the ambitious 'Ayushman Bharat' programme, the Government of India is developing a plan to upgrade SCs to health and wellness centres (HWCs). This change involves upgradation of the existing SCs in terms of workforce, drugs, supplies and other capital infrastructure⁹. The current estimates of the total and unit cost and input wise distribution of the cost provide essential data for the allocation of additional resources. Secondly, the Government of India has created a formal body for health technology assessment (HTA) to assess the cost-effectiveness of newer healthcare interventions, programmes and technologies¹⁰.

Available cost estimates from National Commission on Macroeconomics and Health as well as World Health Organization are out dated^{11,12}. A few other costing studies are available, which are either old¹³, or are confined geographically^{14,15}. Generalizing the cost results from these studies to country level requires caution due to variability regarding the availability or price of infrastructure and service utilization across the States. Given these gaps, this study was undertaken to estimate the overall and unit cost of providing health services at the primary healthcare facilities across the four selected States of India.

Material & Methods

Ethics approval for the present study was obtained from the Institute's Ethics Committee of Postgraduate Institute of Medical Education and Research,

Chandigarh, India. Further, administrative approval for the cost data collection was obtained from the health departments of respective State governments and the civil surgeons of the selected districts.

Study area: The present study was undertaken in four States of India namely Himachal Pradesh (HP), Tamil Nadu (TN), Kerala and Odisha. The selection of the four States was based on the performance of the health system, availability of the infrastructure, service utilization and geographic location.

For selection of the facilities across the selected States, a multistage stratified random sampling was used. Firstly, districts falling under each State were divided into three strata based on a ranking matrix, and one district from each stratum was randomly selected in each State¹⁶. In the second stage, two blocks falling under each of the selected districts were randomly chosen. In the next stage, at least one PHC and around 15 per cent of the total SCs falling under each block were randomly selected. Finally, a total of 33 PHCs and 51 SCs were chosen.

Data collection: The economic cost of health services delivered at the selected health centres was assessed following bottom-up micro-costing methodology^{17,18}. This method required, firstly, identifying cost centres in terms of both patient care-related service cost centres and support cost centres¹⁹. This was followed by an assessment of the outputs produced by each service cost centre from the routine medical records of the facility. Once service centres were classified and output was determined, various inputs utilized in delivering these services were identified and their quantities were measured.

Data on inputs included both the capital resources (space, equipment, furniture, *etc.*) and recurrent items (salaries, drugs, consumables, stationary, *etc.*) spent on the provisioning of healthcare for the reference year of April 2014 to March 2015. For determining the dimensions of the building (in square feet), a facility survey and review of facility maps was undertaken. The stock registers (non-consumable) were assessed for extracting the information on the number of various equipment and furniture items present in the facility. Lastly, for assessing recurrent resource consumption, consumable stock registers, pharmacy records, vouchers and indents were reviewed.

Data on the salaries of the staff posted at the health facility were assessed from the accounts department.

Similarly, expenses on various overheads like laundry, diet, electricity/water, fuel, insurance and maintenance were elicited from the account records. The incentives provided to the beneficiaries and direct cash expenditure underneath specific grants or funds were also assessed from the facility's records and verified from the district health administration office.

Once the list of the quantities of various inputs was drawn, the monetary value was assigned to each of the inputs. For inputs such as equipment, drugs and various surgical consumables, contract rate (procurement rate) as fixed by the respective State government was used. The price charged by the local distributors was assessed where procurement prices were not available. Similarly, local market prices were used for furniture, stationary and sanitary items due to a lack of data on the procurement prices. To determine the average life of the equipment, expert opinion of the staff (involved in using the respective equipment) was elicited and standard literature was reviewed^{20,21}. The current market rental price was determined by key informant interviews. The prices used in this study are for the year 2014-2015.

The staff of the selected health facilities were interviewed with a semi-structured interview schedule to assess their time spent on various activities done either on a routine basis (outpatient consultation, inpatient care, *etc.*) or on a fixed time interval (immunization, family planning camps, pulse polio immunization, *etc.*) *i.e.*, weekly, fortnightly, monthly, quarterly, yearly, *etc.*^{14,15}. All the auxiliary nurse midwives posted at the SCs were interviewed. For PHCs, the medical doctor, the pharmacist and a randomly selected staff nurse (from each functioning cost centre) were interviewed.

Statistical analysis: The cost of equipment and furniture items was annualized using a three per cent discount rate based on standard guidelines^{22,23}. The space cost was estimated by multiplying the floor area with the rental price. The cost of recurrent items was deduced by multiplying the unit price with the consumed quantity of these items. The cost of shared resources (like HR time, space, equipment, furniture, *etc.*) was allocated to specific services using apportioning statistics^{19,24}.

The annual cost incurred by the facility and its distribution by the type of inputs and services (delivered at the facility) was estimated. Further, unit cost of these services was also calculated. The unit

cost calculation required combining the cost of those resources spent on providing a particular service divided by the number of beneficiaries during the reference period^{19,24}. Using the bootstrap method²⁵, the estimates of unit costs from 51 SCs and 33 PHCs were simulated 999 times for calculating 95 per cent confidence interval.

Due to the variation in the utilization of services across the health facilities, the unit cost was standardized by adjusting for 100 and 80 per cent capacity utilization. We used the antenatal care coverage (ANC) rates and the number of outpatient consultations as an indicator to adjust for capacity utilization at SC and PHC, respectively. Based on the birth rate, the population of the area and considering a minimum of four ANC visits per pregnant women, the required number of ANC visits at 100 and 80 per cent capacity was estimated. Further, based on the highest number of outpatient consultations per doctor among the PHCs of a State, the number of outpatient consultations at 100 and 80 per cent capacity was estimated. To adjust for capacity utilization, the recurrent costs on drugs, consumables, stationary and overheads, were changed as per increase or decrease in the service utilization, while the fixed cost on human resource, space, equipment, *etc.* was kept constant.

Results

Profile of the facilities: The SCs and PHCs catered to an average population of 5753 (460 – 10,140) and 25,612 (2623 – 47,313), respectively, across the four States. In terms of service provisioning, 716 patients received outpatient consultations and 379 ANC sessions annually were given at the selected SCs. Similarly, 23,083 and 252 patients received outpatient consultation and inpatient care, respectively, at PHCs annually.

Annual cost: The mean annual cost of provisioning of healthcare services at SC was ₹ 0.69 million (US\$ 11,392), which varied from ₹ 0.58 million (US\$ 9474) in TN to ₹ 0.89 million (US\$ 14,680) in HP. At PHC, the mean annual cost was ₹ 5.1 million (US\$ 83,837), ranging from ₹ 2.01 million (US\$ 33,095) in Odisha to 7.4 million (US\$ 122,283) in Kerala. Nearly 3/4th (74%) of the cost at SC level and 2/3rd (63%) at PHC level were incurred on salaries. Other determinants of cost were drugs/consumables (14 and 23%), space (5 and 4%) and equipment/furniture (2 and 3%) (Fig. 1). Tables I and II show input-wise distribution of annual cost across the four States.

Table I. Input-wise distribution of annual cost at subcentre level across the four States in India for the year 2014-2015

Inputs	Mean annual cost in ₹ (US\$)*									
	Himachal Pradesh (n=6)	Per cent [@]	Odisha (n=16)	Per cent [@]	Kerala (n=19)	Per cent [@]	Tamil Nadu (n=10)	Per cent [@]	Overall (n=51)	Per cent [@]
Human resource	651,221 (10,672)	73	419,882 (6881)	69	636,389 (10,429)	83	332,711 (4542)	58	510,665 (8369)	73
Space and building	110,678 (1814)	12	9758 (160)	2	29,177 (478)	4	48,466 (794)	8	36,455 (597)	5
Equipment and furniture	29,137 (477)	3	8441 (138)	1	17,148 (281)	2	13,420 (220)	2	15,096 (247)	2
Drugs	32,824 (538)	4	118,685 (1945)	20	39,715 (651)	5	103,253 (1692)	18	76,138 (1248)	11
Consumables	29,023 (476)	3	29,994 (492)	5	8242 (135)	1	38,021 (623)	7	23,350 (383)	3
Other recurrent costs	13,424 (220)	1	12,031 (197)	2	8640 (142)	1	18,841 (309)	3	12,267 (201)	2
Fund and cash benefits	29,458 (483)	3	9,197 (151)	2	27,500 (451)	4	23,398 (383)	4	21,184 (347)	3
Total cost	895,764 (14,680)	100	607,987 (9964)	100	766,811 (12,567)	100	578,109 (9474)	100	695,155 (11,392)	100

*Conversion rate of 1 US\$ = ₹ 61.02, as reported by the World Bank for the year 2014-15 was used; [@]Per cent indicates relative proportion/share of inputs of the total cost

*Conversion rate of 1 US\$ = ₹ 61.02, as reported by the World Bank for the year 2014-15 was used; [@]Per cent indicates relative proportion/share of inputs of the total cost**Table II.** Input-wise distribution of annual cost at the level of primary health centres across the four States in India for the year 2014-2015

Inputs	Mean annual cost in ₹ (US\$)*									
	Himachal Pradesh (n=6)	Per cent [@]	Odisha (n=10)	Per cent [@]	Kerala (n=10)	Per cent [@]	Tamil Nadu (n=7)	Per cent [@]	Overall (n=33)	Per cent [@]
Human resource	3,652,874 (59,864)	72	1,371,083 (22,469)	68	4,443,173 (72,815)	60	3,885,626 (63,678)	62	3,250,278 (53,266)	64
Space and building	518,806 (8502)	10	28,375 (465)	1	160,219 (2626)	2	257,509 (4220)	4	206,101 (3378)	4
Equipment and furniture	158,645 (2600)	3	108,067 (1771)	5	135,967 (2228)	2	144,101 (2362)	2	133,361 (2186)	3
Drugs	281,197 (4608)	6	344,801 (5651)	17	2,076,384 (34,028)	28	1,056,873 (17,320)	17	1,009,004 (16,536)	20
Consumables	215,710 (3535)	4	97,987 (1606)	5	47,366 (776)	1	333,296 (5462)	5	153,965 (2523)	3
Other recurrent costs	191,567 (3139)	4	25,580 (419)	1	95,993 (1,573)	1	206,037 (3377)	3	115,375 (1891)	2
Fund and cash benefits	55,181 (904)	1	43,570 (714)	2	502,604 (8237)	7	340,061 (5573)	5	247,674 (4059)	5
Total cost	5,073,981 (83,153)	100	2,019,462 (33,095)	100	7,461,706 (122,283)	100	6,223,503 (101,991)	100	5,115,760 (83,837)	100
*Conversion rate of 1 US\$ = ₹ 61.02, as reported by the World Bank for the year 2014-15 was used; [@] Per cent indicates relative proportion/share of inputs of the total cost										

*Conversion rate of 1 US\$ = ₹ 61.02, as reported by the World Bank for the year 2014-15 was used; [@]Per cent indicates relative proportion/share of inputs of the total cost

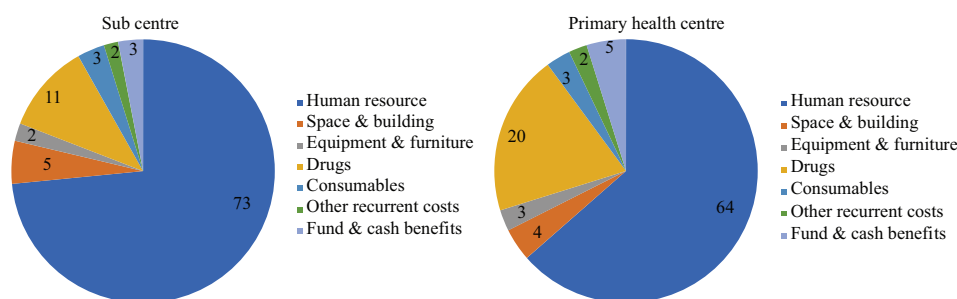


Fig. 1. Input-wise distribution of mean annual cost incurred (%) at sub centres and primary health centres across the four States in India for the year 2014-2015.

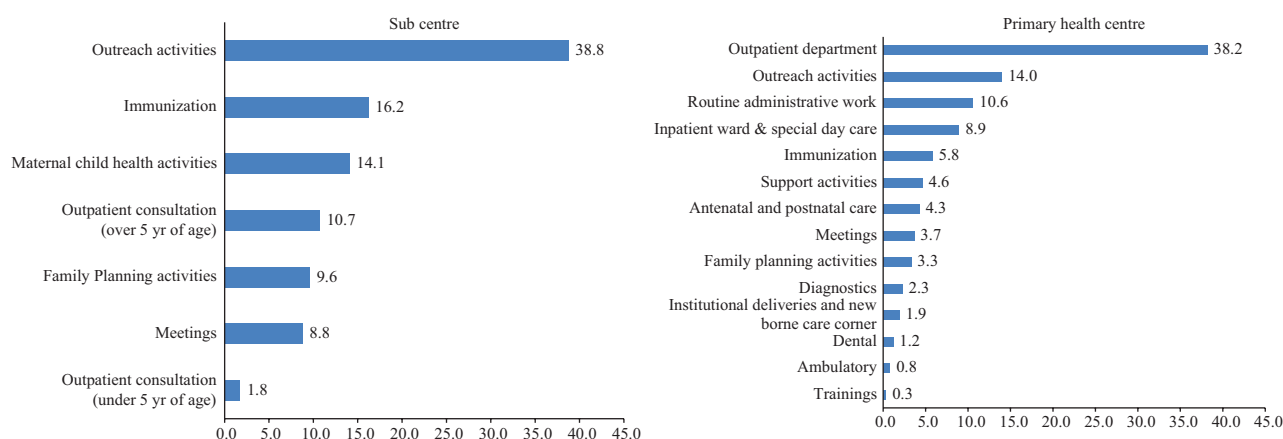


Fig. 2. Distribution of the mean annual cost by specific health services at subcentres and primary health centres across the four States in India for the year 2014-2015.

With regard to specific services, provision of outreach activities accounted for 39 per cent of the annual cost at SCs (Fig. 2). On the other hand, more than 1/3rd of the total cost (38%) was on the provision of outpatient consultation at PHCs (Fig. 2).

Unit costs: At the level of SC, per visit cost of an ANC was ₹ 221 (173-276), and it varied from ₹ 108 (64-162) in Kerala to ₹ 534 (272-771) in HP. Similarly, the unit cost of a postnatal care visit was ₹ 333 (244-461) ranging from ₹ 172 (121-229) in Kerala to ₹ 1009 (261-1936) in the State of HP. At PHCs, per patient outpatient consultation cost was ₹ 121 (91-155), ranging from ₹ 71 (44-109) in TN to ₹ 158 (100-233) in HP. Per bed day cost for inpatient care was ₹ 1168 (955-1468), which varied from ₹ 107 (88-128) in TN to ₹ 5107 in HP. The unit costs of other services at SC and PHC are shown in Tables III and IV.

Discussion

The present study estimated the cost of providing healthcare services at the level of primary healthcare

facilities across four diverse States of India. The findings of our study in terms of input-wise distribution of annual cost are comparable to those of previous studies¹³⁻¹⁵. However, there were differences in the absolute estimate of the annual cost reported from other studies. The annual operational cost of a SC (₹ 1.03 million) and PHC (₹ 8.8 million) from our previous studies in north India (year 2012-2013) was higher than that in the present study^{14,15}. This could be due to variation in the salary structure, availability of capital equipment, drugs, consumables and other cost inputs across States in India.

Some differences in the unit costs were also observed. Specifically, the unit costs of an ANC visit (₹ 677), PNC visit (₹ 740) and outpatient consultation (₹ 139) in the present study were on the lower side, whereas inpatient care (₹ 690) was on the higher side as compared to what was reported in our previous study in north India¹⁵. The unit cost of a service depends on the resource use and the number of beneficiaries (that availed the service). Wide variation in infrastructure and the extent of

Unit cost	Himachal Pradesh		Kerala		Odisha	
	Unadjusted*	Adjusted* 100% 80%	Unadjusted* 100% 80%	Adjusted* 100% 80%	Unadjusted* 100% 80%	Adjusted* 100% 80%
Per antenatal care visit	534 (272-771)	550 (221-821)	663 (303-982)	108 (64-162)	190 (153-228)	186 (155-218)
Per postnatal care visit	1,009 (261-1,936)	1012 (250-2045)	1247 (372-2531)	172 (121-229)	357 (255-503)	357 (254-500)
Per vaccination shot	234 (122-407)	219 (114-364)	261 (141-445)	233 (133-356)	105 (87-126)	106 (85-128)
Unit cost	Overall					
	Unadjusted*	Adjusted* 100% 80%	Unadjusted* 100% 80%	Adjusted* 100% 80%	Unadjusted* 100% 80%	Adjusted* 100% 80%
Per antenatal care visit	297 (229-358)	274 (222-322)	314 (257-375)	221 (173-276)	213 (165-271)	245 (188-321)
Per postnatal care visit	277 (194-349)	274 (174-406)	317 (204-460)	333 (244-461)	316 (221-462)	371 (249-551)
Per vaccination shot	106 (80-132)	100 (76-126)	112 (84-140)	168 (124-222)	169 (111-259)	197 (125-308)

*Figures in parentheses indicate 95% confidence intervals

Table IV. Unadjusted and adjusted (at 100 and 80% capacity utilization) unit costs (in ₹) of delivering various health services at primary health centres across the four States in India for the year 2014-2015

Unit cost	Himachal Pradesh			Kerala			Odisha		
	Unadjusted*	Adjusted*		Unadjusted*	Adjusted*		Unadjusted*	Adjusted*	
		100%	80%		100%	80%		100%	80%
Per antenatal care visit	403 (232-571)	134 (64-205)	157 (74-237)	770 (485-1100)	476 (212-819)	577 (283-956)	571 (520-618)	281 (233-347)	293 (242-356)
Per postnatal care visit	200 (1527-3273)	586 (343-828)	724 (420-1027)	86 (64-110)	54 (37-76)	60 (41-80)	679 (420-991)	237 (147-349)	253 (158-365)
Per vaccination shot	507 (150-942)	217 (50-455)	254 (53-535)	253 (171-356)	148 (96-209)	185 (112-268)	465 (333-640)	96 (70-127)	109 (82-143)
Per patient outpatient consultation	158 (100-233)	57 (48-67)	63 (53-74)	124 (71-241)	102 (63-180)	96 (54-166)	130 (87-192)	75 (51-105)	78 (53-109)
Per tubectomy procedure	1010 [@]	109 [@]	136 [@]	-	-	-	-	-	-
Per IUCD procedure	2434 (2206-2714)	529 (364-745)	659 (445-931)	426 (243-609)	309 (199-417)	370 (249-499)	-	-	-
Per bed day inpatient care	5107 [@]	1283 [@]	1398 [@]	-	-	-	789 (649-916)	679 (544-811)	692 (571-818)
Per institutional delivery	3113 (1721-4374)	1242 (456-2225)	1353 (549-2383)	-	-	-	753 (742-762)	287 (280-294)	328 (315-342)
Unit cost	Tamil Nadu			Overall					
	Unadjusted*	Adjusted*		Unadjusted*	Adjusted*		Unadjusted*	Adjusted*	
		100%	80%		100%	80%		100%	80%
Per antenatal care visit	222 (151-327)	167 (100-280)	179 (110-298)	517 (403-643)	291 (206-395)	338 (236-468)	291 (206-395)	338 (236-468)	338 (236-468)
Per postnatal care visit	286 (169-413)	204 (108-319)	221 (120-345)	546 (357-849)	210 (151-288)	238 (169-332)	210 (151-288)	238 (169-332)	238 (169-332)
Per vaccination shot	160 (86-242)	140 (80-202)	145 (79-212)	311 (230-415)	162 (126-211)	182 (138-241)	162 (126-211)	182 (138-241)	182 (138-241)
Per patient outpatient consultation	71 (44-109)	50 (35-73)	53 (37-76)	121 (91-155)	74 (57-96)	75 (58-98)	74 (57-96)	75 (58-98)	75 (58-98)
Per tubectomy procedure	65 [@]	60 [@]	59 [@]	538 (497-581)	84 (82-86)	97 (94-101)	84 (82-86)	97 (94-101)	97 (94-101)
Per IUCD procedure	115 (93-135)	65 (62-68)	74 (67-80)	917 (744-1142)	326 (281-381)	397 (341-466)	326 (281-381)	397 (341-466)	397 (341-466)
Per bed day inpatient care	107 (88-128)	134 (90-187)	135 (93-189)	1168 (955-1468)	454 (384-538)	475 (401-564)	454 (384-538)	475 (401-564)	475 (401-564)
Per institutional delivery	1797 (1441-2166)	1286 (1051-1563)	1339 (1100-1626)	1967 (1718-2303)	1093 (938-1275)	1159 (1005-1349)	1093 (938-1275)	1159 (1005-1349)	1159 (1005-1349)

*Figures in parentheses indicate 95% confidence intervals; [@]Data for the particular health service were available from a single healthcare facility, so 95% confidence intervals have not been reported, IUCD: Intra-uterine contraceptive device

service utilization across the four States explains this difference.

There was a wide variation in cost inputs as well as service utilization indicators among the facilities of selected States. The difference in the service utilization was adjusted by assessing standardized unit costs at 100 and 80 per cent capacity utilization.

Limitations and methodological challenges: It is to be noted that due to vast differences in the wage rates, infrastructure and health system characteristics for a vast country like India, a more extensive study with broader coverage is required to estimate an average cost which is representative at national level. However, as the State bears major share of healthcare financing, State specific cost information is more important than a national average in India^{7,26}.

The staff members in our study were interviewed to ascertain their time spent on various activities. Similar methodology has been employed and justified in various previous costing studies^{14,15,27}. More research on comparing apportioning statistics with those derived through data collected using time-motion studies should be undertaken. Further, data on overheads, utilization of services and other joint resources were available at a pooled and not in a disaggregated or service-specific form. Standard apportioning statistics were used for allocating these pooled resources among various services¹⁹.

Policy and research implications: Cost data are an essential prerequisite for undertaking a cost-effectiveness analysis to evaluate the efficiency of healthcare delivery. The creation of the HTAIn has identified generation of cost information for creating of a cost database for India¹⁰. In view of this, the present study fills important gaps in evidence which could, in turn, bolster the HTA research. Cost-effectiveness analyses have made use of the existing costing studies to derive cost parameters^{28,29}.

The present study was based on the actual resource consumption and service utilization, and the estimates of cost reflect the real-world setting. While we adjusted for differences in the level of efficiency as part of our standardized estimates, our study findings on cost could still be confounded by lack of adequate infrastructure and supplies, gaps in quality and lack of provision of services, which may be considered as an essential service package as per the provisions under new HWCs³⁰. In view of this, a resource-gap

analysis based on difference between the current availability of inputs and the ideal scenario, and the actual availability of resources at the health facilities should be undertaken. This resource gap could further be used for the projection of additional requirement of resources in case of scale-up of health facilities like in the case of the establishment of HWCs.

In conclusion, the present study findings on the cost of primary healthcare services in India can be used in cost-effectiveness studies, equity analysis, determination of provider payment rates and in assessing the resource gap for the projection of additional requirement of resources in case of scale-up of the present health facilities to HWCs.

Financial support & sponsorship: This study was supported by funding received from the United States Agency for International Development (USAID) India grant AID-386-A-14-00006.

Conflicts of Interest: None.

References

1. Chokshi M, Patil B, Khanna R, Neogi SB, Sharma J, Paul VK, *et al*. Health systems in India. *J Perinatol* 2016; 36 : S9-12.
2. Ministry of Health and Family Welfare, Government of India. *Rural Health Statistics in India, a Digital India Initiative. District-wise availability of health centres in India as on 31st March, 2017*. Available from: <https://data.gov.in/resources/district-wise-availability-health-centres-india-31st-march-2017>, accessed on July 20, 2019.
3. Directorate General of Health Services. Ministry of Health and Family Welfare Government of India. *Indian Public Health Standards (IPHS) guidelines for sub-centres; 2012*. Available from: [http://health.bih.nic.in/Docs/Guidelines/Guidelines-Sub-Centers-\(Revised\)-2012.pdf](http://health.bih.nic.in/Docs/Guidelines/Guidelines-Sub-Centers-(Revised)-2012.pdf), accessed on April 25, 2018.
4. Directorate General of Health Services. Ministry of Health and Family Welfare, Government of India. *Indian Public Health Standards (IPHS) guidelines for primary health centres; 2012*. Available from: <http://health.bih.nic.in/Docs/Guidelines/Guidelines-PHC-2012.pdf>, accessed on April 25, 2018.
5. Oxford Committee for Famine Relief. *Financing healthcare for all in India: Towards a common goal; 2015*. Available from: https://www.oxfamindia.org/sites/default/files/WP-Financing-Healthcare-for-All-In-India-29-05-2015-EN_0.pdf, accessed on February 10, 2018.
6. National Health Accounts Cell. Ministry of Health and Family Welfare. *National health accounts India; 2004-05*. Available from: http://www.planningcommission.nic.in/reports/genrep/health/National_Health_Account_04_05.pdf, accessed on October 20, 2017.
7. National Health Systems Resource Centre, National Health Accounts Technical Secretariat Ministry of Health and Family Welfare, Government of India. *National health accounts: Estimates for India; 2014-15*. Available from: <https://mohfw.gov.in/sites/default/files/National%20Health%20>

- Accounts%20Estimates%20Report%202014-15.pdf*, accessed on February, 15, 2018.
8. Ministry of Health and Family Welfare, Government of India. *National Health Policy; 2017*. Available from: <https://mohfw.gov.in/sites/default/files/9147562941489753121.pdf>, accessed on July 19, 2019.
 9. Press Information Bureau, Ministry of Finance, Government of India. *Ayushman Bharat for a New India - 2022*. Available from: <http://pib.nic.in/newsite/PrintRelease.aspx?relid=176049>, accessed on June 10, 2018.
 10. Prinja S, Downey LE, Gauba VK, Swaminathan S. Health technology assessment for policy making in India: Current scenario and way forward. *Pharmacoecon Open* 2018; 2 : 1-3.
 11. World Health Organization. *Choosing interventions that are cost-effective (WHO CHOICE): Results for unit costs for patient services for 14 GBD regions*. Geneva: WHO; 2005.
 12. National Commission on Macroeconomics and Health. Ministry of Health and Family Welfare, Government of India. *Report of the National Commission on Macroeconomics and Health*. New Delhi, India: MoHFW, GoI; 2005.
 13. Anand K, Kapoor SK, Pandav CS. Cost analysis of a primary health centre in Northern India. *Natl Med J India* 1993; 6 : 160-3.
 14. Prinja S, Jeet G, Verma R, Kumar D, Bahuguna P, Kaur M, et al. Economic analysis of delivering primary health care services through community health workers in 3 North Indian states. *PLoS One* 2014; 9 : E91781.
 15. Prinja S, Gupta A, Verma R, Bahuguna P, Kumar D, Kaur M, et al. Cost of delivering health care services in public sector primary and community health centres in North India. *PLoS One* 2016; 11 : E0160986.
 16. Ram F, Shekhar C. *Ranking and mapping of districts: Based on socio-economic and demographic indicators*. Ministry of Health and Family Welfare, Government of India; 2006. Available from: http://iipsindia.org/pdf/05_b_13acp.pdf, accessed on December 5, 2017.
 17. Chapko MK, Liu CF, Perkins M, Li YF, Fortney JC, Maciejewski ML. Equivalence of two healthcare costing methods: Bottom-up and top-down. *Health Econ* 2009; 18 : 1188-201.
 18. Waters HR, Hussey P. Pricing health services for purchasers-a review of methods and experiences. *Health Policy* 2004; 70 : 175-84.
 19. Drummond ME, Stoddard GL, Torrance GW. *Methods for the economic evaluation of health care programmes*, 1st ed. Oxford: Oxford University Press; 1987.
 20. Johns B, Baltussen R, Hutubessy R. Programme costs in the economic evaluation of health interventions. *Cost Eff Resour Alloc* 2003; 1 : 1.
 21. World Health Organization. *Making choices in health: Who guide to cost-effectiveness analysis*. Available from: <https://apps.who.int/iris/bitstream/handle/10665/42699/9241546018.pdf;jsessionid=1F1F74B0EE22C7B92F9996A32FAF0E77?sequence=1>, accessed on August 4, 2018.
 22. Walker D, Kumaranayake L. Allowing for differential timing in cost analyses: Discounting and annualization. *Health Policy Plan* 2002; 17 : 112-8.
 23. Fox-Rushby J, Cairns J. *Economic evaluation*. London: Oxford University Press; 2006.
 24. Joint Learning Network for Universal Health Coverage. *Costing of health services for provider payment: A practical manual based on country costing challenges, trade-offs, and solutions*. Available from: https://www.jointlearningnetwork.org/wp-content/uploads/2019/11/JLN_Costing_Manual.pdf, accessed on August 4, 2020.
 25. Yung YF, Chan, W. Statistical analyses using bootstrapping: Concepts and implementation. In R. H. Hoyle editor, *Statistical strategies for small sample research*. Thousand Oaks, CA: SAGE; 1999. p. 82-108.
 26. Bahuguna P, Mukhopadhyay I, Chauhan AS, Rana SK, Selvaraj S, Prinja S. Sub-national health accounts: Experience from Punjab State in India. *PLoS One* 2018; 13 : E0208298.
 27. Prinja S, Balasubramanian D, Jeet G, Verma R, Kumar D, Bahuguna P, et al. Cost of delivering secondary-level health care services through public sector district hospitals in India. *Indian J Med Res* 2017; 146 : 354-61.
 28. Prinja S, Bahuguna P, Faujdar DS, Jyani G, Srinivasan R, Ghoshal S, et al. Cost-effectiveness of human papillomavirus vaccination for adolescent girls in Punjab state: Implications for India's universal immunization program. *Cancer* 2017; 123 : 3253-60.
 29. Chugh Y, Dhiman RK, Premkumar M, Prinja S, Singh Grover G, Bahuguna P. Real-world cost-effectiveness of pan-genotypic Sofosbuvir-Velpatasvir combination versus genotype dependent directly acting anti-viral drugs for treatment of hepatitis C patients in the universal coverage scheme of Punjab state in India. *PLoS One* 2019; 14 : E0221769.
 30. Johns B, Torres TT; WHO-CHOICE. Costs of scaling up health interventions: a systematic review. *Health Policy Plan* 2005; 20 : 1-13.

For correspondence: Dr Shankar Prinja, School of Public Health, Postgraduate Institute of Medical Education & Research, Chandigarh 160 012, India
e-mail: shankarprinja@gmail.com