REDUCING WAIT TIMES FOR UNSCHEDULED OUTPATIENT CT AND ULTRASOUND SERVICES IN INDIAN TERTIARY-CARE HOSPITALS: A NARRATIVE REVIEW OF PATIENT FLOW INTERVENTIONS

Aahana Sujnani
CHRIST (Deemed to be University), Bengaluru, India —
aahana.sujnani@bsclsh.christuniversity.in

Abstract

Background: Long waiting times in outpatient diagnostic imaging remain a persistent source of patient dissatisfaction in Indian tertiary-care hospitals, particularly for computed tomography (CT) and ultrasound (USG) services. Unlike magnetic resonance imaging (MRI), which is typically scheduled in advance, outpatient CT and ultrasound studies in India are frequently ordered reactively. A physician examines a patient in the outpatient department (OPD) and determines at that moment that imaging is required. Because most Indian tertiary-care hospitals, both private and government-run, continue to process such requests on a first-come, first-served walk-in basis, patients commonly experience wait times far exceeding the actual scan duration.

Objective: To synthesise Indian and international literature on outpatient waiting-time patterns and workflow interventions relevant to unscheduled CT and ultrasound demand, and to propose an operational framework adapted specifically to Indian hospital imaging departments.

Methods: A narrative review was conducted using web-based academic search tools between July and August 2026, combining Indian hospital-based waiting-time literature with international radiology-specific workflow-improvement studies.

Results: Indian outpatient department (OPD) waiting-time studies consistently document waits of 90–120 minutes or more against consultation or procedure times of only a few minutes. The delay is attributable primarily to departmental process factors rather than patient behaviour. Radiology-specific Indian evidence remains comparatively limited, while international literature demonstrates that Lean/Value-Stream-Mapping interventions, decoupled emergency pathways, and predictive scheduling can substantially reduce imaging wait times.

Conclusion: A seven-point operational framework adapted to the Indian walk-in, physician-initiated imaging model is proposed. It covers real-time order transmission, decoupled billing, predictive staffing, priority-weighted queuing, parallel preparation, transparent queue communication, and turnaround-time monitoring. The framework is intended as a starting point for prospective quality-improvement work in Indian radiology departments.

Keywords: radiology patient flow; outpatient imaging; turnaround time; Lean Six Sigma; queue management; India; computed tomography; ultrasound

1. Introduction

This review originated from direct clinical observation. During an internship in the radiology department of a tertiary-care hospital in Bengaluru, I observed that patients waiting for computed tomography (CT) and ultrasound (USG) examinations frequently displayed visible frustration during prolonged waiting periods, despite the examinations themselves typically requiring only 10–20 minutes to perform. This gap between short procedure times and long, visibly distressing waits raised a specific question: why does this mismatch persist in outpatient imaging departments, and what operational factors make it difficult to resolve through routine scheduling?

Diagnostic imaging is one of the most frequent points of contact between patients and hospital services in India, and the experience patients have while waiting for these examinations disproportionately shapes their overall perception of care quality. Indian outpatient department (OPD) studies have repeatedly documented mean waiting times well beyond patients' consultation or procedure time. A cross-sectional study at a tertiary-care hospital in Kolkata recorded a mean OPD waiting time of 98.6 minutes against a mean consultation time of only 6.5 minutes [1]. Within radiology specifically, a study conducted across the Neurology, Pathology, and Radiology departments of a tertiary-care Armed Forces hospital in northern India found that while 95% of patients spent under 30 minutes at registration, 29% of patients undergoing radiology investigations still waited more than 30 minutes for the investigation itself, and a further 14% waited 20–25 minutes [2]. This indicates that delay concentrates at the imaging step rather than at entry into the hospital system.

This pattern reflects a structural feature of CT and ultrasound demand that is easy to overlook. Unlike MRI, which is long and resource-intensive enough that advance appointment scheduling is standard practice, CT and ultrasound studies are frequently ordered reactively during an OPD consultation. A physician examines a patient and determines at that moment that imaging is required. In many Indian tertiary-care hospitals, whether large private chains or government and military-run institutions, CT and ultrasound services therefore continue to operate on a first-come, first-served walk-in basis, with inpatient and outpatient cases interleaved by arrival order rather than by a booked slot system.

A separate but related body of Indian health-services research has examined OPD waiting time and patient flow more broadly. One widely cited study of a North Indian tertiary hospital found that 71% of patient waiting time was attributable to factors within the department itself rather than to patient behaviour [3]. Queuing-network and discrete-event simulation studies at Indian hospitals have also demonstrated that structured resource modelling can meaningfully reduce excessive waits [4,5]. However, this literature has focused predominantly on general OPD consultation flow rather than on the imaging department specifically, and only one Indian study identified in this review, a Lean Six Sigma project at a tertiary-care hospital radiology department in Kolkata, directly addresses radiology turnaround time [6]. By contrast, substantial international literature exists on imaging-specific workflow interventions, but it comes almost entirely from appointment-capable, insur-ance-billed health systems in the United States and Europe, where the underlying operational constraints differ considerably from a walk-in, cash- or scheme-billed Indian OPD-to-radiology pathway.

This review therefore aims to (1) bring together Indian OPD and hospital waiting-time

literature with international radiology-specific workflow-improvement literature, and (2) propose an operational framework adapted to Indian tertiary-care imaging departments, where CT and ultrasound demand is generated reactively and cannot be pre-scheduled.

2. Methods

This narrative review synthesises Indian and international literature on outpatient imaging wait-time interventions using a structured, reproducible search and selection process. Literature was identified through keyword searches of PubMed-indexed content, Google Scholar, ScienceDirect, ResearchGate, and publisher databases, conducted across multiple sessions in July–August 2026. As a narrative rather than systematic review, sources were selected for thematic and methodological relevance to unscheduled, physician-initiated outpatient CT and ultrasound demand. Indian-context studies were prioritised, while international radiol-ogy-specific workflow literature supplemented areas where Indian imaging-specific evidence was limited.

More than 20 keyword-based search queries were conducted, using combinations of "OPD waiting time India," "radiology patient flow India," "outpatient CT ultrasound wait time," "Lean Six Sigma radiology," "hospital queuing India," and "diagnostic imaging turnaround time." Approximately 30 candidate sources were identified, including several located through citation snowballing from related literature. Sources were retained if they addressed outpatient or emergency-department wait-time or patient-flow interventions in radiology or general OPD settings. Sources focused exclusively on MRI appointment-scheduling optimisation or lacking accessible findings were excluded.

Bibliographic details for all citations were verified against primary source records (PubMed, DOI, or publisher metadata) prior to inclusion. Seventeen studies met the relevance criteria and were included in this review: 9 from Indian hospital or health-systems settings and 8 from international radiology-specific workflow-improvement literature.

Figure 1. Literature Search and Study Selection Process

Narrative review — outpatient CT/ultrasound wait-time interventions

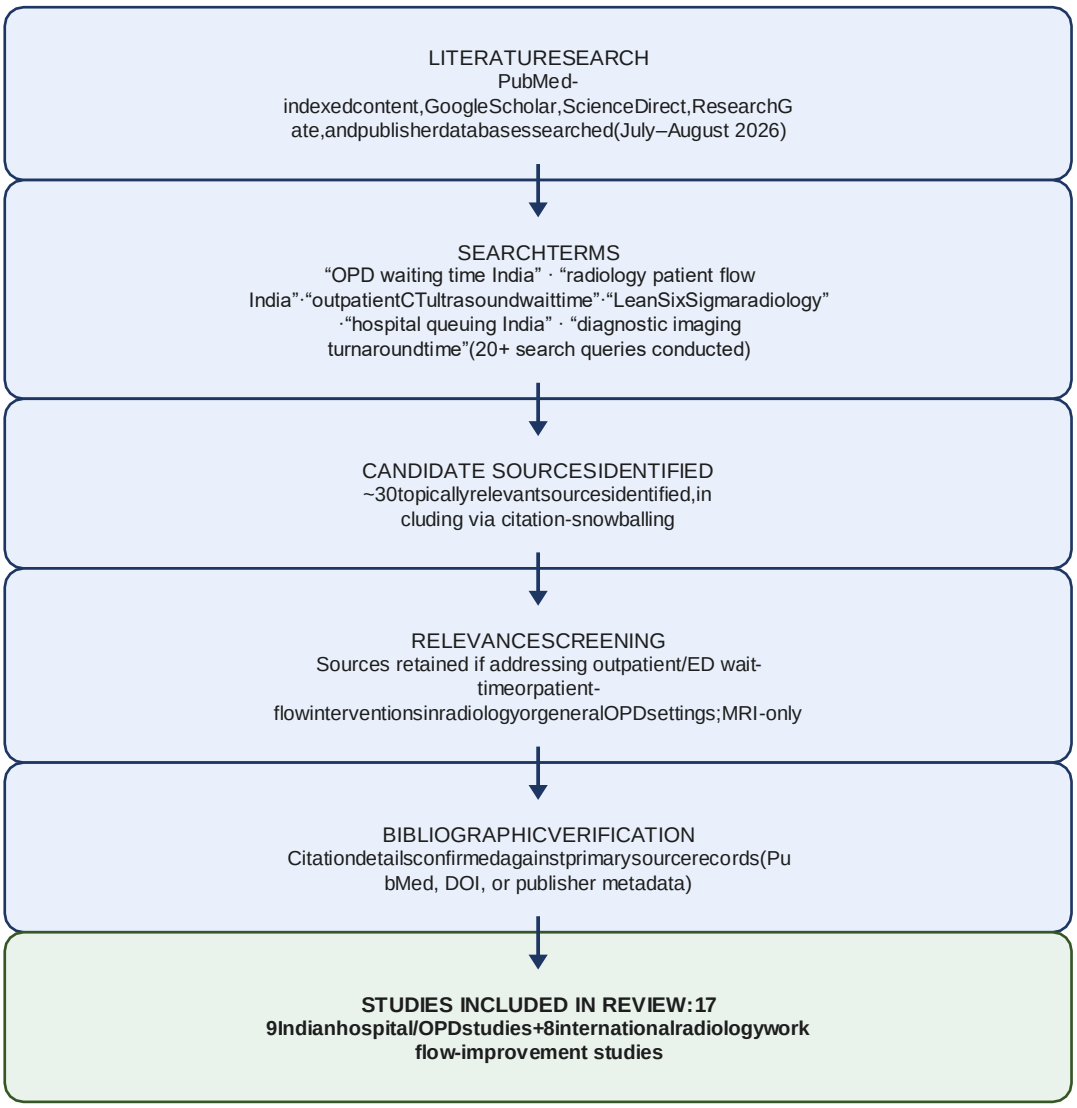

Figure 1. Literature search and study selection process.

3. Results

3.1 The scale of outpatient waiting time in Indian tertiary-care hospitals

Several Indian studies have quantified the gap between OPD waiting time and actual service time. At a tertiary-care teaching hospital in Kolkata, a cross-sectional study of 432 patients recorded a mean waiting time of 98.6 minutes (SD 45.4) against a mean consultation time of 6.5 minutes, with waiting time highest in general medicine OPD (mean 122 minutes) [1]. A study at a tertiary-care Armed Forces hospital in northern India, examining patients across Neurology, Pathology, and Radiology departments, found that while registration itself was rapid, with 95% of patients completing it in under 30 minutes, 29% of patients undergoing radiology investigations waited more than 30 minutes for the investigation itself [2]. A cross-sectional study at a tertiary-care teaching hospital in Uttarakhand used direct observation and a structured data-collection sheet across 300 radiation oncology OPD patients to

separately quantify waiting time and consultation duration [7]. Most fundamentally, a study of a North Indian tertiary-level emergency OPD found that 71% of total patient waiting time was attributable to factors internal to the department, not to patient arrival patterns or behaviour [3]. This reframes waiting time as a solvable operational problem rather than an unavoidable consequence of patient volume.

3.2 Structured resource and queuing models applied in Indian OPDs

A small but growing body of Indian research has applied formal operations-research methods to hospital patient flow. A discrete-event simulation study at an apex cancer institute in India identified physician utilisation rates of 83.5% as a critical bottleneck constraining OPD throughput [4]. A queuing-network analysis of a multispecialty rural hospital in Gujarat, based on data from 438 patients, found a median total time in the hospital system of 44 minutes (range 7.6–382 minutes), with day of arrival, time of arrival, and service category all significantly associated with waiting time [5]. In a heavily loaded orthopaedic OPD setting, a structured urgency-categorisation concept termed "OPD TRIAGE," evaluated across 1,800 patients, demonstrated measurable improvement in both patient and doctor satisfaction on triage days [8]. These studies collectively show that Indian OPDs have a domestic evidence base for operations-research-driven improvement, although none is specific to the radiology or imaging department.

3.3 India-specific radiology workflow intervention

The clearest India-specific precedent for this review's focus is a Lean Six Sigma DMAIC (Define-Measure-Analyze-Improve-Control) project conducted at a tertiary-care hospital radiology department in Kolkata [6]. The project used direct process observation, known as a "Gemba walk," and a formal time-motion study to identify root causes of delay, then used Pareto analysis to prioritise interventions. Improvements focused on increasing patient orientation and preparedness before the scan to reduce pre-test waiting time, alongside streamlining the reporting process to reduce post-test waiting time. This remains one of very few published India-specific studies applying structured process-improvement methodology directly to a radiology department's turnaround time, underscoring the gap this review seeks to address.

3.4 International comparative evidence: CT/ultrasound-specific workflow interventions

Where Indian imaging-specific evidence is limited, international literature offers transferable operational principles, even though these systems differ from India's largely walk-in, cash- or government-scheme-billed model. A systematic review of 57 studies evaluating service-delivery initiatives aimed at reducing patient waiting times in clinical radiology departments found consistent evidence that scheduling, staffing, and process-redesign interventions can meaningfully reduce wait times, although nearly all included studies originated from the UK, US, or other high-income settings [9]. At Temple University Hospital in Philadelphia, a Value Stream Mapping-based quality-improvement project found that a large share of in-department delay stemmed from administrative verification tasks being completed only after the patient arrived. Moving this verification earlier reduced total time from arrival to exam completion from three hours to one hour, and true process time from 87 minutes to 32 minutes [10]. A multidisciplinary emergency-department initiative reduced CT turnaround time by 1.2 hours despite a 13.8% increase in scan volume, mainly through improved coordination among physicians, technologists, transporters, and informatics staff rather than added capacity [11].

A more recent "direct-to-CT" pathway allowed urgent primary-care patients to bypass the emergency department. In a retrospective comparison of 155 DREAM-enrolled patients against 4,182 comparable ED patients, median time from arrival to imaging report finalisation was significantly shorter for the DREAM group, at 156 minutes (IQR 130–196), than for the ED group, at 305 minutes (IQR 158–484; p<.001) [12]. A Monte Carlo simulation study of outpatient imaging scheduling found that a "rolling release" capacity-reservation strategy improved wait-time outcomes during high-demand periods without proportionally large staffing increases [13]. A broader systematic review of health information systems found that adoption most consistently improved flow when it enabled real-time visibility of a patient's status and location across departments [14]. A systematic review of 23 studies applying Lean, Six Sigma, or combined methodologies within radiology departments identified seven recurring aims, including reduced in-department wait time, reduced cycle time, and improved patient satisfaction [15]. These principles, including pre-visit verification, multidisciplinary coordination, decoupled pathways, reserved capacity, and real-time information visibility, can be adapted to a walk-in Indian OPD-to-radiology pathway even when formal appointment scheduling is not feasible.

3.5 The structural evidence gap

A study examining determinants of hospital waiting time for outpatient care in India found that both institutional and patient-level factors contribute to delay, reinforcing that the problem is measurable and multi-causal rather than attributable to a single cause [16]. More broadly, work applying Lean Six Sigma methodology across Indian healthcare has noted that critical implementation factors, such as leadership commitment, staff training, and organisational communication structures, remain comparatively underexplored within India's socio-economic and operational healthcare context [17]. Indian tertiary-care hospitals therefore have a domestic literature on general OPD waiting time and an emerging literature on OPD queue optimisation methods, but very little published radiology-specific workflow research addressing unscheduled, physician-initiated CT and ultrasound demand.

4. Discussion

4.1 A framework adapted to the Indian hospital imaging workflow

This review proposes a seven-point framework grounded in the operational features of Indian tertiary-care imaging departments: walk-in registration, point-of-care cash or scheme billing, physician-initiated same-day orders, and combined inpatient and outpatient work-lists.

1. Real-time order transmission through the hospital information system (HIS). An imaging order entered by the treating physician should appear in the radiology worklist immediately, rather than only after the patient physically arrives and registers at the imaging counter. India's expanding digital health infrastructure, including the Ayushman Bharat Digital Mission and ABHA-linked health records, offers a plausible future backbone for this kind of real-time order flow across public and private facilities [14].

2. Decoupled billing and registration. The next patient's cash or scheme billing can be processed while the current patient is still inside the scanner, rather than sequentially afterward. This follows the pre-visit verification principle demonstrated internationally [10].

3. Predictive rather than reactive staffing. Departments can use historical hourly OPD-to-imaging conversion data to align technologist availability with anticipated demand peaks.

This applies the reserved-capacity logic demonstrated in simulation-based scheduling research [13] and the Indian evidence identifying physician and resource utilisation as key bottleneck variables [4].

4. Priority-weighted rather than strictly sequential queuing between inpatient and outpatient cases. Cases should be interleaved according to clinical urgency rather than pure arrival order, adapting the structured urgency-categorisation approach piloted in an Indian orthopaedic OPD setting [8].

5. Parallel patient preparation. Consent, contrast-safety screening, and change-of-clothing procedures for the next patient can be completed while the imaging suite is occupied, rather than beginning only once the room becomes free.

6. Transparent queue communication. A visible token or display system showing real-time wait estimates will not reduce actual wait time, but it can improve perceived waiting time and patient satisfaction.

7. Turnaround time (TAT) as a tracked departmental metric. TAT, not merely scan volume, should be monitored routinely as a key performance indicator. Sustained improvement in the reviewed Lean and Six Sigma literature was consistently associated with continuous measurement and leadership engagement rather than one-time interventions [6,15].

4.2 Scope and Limitations

This synthesis reflects deliberate scope choices appropriate to a narrative review rather than gaps in rigour. The source base was assembled through targeted web-based academic searches rather than a formally registered systematic protocol. This was appropriate because the review aims to establish an operational framework rather than pool quantitative effect sizes. Since published India-specific radiology-workflow evidence remains sparse, several elements of the proposed framework draw on general Indian OPD-flow literature alongside international radiology-specific literature. The international studies cited are predominantly single-institution, pre-post quality-improvement designs, which is the standard evidence type for operational process-improvement literature rather than randomised efficacy trials. Accordingly, the seven-point framework is offered as a structured, evidence-grounded starting point for local piloting and measurement at an Indian site.

4.3 Implications for future research

The most direct contribution this review can motivate is a prospective, India-specific quality-improvement study using the DMAIC or Value-Stream-Mapping methodology already demonstrated at the Kolkata radiology department [6]. The study should focus specifically on unscheduled, physician-initiated CT and ultrasound demand at a second Indian tertiary-care site, ideally one that combines high patient volume with a walk-in, cash-billed operational model similar to the setting motivating this review.

5. Conclusion

Outpatient CT and ultrasound services in Indian tertiary-care hospitals occupy a structurally different position from MRI because demand is generated reactively during OPD consultations and cannot be addressed through appointment-based scheduling alone. Indian OPD waiting-time literature confirms that this delay is real, substantial, and largely attributable to departmental process factors rather than patient behaviour, while a single India-specific radiology workflow study demonstrates that structured process-improvement

methodology can meaningfully reduce it. This review has combined the domestic evidence base with international radiology-specific workflow literature to propose a seven-point operational framework adapted to the Indian hospital imaging workflow. Given the scarcity of published radi-ology-specific Indian evidence, prospective quality-improvement studies conducted within Indian tertiary-care imaging departments represent a meaningful and underexplored contribution to this literature.

References

1. Datta M. Assessment of outdoor patients waiting time and consultation time in a tertiary care hospital of Kolkata [conference abstract]. Indian J Community Med. 2024;49(Suppl 7):61.
2. Saxena R, Sharma S, Sharda V, Nalini G, Yadav MK. A study of waiting time of patients in outpatient department of armed forces Tertiary Hospital in Northern India. J Community Health Manag. 2020;7(4):125-127. doi:10.18231/j.jchm.2020.027.
3. Tiwari Y, Goel S, Singh A. Arrival time pattern and waiting time distribution of patients in the emergency outpatient department of a tertiary level health care institution of North India. J Emerg Trauma Shock. 2014;7(3):160-165.
4. Singh AR, Gupta A, Satpathy S, Gowda N. Study to assess the utility of discrete event simulation software in projection and optimisation of resources in the OPD at an apex cancer institute in India. Health Sci Rep. 2022;5(3):e627.
5. Makwana K, Dave GB. A study of improving hospital out patient department (OPD) using queuing network analysis methodology. J Manag. 2019;6(3):140-149.
6. Pandit AP, Debmallik T. A Lean Six Sigma approach to reduce waiting and reporting time in the radiology department of a tertiary care hospital in Kolkata. Int Educ Res J. 2016;2(6).
7. Joshi DC, Saini RS, Samant S, Biljwan S. Estimation of waiting time and consultation duration for patients in the outpatient department of radiation oncology at a tertiary care teaching hospital in Uttarakhand, India: a cross-sectional study. J Clin Diagn Res. 2023;17(8):IC05-IC10.
8. Goyal ND, Chavan RK, Pahwa A, Gautam VK, Mishra N, Tripathi PK. "OPD TRIAGE": a novel concept for better patient management in heavily loaded orthopaedic OPDs. J Clin Orthop Trauma. 2020;11(Suppl 4):S472-S478. doi:10.1016/j.jcot.2020.04.008. PMID: 32774014.
9. Olisemeke B, Chen YF, Hemming K, Girling AJ. The effectiveness of service delivery initiatives at improving patients' waiting times in clinical radiology departments: a systematic review. J Digit Imaging. 2014;27(6):751-778. doi:10.1007/s10278-014-9706-z.
10. Dako F, Cobb R, Verdi S, Grygorenko M, Patel T, Zink R, Belden C. Use of value stream mapping to reduce outpatient CT scan wait times. J Am Coll Radiol. 2017. doi:10.1016/j.jacr.2017.07.003.
11. Perotte R, Lewin GO, Tambe U, et al. Improving emergency department flow: reducing turnaround time for emergent CT scans. AMIA Annu Symp Proc. 2018;2018:897-906.
12. Vachha BA, Ruppell E, Reynolds K, Mahoney R, Weinstein B, Rosen MP, Baccei S. Direct to Radiology Emergency Avoidance Management (DREAM): a qualitative

research study on reducing emergency department overcrowding. J Comm J Qual Patient Saf. 2026. doi:10.1016/j.jcjq.2026.08.002.

13. Pisharody VA, Yarmohammadi H, Ziv E, Sotirchos VS, Alexander E, Sofocleous C, Erinjeri JP. Reducing wait times for radiology exams around holiday periods: a Monte Carlo simulation. J Imaging Inform Med. 2022. PMID: 36344634.
14. Nguyen Q, Wybrow M, Burstein F, Taylor D, Enticott J. Understanding the impacts of health information systems on patient flow management: a systematic review across several decades of research. PLoS One. 2022;17(9):e0274493. doi:10.1371/journal.pone.0274493. PMID: 36094946.
15. Amaratunga T, Dobranowski J. Systematic review of the application of Lean and Six Sigma quality improvement methodologies in radiology. J Am Coll Radiol. 2016;13(9):1088-1095.e7. doi:10.1016/j.jacr.2016.02.033.
16. Sriram S, Noochpoung R. Determinants of hospital waiting time for outpatient care in India. Int J Community Med Public Health. 2018;5(7):2692-2698. doi:10.18203/2394-6040.ijcmph20182601.
17. Bucci RV, Musitano A. A Lean Six Sigma journey in radiology. Radiology Management. 2011;33(3):27-33. PMID: 21793459.