

Factors Affecting the Medical Coding Errors of COVID-19 Hospital Records: A Cross-Sectional Study in East Iran

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Background: During the COVID-19 pandemic, disease coding significantly influenced national and international strategies for prevention, treatment, and control. This study aimed to assess the factors influencing COVID-19 records' coding errors in teaching hospitals in South Khorasan province.

Materials and Methods: In 2022, researchers conducted a cross-sectional study in South Khorasan Province, Iran. Data was gathered using a self-developed questionnaire distributed among medical coders in all hospitals. Descriptive statistics were employed in the data analysis using SPSS version 19.

Results: The study's results showed that non-observance of diagnostic principles by physicians (66 out of 92), a lack of specialized medical coding specialists (52 out of 92), and the use of ambiguous and non-standard abbreviations (51 out of 92) were the most significant factors affecting COVID-19 coding errors. Among the three main factors affecting COVID-19 records' coding errors, factors related to the medical coder (47.66 out of 92), factors related to healthcare providers (29.8 out of 92), and organizational and environmental factors (21.4 out of 92) were the most significant.

Conclusion: This study revealed that multiple factors contribute to coding errors in COVID-19 records, with the most critical being physicians' non-adherence to diagnostic principles, the shortage of medical coding specialists, the use of unclear and non-standard abbreviations, and the absence of COVID-19 coding continuing education. Therefore, we recommend conducting workshops on diagnosis and coding for medical coders, particularly emphasizing the precise coding of COVID-19 records.

Keywords: Coding error; Clinical coding; Medical Records; COVID-19

INTRODUCTION

The International Classification of Diseases (ICD) diagnostic codes is a valuable tool for identifying and tracking healthcare facility exposure. In clinical coding, medical terms recorded by physicians are converted into codes that describe complaints, problems, diagnoses, treatments, or reasons for patients to visit medical centers. This enables epidemiological studies and measures treatment effectiveness in healthcare systems. The primary purpose of clinical coding is to facilitate information

retrieval and classification of complications and deaths, making it one of the important factors that affect the quality of clinical data in healthcare centers (1).

Clinical coding is highly beneficial for making choices at the national and international levels, as well as for disease prevention and treatment. The World Health Organization has conducted many studies on the classification of diseases, which have resulted in the development of disease classification systems in various fields (2). Clinical coding is a useful tool to effectively

influence functions such as health service planning, research activities, fee-for-service payment, patient safety monitoring, and developing decision support tools. Additionally, it reduces data duplication, standardizes language, and makes it easier to compare illness statistics on a national and global level (3-5). Since the patient's medical record is proof of their treatment process (6) and clinical data coding is the foundation for the standardization and retrieval of medical information standards (7), maintaining correct coding is crucial for the accurate analysis of clinical data (8).

If there is a coding error, it can cause significant issues with the organization's planning and research; the quality of the data and coding will decline and there will be issues with insurance companies reimbursing patients (9, 10). Coding errors can occur during a coding audit when codes assigned by internal coders differ from those assigned by an independent reviewer (11). Generally, there are multiple causes for coding errors. Some errors are within the scope of the health information management process, while others are outside the scope of health information management, and as a result, more information is not available or the integrity of the information is extracted from standard computer software. Ensuring the accuracy of coded data is a shared responsibility between health information management professionals, clinical specialists, and information systems integration specialists (12).

The accuracy of diagnostic coding is strongly influenced by the quality of medical information used as a basis for coding. The completeness of the discharge summary sheet by physicians is a critical factor in determining the quality of medical information. The coder must use medical information and coding rules to determine the relevant diagnostic code in the International Classification of Diseases, Tenth Revision (ICD-10) (12). ICD is one of the most important classifications of the World Health Organization, developed to standardize coded data (13).

The COVID-19 pandemic has highlighted the importance of high-quality information and data for

planning and the necessary interventions for disease prevention and treatment. Health records are one of the most valuable sources of information related to COVID-19. Since the diagnosis process for any disease, including COVID-19, is subject to considerations and rules, the World Health Organization has published guidelines to document this disease based on a unified and standardized process. As a result, coding COVID-19 can be complicated and may be accompanied by errors.

The current study takes a comprehensive approach by examining factors related to medical coders, healthcare providers, and organizational/environmental aspects that influence COVID-19 coding errors. This multi-faceted analysis provides a more holistic understanding of the issue. Furthermore, this study is conducted in the specific regional context of South Khorasan province in Iran, which adds valuable insights from a different geographic and healthcare system setting compared to previous studies. Also, this study uses a cross-sectional design to gather data directly from medical coders through a self-developed questionnaire, providing first-hand insights into their challenges. This primary data collection approach is novel compared to studies that may rely solely on secondary data sources (14, 15).

Despite the importance of coding diagnoses and interventions in the health system and the existence of many rules and regulations, few studies have been conducted to evaluate the accuracy of coding. The results of these studies have indicated that the accuracy of coding is low (9, 16). These novel elements position the study as a valuable contribution to the field of health information management, particularly in the context of a global health crisis. The findings could have significant implications for coding practices, healthcare quality, and policy-making. Therefore, the present study was conducted to investigate the factors affecting the coding errors of COVID-19 records in the teaching hospitals of South Khorasan province to prevent possible errors, unify diagnoses, and resolve existing ambiguities and problems.

MATERIALS AND METHODS

In 2022, a cross-sectional descriptive study was conducted among medical records staff at hospitals in South Khorasan province, including Birjand, Qaen, Ferdows, Tabas, Boshrouyeh, Sarayan, Khouf, Nehbandan, Zirkooh, Darmian, and Sarbisheh.

Data gathering tool

The research team reviewed previous studies (17-19) and held several meetings to design a questionnaire. Then the designed questionnaire was validated through a validation process with feedback from five faculty members in the field of health information management. The final version of the questionnaire was divided into two sections, with the first section collecting the personal characteristics of participants such as age, gender, academic level, employment status, and work experience. The second section discusses the factors affecting medical coding errors. These parts include organizational and environmental factors (seven questions), factors related to the medical coders (five questions), and factors related to the healthcare providers (four questions).

Study variables

The questionnaire included 15 items grouped into three main parts: factors related to the organization and environment, factors related to the medical coder, and factors related to the healthcare providers. There was also a section for additional factors affecting coding errors in COVID-19 patients' records.

Data gathering and Sampling

The questionnaires were published in both electronic and print form after obtaining approval from the ethics committee of Birjand University of Medical Sciences. Participants were made aware of the study's aims and ethical rules. The questionnaires were made available through various means. All medical records staff of the South Khorasan Province were assessed. The inclusion criteria were having at least one year of work experience in

the health information management unit, and the exclusion criteria were partial completion of the questionnaire with more than 20% of the questions remaining unanswered.

Data analysis

Data analysis was done using descriptive statistics with the help of SPSS version 19 software. The results were summarized and reported in the form of tables and graphs based on the objectives of the study.

Ethical Approval

This study was approved by the ethics committee of Birjand University of Medical Sciences with the ethics code IR.BUMS.REC.1401.236.

RESULTS

Table 1 provides the demographic characteristics of the study participants. The table shows that 78.3% of the participants were women, with more than 82% having a bachelor's degree. 64.1% of the participants had permanent employment status, and 69.6% had work experience of less than 10 years.

Table 1. Demographic characteristics of the people in the study

Demographic Information	Frequency	Percentage	
Age	35-25	47	1.51
	50-36	45	9.48
Gender	Female	72	3.78
	Male	20	7.21
Academic Level	Associate degree	5	4.5
	Bachelor degree	76	6.82
	Master degree	11	0.12
	Temporary-to permanent	8	7.8
Employment Status	Collaborative	2	2.2
	Permanent	59	1.64
	Contractual	23	0.25
Work Experience	5>	33	9.35
	10-5	31	7.33
	15-10	18	5.19
	15<	10	9.10

Table 2 demonstrates the frequency of participants based on the cities in the province. The table indicates that the highest number of participants were from Birjand (28.3%), followed by Ferdows (20.7%).

Table 2. Frequency of participants according to the hospitals of the cities

City	Frequency	Percentage
Birjand	26	28.3
Ferdows	19	20.7
Qaen	4	4.2
Tabas	7	7.5
Sarayan	12	13.0
Boshrouyeh	11	12.0
Nehbandan	2	2.2
Sarbisheh	3	3.3
Khaaf	2	2.2
Zirkooh	3	3.3
Darmian	3	3.3
Total	92	100

Table 3 outlines the main factors and sub-factors affecting coding errors. According to this table, sub-factors such as non-observance of diagnostic principles by physicians, lack of clinical coding specialists, and use of ambiguous and non-standard abbreviations are identified as among the most significant factors, along with lack of access to accurate information regarding the new guidelines for COVID-19 coding and non-use of EHR. Other factors, such as time constraints, high workloads, and insufficient knowledge and experience of medical coders, were also found to be significant contributors to coding errors.

Figure 1 illustrates the most important factors affecting the coding errors of COVID-19 patients' records based on their frequency in all three dimensions. According to this chart, non-observance of diagnostic principles is identified as the most important factor affecting coding errors in COVID-19 records.

Figure 2 compares the impact of organizational and environmental factors, factors related to medical coders, and factors related to healthcare providers. Based on the analysis, factors related to medical coders were identified

as the most significant factors, with a score of 47.66 out of 92.

Table 3. Factors affecting the coding errors of COVID-19 records from the perspective of the participants

Main Factors	Sub-factors	Frequency (of 92)	Percentage (%)
Organizational and environmental factors	Failure to hold COVID-19 coding continuing education	41	44.6
	Lack of access to accurate information regarding the new guidelines for COVID-19 coding	3	3.3
	A non-specialized look at coding in the hospital	16	17.4
	Not using modern coding tools (coding software)	29	31.5
	Failure to use EHR	2	2.2
	Failure to regularly evaluate the coding of records	29	31.5
	Incomplete medical documentation	30	32.5
	Medical coder's high workload	29	31.5
	Medical coder's insufficient knowledge	37	40.2
	Failure to read the new guidelines for COVID-19 coding	9	9.8
Factors related to medical coder	Lack of medical coding specialists	52	56.5
	Failure to fully review the record by the medical coder	22	23.9
	Non-observance of diagnostic principles by physicians	66	71.7
Factors related to the healthcare providers	Use of ambiguous and non-standard abbreviations	51	55.4
	Illegibility of the medical records	26	28.3

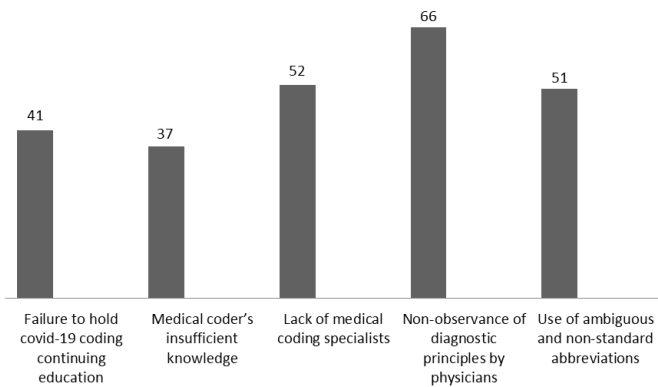
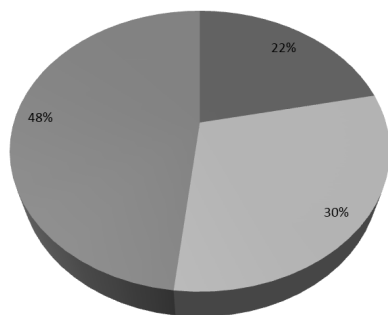


Figure 1. The most important factors affecting the coding errors of the COVID-19 patients' records



■ Organizational and Environmental Factors ■ Factors related to treatment staff ■ Factors related to medical coder

Figure 2. Comparison of the main factors affecting the coding errors of COVID-19 records

DISCUSSION

Clinical coding is a comprehensive database that has various applications, including planning, monitoring healthcare, and facilitating epidemiological research. It can be sufficient in some instances to understand the burden of disease (13).

Due to its function as a gateway for standardization and retrieval of medical information, it is crucial to maintain optimal coding quality for precise analysis and interpretation of clinical data. Neglecting coding quality and the occurrence of coding errors can result in inaccurate disease classification. This may endanger epidemiological and medical research and planning for healthcare providers and administrators due to the reliance on data with ambiguous or low classification quality (20). These errors can also impede the efficient financial

management of hospitals and lead to potentially incorrect national statistics on the prevalence of diseases in hospitals.

A recent study aimed to identify the factors responsible for coding errors in COVID-19 patient records. The study found that healthcare-provider-related factors were the primary causes of coding errors in COVID-19 records, with the non-observance of diagnostic principles by physicians and the use of ambiguous and non-standard abbreviations being the most significant sub-factors (21).

The study results revealed that healthcare-provider-related factors are the primary causes of coding errors in COVID-19 records. Meanwhile, the most important sub-factors of these factors were the non-observance of diagnostic principles by physicians and the use of ambiguous and non-standard abbreviations.

The results of the current study support Opitasari and Nurwahyuni's study (22) on the completeness and accuracy of clinical coding for medical diagnoses and procedures in Indonesia. This study revealed that illegible handwriting by physicians, inadequate documentation, and ambiguous abbreviations in medical records contribute to misinterpretation and incorrect code selection.

Additionally, the findings of the study conducted by Asadi et al. (19) to determine the factors affecting clinical coding errors revealed that non-observance of diagnostic principles by physicians, illegibility of medical records, the use of ambiguous and non-standard abbreviations, and the incomplete documentation of medical records ranked higher than 80% of the most significant causes of coding errors.

In 2018, Lyu et al. (23) conducted a study to evaluate the accuracy of the coding of patients with sarcoma. According to the findings of this study, 61.8% of the 1237 codes evaluated were correctly coded, 16.8% were incorrect, and 21.4% were incomplete. This study also highlighted how ambiguity in disease definitions might result in coding errors.

In another study, Mirhashemi et al. (4) showed that the use of ambiguous and non-standard abbreviations, the illegibility of medical records, and the non-observance of diagnostic principles by physicians all contribute to coding errors. Moreover, the non-observance of diagnostic principles by physicians was identified as the most effective factor affecting the incidence of coding errors, accounting for 33% of the factors affecting the occurrence of coding errors. In this regard, the results of the mentioned studies are consistent with the results of the present study.

According to the findings of a study conducted by Heywood et al. (24), coding errors are caused by non-observance of diagnostic principles and related international standards, less experienced coding specialists, training gaps, high workloads on staff, and time constraints in the coding of clinical records. Additionally, the results of this study indicated that the errors related to the medical coder include 31.3 to 64.7 percent of the coding errors. The findings are consistent with the findings of the current study in the sense that both organizational and environmental factors, as well as factors related to the medical coder, are effective in reducing the occurrence of coding errors.

According to Campbell et al.'s study (21), the Australian Ministry of Health expressed concern about the lack of clinical coding specialists and the increasing workload of medical coders to generate clinically coded data on time. This study suggested that health information management departments should be equipped with technologies that can lead to increased productivity among clinical coding specialists. The study also considers computer-assisted clinical coding (CAC) as an evolving technology that can improve the accuracy and quality of clinical coding and reduce the pressure on clinical coding specialists.

Due to the COVID-19 disease's complex nature, which results in multisystem symptoms, complications, and long-term effects, physicians must spend more time accurately and thoroughly documenting the records of these patients.

The coding of the COVID-19 records entirely depends on the accuracy of the medical records and should be assigned to a set of symptoms, family history, contact, and travel of the person.

Binkheder et al. (14) reported that incomplete medical documentation can result in COVID-19 patients being miscategorized and inaccurate medical codes being assigned to their medical records. Furthermore, they considered the illegibility of medical records to be one of the most common errors that occurred and suggested evaluating the data quality to ensure patient safety and readiness for secondary research and predictive analytics. Similar to this study, Klappe et al.'s (15) findings showed that, because of incomplete medical documentation, one cannot rely on individual routinely collected data items, such as coded COVID-19 on problem lists, to identify all COVID-19 patients. Both of their findings are consistent with ours (2,1 24)

To avoid errors caused by organizational and medical coder-related factors, it is suggested to regularly monitor the quality of clinical coding to prevent any errors in the future. Coders must receive continuous training and strictly adhere to ICD coding standards and guidelines to reduce coding errors. It is essential to have adequate coding skills when documenting COVID-19 records, considering various factors such as symptoms, underlying diseases, and accompanying diagnoses. The American Health Information Management Association (AHIMA) recommends that coding guidelines should be easily accessible. It also emphasizes the importance of communication between coders and physicians. Furthermore, coding should be carried out by health information management professionals to ensure accurate coding of diagnoses and medical procedures (25).

Although the non-use of electronic health records in the current study had less of an effect on the occurrence of coding errors in COVID-19 records from the staff's perspective, computerizing paper records can resolve many issues related to poor and illegible documentation and increase the accuracy of clinical coding (26). Stausberg

et al. (27) concluded that errors in clinical record coding were not related to coder weakness, and their study's results are inconsistent with the results of the present study. Additionally, this study highlighted the role of ICD-10 in reducing the reliability of coding diagnoses, as the researchers considered that ICD-10 contains ambiguities and contradictions that can obscure the coding process.

The use of ICD-10 books has undeniably contributed to certain coding errors. This classification system is outdated in terms of science and technology and does not reflect the most recent medical developments. Consequently, the publication of the ICD-11 by the World Health Organization in 2020 marks a significant development, particularly for COVID-19. ICD-11 is now simpler to use than ever, and coding is inexpensive with it. Thanks to modern technology, data recording is more accurate for the best possible output. The novel design and digital format also guarantee compatibility with the current IT infrastructure. Therefore, it is advised to interact extensively with medical coders, clinical staff, potential suppliers, and other countries where ICD-11 has been implemented to move toward ICD-11 (28).

Based on the investigations carried out by the researchers, this is the first study that has examined the factors affecting the coding errors of COVID-19 records. However, more studies are recommended to achieve more reliable results. It is suggested that this study be conducted in various cities across the country that use both paper and electronic record systems for documenting and coding medical records.

CONCLUSION

The study findings suggest that several factors contribute to coding errors in COVID-19 records. The most significant factors include physicians' non-observance of diagnostic principles, a shortage of medical coding specialists, the use of ambiguous and non-standard abbreviations, and a lack of continuing education on COVID-19 coding. To address these issues, it is

recommended to organize workshops on diagnosis and coding, especially for COVID-19 records, and ensure that physicians adhere to diagnostic principles. Collaborating between physicians and clinical coders can improve the accuracy and completeness of coded data. Therefore, regular interaction between all relevant groups during the coding process is critical, along with frequent review of clinical documents. Based on the experience of other leading countries, it is also advisable for healthcare organizations to electronic medical records and successfully deploy ICD-11, both of which can significantly reduce coding errors.

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Declaration of competing interest

The authors declare that there is no conflict of interest in this study.

Availability of data and material

The original contributions presented in the study are included in the article; further inquiries can be directed to the corresponding author.

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