

Performance Indicators for Optimising Hospital Revenue Collection: A Case Study of an Admission and Billing Office in a University Hospital in Morocco

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Abstract

Original Research Article

The financial stability of hospitals depends largely on the efficiency of revenue collection. In Morocco, the generalisation of compulsory health insurance has placed the admission and billing office at the centre of the hospital value chain, yet high claim rejection rates, delays in dispatching claim files and limited digitalisation persist. This study aimed to diagnose the revenue collection process of the back-office of the admission and billing office of a university hospital in Morocco and to analyse its performance indicators. A mixed-methods case study was conducted, combining documentary analysis of the regulatory framework, two weeks of participant observation of the complete admission, billing, dispatch and collection circuit, semi-structured interviews with 14 staff members, and analysis of monthly indicators from January to June 2025. Process mapping, a responsibility assignment matrix, Pareto analysis, failure modes, effects and criticality analysis, and an interactive Power BI dashboard were used. Over the six months, the net collection rate rose from 75% to 84%, the mean claim dispatch delay fell from 12 to 7 days, and patient identity verification errors decreased from 4.5% to 3.1%. The rejection rate decreased from 18% to 12% but remained high. Billing errors and missing supporting documents accounted for 40% of the causes of delay and rejection, and the manual cash-collection system carried the highest risk criticality. These findings suggest that digital monitoring tools and continuous-improvement methods can strengthen collection performance, although structural harmonisation of procedures with paying organisations remains necessary.

Keywords: Hospital revenue collection; Admission and billing office; Key performance indicators; Power BI; Lean Six Sigma; Morocco.

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INTRODUCTION

The financial stability of hospitals is a major challenge of governance and performance, particularly in a context of constrained funding and expanding health coverage. In Morocco, the Basic Medical Coverage Code (Law 65-00) established compulsory health insurance (Mandatory Health Insurance, AMO) and the medical assistance scheme AMO-Tadamon.[1] This reform transformed hospital financial circuits by transferring a large share of hospital revenue to the organisations that manage AMO, namely the National Fund of Social Security Organisations (CNOPS), the National Social

Security Fund (CNSS) and, more recently, the National Health Insurance Fund (CNAM).

In this framework, the admission and billing office (Bureau d'Accueil et de Facturation, BAF) is a pivotal component of the hospital value chain. It admits patients, bills medical acts according to the General Nomenclature of Professional Acts (NGAP), dispatches claim files and follows up collection from paying organisations. The reliability of this process directly influences hospital cash-flow and investment capacity: a dysfunction results in a lower collection rate and a fragile treasury. The National Agency for Health Insurance

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(ANAM) has set billing standards and a national reference tariff, and stresses the need for rigorous billing management, with clear coding and follow-up rules, to reduce rejections and ensure transparency.[2]

Nevertheless, achieving these objectives remains difficult. Studies conducted in France and in Morocco have shown that process fragmentation and the lack of coordination between departments are significant obstacles to effective revenue collection,[3-5] and that reorganising the admission office and professionalising its practices improve financial stability.[3,4,6] Lean Six Sigma approaches are widely used to optimise hospital processes,[7] and revenue cycle management (RCM) approaches describe standardisation and digitalisation as ways to reduce claim rejections and accelerate settlement.[8] Evidence on hospital payment reform also underlines the importance of reliable performance measurement,[9] while the digitalisation of hospital information systems is under way in Moroccan university hospitals.[10]

A preliminary diagnosis of the BAF back-office of an international university hospital in Morocco revealed difficulties similar to those reported nationally: a high rate of claim rejections, delays in dispatching claim files, the absence of automated payment reminders and the lack of real-time monitoring tools. These dysfunctions reduce the net collection rate (NCR) and affect the financial performance of the hospital. The objective of this study was to diagnose the billing and collection process of the BAF back-office, to analyse its performance indicators over six months, and to propose improvements consistent with regulatory standards (NGAP, ANAM) and good hospital management practice.

MATERIALS AND METHODS

Study design and setting

A mixed-methods case study combining qualitative and quantitative approaches was carried out in the back-office of the BAF of an international university hospital in Morocco. The approach relied on methodological triangulation of documentary analysis, participant observation, semi-structured interviews and analysis of internal indicators, in order to obtain a

complete and objective view of the functioning of the service.

Documentary analysis

The regulatory and institutional references on hospital billing were reviewed: Law 65-00,[1] the ANAM directives and the national reference tariff strategy 2020-2024,[2] the NGAP, the circulars of the Moroccan Federation of Insurance and Reinsurance Companies (FMSAR) and the recommendations of the National Council of the Order of Physicians (CNOM). The scientific literature on revenue cycle management and Lean Six Sigma was also examined.[7,8]

Participant observation

A participant observation lasting two weeks covered all the steps of the circuit: admission, billing, cash office, dispatch of claim files and collection. It made it possible to map the processes, to identify limiting constraints and to record operational practices in real time.

Interviews and sampling

Semi-structured interviews were conducted using an interview guide covering four themes: the hospital information system, management control and financial performance, organisation and coordination with other services, and quality and risk management. The sample comprised five front-office and back-office agents, eight cell heads and the head of the department ($n = 14$), covering all the links of the admission, billing, dispatch and collection chain. The interviews explored the perceived obstacles, the frequent causes of rejection and the possible improvements.

Data sources and indicators

Quantitative data were extracted from internal files provided by the head of the department and covered six months, from January to June 2025. The indicators analysed were the number of admissions and discharges, the dispatch rate, the mean dispatch delay, the NCR, the rejection rate and the rate of patient identity verification errors. The indicators were defined according to the recommendations of the French National Authority for Health (HAS) and validated with the heads of the BAF to ensure their operational and scientific relevance. A simplified dictionary of the three main key performance indicators (KPI) is given in Table 1.

Table 1: Simplified dictionary of the key performance indicators (KPI) of revenue collection

KPI	Definition	Formula	Thresholds (green / orange / red)
Net collection rate (NCR)	Percentage of amounts collected relative to amounts billed	$\text{Amount collected} / \text{amount billed} \times 100$	$\geq 85\%$ / 75-85% / $< 75\%$
Mean dispatch delay	Mean time between billing and dispatch of the claim file	$\text{Sum of dispatch delays} / \text{number of files}$	≤ 7 days / 8-12 days / > 12 days
Rejection rate	Percentage of files rejected by paying organisations	$\text{Number of rejections} / \text{files dispatched} \times 100$	$\leq 8\%$ / 9-12% / $> 12\%$

Thresholds are given as green / orange / red.

Analytical tools

Several quality and management tools were used to structure the interpretation of the data: strengths, weaknesses, opportunities and threats (SWOT) analysis, political, economic, social, technological, environmental and legal (PESTEL) analysis, Ishikawa diagram, the 5 whys method, Pareto analysis, a responsibility assignment matrix (RACI: responsible, accountable, consulted, informed) and failure modes, effects and criticality analysis (FMECA). In the FMECA, each risk was rated for frequency (F), severity (G) and detectability (D) on ordinal scales, and criticality (C) was calculated as $F \times G \times D$. Data were processed and presented with Microsoft Excel and PowerPoint, and an

interactive dashboard was developed in Microsoft Power BI for the dynamic monitoring of the indicators.

RESULTS

Organisation of the service and distribution of responsibilities

The BAF comprises a front office and a back office. The back office is led by a head of department and includes billing, cash office and collection teams as well as agents dealing with specific paying organisations. The distribution of roles between the actors involved in billing and collection is summarised in the RACI matrix (Table 2).

Table 2: RACI matrix of the main activities of the BAF

Activity	Front office	Back office	Cash office	Collection cell	Admin. and finance	Accounting	Payers
Patient admission	R/A	I					
Reception and patient identity verification	R	C					
Billing of medical acts	C	R/A					
File verification	C	R/A					
Cash collection and deposits			R/A		C	I	
Dispatch of claim files		R/A			I		I
Follow-up of rejections		C		R/A	I		C
Automatic payment reminders				R/A	I		C
Financial reconciliation	I	C	C		A	R/A	
Financial reporting		C		C	R/A	R	I

R, responsible; A, accountable; C, consulted; I, informed. Payers, paying organisations; Admin. and finance, administrative and financial department.

Process mapping

The collection process follows five main steps (patient admission, billing, cash office, dispatch of claim files and collection), governed by strategic steering and quality management, and interacts with three transversal functions: the hospital information system (linked to

billing), human resources (cash office) and financial management (collection) (Fig. 1). This mapping made it possible to visualise the interdependencies and to identify the points of rupture and responsibility, particularly at the dispatch and collection stages.

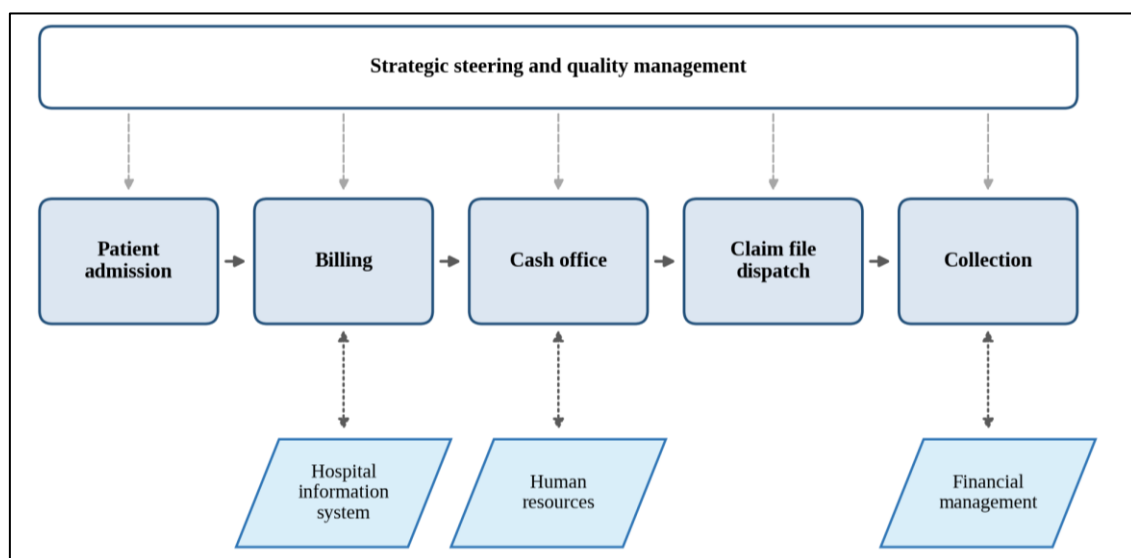


Fig. 1: simplified map of the revenue collection process of the BAF

Priority Analysis

The Pareto analysis of the 100 recorded occurrences of causes of delay and rejection identified billing errors and missing supporting documents as the main cause (40%), followed by the absence of automated

reminders for unpaid claims (25%) and reimbursement delays (15%). Together, these three causes accounted for 80% of occurrences (Table 3, Fig. 2) and therefore represent the priority targets for corrective action.

Table 3: Pareto analysis of the causes of delay and rejection in the collection process

Rank	Cause	Occurrences (n)	Share (%)	Cumulative (%)
1	Billing errors and missing supporting documents	40	40	40
2	Absence of automated reminders for unpaid claims	25	25	65
3	Reimbursement delays	15	15	80
4	Lack of coordination between departments	10	10	90
5	Excessive staff workload	5	5	95
6	Multiple interfaces slowing processing	5	5	100
	Total	100	100	

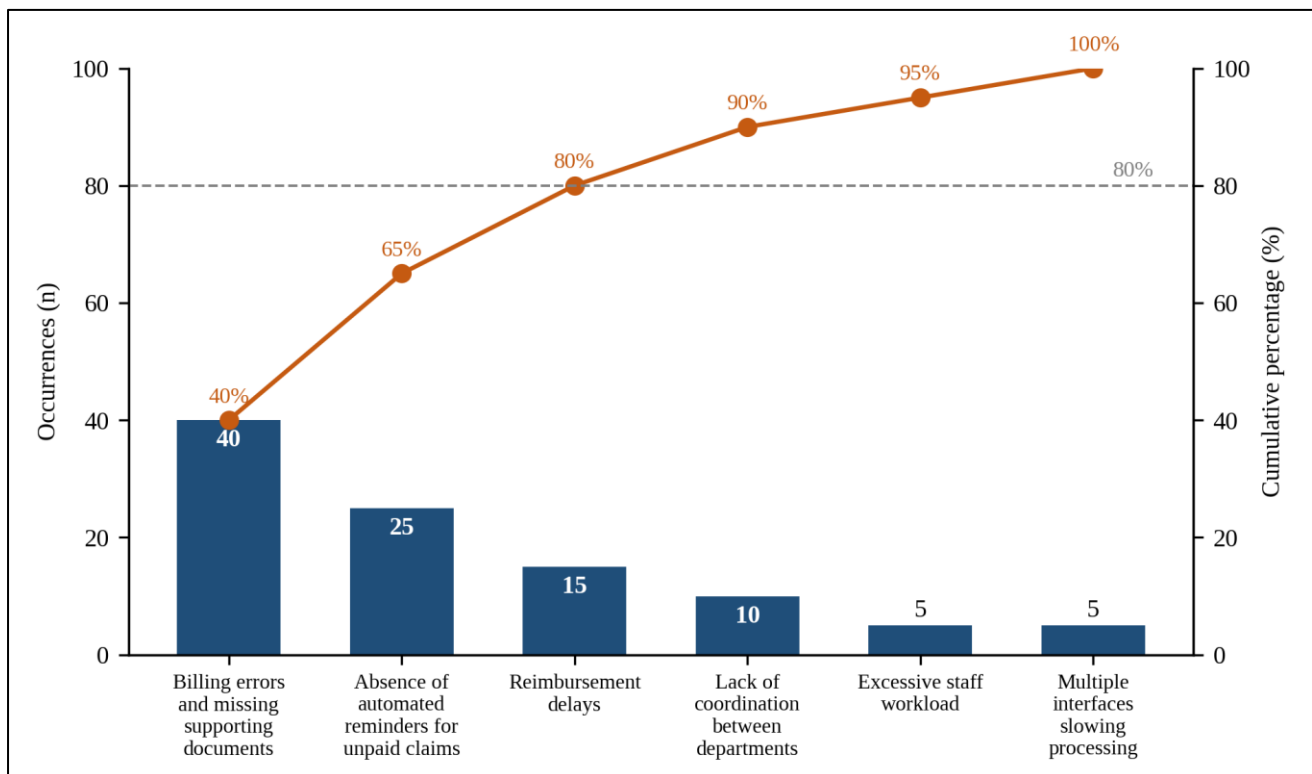


Fig. 2: Pareto chart of the main causes of delay and rejection

Risk Analysis

The FMECA ranked the risks of the collection process by criticality (Table 4). The highest criticality was associated with the manual cash-collection system

(C = 80), followed by billing errors (C = 50) and patient identity errors (C = 48). Corrective actions, owners, deadlines and follow-up indicators were defined for each risk.

Table 4: FMECA of the risks of the revenue collection process of the BAF

Activity	Risk / cause	Effect	F	G	D	C	Corrective action	Owner (deadline)	Follow-up KPI
Admission	Identity error	Patient confusion; file rejection	4	4	3	48	Verification of identity documents; double check	Front-office manager (3 months)	% identity verification errors
Coverage request	Documents not available	Rejection of authorisation request	2	3	3	18	Inform patients; mandatory checklist	Front and back office (2 months)	% rejections related to authorisation

Activity	Risk / cause	Effect	F	G	D	C	Corrective action	Owner (deadline)	Follow-up KPI
Billing	Billing errors	Rejections	5	5	2	50	Continuous NGAP training; update of the reference database	Back-office head (3 months)	% NGAP-related rejections
Dispatch	Incomplete files	Rejections by paying organisations	3	4	3	36	Introduction of a checklist	Back-office head (3 months)	% incomplete files
Collection	Data-entry errors in payments	Delays; overload	2	3	3	18	Training; double verification	Collection manager (2 months)	% payment data-entry errors
Cash office	Non-compliant cheques	Delayed cash collection	3	3	3	27	Staff training; upstream control	Cash office manager (4 months)	% rejected cheques
Cash office	Manual system	Repetitive errors	5	4	4	80	Digitalisation of cash collection	Admin. and financial director; cash office (12 months)	% digitalised operations

F, frequency; G, severity; D, detectability; C, criticality ($F \times G \times D$).

Performance indicators

Activity and dispatch. Mean monthly admissions were 492 over the six months, and activity in the second quarter was about 12% higher than in the first quarter (mean 520 versus 463 admissions per month). Discharges followed a similar trend, indicating a stable

patient flow (Table 5, Fig. 3a). The dispatch rate increased from 85% in January to 94% in June, and the mean dispatch delay decreased from 12 to 7 days, reaching the target threshold of the KPI dictionary (Table 1).

Table 5: Monthly activity and dispatch indicators of the BAF back-office, January to June 2025

Month	Admissions (n)	Discharges (n)	Dispatch rate (%)	Mean dispatch delay (days)
January	420	400	85	12
February	460	450	88	11
March	510	490	90	10
April	480	470	87	9
May	530	520	92	8
June	550	540	94	7
Monthly mean	492	478	89.3	9.5

Collection and quality. The NCR increased from 75% to 84% (+9 percentage points) and remained slightly below the 85% target. The rejection rate decreased from 18% to 12% but was still above the 8% threshold in June; rejections were mainly related to

discrepancies in the application of the NGAP, coding inconsistencies and missing supporting documents. The rate of patient identity verification errors decreased from 4.5% to 3.1% (Table 6, Fig. 3b).

Table 6: Monthly net collection rate, rejection rate and identity verification errors of the BAF back-office, January to June 2025

Month	NCR (%)	Rejection rate (%)	Identity verification errors (%)
January	75	18	4.5
February	78	16	4.2
March	80	14	3.8
April	79	15	3.6
May	82	13	3.3
June	84	12	3.1

NCR, net collection rate.

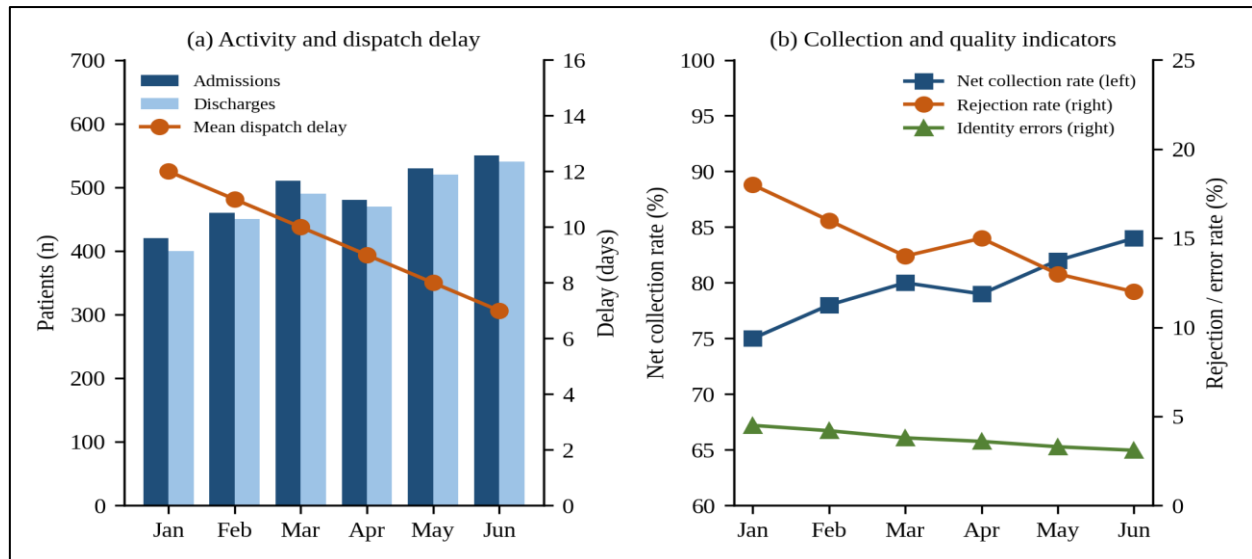


Fig. 3: monthly evolution of (a) admissions, discharges and mean dispatch delay and (b) net collection rate, rejection rate and identity verification errors, January to June 2024

Dashboard. The Power BI dashboard developed during the study made it possible to visualise these indicators in real time and to identify anomalies rapidly. It provided increased traceability, automated alerts and an objective support for decision-making.

DISCUSSION

This study described the collection process of the BAF back-office of a Moroccan university hospital and its performance over six months. The indicators improved overall: the NCR increased from 75% to 84%, the mean dispatch delay decreased from 12 to 7 days, and identity verification errors decreased. These trends are compatible with the benefits that the literature attributes to the reorganisation of the billing and collection circuit and to the central role of the admission office in the fluidity of hospital finances. [3,4] They also suggest that process mapping and regular monitoring through interactive dashboards contribute to a better control of the process.

The rejection rate, although reduced, remained high (12% in June) and above the 8% threshold. The Pareto analysis and the FMECA converge on this point : billing errors and missing supporting documents were the leading cause of delay and rejection (40%) and the second most critical risk ($C = 50$), pointing to discrepancies in the application of the NGAP, coding inconsistencies and incomplete files. The underlying weakness appears structural: procedures are not standardised between the BAF and the paying organisations (CNOPS, CNSS and private mutual insurers), and there is no integrated follow-up system, which generates delays and rejections. This observation is consistent with the proposal to reorganise the admission and billing office into a reception and admission service in order to strengthen coordination between departments and to optimise hospital financial management.[5] The manual cash-collection system,

which had the highest criticality score, supports the priority given to the digitalisation of collection operations.

The mapping of the process and the identification of its critical points, especially dispatch and collection, are consistent with the logic of the DMAIC cycle (define, measure, analyse, improve, control) of Lean Six Sigma, which aims to reduce dysfunctions through standardisation and the reduction of variability.[7] The RCM literature likewise treats registration, billing and collection as a single continuous cycle.[8] Outside Morocco, a case study from a paediatric hospital in the United States described the use of an analytical dashboard to monitor billing denials, with reported reductions in denials and in administrative workload,[11] and recent work on artificial intelligence in the revenue cycle suggests possible gains in coding accuracy and claim processing speed.[12] These experiences are not directly transferable to the Moroccan context and their evidence base is largely descriptive, but they support further exploration of digital monitoring tools.

On the basis of these results, several improvement measures can be proposed: (i) strengthening digitalisation through a full integration of the hospital information system and a connection to the platforms of paying organisations; (ii) standardising billing and collection procedures to reduce variability and data-entry errors; (iii) setting up a national dashboard aligned with the ANAM indicators to monitor and compare hospital performance;[2] (iv) training BAF staff in Lean Six Sigma tools and digital systems; and (v) developing a proactive collaboration with paying organisations through regular follow-up committees, in order to anticipate and resolve coverage-related blockages.

This study has limitations. It is a single-centre case study covering six months, with a small qualitative sample ($n = 14$), and the indicators were supplied by the department itself. The design is descriptive and has no control group, so the observed changes cannot be attributed causally to the organisational measures or to the dashboard, and seasonal effects cannot be excluded. Multicentre studies over longer periods are needed to confirm these findings.

CONCLUSION

The optimisation of hospital revenue collection is a strategic lever of financial governance. In this case study, the combination of process mapping, reliable indicators, continuous-improvement methods and a digital dashboard was associated with a higher net collection rate, a shorter claim dispatch delay and fewer identity verification errors, although the rejection rate remained high. Reaching optimal performance will require the standardisation of procedures, a stronger interoperability between hospital and payer information systems, and the continuous training of teams, in order to secure hospital revenue and to support the successful generalisation of compulsory health insurance in Morocco.

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Disclosure of conflict of interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Statement of Informed Consent

Informed consent was obtained from all participants prior to their inclusion in the study. Participants were informed about the purpose and procedures of the study, and their participation was entirely voluntary.

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