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## Cost of delivering secondary-level health care services through public sector district hospitals in India

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**Background & objectives:** Despite an impetus for strengthening public sector district hospitals for provision of secondary health care in India, there is lack of robust evidence on cost of services provided through these district hospitals. In this study, an attempt was made to determine the unit cost of an outpatient visit consultation, inpatient bed-day of hospitalization, surgical procedure and overall per-capita cost of providing secondary care through district hospitals.

**Methods:** Economic costing of five randomly selected district hospitals in two north Indian States - Haryana and Punjab, was undertaken. Cost analysis was done using a health system perspective and employing bottom-up costing methodology. Quantity of all resources - capital or recurrent, used for delivering services was measured and valued. Median unit costs were estimated along with their 95 per cent confidence intervals. Sensitivity analysis was undertaken to assess the effect of uncertainties in prices and other assumptions; and to generalize the findings for Indian set-up.

**Results:** The overall annual cost of delivering secondary-level health care services through a public sector district hospital in north India was ₹ 11,44,13,282 [US Dollars (USD) 2,103,185]. Human resources accounted for 53 per cent of the overall cost. The unit cost of an inpatient bed-day, surgical procedure and outpatient consultation was ₹ 844 (USD 15.5), ₹ 3481 (USD 64) and ₹ 170 (USD 3.1), respectively. With the current set of resource allocation, per-capita cost of providing health care through district hospitals in north India was ₹ 139 (USD 2.5).

**Interpretation & conclusions:** The estimates obtained in our study can be used for Fiscal planning of scaling up secondary-level health services. Further, these may be particularly useful for future research such as benefit-incidence analysis, cost-effectiveness analysis and national health accounts including disease-specific accounts in India.

**Key words** Cost per capita - cost per case operated - cost per inpatient bed-day - cost per outpatient consultation - district hospital - economic evaluation - secondary healthcare

District hospitals are the hub of provision of secondary care services in India, with a hospital present in each district. Cases requiring specialist care are referred from a primary health centre to a community health centre or a district hospital. In view of staff shortages at lower levels, district hospitals provide the bulk of secondary health care services<sup>1,2</sup>.

Various publicly financed health insurance schemes, which cover more than 300 million Indian population, focus on the provision of secondary health care services, with some schemes focusing on tertiary care<sup>3</sup>. However, when it comes to paying providers for the provision of secondary care, there is no robust evidence of cost of provision of secondary care services. The World Health Organization CHOosing Interventions that are Cost-Effective (WHO-CHOICE) estimates though available, but may not be completely generalizable to Indian setting<sup>4</sup>. Most of the costing studies available from India are for specific services such as paediatric care<sup>5,6</sup> and referral transport<sup>7</sup>. Although Chatterjee *et al*<sup>8</sup> comprehensively estimated the cost of provision of hospital care, only one typical district hospital from public sector was included in the study. Moreover, this hospital was also chosen using convenience sampling, thus limiting generalizability<sup>8</sup>. Hence, there is a need to generate evidence for cost of provision of secondary services through district hospitals in public sector in India. We, therefore, undertook this study to estimate the cost of provision of secondary health care services through public sector district hospitals in north India.

### Material & Methods

This study was conducted in two north Indian States of Haryana and Punjab. Of the total 43 district hospitals

in the two States, five were chosen using simple random sampling: three in Haryana (Panchkula, Jhajjar and Rohtak) and two in Punjab (Sangrur and Ropar). In terms of financing, these hospitals were predominantly tax-funded, with user charges contributing just about 5-10 per cent of revenue<sup>9</sup>. Table I provides the profile of the study districts and their hospitals.

**Cost data collection:** Economic costing was done from a health system perspective and a bottom-up costing methodology was employed<sup>10,11</sup>. Cost centres at each district hospital were identified in terms of patient care cost centres (PCCs) and support cost centres (SCCs). PCCs, such as the inpatient department, outpatient department (OPD) and operating theatre, are responsible for direct patient services. SCCs provide support for patient care through administration, laundry, kitchen, transport and other units. Data on all resources, capital and recurrent, consumed from April 2012 to March 2013 were collected. Routine records at the district hospital (such as outpatient register, inpatient register, operation theatre register, stock register, indent book and monthly reports) were used to collect the data. This was supplemented with data on incentives paid under various health schemes (to service providers or beneficiaries in case of conditional cash transfers), untied funds and annual maintenance grants, which were collected from the Office of Civil Surgeon (chief of district health administration) at district level. Facility survey of district hospital was undertaken to assess the capital resources *i.e.* building. Non-consumable stock register was reviewed for a number of equipment's and other capital goods. This was supplemented by physical observation of facility.

**Table I.** Profile of hospitals studied

Characteristic	Panchkula	Jhajjar	Rohtak	Sangrur	Ropar
Population covered (n)	558,890	958,405	1,061,204	1,655,169	628,846
Number of beds					
Reported	150	100	100	130	100
Observed	167	100	159	100	85
Human resources	179	124	118	124	112
Doctors-Nurses ratio	1.0	0.9	0.9	1.1	0.8
Doctors-beds ratio	0.3	0.4	0.3	0.2	0.3
Annual outpatient attendance (n)	526,508	274,718	278,692	192,257	169,314
Hospitalizations (n)	31,799	14,357	12,650	19,169	12,391
Total Bed-days	63,598	38,764	34,155	42,172	27,260
Bed-occupancy rate (%)	104	106	59	116	88

The staff members at the district hospital were interviewed using a semi-structured interview schedule on time allocation for different services. At least one specialist in each speciality of the district hospital was interviewed. If there were more than one specialist, then one of them was randomly selected for assessment. In case of paramedical staff, 30 per cent of the total staff at each functional cost centre, *i.e.* having similar activities, were randomly selected and interviewed. A tool was developed to capture details of all such activities undertaken at different frequencies such as once or twice a year, once a quarter, monthly or weekly, besides daily activities, and time spent each time when the activity was carried out. Output of each activity session was retrieved from the routine records and reports and validated by observation during the period of data collection. Fixed-time equivalents of each staff were estimated. Data on services provided and other demographic details of the population covered were collected from routine monthly reports and respective service registers.

**Data analysis:** Shared resources were apportioned to outpatient and inpatient care, and to various contributing departments. The joint or shared costs for drugs, consumables, diagnostics and overheads were apportioned at two levels *i.e.* various departments and between outpatient and inpatient care. For the former, the proportion of patients reported was used for various specialities to allocate the joint costs. In case of allocation between outpatient and inpatient care, the average proportional time allocation of the human resources in the given department was used. In the specific case of electricity and sanitation costs, proportional floor area used for particular services to apportion joint costs was considered. Equivalent annualized cost was computed for each capital item which was based on the life of equipment and a discount rate of 3 per cent. Replacement cost was used instead of original cost. In terms of cost of space, rental price and floor area of space were used to assess the opportunity cost.

**Unit costs:** Unit costs for outpatient care (per patient OPD visit) and inpatient care (per bed-day hospitalization) were estimated for each speciality. Since the capacity utilization varied across the sites, we standardized the costs using bed occupancy as the indicator for capacity utilization<sup>10</sup>. The costs were considered under heads of human resource, drugs and consumables, laboratory and utilities while adjusting for capacity utilization.

Costs not sensitive to capacity utilization *i.e.* capital costs, medical equipment and other non-medical items (such as furniture and air-conditioners) were not adjusted. Finally, the population of the district was used as the denominator to estimate the per-capita cost of provision of secondary health care services through public sector district hospitals. All costs were converted to 2012 prices and monthly average for conversion of Indian Rupees (₹) to US Dollar (USD) was used to report the costs in USD (1 USD=₹ 54.4).

**Sensitivity analysis:** A univariate sensitivity analysis was done wherein the base value of salaries, price of equipment, building cost, rental prices and assumptions on time allocation varied by 25 per cent on either side. Prices of drugs and consumables showed wide variation; hence, we varied these by 100 per cent on either side. Second, a probabilistic sensitivity analysis was done to assess the effect of joint uncertainty on unit costs and to compute 95 per cent confidence interval (CI) of unit cost estimates. Using Monte-Carlo method, the unit cost was simulated over 1000 times. A uniform distribution was assumed to randomly select one price assumption for each simulation. The distribution of simulated unit costs was used to compute median, 2.5<sup>th</sup> and 97.5<sup>th</sup> percentiles<sup>12</sup>.

The study was approved by the Ethics Committee of the Post Graduate Institute of Medical Education and Research, Chandigarh, India. Administrative approval was taken from the Department of Health of respective State Governments; Civil Surgeons of respective districts and the in-charge medical officer of each district hospital. Written informed consent was taken from participants to interview staff for time allocation.

## Results

A total of five district hospitals were covered in the two States: Panchkula, Jhajjar and Rohtak districts in Haryana and Sangrur and Ropar districts in Punjab. While the annual outpatient attendance ranged from 169,314 in Ropar to 526,508 in Panchkula, the number of inpatient hospitalizations varied from 12,391 in Ropar to 31,799 in Panchkula (Table I). The bed-occupancy rate reported ranged between 59 per cent in Rohtak and 116 per cent in Sangrur.

**Annual costs:** The median annual cost for providing the gamut of secondary health care services in the study hospitals was ₹ 114.4 million (2.5<sup>th</sup> - 97.5<sup>th</sup> percentile; 94-138). While the total capital cost was ₹ 17.1 million (7.3-29.9), recurrent cost was ₹ 97.4 million (86.6-107.7)



(Table II). Human resources accounted for 53 per cent of the overall costs, while drugs, consumables and building, and grants accounted for 14 and 10 per cent, respectively. The sensitivity analysis showed that annual cost was most sensitive to variation in prices of drugs and consumables (Figure).

**Unit costs:** The cost of providing services at district hospital was ₹ 844 (665-1074) per bed-day hospitalization, ₹ 3481 (1169-5681) per surgery and ₹ 170 (128-222) per outpatient visit (Table III). The standardized unit costs were ₹ 834 per bed-day, ₹ 3439 per case operated and ₹ 168 per outpatient visit at 100 per cent capacity utilization (Table III). The variation in costs between hospitals is shown in Table IV. There was also a significant variation among the various specialties for unit cost of outpatient and inpatient services. In case of inpatient admission, the cost ranged from ₹ 210 per bed-day in emergency ward and ₹ 4407 per bed-day in otorhinolaryngology. In case of an outpatient consultation, the unit cost ranged from ₹ 122 in dermatology to ₹ 220 in medicine (Table V).

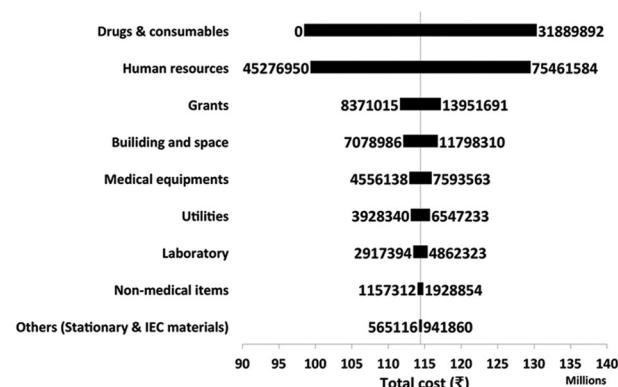
**Per-capita costs:** At the population level, per-capita cost of providing secondary care health care services in India through public sector district hospitals in north India was ₹ 139 (2.5<sup>th</sup> - 97.5<sup>th</sup> percentile 89-208) (Table III).

## Discussion

District hospitals in public sector form the core facility for provision of secondary health services in

India. While detailed analysis of cost of provision of primary health care services through community health workers is available<sup>13,14</sup>, the evidence base for cost of provision of secondary-level health care through district hospitals is weak.

Our estimates of unit costs for inpatient bed-day, operating cost and outpatient visit were comparable to that reported earlier<sup>8</sup>. Adjusting for inflation over the intervening years at the rate of 8.23 per cent from the year of reporting, the cost of outpatient consultation was reported to be USD 2.45 by Chatterjee *et al*<sup>8</sup> and USD 3.6 by WHO-CHOICE study for South East Asia Region<sup>4</sup>. In the WHO-CHOICE, inpatient unit costs are estimated per hospital bed-day and represent only the 'hotel' component of hospital costs *i.e.* excluding the cost of drugs and diagnostic tests but including costs



**Figure.** Sensitivity of estimated annual cost to variation in prices of resources.

**Table II.** Annual cost of delivering secondary health care services at public sector district hospitals in north India

Cost head	Median ₹ (USD)	2.5 <sup>th</sup> Percentile ₹ (USD)	97.5 <sup>th</sup> Percentile ₹ (USD)
Capital cost			
Building and space	9,438,648 (173,504)	5,429,880 (99,813)	12,803,328 (235,355)
Medical equipment	6,074,850 (111,670)	967,560 (17,786)	14,555,074 (267,556)
Non- medical items	1,543,083 (28,365)	927,070 (17,041)	2,493,818 (45,842)
Recurrent cost			
Human resources	60,369,267 (1,109,729)	48,109,583 (884,367)	74,205,902 (1,364,079)
Drugs & consumables	15,944,946 (293,105)	9,227,883 (169,630)	22,740,950 (418,032)
Laboratory	3,889,858 (71,504)	2,738,694 (50,343)	5,173,576 (95,102)
Utilities	5,237,786 (96,282)	1,856,130 (34,120)	8,980,836 (165,088)
Grants	11,161,353 (205,171)	5,038,955 (92,627)	18,834,225 (346,217)
Others (stationary & IEC materials)	753,488 (13,850)	195,694 (3,597)	1,555,328 (28,590)
Total	114,413,282 (2,103,185)	93,896,311 (1,726,035)	137,573,770 (2,528,929)

1 USD=₹ 54.4 (2012). IEC, information education and communication

**Table III.** Unit cost of provision of health care services delivered at public sector district hospitals in India

Unit cost	Unadjusted ₹ (USD)			Adjusted at 80% capacity utilization ₹ (USD)			Adjusted at 100% capacity utilization ₹ (USD)		
	Median	2.5 <sup>th</sup> percentile	97.5 <sup>th</sup> percentile	Median	2.5 <sup>th</sup> percentile	97.5 <sup>th</sup> percentile	Median	2.5 <sup>th</sup> percentile	97.5 <sup>th</sup> percentile
Per bed-day	844 (15.5)	665 (12.2)	1074 (19.7)	879 (16.2)	692 (12.7)	1118 (20.6)	834 (15.3)	657 (12.1)	1061 (19.5)
Per case operated	3481 (64)	1169 (21.4)	5681 (104.4)	3624 (66.6)	1217 (22.4)	5914 (108.7)	3439 (63.2)	1155 (21.2)	5612 (103.2)
Per outpatient visit	170 (3.1)	128 (2.3)	222 (4)	177 (3.3)	133 (2.4)	231 (4.2)	168 (3.1)	126 (2.3)	219 (4.0)
Per capita	139 (2.5)	89 (1.6)	208 (3.8)	145 (2.7)	93 (1.7)	217 (4.0)	137 (2.5)	88 (1.6)	205 (3.8)

1 USD = ₹ 54.4 (2012)

**Table IV.** Hospital-wise unit cost of provision of healthcare services in India

District hospitals	Unstandardized unit cost ₹ (USD)			Standardized unit cost (80% capacity utilization) ₹ (USD)			Standardized unit cost (100% capacity utilization) ₹ (USD)		
	Per bed-day	Per surgery	Per outpatient consultation	Per bed-day	Per surgery	Per outpatient consultation	Per bed-day	Per surgery	Per outpatient consultation
Panchkula	524 (9.6)	7237 (133)	117 (2.1)	546 (10.0)	7544 (138.7)	122 (2.2)	527 (9.7)	7278 (133.8)	118 (2.2)
Jhajjar	863 (15.8)	3167 (58.2)	134 (2.4)	899 (16.5)	3299 (60.6)	140 (2.6)	870 (16.0)	3191 (58.7)	135 (2.5)
Rohtak	1216 (22.3)	5666 (104.1)	141 (2.5)	1171 (21.5)	5454 (100.3)	136 (2.5)	1145 (21.0)	5335 (98.1)	133 (2.4)
Sangrur	730 (13.4)	310 (5.6)	262 (4.8)	885 (16.3)	376 (6.9)	318 (5.8)	785 (14.4)	333 (6.1)	282 (5.2)
Ropar	891 (16.3)	1029 (18.9)	196 (3.6)	917 (16.9)	1060 (19.5)	202 (3.7)	859 (15.8)	992 (18.2)	189 (3.5)

**Table V.** Specialty-wise unit cost for outpatient consultation and inpatient bed-day in public sector district hospitals of north India

Unit cost	Median ₹ (USD)	2.5 <sup>th</sup> percentile ₹ (USD)	97.5 <sup>th</sup> percentile ₹ (USD)
Inpatient (per bed-day by ward)			
Obstetrics & Gynaecology	997 (18.3)	592 (10.8)	1412 (25.9)
Medical	1937 (35.6)	1212 (22.2)	2659 (48.8)
Surgery	1082 (19.9)	657 (12)	1508 (27.7)
Paediatrics	1028 (18.9)	444 (8.1)	1703 (31.3)
Otorhinolaryngology	4407 (81)	1333 (24.5)	7960 (146.3)
Neonatal Intensive Care	1438 (26.4)	960 (17.6)	1958 (36)
Emergency	210 (3.8)	87 (1.6)	334 (6.1)
Outpatient (per outpatient consultation)			
Paediatrics	137 (2.5)	102 (1.8)	182 (3.3)
Medicine	220 (4)	119 (2.1)	313 (5.7)
Ophthalmology	147 (2.7)	98 (1.8)	210 (3.8)
Otorhinolaryngology	189 (3.4)	105 (1.9)	284 (5.2)
Dermatology	122 (2.2)	80 (1.4)	164 (3)
Orthopaedics	140 (2.5)	72 (1.3)	202 (3.7)
Surgery	161 (2.9)	95 (1.7)	244 (4.4)
Dental	146 (2.6)	86 (1.5)	231 (4.2)
Obstetrics & Gynaecology	165 (3)	68 (1.2)	274 (5)
Psychiatry	166 (3)	29 (0.5)	303 (5.5)
1 USD=₹ 54.4 (2012)			

such as personnel, capital and food costs. Similarly, outpatient unit costs represent the estimated cost per outpatient visit and include all cost components, except drugs and diagnostics. Human resources, and drugs and consumables accounted for 53 and 14 per cent, respectively, of the overall costs in our study, similar to 52.6 and 21.8 per cent observed in PHC, and 58.9 and 11.3 per cent respectively in CHC, in our earlier study<sup>15</sup>. Mahapatra and Berman<sup>16</sup> found the cost of inpatient care as USD 17.4 per bed-day. However, this study was undertaken in 1989-1990 and many changes in health care delivery infrastructure, prices, patient profile and treatment-seeking behaviour have taken place since then. In terms of cost of specialties, our estimates for newborn intensive care (₹ 1438 per bed-day) were similar to ₹ 889 reported in 2010 in our previous study which included four Special Newborn Care Units in district hospitals covering three Indian States<sup>6</sup>. This could be due to the different setting in which the study was undertaken.

Significant variation in cost among various specialties was observed in our study. Fixed allocation of number of beds to various specialties despite a

low bed occupancy rate could explain the high costs of otorhinolaryngology. In the outpatient medicine department, in addition to higher resource allocation, it served as first point of contact for all patients prior to being referred to any speciality which could explain higher unit cost. The unit costs in dermatology outpatient department were particularly low. This could be attributed to higher patient loads. Many studies have shown beneficial effects of interventions on increasing the public sector utilization of maternal health care services<sup>17-19</sup>.

The required cost of universal health care (UHC) delivery through the existing mix of public and private health institutions has been reported to be ₹ 1713 (USD 38, 95% CI USD 18-73) per person per annum in India<sup>20</sup>. In this context, the present study's per-capita cost of ₹ 139 for the provision of curative care in district hospitals showed that investment in public facilities for provision of curative care should be increased if India envisages achieving UHC<sup>20,21</sup>. In per capita terms, the public expenditure on health in the country has nearly doubled in the period from ₹ 263 in 2004-2005 to ₹ 486 in 2010-2011 in constant terms

(2004-2005 prices) and ₹ 960 per-capita in real terms (no adjustment)<sup>22</sup>. However, this increase has mostly occurred for reproductive and child health services under the National Health Mission (NHM). Hence, there is a need for a broader focus of investment in health care which involves a comprehensive primary care which is well integrated with secondary care.

Our study findings point to an imperative need to improve hospital efficiency. Two factors appear important in explaining inefficiencies. First, majority of the supply-side health system spending occurs on account of paying salaries. Moreover, little is left to meet other recurrent resource needs which are required for service delivery, for example, drugs and diagnostics<sup>23</sup>. As a result, there is a need to reorient health system spending by ensuring a minimum threshold spending on drugs. Evidence from Tamil Nadu and Bihar suggested that improving access to medicines in public sector facilities improved the patient attendance in public sector facilities significantly<sup>24</sup>. On the contrary, findings from a recent study show that the only about half of the essential medicines are available in public sector hospitals in Punjab and Haryana<sup>25</sup>.

The capital cost accounted for just about one-sixth of the total cost of care<sup>8,26,27</sup>. However, there is a significant variation in capital cost among different hospitals, ranging from ₹ 3.4 to 29.3 million, which is associated with scale of operation. This implies that increases in service utilization will have to be matched with commensurate increase in capital infrastructure.

Findings of our study could be used to revise the existing estimates and pay providers under these schemes, and estimates on cost could be used to undertake further analysis. These could help in doing cost-effectiveness analysis of various health services<sup>28</sup>.

Our study had certain limitations. First, there are wide variations in health care delivery infrastructure in various parts of India. Hence, it is recommended to undertake a study with a bigger and more representative sample from multiple States of India to generalize the findings. Second, we did not undertake a time-motion study to assess time contribution of staff performing multiple tasks. However, omission of a detailed time-motion study and application of methods used in our study have been justified in other studies<sup>6,13,14</sup>. Third, it was important to highlight that for a number of services, resources were available at pooled hospital level only. We used standard apportioning techniques which are recommended elsewhere<sup>10</sup>. Hospital management

information systems should provide disaggregated data to help determine specific speciality costs in a more robust manner in future studies. Fourth, our estimates of cost are reflective of the current level of infrastructure and services delivered. However, these may not be completely representative of costs in an ideal scenario as envisaged by the Indian Public Health Standards<sup>2</sup>. For example, the overall number of human resources and the mix of staff were not exactly as per recommendations. Similarly, these hospitals may not have had the desired set of all medicines available throughout the year. In a study done during the similar period, it was reported that 47.8 per cent of the basket of medicines were available in public sector district hospitals in Punjab<sup>25</sup>. In another study from Punjab State, a shortage of medicines was pointed out which led to high out-of-pocket (OOP) expenditures for patients<sup>29</sup>. Our estimates on cost of care have not accounted for the OOP expenditures which people incur in public sector hospitals. However, there is abundant evidence available on the extent of OOP in public sector hospitals of north India<sup>29-32</sup>.

In conclusion, our study provided detailed estimates of cost of provision of secondary-level health care services delivered through public sector district hospitals in north India. These estimates can be used for evidence-based scale-up of curative secondary care services and refining provider payment rates under health insurance schemes. Our study estimates on cost can be used for further economic research such as undertaking cost-effectiveness analysis of secondary health care services, disease-specific health accounts and benefit-incidence analysis to evaluate the distributional benefits of public subsidy.

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**Conflicts of Interest:** None.

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