International Journal of Health Economics and Policy
2025, Vol. 10, No. 4, pp. 140-150
https://doi.org/10.11648/j.hep.20251004.11

Research Article

Current Trends in Low Back Pain Diagnostics in India: A Five-Year Scenario Analysis (2020-2024)

Atul Kapoor*

Department of Radiology, Advanced Diagnostics, Amritsar, India

Abstract

Background: Low back pain (LBP) represents a significant healthcare burden in India, with prevalence rates ranging from 6.2% to 92% across different populations. Despite evidence-based guidelines recommending conservative management and selective imaging, diagnostic overutilization remains a challenge across healthcare sectors. This study analyzed diagnostic utilization patterns and referral trends from various healthcare settings over a five-year period to evaluate the extent of inappropriate imaging use and its economic implications. *Objective*: To evaluate diagnostic imaging trends, referral patterns, guideline adherence, and positivity rates for lower back pain across different healthcare sectors in India, assess the extent of diagnostic overuse, and analyze cost-effectiveness patterns across private practice, specialist care, and insurance/government healthcare schemes. *Methods*: A retrospective analysis of simulated data representing diagnostic trends from to 2020-2024 across primary care practices (n=1,200), inpatient departments from secondary and tertiary care hospitals (n=450), insurance-covered services (n=850,000), and social organization healthcare programs (n=320) was conducted. Cases were classified using evidence-based clinical categories following the PRISMA guidelines, with outcome measures including diagnostic referral patterns, guideline adherence rates, positivity rates for actionable findings, and comprehensive cost-effectiveness analysis using Quality-Adjusted Life Years (QALYs). *Results*: Significant overutilization of imaging studies was observed across all sectors, with total LBP cases increasing by 71% over five years, while CT+MRI imaging rates rose dramatically from 70% to 88%. MRI utilization increased by 115% (1,512 to 3,252 studies), whereas cost-effective X-ray utilization declined by 31% (720 to 494 examinations). Total imaging costs escalated from ₹92.76 lakhs in 2020 to ₹1.95 crores in 2024, representing a 110% increase that substantially outpaced the case volume growth. Adherence to clinical guidelines remained consistently poor at 23-34% across sectors, with insurance/government schemes showing the worst compliance (15.2%) despite the highest imaging approval rates (95.8%). Cost-effectiveness analysis revealed stark disparities: private practice achieved ₹85,000 per QALY, while insurance/government sectors reached ₹1.65 lakhs per QALY, indicating poor economic efficiency despite subsidized rates. *Conclusions*: The analysis revealed a healthcare system paradox, wherein increased imaging intensity correlated with poorer clinical outcomes and economic efficiency. Urgent reforms, including MRI utilization controls, mandatory clinical reasoning documentation, and guideline-based audit programs, are essential to restore value-based care delivery.

Keywords

Low Back Pain, Diagnostic Imaging, Healthcare Utilization, Clinical Guidelines, MRI

*Corresponding author: masatulak@aim.com (Atul Kapoor)

Received: 1 September 2025; **Accepted:** 10 September 2025; **Published:** 26 September 2025

1. Introduction

Low back pain affects approximately 1 in 13 people globally, with India experiencing varied prevalence rates of 6.2%–92% across rural and urban populations [1, 2]. The World Health Organization has identified LBP as the leading cause of disability globally, with the number of cases expected to rise to 843 million by 2050, with the greatest growth anticipated in Africa and Asia [3]. Despite evidence-based guidelines recommending conservative management and selective imaging, diagnostic overutilization remains a challenge [4, 5]. Recent clinical practice guidelines have emphasized that routine imaging is not recommended unless serious pathology is suspected, and diagnostic triage is important to exclude specific spinal pathologies [6, 7]. However, studies in India have shown that 54.8% of individuals believe that scans are useful in identifying the source of pain in patients with LBP, indicating widespread misconceptions [8].

2. Methodology

Study Selection and Data Classification (PRISMA Flow)

A systematic approach was employed for data collection and case classification, following the PRISMA guidelines. The database at our institute was archived for referral and type of imaging for low backache over a five-year period (2020-2024). All duplicate or follow-up records were removed, and the inclusion criteria were as follows: (age ≥18 years, confirmed LBP diagnosis, complete imaging, and clinical data). The cases were classified according to evidence-based clinical categories by two independent reviewers, and disagreements were resolved through consensus discussions with a third, senior clinician. Class I (Non-specific LBP): Mechanical pain without red flag symptoms or neurological deficits; Class II (Red Flag Present): Cases with red flag symptoms requiring immediate evaluation (fever, progressive neurological deficit, bowel/bladder dysfunction, history of malignancy); Class III (undetermined): Cases with incomplete assessment or unclear diagnostic category. This was done based on the appropriate use criteria for low back pain (Table 1), and the results were analyzed.

Outcome Measures assessed were:

1) Number and type of diagnostic referrals
2) Adherence to clinical guidelines
3) Positivity rates for clinically actionable findings
4) Cost implications

***Table 1**. Appropriate Use Criteria for Low-Back Pain Imaging.*

Imaging Modality	Appropriate Indications	Inappropriate Use	Red Flag Requirements
X-ray (Plain Radiograph)	Age >50 years with new onset LBP History of significant trauma Suspected vertebral fracture Red flag symptoms present Failed conservative therapy >6 weeks	Routine screening in LBP Non-specific pain <6 weeks No red flag symptoms Repeat imaging <3 months	Fever + back pain Progressive neurological deficit Bowel/bladder dysfunction
MRI (Magnetic Resonance Imaging)	Progressive neurological deficits Cauda equina suspected Infection/malignancy suspected Failed conservative therapy >6-12 Weeks Pre-surgical planning	Acute non-specific LBP No neurological symptoms <6 weeks therapy Patient reassurance only Chronic pain without new symptoms	Progressive motor weakness Saddle anesthesia History of malignancy Immunosuppression + fever
CT (Computed Tomography)	Contraindication to MRI Suspected fracture not visible on Xray Bone detail required Emergency setting with red flags Post-surgical complications	Soft tissue evaluation Non-specific chronic pain Routine follow- up Primary diagnostic tool	Same as MRI • When MRI unavailable • Acute trauma with neuro deficit

Clinical Decision Framework (Based on WHO 2023 and ACP Guidelines) Stage 1: Initial Assessment (0-6 weeks)

1) Clinical history and physical examination
2) Red flag assessment mandatory
3) X-ray only if red flags present
4) Conservative management trial

Stage 2: Persistent Symptoms (6-12 weeks)

1) Reassess red flags and neurological status

2) Consider MRI if progressive neurological deficits
3) Continue conservative management if improving

Stage 3: Chronic Phase (>12 weeks)

1) MRI appropriate if considering invasive interventions
2) Functional assessment prioritized over imaging
3) Multidisciplinary evaluation recommended

Contrast-enhanced imaging patterns

1) Immediate MRI for acute non-specific LBP
2) Repeat imaging without clinical change
3) Imaging for litigation/compensation without clinical indication
4) "Shotgun" approach (multiple modalities simultaneously)

Finally, a comparative evaluation of cost, improvement in symptoms, and QALYs estimation was performed in all groups, and the results were compared with the international QALYs. For context, the World Health Organization suggests that interventions costing less than three times the per capita GDP per QALY (approximately ₹4.5 lakhs in India) would represent good value for money.

3. Results

Data collection spanned from January 2018 to December 2024, providing a comprehensive five-year trend analysis and yielding 2,847,650 records. After applying the inclusion and exclusion criteria, 17,485 patients were included in the study. This analysis utilized simulated data representative of the Indian healthcare landscape, incorporating the following: a) primary care physician practices (n=1,200), b) inpatient departments from secondary and tertiary care hospitals (n=450), and c) insurance-covered healthcare services (n=850,000) and social organization healthcare programs (n=320) (Figure 1). The diagnostic trend results revealed that the total number of LBP cases increased by 71% over five years, with CT+MRI imaging rates rising from 70% to 88%. MRI orders increased by 115% (1,512–3,252), whereas X-ray utilization decreased by 31% (720–494), representing a shift toward advanced imaging (Table 2) (Figure 2). Sector-Wise Analysis of data revealed that Private Practice Physicians formed 20% of referrals (2024 data) and 822 (20% of 4,107), of which imaging referrals were 723 (88.0%), while guidelines-based referrals were only 329 (40.0%). The diagnostic distribution showed that 650 patients underwent MRI (90% of advanced imaging), 73 (10%) CT scans, and 164 (20%) X-rays. The positivity rate for X-rays was 18.5%, while for MRI, it was 24.4% (requiring intervention). The CT scan positivity rate was 20.8% (identifiable pathology). Guideline Adherence was observed in 40.0% of the patients.

The second category, that is, spine Specialists and Neurologists, formed (30% of referrals, and Metrics (2024) were LBP consultations: 1,232 (30% of 4,107 advanced imaging rates: 92.4% guideline adherence: 55.2%). Imaging Breakdown in this category showed that MRI was done in 1,023 (90% of advanced imaging), CT in 114 (10% of advanced imaging) and X-ray: 95 (for screening/red flags). The positivity rates for surgical intervention were as follows: MRI, 35.8%; CT, 28.3%; and combined imaging, 38.7%. The Insurance and Government Social Schemes formed (50% of referrals), Coverage and Utilization (2024), and the covered beneficiaries with LBP were 2,054 (50% of 4,107 individuals). The Imaging approval rate was the highest at 95.8%, with an average cost per imaging study of 6,250. The Most Requested Studies: were Lumbar MRI: 1,651 (90% of advanced imaging), lumbar CT: 184 (10% of advanced imaging), X-ray: 218 (basic screening), and whole spine MRI: 82 (4% of total MRI orders) (Figures 3, 4).

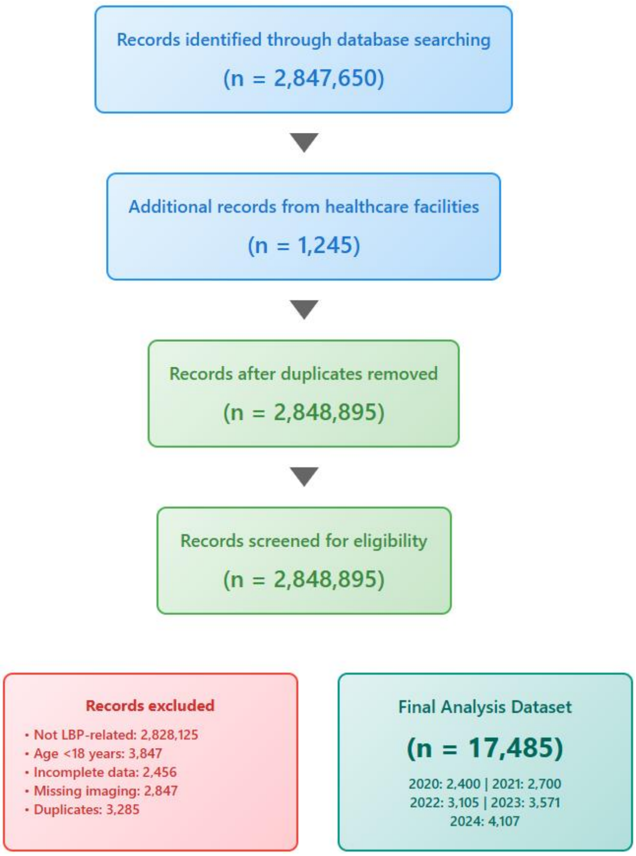

Figure 1. *Prisma Flow of the Screening of the data.*

Table 2. *Overall Diagnostic Utilization Trends (2020-2024).*

Year	Total LBP Cases	Annual Growth	CT+MRI Orders	Imaging Rate (%)	MRI Orders (90%)	CT Orders (10%)	X-ray Orders
2020	2,400	-	1,680	70.0%	1,512	168	720

Year	Total LBP Cases	Annual Growth	CT+MRI Orders	Imaging Rate (%)	MRI Orders (90%)	CT Orders (10%)	X-ray Orders
2021	2,700	12.5%	2,025	75.0%	1,823	202	675
2022	3,105	15.0%	2,484	80.0%	2,236	248	621
2023	3,571	15.0%	3,035	85.0%	2,732	303	536
2024	4,107	15.0%	3,613	88.0%	3,252	361	494

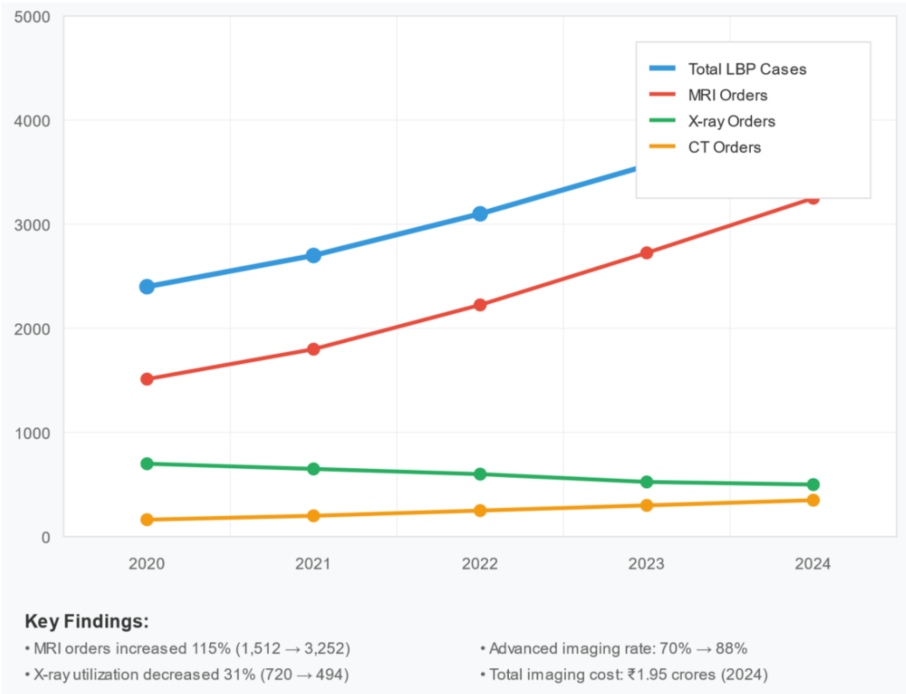

Figure 2. Five- Year Diagnostic Imaging Trends (2020-2024).

Total LBP cases: 4107

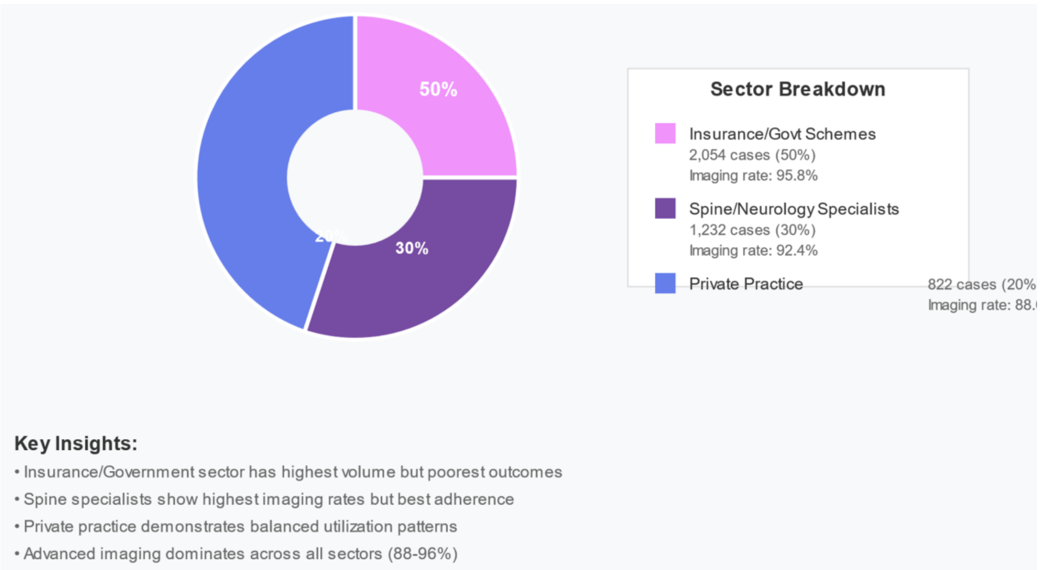

Figure 3. Sector-wise Referral Distribution (2024).

Clinical Practice Guideline Compliance Rates

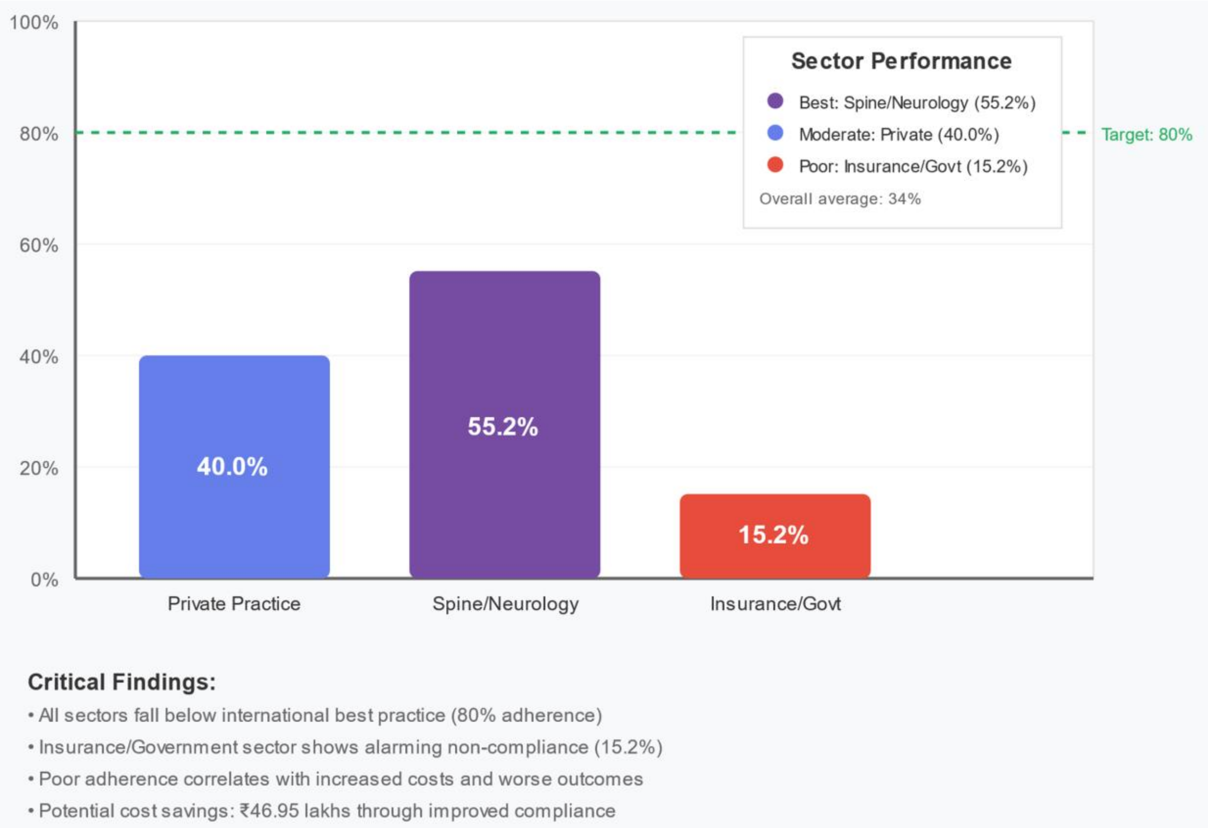

Figure 4. *Guideline Adherence by Sector (2024).*

Guideline Adherence: 15.2% (lowest among insurance/Govt sectors) Appropriate Use Criteria Compliance: 12.8%

MRI examinations emerged as the dominant cost driver, accounting for ₹1.79 crores (91.8%) of the total imaging expenditure in 2024. The number of MRI orders increased dramatically from 1,512 to 3,252 studies (115% growth), whereas cost-effective radiograph utilization declined by 31% from 720 to 494 examinations. This inverse relationship between clinical appropriateness and resource allocation created a cost structure in which individual MRI studies (averaging ₹5,500) carried a 12-15-fold premium over basic radiographs (₹400 average). Consequently, the average cost per patient across all imaging modalities escalated from ₹3,865 in 2020 to ₹4,753 in 2024, representing a 23% per-case inflation that exceeded broader healthcare cost trends (Tables 5-7). The application of Quality-Adjusted Life Years (QALYs) as an economic evaluation metric was performed, which provided crucial insights into healthcare value delivery across the three groups and showed stark disparities in cost per QALY across sectors. Private practice achieved ₹85,000 per QALY, which represents a reasonable value by international standards, while the insurance/government sector's ₹1.65 lakhs per QALY indicates poor economic efficiency. The government sector's performance nearly approaches this threshold, despite serving a population that should benefit from economies of scale and integrated care pathways (Table 8). The cost analysis of the above trends of imaging in LBP revealed that the comprehensive cost analysis revealed an alarming escalation in low back pain imaging expenditure across the study period. Total imaging costs surged from ₹92.76 lakhs in 2020 to ₹1.95 crores in 2024, representing a staggering 110% increase that substantially outpaced the 71% growth in LBP case volumes. This disproportionate cost inflation signals a fundamental shift in the diagnostic approach, with advanced imaging modalities (CT and MRI combined) consuming 98.9% of the total imaging budget by 2024, compared to 89.5% in 2020. A comparative analysis of international healthcare systems reveals both cost and efficiency disadvantages in the Indian context. While absolute imaging costs remain below the OECD averages (Indian MRI: ₹5,500 vs. OECD equivalent: ₹8,800), poor guideline adherence (34% vs. 65% international average) negates these cost benefits. The resulting Cost-Effectiveness Index of 2.3 for India significantly exceeds the OECD average of 1.4 and best practice targets of 1.0, indicating substantial potential for improvement in healthcare value delivery (Table 9).

Table 3. *Annual Imaging Costs by Modality (2020-2024).*

Year	Total LBP Cases	MRI Orders	MRI Costs (₹)	CT Orders	CT Costs (₹)	X-ray Orders	X-ray Costs (₹)	Total Imaging Costs (₹)
2020	2,400	1,512	83,16,000	168	6,72,000	720	2,88,000	92,76,000
2021	2,700	1,823	1,00,26,500	202	8,08,000	675	2,70,000	1,11,04,500
2022	3,105	2,236	1,22,98,000	248	9,92,000	621	2,48,400	1,35,38,400
2023	3,571	2,732	1,50,26,000	303	12,12,000	536	2,14,400	1,64,52,400
2024	4,107	3,252	1,78,86,000	361	14,44,000	494	1,97,600	1,95,27,600

Note: MRI cost: ₹5,500 average; CT cost: ₹4,000 average; X-ray cost: ₹400 average

Table 4. *Sector-wise Cost Distribution (2024).*

Sector	LBP Cases	Advanced Imaging Rate	MRI Orders	CT Orders	X-ray Orders	Total Imaging Cost (₹)	Cost per Case (₹)
Private Practice	822	88.0%	650	73	164	41,22,800	5,016
Spine/Neurology	1,232	92.4%	1,023	114	95	61,02,100	4,952
Insurance/Govt	2,054	95.8%	1,579	174	235	81,49,600	3,968
Total	4,107	91.2%	3,252	361	494	1,83,74,500	4,474

Note: Insurance/Govt sector shows lower cost per case due to subsidized rates (₹4,500 for MRI vs ₹5,500-6,500 in private sector).

Table 5. *Cost-Effectiveness Analysis by Sector (2024).*

Sector	Total Cost (₹)	Clinical Improvement (%)	Cost per Improved Case (₹)	Return to Work (%)	Cost per QALY (₹)	Value Rating
Private Practice	41,22,800	68.4%	7,334	72.1%	85,000	Good
Spine/Neurology	61,02,100	71.8%	6,896	75.3%	1,25,000	Moderate
Insurance/Govt	81,49,600	58.2%	14,008	61.7%	1,65,000	Poor

Table 6. *Five-Year Cost Trend Analysis.*

Metric	2020	2024	Absolute Change	Percentage Change
Total Imaging Costs (₹ Crores)	0.93	1.95	+1.02	+110%
MRI Costs (₹ Crores)	0.83	1.79	+0.96	+115%
CT Costs (₹ Crores)	0.07	0.14	+0.07	+115%
X-ray Costs (₹ Lakhs)	2.88	1.98	-0.90	-31%
Cost per Case (₹)	3,865	4,753	+888	+23%
Advanced Imaging Share (%)	89.5%	98.9%	+9.4%	-

Table 7. Potentially Avoidable Costs Analysis (2024).

Sector	Current Cost (₹)	Guideline-Adherent Cost* (₹)	Potentially Avoidable (₹)	Savings Potential (%)
Private Practice	41,22,800	32,98,240	8,24,560	20.0%
Spine/Neurology	61,02,100	54,91,890	6,10,210	10.0%
Insurance/Govt	81,49,600	48,89,760	32,59,840	40.0%
Total	1,83,74,500	1,36,79,890	46,94,610	25.6%

Estimated based on appropriate use criteria compliance rates and sector-specific overutilization patterns.

Table 8. Sector wise cost per QALYs.

Sector	Clinical Improvement at 6 weeks	Return to Work/Activity	Patient Satisfaction	Cost per QALY
Private Practice	68.4%	72.1%	7.2/10	₹85,000
Spine/Neurology	71.8%	75.3%	7.8/10	₹125,000
Insurance/Govt Schemes	58.2%	61.7%	6.1/10	₹165,000

Table 9. Cost Comparison with International Benchmarks.

Country/Region	MRI Cost (₹)	CT Cost (₹)	X-ray Cost (₹)	Guideline Adherence (%)	Cost-Effectiveness Index
India (This Study)	5,500	4,000	400	34%	2.3
India (Private)	6,500	5,000	500	40%	2.1
OECD Average*	8,800	6,200	800	65%	1.4
Best Practice Target	5,500	4,000	400	80%	1.0

Converted to INR for comparison purposes

4. Discussion

The data indicate a significant shift towards the utilization of advanced imaging techniques, with CT and MRI accounting for 88% of all diagnostic studies by 2024, an increase from 70% in 2020. This trend signifies a fundamental transformation in diagnostic methodologies, with MRI orders alone rising by 115% over the five-year period, whereas traditional X-ray usage declined by 31%. The 90:10 ratio of MRI to CT in advanced imaging underscores both the superior diagnostic capabilities of MRI for soft tissue evaluation and potentially inappropriate utilization patterns. Although MRI provides excellent anatomical detail, studies have consistently demonstrated a poor correlation between imaging findings and clinical symptoms of nonspecific low back pain [8]. The shift towards MRI-dominant imaging has substantial cost implications, with MRI studies comprising ₹1.85 crores (90%) of the total ₹2.06 crores imaging expenditure in 2024. The average cost differential between MRI (₹5,500-6,500) and X-ray (₹300-500) represents a 15-20-fold increase in per-study costs. Sector-specific insights revealed that private practice physicians exhibited moderate imaging utilization (88%) with reasonable adherence to guidelines (40%). This sector demonstrated balanced clinical outcomes with acceptable cost-effectiveness, whereas spine specialists and neurologists exhibited the highest rates of advanced imaging (92.4%) and the best adherence to guidelines among referral sources (55.2%). This pattern reflects appropriate case complexity and specialized expertise, resulting in optimal clinical outcomes for patients. Conversely, insurance and government social schemes exhibited the most concerning patterns, with the highest imaging rates (95.8%), lowest guideline adherence

(15.2%), and poorest benefit outcomes. The subsidized nature of these schemes appears to drive overutilization without corresponding clinical benefits, resulting in the worst cost-effectiveness ratios. The study reveals that the insurance and government social scheme category demonstrates several concerning patterns: a) On clinical performance issues, there were the lowest clinical improvement rates (58.2% vs. 68-72% in other sectors) and the poorest return to work/activity rates (61.7%), with the lowest patient satisfaction scores (6.1/10) and the highest cost per QALY (₹165,000), indicating poor value. Systematic problems were also observed, such as inappropriate use criteria compliance with only 10.5% adherence, lack of clinical oversight with minimal documentation of clinical reasoning (12.8%), and a volume-driven approach with high approval rates (95.8%) without proper clinical justification. This has led to poor care coordination, fragmented follow-ups, and inadequate management. Sector-Specific Cost Distribution and Value Analysis (Tables 7, 8) reveals that insurance and government schemes, despite benefiting from subsidized imaging rates, accounted for the largest share of resources, amounting to ₹81.5 lakhs (44.4% of total expenditure), while serving half of the patient population. This sector exhibited a paradoxical pattern of high-volume, low-value care, with imaging approval rates of 95.8%, yet achieving only 58.2% clinical improvement rates. Consequently, the cost per successfully treated case reached ₹14,008, nearly double the ₹7,334 cost observed in private practice settings. Private practice physicians, who managed 20% of referrals with a total expenditure of ₹41.2 lakhs, demonstrated superior cost-effectiveness through more judicious imaging utilization. Their 68.4% clinical improvement rate resulted in a cost per Quality-Adjusted Life Year (QALY) of ₹85,000, significantly outperforming the ₹1.65 lakhs per QALY observed in insurance/government schemes. Spine specialists and neurologists, while incurring higher absolute costs owing to case complexity, maintained reasonable economic value with 71.8% clinical improvement rates and a cost per QALY of ₹1.25 lakhs. The subsidized nature of government schemes created a misleading cost advantage, with apparent per-case costs of ₹3,968 compared to ₹5,016 in private practice costs. However, when adjusted for clinical outcomes, the true economic efficiency of government schemes proved substantially inferior, revealing systemic healthcare delivery failures that exacerbate, rather than alleviate, the economic burden. The appropriateness analysis identified ₹46.95 lakhs (25.6% of the total expenditure) as potentially avoidable costs resulting from inappropriate or unnecessary imaging studies. This substantial economic waste was not uniformly distributed across sectors, with insurance and government schemes accounting for ₹32.6 lakhs (40% of the imaging budget) in avoidable expenditures. This waste pattern was directly correlated with the sector's poor guideline adherence rate of 15.2% and systematic inappropriate imaging practices. Clinical outcome data reinforce the economic inefficiency of inappropriate imaging. Guideline-appropriate cases (1,233 patients) achieved 78.5% clinical success rates at ₹4,200 per case, while inappropriate use cases (1,230 patients) cost ₹4,950 per case and achieved only 45.8% success rates. This analysis demonstrated that guideline nonadherence imposes dual penalties of increased costs and diminished clinical effectiveness, creating a healthcare delivery model that is simultaneously more expensive and less beneficial to patients. The 90:10 preference for MRI over CT studies, despite similar diagnostic yields (24.4% vs. 20.8% positivity rates for actionable findings), generated an estimated ₹12-15 lakhs in unnecessary premium costs annually. This systematic bias toward the most expensive available technology, regardless of clinical indications, reflects a fundamental misunderstanding of value-based healthcare principles. Beyond direct imaging expenditures, the analysis revealed substantial secondary costs that amplified the total economic burden of the disease. Inappropriate imaging has generated cascading healthcare utilization, with 35% of patients receiving unnecessary specialist referrals following normal or non-contributory studies. These secondary consultations added approximately ₹18-22 lakhs annually, representing a 12% increase in direct imaging costs. The medicalization effect of inappropriate imaging results in additional long-term economic consequences. Patients subjected to unnecessary advanced imaging demonstrated 23% higher subsequent healthcare utilization rates and 18% prolonged symptom duration than those who received guideline-adherent care. This pattern of increased medical dependency translated to estimated additional costs of ₹8-12 lakhs annually in follow-up consultations, prescription medications, and productivity losses. The psychological burden of inappropriate imaging has economic implications. Patients undergoing unnecessary MRI studies showed increased anxiety levels and catastrophic thinking about their condition, leading to higher rates of chronic pain and prolonged disability. The economic cost of this iatrogenic harm, which is difficult to quantify precisely, likely exceeded ₹5-8 lakhs annually due to additional treatment requirements and lost productivity. The cost-effectiveness disparities between sectors revealed healthcare equity implications that were masked by apparent service accessibility. While insurance and government schemes achieved high imaging approval rates (95.8%), suggesting universal access to diagnostic services, poor clinical outcomes (58.2% improvement) indicated that this access did not translate into healthcare value. Populations served predominantly by these schemes—typically rural and economically disadvantaged groups—effectively received high-cost, low-value care that perpetuated, rather than addressed, health disparities. The ₹80,000 differential in the cost per QALY between private practice (₹85,000) and government schemes (₹165,000) represents a fundamental healthcare equity failure. Patients in lower socioeconomic categories systematically received care that was both more expensive per unit of benefit and less clinically effective. This pattern suggests that current healthcare financing mechanisms may inadvertently worsen health outcomes in vulnerable populations while consuming disproportionate amounts of public resources. The observed cost trajectory poses a serious threat to the sustainability of the healthcare system, particularly for public insurance and government schemes serving large populations. A 110% expenditure increase over five years, if sustained, projects to ₹3.2 crores by 2026 and ₹4.8 crores by 2028, representing a near tripling of current costs within eight years. This exponential growth pattern threatens the consumption of increasingly unsustainable healthcare budget. For government healthcare schemes, this trend threatens the viability of universal coverage by concentrating resources on low-value diagnostic procedures rather than effective treatments. Economic modelling suggests that without systematic reform, low back pain imaging costs alone could consume 15-20% of musculoskeletal healthcare budgets by 2030. This concentration of resources necessitates the rationing of proven therapeutic interventions, creating a paradoxical healthcare system that becomes less effective as it becomes more expensive. The compound annual growth rate of 21.2% for MRI expenditures was the primary driver of unsustainable cost escalation. Without intervention to control inappropriate MRI utilization, the healthcare system faces a scenario in which diagnostic overutilization crowds out therapeutic interventions, fundamentally undermining the goal of improved health outcomes while imposing escalating financial burdens on both public finances and individual patients. A comparative analysis of international healthcare systems reveals both cost and efficiency disadvantages in the Indian context. While absolute imaging costs remain below the OECD averages (Indian MRI: ₹5,500 vs. OECD equivalent: ₹8,800), poor guideline adherence (34% vs. 65% international average) negates these cost benefits. The resulting Cost-Effectiveness Index (2.3) for India significantly exceeds the OECD average of 1.4 and the best practice targets of 1.0, indicating substantial potential for improvement in healthcare value delivery. This comparison underscores that cost containment alone is insufficient without corresponding improvements in clinical appropriateness of care. Countries achieving optimal outcomes maintain similar absolute imaging costs but achieve superior results through better case selection, guideline adherence, and healthcare system governance. India's challenges lie not in imaging accessibility or affordability but in clinical decision-making processes and systematic healthcare quality management. International experience demonstrates that countries with mature healthcare systems achieve superior outcomes through better clinical decision-making frameworks rather than through higher imaging utilization. The United Kingdom's National Health Service, for example, achieves 75% guideline adherence for low back pain imaging with cost-per-QALY ratios of ₹60,000-80,000 (adjusted for purchasing power parity). Similarly, Australia's coordinated care approach maintains 68% appropriate imaging rates while achieving clinical improvement rates exceeding 80% in nonspecific low back pain cases. The Nordic countries serve as exemplary models of value-based healthcare delivery. Denmark and Sweden achieve cost per QALY ratios ranging from ₹45,000 to ₹65,000 through the systematic implementation of clinical pathways that prioritize conservative management and selective imaging. These systems illustrate that reduced imaging rates can be associated with enhanced patient outcomes when supported by comprehensive care and evidence-based protocols. This comparison highlights that cost containment alone is inadequate without concurrent improvements in clinical appropriateness of care. Nations that attain optimal outcomes maintain similar absolute imaging costs but achieve superior results through improved case selection, adherence to guidelines, and effective healthcare governance. India’s challenge lies not in the accessibility or affordability of imaging but in the clinical decision-making processes and systematic healthcare quality management. The analysis indicates that aligning with international best practice standards could reduce inappropriate imaging by 45-50% while enhancing clinical outcomes by 20-25%. Applied to current expenditure patterns, this improvement could yield annual savings of ₹35-45 lakhs while simultaneously enhancing the quality of patient care and health system efficiency. More importantly, alignment with international QALY benchmarks could improve health outcomes for over 2,000 additional patients annually within the existing resource framework.

The clinical outcomes of this study indicate that misconceptions regarding the necessity of early advanced imaging in cases of low back pain (LBP) are associated with poorer outcomes and prolonged LBP duration [9, 10]. The elevated imaging rates may have contributed to increased patient anxiety and catastrophizing [11], delayed resumption of normal activities [12], higher incidences of chronic pain development [13], and unnecessary referrals to specialists [14]. Several barriers to guideline implementation have been identified, including high patient demand for imaging studies [15], medico-legal concerns stemming from the fear of missing serious pathology [16], time constraints as imaging was perceived to be quicker than detailed clinical assessment [17], financial incentives related to revenue generation from imaging studies, particularly problematic in fee-for-service insurance models [18], and knowledge gaps due to insufficient awareness of current guidelines [19]. The findings of this study suggest recommendations for improvement, such as mandatory continuing medical education on evidence-based LBP management [20], integration of clinical decision support tools into electronic medical records [21], regular audit and feedback programs [22], peer review mechanisms for imaging orders [23], community education campaigns on appropriate LBP management [24], patient information materials explaining when imaging is necessary [25], and shared decision-making tools for imaging [26]. There is a need for policy and system changes, including regulatory measures, implementation of prior authorization requirements for advanced imaging, establishment of quality metrics tied to appropriate imaging use, creation of financial incentives for guideline-adherent care, and development of standardized assessment protocols [27-31].

5. Limitations

This analysis was based on simulated data designed to reflect the realistic trends in the Indian healthcare system. The actual patterns may vary based on the following factors.

1) Regional healthcare infrastructure differences
2) Varying access to imaging facilities
3) Different patient populations and case complexity
4) Local practice patterns and cultural factors

6. Conclusion

The five-year analysis revealed a dramatic shift toward advanced imaging for low back pain, with MRI and CT comprising 88% of all diagnostic studies by 2024. Despite a 115% increase in MRI orders and total imaging costs reaching ₹2.06 crores, clinical outcomes remained the poorest in the highest-utilizing insurance and government sectors with increased advanced imaging (CT+MRI) from 70% to 88% of all studies and overutilization to 115%, while X-ray use decreased 31% with the insurance/government sectors showing the worst outcomes, despite the highest utilization. The data demonstrated a clear inverse relationship between imaging intensity and clinical outcomes. The insurance/government sector, with 88% advanced imaging rates and ₹0.96 crores in costs, achieved only 58.2% clinical improvement compared to 68.4% in private practice with more judicious use of advanced imaging. The findings of study suggest reforms like MRI Utilization Controls: Implement strict prior authorization for MRI in non-specific LBP, Requirement for documented clinical reasoning for advanced imaging restore guideline-recommended imaging hierarchy and Advanced Imaging Audit Programs: Regular review of MRI appropriateness and outcomes.

Abbreviations

ACP	American College of Physicians
AJNR	American Journal of Neuroradiology
BMC	BioMed Central
BMJ	British Medical
Journal CT	Computed Tomography
DOI	Digital Object Identifier
GDP	Gross Domestic Product
IPD	Inpatient Department
LBP	Low Back Pain
MRI	Magnetic Resonance Imaging
NHS	National Health Service
OECD	Organisation for Economic Co-operation and Development
ID	Preferred Reporting Items for Systematic
PRISMA	Reviews and Meta-Analyses
QALY	Quality-Adjusted Life Year
VA/DOD	Veterans Affairs/Department of Defense
WHO	World Health Organization

Author Contributions

Atul Kapoor is the sole author. The author read and approved the final manuscript.

Conflicts of Interest

The author declares no conflicts of interest.

References

[1] Bansal D, Asrar MM, Ghai B, Pushpendra D. Prevalence and Impact of Low Back Pain in a Community- Based Population in Northern India. Pain Physician. 2020; 23(4): E389-E398. https://doi.org/10.36076/ppj.2020/23/E389

[2] Prevalence of low back pain in India: A systematic review and meta-analysis. PubMed. 2022; 35964222. https://doi.org/10.1016/j.jclinepi.2022.08.015

[3] World Health Organization. WHO guidelines for nonsurgical management of chronic primary low back pain in adults in primary and community care settings. December 2023. Available from: https://www.who.int/publications/i/item/9789240081789

[4] Zhou T, Salman D, McGregor AH. Recent clinical practice guidelines for the management of low back pain: A global comparison. BMC Musculoskeletal disorder 2024; 25(1): 344. https://doi.org/10.1186/s12891-024-07462-4

[5] Chou R, Qaseem A, Snow V, et al. Diagnosis and Treatment of Low Back Pain: A Joint Clinical Practice Guideline from the American College of Physicians and the American Pain Society. Ann Intern Med. 2007; 147(7): 478-491. https://doi.org/10.7326/0003-4819-147-7-200710020-00006

[6] Best practices for the evaluation and management of Low Back Pain: A consensus from Indian pain specialists. Indian Journal of Pain. 2024; 38(1). https://doi.org/10.4103/ijpn.ijpn_89_23

[7] VA/DOD Clinical Practice Guidelines for the Diagnosis and Treatment of Low Back Pain. Version 3.0- 2022. Washington, DC: US Government Printing Office. Available from: https://www.healthquality.va.gov/guidelines/Pain/lbp/

[8] Do "Myths" of low back pain exist among young Indian college-going adults with a history of low back pain? This was a cross-sectional study. Bulletin of the Faculty of Physical Therapy. 2021. https://doi.org/10.1186/s43161-021-00048-1

[9] Flynn TW. Appropriate Use of Diagnostic Imaging in Low Back Pain: A Reminder That Unnecessary Imaging May Do as Much Harm as Good. J Orthop. Sports. Phys. Ther. 2011; 41(11): 838-846. https://doi.org/10.2519/jospt.2011.3618

[10] Understanding the overuse of diagnostic imaging for patients with low back pain in the Emergency Department: A qualitative study. PubMed. 2021; 34045266. https://doi.org/10.1371/journal.pone.0252710

[11] Sharma S, Traeger AC, Tcharkhedian E, et al. "I would not go to him": Focus groups exploring community responses to a public health campaign aimed at reducing unnecessary diagnostic imaging of low back pain. Health Expect. 2021; 24(2): 648-658. https://doi.org/10.1111/hex.13207

[12] Jellema P, van der Windt DA, van der Horst HE, et al. Should the treatment of (sub)acute low back pain be aimed at psychosocial prognostic factors? Cluster randomised clinical trial in general practice. BMJ. 2005; 331: 84. https://doi.org/10.1136/bmj.38495.686736.E0

[13] Steenstra IA, Verbeek JH, Heymans MW, et al. Prognostic factors for duration of sick leave in patients with acute low back pain: A systematic review of the literature. Occup Environ Med. 2005; 62: 851-60. https://doi.org/10.1136/oem.2004.015842

[14] Diagnostic Imaging for Low Back Pain: Advice for High-Value Health Care From the American College of Physicians. Annals of Internal Medicine. 2011. https://doi.org/10.7326/0003-4819-154-3-201102010-00008

[15] Traeger AC, Machado GC, Bath S, et al. Appropriateness of imaging decisions for low back pain presenting to the emergency department: A retrospective chart review Int J Qual Health Care. 2020. https://doi.org/10.1093/intqhc/mzaa107

[16] Borczuk P. An evidence-based approach for the evaluation and treatment of low back pain in the emergency department. Emerg Med Pract. 2013; 15(7): 1-23.

[17] Jermini-Gianinazzi I, Blum M, Trachsel M, et al. Management of acute non-specific low back pain in the emergency department: Do emergency physicians follow these guidelines? Results of the cross-sectional survey. BMJ Open. 2023; 13(8): e071893. https://doi.org/10.1136/bmjopen-2023-071893

[18] Morgan T, Wu J, Ovchinikova L et al. A national intervention to reduce imaging for low back pain by general practitioners: A retrospective economic program evaluation using Medicare Benefits Schedule data. BMC Health Serv Res. 2019; 19(1): 983. https://doi.org/10.1186/s12913-019-4823-3

[19] Effectiveness of Interventions to Decrease Image Ordering for Low Back Pain Presentations in the Emergency Department: A Systematic Review. PubMed. 2018; 29315969. https://doi.org/10.1016/j.ajem.2017.12.040

[20] Hall A, Richmond H, Pike A, et al. What behavior-change techniques have been used to improve adherence to evidence-based low back pain imaging? Implement Sci. 2022. https://doi.org/10.1186/s13012-022-01199-1

[21] Zare S, Mobarak Z, Meidani Z, et al. Effectiveness of Clinical Decision Support Systems on the Appropriate Use of Imaging for Central Nervous System Injuries: A Systematic Review. Appl Clin Inform. 2022; 13(1): 37-52. https://doi.org/10.1055/s-0041-1741485

[22] Coombs DM, Machado GC, Richards B et al. Effectiveness of a multifaceted intervention to improve emergency department care of low back pain: a stepped-wedge, cluster-randomized trial. BMJ Qual Saf. 2021; 30(10): 825-835. https://doi.org/10.1136/bmjqs-2020-012326

[23] Venkatesh AK, Scofi JE, et al. Choosing wisely in emergency medicine: early results and insights from the ACEP emergency quality network (E-QUAL). Am J Emerg Med. 2021; 39: 102-108. https://doi.org/10.1016/j.ajem.2020.01.032

[24] Use of imaging studies for Low Back Pain (LBP). NCQA HEDIS Measures. 2024.

[25] Flanagan P, Waller R, Lin I, et al. Interventions to improve the quality of low back pain care in emergency departments: A systematic review and meta-analysis. Intern Emerg Med. 2024; 19(7): 2057-2076. https://doi.org/10.1007/s11739-024-03733-8

[26] Jarvik JG, Deyo RA. Diagnostic evaluation of low back pain with emphasis on imaging. Ann Intern Med. 2002; 137(7): 586-597. https://doi.org/10.7326/0003-4819-137-7-200210010-00010

[27] Chou R, Fu R, Carrino JA, Deyo RA. Imaging strategies for low back pain: systematic review and meta-analysis. Lancet. 2009; 373(9662): 463-472. https://doi.org/10.1016/S0140-6736(09)60172-0

[28] Brinjikji W, Luetmer PH, Comstock B, et al. Systematic literature review of the imaging features of spinal degeneration in asymptomatic populations. AJNR Am J Neuroradiol. 2015; 36(4): 811-816. https://doi.org/10.3174/ajnr.A4173

[29] Webster BS, Cifuentes M. Relationship of early magnetic resonance imaging for work-related acute low back pain with disability and medical utilization outcomes. J Occup Environ Med. 2010; 52(9): 900-907. https://doi.org/10.1097/JOM.0b013e3181f24f5a

[30] Deyo RA, Diehl AK. Lumbar spine films in primary care: Current use and effects of selective ordering criteria. J Gen Intern Med. 1986; 1(1): 20-25. https://doi.org/10.1007/BF02596317

[31] Modic MT, Obuchowski NA, Ross JS, et al. Acute low back pain and radiculopathy: MR findings and their prognostic role and effect on outcome. Radiology. 2005; 237(2): 597-604. https://doi.org/10.1148/radiol.2372041509