Original Article

Interventional Scenario of Cardiology in Uttar Pradesh for 2022–2024 – Insights from Mid-term Intervention Council Meet of Cardiological Society of India, Uttar Pradesh State Chapter

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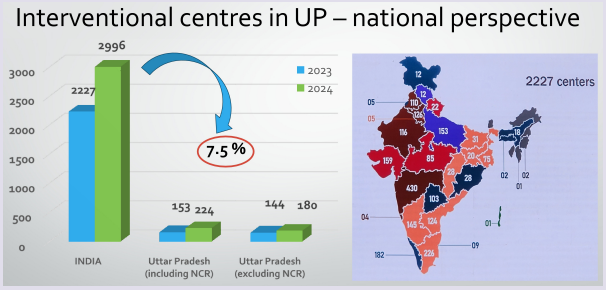
Abstract

Background: Uttar Pradesh, being the largest populated state, contributes significantly to the total burden of cardiovascular diseases in India. Nevertheless, due to the paucity of resources and operational quantification appertaining to the interventional cardiological arena in the state, we sought to address the problem by reporting the contemporaneous infrastructure and spectrum of procedures being performed. **Methods:** Pro forma-based qualitative and quantitative data about interventional cardiology were collected retrospectively through offline and/or digital modes for two calendar years (2022–2023). Modes of data reception involved online reporting (38%), industry-sourced (41%), and through interpersonal engagements (21%). **Results:** In 224 cath labs spread across Uttar Pradesh, 302 cardiologists offered consulting and operative services during 2022–2023. The total number of percutaneous coronary intervention (PCI) performed in 2022 and 2023 was 46,370 and 52,655, respectively, out of which 18% were primary PCIs. 76,268 and 80,382 coronary stents were deployed in 2022 and 2023, respectively. Among various structural heart interventions performed in 2023, balloon mitral valvotomy ($n = 1465$) and congenital defect device closure ($n = 1002$) were the commonly performed procedures. Overall, 4234 and 7186 pacemakers were implanted in 2022 and 2023, respectively, of which more than 60% were single-chamber implants. **Conclusion:** This report symbolizes the growth and development of the interventional cardiovascular care in Uttar Pradesh. Immense potential for pediatric interventions, electrophysiology, and metal-less PCI exists, which remains to be tapped. Existing leadership, with their experience and vision, need to lead the way for early career enthusiasts so that high-quality tertiary cardiovascular care can be ensured for the state population.



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Introduction

According to the updated Global Burden of Disease collaboration report in 2023, cardiovascular diseases (CVD) mortality recorded an annual growth of 0.23 million per year in the past 32 years (1990–2022).[1] In 2015, South Asia was the largest contributor to an estimated 422 million prevalent cases of CVD.[2] In 2021, the estimated age-standardized CVD death rate of 272 per 100,000 population (range: 248.6–350.9 per 100,000) in India was much higher than the global average of 233 per 100,000 population (range: 229–236 per 100,000).[1] Given the fact that roughly 10% of the population lives below the international poverty line, it's not surprising that mortality from noncommunicable diseases accounted for 65% of total deaths in India in 2019, of which more than 25% could be attributed to CVD and related risk factors like diabetes.[3] According to the Public Health Foundation of India,[4] approximately 50% of individuals who develop heart disease in India die within 3–4 years of diagnosis, a rate which is double that in the Western population. The total number of sudden deaths (56,450) recorded in India in 2022 is indicative of a disturbing upward trajectory over the past 3 years. Within this spectrum, myocardial infarction-specific mortality has also seen a sharp spike, from 28,579 in 2020 to 32,457 in 2022.

On the national scale, CVD is a leading cause of mortality irrespective of gender (23.3% in males and 17.7% in females).[5] The elderly population being more susceptible, contributes to CVD mortality of 22.4% in persons above 60 years and 19.1% in persons aged 45–60 years.[6] In comparison to the global average, the age-standardized disability-adjusted life year (DALY) rate of ischemic heart disease (IHD) in India was 1.6 times higher in 2016, amounting to 23.1% of global DALYs due to IHD.[7] With an annual population growth of 1.01%, current estimates project the population of Uttar Pradesh to 238.9 million in 2024, accounting for 17% of the national population.[8] The contribution of DALY caused by IHD in Uttar Pradesh rose from 2.2% in 1990 to 5.8% in 2016. In Uttar Pradesh, among both sexes, CVD contributed to 24% of all-cause mortality in adults aged 40 years or more.[9] IHD was also the leading cause of years of life lost due to premature mortality in males (10%), which was much more as compared to females (6%) residing in Uttar Pradesh. Limited data from Uttar Pradesh suggest an exponential increase in the cardiovascular and noncommunicable disease burden in recent years. A study from a tertiary-care hospital in central Uttar Pradesh showed that within a span of 3 years (2014–2016), the number of cases admitted secondary to CVD had increased from 19% to 27%.[10]

Multiple attempts have been made to document the scenario of interventional cardiology in terms of dedicated hospital setup, cath lab resources, cardiologist-population ratio, spectrum and outreach of various cardiovascular interventions, upgradation, and receptivity for different technological and skill advancements existing at a national level, concerning the findings presented at national interventional council meetings in the previous years.[11-13] However, despite the precarious infrastructure of interventional cardiology and a skewed demand-supply mismatch, this exercise had not been put forth on paper and ink. Herein, we sought to conceive the prevalent panoramic notion of interventional cardiology in the state of Uttar Pradesh by presenting the exhaustive analysis of the findings put forth in the 13th and 14th Mid-term interventional meet of UP chapter, Cardiological Society of India (CSI) held on October 1, 2023 and September 22, 2024, respectively at Lucknow.

Methods

Interventional data for the previous year were collected retrospectively during the second quarter of the following calendar year. We have primarily analyzed the data collected for the years 2022 and 2023. However, to depict a continuum for certain specific parameters, we have also used the data from 2020 to 2021. Data from national interventional council meetings (2022–2023) were also used for comparative analysis, keeping the national perspective in mind.[14,15] An exhaustive registry pro forma involving the details of interventional centres, cath lab procedures, resource utilization, and hardware/strategy was employed for data collection. All diagnostic and/or therapeutic cath lab procedures, including coronary, structural, peripheral, pediatric, pacing, and electrophysiological spectrum, were considered for inclusion. While devising the data collection tool for this registry, we ensured that the emerging therapies (orbital atherectomy, intravascular lithotripsy, nonadenosine based physiological flow measurements), hardware enhancements (ultra-high pressure non-compliant balloon, leadless pacing, mechanical circulatory support [MCS] devices) and niche procedures (physiological pacing, transcatheter valvular interventions, and renal artery denervation) were also included in the study. Hospital-level data only from centers having cardiac cath labs in the entire state of Uttar Pradesh, except the national capital territory region panning across 73 districts and 18 administrative divisions, were collected digitally (Google Forms/link, email) or manually. E-filing and digital retrieval were encouraged. Industry-level data were also collected, collated, checked, verified, and analyzed on an independent basis. Data were entered into Microsoft Excel worksheets, following which descriptive analytics and graphical modeling were performed. Data reportage has steadily increased from 45% to 72% over 3 years (2021–2023) owing to continued individual efforts of organizing chairmen, an inclusive approach to enlarge the ambit and scope of mid-term interventional meetings, and incentivizing centers for sharing their data. This report represents the findings tabled in the mid-term interventional meeting of the UP chapter, CSI for 2023–2024.

Results

Total number of interventional centers in Uttar Pradesh (excluding National Capital Region [NCR]) rose from 144 in 2022 to 180 in 2023, contributing 7.5% to the nationwide count, being only the fourth-largest after

Maharashtra (n = 503), Tamil Nadu, and Gujrat. Year-wise estimates for the last 10 years of interventional centres in Uttar Pradesh (excluding NCR) show a steady growth rate of 10%–15% [Figure 1]. Although the estimates before 2022 had included centres from Uttarakhand, even after adjusting for that, a whopping 37% hike in this sector is reported on a year-on-year basis. The ratio of interventional cardiologists per center, interventional cardiologist per cath lab, and cardiac cath labs per centre was 1.7, 1.6, and 1.1, respectively. Despite the rise in the number of interventional cardiologists that may also outnumber the number of labs in the near future for group practice and close collaborations, we are still striving to achieve a goal of at least 2 cardiologists per center. Seventy-five percent of the centers had single operators, with most of them being in the private sector. Only 10% of the centers belonged to the government sector. One-third of the centers had onsite surgical backup teams, whereas only 5% of the centres had multiple cath labs. However, barring a few, most centres are yet to incorporate the concept of back-up labs at a centre, probably because of logistics and financial constraints. The top five centres in terms of overall interventional cardiology workload per year were Lari cardiology centre (KGMU), Laxmipat Singhania Institute of Cardiology and Cardiac Surgery, RMLIMS, SGPGIMS, and Medanta Heart Institute. As cardiovascular interventions do incur a financial burden, we also assessed the source of procedural funding to evaluate patterns related to patient-level healthcare expenditure. The majority of the spending was out of pocket (38%), with private insurance reimbursement seen in only one-fourth of the cases. Ayushman Bharat Pradhan Mantri Jan Arogya Yojna (ABPMJAY) was the funding source for three-fifths of all government insurance schemes [Table 1].

Geographical distribution and manufacturer market share of cath labs

As per the minimum global standards, 1 cardiologist per 0.1 million population is required.[16,17] However, only 302 cardiologists were available for a population of 241 million against a minimum requirement of 2410, thereby highlighting the acute dearth of specialized cardiac caregivers in the state. The majority of the cath labs were concentrated in 7 administrative divisions (Lucknow [n = 31], Agra [n = 26], Varanasi [n = 17], Gorakhpur [n = 11], Bareilly [n = 11], Moradabad [n = 10], and Kanpur [n = 9]). More than half of the districts (55%) didn't have any cath lab forasmuch as 16% of the districts had more than 5 cath labs in operation. With respect to the cath lab manufacturer market share, the majority of installations belonged to Siemens healthineers (33%), Phillips healthcare (24%), and Allengers medical systems (24%) in contrast to the national perspective where Phillips health care (47%), General electric (GE) health care (28%), and Siemens healthineers (18%) took the lead.

Coronary interventions

Overall, percutaneous coronary intervention (PCI) trends have witnessed a constant increment of 6% in 2022 and 13% in 2023 [Figure 2]. Of all the PCI performed for ST-segment elevation myocardial infarction (STEMI), 18.9% were primary PCI, whereas 21.3% belonged to a pharmacoinvasive strategy, which was marginally better when compared to the national average (16.5%). As far as PCI for other acute coronary syndromes is concerned, 12% had Non-STEMI and 20.7% had unstable angina. On the other hand, PCI for chronic coronary syndromes was performed in 27% of cases. Of all PCI, multivessel PCI, left main (LM) intervention, bifurcation PCI, chronic total occlusion PCI, and in-stent restenosis PCI were carried out in 40%, 6%, 10.5%, 10%, and 4%, respectively [Table 2]. Use of MCS devices in complex high-risk PCI (CHIP) was employed in the form of intra-aortic

Table 1: Distributional share of government funding sources for cardiac interventions

Funding source	Funding share (%)
ABPMJAY	56
Pandit Deendayal Upadhyay Rajya Karmchari Cashless Chikitsa Yojna	15
CGHS	10
ECHS	3
ESIC scheme	1
Other schemes	15

ABPMJAY: Ayushman Bharat Pradhan Mantri Jan Arogya Yojna, CGHS: Central Government Health Scheme, ECHS: Ex-Servicemen Contributory Health Scheme, ESIC: Employee State Insurance Corporation

Table 2: Pattern of coronary artery involvement and lesion characteristics encountered during percutaneous coronary intervention

	Prevalence (%)
Coronary artery disease attributes	
SVD	40
MVD	60
Vessel involvement	
LAD	44
LCx	28
RCA	20
LM coronary artery	8
Lesion complexity during PCI	
Bifurcation PCI	10.5
Trifurcation PCI	2
CTO-PCI	10
Antegrade approach	8.6
Retrograde approach	1.4
In-stent restenosis PCI	4
PCI for ostial lesion	15.3
LM PCI	6
SVG PCI	0.5
LIMA graft PCI	0.6
PCI for stent thrombosis	1.5

SVD: Single vessel disease, MVD: Multi-vessel disease, LAD: Left anterior descending, LCx: Left circumflex artery, RCA: Right coronary artery, LM: Left main, SVG: Saphenous venous graft, LIMA: Left internal mammary arterial, PCI: Percutaneous coronary intervention

balloon counter-pulsation, impella, extracorporeal membrane oxygenation in 10%, 4%, and <1% of CHIP cases, respectively.

The number of coronary stents deployed increased from 68,458 in 2021 to 80,382 in 2023, marking an average increment of 10% on a yearly basis. Although radial artery access was the preferred vascular approach seen in 83% of total PCI and 70% of primary PCI, only a meagre upward trend has been noted over 4 years in this regard, demonstrating operator inertia and discomfort amidst changing practice. The majority of market share apropos of coronary stents was constituted by Translumina Therapeutics (23%), Abbott Cardiovascular (22%), Sahajanand Medical Technologies (17%), and Boston Scientific (15%). With regard to stent deployment pattern, as part of a government initiative, make-in-India stents surpassed multinational company counterparts, occupying 54% of the market share [Figure 3]. Bare-metal stents, drug-eluting balloons (DEB), and bio-absorbable vascular scaffolds (BVS), representing niche technological advancements, were engaged in only 0.17%, 0.17%, and 0.07% of all PCI.

Use of ancillary technologies for coronary calcium management involving rotational atherectomy, cutting balloon, and/or scoring balloon, ultra-high pressure noncompliant balloon, intravascular lithotripsy, and orbital atherectomy witnessed a significant escalation in the past 2 years [Table 3]. However, coronary excimer laser angioplasty was used scarcely (0.8-1%), predominantly because of pending regulatory authority approvals and prohibitive costs involved in the procedure.

Intravascular imaging

The usage pattern of calcium debulking strategies is corroborated by the parallel surge in intravascular imaging during this period, predominantly being driven by intravascular ultrasound (IVUS). Only 88% of centers reported the use of IVUS during LM coronary interventions as opposed to the global recommendation of 100% coverage during LM PCI. Contrary to the national trend of 2022, where IVUS use was 1.5 times that of optical coherence tomography (OCT), in Uttar Pradesh, both modalities were used more or less equally during the same period. Nonetheless, in 2023, IVUS (32%) use surpassed OCT (11%) by a colossal margin. It may be related to the higher initial investment costs involved in procuring the OCT console, high-priced newer generation OCT imaging catheters (Dragonfly OpStar™, Abbott cardiovascular), and delay in the launch of the latest generation OCT platform (Ultreon™ 2.0 software, OPTIS™ mobile next imaging system, Abbott cardiovascular), especially in the government sector. Most of the imaging and physiology-guided PCI was contributed by the government sector hospitals. As far as intravascular imaging is concerned, state-wise imaging penetration showed Uttar Pradesh in 6th place with 21 and 10 cath labs enabled with IVUS and OCT, respectively [Figure 4].

Structural heart interventions

Among the structural heart interventions, significant augmentation in balloon mitral valvotomy and device closures for acyanotic heart diseases was observed in 2022–2023 [Figure 5]. Transcatheter device closure was done commonly for atrial septal defect (33%) followed by patent ductus arteriosus (30%) and ventricular septal defect (28%). Transcatheter aortic valve implantation also soared 3 times from 12 in 2021 to 36 in 2023 with balloon-expandable valves (Myval THV, Meril Lifesciences) being preferred in approximately 75% of cases. Uttar Pradesh contributed only 2% to the overall national transcatheter valve implants.

Peripheral vascular interventions

For cardiological procedures involving large-bore arterial access, suture-based closure (52%) was employed more commonly as compared to collagen-based closure (48%). This is expounded by the fact that for arterial access >8F, only suture-based closure devices are currently available. Although a lot of peripheral vascular interventions are now being performed by interventional radiologists, yet an increasingly significant number of carotid artery stenting, renal artery stenting and coarctation interventions were reported by the interventional cardiology centres also. Balloon dilatation without stenting was seen in very few of the cases, including Takayasu arteritis, neonatal coarctation, etc., Peripheral vascular procedures in Uttar Pradesh account for only 3.5%–7% of all such interventions on the national scale [Figure 6].

Cardiac implantable device implantation and radiofrequency ablations

Seventy percent growth has been recorded for state-wide pacemaker implantations in 2022–2023 [Figure 7]. The most commonly reported indications for pacing included degenerative complete heart block (81%), followed by sick-sinus syndrome (9%), postoperative (5%), and congenital (2%). Single-chamber implants were twice as common (n = 4561) as dual-chamber implants (n = 2625). Pacemaker implantations in the state made up 16.9% of the nationwide implants in 2022–2023. Uttar Pradesh accounted for 4% of all cardiac resynchronization therapy (CRT) implantations across the country in 2022–2023. Conduction

Table 3: Prevalence of use of various ancillary therapies during percutaneous coronary intervention

Hardware used	Prevalence (%)
DES	99.6
BMS	0.2
DCB	0.2
POBA	2.2
Ultra-high pressure noncompliant balloon	1.7
Scaffold BVS	0.07
Embolic protection device	
SVG PCI	5
Carotid artery intervention	10
Glycoprotein IIb/IIIa inhibitors use	9.4

SVG: Saphenous venous graft, BVS: Bioabsorbable vascular stent, DES: Drug eluting stent, BMS: Bare metal stent, DCB: Drug coated balloon, POBA: Plain-old balloon angioplasty, PCI: Percutaneous coronary intervention

system pacing also increased from 18 in 2021 to 76 in 2023 [Figure 8]. Market share analysis revealed sustained gains of St. Jude Medical, Medtronic, and Biotronik stakes at the cost of declining shares of Boston Scientific as far as new implants were considered. However, Medtronic was the leader in pulse generator replacements during this period [Figure 9]. More than 300 radiofrequency ablations (RFA) were also performed during this period, most commonly for atrioventricular nodal reentrant tachycardia (73%), followed by atrioventricular reentrant tachycardia (20%), preexcitation syndrome (4%), and atrial fibrillation (3%).

Discussion

Coronary interventions in the nation and the region are increasing exponentially each year.[11-13] In 2023, this registry had excellent coverage of 72% among all the interventional centers of Uttar Pradesh, including. The top five centers alone contributed to around 50% of all procedures done in the state during this period. More than 80,000 stents were implanted in 52,655 PCI, with a stent to PCI ratio being 1.53:1. Multifactorial expansion of centers and number of procedures is due to a rise in several single-operator labs primarily in the periphery and underserved areas of the state,

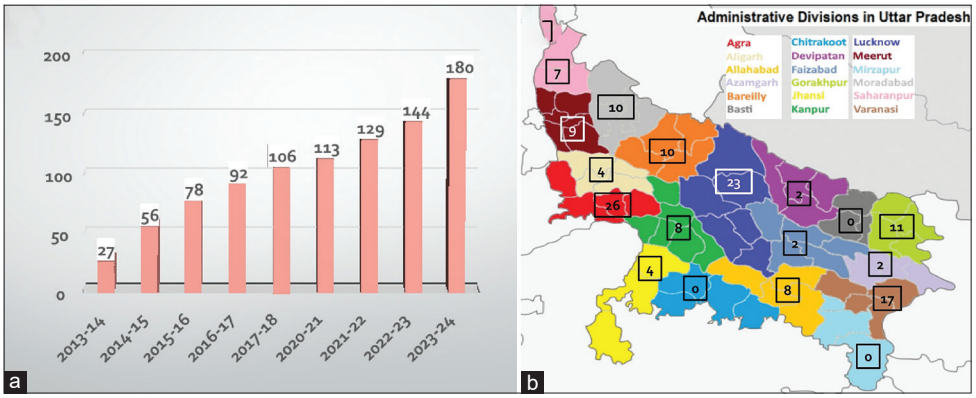

Figure 1: (a) Showing the growth of interventional cardiology centres in Uttar Pradesh (excluding National Capital Region [NCR]), showing 10-year trends (figures before 2022–2023 are inclusive of Uttarakhand centres). (b) Showing division-wise distribution of interventional cardiology centres (n = 144) in Uttar Pradesh (excluding NCR) in 2022–2023.

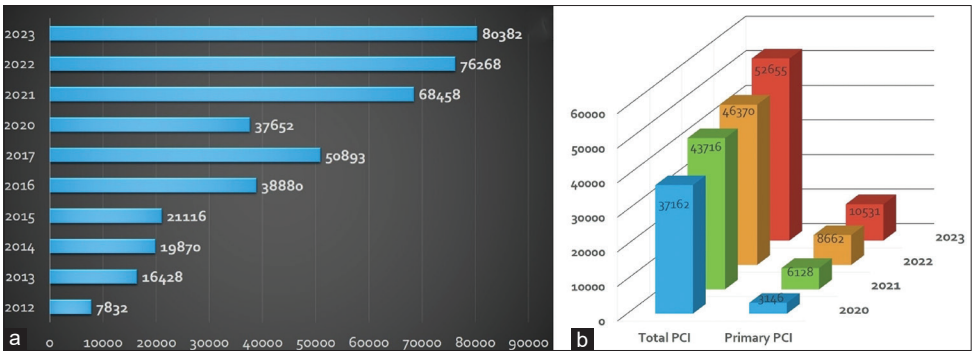

Figure 2: Coronary stent deployment pattern over 10 years (2012–2023) in Uttar Pradesh (a). Growth trends (2020–2023) for the total number of percutaneous coronary intervention (PCI) and primary PCI in Uttar Pradesh (b). PCI: Percutaneous coronary intervention.

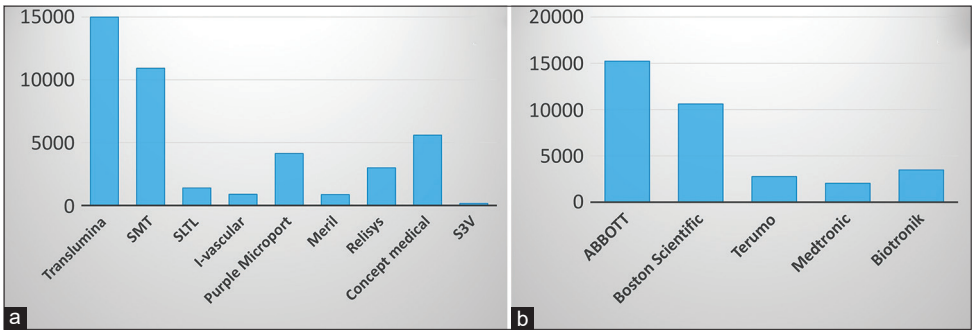

Figure 3: Company-wise distribution for coronary stent market share showing various Indigenous (a) and multinational enterprises (b). SMT: Sahajanand medical technologies, SLTL: Sahajanand laser technology limited.

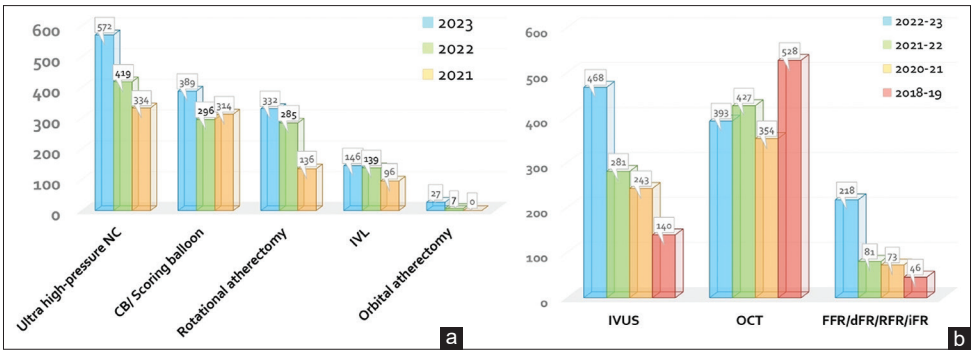

Figure 4: (a) Showing trends for the use of auxiliary athero-ablative therapies for calcium management for the last 3 years (2021–2023) in Uttar Pradesh. (b) Showing trends for the use of coronary imaging and flow assessment for the last 4 years (2018–2023) in Uttar Pradesh. IVUS: intravascular ultrasound, OCT: Optical coherence tomography, NC: Non complaint balloon, CB: Cutting balloon, IVL: Intravascular lithotripsy, FFR/dFR/RFR/iFR: Fractional flow reserve/Diastolic flow reserve/Resting free-cycle ratio/Intantaneous wave-free ratio.

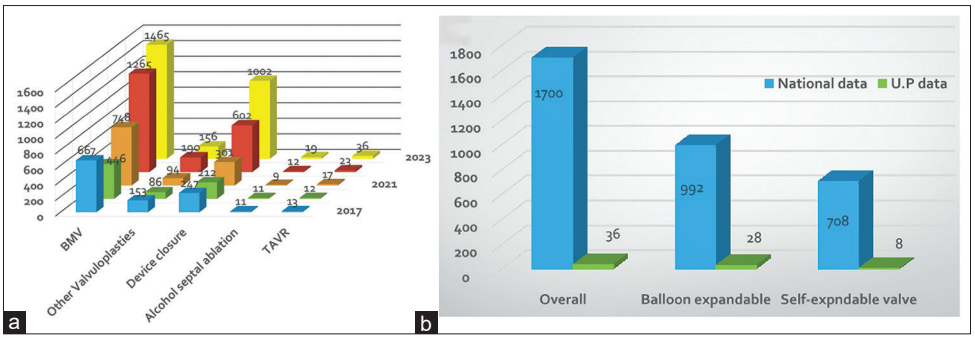

Figure 5: Various structural heart interventions performed during 2017–2023 in Uttar Pradesh (a). Comparison of national and state data outlining transcatheter aortic valve implants performed in 2023 (b). BMV: Balloon mitral valvotomy, TAVR: Transcatheter aortic valve replacement.

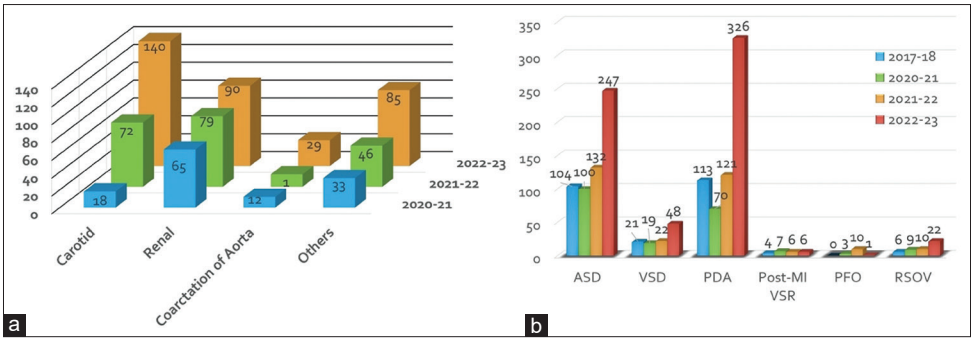

Figure 6: Various peripheral vascular interventions (a) and congenital heart disease interventions (b) performed during 2022–2023 in Uttar Pradesh. ASD: Atrial septal defect, VSD: Ventricular septal defect, PDA: Patent ductus arteriosus, MI VSR: Myocardial infarction related ventricular septal rupture, PFO: Patent foramen ovale, RSOV: Ruptured sinus of valsalva aneurysm.

increase in number of super-specialty postgraduation medical seats in academic institutions, creation of super-specialty blocks in tier-II cities under one district-one medical college scheme, implementation of 2-year government service bond for passing out Doctorate of Medicine cardiology students, rise in prevalence of coronary artery disease often at a younger age, high public awareness, government-sponsored financial aid, etc.

The proportional share of primary PCI is still under 20% owing to the widespread effective use of the pharmacoinvasive strategy coupled with the longer turnaround time for financial approvals in the ABPMJAY scheme, effectively precluding early interventions in acute coronary syndromes. However, the silver lining lies in the fact that primary PCI is rising over the years from 11.8% in 2021, 14% in 2022 to 18.9% in 2023. Over the years, more proportion of interventions are performed in extreme age groups; younger <40 years and older >80 years. The penetration of drug-eluting stents has increased in the last few years, which could be attributable to price capping by the government, increased affordability, and the introduction of multiple home-grown players under the "make-in-India" initiative. Owing to the multiple studies and recent U.S. Food

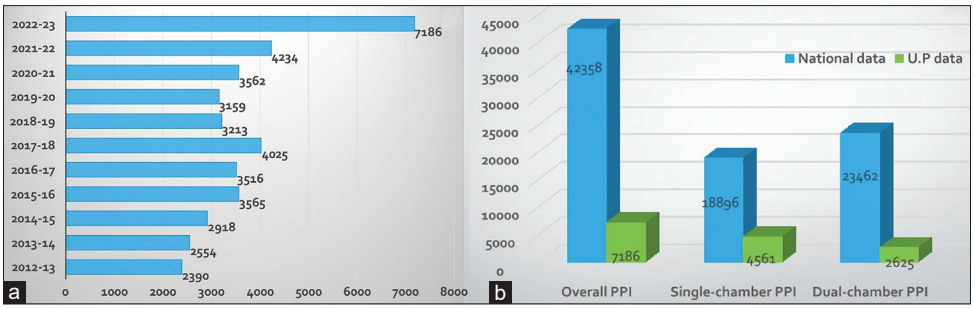

Figure 7: Pacemaker implantation trends during the last 10 years in Uttar Pradesh (a). Comparison of national and state data outlining pacemaker implantations done in 2022–2023 (b). PPI: Permanent pacemaker implantation.

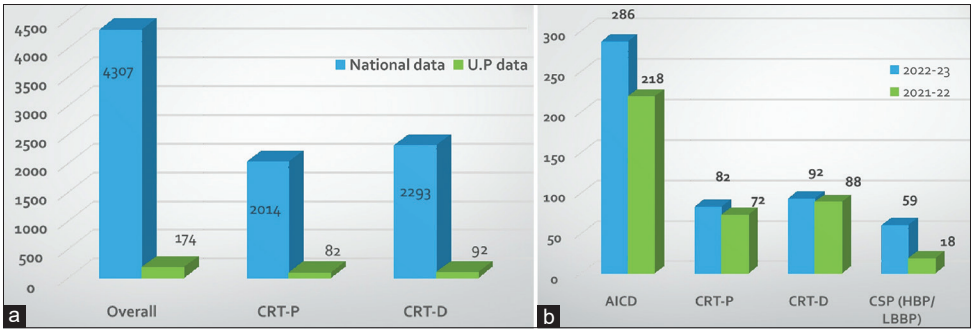

Figure 8: (a) Comparing national and state data outlining cardiac resynchronization therapy performed in 2022–2023 in Uttar Pradesh. (b) Showing trends for various cardiac implantable electronic device implantations done in 2021–2023 in Uttar Pradesh. CRT-P: Cardiac resynchronization therapy-P, CRT-D: Cardiac resynchronization therapy-D, AICD: Automated internal cardiac defibrillator, CSP (HBP/LBBP): Conduction system pacing (His bundle pacing/left bundle branch pacing).

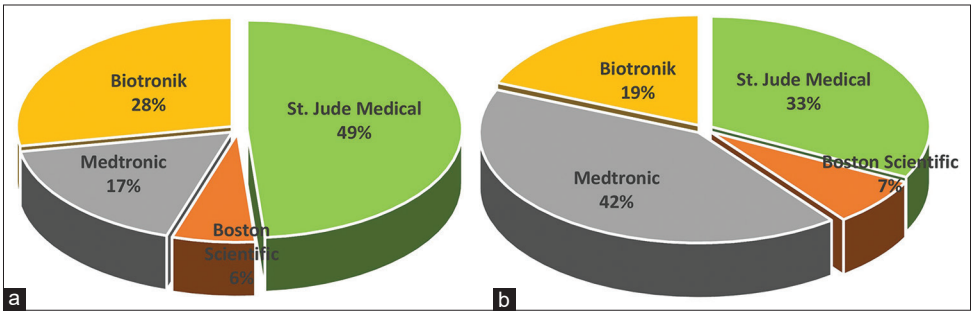

Figure 9: Pie-charts depicting the market share for new implants (a) and pulse generator replacements (b) done in 2022–2023 in Uttar Pradesh.

and Drug Administration (FDA) approval, DEB usage is on the rise but still far behind the national consumption, mainly due to prohibitive costs, which in some cases even exceed the price of a drug eluting stent (DES). Similarly, the growing concept of metal-less PCI is rekindling the interest in BVS, albeit in a small section of cardiologists.

As more and more complex lesions are witnessed, there is an ever-growing need for the use and development of various plaque-modifying auxiliary strategies, either alone or in combination, which has been well documented in this registry data. The recent introduction of orbital atherectomy and excimer laser ablation for coronary calcium has also mandated the concurrent use of intravascular imaging to guide therapy and optimize outcomes. This was reflected in the data by a proportional escalation in the use of intravascular imaging (IVUS or OCT) and physiological flow assessments (Fractional flow reserve[FFR], instantaneous wave-free ratio [iFR], diastolic flow reserve [dFR], resting full-cycle ratio [RFR]). In contrast, the use of intravenous antiplatelet drugs has plummeted due to the advent of potent antiplatelet drugs, newer generation stents, lower incidence of thrombus-containing lesions, and image-guided PCI optimization. Even though complex PCI in sicker patients is being performed more often, the use of MCS has been rare, which is probably related to deterring costs and limited availability.

Although there was a meagre numerical rise in transcatheter aortic valve replacement (TAVR) in 2023, TAVR in Uttar Pradesh portrays an extremely dismal figure in terms of contribution to the national numbers. This could be because

the number of operators and the centers performing TAVR have been constant over 2 years in spite of the reduction in the cost of made-in-India valves (Myval®, Meril Lifesciences). We are expecting a significant increase in the number of TAVR procedures in the coming years, with expanding indications for TAVR and increased longevity. Despite a huge potential in the state, pediatric heart interventions were less prevalent, highlighting the unmet need for dedicated pediatric cardiac care centers, specialized training for the healthcare personnel involved, experienced pediatric cardiac surgeons, and a collaborative heart team. Similarly, for peripheral vascular interventions, one needs to develop interventional radiology programs at the medical college level.

Although the growth in pacemaker implants is commendable, it could not be replicated as far as CRT or physiological pacing is considered. It may be related to operator inertia, prolonged procedure duration, steeper learning curve, and improvement in the medical management of heart failure. Electrophysiological studies and RFA were mainly concentrated in a handful of centres, outlining the dearth of dedicated electrophysiologists across the state. Wide variability in data reporting was noted, with some centers drastically excelling over others. The need for real-time capture of individualized data that is accurate and robust is a must to have an enormous consequent research potential. New online data collection has been proposed and will be implemented in parallel to the existing system over the coming years. However, this requires cooperation from all the professional colleagues and hospitals with provision for separate funding and manpower for the same.

Limitations

Inadequate data reportage was attributable to the unavailability of a centralized mandatory digital repository portal, the disillusionment of peripheral centers, and operator inertia to report procedural data. The registry is pro forma lacked data on pacemaker explants/infections, use of extended loop recorders, non-FDA/European Conformity approved devices (stents/cardiac implantable electronic device [CIED]), stent size and length, combination of imaging and physiology assessment modalities, and combination of atherectomy modalities used.

Conclusion

With the ever-evolving scientific advancements in technology, skill, and evidence-based clinical practice, the state of Uttar Pradesh is sitting currently on the cusp of a revolution in the interventional cariological arena. The growth of interventional cardiology in the state has been notable over recent years, driven by advancement in infrastructure development, training, research, super specialty education, increased public awareness, increased accessibility to cardiac care, adoption of technological advancement, rise in public-sector healthcare expenditure, and initiatives for indigenous high-quality manufacturing among various other factors. However, there is a huge scope for improvement in ensuring cardiovascular care penetration in the peripheral districts. We are way below the national average in congenital heart disease interventions, structural heart interventions, DEB usage, and physiological pacing. Specialized training avenues, dedicated operators, and independent centers for these procedures can help to bridge this gap. More than half of the districts still don't have a cardiac cath lab, thereby forcing the patients to seek quality cardiac care at places which are already overburdened. Public–private partnerships can provide short-term solutions, but long-term infrastructural reforms in the public sphere are mandatory to prevent this influx and provide lasting solutions.

Ethics statement

The authors confirm that this study was conducted using data and methods that did not involve human or animal participants and did not involve any procedures for which written informed consent is normally required outside the research context. The authors affirm their commitment to maintaining confidentiality, data integrity, and ethical standards throughout the research process.

Patient consent statement

Since this manuscript does not involve any personal, demographic, or clinical data of individual patients, the requirement of ethical clearance or patient consent statements was not applicable. The authors take full responsibility for maintaining confidentiality and ethical conduct throughout the research process.

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Conflicts of interest

There are no conflicts of interest.

References

1. Mensah GA, Fuster V, Murray CJ, Roth GA, Global Burden of Cardiovascular Diseases and Risks Collaborators. Global Burden of Cardiovascular Diseases and Risks, 1990-2022. J Am Coll Cardiol 2023;82:2350-473.
2. Roth GA, Johnson C, Abajobir A, Abd-Allah F, Abera SF, Abyu G, *et al.* Global, regional, and national burden of cardiovascular diseases for 10 causes, 1990 to 2015. J Am Coll Cardiol 2017;70:1-25.
3. Kalra A, Jose AP, Prabhakaran P, Kumar A, Agrawal A, Roy A, *et al.* The burgeoning cardiovascular disease epidemic in Indians – Perspectives on contextual factors and potential solutions. Lancet Reg Health Southeast Asia 2023;12:100156.
4. Prabhakaran D, Jeemon P, Roy A. Cardiovascular diseases in India: Current epidemiology and future directions. Circulation 2016;133:1605-20.
5. Kundu J, Kundu S. Cardiovascular disease (CVD) and its associated risk factors among older adults in India: Evidence from LASI wave 1. Clin Epidemiol Glob Health 2022;13:100937.
6. International Institute for Population Sciences (IIPS), National Programme for Health Care of Elderly (NPHCE), MoHFW, Harvard TH. Chan School of Public Health (HSPH) and the University of Southern California (USC) 2020. Longitudinal Ageing Study in India (LASI) Wave 1, 2017-18, India Report, International Institute for Population

Sciences, Mumbai.
7. India State-Level Disease Burden Initiative CVD Collaborators. The changing patterns of cardiovascular diseases and their risk factors in the states of India: The Global Burden of Disease Study 1990-2016. Lancet Glob Health 2018;6:e1339-51.
8. Population Projections for India and States (2011-2036): Report of the Technical Group on Population Projections, National Commission on Population, Ministry of Health and Family Welfare (MoHFW), New Delhi 2020.
9. Indian Council of Medical Research, Public Health Foundation of India, and Institute for Health Metrics and Evaluation. India: Health of the Nation's States – The India State-level Disease Burden Initiative. New Delhi, India: Indian Council of Medical Research, Public Health Foundation of India, and Institute for Health Metrics and Evaluation; 2017.
10. Gupta SK, Mahima, Mishra BN, Kumar S, Krishnappa K, Shukla SK. Burden of non-communicable diseases at a tertiary care hospital of central Uttar Pradesh: A retrospective study. Open J Prev Med 2018;8:102-8.
11. Ramakrishnan S, Mishra S, Chakraborty R, Chandra KS, Mardikar HM. The report on the Indian coronary intervention data for the year 2011 – National Interventional Council. Indian Heart J 2013;65:518-21.
12. Arramraju SK, Koganti S, Janapati R, Emmareddy SK, Mandala GR. The report on the Indian coronary intervention data for the year 2017-National Interventional Council. Indian Heart J 2019;71:146-8.
13. Arramraju SK, Janapati RK, Sanjeeva Kumar E, Mandala GR. National interventional council data for the year 2018-India. Indian Heart J 2020;72:351-5.
14. Kasturi S, Prathap Kumar N. National Interventional Data for the Year 2022. Presented at the Cardiological Society of India- National Interventional Council (CSI-NIC) Mid-Term Meet. Hyderabad; 2023.
15. Sahoo PK, Kesavamoorthy B. National Interventional Data for the Year 2023. Presented at the Cardiological Society of India- National Interventional Council (CSI-NIC) Mid-Term Meet. Chennai; 2024.
16. Nagapetyan A, Drozd A, Subbotovsky D. How to determine the optimal number of cardiologists in a region? Mathematics 2023;11:4422.
17. Narang A, Sinha SS, Rajagopalan B, Ijioma NN, Jayaram N, Kithcart AP, *et al.* The supply and demand of the cardiovascular workforce: Striking the right balance. J Am Coll Cardiol 2016;68:1680-9.