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Assessment of clinical miscoding errors and potential financial their implications on healthcare management – A case of local hospital in Najran, Saudi Arabia

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ABSTRACT

Background: Healthcare systems can potentially improve their safety, quality of service, and performance efficiency with a cost reduction, through the introduction and implementation of healthcare information management systems. This study aims to examine the frequency of miscoding errors in principal and secondary diagnoses, exploring demographic and coder-related factors contributing to these errors through the use of the QuadraMed system. The study also investigates the association of coding errors with patient safety and service quality to estimate the potential financial implications resulting from these inaccuracies in the healthcare system.
Methods: This analytical cross-sectional retrospective study was conducted at a local hospital in Najran, Saudi Arabia, from July 2021 to February 2022 using the International Statistical Classification of Diseases and Related Health Problems, Tenth Revision, Australian Modification (ICD-10-AM) coding system. The costing and financial data were collected from the reimbursement department for eligible 750 patient cases in terms of payment mode, services availed, and length of stay. The financial claims were evaluated to estimate the impact on the quality of service and patient safety. The reimbursement amount was calculated based on codes. The data were analyzed using SPSS and the odds ratio was calculated to estimate the risk of major coding errors in different departments.
Results: Primary codes 240 (32%) and 40 (5.3) secondary codes were reviewed and percentages and inaccuracies were calculated after recording. The percentage of inaccurate medical codes in principal diagnosis was 57 (26.8%) and the percentage of inaccurate medical codes in secondary diagnosis was 21 (9.9%). The primary diagnostic codes have more coding errors with a total number of 240 (32%) coding errors with a moderate level of agreement between the original coder and independent coder with a kappa value of 0.462. The identified recording was done by the independent coder, and the secondary diagnostic code showed 40 (5.3%) cases, with a poor kappa value of 0.128. The results showed the highest number of primary diagnostic codes was among surgery clinics 79 (63.2%). The highest number of secondary diagnostic codes were reported among consultant clinics 12 (9.6%)
Conclusions: The study concludes that the identification of miscoding in the healthy population has a financial impact on the healthcare organization's infrastructure.

1. Introduction

Healthcare systems can potentially improve their safety, quality of service, and performance efficiency with a cost reduction, through the introduction and implementation of healthcare information management systems (HMIS) (Campbell and Giadresco, 2020). The Ministry of Health (MOH) in the Kingdom of Saudi Arabia (KSA) introduced the International Classification of Diseases, Tenth Revision (ICD-10) modified version of the Australian modification as International Statistical Classification of Diseases and Related Health Problems, Tenth Revision, Australian Modification (ICD-10-AM) at public healthcare setups of the kingdom (Alharbi et al., 2019). The HMIS facilitates data management

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and control in the healthcare setup in terms of medical records storage, records of the individual patient-provided clinical and financial services, diagnosis and procedures coding as per guidelines, and billing compilations (Basajja and Nambobi, 2022). Clinical coding is a healthcare administrative function involving written clinical information abstraction and transfer into clinical code. The procedure involves patient file review for identification of diagnostic and procedural activities performed on patients during admission or outpatient visits to the hospital. These codes were then assessed for implementation according to the identification of the disease and introduced interventions based on disease classification and procedure used during treatment. The clinical coder assigns codes according to disease classification (Alonso et al., 2020). This helps in the development of an administrative database utilized for reimbursement, financial reconciliation, audit, and research purposes (Sousa-Pinto et al., 2018).

After disease and procedure code correct assessment, two financial systems help establish the cost of care and the patient's income such as Diagnostic Related Group (DRGs) and Case Mix Index (CMI). According to their diagnosis, DRGs are a relatively newly established concept in Saudi healthcare setups and they classify patients into distinct groups based on their diagnoses. These groups typically utilize the same medical resources and hence pay roughly the same price. DRGs are primarily used to calculate reimbursement for each patient category. Studies in KSA reported a significant relationship between DRGs to the patient length of stay in the hospital, in addition to the patient's age (Sara and Shoukri, 2021). In terms of financial impact, DRG is considered a reliable and patient services representative system preferred for reimbursement purposes (Mehmood et al., 2021). The hospital then utilized CMI to understand the hospital's revenues and expenditures. Therefore, through CMI utilization, hospitals can assess if they have lost or gained more, than the expected amount of payments (Zafirah et al., 2018). It is essential to guarantee the correctness during the coding process that will be used for payments, health statistics, research, and planning (Ershad Sarabi et al., 2020). When a hospital uses diagnosis-related groups and Case mix index as payment systems, the accuracy of the coding is crucial. However, during the coding process, Clinical codes are deemed incorrect or erroneous, which can result in enormous financial ramifications (He et al., 2021).

Several contributing factors that result in the miscoding of healthcare reimbursement records include conflict or difference in the coding allocated at the point of care and at the compensation department, which results in a difference in the relative cost of treatment and paid cost. This is an irreversible type of error (Aldosari and Alanazi, 2018). Some other barriers that lead to miscoding include primary care professionals' skill gap and level of motivation, organizational priority, structured data reporting and recording taking time for consultation which is distracting, and limitation of available technologies and coding systems (Karhade et al., 2018). Studies have examined the functional capability of "The quadraMed" and "BestCare" systems in Riyadh, KSA. Both systems showed 88% of all authorship functions availability. The lack of diagnostic codes limited physicians' capability to incorporate documented patient diagnoses and was the only non-compliance observed with the QuadraMed system (Al-Kahtani et al., 2019). Another study used QuadraMed for coding purposes as it provides health atm to gather patient-centered information including patient health track (Aldosari, 2017). Coding accuracy is critical in diagnosis-related group assessment to monitor resource allocation and monitoring of efficiency. Clinical miscoding errors are adversely impacting hospital efficiencies, quality of service, and likely patient safety. Therefore, this study aims to examine the frequency of miscoding errors in principal and secondary diagnoses, exploring demographic and coder-related factors contributing to these errors through the use of the QuadraMed system. The study also investigates the association of coding errors with patient safety and service quality to estimate the potential financial implications resulting from these inaccuracies in the healthcare system southern Saudi Arabia.

The rest of the paper is organized as follows; the section after the introduction explains the methods applied in this study. After the methods results and discussion are narrated, followed by a conclusion.

2. Material and methods

2.1. Study setting, design, and population

This analytical cross-sectional study was conducted at a 50-bed, multi-specialty local hospital in Najran, Saudi Arabia. The data collection period was from July 2021 to February 2022 to evaluate and measure the accuracy and financial impact of coded cases on hospital revenue. The patient records were extracted from hospital electronic health records and medical paper charts and sheets.

2.2. Inclusion and exclusion criteria

The data obtained from sources included all patient's healthcare records with ICD-10-AM coding including the diagnosis, admission, and other related healthcare details of patients. The study included cases from all departments within the local hospital that were coded according to ICD-10-AM, and it specifically targeted cases with additional requests for costing. The miscoding was investigated by recording all provided cases of indirect treatment as well as involving the cost of healthcare services. All other cases which were not coded or did not follow ICD-10-AM coding were excluded.

2.3. Data sources

A total of 1129 cases were identified initially through QuadraMed electronic healthcare system (QuadraMed, Reston, Virginia, United States of America) to examine medical data and records. The medical records were reviewed retrospectively. Initial screening of records was done for completion. All identified records were screened by the researcher for categorical patient parameters such as date of admission, date of discharge, diagnosis, age, and gender. Free text data was also evaluated. All records with incomplete data, wrong codes, patients visiting only the outpatient department, and duplicate records were removed. Final of 750 cases were included in this study (Table 1) (see Fig. 1).

The costing and financial data were collected from the reimbursement department for eligible 750 patient cases in terms of payment mode, services availed, and length of stay. This represented 22% of the population. The financial details were extracted for enrolled cases from the software. Discussion between the reviewer and the clinical coder was done to resolve any inconsistencies in the reviewed medical records and codes were reviewed in the presence of ICD 10 coding guidelines. The reimbursement amount was calculated based on codes identified by coders. Other information including patient demographic characteristics, nationality, death before discharge, date of admission and discharge, and ICD-10-AM procedure codes were extracted. The clinical health record of patients was collected from the medical record

Table 1
Medical miscoding in principal and secondary diagnosis in different departments.

Department	Present	Absent	P-value*
Medical miscoding in Primary Diagnosis, N (%)			
ER	16 (7.5)	197 (92.5)	<0.05
Surgery Clinics	10 (4.7)	203 (95.3)	
Obstetrics/Gynecology	5 (2.3)	208 (97.7)	
Medical Miscoding in Secondary Diagnosis			
Consultation Clinics	6 (2.8)	207 (97.2)	<0.05
Nephrology Clinics	9 (4.2)	204 (95.8)	
Diabetes Clinics	2 (0.93)	211 (99.1)	

Chi-Square*, ER: Emergency department (Emergency room).

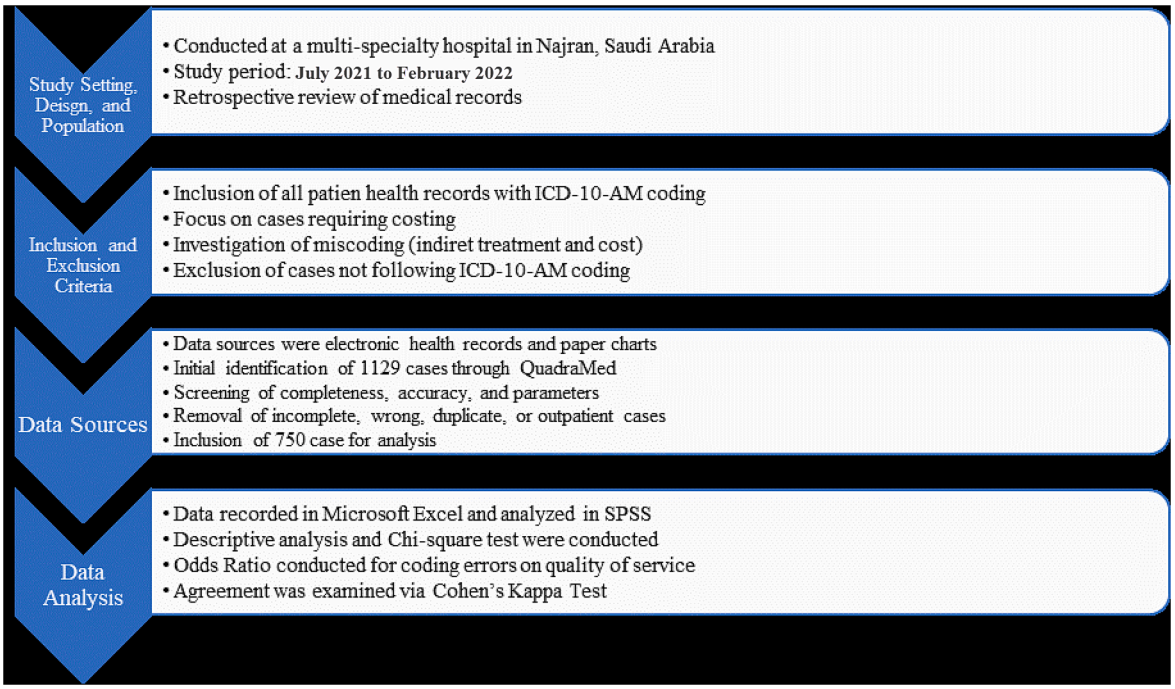

Fig. 1. Steps involved in the extraction of selected cases for miscoding errors assessment.

department, for which coding was done by the hospital's clinical coders. The basic training for the clinical coders was done within the hospital from time to time to maintain coding records. All medical records were available and complete, there was no shortage of reports from the treating physician and medical staff and any report represents medical services received by the patient. The final 213 codding errors were extracted from overall 750 health records from all departments.

Re-examining and re-coding all cases were done by using Australian coding standards and the same versions of ICD-10-AM, ACHI, and ACS used by coders. After re-examining and re-coding all cases, corrected codes in a special form were entered. All medical records were initially reviewed by two independent researchers, and the final extraction of 213 errors was rechecked and evaluated by a senior researcher with previous clinical coding experience.

2.4. Ethical approval

The study was conducted after approval from the local hospital's ethics committee.

2.5. Statistical analysis

Microsoft Excel (2016) was used to maintain records of patient characteristics and codes. Statistical Package for Social Sciences (SPSS) version 23.0 was used to analyze data statistically. A descriptive analysis was used to measure the percentage of accuracy and inaccuracy after re-coding cases. The chi-square test was used for categorical variables to examine the association between the contributing factors identified for miscoding in health information records among both genders. The odds ratio was calculated to estimate the risk of different types of coding errors on quality of service and patient safety in a hospital. A p-value of < 0.05 was considered to be significant. The level of agreement between the original and independent researchers for the primary and secondary diagnostic codes was examined through Cohen's kappa test.

3. Results

Our results showed that 57 (26.8%) inaccurate medical codes were identified in the principal diagnosis records and 21 (9.9%) were reported from secondary diagnosis records. The medical code inaccuracies were observed between the departments and it was found that 16 (7.55%) occurred in the ER followed by surgery clinic 10 (4.7%) and obstetrics/gynecology 5 (2.3%) and it was statistically non-significant. However, in consulting, nephrology, and diabetes clinics, the percentage of inaccurate medical codes of secondary diagnosis was higher in consulting clinic 6 (2.8%) followed by nephrology clinic 4 (1.9%). The medical inaccuracies in the principal diagnosis and secondary diagnosis were found statistically significant (P-value < 0.05) (Table 1). The demographic details of the included cases are attached in Appendix A.

The association between the contributing factors to miscoding among both genders was examined in (Table 2) and results showed 172 (36.8%) participants were male with a statistically significant difference ($p = 0.007$). The results showed a statistically significant difference in the number of miscoding cases reported among both genders in the emergency room (ER) ($p = 0.046$), surgery clinic ($p = 0.041$), and Obstetrics/gynecology ($p = 0.003$). There was a difference in the number of

Table 2
Patients' details contributing to medical information miscoding.

Variables	Coding errors N (%)		Chi (X^2) Value	p-value
	Male	Female		
Patient Details	172 (36.8)	89 (31.4)	11.41	0.007*
Departments				
ER	49 (28.5)	12 (13.5)	89.7	0.046*
Surgery Clinic	62 (41.9)	17 (19.1)	125.1	0.041*
Obstetrics/Gynecology	0 (0)	27 (30.3)	148.3	0.003*
Nephrology	4 (2.3)	5 (5.6)	2.4	0.414
Diabetes	19 (11)	13 (14.6)	9.6	0.063
Consultant clinics	17 (16.3)	15 (16.9)	10.1	0.089
Type of service event				
Readmission patient	47 (27.3)	14 (15.7)	23.6	0.038*
Initial admission	125 (72.7)	75 (84.3)	19.7	0.051
Patient medical information (admission)				
Incomplete admission form	53 (30.8)	17 (19.1)	58.4	0.024*
Complete admission form	119 (69.2)	72 (80.9)	41.3	0.052
Patient medical information (discharge)				
Incomplete discharge form	62 (36)	33 (37.1)	84.2	0.048*
Complete discharge form	110 (64)	56 (62.9)	76.8	0.047*

miscoding cases during readmission patients among both genders (p = 0.038).

Table 3 considering coder characteristics showed a statistically significant difference in terms of qualification of staff (p = 0.012). The analysis indicates that 37.3% of selected samples were inaccurately coded in both principal and secondary diagnosis and due to these inaccuracies; the hospital is subject to lose some financial claims, estimated at 12,927 Saudi Riyals (USD 3442.61).

Table 4 showed that during the recoding process, the primary diagnostic codes had more coding errors with a total number of 240 (32%) coding errors with a moderate level of agreement between the original coder and independent coder with a kappa value of 0.462. As the recoding of the identified documents was done by the independent coder, the secondary diagnostic code showed 40 (5.3%) cases, with a poor kappa value of 0.128. The results also showed that the highest number of primary diagnostic codes was among surgery clinics 79 (63.2%). highest secondary diagnostic codes were reported among consultant clinics 12 (9.6%).

The estimation of the association of patient safety and quality of service with different types of coding errors in different departments was demonstrated in Table 5. The results showed documentation coding and incomplete electronic information as potential risk factors. The odds of getting errors that impact the quality of service and patient safety more in the emergency department [OR: 14.21 (95% CI: 6.02–22.63); 0.002]. The highest odds of diagnosis miscoding were reported in the surgery clinic [OR: 8.12 (95% CI%:3.51–12.47); 0.025], Wrong clinical interpretation was reported in the consultation clinic [OR: 0.22 (95% CI: 0.58–6.98); 0.053] and Incomplete electronic information was reported highest in the emergency department [OR: 15.11 (95% CI: 9.67–22.65); 0.005].

4. Discussion

Clinical coding is the important process through which clinical coders convert clinical terminology into numeric and alphabetic codes (Karhade et al., 2018). The results of our study showed a significant difference in the identification of miscoding in the health information system ($p < 0.05$). We also studied the impact of coder knowledge, qualification, and experience as a contributing factor to coding and results showed statistically significant differences among both genders ($P < 0.05$). The kappa results for the primary diagnostic codes showed a moderate level of agreement between the original coder and independent evaluator of codes (k = 0.462) and a low level of agreement between two coders in the secondary diagnostic codes (k = 0.128) while using the QuadraMed health information management system. A study conducted in KSA assessed the perception of physicians related to the use of the QuadraMed system as an e-prescription system with appropriate coding and a 52% satisfaction rate among physicians for the e-prescription system. The study also reported limitations of complicated and hard data availability, limited access to patient records, and skills gap (Al-Kahtani et al., 2019). The poor kappa value (0.128) in our results for the secondary diagnostic code showed a poor and low level of agreement between the original coder and the independent coder. These issues could be resolved with internal training of employees involved in code generation and implementation.

We calculated the financial discrepancies between the original codes in selected medical records and the codes of an independent medical coder, and the results indicated that these inaccuracies led to incorrect financial readings and impacted hospital income. The findings confirmed that flaws in the medical coding procedure directly led to errors in financial claims. The analysis indicates that 37.3% of selected samples were inaccurately coded in both principal and secondary diagnosis and due to these inaccuracies; the hospital is subject to lose some financial claims, estimated at 12,927 Saudi Riyals. The finding of this study was supported by studies done by Zafirah et al. (2018) in Malaysia, Jordan et al. (2012) in liaison psychiatry service, and Mole et al. (2018) in plastic surgery cases. They also found that there are inaccuracies in the medical codes of selected samples, and these inaccuracies may lead to financial consequences. Whereas, Zafirah et al. (2018) found that 89.4% of samples were coded inaccurately which led to the loss of RM654, 303.91. In a study conducted by Jordan et al. (2012) 12.7% of patients changed to a higher-paying DRG and the hospital could gain €305,349 which is considered a significant increase in reimbursement to the hospital. Mole et al. (2018) found that 34% of cases were coded inaccurately and the hospital could lose £29,000. All studies revealed that the relationship between medical coding and financial claims is a consensual relationship and any inaccuracies in the coding process may lead to financial consequences.

The main objective of Priyatilake et al. (2019) was to assess the inaccuracy of the coding process in their existing practices and create a type of remedy or intervention that would help solve this issue suitably and economically. According to the findings, doctors were responsible for the majority of coding errors because of their unclear documentation, while clinical coders were responsible for the remaining errors. The difference in quantities was determined to determine the net income loss after really checking for errors, and it was around 11,000 lb.

According to Khwaja et al. (2009), 36% of records for a sample of patients had incorrect and incomplete clinical coding. These errors happened as a result of outdated coding and categorization systems, which need to be updated, and clinical coders who lacked coding experience. As a result of these two issues over four months, the hospital

Table 3
Coders' characteristics contributing to medical information miscoding.

Variables	Coding errors N (%)		Chi (X^2) Value	p-value
	Male	Female		
Coders Knowledge	18	11		
Qualified staff (degree)	12 (66.7)	6 (54.5)	21.4	0.012*
Basic education (non-degree)	6 (33.3)	5 (45.5)	0.89	0.813
Employees Experience				
Experience > 3 years	5 (27.7)	3 (27.2)	65.81	0.044*
Experience 1–3 year	4 (22.3)	4 (36.3)	1.81	0.613
Experience < 1 year	9 (50)	4 (36.3)	23.7	0.039*
Mode of work (clinical code)				
Full time	2 (40)	2 (66.7)	1.2	0.813
Part-time	3 (60)	1 (33.3)	9.7	0.071
Financial Impact				
Saudi Riyal				12,927

Table 4
Clinical miscoding errors leading to the potential financial impact on quality of service in healthcare setup.

Codes for Items	Total reviewed cases	Total recorded errors (%)	Kappa value	p-value
Primary diagnostic codes				
ER	125	61 (48.8)	0.468	<0.001
Surgery Clinic	125	79 (63.2)	0.496	<0.001
Obstetrics/ Gynecology	125	27 (21.6)	0.447	<0.001
Nephrology	125	9 (7.2)	0.513	<0.001
Diabetes	125	32 (35.6)	0.557	<0.001
Consultant clinics	125	32 (25.6)	0.491	<0.001
All cases	750	240 (32)	0.462	<0.001
Secondary diagnostic codes				
ER	125	6 (4.8)	0.102	<0.001
Surgery Clinic	125	11 (8.8)	0.013	<0.001
Obstetrics/ Gynecology	125	5 (4)	0.121	<0.001
Nephrology	125	3 (2.4)	0.016	<0.001
Diabetes	125	9 (7.2)	0.023	<0.001
Consultant clinics	125	12 (9.6)	0.173	<0.001
All cases	750	40 (5.3)	0.128	<0.001

Table 5
Association of patient safety and quality of service with different types of coding errors.

Coding Error	ER [OR (p-value)]	Surgery [OR (p-value)]	Gynaecology [OR (p-value)]	Consultation [OR (p-value)]	Nephrology [OR (p-value)]	Diabetes [OR (p-value)]
Documentation miscoding	14.21 (0.002)	11.28 (0.041)	1.99 (0.056)	1.42 (0.04)	0.54 (0.781)	4.21 (0.41)
Diagnosis miscoding	3.99 (0.037)	8.12 (0.025)	23.39 (0.0001)	1.89 (0.051)	1.02 (0.634)	1.02 (0.52)
Wrong clinical interpretation	1.09 (0.066)	1.99 (0.049)	0.88 (0.073)	2.22 (0.053)	0.17 (0.189)	2.11 (0.044)
Incomplete electronic info	15.11 (0.005)	12.57 (0.04)	9.73 (0.038)	3.21 (0.072)	0.05 (0.621)	1.06 (0.067)

may have lost £19,427. The authors offered two ways to avoid clinical coding errors. First, with the assistance of a skilled clinical coder, clinical coders must accurately record and translate data into codes. Second, hospital finance management needs to be aware that a single patient can have two distinct treatments, each with its codes and bills.

To conduct interventions to enhance coding in connection to two frequent orthopedic procedures, Tucker et al. (2016) highlighted the financial consequences of incorrect clinical coding. The causes for the inaccuracy could be linked to the coding system's ambiguity; untrained personnel are unable to effectively apply ambiguous clinical data with codes. More than one-third of the acute care trusts in the National Health Service had materially inaccurate data, according to the audit committee. To reduce error, the authors focused on improving communication between surgeons and the personnel of the coding department when designing the interventions in this article.

Studies reported that the auditing process is crucial for identifying the root causes of coding errors, improving coding accuracy for routine disease and treatment classification, and getting adequate financial compensation (Ryan et al., 2021; Palamuthusingam et al., 2022; Timon et al. 2023). The study examined the inaccuracy of coding as a hindrance to the functioning of the health system and the degree of the financial impact of such errors on the patient and healthcare provider levels. In addition to researching the various causes that lead to these types of errors throughout the medical coding process, this project examined the effects of these errors. Our study results showed that the odds of getting documentation error during coding and incomplete electronic information was reported more in the emergency department. The diagnostic miscoding was reported highest in obstetrics and surgery clinics. The possible reason behind this frequency of coding errors is the inappropriate training of healthcare staff to select codes and incorporate data properly. The limited resources available including human resources per patient bed and complete availability of record sets by the billing and finance department also influence miscoding. The reimbursement of records after the correction of coding errors reported a financial difference of 18,514 SAR in our records during the study period.

The limitation of our study was the unavailability of hospital resources due to the COVID-19 pandemic, hindering direct access to hybrid health records and certain procedure codes. This restricted the comprehensive analysis of coding accuracy and documentation completeness. Although the research conducted a thorough examination within a single Saudi Arabian local hospital, the study's scope limited its generalizability to broader healthcare contexts. To enhance the study's comprehensiveness, future research should focus on replicating the study across diverse healthcare settings, exploring variations in coding accuracy, data availability, and administrative data completeness. Incorporating more extensive electronic methods for data collection and conducting longitudinal studies to track changes in coding practices over time could offer valuable insights. Continuous assessments and improvements in coding practices amidst evolving healthcare landscapes would be beneficial for ensuring accurate and comprehensive healthcare data management on a broader scale. Moreover, another limitation of the study is a single-centered study at a local hospital in Saudi Arabia, potentially restricting the generalizability of its findings to broader healthcare landscapes. The emphasis on coding accuracy and financial impact within this specific hospital setting highlights the need for further research to delve into coding accuracy, document completeness, and administrative data across larger and more diverse sample sizes encompassing various healthcare settings. To augment the external validity of the findings, it is essential to consider potential variations in coding practices, data availability, and administrative structures across different healthcare settings. This approach would afford a more comprehensive understanding of coding practices and their implications within the broader healthcare spectrum.

This research aimed to shed light on the real financial effects resulting from the inaccuracy of coding. Therefore, we recommend proper training of healthcare staff to ensure the incorporation of correct codes that will not only ensure the safety of patients in terms of treatment outcomes but also aid hospital administration in the generation of proper financial reconciliation and avoid any loss.

5. Potential applications

The study's outcomes extend far beyond coding accuracy, offering wide-ranging applications in healthcare advancement. Firstly, the improved precision in medical coding ensures more accurate healthcare records, thereby diminishing errors and ultimately elevating patient care. Additionally, the insights gained provide invaluable financial guidance for hospital administrators, enabling better comprehension of the actual costs linked to coding errors. This knowledge empowers informed decisions on resource allocation and revenue management within healthcare facilities. Furthermore, the dataset and research outcomes serve as catalysts for the development of predictive machine learning models tailored for coding accuracy prediction and financial impact assessment in healthcare. Implementing these models into healthcare information systems equips clinical coders and administrators with predictive capabilities, aiding proactive error prevention and efficient cost management. Moreover, the study's insights pave the way for the creation of AI-driven tools, such as chatbots, designed to aid clinical coders in achieving precise ICD-10-AM coding. These tools streamline the coding process, minimize errors, and enhance operational efficiency in healthcare settings, marking a significant step toward improved healthcare quality and management.

6. Conclusion

Our study concludes that the identification of miscoding in the healthy population has a financial impact on the healthcare organization. Additionally, it influences the quality of service provided to patients due to misinterpretation of clinical data and ultimately impacts patient safety. It is recommended that proper training for healthcare organization staff must be provided and systems must be first pre-tested for the presence of all important variables to improve its accuracy. This will minimize the risk of miscoding and avoid potential financial losses.

7. Declarations

7.1. Ethics approval and consent to participate

The study was approved by the institutional ethics committee.

8. Consent for publication

Not applicable.

9. Availability of data and materials

The data will be available for review from the corresponding author on request.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Enrolled Cases characteristics

Age	
(mean±SD)	43.31±7.11
Median (Range)	39.00 (28.0 to 71.0)
Gender, N (%)	
Male	166 (77.9)
Female	47 (22.1)
Principal Diagnosis	
Central Nervous system	11 (5.16)
Endocrine	21 (9.99)
Cardiovascular event	48 (22.53)
Gastrointestinal/ hepatic	35 (16.4)
Respiratory	24 (11.26)
Blood disorder	9 (4.22)
Musculoskeletal	20 (9.38)
Gynecological	36 (16.98)
Other	9 (4.22)
Length of stay	
(mean±SD)	5.99±11.63
Median (Range)	4.00 (1 to 12)

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