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ORIGINAL RESEARCH ARTICLE

Translating Research to Policy: Setting Provider Payment Rates for Strategic Purchasing under India's National Publicly Financed Health Insurance Scheme

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Abstract

Background In 2018, the Government of India launched *Ayushman Bharat Pradhan Mantri-Jan Aarogya Yojana* (AB PM-JAY), a large tax-funded health insurance scheme. In this paper, we present findings of the Costing of Health Services in India (CHSI) study, describe the process of use of cost evidence for price-setting under AB PM-JAY, and estimate its fiscal impact.
Methods Reference costs were generated from the first phase of CHSI study, which sampled 11 tertiary public hospitals from 11 Indian states. Cost for Health Benefit Packages (HBPs) was estimated using mixed (top-down and bottom-up) micro-costing methods. The process adopted for price-setting under AB PM-JAY was observed. The cost of each HBP was compared with AB PM-JAY prices before and after the revision, and the budgetary impact of this revision in prices was estimated.
Findings Following the CHSI study evidence and price consultations, 61% of AB PM-JAY HBP prices were increased while 18% saw a decline in the prices. In absolute terms, the mean increase in HBP price was ₹14,000 (₹450–₹1,65,000) and a mean decline of ₹6,356 (₹200–₹74,500) was observed. Nearly 42% of the total HBPs, in 2018, had a price that was less than 50% of the true cost, which declined to 20% in 2019. The evidence-informed revision of HBP prices is estimated to have a minimal fiscal impact (0.7%) on the AB PM-JAY claims pay-out.
Interpretation Evidence-informed price-setting helped to reduce wide disparities in cost and price, as well as aligning incentives towards broader health system goals. Such strategic purchasing and price-setting requires the creation of systems of generating evidence on the cost of health services. Further research is recommended to develop a cost-function to study changes in cost with variations in time, region, prices, skill-mix and other factors.

1 Introduction

In 2018, the Government of India launched *Ayushman Bharat Pradhan Mantri-Jan Aarogya Yojana* (AB PM-JAY)—a tax-funded national health insurance scheme, to cover 100 million families with an annual household coverage of INR 500,000 (≈US$ 7000) for provision of hospitalisation services provided through a network of public and private hospitals [1]. This provides the government with an opportunity to become a strategic purchaser. Through the function of strategic purchasing, the government can set provider payment rates that provide incentives for broader health system goals and control cost [2, 3].

Controlling costs, while ensuring quality services, depends on the reimbursement rates and the payment mechanism agreed upon such as fee-for-service, capitation or diagnosis-related group (DRG) methods [4]. In determining provider payment rates, three basic principles should be followed. First, case-based payments need to reflect the costs of delivery; second, healthcare providers are reimbursed fairly; and finally, the pricing structure incentivises achievement of health system goals [5].

Cost evidence is a critical component of strategic purchasing to determine the price-setting. Costing, therefore, needs to consider the full set of resources used to provide a

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Key Points for Decision Makers

In low- and middle-income countries (LMICs), implementation and expansion of health insurance is a key policy decision to provide financial risk protection and achieve universal health coverage.

Setting provider payments is a critical component for successful implementation of a health insurance scheme.

Besides a few state-level initiatives, this study is the first national level evaluation of healthcare costs to serve as evidence for consultation of prices of health-benefit packages (HBPs) in the context of a large tax-funded national health insurance in India.

Disclosure of a price-setting process in the public domain will increase transparency and public scrutiny. It will guide other LMICs about the use of health-system costing as an effective tool for price-setting.

unit of service. While costing might provide an estimate of full economic costs, pricing decisions are based on a combination of factors such as marginal cost, capacity utilisation, economies of scale and scope, cost of market entry or marginal benefit of quality [3]. The final prices agreed as a result of negotiations between two parties depend on two factors: the market share a purchaser or provider controls, and whether the negotiation is done centrally or in a decentralized way.

In a fragmented private system like the USA, the reimbursement rates vary dramatically, reflecting the market power of the two parties [6]. Under a system where a central purchaser operates, such as in the UK, France, Australia and Thailand, it is possible to have schedules of reimbursement rates uniform across sets of providers and based on the cost of provision. This uniform price-setting by the central regulator has the greatest potential to contain growth in costs [3].

In India, the provider payment rates for the AB PM-JAY health benefit packages (HBPs) were first determined, in 2018, through a consultative process with experts and a review of existing national and state-level health insurance schemes [7]. This was so because there was hardly any evidence on the cost of providing health services. Subsequently, however, numerous limitations of this process have been highlighted [8]. As a result, the 'Costing of Healthcare Services in India' (CHSI) study was commissioned. The objective of the study was to estimate the unit cost of individual healthcare services and the consequent HBPs covered under the AB PM-JAY scheme, which could be used for price-setting. The results from the tertiary public hospitals of phase I of the CHSI study were used in revising the HBP prices in 2019. The AB PM-JAY comprises 1573 packages/procedures [7]. In order to prioritize for CHSI phase I, we chose eight specialities encompassing 844 HBPs. These eight specialities were chosen since the HBPs under these specialities accounted for approximately 60% of the total claims in the previous publicly financed national health insurance scheme (Rashtriya Swasthya Bima Yojana; RSBY). In this paper, we present the findings of phase I of the CHSI study covering 11 tertiary public hospitals for the cost according to the nature of services (outpatient, inpatient, intensive care, operation theatre) in eight specialities and compute the overall cost incurred to deliver the HBPs under different scenarios. We also describe the process of incorporating cost information into pricing decisions, provide a comparative assessment of cost and prices for HBPs in 2018 and 2019, and, finally, estimate the fiscal impact of the price revision.

2 Methodology

2.1 Study Overview

The CHSI study aims to estimate the costs of all 1,573 AB PM-JAY HBPs. The details of services that are included for reimbursement to the hospitals are provided in Supplementary Table S1 (Online Supplementary Material, OSM). The sample includes public sector tertiary and district hospitals, as well as private sector hospitals. A multi-stage stratified sampling method was used to select health facilities. Eleven states were selected to represent the heterogeneity based on geography, human development index (HDI), gross state domestic product (GSDP) and health workforce density. Within each state, a public tertiary level teaching hospital was selected [9]. The choice of the tertiary level healthcare facility was guided by the availability of specialities to maximise the number of HBPs that can be costed across the sample. The distribution of specialities among the sampled states is available in Supplementary Table S2 (OSM). The detailed study methodology and sampling strategy for the tertiary, district and private hospitals are presented in detail in the protocol paper and its process evaluation [9, 10]. The process evaluation of the CHSI study aimed to outline the process followed and challenges faced during data collection and identifying critical lessons that can feed into subsequent methodological improvement, as well as improve the quality of data collection in the present and future costing studies in India and LMICs. Figure 1 illustrates the framework of the CHSI study including study coverage in different phases and the findings presented in this paper. In this paper, we present the analysis and findings of data collected for the price-setting of AB PM-JAY in 2019. This includes data from 11 states in 11 public sector tertiary hospitals covering eight specialities and 844 packages/procedures out of 1573 HBPs.

2.2 Data Collection

2.2.1 Study Perspective and Costing Approach

The full economic costs from a health system's/payer's perspective were collected [11]. A mixed top-down and bottom-up micro-costing method was used for data collection. The nature of services within each HBP includes outpatient care, inpatient care, diagnostic services, surgical care and follow-up outpatient care after a patient has been discharged. In each hospital all the speciality-specific HBPs were covered. For a typical HBP, data on resources consumed for each service were based on 'real-world' practices defined at the speciality level. This implies that data on actual resource consumption for different services were collected, which was representative of prevailing practices of care delivery. Hence, the estimated cost of an outpatient visit, inpatient bed-day stay in routine care and intensive care settings for each speciality represent the real-world practices. The unit cost of the procedure in the operation theatre was estimated specifically for each HBP, which was also based on the quantity of resources used as per actual settings and practices. However, data on the volume and nature of different services required under each HBP such as the number of outpatient visits, length of stay in an inpatient department or in intensive care, were collected using the expert opinion. Subsequently, speciality-specific unit costing for an outpatient visit or bed-day hospitalisation was used along with the number of outpatient visits or length of stay was derived by expert opinion to derive the overall cost specific to each condition-specific HBP.

2.2.2 Measurement and Valuation of Resources

An inventory of cost centres was prepared for each facility. For each cost centre, the annual quantity of outputs produced and inputs used for this were identified and their quantity was measured. The data were sourced from the routine physical or electronic records at the cost centre and hospital level. The details of data sources, prices, apportioning of shared costs and assumptions and process of data analysis are reported in the protocol and process evaluation paper [9, 10]. The data collection for the present analysis was undertaken for 8 months from September 2018 to April 2019.

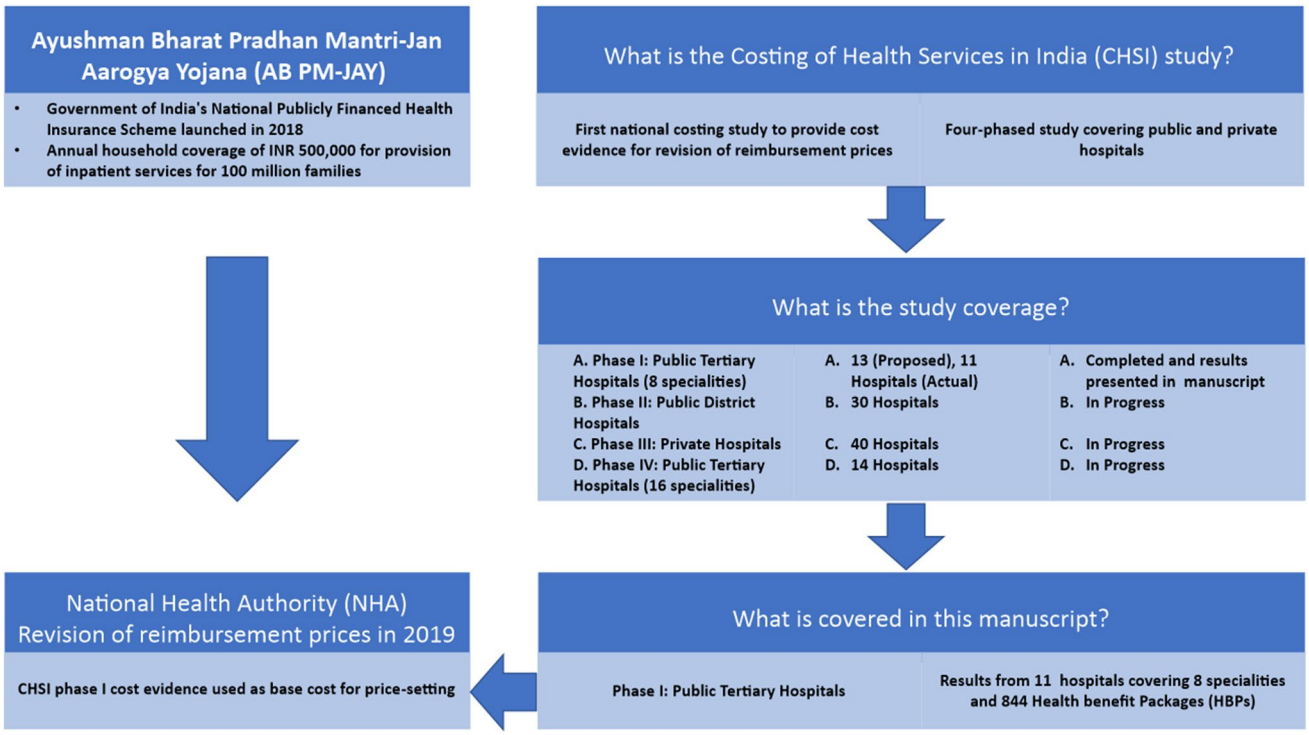

Fig. 1 Framework of costing of health services in India (CHSI) study

2.3 Data Analysis

2.3.1 Estimation of Unit Costs

The total cost of capital and recurrent resources was valued for each cost centre/service. The capital costs were annualized using a discount rate of 3% to estimate the equivalent annualized uniform cost [11]. The annual cost of recurrent resources was calculated by multiplying the unit price by the number of inputs used for a given time period. The unit cost was estimated by the ratio of total annual cost and number of services delivered/output. The detailed description of data analysis is reported in the protocol paper and Supplementary Box B1 (OSM) [9]. The unit costs for services in each of the specialities were generated such as cost per outpatient (OP) visit, inpatient (IP) bed-day and ICU bed-day. If a speciality was costed at more than one site, the mean and median unit cost across the sites was computed. To estimate the cost of an AB PM-JAY HBP, unit cost data for all the individual services within an HBP, i.e., outpatient consultation, inpatient/intensive care, surgery, etc., were multiplied by the number of times an individual service was utilised per HBP. Supplementary Box B1 illustrates the framework used for unit cost estimation of an HBP. An example of HBP for atrial septal defect (ASD) is used to demonstrate the costing of HBP. The unit costs of the HBPs were then compared with the AB PM-JAY prices. The mean and median values were reported along with the range and interquartile range, respectively, for unit cost of services (OP, IP and ICU) and each AB PM-JAY health benefit package (HBP). All costs represent current prices for the financial year 2017–18 and are reported in Indian Rupees (₹) and US dollars (US$). A monthly average was used for conversion of Indian Rupees to US dollar, i.e., US$1 = ₹66.2 [12].

2.4 Quality Assurance

As a first step, the methods of the CHSI study were reviewed and approved by the Technical Appraisal Committee (TAC) set up by the Department of Health Research (DHR), which comprised scientists, clinicians, public health experts, health economists and representatives from the Ministry of Health and Family Welfare. In addition, a National CHSI Review Committee was set up by the TAC to oversee the study progress, i.e., data collection and data analysis.

Secondly, multiple stakeholder consultations were held for wider acceptability of the study methodology as well as obtaining inputs from the private sector, development agencies, insurance companies and third-party administrators (TPAs). The list of participants of these meetings is provided in the Supplementary List L1 (OSM). Finally, the National Health Authority (NHA), implementation agency AB PM-JAY commissioned an independent review by an international expert from Global Health Costing Consortium (GHCC). As part of routine quality assurance, the study investigators from the lead agency (Post Graduate Institute of Medical Education & Research; PGIMER) reviewed the completeness and quality of data collected at the respective hospitals. Fortnightly virtual and quarterly physical meetings were organized to address the gaps in data completeness and quality.

2.5 Price Setting

To inform price consultations, the cost estimates were standardized to adjust for the level of efficiency, for example, capacity utilisation. To account for variations in capacity utilisation, the unit costs of the specialities were adjusted to the levels of 80% and 100% of full capacity. Bed occupancy rate is a standard indicator to adjust for the capacity utilisation of IP care [13], which was used for the adjustment of capacity utilisation for each cost centre (OP, IP, ICU, Operation Theatre (OT)) in our study [14] (Supplementary Box B2, OSM). For standardisation, the observed variable costs were adjusted whereas the fixed cost remained constant. The variable costs included drugs, consumables, diagnostics, utility (kitchen and laundry) and overheads (electricity, water, etc), while the fixed costs included building, equipment, other non-consumables such as furniture and human resources. Secondly, based on consultation with NHA, it was decided to use unit costs at full efficiency (100% capacity utilisation) for determining HBP cost. Further, costs were estimated for different scenarios, which included the full value of the variable cost and different levels of fixed cost (50% and 100%). The base-case HBP cost was assumed to be the value with fixed costs at 50%, as the majority of AB PM-JAY empanelled hospitals are private facilities that are currently operating at approximately 60% of their capacity and in the short term will not require additional fixed costs [15] (Supplementary Box B3, OSM).

2.5.1 Process of Price Setting

The NHA is the independent central agency entrusted with the task of implementing the AB PM-JAY, including determining the HBPs and its price. A single price was determined for each HBP at the national level. Using the CHSI cost as the evidence base, the prices were set following consultations with the associations of private providers. The first step was a review of CHSI cost for AB PM-JAY HBPs by the Standard Treatment Workflow (STW) committees constituted by the Indian Council of Medical Research (ICMR) for each speciality. Each STW meeting consisted of members of STW group (clinical experts), representatives from NHA, Department of Health Research (DHR), and provider associations such as Indian Medical Association

(IMA), Association of Healthcare Providers India (AHPI), and the Federation of Indian Chambers of Commerce and Industry (FICCI). Based on CHSI cost, experts' inputs and prevailing reimbursement prices, a set of HBP prices was recommended. Next, a state-level consultation workshop was organized for building consensus. Subsequently, another review committee met to incorporate the feedback from different stakeholders, following which the prices were presented to the Board of Governors of NHA. Finally, the Board approved the revision in the AB PM-JAY HBP prices (Fig. 2).

2.6 Budget Impact Analysis (BIA)

We undertook a budget impact analysis (BIA) to assess the fiscal impact of change in prices for the 600 HBPs with the highest number of claims, on the overall budget of the AB PM-JAY. The BIA was undertaken from the payer's perspective, i.e., NHA. The time horizon of 1 year was used without discounting future costs. The eligible population was estimated using the bottom-up approach from the claims data of the AB PM-JAY beneficiaries in 2018 [16]. The claims payout post-price revision was predicted based on the 2018 utilisation rates and AB PM-JAY 2019 prices. The details of the BIA methodology are included in Supplementary Box B4 (OSM). The scenario of HBP prices in 2018 was compared with revised HBP prices in 2019 to estimate the total financial outlay.

3 Results

3.1 Unit Costs of Hospital Care

The mean and median unit costs of OP consultation, IP and ICU care hospitalisation in the selected specialities are presented in Table 1. At 100% capacity utilisation, the highest mean cost per OP consultation, per bed-day stay in IP and ICU care was ₹410 (US$6) for obstetrics and gynaecology (OBG), ₹1814 (US$27) for cardiothoracic and vascular surgery (CTVS) and ₹9723 (US$177) for orthopaedics, respectively (Table 1).

3.2 Cost and Price of the AB PM-JAY Health Benefit Packages

The mean and median cost, range (minimum-maximum) and interquartile range for the top five AB PM-JAY HBPs (arranged in descending order in terms of the number of claims) for eight specialities are shown in Table 2. The details for 844 HBPs are provided in Supplementary Table S3 (OSM). Significant variation in cost across sites was observed. The HBP with the highest mean cost was from the cardiology speciality, i.e., atrial septal defect device closure ₹232,307 (US$3,087) followed by coronary artery bypass grafting ₹217,860 (US$3,001) from the speciality of CTVS. The HBPs with the lowest mean cost were from the speciality of otolaryngology, i.e., partial turbinectomy—unilateral ₹5,777 (US$87) followed by aspiration of emphysema ₹5790 (US$87).

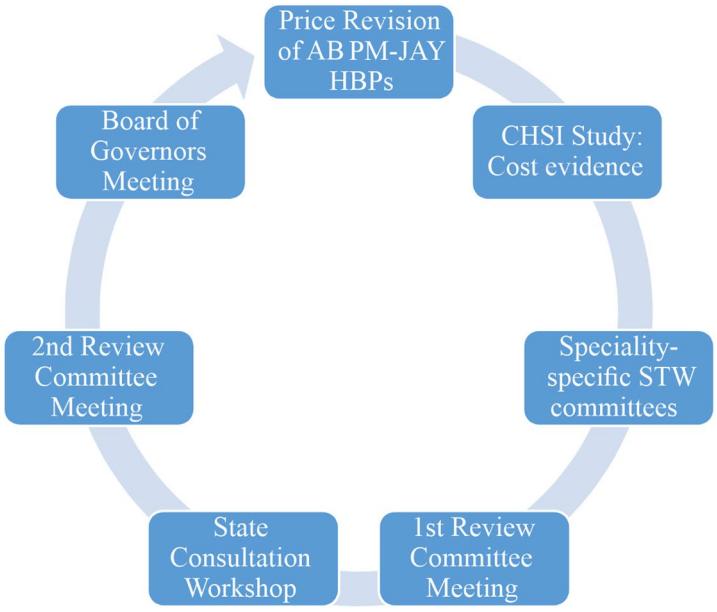

Fig. 2 Process of price setting for AB PM-JAY HBPs. *AB PM-JAY* Ayushman Bharat Pradhan Mantri-Jan Aarogya Yojana, *CHSI* Costing of Health Services in India, *HBP* Health Benefit Packages, *STW* Standard Treatment Workflow

AB PM-JAY: Ayushman Bharat Pradhan Mantri Jan Aarogya Yojana; CHSI: Costing of Health Services in India; HBP: Health Benefit Package; STW: Standard Treatment Workflow

Table 1 Unit cost for outpatient (OP) department visit, inpatient (IP) department and intensive care unit (ICU) hospitalization at tertiary public sector hospitals in India in INR (US$)

Unit cost in INR (US$)															
Speciality	Capacity utilization	Outpatient department (OP)[a]				Per bed day IP hospitalization				Per bed day ICU hospitalization				Average current bed occupancy	
		Mean	Range	Median	Interquartile Range	Mean	Range	Median	Interquartile Range	Mean	Range	Median	Interquartile Range	IPD	ICU
Cardiology	Current	187 (3)	125–294 (2–4)	197 (3)	72 (1)	580 (9)	357–2960 (5–44)	1594 (24)	2211 (33)	2430 (37)	1385–7133 (21–108)	2643 (40)	2830 (43)	201%	183%
	80%	303 (5)	131–803 (2–12)	274 (4)	300 (5)	1389 (21)	1268–2299 (19–35)	1758 (27)	887 (13)	4563 (69)	2777–9912 (42–150)	5615 (85)	6040 (91)		
	100%	251 (4)	107–646 (2–10)	237 (4)	235 (4)	1324 (20)	1048–1961 (16–30)	1519 (23)	856 (13)	3815 (58)	2315–8114 (35–123)	4763 (72)	5065 (77)		
CTVS	Current	498 (8)	234–839 (4–13)	492 (7)	303 (5)	5293 (80)	2577–7669 (39–116)	5553 (84)	2546 (39)	19,080 (288)	10834–43692 (164–660)	12224 (185)	16429 (248)	27%	17%
	80%	259 (4)	128–446 (2–7)	285 (4)	159 (2)	2147 (32)	1593–2338 (24–35)	2179 (33)	372 (6)	6691 (101)	4238–25,189 (64–380)	5534 (84)	10,476 (158)		
	100%	234 (4)	121–349 (2–5)	264 (4)	114 (2)	1814 (27)	1380–1990 (21–30)	1826 (28)	305 (5)	6050 (91)	3957–21,307 (60–322)	5238 (79)	8675 (131)		
ENT	Current	263 (4)	101–324 (2–5)	237 (4)	70 (1)	1663 (25)	721–3720 (11–56)	1865 (28)	1341 (20)	–	–	–	–	69%	
	80%	270 (4)	140–313 (2–5)	185 (3)	128 (2)	1198 (18)	639–3366 (10–51)	1187 (18)	1429 (22)	–	–	–	–		
	100%	254 (4)	113–299 (2–5)	150 (2)	112 (2)	1017 (15)	549–2804 (8–42)	983 (15)	1146 (17)	–	–	–	–		
General Surgery	Current	384 (6)	214–563 (3–9)	360 (5)	148 (2)	821 (12)	566–3545 (8–53)	978 (15)	1617 (24)	7784 (118)	6965–10,718 (105–162)	8842 (134)	1876 (28)	193%	86%
	80%	452 (7)	264–1,514 (4–23)	338 (5)	339 (5)	1289 (20)	598–2755 (9–42)	1841 (28)	1411 (21)	3549 (54)	6186–11,886 (93–180)	9036 (137)	2850 (43)		
	100%	369 (6)	210–1,280 (3–19)	285 (4)	296 (5)	1163 (18)	517–2675 (8–40)	1583 (24)	1156 (18)	4885 (74)	5381–9839 (81–149)	7610 (115)	2229 (34)		

Table 1 (continued)

Unit cost in INR (US$)

Speciality	Capacity utilization	Outpatient department (OP)[a]				Per bed day IP hospitalization				Per bed day ICU hospitalization				Average current bed occupancy	
		Mean	Range	Median	Interquartile Range	Mean	Range	Median	Interquartile Range	Mean	Range	Median	Interquartile Range	IPD	ICU
OBG	Current	392 (6)	119–663 (2–10)	439 (6)	103 (2)	716 (11)	229–3763 (4–57)	799 (12)	465 (7)	2859 (43)	1332–5096 (20–77)	4281 (65)	1717 (26)	160%	97%
	80%	524 (8)	143–1,324 (2–20)	608 (9)	120 (2)	1126 (17)	638–3568 (10–54)	843 (13)	482 (7)	3169 (48)	2130–5555 (32–84)	2732 (41)	1665 (25)		
	100%	410 (6)	127–1,079 (2–16)	456 (7)	166 (3)	1031 (16)	520–3395 (8–51)	747 (11)	450 (7)	2939 (44)	1917–4593 (29–69)	2957 (45)	1774 (27)		
Ophthalmology	Current	394 (6)	244–1,431 (4–22)	380 (6)	330 (5)	1325 (20)	531–17812 (8–269)	872 (13)	2267 (34)	–	–	–	–	77%	
	80%	244 (4)	133–815 (2–12)	306 (5)	217 (3)	1127 (17)	497–5532 (7–84)	1186 (18)	1235 (19)	–	–	–	–		
	100%	215 (3)	111–691 (2–10)	274 (4)	168 (3)	991 (15)	414–5023 (6–76)	974 (15)	1093 (17)	–	–	–	–		
Orthopaedics	Current	275 (4)	118–342 (2–5)	253 (4)	169 (3)	833 (13)	640–9067 (10–137)	834 (13)	731 (11)	7258 (110)	7258–7258 (110–110)	7258 (110)	–	83%	197%
	80%	180 (2.7)	64–478 (1–7)	90 (1)	158 (2)	859 (13)	538–2634 (8–40)	667 (10)	633 (10)	10973 (166)	10973–10973 (166–166)	10,973 (166)	–		
	100%	153 (2)	53–427 (1–7)	74 (1)	126 (2)	725 (11)	457–2243 (7–34)	579 (9)	493 (7)	9723 (147)	9723–9723 (147–147)	9723 (147)	–		
Urology	Current	352 (5)	191–456 (3–7)	323 (5)	159 (2)	1574 (24)	857–3654 (13–55)	1704 (26)	778 (12)	4809 (73)	4809–4809 (73–73)	4809 (73)	–	73%	72%
	80%	298 (5)	124–876 (2–13)	298 (5)	135 (2)	1475 (22)	861–2584 (13–39)	1471 (22)	1045 (16)	4484 (68)	4484–4484 (68–68)	4484 (68)	–		
	100%	251 (4)	110–703 (2–11)	244 (4)	89 (1)	1270 (19)	730–2091 (11–32)	1338 (20)	846 (13)	3894 (59)	3894–3894 (59–59)	3894 (59)	–		

Table 1 (continued)

Unit cost in INR (US$)															
Speciality	Capacity utilization	Outpatient department (OP)[a]				Per bed day IP hospitalization				Per bed day ICU hospitalization				Average current bed occupancy	
		Mean	Range	Median	Interquartile Range	Mean	Range	Median	Interquartile Range	Mean	Range	Median	Interquartile Range	IPD	ICU
Overall	Current	343 (5)	144–666 (2–10)	368 (6)	121 (2)	1601 (24)	460–6611 (7–100)	1079 (16)	802 (12)	7370 (111)	1632–27,958 (25–422)	6034 (91)	4306 (65)		
	80%	316 (5)	80–626 (1–9)	284 (4)	85 (1)	1326 (20)	632–11911 (10–180)	1244 (19)	284 (4)	5572 (84)	2292–15,362 (35–232)	4524 (68)	2376 (36)		
	100%	267 (4)	67–532 (1–8)	251 (4)	54 (1)	1167 (18)	551–2092 (8–32)	1097 (17)	273 (4)	5218 (79)	2030–13,273 (31–200)	4390 (66)	1924 (29)		

OP outpatient department, *IP* inpatient department, *ICU* intensive care unit, *CTVS* cardiothoracic and vascular surgery, *ENT* otolaryngology, *OBG* obstetrics and gynaecology

[a]OP capacity utilisation is adjusted by using IP bed capacity

For ENT and ophthalmology, none of the study hospitals had a dedicated department level ICU

Following the CHSI study evidence and price consultations, 61% of AB PM-JAY HBP prices were increased while 18% saw a decline in the prices. In absolute terms, the mean and median increase was ₹14,000 (US$211) (range ₹450 (US$7)–₹1,65,000 (US$2,492))and ₹6400 (US$97) (interquartile range ₹9688 (US$146)), respectively. The mean and median decline was ₹6356 (US$96) (range ₹200 (US$3)–₹74,500 (US$1,125)) and ₹5,000 (US$76) (interquartile range ₹7050 (US$106)), respectively. More than one-third (42%) of the total HBPs in 2018 had a price that was less than 50% of the cost. This disparity declined to 20% in 2019 (Fig. 3). Similarly, only 13% of HBPs had prices in 2018 that were close (± 10%) to the actual cost, which increased to 17% in the revised AB PM-JAY prices in 2019. The speciality specific difference between the CHSI unit cost and reimbursement prices (2018 and 2019) for AB PM-JAY HBPs is shown in Supplementary Fig. S1 (OSM).

3.3 Budget Impact Analysis

The revision of prices is estimated to increase the NHA budget by ₹203 million (US$3 million), i.e., 0.7% per year, assuming the utilisation of services is as per AB PM-JAY claims in 2018 (Fig. 4). However, the differences vary across specialities and speciality-specific comparison of AB PM-JAY 2018 and 2019 prices as per share of overall claims are shown in Fig. 5. The change in the prices is likely to increase the claims pay-out for CTVS HBPs by 25%, and decrease the same for orthopaedics by 18%.

4 Discussion

In this paper, we report on the findings of a national health system costing study that is being used for price-setting under the AB PM-JAY scheme in India. Overall, we found that the prices that were previously set using expert consultations and literature reviews deviated substantially from the actual cost of production. The proportion of HBPs, which deviated by 50% (less than) from the actual cost, were brought down by half after evidence-based price-setting using CHSI cost information. Price-setting also considered the broader policy objectives of keeping the cost under control as well as increasing empanelment of private providers. The resulting evidence-informed prices are likely to have a minimal fiscal impact of ₹ 203 million (0.7%).

Determination of prices depends upon the method of payment, availability of cost information and purchaser-provider characteristics [17]. In systems where uniform prices are set, cost surveys are carried out regularly. These can involve all participating providers, for example the UK, USA (Medicare) and Australia, or a sample of representative providers, for example France, Germany and Thailand [3]. In many LMICs, routine reporting of the cost of health services is non-existent [18] and literature on the use of cost information for price setting is limited [19, 20]. A manual by Joint Learning Network (JLN) provides guidance for generation of cost evidence and its use for price setting using examples from seven LMICs [13]. In India, data on the cost of healthcare services is limited to a few services, in focal geographical areas, and restricted to the public sector [14, 21–27].

The CHSI study is the first national health system costing study in India. Standard costing methods rigorously reviewed by experts were used for data collection and analysis, increasing the validity of the study results for use in price-setting consultations at the national level. In general, we observed that human resources have the highest share of 41% (9–63%) in the cost of service delivery for HBPs followed by consumables 15% (2–45%) and drugs 10% (1–23%). Specifically, for the HBPs that do not require implants, human resources have the highest share in the cost of 45% (16–63%) followed by the consumables and drugs, i.e., 15% (5–45%) and 10% (3–23%), respectively. However, for the HBPs that require implants, the highest share of 31% (1–78%) is for implants followed by human resources and consumables, i.e., 27% (9–56%) and 15% (2–41%), respectively.

The study has a few limitations. Firstly, due to the nature of data recording and reporting at the facility level, resource data were often available as aggregated information at the cost centre, which had to be apportioned to respective services. Secondly, due to the absence of electronic health records (EHRs), disease-specific data on resource utilisation were not available. As a result, standard methods for allocation of cost to disease-specific services or pooled unit costs were used. Thirdly, bed occupancy rate of IP care was used to standardize the OP services due to lack of a standard indicator. There is a need for further research on this important dimension to determine a refined indicator for standardisation the OP services as per capacity utilisation. Fourthly, factors such as prices, wages or salaries, level of hospital (secondary or tertiary), type of health facility (public or private) and level of capacity utilisation can influence the cost of service delivery. There is a need for further research to design a cost function to explain heterogeneity. Fifthly, the provider payment rates under the CGHS—a national social health insurance scheme—were used as a proxy for the cost of diagnostic tests. However, in order to address this limitation, primary data on cost of diagnostic tests are being collected in the ongoing phase of the data collection. Lastly, the cost of HBPs were assessed based on the existing treatment practices, supplemented with expert opinion. This may imply that the cost of treatment may not represent provision of care as per standard treatment guidelines if there is a difference between them. This is another important potential area of future research that can highlight

Table 2 CHSI unit cost for AB PM–JAY Health Benefit Packages (HBPs) in INR (US$)

Speciality	AB PM–JAY HBPs		100% fixed and 100% variable cost in INR (US$)				50% fixed and 100% variable cost in INR (US$)			
	Pre CHSI 2018	Post CHSI 2019	Mean	Range	Median	Interquartile range	Mean	Range	Median	Interquartile range
Cardiology	PTCA – single stent (medicated, inclusive of diagnostic angiogram)	PTCA, inclusive of diagnostic angiogram	79,139 (1,195)	42,912–153,254 (648–2,315)	60,195 (909)	38,349 (579)	54,265 (820)	33,122–88,647 (500–1339)	47,646 (720)	20,162 (305)
	Medical treatment of acute MI with thrombolysis / stuck valve thrombolysis	Systemic thrombolysis (for MI)	24,400 (369)	12,500–35,924 (189–543)	24,587 (371)	15,521 (234)	15,297 (231)	7678–21,516 (116–325)	15,997 (242)	11,411 (172)
	PTCA – double stent (medicated, inclusive of diagnostic angiogram)	PTCA, inclusive of diagnostic angiogram	108,310 (1636)	67,416–197,831 (1018–2988)	83,996 (1269)	41,655 (629)	79,580 (1202)	55,463–121,034 (838–1828)	70,912 (1071)	19,902 (301)
	ASD device closure	ASD device closure	232,307 (3509)	90,047–620,426 (1360–9372)	109,377 (,652)	136,860 (2067)	151,589 (2290)	82,786–343,412 (1251–5187)	90,079 (1361)	71,382 (1,078)
	Balloon mitral valvotomy	Balloon mitral valvotomy	130,684 (1974)	68,152–266,344 (1029–4023)	94,121 (1422)	64,501 (974)	97,347 (1470)	62,816–162,871 (949–2460)	81,851 (1236)	33,239 (502)
Cardiothoracic & vascular surgery	Coronary artery bypass grafting (CABG)	Coronary artery bypass grafting (CABG), including intra operative balloon pump (if required)	217,860 (3291)	151,435–253,880 (2288–3835)	248,263 (3750)	51,222 (774)	194,630 (2940)	143,614–224,021 (2169–3384)	216,255 (3267)	40,203 (607)
	Mitral valve replacement (mechanical valve)	Single valve procedure	130,922 (1,978)	82,323–179,994 (1244–2719)	130,448 (1971)	48,836 (738)	112,740 (1703)	74,508–144,673 (1125–2185)	119,040 (1798)	35,083 (530)
	Coronary artery bypass grafting (CABG) with intra-aortic balloon pump (IABP)	Coronary artery bypass grafting (CABG), including intra operative balloon pump (if required)	211,252 (3,191)	153,722–256,470 (2322–3874)	223,563 (3377)	51,374 (776)	187,258 (2829)	144,900–217,552 (2189–3286)	199,321 (3011)	36,326 (549)

Table 2 (continued)

Speciality	AB PM–JAY HBPs		100% fixed and 100% variable cost in INR (US$)				50% fixed and 100% variable cost in INR (US$)			
	Pre CHSI 2018	Post CHSI 2019	Mean	Range	Median	Interquartile range	Mean	Range	Median	Interquartile range
	Atrial septal defect (ASD)	Surgical Correction of Category – I Congenital Heart Disease Isolated Secundum Atrial Septal Defect (ASD) Repair	70,444 (1,064)	32,173–100,671 (486–1,521)	78,488 (1,186)	34,249 (517)	56,352 (851)	24,862–76,526 (376–1,156)	67,669 (1,022)	25,832 (390)
	Ventricular septal defect (VSD)	Coronary artery bypass grafting (CABG), including intra operative balloon pump (if required)	116,790 (1,764)	69,894–162,678 (1,056–2,457)	117,799 (1,779)	46,392 (701)	99,033 (1,496)	62,079–129,495 (938–1,956)	105,525 (1,594)	33,708 (509)
Obstetrics & Gynaecology	Caesarean delivery	Caesarean delivery	24,567 (371)	12,040–35,306 (182–533)	24,075 (364)	13,781 (208)	17,099 (258)	7801–22,479 (118–340)	18,819 (284)	4428 (67)
	Conventional tubectomy	Excluded in revision	22,401 (338)	12,262–34,098 (185–515)	23,511 (355)	9857 (149)	15,828 (239)	7210–22,479 (109–340)	17,190 (260)	7159 (108)
	High-risk delivery	High-risk delivery	28,636 (433)	16,518–38,103 (250–576)	30,417 (459)	5598 (85)	22,778 (344)	12,760–35,241 (193–532)	21,136 (319)	6463 (98)
	Hysterectomy ± salpingo–oophorectomy	Abdominal hysterectomy + salpingo–oophorectomy	23,573 (356)	10,090–37,278 (152–563)	25,021 (378)	18,224 (275)	16,933 (256)	6341–33,668 (96–509)	15,950 (241)	12,159 (184)
	Laparoscopic hysterectomy (TLH)	Laparoscopic hysterectomy (TLH)	19,883 (300)	11,047–26,750 (167–404)	22,452 (339)	9815 (148)	13,901 (210)	5348–22,479 (81–340)	13,498 (204)	12,593 (190)

Table 2 (continued)

Speciality	AB PM–JAY HBPs		100% fixed and 100% variable cost in INR (US$)				50% fixed and 100% variable cost in INR (US$)			
	Pre CHSI 2018	Post CHSI 2019	Mean	Range	Median	Interquartile range	Mean	Range	Median	Interquartile range
Ophthalmology	Cataract with foldable hydrophobic acrylic IOL by phaco emulsification	Phaco emulsification with foldable hydrophobic acrylic IOL	16,300 (246)	11,199–23,064 (169–348)	16,182 (244)	5970 (90)	11,631 (176)	7750–17,034 (117–257)	11,346 (171)	2790 (42)
	Cataract with non–foldable IOL using SICS technique	SICS with non–foldable IOL	14,162(214)	9,380–20,796 (142–314)	13,516 (204)	6700 (101)	9541 (144)	5888–14,900 (89–225)	8929 (135)	1564 (24)
	Pterygium + conjunctival autograft	Pterygium + conjunctival autograft	14,786 (223)	9,101–20,395 (137–308)	14,664 (222)	8590(130)	9307 (141)	5,748–13,900 (87–210)	9222 (139)	4396 (66)
	Conjunctival tumour excision + AMG	Conjunctival tumour excision including amniotic membrane graft	19,435 (294)	8,386–28,916 (127–437)	18,365 (277)	9963(150)	11,895 (180)	4892–17,356 (74–262)	11,868 (179)	4948 (75)
	Vitrectomy + retinal detachment surgery	Vitreoretinal surgery (with silicon oil insertion)	47,629 (719)	25,097–94,496 (379–1427)	36,559 (552)	27,359(413)	31,327 (473)	16,247–56,859 (245–859)	26,652 (403)	19,692 (297)
General Surgery	Laparoscopic cholecystectomy	Cholecystectomy–Lap	34,085 (515)	12,232–91,931 (185–1389)	27,056 (409)	18,272(276)	21,329 (322)	7788–50,747 (118–767)	19,695 (298)	8152 (123)
	Hernioplasty – inguinal	Groin hernia repair	23,354 (353)	15,365–48,750 (232–736)	18,020 (272)	7329(111)	16,976 (256)	10,695–30,111 (162–455)	13,081 (198)	7755 (117)
	Laparoscopic appendicectomy	Laparoscopic appendicectomy	22,602 (341)	11,060–33,577 (167–507)	20,608 (311)	11,860(179)	15,490 (234)	8551–20,834 (129–315)	16,459 (249)	8277 (125)
	Fissurectomy and haemorrhoidectomy	Excluded in revision	20,953 (317)	8,068–49,768 (122–752)	18,103 (273)	8866 (134)	14,203 (215)	6600–27,225 (100–411)	12,263 (185)	11,014 (166)
	Appendicectomy	Appendicectomy	27,994 (423)	11,060–62,808 (167–949)	19,855 (300)	23,695 (358)	19,701 (298)	7682–34,016 (116–514)	17,393 (263)	19,977 (302)

Table 2 (continued)

Speciality	AB PM–JAY HBPs		100% fixed and 100% variable cost in INR (US$)				50% fixed and 100% variable cost in INR (US$)			
	Pre CHSI 2018	Post CHSI 2019	Mean	Range	Median	Interquartile range	Mean	Range	Median	Interquartile range
Orthopaedics	Fracture – hip internal fixation (intertrochanteric fracture with implant) + rehabilitation	Intertrochanteric fracture with dynamic hip screw	32,845 (496)	11,365–85842 (172–1297)	25,607 (387)	19,643 (297)	23,415 (354)	9840–51,073 (149–771)	20,256 (306)	14,965 (226)
	Open reduction internal fixation (large bone)	Fracture – long bones – metaphyseal – ORIF	34,404 (520)	13,004–85857 (196–1297)	26,899 (406)	21,496 (325)	24,784 (374)	11,222–51,291 (170–775)	23,328 (352)	14,582 (220)
	Internal Fixation Lateral Epicondyle	Fracture Condyle – Humerus – ORIF	21,373 (323)	6,314–50456 (95–762)	18,205 (275)	18,546 (280)	15,160 (229)	5173–30,921 (78–467)	14,175 (214)	13,657 (206)
	Application of P.O.P. casts for upper & lower limbs	Application of P.O.P. casts	30,457 (460)	4205–12,157 (64–1815)	15,250 (230)	11,546 (174)	19,375 (293)	3166–65,528 (48–990)	12,109 (183)	11,490 (174)
	Total knee replacement	Total knee replacement	84,497 (1276)	61,764–13,857 (933–2037)	78,891 (1,192)	22,763 (344)	73,672 (1,113)	59,792–100,291 (903–1,515)	70,433 (1,064)	16,233 (245)
Urology	TURP–Transurethral Resection of the Prostate, BPH, Monopolar/Bipolar/Laser	TURP–Transurethral Resection of the Prostate, BPH	31,483 (476)	14,685–86,730 (222–1310)	18,115 (274)	3461 (52)	18,506 (280)	10,082–44,930 (152–679)	13,184 (199)	3640 (55)
	PCNL (Percutaneous Nephrolithotomy) – Unilateral	PCNL (Percutaneous Nephrolithotomy) – Unilateral	20,605 (311)	12,518–40,287 (189–609)	15,365 (232)	7922 (120)	13,126 (198)	8,257–21,463 (125–324)	11,160 (169)	3323 (50)
	Ureterocalycostomy Open	Ureterocalycostomy – Open	34,736 (525)	18,324–66,538 (277–1005)	24,066 (364)	22,613 (342)	21,466 (324)	11,623–34,736 (176–525)	18,897 (285)	11,216 (169)
	PCNL (Percutaneous Nephrolithotomy) – Bilateral	PCNL (Percutaneous Nephrolithotomy) – Bilateral	27,603 (417)	16,147–57,266 (244–865)	17,227 (260)	14,632 (221)	16,964 (256)	10,361–30,002 (157–453)	13,120 (198)	8047 (122)
	Ureteroscopy+stone removal with lithotripsy, bilateral	Ureteroscopy+stone removal with lithotripsy, bilateral	20,207 (305)	9503–41,483 (144–627)	14,576 (220)	10,437 (158)	12,937 (195)	6097–21,940 (92–331)	10,318 (156)	9817 (148)

Table 2 (continued)

Speciality	AB PM-JAY HBPs		100% fixed and 100% variable cost in INR (US$)				50% fixed and 100% variable cost in INR (US$)			
	Pre CHSI 2018	Post CHSI 2019	Mean	Range	Median	Interquartile range	Mean	Range	Median	Interquartile range
Otolaryngology	Myringoplasty	Tympanoplasty	19,623 (296)	9881–34,068 (149–515)	18,553 (280)	11,258 (170)	11,686 (177)	5972–17,568 (90–265)	12,296 (186)	6922 (105)
	Tympanoplasty	Tympanoplasty	24,876 (376)	17,276–42,154 (261–637)	22,491 (340)	3352 (51)	18,926 (286)	13,341–30,713 (202–464)	16,833 (254)	5284 (80)
	Mastoidectomy with tympanoplasty	Excluded in revision	22,889 (346)	15,360–38,394 (232–580)	19,610 (296)	11,026 (167)	14,504 (219)	8799–25,191 (133–381)	12,305 (186)	7905 (119)
	Functional Endoscopic Sinus (FESS)	Functional Endoscopic Sinus (FESS)	13,270 (200)	5,521–30,381 (83–459)	10,863 (164)	30,381 (459)	9220 (139)	4218–21,110 (64–319)	6,34 (105)	3,136 (47)
	Septoplasty + FESS	Excluded in revision	18,800 (284)	10,261–34,543 (155–522)	14,681 (222)	10,817 (163)	11,832 (179)	6717–22,923 (101–346)	10,548 (159)	5591 (84)

CHSI Costing of Healthcare Services in India, *AB – PMJAY* Ayushman Bharat – Pradhan Mantri Jan Aarogya Yojana, *HBP* Health Benefit Package

the cost of augmenting quality of care as per standard guidelines. However, since the purpose of the present cost analysis was to inform the setting of provider payment rates, the present approach of valuing the quantity of resources consumed in delivering care as per existing practices was considered appropriate. These limitations and the resulting lessons learned for future data collection have been recorded elsewhere [10]. Drawing upon the experience of the CHSI study and subsequent price-setting in India, the NHA has recently developed a template for data sharing by hospitals on resources consumed to provide services. This would help in expanding the sample in future for estimating costs, as well as regular updating of cost with changes in patterns of resource consumption and prices. Moreover, the NHA has initiated reforms in the data systems through information technology (IT) innovations and platforms [28]. Besides being of use in the monitoring of resources for the provision of care, the IT platform will also help in fraud control.

Price-setting is a complex process with wide financial implications. While on one hand prices should be reasonably acceptable to the providers and boost overall empanelment of hospitals in the scheme, these should be within fiscal space for the government/payee. Prices should incentivise the efficient use of resources and encourage the health system to improve equitable population coverage. Thus, it requires a comprehensive price-setting mechanism to create a level playing field that should be free from political and healthcare industry pressure, credible and free from conflict of interests.

Any discrepancy in reimbursement prices that are lower than actual cost can negatively impact the empanelment of service providers. This is likely to limit the geographic and population coverage and quality of care of the healthcare services under the AB PM-JAY scheme. As a result, it is important to price HBPs appropriately to reflect the actual cost of production. In India, the teaching hospitals have to meet rigorous accreditation standards in terms of hospital infrastructure, manpower, availability of services, etc., set by the regulatory authorities [29]. The NHA is committed to incentivise the quality. In view of this, accreditation by National Medical Commission (NMC) for teaching hospitals leads to a differential higher provider payment rate. Secondly, in the price-setting for certain HBPs, resource consumption was modelled for the provision of services under ideal circumstances. For example, the reuse of certain consumables is prevalent by providers in many cardiology and cardiovascular surgeries. So, the real-world cost would be an underestimate of the true cost. To avoid this, the cost of such procedures with the ideal use of consumables was estimated, which was used to inform prices. Future research needs to be focused on empirically assessing the factor by which payment to providers with quality standards should be scaled up. Other measures through which the NHA can incentivise

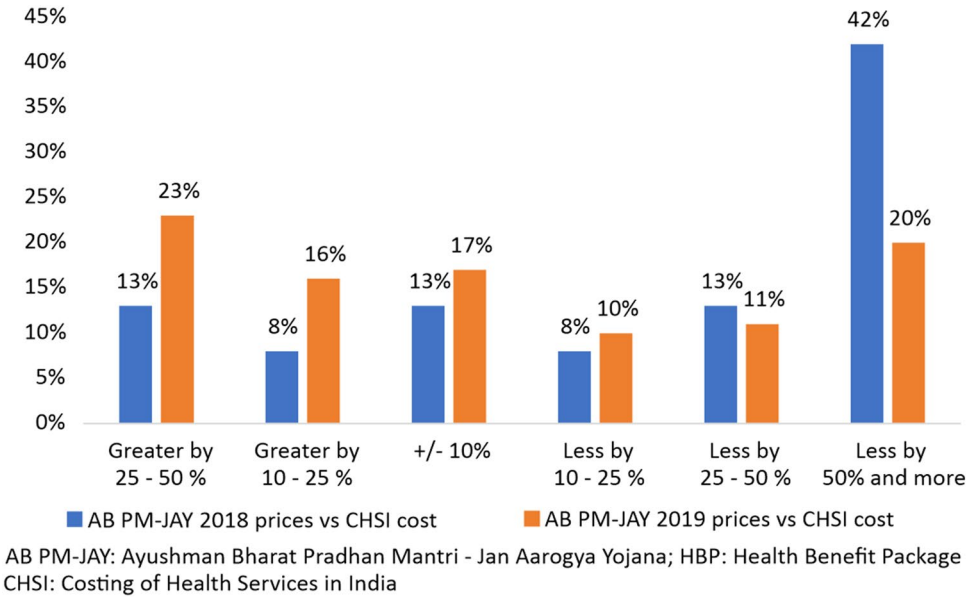

Fig. 3 Percentage of AB PM-JAY HBP's with price variation (2018 & 2019) from CHSI cost. *AB PM-JAY* Ayushman Bharat Pradhan Mantri-Jan Aarogya Yojana, *CHSI* Costing of Health Services in India

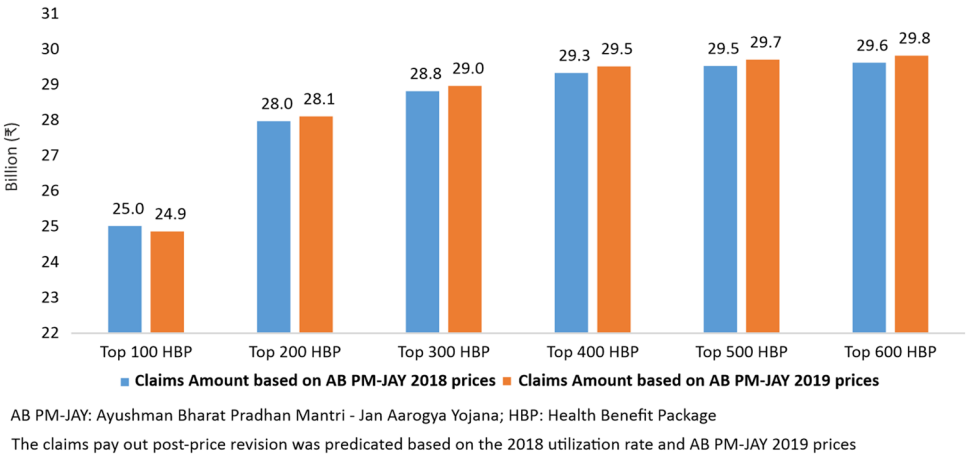

Fig. 4 Budget impact analysis. *AB PM-JAY* Ayushman Bharat Pradhan Mantri-Jan Aarogya Yojana, *HBP* Health Benefit Packages. The claims pay out post-price revision was predicted based on the 2018 utilization rate and AB PM-JAY 2019 prices

quality and reduce the moral hazard or over-utilisation are restricting treatment of certain conditions such as hysterectomy, high-risk delivery, etc., to public sector hospitals or subject certain conditions to pre-approval.

Considerably more needs to be done in the production of the cost information base for price-setting in India [30]. There is wide heterogeneity in disease profile, type of service providers, skills mix of providers, input prices, wage rates and infrastructure, which affects cost. Hence, a 'one size fits all' approach with a common national reimbursement price may appear to be insufficient. Recognizing this, the NHA has given the flexibility to the states for increasing the prices based on local evidence (up to 110%) in their respective states. In future, the NHA could plan for differential price-setting that transparently incorporates the above-mentioned heterogeneity. A national and even state-wise cost-function, as has been done for primary and secondary health services, should be developed using CHSI data to model the cost of tertiary healthcare services and identify its important determinants [31]. It will help to explore the heterogeneity in the cost of service delivery at both the sectoral (public vs. private) and the level of health system (tertiary vs. secondary). Further, it will also help to reduce the need for repeated primary data collection, which is a labour-intensive and time-consuming process. Going forward, in India, to provide health-system cost data either an independent agency should be established or NHA will need to expand its capacity to take on this role. This requires trained staff and budget. For example, the Independent Hospital Pricing Agency (IHPA) in Australia has 42 staff employed with a total expenditure of US$2.4 million in 2017–18. The NHA has put in place a mechanism to continuously generate evidence on cost and monitor prices. It is also considering a system for empanelment of a hospital that mandates

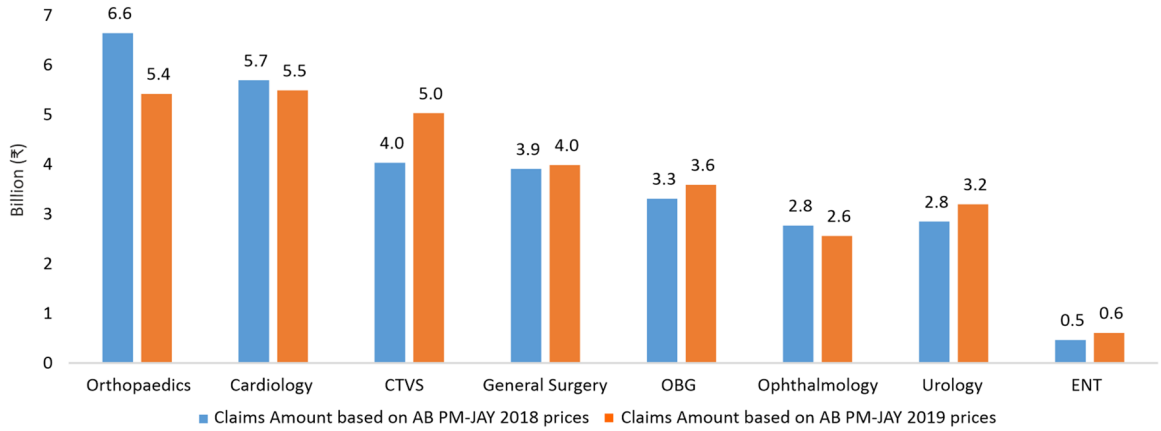

Fig. 5 Speciality wise claims share AB PM-JAY 2018 and 2019. *AB PM-JAY* Ayushman Bharat Pradhan Mantri-Jan Aarogya Yojana, *CTVS* Cardiothoracic and vascular surgery, *ENT* Otolaryngology, *OBG* Obstetrics andf Gynaecology. The claims pay out post-price revision was predicted based on the 2018 utilization rate and AB PM_JAY 2019 prices

the reporting on resource use as an essential criterion for empanelment of service providers under AB PM-JAY. This will facilitate the conducting of more robust and regular cost analysis, as well as quality assurance.

Generating cost information for price-setting is a complex and resource-intensive process but can provide critical information to encourage healthcare providers towards more efficient service delivery. In India where health service data is still poor, the cost data, from a representative sample of facilities, reported here have provided the foundation from which prices can be negotiated. The application of evidence-based price-setting using the cost information generated by the CHSI study brought HBP prices closer in line with the costs, demonstrating how evidence can enable the government to move towards more strategic purchasing and more efficient delivery. Incorporating the study results into the Indian national health system cost database is the way forward for the future [30, 32].

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Declarations

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Conflicts of interest None of the authors have any conflicts of interest to declare.

Ethical approval The study was approved by the Institutional Ethics Committee (IEC) vide letter no. PGI/IEC/2018/00125A and Institutional Collaborative Committee (ICC) vide letter no. 79/30-Edu-13/111273 of Postgraduate Institute of Medical Education and Research, Chandigarh, India.

Consent to participate Written informed consent was obtained from the participants.

Consent for publication All the authors give their consent for the publication

Availability of data and material All the cost information generated by the study is included in the paper and supplementary material. The code availability is not applicable.

Author's contributions Study Conception: Shankar Prinja, Balram Bhargava, Praveen Gedam. Development of data collection tools: Maninder Pal Singh, Oshima Sachin, CHSI Study Group. Data Collection: Maninder Pal Singh, Oshima Sachin, CHSI Study Group. Data Analysis: Maninder Pal Singh, Shankar Prinja. Data Interpretation: Shankar Prinja, Balram Bhargava, Praveen Gedam, Anu Nagar, Kavitha Rajsekar. Draft Manuscript: Maninder Pal Singh, Shankar Prinja. Critical contribution in revising manuscript: All Authors.

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