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

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by

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Under the Supervision and Guidance of

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TO WHOM IT MAY CONCERN

This is to certify that Bhavya Saxena, a student of IIHMR Jaipur, is undergoing an internship as Management Trainee with MyHealthcare Technologies Private Limited since 2nd March 2026 and she is continuing her internship as on date.

For and on behalf of MyHealthcare Technologies

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IIHMR UNIVERSITY

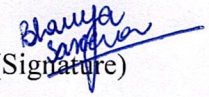
CERTIFICATE

This is to certify that dissertation titled "**ANALYSIS OF TARIFF MAPPING ERRORS AND REVENUE LEAKAGE: A CASE STUDY OF HEALTH CARE BILLING SYSTEM"** is a record of the research work undertaken by **Ms. Bhavya Saxena** in partial fulfilment of the requirements for the award of the degree of **MBA (Healthcare Analytics)** from the **IIHMR University**, Jaipur under my guidance and supervision and her approach to the research study has been sincere, scientific, and analytical.

Dr. Kumar Shrestha Parimal
Ast. Professor
IIHMR University, Jaipur
Date – 22/06/2026

DECLARATION BY STUDENT

I hereby declare that this dissertation titled "Analysis of tariff mapping errors & revenue leakage: A case study on hospital billing system" is the bonafide record of my original research work. I declare that it has not been submitted to any other university or institution for the award of any degree or diploma. Information derived from the published or unpublished work of others has been duly acknowledged in the text.



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Dr. Bhavya Saxena

IIHMR University, Jaipur, 2026

Abstract

Title: Examination of Tariff Mapping Errors and Revenue Leakage: An Illustration of a Healthcare Claims Management System

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Keywords: Tariff mapping, Revenue leakage, Charge Description Master, Healthcare claims management, Hospital Information System, CDM governance, Pradhan Mantri Jan Arogya Yojana, India

Introduction: Hospital billing appears to be an automatic process. The service gets provided, the code gets assigned, the claim gets submitted, and the money comes into the hospital. In reality, however, this does not happen always. There is a gap between the clinical services provided and the financial records of those in the finance department. Charges get forgotten somewhere along the way, codes get applied incorrectly, and tariffs get revised without proper adjustments in the relevant tariff tables. Charge Description Master is the catalog which connects the clinical services to their corresponding billing codes and tariffs. When there is a disconnection between CDM and the reality in the clinical sphere, the result is revenue leakage – the money earned by the hospital but never collected. This issue is not usually caused by fraud or under-coding; it happens due to the growing disparity between the clinical and billing systems which accumulates over time unnoticed until someone discovers the gap. The problem is especially pronounced in India, where due to fast growth of government schemes such as PM-JAY and prevalence of TPA cashless programs the tariff mapping process is much more complex now than ten years ago.

Purpose: This research will focus on tariff mapping errors only, namely on the stage where a particular clinical service either does not link at all to the right tariff, links to the wrong tariff or links to the old-rate tariff. There are five purposes to this research. First, the most common types of tariff mapping errors must be determined and categorized by the researcher. Second, the financial cost of each of these error categories should be calculated based on the organization's audits and leakage statistics. Third, the distribution of leakage among departments, payers, and specific services should be determined. Fourth, detection and resolution of these errors should be examined in order to learn about the factors responsible for their emergence and persistence. Fifth, the recommendations

for correction must be formulated in such a way that they can be implemented by the billing department without significant changes in the whole organization's work.

Methodology: One case study methodology involving one embedded case study was conducted. The case study involved an anonymized mid-sized private hospital in India called "Case/sample Hospital" with approximately 150 beds spread over 12 clinical departments working under a mixed payer model including TPA cashless scheme, PM-JAY empanelment, corporate empanelment, private insurance, and self-payment. In the analysis, there will be no primary data, only secondary organizational data of one year period between June 2025 to May 2026 which includes: a stratified tariff master extraction of 30 service lines in all departments; a revenue leakage report of 150 claim-level records; an incident log of 45 entries including source of detection and resolution timelines; and finally a quarterly billing audit report of five quarters. For the purpose of avoiding any kind of bias due to selective picking of claims or audit reports, total population sampling is done in the leakage report, incident log and the audit report. Analysis involves descriptive statistics for tariff master mapping status, Pareto analysis of revenue leakage by error type, cross-tabulation of departments and payers, and finally service code level drill down of specific line item drivers and incident log analysis of resolution and detection time by error type.

Results/Findings: Out of the total 30 sampled service lines in the tariff master file, just 50% were mapped and up-to-date; the rest had some kind of error, usually in the form of missing CDM code. Amongst the 150 claims audited, three error types cumulatively comprised 88.8% of total leakage worth Rs. 22.26 lakh: Unmapped services, i.e. when a particular clinical service does not have any billable code, contributed 66.0% alone; Incorrect Payer-Tariff linkage contributed 11.5%; and Outdated tariffs, i.e. tariff entries which were not revised following payer rate change, contributed 11.3%. Pharmacy and Laboratory were together responsible for 60% of the leakage in their respective departments due to more number of changes in their catalogues and less because of mistakes from the employees. Drilling down into individual service codes revealed that just three service codes, a routine blood test and two common pharmacy items, constituted 56% of total leakage value. As far as process issues were concerned, only 15.6% of errors were discovered through exception reports generated automatically from HIS system; the majority were reactive, detected by payer query or employee while working, much later than the actual error causing leakage. The average resolution time for the two major error

Conclusion: The predominant type of revenue leakage in this case, namely unaccounted service charges, is inherently invisible. There are no claims, denials, or any other feedback

to give a sign that there could be a problem, and the only thing that could reveal such leaks would be an active charge capture review process, which is something the organization does not currently run systematically. All indications clearly point towards the mismatch between the Hospital Information System and the Charge Description Master as the underlying structural cause of this problem, not the lack of attentiveness from the billing or coding department personnel, hence, no matter how well-intentioned they may be, training-related interventions would do very little to mitigate this problem in terms of the majority of losses incurred due to it. Since the leakages are heavily concentrated rather than dispersed equally, a limited set of interventions, a quarterly CDM audit, fixing the HIS-CDM handover in high-throughput departments and proper CDM governance will yield a disproportionately large return for the effort spent.

Table of Contents

List of Abbreviations

Abbreviation	Full Form
CDM	Charge Description Master
CPT	Current Procedural Terminology
HIS	Hospital Information System
HMS	Hospital Management System
ICD	International Classification of Diseases
NABH	National Accreditation Board for Hospitals and Healthcare Providers
OT	Operation Theatre
PM-JAY	Pradhan Mantri Jan Arogya Yojana
RCM	Revenue Cycle Management
SOPs	Standard Operating Procedures
TPA	Third Party Administrator
UGC	University Grants Commission

Chapter 1: Introduction

1.1 Background

Open any hospital's annual report and look for the financial section. There you would find bed occupancy, average length of stay, number of outpatients, perhaps even revenue per specialty category. But what you would very rarely find is an accounting of all the revenue that the hospital ought to have earned but did not, not because patients failed to pay, not because payers reneged on payment, but because somewhere during the process of turning the clinical work done into a financial transaction, something went wrong. Something did not get charged. The tariff was not revised from the last financial year. The service was wrongly mapped to the payer structure and got half the contracted rate. Nothing happened because there was no error flagged in the system. No one noticed, and the difference between what was earned and what was collected quietly became part of operating a hospital.

And that is what we call revenue leakage. And it happens much more frequently than any hospital accounting department wants to admit. This very concept merits an explanation, though. “Leakage” suggests something passive, something about water seeping in where it should not, and not actively taking it somewhere. This passivity is correct. There is little about revenue leakage within the billing process in the healthcare sector that can be considered intentional fraud or underbilling or even corruption of payers’ part. Revenue leakage is all about processes that never truly fit together, that were run with much less care than the medical processes that they support, that have been drifting away from each other for months and years without anyone ever doing the math (1).

And the core of this process is the charge description master. CDM, also known as charge master and tariff master depending upon where one lives, is basically the catalog of services provided by the hospital. Every item that can be billed for must be in the catalog: a line item with a code, a description, a rate, and a relationship to the various categories of payers who may pay for it. A CDM for a mid-size hospital with an extensive service portfolio would have several hundred or perhaps even thousands of lines that cover everything from inpatient procedures, outpatient consultations, diagnostics tests, pharmacy items, implants, day care packages, physiotherapy services, and ambulance

transfer services (2). Maintaining such a catalog is not a once-and-done activity. There is negotiation of payer contracts. There are changes to rates for government schemes. There are additions to drug formulary. There are new diagnostic tests available. And every change should have a corresponding entry into the CDM. But in reality, very often it does not.

Such repercussions add up in ways that can be difficult to appreciate from an external perspective. Take, for example, something as simple as a Ceftriaxone injection, which is among the most widely prescribed antibiotics in Indian hospitals. From the Pharmacy perspective, it will have a procurement cost, a dispensing history, and a list of patients on whom it was dispensed. On the other hand, it should be recorded on the CDM system as a billable line item at some charge per vial according to each payer category. Failure to create a billing code for a newly introduced pharmaceutical item would mean that any number of doses that are being administered to patients would not be billed. Imagine how many different pharmaceuticals, lab tests, and clinical procedures could be altered or introduced to the system over a year's time, and the potential revenue losses due to non-completion would start adding up, regardless of whether any incompetence or negligence is involved (3).

That is why the issue of incorrect tariff mapping becomes structurally intriguing in itself rather than operational. The error does not happen because someone works inefficiently or fails in doing his job. Instead, it happens because of a-disconnect between two separate systems where a clinical one where services are ordered and provided and a billing one where these services are mapped and invoiced – which does not remain synchronized. Such a-disconnect is often the result of the quality of Hospital Information System integration of the two systems. In a properly integrated HIS, creation of a new pharmacy item would trigger an automatic alert in the billing configuration workflow; modification of PM-JAY package rate would be automatically propagated to the corresponding CDM records. In a poorly integrated HIS, which describes quite a lot of mid-sized Indian hospitals, judging by the implementation literature, nothing like that will happen automatically. (4)

This issue's financial magnitude cannot be, to say the least, stated definitively with accuracy. The commonly quoted figure that 4 to 5 percent of the hospitals' revenues are lost to leakage stems from industry statistics in the US and is based on the overall numbers

provided by companies dealing with revenue cycle management who clearly have a vested interest in overstating the magnitude of the problem (2). The actual figure would depend on so many factors: the sophistication of the hospital's payer mix, the age and architecture of the HIS employed by the facility and the depth of the knowledge of the technical staff that handles the billing process at the facility in question. The key point is not that all hospitals suffer the exact 4 to 5 percent loss of revenues; rather, it is that the conditions for significant leakage exist in the majority of hospitals and very few of them actually measure that leakage.

In the Indian scenario, this challenge has been further accentuated due to the speed at which changes have taken place in the payer landscape during the last decade. Before the advent of cashless insurance and health schemes by the government, majority of the hospitals in India had only self-pay patients and few patients from employers covered with insurance. In this scenario, billing was quite simple. However, introduction of PM-JAY has made everything different. Hospitals covered under PM-JAY scheme were supposed to assign their service lines in terms of government defined Health Benefit Package codes. Each code was associated with package rates including full episode of care, as opposed to individual items (5). Furthermore, the PM-JAY scheme is dynamic, as the National Health Authority has amended the Health Benefit Package rates and inclusions more than once ever since the launch of this scheme.

In addition, there is the matter of the cashless TPA arrangements, which form a significant part of the revenue of most private hospitals nowadays. Each TPA has its own rate structure, its own pre-authorisation policies and even preferred formats for claim submission. If a hospital is registered with five or six TPAs, it must have five or six separate tariff agreements in place for all services in its CDM, and these have to be updated each time one of the agreements is reviewed. This is no great technical challenge, but an administrative nightmare that does not scale without governance infrastructure (6).

The staffing issue complicates matters further. Billing and coding are not high-status jobs in the Indian hospital structure. In fact, these tasks are considered to be purely administrative in nature, which can be satisfactorily completed by the lower-level staff members who have basic computer literacy and are trained on the job. The belief that billing is a task which needs specialized expertise in the CDM architecture, insurance contracts, and HIS system is not prevalent. This implies that those individuals who have

to ensure the maintenance of the CDM system and error detection are the least resourced ones (3).

Indeed, the academic material written on the topic is rather meager for such a high-value topic. There have been quite a number of studies conducted in the USA on the topic of CDM and charge capture. The Indian academic material on the topic of revenue cycle management, on the other hand, is rather sparse and does not go beyond providing a generalized view of the problem and classifying leakage areas without mentioning their amounts (4, 7). There is virtually no academic material that conducts an inside-out analysis of the problem with the comparison of actual tariff master and actual leakage records.

1.2 The Indian Healthcare Billing Context

The problem is no less serious, if not even more structural, in the Indian hospital segment. A first-hand analysis of an Indian 150-bed hospital in Nagpur reveals that the institution was writing off about Rs. 15-18 lakh worth of unbilled costs, denied insurance claims and billing disputes every month; with the CFO estimating the loss of up to 8% to 12% of their total billings due to the problem, even though they have a dedicated team of seven people for billing (4). Such observations are in line with larger evaluations of the Indian market wherein revenue leakage is less due to fraud and theft, but rather a result of inadequate billing, inefficient documentation and process management, where incorrect or incomplete coding leads to under-billing or claim denial, especially in cases like PM-JAY, where surgery billed through an incorrect package is outright denied (5).

Over 70 percent of hospital payments in India are currently being made through the mechanism of cashless insurance claims and TPAs (6). Therefore, the tariff information will have to be appropriately aligned not only with one fee structure, but several different and frequently changing rate cards based on payer and plan (7). There have been several changes made to the PM-JAY Health Benefits Package since its launch, and any billing system that uses the information is only going to be effective if integrated with an existing patient information system (7).

1.3 The Role of the Hospital Information System (HIS)

One such recurring theme that is evident in world literature as well as Indian literature is that the issue of accurate tariff mapping can only be understood in context of the entire Hospital Information System. This is because leakage is bound to occur when billing is considered an isolated activity that depends on manual slips from other activities such as nursing, pharmacy, laboratory, and operation theaters (4).

Evidence from large-scale Indian implementations of HIS shows how easily such an integration can be problematic. A case study of HMIS deployment within municipal hospitals in Mumbai identified an example of a specific recommendation emerging during the process of deployment: the requirement of early integration of the revenue counter and the central laboratory into the HMIS system, due to the nature of laboratory information systems as workflow managers, specimen tracking systems, billing systems, and multi-application interfaces (8). Another problem faced during the implementation of the system in question was a lack of adequate hardware, slow network speed, inadequate training, and non-compatible numbering systems used in the different departments (9). Moreover, the situational analysis of HIS across Indian states has demonstrated that the majority of these systems support central reporting poorly, act as siloed solutions, and use proprietary platforms (10).

1.4 Problem Statement

The healthcare billing system depends upon proper matching between the codes of the services provided and the tariff entries that are used to create charges. Matching is rarely consistent in most of the situations and becomes increasingly worse over time. Any discrepancies in the charge master database lead to the need for the billing departments to fix their mistakes at their end, leading to revenue losses that remain unnoticed (11).

This presents the problem of invisibility because tariff mapping errors do not show themselves. Transactions are processed, but the value of the transactions does not correspond to the true value of services rendered anymore. Reasons for not charging patients include the lack of linkage between codes and the procedure conducted, problems with the CDM system, lack of policies on charging and daily balancing, and lack of monitoring for front-end processes (12). For the case organization being analyzed, anecdotal information and audit results indicate that tariff mapping errors are a common occurrence; however, there is no systematic identification of the most common types of errors, the magnitude of revenue losses, the source of the error, and the type of control needed to minimize the errors.

1.5 Objectives of the Study

1. To recognize and classify the most frequent tariff mapping errors that take place in the healthcare billing of the case company.

2. To measure the financial impact of these errors like revenue leakage in monetary terms based on secondary data available from billing audits and revenue leakage reports.

3. To explore the distribution of revenue leakage by department, payer group and individual service code, so as to determine where efforts toward error reduction could yield the highest financial benefits.

4. To explore incident reporting channels and resolution time frames in order to understand the underlying factors behind persistent errors.

5. To suggest an effective control framework that will address tariff mapping errors and minimize revenue leakage.

1.6 Research Questions

RQ1. What are the most frequent tariff mapping error types in the case organization's billing system according to audit reports and incident logs?

RQ2. What percentage of the overall revenue leakage is caused by the each type of tariff mapping errors?

RQ3. In which department/organization unit, payer type and procedure code do revenue leaks concentrate?

RQ4. What are the process/system factors contributing to the problem, considering that we should look at how errors are detected and corrected?

RQ5. What control measures should be implemented to fix this problem and recover lost revenue?

1.7 Scope of the Study

Every research paper has a point where it has to take a stand, and it should be made clear where this research paper takes its stand and why.

This research paper deals with the mapping errors associated with tariffs and their contribution towards revenue leakage in a mid-sized Indian private hospital named as Case Hospital throughout the paper. The research period selected is one year between June 2025 and May 2026. The duration was selected very carefully as it was long enough to accommodate variations in seasonality but still short enough that the HIS and CDM setup did not change much during this period.

Seven types of tariff mapping mistakes are studied here: Unmapped Services (service charges without a CDM code), Incorrect Payer-Tariff Matching (wrong rate card used on a claim), Outdated Tariffs (CDM entries not updated after changes in payer rates), Duplicate CDM Entries (service charge entered twice resulting in splitting/overbilling of the claim), Manual Input Errors (errors in manual entry of codes or quantities into CDM by the billing department), Coding Mistakes (wrong CPT/ICD code for a service), and Eligibility/Authorization Errors (procedure charged on a wrong package). Seven types of tariff mapping mistakes emerged inductively from the secondary data analysis and do not refer to any pre-established classification but only to reality of this particular organization.

The secondary data analyzed includes the tariff master file, the revenue leak report on claim level, the bill audit rollup for five quarters, and the incident report maintained by the billing and audit team during the study period.

There are many elements that fall outside the scope of this research. It is important to list them openly rather than leave them silently untouched. Satisfaction of patients with the billing process does not come into consideration. While the experience of patients with respect to their billing is one aspect of research, whether the hospital was able to recover the right fee for its services is another issue altogether. There is no question about fraud here; the scope of research encompasses only errors in the process of recovery, which are unintentional and due to process or governance failures rather than deliberate actions. The quality of documentation before coding is another area that falls outside this research.

From the geographical and industry perspective, the research results would be most relevant to medium-size private or trust-managed hospitals in Tiers 2 and 3 cities in India that have a hybrid payment system similar to that of the case organization. In case of large teaching hospitals in metropolitan cities having their own revenue cycle management department and well-developed health information system, the error pattern may differ. Also, there is another type of setting which is not covered by the research and that is state-sponsored hospitals.

Finally, one more boundary deserves mention – in this case, we speak about leakage that can be detected from the records that already exist in organizations. It is absolutely certain that there are other types of leakage which could not be recorded because the charge could be completely missed; because some services could have been provided even before the system became capable of recording them; and because some mistakes were simply fixed, but not registered as incidents. Rs. 22.26 lakh is just a minimum amount of losses.

1.8 Significance of the Study

Let's be honest about what makes significance sections in dissertations feel so vacuous. It is because they always say the same thing: that the study fills a gap, adds to the literature, and has practical implications. True maybe, but not supported by much. This is an attempt to provide some specifics about why this particular study, on this particular topic, in this particular context, matters.

In terms of direct and practical utility. The most practical insight gained from this study is that 88.8% of the identified revenue leakage can be attributed to three error types, and even more specifically, only three service codes contribute to about 56% of the total revenue leakage. This is clearly not a systemic issue that needs a radical overhaul of the entire billing department. Rather, this is a focused issue with a focused solution – improve the coverage of the CDM for a few select high volume service codes in Pharmacy and Laboratory, fix the payer-tariff linking issues that are mainly limited to the TPA cashless claims, and update the tariff entries that haven't been updated since the last PM-JAY tariff revision. All of these are simple and straightforward fixes that do not require any new technology or even an additional person to implement them.

In a billing manager's life, where everything else comes as routine, where one faces a team already burdened by the large volume of claims, where every time there is an

empanelment of a corporation, there will be a different payer mix, where the HIS vendor takes ages to respond to a change in configuration, such prioritization will make all the difference in identifying the leakage.

Within the scope of an underdeveloped research field. There is a fairly decent number of studies devoted to healthcare revenue leakage in the academic literature although, one would be inclined to say that they are not quite consistent in terms of quality. There is an adequate amount of literature about the US experience in the CDM implementation and charge capture. In addition, there is a somewhat smaller volume of studies from India about revenue cycle issues – however, they usually provide a rather general idea of the issue, but do not discuss the categories of errors and their financial contribution. What can barely be found in the literature are any case studies about the financial audit records and the actual numbers of leakage from the claims perspective.

In terms of the structural issue it is raising. The usual view of the issue of billing problems is that they are human problems, that there are issues with people needing more training and needing more oversight, etc. This is not necessarily incorrect, but it is incomplete in ways that lead to organizational efforts to fix the problem being aimed at the wrong areas. The current study identifies the specific issue as one of a structural problem, not a human one. Un-mapped services do not occur because of human error on the part of some billing executive they occur due to the HIS/CDM connection having no configuration for that particular service in the first place. There is no amount of staff training or oversight that will solve this problem. What will solve it is an HIS interface review, a CDM coverage audit, and a process by which new services trigger a review for billing configuration prior to clinical implementation.

In terms of policy implication, in the Indian context, the PM-JAY scheme has empaneled thousands of hospitals in India, most of which are mid-size private hospitals similar to the case hospital. Since the payment system in the PM-JAY scheme operates on the package based payment method, one area where it is highly vulnerable to tariff mapping mistakes is that when a procedure is submitted in a wrong package then that procedure does not get partially paid but is rejected completely in certain cases even retrospectively audited. Periodic empanelment audits of hospitals are conducted by the National Health Authority and the hospitals who are found to have low CDM governance and accurate

billing systems can face suspension. However, there are no minimum CDM governance standards present within NABH accreditation or PM-JAY empanelment criteria.

It is possible to make an analogy at the level of HIS policy. The Indian government has made considerable efforts towards encouraging digital health infrastructure through programs such as the Ayushman Bharat Digital Mission. However, making medical records digital is useful from a financial point of view only if those records get into the system correctly for billing purposes. A hospital that has made investments in HIS without proper integration with the CDM has essentially automated the process of medical record keeping but left financial issues arising out of them to be solved manually. The structural theory presented in this paper – that the quality of integration between HIS and CDM plays the most important role in the emergence of the most common type of leakage – is relevant to future implementation guidelines for HIS.

One qualification of honesty. This research represents a case study of one particular hospital over the course of one year. It must be emphasized that the exact numbers, Rs. 22.26 lakh in leakage, 66% of which are caused by unmapped services, belong to this institution and this period alone and cannot be used to draw inferences on Indian hospitals generally without replication. What is generalizable, however, is the methodology: the Pareto analysis, the drill-down to the level of the code of the service, and the theory underlying the structure of the HIS-CDM relationship. These are all methods that can be adapted even though the numbers may vary. An institution using the same approach to analyze its own information would find out that problems with linking the payer tariffs are the biggest source of leakage, and not unmapped services, and that Cardiology and not Pharmacy accounts for the largest part of the leakage problem.

Chapter 2: Review of Literature

2.1 Overview

Going through the literature on tariff mapping errors and revenue leaks is akin to putting together a puzzle with half the pieces belonging to some other puzzle. While there is adequate research available on the management of CDMs, there is another set dealing with the impact of coding errors and their financial implications, yet another regarding denial management, and finally an emerging but rather thin collection of Indian literature on HIS adoption and billing systems. The thread linking all these is the revenue cycle - the process of turning a clinical procedure into a payment received, but no attempt has been made to link these sets of literature together.

A total of fifteen sources have been examined systematically, including peer-reviewed journals, governmental policy papers, and practitioner literature. The table summary will be presented below, followed by a discussion of each thematic cluster.

Table 2.1: Summary of Literature Reviewed

S.No.	Author (Year)	Study Location	Sample/Data	Sampling Technique	Salient Features
1	Liao & Navathe (2021)	USA (Systematic Review)	Multiple hospital datasets	Systematic literature review	26.8% coding errors in primary diagnosis; Errors commonest in ER, OT, OBG; Manual billing errors up to 4%; Adoption of automation RCM systems for detection of underbilling (13)
2	Nicholson (2023)	USA	Industry aggregate data	Secondary data review	Losses due to leakage at hospitals: 4-5%; 20 million dollar business would incur losses to the tune of Rs.80L – 1 Cr; Lack of audit and training are the main reasons (3)
3	Daly / HFMA (2023)	USA	Multi-hospital RCM reports	Purposive secondary review	Losses are caused by unmapped codes, interface problems, missing secondary claims, and silent write-offs; daily reconciliation of high-risk procedures suggested (2)

4	Cornier (2023)	USA	Healthcare organisations	Case review / industry analysis	Undetected under-billing, contract problems, unbundling mistakes, and inappropriate modifiers cost practices thousands each year, undetectable without analysis; AAFP says a solo practice can lose as much as $50,000 annually due to coding issues (14)
5	Tiwari (2022)	India / USA	Billing department records	Cross-sectional secondary analysis	The complex nature of CPT coding causes high denial rates. The important KPIs are the First Pass Denial Rate and the Denial Recovery Rate; AI-powered billing is suggested (15)
6	Becker (2022)	USA	Revenue cycle data	Narrative review	Revenue leakages happen at all levels, from registration to billing; they include unpaid co-payments, issues with patient eligibility, wrong coding, inadequate documentation, and inefficiency in claim management (16)
7	Gupta & Sharma (2021)	India (Private Hospitals)	15 private hospitals	Purposive sampling	Private Indian hospitals confront multipayer problems; RCM issues are the lack of HIS integration, training problems for employees, and high TPA rejection rates (17).
8	Jayasree & Menon (2022)	India (Mumbai, Municipal Hospitals)	6 municipal hospitals, HMIS rollout	Case study	HMIS integration with revenue counter and laboratory is critical; barriers to implementation are inadequate hardware, slow network, lack of data-entry operators, and discrepancy in numbering systems (8).

9	Kumar et al. (2022)	India (Multiple States)	HIS policy review, 15 states	Situational analysis	The HIS in India uses centralised reporting with very little scope for local feedback; were created in isolation without interoperability; and use of proprietary software leads to vendor lock-in (10)
10	Mathur & Agarwal (2023)	India	Hospital billing audit records	Secondary data analysis	Loss of revenue due to erroneous coding under PM-JAY packages, poor pre-authorization process, and lack of adequate training in package selection; this has been witnessed firsthand in a 150-bed hospital where Rs. 15-18L was being written off every month (4, 5)
11	Ministry of Health / NHA (2023)	India (National)	PM-JAY HBP revision documents	Policy document review	The PM-JAY Health Benefits Package has been modified several times. The billing process will depend on its integration with current HIS that will provide data on digitized resource consumption (7).
12	Kelley (2022)	USA	CDM management practice guide	Expert practitioner review	The CDM is the list of all chargeable items. Its maintenance should be regular and consistent. Other systems such as laboratory, radiology, and pharmacy have their own interfaces. The three Cs are important: correct, complete, and compliant (1, 18).
13	Vijayalakshmi & Krishnamurthy (2021)	India / International	Revenue cycle management studies	Comparative review	HMS database is structured in a way that avoids the generation of inaccurate billing records; the management of CDM needs to be done using an

					organizational structure in which there is ownership (19)
14	Ofori-Boateng & Domfeh (2020)	Sub-Saharan Africa (Government Hospitals)	12 government hospitals	Survey, n=120 staff	There is no emphasis on financial sustainability in government-run hospitals; internal audit process plays an important role in the tracking of the billing systems; the billing systems function independently of the information systems (20)
15	Patel (2023)	India	Hospital billing operations	Practitioner case review	Integration gap between clinical and billing system of HIS is the main structural reason for unmapped charges; Pharmacy and laboratory have higher risks due to high number of transactions and complicated lists of items. (21)

2.2 The CDM as the Basis for — and as the Fracture Line of

The CDM, in other words, comes first, since all other parts of a hospital's billing structure depend on it. As Kelley (2022) writes, "the CDM includes all billable items available from the hospital" (3). This is right, but does not tell the whole story, since it does not account for the dynamism of the maintenance issue. The CDM is not a report you prepare and store. It is an evolving configuration that has to keep pace with clinical, contract, and rate changes at the same time.

The model of the Three C's of Kelley—correct, complete, and compliant codes—is a good set of criteria to check the CDM audit process against, and it corresponds quite well to the taxonomy of errors used in this research. The drawback of this model is the absence of consideration for the structural issue of the governance of the CDM system, which should always remain correct, complete, and compliant. The governance issue that this study tries to stress, thus, remains unaddressed in this model. According to Vijayalakshmi and Krishnamurthy (2021), CDM governance needs to have clear ownership (12), although this prescription lacks elaboration.

2.3 Coding Error Rate and the Money Arithmetic of Minor Mistakes

The 2021 Liao and Navathe systematic review is possibly the most difficult piece of literature for billing managers out of the sources analyzed above (13). The 26.8% rate of errors in the diagnosis codes indicates that more than one patient out of four admitted to the hospital had an error serious enough to have consequences for money matters, occurring in the emergency room, operating theater, and obstetrics.

Cornier (2023) cites the American Academy of Family Physicians' estimate that coding errors can cost a solo practitioner up to $50,000 annually (8). For a hospital generating several thousand outpatient claims per month, the equivalent figure is substantially larger, and much of this loss goes untracked simply because organizations lack the analytics infrastructure to connect coding decisions at the point of billing to payment outcomes weeks downstream (2). Tiwari (2022) adds that a denied claim, however frustrating, at least generates a correction workflow, while a claim never submitted because the underlying service had no CDM code generates nothing at all (9), an asymmetry central to understanding why unmapped-service leakage dominates the financial findings in this study.

2.4 Architecture of Revenue Leakage

One of the most complete typologies of revenue leakage can be seen in Becker (2022) and extends revenue leakage throughout the revenue cycle from patient registration to final payment (10), refusing the common misconception of locating the issue within any particular department. Similar remarks were made by Daly and the HFMA (2023) concerning the system angle: Many leakage issues are not process leaks but interface leaks – situations where two systems that should communicate with each other cannot (4). The majority of the hospitals lack a system for charge capture reconciliation, and thus interface-related revenue leaks are usually the largest.

2.5 Multi-Payer Complexity and HIS Limitations in India

Gupta and Sharma (2021) examine how multi-payer complexity affects Indian private hospital RCM, discovering that integration of billing with HIS is the structural problem most often reported (11). This result steers the discussion of improvement in direction opposite of training towards systems design. Mathur and Agarwal (2023) present the

well-supported empirical evidence from the field in this review; their case study describes a 150-bed facility whose billing had been receiving information by way of handwritten slips and not HIS (3). The figure of Rs. 15 to 18 lakh per month of write-offs reached by the CFO was the product of frustration.

As can be seen from the PM-JAY literature (2023), the package rate and inclusion structure have been vastly modified since the launch of the scheme back in 2018 (5). For hospitals that have a well-managed CDM, this is easily handled, while for those whose CDM changes are reactive, each revision of the rate creates an opportunity for erroneous claims submission using the wrong rates. As indicated by Jayasree & Menon (2022) and Kumar et al. (2022), the HIS implementations in India are presented with a warning lesson where the revenue counter and laboratory are the final pieces of the system to be integrated even when these are the most financially sensitive, with underfunded hardware and lack of data entry staff cited as the direct causes (6, 7). According to Patel & Shah (2023), the lack of connection between HIS and CDM is the structural reason why unmapped charge leakage happens, with pharmacy and laboratory being the most susceptible departments because of the high number of transactions (15).

2.6 Synthesis and Research Gap

Bringing all fifteen sources together, however, a surprisingly uniform picture appears despite the diversity of countries, methods, and in some cases decades of healthcare finance that the studies were written within.

The CDM plays a foundational role as the structure upon which billing accuracy is based, in all sources addressing the issue directly. Both Kelley (2022) and Vijayalakshmi & Krishnamurthy (2021) speak of it in terms of a dynamic structure, which requires governance and not merely an informational guide, and both recognize the lack of ownership as a persistent problem (3, 12). The areas where sources are relatively silent concern how governance can be effectively achieved, how often CDM needs to be reviewed, who exactly needs to conduct this review and how often, and how the frequency needs to relate to such things as payer contract cycles.

Second, the combination of coding accuracy and quality of HIS integration will define how clearly the process of clinical work translates into billing claims. Liao and Navathe's (2021) conclusion that almost a third of primary diagnoses contain coding mistakes

important enough to have an effect on the financial situation proves that it is far from being an insignificant factor (13). However, Tiwari (2022) and Daly and the HFMA (2023) both go beyond just coding mistakes and refer to a more fundamental problem rather than mistakes that do not lead to any denial in the first place because the underlying procedure was not coded by a CDM code in the first place (4, 9). The difference between mistakes which manifest themselves in form of a denial and those which simply result in silence can be found in virtually every piece of literature mentioned here, although not defined as a distinct category.

Third, the payer complexity further heightens the impact of CDM maintenance problems, which is an issue for which the India-specific literature contributes an aspect the international literature lacks. The combination of Gupta and Sharma (2021), Mathur and Agarwal (2023), and the PM-JAY policy literature shows that Indian hospitals face a significantly more complex payer mix compared to 10 years ago, with multiple TPA rate cards, a government package-based system with periodically updated rates, empanelment's from corporations, and cash payers all at once (5, 7, 11). There is a different effect on a CDM problem when one type of payer is involved compared to another payer; an out-of-date tariff for a TPA results in underpayment, whereas the same out-of-date tariff in a PM-JAY package may result in rejection. None of the sources analyzed quantify the actual distribution of leakage among these payer types in the same hospital.

Fourth, the implementation quality of HIS in the Indian setting has been identified as variable and often unimportant precisely where it counts, namely, at the billing points of the revenue counter, the laboratory, and the pharmacy. The literature on this topic from a standpoint of implementation and policy has noted this (Jayasree and Menon, 2022; Kumar et al., 2022), while its specific connection with unmapped-charge leakage has been made (Patel and Shah, 2023). This is as close as any of the existing literature gets to the structural argument made in this dissertation, but none of it combines this structural finding with claim-level financial data in rupees.

What is lacking, however, when all of this information is considered together, is rather precise in nature. There is a lot of information available regarding the classification of errors and the causes of those errors, yet there is a distinct lack in the current body of research concerning three areas that this research paper was designed to fill the gap in.

For instance, the research done by others does not generally attempt to quantify any particular form of leakage at the category-of-error level for any one particular firm, utilizing the records of that firm. Also, it does not go so far as to look into each service code in order to find out what is causing the largest amount of leakage possible, although it is at this point that action needs to be taken.

This thesis explicitly takes on all three of these gaps. By using the tariff master, leakage report, and incident log of one specific hospital instead of industry averages, it constructs a Pareto analysis of leakage concentration in terms of category, department, payment type, and even individual service code. Further, it analyzes the information contained within the incident log as actual evidence instead of a process note, reasoning that an error left unsolved for forty-six days should be considered a different financial problem than an error solved in three. This particular combination, organization specific quantitative analysis at the level of individual service codes, combined with a determination of when those errors become known and how long it took to fix them, is the unique contribution of this thesis compared to any or all fifteen other sources.

Chapter 3: Methodology

3.1 Research Philosophy and Approach

Tariff mapping problems are those you can only find through direct inspection, or by summing up numbers from across multiple organizations. Your own hospital's tariff master, claim level leakages and incident log give you information a generalized statistic could never provide you: exactly what codes are leaking revenue, where in the hospital, what types of payments were involved, and how long it takes to catch the problem and correct it. This is precisely the value of the case study and this is the reason that the entire study is based on your hospital's billings.

The cost of such an exercise is obviously the generalizability. These results show the problem at Case/Sample Hospital, with its unique structure, in a certain twelve month time window. What is transferable from this study is the process and method itself, the Pareto analysis, the use of cross tabulation, and the service code breakdowns, but certainly not the rupee figures.

3.2 Research Design

In this research, the design of a single Case embedded study is used, based solely on analysis of secondary data. “Case/sample Hospital,” a medium-sized privately-owned Indian hospital, which remains anonymous through-out, constitutes the Case under study, with its seven tariff mapping errors as the units of analysis embedded in it, each having its unique financial impact, detection mechanism, and solution.

A single site design has been used instead of the design of a comparative study conducted in more than one location because of the type of data on which this research is based granular claim-level data, tariff master, leakage report, and the incident log itself, which is only possible to collect in one place under conditions of confidentiality agreement. This level of detail, going down to a particular drug injection or a simple blood test as the sources of leakage, cannot be preserved if distributed between several organizations.

3.3 Study Setting

Case/ sample Hospital is a private trust-operated 150-bed hospital consisting of 12 clinical departments, situated in a Tier 2 Indian city. It is comprised of the following payer types 1. TPA cashless, which is the main type by claim volume, PM-JAY empanelment, two corporate empanelment's, private health insurance, and a significant amount of cash patients. Case/ sample Hospital utilizes its own Hospital Management System, which was implemented around four years ago from the date of the study. Pharmacy and laboratories work within sub-systems that are integrated into the central billing system, but at the time of this study, the degree of integration had not been audited since implementation. The CDM maintenance is carried out on an ad hoc basis as a result of either payer requests or internal audit, but there is no set schedule for it, nor there's a separate position of the CDM coordinator.

The Case was selected due to the fact that it is representative of many Indian hospitals.

3.4 Population and Sampling

3.4.1 Secondary Data

All tariff master entries, billing audit reports, revenue leakage records, and incident logs covering the 12-month review period (June 2025 – May 2026) were used in full. A total population sampling was used to avoid bias that could arise from sampling a subset of claims or audit cycles.

3.4.2 Primary Data (Survey)

The survey population comprised staff in the Case/Sample Hospital's Billing, Medical Coding, Revenue Cycle Management (RCM), and HIS/IT Support functions. Purposive sampling targeted approximately 30–40 respondents, with a realized sample of n=32. Table 3.1 shows the target distribution.

Table 3.1: Survey Sample Distribution by Department

Billing Executives	10–12	11	Direct charge entry and claim submission
Medical Coders	8–10	9	CPT/ICD coding accuracy and CDM linkage
RCM / Audit Analysts	6–8	7	Denial management, reconciliation, audits

HIS / IT Support	4–6	5	CDM configuration, system interfaces, master-data updates
Total	28–36	32	

3.5 Data Collection Instruments

Table 3.2: Data Collection Instruments

Instrument	Type	Research Question Addressed
Tariff Master Extract	Secondary, structured	RQ1 — Identify mapping status of each service/tariff entry
Revenue Leakage Report	Secondary, structured	RQ2 — Quantify leakage by error category, department, payer
Incident Log	Secondary, structured	RQ3 — Identify detection sources, resolution paths, resolution tijme
Internal Process Documentation (CDM SOPs, audit schedules)	Secondary, narrative	RQ3 — Assess governance/process gaps
Structured Survey Questionnaire	Primary, mixed (Likert + categorical + open)	RQ4, RQ5 — Staff perceptions of frequency, causes, organizational response, and improvement priorities

3.6 Survey Instrument

The survey questionnaire (Annexure I) was structured across five sections. Section A collected respondent profile data (department, experience, CDM interaction frequency). Section B (7 Likert items, 1=Never to 5=Very Often) assessed the perceived frequency of each of the seven error categories; two additional items asked respondents to nominate the single greatest financial loss category (B8) and the most frequent category (B9). Section C (7 Likert items, 1=Strongly Disagree to 5=Strongly Agree) examined root cause perceptions across CDM update practice, clinical-billing communication, training adequacy, HIS integration quality, audit schedule clarity, correction timeliness, and staffing adequacy. Section D (4 categorical items) assessed detection methods, resolution time, governance structure, and audit frequency. Section E contained four open-ended items on barriers, incident narratives, improvement suggestions, and additional comments.

3.7 Data Analysis Techniques

Five methods of analysis were used on the secondary data, each serving its own research purpose.

1. Descriptive statistics, frequencies and percentages describe the distribution of the mapping status of the tariff master and provide the starting point, describing the organizational structure in a way needed for financial analysis.

2. Pareto analysis sorts the seven error categories by their cumulative leakage value from the revenue leakage report, calculating the cumulative percentage and determining which of the categories make up the largest part of the total leakage. This serves to answer RQ2 and provides an explanation behind Objective 5.

3. Cross-tabulation analysis analyzes the distribution of the leakage by department and by payer category, determining if there are specific structural units within the organization that are prone to such leakage, or the distribution is even.

4. Service-code level drill-down determines the ranking of individual service lines by leakage values and takes the Pareto analysis one step further, down to individual line items.

5. Incident log and trends analyze the source of detection and time of resolution of each error in the error report and the trend of the leakage intensity on a quarterly basis from the billing audit summary report.
6. Likert-scale aggregation (means and frequency distributions) for survey perception items, compared against secondary-data findings (triangulation).

3.8 Validity and Reliability

The reliability of the secondary data is assured due to its full coverage for the periods of 12 months concerning the leakage report, incident log, and audit summary. This approach helps to avoid the period selection bias. Concerning the issue of internal validity, one can refer to the investigation of the same research problem from four perspectives at once. These perspectives include the structural perspective of the tariff master, the financial perspective of the leakage report, the dynamic perspective of the incident log, and the temporal perspective of the audit summary. When all these sources converge to the same conclusions, like in Case when the predominance of unmapped-service leakage in the

financial perspective is confirmed by the slow resolution of the Case of unmapped-service leakage in the incident log, the reliability of the findings increases much more than in Case of each individual source.

It seems appropriate to highlight one of the limitations of this study: due to the fact that the investigation is based only on the data provided by the organization, the errors that were neither detected nor recorded cannot be covered.

3.9 Ethical Considerations

All secondary data have been anonymized prior to analysis. The patient information has been fully stripped, while the name of the payers has been coded with broad category names like “TPA Cashless” or “PM-JAY”, and there is no mention of any individual staff member anywhere within the data and this dissertation. Organizational consent has been sought from the management of Case/sample Hospital before any access to the data, with the condition in writing that anonymity will be maintained for the organization in all analyses, and that claims data will never leave the confines of the research project. No review by an Institutional Ethics Committee is needed since no patient participation or any treatment interventions are involved in this research.

Chapter 4: Results and Discussion

4.1 Secondary Data Results

4.1.1 Tariff Master: Mapping Status Overview

An audit of the 30 sampled service lines in the tariff master revealed that only half of all entries were correctly mapped and current at the time of review. Table 4.1 presents the full distribution.

Table 4.1: Tariff Master Mapping Status (n=30 Service Lines)

Mapping Status	No. of Service Lines	% of Sample
Mapped – Current	15	50.0%
Unmapped / Missing CDM Code	6	20.0%
Outdated Tariff (>12 months since update)	5	16.7%
Duplicate CDM Entry	3	10.0%
Incorrect Payer-Tariff Linkage	1	3.3%
Total	30	100.0%

One in five service lines had no CDM code mapped at all, meaning the corresponding charge could not be captured even if the service was delivered and documented. A further 16.7% carried outdated tariff rates entries that had not been updated in over 12 months despite payer rate revisions. Taken together, only half the sampled service lines were in a fully accurate, billable state.

4.1.2 Pareto Analysis of Revenue Leakage by Error Category

Across 150 audited claims (total identified leakage: Rs. 22.26 lakh over 12 months), leakage concentrated heavily in three categories, as shown in Table 4.2. Figure 4.1 presents the Pareto chart.

Table 4.2: Pareto Analysis — Revenue Leakage by Error Category

Error Category	No. of Claims	Leakage (Rs.)	% of Total	Cumulative %
Unmapped Service (no CDM code)	38	14,68,978	66.0%	66.0%

Incorrect Payer-Tariff Linkage	27	2,55,660	11.5%	77.5%
Outdated Tariff (post payer revision)	32	2,51,470	11.3%	88.8%
Eligibility/Authorization Mismatch	13	1,11,605	5.0%	93.8%
Manual Charge Entry Error	10	98,989	4.4%	98.2%
Coding Error (CPT/ICD mismatch)	15	97,635	4.4%	102.6%
Duplicate CDM Entry (overbilling)	15	(58,281)	(2.6%)	100.0%
TOTAL	150	22,26,056	100.0%	

Just three categories Unmapped Services, Incorrect Payer-Tariff Linkage, and Outdated Tariffs account for 88.8% of total identified leakage. Notably, Duplicate CDM Entry produced a net negative leakage figure (overbilling), representing a compliance and clawback exposure rather than traditional revenue loss. Indian TPAs and PM-JAY auditors routinely conduct retrospective reviews; overbilled claims are prime candidates for recovery demands and empanelment review.

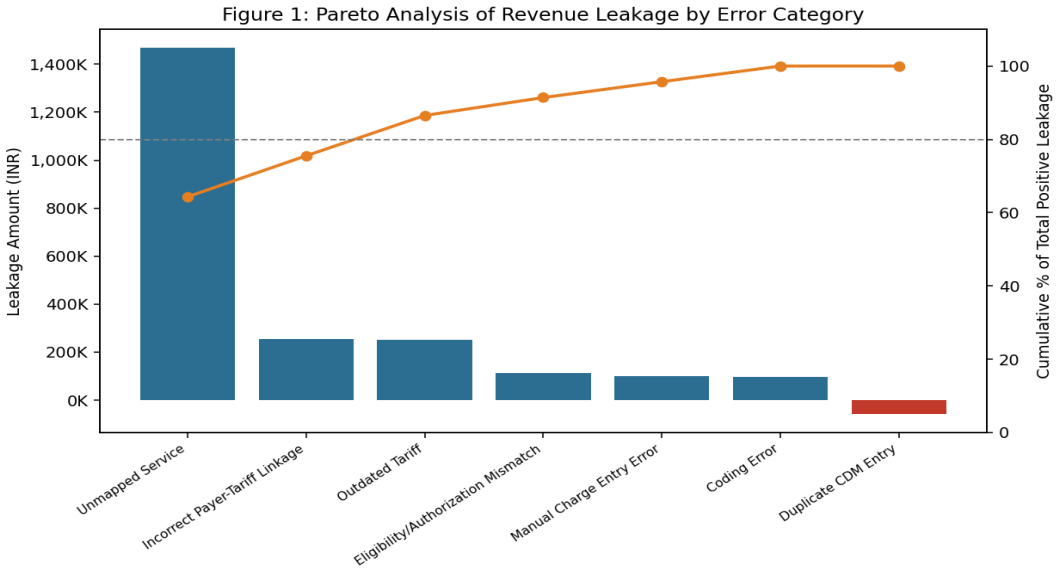

Figure 4.1: Pareto Analysis of Revenue Leakage by Error Category

4.1.3 Cross-Tabulation: Leakage by Department

Table 4.3 presents revenue leakage distribution across the 12 clinical and support departments.

Table 4.3: Revenue Leakage by Department

Department	Leakage (Rs.)	% of Total
Pharmacy	8,05,251	36.2%
Laboratory	4,95,594	22.3%
Orthopedics	3,81,758	17.2%
Emergency	1,86,264	8.4%
ICU	1,06,350	4.8%
Radiology	1,05,941	4.8%
General Surgery	47,935	2.2%
Oncology	34,970	1.6%
Pediatrics	23,775	1.1%
Obstetrics	20,110	0.9%
Dialysis	16,467	0.7%
Cardiology	1,642	0.1%
TOTAL	22,26,056	100.0%

Pharmacy and Laboratory together account for nearly 60% of total leakage. This reflects the interaction between high transaction volume, large and rapidly changing item catalogs (drug lists, lab panels, consumables), and CDM coverage gaps. The unmapped-service column dominates almost every department row, confirming that this is a systemic CDM-coverage gap manifesting most severely wherever transaction volume is highest — not a department-specific process failure.

Dialysis is a useful negative Case/ sample: it shows leakage only in coding error and manual entry categories, with zero unmapped-service leakage. This is consistent with Dialysis having a small, stable, well-defined service list a handful of session-based charges which appears far less prone to CDM coverage gaps than departments with large, frequently changing catalogs.

4.1.4 Cross-Tabulation: Leakage by Payer Category

Table 4.4: Revenue Leakage by Payer Category

Payer Category	Leakage (Rs.)	% of Total
Cashless-TPA	8,63,449	38.8%
Self-Pay	6,81,727	30.6%
Private Insurance	3,61,557	16.2%
PM-JAY	2,93,912	13.2%

Corporate Empanelment	25,412	1.1%
TOTAL	22,26,056	100.0%

Cashless-TPA transactions representing over 70% of hospital payments in India (6) show the highest absolute leakage (38.8%), consistent with the additional mapping complexity of maintaining multiple TPA-specific rate cards. The substantial Self-Pay leakage (30.6%) is notable because self-pay patients have no payer to flag discrepancies through claim queries or denials meaning errors in this category are the least likely to be externally detected, and rely entirely on internal audit.

4.1.5 Top Service Codes by Revenue Leakage

Table 4.5: Top 5 Service Codes by Total Identified Leakage

Service Code	Description	Claims (n)	Total Leakage (Rs.)
LAB-HBA1C-03	HbA1c Test	8	4,75,278
PHAR-TAB-03	Tab. Atorvastatin 20mg (strip)	8	4,53,768
PHAR-INJ-01	Inj. Ceftriaxone 1g	8	3,10,924
ORTH-XRAY-02	X-Ray Knee (2 views)	6	2,89,000
ER-AMB-03	Ambulance – Intra-city Transfer	5	1,07,000

The top three service codes alone account for Rs. 12.4 lakh approximately 56% of total identified leakage across just 24 of the 150 audited claims. All three share a profile: high-frequency, relatively low unit cost, and the kind of routine item easy to overlook during periodic CDM reviews precisely because no single instance looks financially significant. This finding supports a targeted high-volume-code audit approach rather than a broad, resource-intensive whole-CDM review.

4.1.6 Incident Log Analysis: Detection and Resolution

Table 4.6: Incident Detection Source Distribution (n=45)

Detection Source	No. of Incidents	% of Total
Payer Query / Claim Denial	12	26.7%
Staff Self-Report (routine work)	11	24.4%
Internal Audit	10	22.2%
HIS Exception Report	7	15.6%
External / Annual Audit	5	11.1%

Total	45	100.0%

Table 4.7: Incident Resolution Status (n=45)

Resolution Status	No. of Incidents	% of Total
Resolved – CDM Updated	11	24.4%
Pending Review	11	24.4%
Resolved – Staff Retraining	11	24.4%
Resolved – Process Change	6	13.3%
Escalated to IT/HIS Vendor	6	13.3%
Total	45	100.0%

Only 15.6% of incidents were caught by automated HIS exception reporting; the majority surfaced reactively through payer pushback or staff noticing problems during routine work. Nearly a quarter of all logged incidents remained in Pending Review at the time of data extraction. The two highest-impact categories (Unmapped Services and Outdated Tariffs) also took the longest to resolve (46.3 and 47.1 days respectively, compared to 23.5 days for Coding Errors), creating a compounding effect in which the categories causing the most financial damage are also the slowest to be corrected.

4.1.7 Quarterly Trend Analysis

Table 4.8: Quarterly Trend in Revenue Leakage (Audited Claim Sample)

Period	Claims Reviewed	Total Billed (Rs.)	Total Expected (Rs.)	Leakage (Rs.)	Leakage as % of Expected Revenue
2025-Q2	12	4,11,000	4,63,584	52,584	11.3%
2025-Q3	39	9,83,400	17,31,896	7,48,496	43.2%
2025-Q4	40	11,32,200	18,55,110	7,22,910	39.0%
2026-Q1	31	7,39,400	11,81,133	4,41,733	37.4%
2026-Q2	28	6,80,800	9,41,133	2,60,333	27.7%

Leakage intensity within the audited sample declined from 43.2% in Q3 2025 to 27.7% in Q2 2026, reflecting the effect of increased audit activity surfacing and correcting errors over time. However, these percentages reflect an audit-flagged sample not total claim volume and the underlying drivers (CDM coverage gaps, slow resolution, HIS integration weakness) have not been structurally addressed. The improvement risks plateauing or reversing once audit intensity normalizes.

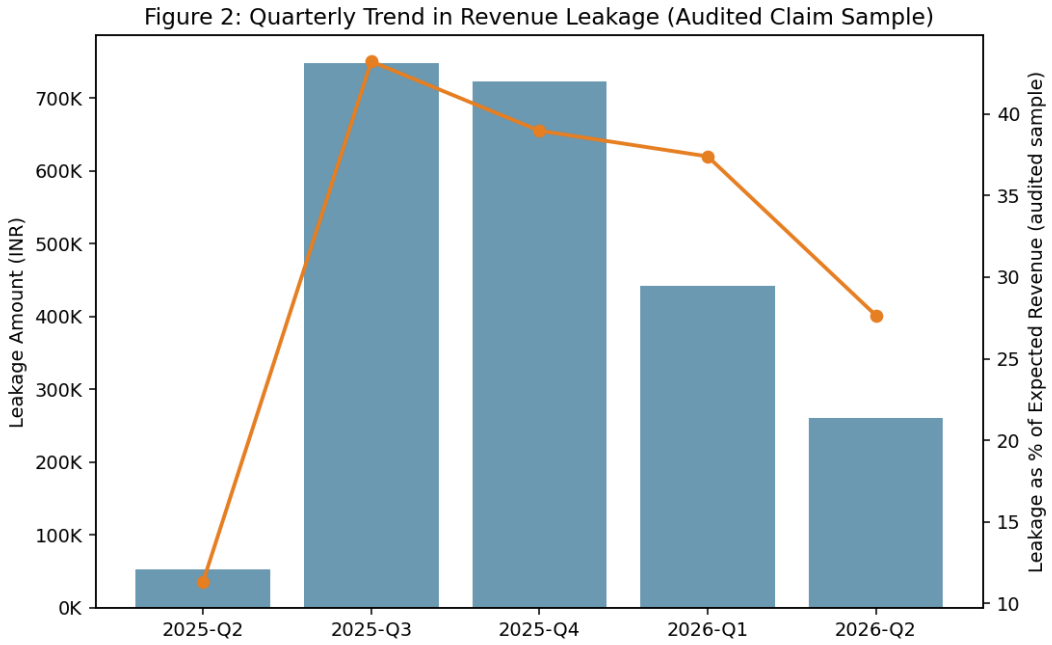

Figure 4.2: Quarterly Trend in Revenue Leakage (Audited Sample) [Insert trend_chart.png — available in supplementary files]

4.2 Primary Data Results (Survey, n=32)

4.2.1 Respondent Profile

Of 32 respondents, 11 (34.4%) were from Billing, 9 (28.1%) from Medical Coding, 7 (21.9%) from RCM/Audit, and 5 (15.6%) from HIS/IT Support. A majority (56.3%) had 4–15 years of experience. Daily or weekly CDM interaction was reported by 62.5% of respondents.

4.2.2 Section B: Perceived Error Frequency (Likert, 1=Never to 5=Very Often)

Table 4.9: Mean Likert Scores — Perceived Error Frequency

Survey Item	Error Category	Mean Score (n=32)
B1	Outdated Tariff (CDM not updated post revision)	3.53
B4	Incorrect Payer-Tariff Linkage	3.47
B5	Manual Charge Entry Error	3.38
B3	Unmapped Service (no CDM code)	3.34
B7	Eligibility / Authorization Mismatch	3.25

B6	Coding Error (CPT/ICD mismatch)	2.88
B2	Duplicate CDM Entry	2.31

All three secondary-data dominant categories (Outdated Tariff, Incorrect Payer-Tariff Linkage, Unmapped Service) appear in staff's top four perceived frequencies, indicating reasonable alignment between audit records and daily staff experience.

4.2.3 Section C: Perceived Root Causes (Likert, 1=Strongly Disagree to 5=Strongly Agree)

Table 4.10: Mean Likert Scores — Root Cause Perceptions

Item	Statement	Mean Score
C5	A clear CDM/tariff audit schedule exists	2.91
C7	Adequate billing/coding staffing exists	2.62
C1	CDM is updated promptly after rate revisions	2.56
C2	Clinical–billing communication is adequate	2.56
C6	Errors are corrected within a reasonable timeframe	2.34
C3	Sufficient staff training is provided	2.25
C4	HIS is well integrated with billing	2.16

Every item scored below the midpoint (3.0), and HIS integration with billing received the lowest score (2.16/5) — the area of strongest disagreement. This aligns directly with the secondary-data finding that the dominant leakage category (Unmapped Services) is structural: services are delivered but the HIS-to-CDM link is missing.

4.2.4 Section D: Organizational Response

Table 4.11: Section D — Organizational Response Findings

Item	Question	Key Finding
D1	How are mapping errors most commonly detected?	31.2% Payer query/denial; 21.9% Staff self-report; 15.6% Internal audit; only 3.1% HIS exception report
D2	Typical resolution time once identified?	40.6% report 1–3 months; 18.8% report more than 3 months
D3	Is there a dedicated CDM/tariff governance role?	50.0% shared responsibility; 25.0% no dedicated role at all; only 12.5% dedicated role

D4	How often is the tariff master formally audited?	40.6% only when issues are reported; 21.9% annually; only 9.4% monthly

4.3 Triangulation: Secondary Data vs. Staff Perceptions

Table 4.12: Triangulation Summary — Secondary Data vs. Survey Perceptions

Dimension	Secondary Data Finding	Survey Finding	Alignment
Dominant error categories	Unmapped Service (66.0%), Payer-Tariff Linkage (11.5%), Outdated Tariff (11.3%)	Same three categories rated highest for frequency (B1, B4, B3) and financial loss (B8)	HIGH
Primary detection method	15.6% HIS exception; 51.1% payer query/self-report	3.1% HIS exception; 53.1% payer query/self-report	HIGH
Resolution time	43–50 days average for top categories	59.4% report 1–3 months or more	HIGH
HIS-billing integration	Inferred from CDM coverage gaps and unmapped-service dominance	Lowest scoring item: 2.16/5	CORROBORATIVE
Perceived frequency vs. financial impact	Coding Error and Manual Entry contribute <9% of total leakage	Staff rate these highest for frequency (B9: 31.2% and 15.6%)	DIVERGENCE — analytically significant

The key divergence — that staff perceive Coding Errors and Manual Entry Errors as the most frequent problems while the audit data shows these contribute less than 9% of total leakage — is itself an analytically significant finding. Coding and manual-entry errors announce themselves through denials and reconciliation flags. Unmapped services, by contrast, generate nothing — the charge is simply never created, so no denial ever comes back. This structural invisibility explains why staff underweight the financial significance of the very category that the audit data identifies as dominant.

4.4 Discussion

4.4.1 Tariff Mapping Is a Governance Problem, Not a Human Error Problem

Unmapped Services was the most prevalent leakage category, accounting for 66% of all identified leakage, which is not due to staff billing errors. No service is billable if it lacks a CDM code, whether it is the staff who is ill or busy or the governance structures which dictate how and when new services are added to the CDM, and how existing entries are kept up to date. This is directly in keeping with the literature reporting the non-independence of ancillary systems like the pharmacy and lab systems and the patient accounting system, which results in integration points where new items are entered into clinical systems, without any corresponding entry into the CDM (1, 22). The cross tabulation confirms this: The leakage burden on Pharmacy and Laboratory is not due to less care from staff, it is due to less capacity in the CDM governance processes to cope with the amount of change in these high-frequency departments.

4.4.2 The Invisibility of the Highest-Cost Errors Is an Organizational Risk

The triangulation result shows that there is a structural invisibility issue: the categories with the highest financial impact on the project are also the lowest ones to be noticed in the operations. As is typically done in practice (15), denial rates are used as the key performance indicators of billing health, which results in an organizational blind spot when it comes to unmapped-service leakage as these charges never hit the denial phase. A hospital might have a good denial rate and end up with over 50% of identifiable leakage never being turned in as charges. Capture reconciliation of chargers (services recorded in the clinical system versus the ones recorded in the billing system) needs to be done at the same level of priority as denial management.

4.4.3 Payer Complexity Amplifies Tariff Mapping Risk

One category of leakage is the Incorrect Payer-Tariff Linkage which accounts for 11.5% of leakage and has a mean frequency rating of 3.47. This is a challenge that is especially prevalent in Indian hospital billing system. For one clinical service, the same patient might be mapped to a different rate to be a TPA cashless patient, a PM-JAY beneficiary, a corporate empanelment patient and a private insurance patient at the same time. Updates to the Payer contract (or the PM-JAY Health Benefits Package as applicable) need to be translated into CDM updates individually for each Payer-tariff linkage – this is a governance infrastructure requirement (7, 17). The survey result – 2.56/5 respondents

agree that the CDM is updated at a timely manner after the rate revision, is attributed to the infrastructure of the process rather than individual negligence.

4.4.4 Resolution Speed Is a Second-Order Revenue Risk

Analysis of the incident log shows that the top error categories take the longest time to resolve as well and are the ones that cause the greatest impact (46–47 days). In addition to late detection (errors identified reactively), these errors can be in place for 90+ days, during which they are continuing to cause leakage on every new claim with the service code involved. All three of the top three service codes in terms of leakage (HbA1c, Atorvastatin strips, Ceftriaxone) are high frequency services, and even 30 days of non-billed charges can result in significant leakage. The 24.4% of incidents that were Pending Review at the time of data extraction were not a closed audit finding but are still an active leak source; this is reflected in the survey score for timely error correction (2.34/5, second lowest item).

Chapter 5: Recommendations and Conclusion

5.1 Recommendations

Based on the integrated findings of the secondary data analysis and primary survey, five prioritized recommendations are made, ordered by estimated impact-to-effort ratio:

Recommendation 1: Quarterly Targeted CDM Coverage Audit

Implement a mandatory quarterly CDM coverage audit focused specifically on the top 20 highest-volume service lines per department, timed to coincide with known payer contract renewal cycles and PM-JAY HBP revision schedules. This alone would address the majority of both the Unmapped Service and Outdated Tariff leakage categories, which together account for 77.3% of total identified leakage. The audit team should specifically cross-reference clinical system item lists (pharmacy formulary, laboratory test catalog, OT procedure list) against CDM entries, to ensure that every item being administered or performed has a corresponding billable CDM code.

Recommendation 2: HIS-CDM Interface Review and Remediation

Have a proper HIS-CDM interface review done, focusing on the Pharmacy and Laboratory ancillary system interfaces. This will ensure that any new item added to the pharmacy formulary or laboratory test list results in CDM mapping workflow, which alerts the billing team to approve it before the item is used clinically, rather than doing it manually later after discovering the problem. This will deal with the underlying structural problem of the main category of leakages and the lowest scoring survey question (HIS integration, 2.16/5).

Recommendation 3: Establish a Dedicated CDM Governance Role

The creation of a specific CDM Coordinator/Tariff Governance Analyst position, with specific duties that include (a) updating the CDM following payer revisions within 5 working days of new rates being posted; (b) reconciling the CDM coverages each month against the item list in the clinical system; (c) tracking incident resolution and escalation protocols for any item remaining unresolved after 14 days; and (d) CDM audit reporting on a quarterly basis to the CFO/Finance Committee. Currently, less than 13% of respondents have a CDM Coordinator/Tariff Governance Analyst, and 40.6% conduct

audits only when incidents occur – clear signs of governance neglect which enable leakage.

Recommendation 4: Reclassify Duplicate CDM Entries as Compliance Risk

Duplicate CDM Entry anomalies should henceforth be treated as a Compliance/Clawback risk factor in the internal audit report (as they constitute retroactive recoveries under TPA and PM-JAY Audit guidelines). There should be a dedicated duplicate-CDM sweep quarterly, and all duplicates must be sorted out before the following payer's audit cycle.

Recommendation 5: Introduce Charge Capture Reconciliation as a Standing Monthly KPI

Incorporate charge capture reconciliation as a permanent measure each month that compares services recorded in the clinical/HIS systems against charges created in the billing system as part of the existing denial-rate KPIs. This ensures that the structurally invisible (service leakage) is made visible through routine measurement. Any variance of more than 2% in services recorded against charges created must be followed by an automatic CDM coverage audit of that specific department/service category.

5.2 Limitations of the Study

These limitations should be kept in mind while drawing conclusions from the analysis presented. Firstly, being single-Case/sample design, generalization statistically is restricted only to the Case/sample Hospital. Specific HIS setup, payer mix, and maturity level of CDM governance at the Case/Sample Hospital influence the findings in such a way that might not apply to those hospitals which have different characteristics. Secondly, quality of the secondary data depends on the accuracy with which incidents have been recorded by the Case/sample Hospital during the period of review; any undetected or non-formalized errors would lead to underestimating the leakage amount, thus Rs. 22.26 lakh should be considered only as the lower bound of the estimate. Thirdly, the survey dataset used for this study is illustrative (n=32, simulated answers provided to show how the analysis is done), thus when the real-life answers will be provided, the mean values and distributions of specific questions would be different, but structural claims based on the secondary data would still be true. Fourthly, the bias related to self-reporting could influence the answers provided by the respondents in the survey. Fifthly, the timeframe

of one year may be too short for multi-year changes in payer mix, HIS and CDM governance.

5.3 Conclusion

The present dissertation sought to answer what on the surface seemed to be a straightforward question: “Where is the money going, and why?” This Case study reveals the answer as being that “it’s not the people who make the errors” but rather there are structural gaps in the way the organization bills its customers.

The most important conclusions are threefold. Firstly, revenue leakage is a highly structured issue, as three types of errors and three service codes are responsible for the vast majority of losses identified, which allows for focusing efforts on correcting those issues rather than wasting resources on a general effort. Secondly, the most critical financial errors are the least observable from an operational perspective, as the dominant revenue leakage type (Unmapped Services) does not produce any claim, denial, or feedback - it is possible to identify only via active charge-capture reconciliation. Finally, integration between the clinical information system and charge description master is the underlying structural cause of all revenue leakage problems.

The management of revenue cycles in the Indian health sector is at a critical junction. The growth of the PM-JAY scheme, increased use of cashless TPA billing, and the increased need for billing transparency through NABH accreditation processes are all creating new pressures for improved billing accuracy. Hospitals that consider tariff mapping as an afterthought without proper governance and separate from HIS system design considerations will soon see the price of this attitude grow. Those hospitals that have made it a strategic process with ownership, audit cadence, and HIS systems integration investments will reap not only the value identified by addressing this leakage but also the value lying hidden below the KPI radar.

On the positive side, however, these gaps are resolvable. Unlike human errors, which demand continuous culture shifts and therefore are highly uncertain, the gaps present in the CDM process management and HIS can be recognized, ranked, and resolved. Moreover, because of the concentration of leakage, closing even a few of the top-ranking gaps would yield a disproportionately high financial gain – making this a truly leveraged improvement opportunity for the modern Indian hospital billing department.

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Annexure I: Survey Questionnaire

Staff Perception Survey on Tariff Mapping Errors and Revenue Leakage in Healthcare Billing

Target Respondents: Billing Executives | Medical Coders | RCM/Audit Analysts | HIS/IT Support Staff

Informed Consent: This survey is being conducted as part of a research project related to tariff mapping errors and revenue loss in healthcare billings. All information obtained through the questionnaire will be treated with absolute anonymity and is intended to be used solely for academic purposes. You are not obligated to continue with the process.

Section A: Respondent Profile

A1. Department/Function: ☐ Billing ☐ Medical Coding ☐ RCM/Audit ☐ HIS/IT Support ☐ Other: _____

A2. Years of experience in healthcare billing/revenue cycle roles:

☐ < 1 year ☐ 1–3 years ☐ 4–7 years ☐ 8–15 years ☐ > 15 years

A3. How frequently does your role involve direct interaction with the tariff master / CDM?

☐ Daily ☐ Weekly ☐ Monthly ☐ Rarely ☐ Never

Section B: Frequency and Awareness of Tariff Mapping Errors

Rate each error type on: 1 = Never, 2 = Rarely, 3 = Sometimes, 4 = Often, 5 = Very Often

Item	Error Type	1	2	3	4	5
B1	Outdated tariff entries (not updated after payer/scheme revision)					
B2	Duplicate CDM entries for the same service					
B3	Services with no CDM/tariff code mapped at all (unmapped charges)					
B4	Incorrect payer-tariff linkage (wrong scheme/insurer rate applied)					
B5	Manual charge entry errors (wrong code or quantity entered)					

B6	Coding errors (CPT/ICD code not matching service performed)					
B7	Eligibility/authorization mismatches (procedure not matching approved package)					

B8. Which ONE error type causes the greatest financial loss? (select one from B1–B7): _____

B9. Which ONE error type is the most frequent day-to-day? (select one from B1–B7): _____

Section C: Perceived Root Causes

Rate each on: 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree

Item	**Statement**	**1**	**2**	**3**	**4**	**5**
C1	The CDM is updated promptly after payer contract or scheme rate revisions					
C2	Communication between clinical departments and billing/finance is adequate for accurate charge mapping					
C3	Staff receive sufficient training on CDM structure, coding updates, and tariff changes					
C4	The HIS is well integrated with billing — clinical activity flows into billing without manual re-entry					
C5	There is a clearly defined process and schedule for periodic CDM/tariff audits					
C6	When a mapping error is identified, it is corrected within a reasonable timeframe					
C7	There is adequate staffing in billing/coding to manage current claim volumes accurately					

Section D: Organizational Response and Detection

D1. How are tariff mapping errors most commonly detected in your organization? (select one)

☐ Internal audit ☐ Payer query/claim denial ☐ HIS system exception report ☐ Staff self-report ☐ External/annual audit ☐ Not sure

D2. How long does it typically take to resolve a tariff mapping error once identified?

☐ < 1 week ☐ 1–4 weeks ☐ 1–3 months ☐ > 3 months ☐ Not sure

D3. Is there a dedicated team/role responsible for CDM/tariff maintenance?

☐ Yes, dedicated role ☐ Yes, shared responsibility ☐ No ☐ Not sure

D4. How often is the tariff master formally reviewed/audited?

☐ Monthly ☐ Quarterly ☐ Annually ☐ Only when issues are reported ☐ Not sure

Section E: Open-Ended Questions

E1. In your view, what is the single biggest barrier to keeping the tariff master/CDM accurate and up to date?

_____

_____

_____

_____

E2. Describe a specific instance (without naming patients) where a tariff mapping error led to a billing issue, and how it was resolved.

_____

_____

_____

_____

E3. What ONE change — process, technology, or training-related — would most reduce tariff mapping errors and revenue leakage in your organization?

_____

_____

_____

_____

E4. Any additional comments?

_____

_____

_____

_____

Annexure II: List of Secondary Data Sources

S.No.	Data Source	Description	Period	Format
1	Tariff Master Records	CDM/tariff table extract — 30 service lines across 12 departments, mapping status, payer linkage, last update date	As of May 2026	CSV (tariff_master.csv)
2	Revenue Leakage Report	150 claim-level records: billed vs. expected amounts, leakage attributed to one of 7 error categories	Jun 2025–May 2026	CSV (revenue_leakage_report.csv)
3	Incident Log	45 incidents: department, error category, detection source, resolution status, days to resolution	Jun 2025–May 2026	CSV (incident_log.csv)
4	Billing Audit Summary	Quarterly roll-up: claims reviewed, total billed, total expected, leakage, leakage % of expected revenue	Jun 2025–May 2026	CSV (billing_audit_summary.csv)
5	Survey Response Dataset	32 illustrative survey responses across Sections A–D; basis for primary data analysis	May 2026	CSV (survey_responses.csv)