

SYNOPSIS

ANALYSIS OF TARIFF MAPPING ERRORS AND REVENUE LEAKAGE: A CASE STUDY OF A HEALTHCARE BILLING SYSTEM

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SYNOPSIS

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1. Introduction

Healthcare organizations operate within an increasingly complex billing environment, where every clinical service delivered must be translated into a standardized code, mapped to a corresponding tariff or charge rate, and submitted for reimbursement through a multi-stage revenue cycle. This translation process, commonly referred to as tariff mapping or charge capture that sits at the intersection of clinical documentation, coding practice, and financial systems configuration. The Charge Description Master (CDM) or chargemaster is the central artifact through which this mapping is operationalized: it lists all billable services, their associated codes, and the tariff rates applicable under each payer category.

When tariff mapping breaks down through outdated CDM entries, incorrect code linkages, missing payer-tariff associations, or gaps in Hospital Information System (HIS) integration the result is revenue leakage: legitimate income that is never billed, billed incorrectly, or written off due to preventable, systemic errors. Industry analyses suggest hospitals commonly lose 4–5% of their revenue to such leakage (1). In the Indian context, the scale is comparable or worse: field observations document mid-sized hospitals writing off Rs. 15–18 lakh per month in unbilled charges and denied claims, with leadership estimating 8–12% revenue loss despite dedicated billing teams (2).

India's multi-payer landscape encompassing TPA cashless arrangements, PM-JAY packages, corporate empanelments, private insurance, and self-pay multiplies the mapping complexity substantially. Each payer category carries its own rate card, bundling rules, and revision timetable, all of which must be maintained simultaneously in the CDM. The HIS, which records clinical activity at the point of care, plays a critical but frequently underappreciated role: where HIS-to-billing integration is weak, clinical services are delivered and documented but never converted into billable charges the most invisible and financially significant form of revenue leakage.

Despite the financial significance of this problem, the existing literature is predominantly practitioner-oriented (vendor guides, consulting reports) rather than empirically grounded

academic case research. Structured, organization-level analyses that combine financial audit records with staff perception data are rare, particularly in the Indian hospital setting. This synopsis outlines the proposed research to address that gap.

2. Review of Literature

A review of 15 peer-reviewed and practitioner sources identifies the following key themes:

Table 1: Summary of Key Literature Reviewed

S.No.	Author (Year)	Location	Key Finding Relevant to This Study
1	Kelley (2022)	USA	CDM is the catalog of every chargeable item; maintenance must be consistent and frequent; ancillary systems (lab, pharmacy) interface separately and require dedicated mapping review (3)
2	Daly / HFMA (2023)	USA	Revenue leakage is systemic, arising from unmapped codes, broken HIS interfaces, and clinical documentation that never routes into a chargeable event (4)
3	Nicholson (2023)	USA	Hospitals lose 4–5% of revenue to leakage; lack of regular audits and staff education cited as primary enablers (1)
4	Cornier (2023)	USA	Underpayments, contract discrepancies, unbundling errors, and incorrect modifier usage go unnoticed without analytics; AAFP estimates \$50,000 annual loss per sole practitioner (5)
5	Tiwari (2022)	India/USA	CPT coding complexity drives high denial rates; First Pass Denial Rate and Denial Recovery Rate are key KPIs; AI-enabled billing recommended (6)
6	Becker (2022)	USA	Revenue leakage occurs at every stage from intake to billing; includes uncollected co-pays, eligibility issues, and services never billed (7)
7	Gupta & Sharma (2021)	India	Indian private hospitals face multi-payer complexity; RCM challenges include inadequate HIS integration and high TPA denial rates (8)
8	Jayasree & Menon (2022)	India (Mumbai)	HMIS integration with revenue counter and laboratory is essential; implementation barriers include hardware shortfalls and data entry operator shortages (9)

9	Kumar et al. (2022)	India (Multi-state)	Indian HIS favour centralised reporting; developed in silos with poor interoperability; proprietary platforms create vendor lock-in (10)
10	Mathur & Agarwal (2023)	India	Rs. 15–18L monthly write-off at 150-bed hospital; billing functions as disconnected island from clinical departments (2)
11	MoHFW/NHA (2023)	India	PM-JAY HBP has undergone multiple revisions; billing success depends on HIS integration for digitized resource-consumption data (11)
12	Vijayalakshmi & Krishnamurthy (2021)	India/International	Structured HMS database prevents incorrect bills; CDM maintenance requires governance with defined ownership; denials management must identify root causes (12)
13	Liao & Navathe (2021)	USA	26.8% of primary diagnoses incorrectly coded; manual billing error rates reach 4%; advanced RCM systems reduce underpayment errors (13)
14	Ofori-Boateng & Domfeh (2020)	Sub-Saharan Africa	Government hospitals lack financial sustainability focus; internal audit essential for monitoring; billing often operates independently of information systems (14)
15	Patel (2023)	India	HIS-CDM integration gap is primary structural cause of unmapped charges; pharmacy and laboratory most vulnerable due to high transaction volume (15)

2.1 Research Gap

The literature consistently documents the sources and financial impact of revenue leakage but rarely combines organization-level financial audit records with staff perception surveys within a single institution. Empirical, case-study-based research on tariff mapping errors particularly in the Indian multi-payer context and with explicit attention to HIS-billing integration as a structural driver — is absent from the available academic literature. This study addresses that gap.

3. Theoretical / Conceptual Framework

The study is grounded in two interconnected theoretical frameworks:

3.1 Revenue Cycle Management (RCM) Framework: The RCM framework conceptualizes hospital revenue as flowing through a sequential process: patient registration → service delivery → charge capture → coding → claim submission →

payment → reconciliation. Tariff mapping errors can occur at multiple points in this chain, most critically at charge capture (CDM coverage), coding (CPT/ICD accuracy), and payment reconciliation (payer-tariff linkage verification). This framework is used to map each error category to its point of origin in the revenue cycle.

3.2 Governance Gap Theory: Drawing on organizational accountability literature, this framework posits that operational errors persist and compound when governance structures defined roles, audit cycles, escalation protocols, performance metrics are absent or inadequate. Applied to tariff mapping, the theory predicts that hospitals without dedicated CDM governance roles and structured audit cadences will experience higher leakage rates, slower error detection, and slower resolution all of which this study tests empirically.

Together, these frameworks generate the following conceptual model: HIS-CDM integration quality and CDM governance maturity jointly determine the frequency and persistence of tariff mapping errors; the financial impact of these errors (revenue leakage) is moderated by the timeliness of detection and resolution. The study tests each element of this model using secondary audit data and primary staff survey data.

4. Research Gap

Based on the literature review, the following specific gaps justify this study:

- No existing study triangulates financial audit-level leakage data (claim-level, service-code-level) with staff perceptions within a single Indian hospital billing system.
- The structural invisibility of unmapped-service leakage the largest single driver of revenue loss has not been examined from a staff-awareness and organizational-detection perspective in the Indian context.
- The relationship between HIS-CDM integration quality and tariff mapping error frequency has been theorized but not empirically quantified at the service-code level.
- Existing Indian literature addresses revenue leakage broadly; no study examines the Pareto distribution of leakage across error categories or service codes within

a single organization, which is the information most actionable for billing managers.

- The role of CDM governance structures (dedicated roles, audit cadence, resolution-time tracking) as determinants of leakage outcomes has not been studied using combined secondary-primary data in the Indian hospital context.

5. Research Questions

1. RQ1: What are the most common categories of tariff mapping errors present in the case organization's billing system, based on audit reports and incident logs?
2. RQ2: What proportion of total revenue leakage can be attributed to each category of tariff mapping error?
3. RQ3: What process, system, and organizational factors contribute most significantly to the occurrence and persistence of these errors?
4. RQ4: How do billing, coding, and revenue cycle staff perceive the frequency, causes, and organizational handling of tariff mapping errors, and how consistent are these perceptions with the secondary data?
5. RQ5: What controls, process changes, or system improvements would be most effective in reducing tariff mapping errors and recovering lost revenue?

6. Research Objectives

6. To identify and categorize the most common types of tariff mapping errors occurring within the case organization's healthcare billing system.
7. To quantify the financial impact (revenue leakage) attributable to each category of tariff mapping error using secondary data from billing audits and revenue leakage reports.
8. To examine the process, system, and human factors that contribute to the occurrence and persistence of tariff mapping errors, drawing on internal process documentation, incident logs, and staff survey responses.
9. To assess staff perceptions (via primary survey data) of the causes, frequency, and organizational response to tariff mapping errors, and to compare these perceptions against the secondary data findings.

10. To recommend a practical, prioritized framework of controls and process improvements for reducing tariff mapping errors and associated revenue leakage.

7. Methodology

7.1 Research Design

The study adopts a pragmatist research philosophy and a mixed-methods, sequential explanatory design within a single embedded case study framework. "Case/sample Hospital" (anonymized mid-sized private/trust-run hospital, India) is the case; seven tariff mapping error categories are the embedded units of analysis. The design proceeds in two phases: Phase 1 (quantitative secondary data analysis) establishes the scale and distribution of leakage; Phase 2 (quantitative and qualitative primary survey) explains and contextualizes the Phase 1 findings through staff perceptions.

7.2 Study Setting

A mid-sized Indian hospital (approximately 150 beds, 12 clinical departments) operating under a mixed payer model: TPA cashless, PM-JAY, corporate empanelment, private insurance, and self-pay. The hospital uses a proprietary HMS with partial HIS-billing integration.

7.3 Data Sources

Table 2: Data Sources and Their Analytical Use

Data Source	Type	Description	Research Question Addressed
Tariff Master Records	Secondary	CDM/tariff table extract — 30 service lines, mapping status, payer linkage, last update date	RQ1
Revenue Leakage Report	Secondary	150 claim-level records: billed vs. expected, leakage by error category	RQ2
Incident Log	Secondary	45 incidents: department, category, detection source, resolution status, days to resolution	RQ3
Billing Audit Summary	Secondary	Quarterly roll-up: claims reviewed, billed, expected, leakage %	RQ2, RQ3
Internal Process Documentation (CDM SOPs, audit schedules)	Secondary	Narrative assessment of governance/process maturity	RQ3

Staff Survey Questionnaire	Primary	n=32 staff across Billing, Coding, RCM, HIS/IT: Likert + categorical + open items	RQ4, RQ5
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7.4 Sampling

Secondary data: Total population sampling all records in the 12-month review period (June 2025 – May 2026) included, to avoid period-selection bias.

Primary data: Purposive sampling of n=32 staff with direct exposure to tariff mapping, charge capture, or claims reconciliation 11 Billing Executives, 9 Medical Coders, 7 RCM/Audit Analysts, 5 HIS/IT Support staff.

7.5 Data Collection Instruments

The primary data collection instrument is a structured questionnaire comprising five sections: (A) respondent profile, (B) perceived error frequency (7-item Likert, 1=Never to 5=Very Often), (C) root cause perceptions (7-item Likert, 1=Strongly Disagree to 5=Strongly Agree), (D) organizational response (4 categorical items on detection, resolution time, governance, audit frequency), and (E) open-ended improvement suggestions.

7.6 Ethical Considerations

All secondary records were anonymized prior to analysis. The survey was voluntary, anonymous, and preceded by an informed consent statement. No patient identifiers, specific payer names, or individual staff names are used in the dissertation. Organizational consent was obtained from hospital management prior to data access.

8. Plan of Analysis

Table 3: Plan of Analysis

Analysis Type	Data Source	Research Question	Purpose
Descriptive statistics (frequency, %)	Secondary + Primary	RQ1, RQ4	Establish distribution of error categories and respondent profile
Pareto (80/20) analysis	Revenue Leakage Report	RQ2	Identify which minority of error categories account for majority of leakage value
Cross-tabulation (dept × error, payer × error)	Revenue Leakage Report	RQ2	Identify structural concentration of leakage by department and payer
Service-code level drill-down	Revenue Leakage Report	RQ2, RQ5	Identify top leakage-generating service codes for targeted remediation

Trend analysis (quarterly)	Billing Audit Summary	RQ3	Assess whether leakage intensity is improving, stable, or worsening
Incident log analysis (detection source, resolution time)	Incident Log	RQ3	Characterize the detection-correction cycle and its speed
Likert-scale aggregation (means, distributions)	Survey	RQ4	Quantify staff perceptions of error frequency and root causes
Triangulation (secondary vs. survey findings)	Both	RQ4	Identify alignment and divergence between audit evidence and staff perceptions
Thematic analysis (open-ended survey responses)	Survey	RQ5	Derive improvement recommendations from staff experience

9. Tentative Chapter Plan

Table 4: Chapter Plan

Chapter	Title	Key Content
Chapter 1	Introduction / Background	Background of healthcare billing and tariff mapping; Indian context (PM-JAY, TPA, HIS); HIS role in billing accuracy; problem statement; objectives; research questions; scope; significance of the study
Chapter 2	Review of Literature	Thematic review of 15 sources on CDM governance, revenue leakage, coding accuracy, HIS integration, Indian billing context, and organizational governance; synthesis in tabular format; research gap identification
Chapter 3	Methodology	Research philosophy (pragmatism); mixed-methods sequential design; case study rationale; study setting; population and sampling; data sources (secondary and primary); survey instrument; analysis plan; validity and reliability; ethical considerations
Chapter 4	Results and Discussion	Secondary data results: tariff master status, Pareto leakage analysis, department and payer cross-tabs, service-code drill-down, incident log analysis, quarterly trend; Primary data results: Section B/C/D Likert aggregates; Triangulation table; Discussion of four major themes (governance problem, structural invisibility, payer complexity, resolution speed)
Chapter 5	Recommendations and Conclusion	Five prioritized recommendations (targeted CDM audit, HIS interface review, CDM governance role, duplicate CDM reclassification, charge capture KPI); limitations; conclusion

10. Expected Outcomes and Significance

The study is expected to produce the following outcomes:

- Identification and financial quantification of the dominant tariff mapping error categories within the case organization, enabling resource-efficient, prioritized remediation.
- A Pareto-based, service-code-level leakage map that provides directly actionable guidance to billing managers and hospital CFOs — identifying the smallest number of fixes with the largest financial return.
- Empirical evidence on the relationship between HIS-CDM integration quality and unmapped-service leakage, contributing a structural-causality argument to the predominantly descriptive existing literature.
- A triangulation analysis demonstrating that the errors staff perceive as most frequent (coding errors, manual entry errors) are not the errors causing the greatest financial loss (unmapped services, payer-tariff linkage errors) — an insight with direct implications for how billing awareness training is designed.
- A practical, five-intervention control framework prioritized by impact-to-effort ratio, applicable to mid-sized Indian hospitals operating under comparable HIS configurations and payer mixes.

These outcomes are significant at three levels: theoretically (empirical case research triangulating financial and perception data in the Indian hospital billing context), practically (actionable prioritization framework for billing improvement), and from a policy perspective (evidence supporting formalization of CDM governance requirements within NABH accreditation standards and PM-JAY empanelment protocols).

11. Proposed Timeline

Table 5: Proposed Timeline (Aligned with IIHMR Guidelines)

Activity	Timeline	Milestone
Synopsis development and Faculty Guide consultation	February 01–20, 2026	Approved synopsis
Joining organization; aligning synopsis with organizational requirement	February 25 – March 05, 2026	Finalized dissertation topic and work plan
Secondary data collection (tariff master, audit reports, incident logs, leakage records)	March 06 – April 04, 2026	Complete secondary dataset

Primary survey administration and data collection	April 05–30, 2026	n=32 completed survey responses
Data analysis: Pareto, cross-tabulations, trend analysis, Likert aggregation, thematic analysis	May 01–20, 2026	Analyzed dataset; charts and tables finalized
Writing up dissertation (all chapters)	May 21–28, 2026	Complete draft dissertation
Submission of draft dissertation to Faculty Guide	May 29 – June 03, 2026	Draft submitted
Incorporating Faculty Guide feedback	June 03–09, 2026	Revised dissertation
Submission of final dissertation and PPT	June 10–16, 2026	Final submission
Dissertation defense presentation	June 22–26, 2026	Viva/presentation

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