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Original Article

Discrepancy Between Admission Diagnosis and Discharge Diagnosis in Cardiovascular Diseases: An Analysis Based On the Groups of International Classification Disease, 10th Revision

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Abstract

Introduction: There is a significant relationship between the appropriate treatment plans and accurate medical diagnosis. Admission and discharge diagnoses in hospitals are often different and this has significant implications on patient care and safety. The aim of this study was to explore the discrepancies between the admission diagnosis and the discharge diagnosis.

Methods: This was a longitudinal study conducted at Zanjan University of Medical Sciences (ZUMS). The study sample included admitted patients in hospitals during 2012-2019. The ICD-10 codes between I00 and I99 were selected as Cardiovascular Diseases. Data analysis was conducted by R (v3.6.0) and Rstudio (v1.2.1335) software. Agreement analysis was conducted by Cohen's Kappa statistics, and Chi Square statistic was used for examining the relationships between categorical variables.

Results: Agreement analysis of cardiovascular diseases subgroups showed that the values of Kappa coefficient range were varied between κ=0.34 for Chronic rheumatic heart diseases and κ=0.93 for Acute rheumatic fever diseases. The values of the Kappa coefficient for the 10 most common ICD-10 codes were in the range from κ=0. 44 for I25.9 to κ=0.77 for I80.2.

Conclusion: The results of this study showed that there was a significant difference between ADx and DDx, and the values of kappa coefficient were not the same between CVDs subgroups. There are definite needs for improvement on diagnostic accuracy, especially in regard to CVDs cases with acute condition.

Keywords: Admission diagnosis, Discharge diagnosis, Medical diagnosis, cardiovascular disease, international classification of diseases.

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Introduction

Medical diagnosis is the basis for decision-making in clinical practice. It provides essential information that can affect the quality of patient care in acute diseases (1). In fact, there is a strong relationship between the accurate diagnosis and appropriate treatment (2). Hospitalization, laboratory test, medication, treatment approach and length of stay(LOS) depend on the admission diagnosis (AD_X) (3). AD_X can be considered as a primary or presumptive diagnosis of a patient's condition or disorder at the admission time. The discharge diagnosis (DD_X) is the final diagnosis made for a patient before discharge from the hospital after all testing, surgery and workup are complete. The agreement of ADx and DD_X is an important factor in the evaluation of health care system efficiency. Discrepancies between them can occur in various diseases and lead to incorrect treatments and medical errors and affect the quality and efficiency of healthcare systems (3). The health care system can improve the quality of care and decrease the additional treatment costs by reducing the mismatch rates of ADx and DDx (4, 5).

According to the World Health Organization (WHO) report, chronic diseases are the main cause of mortality and morbidity in the world. Cardiovascular diseases (CVDs) are the most common chronic disease which, if not managed properly, will be a serious and costly problem in the health care system and society (6). CVDs includes coronary artery disease, heart failure, myocardial infarction, arrhythmia and cardiomyopathy, etc. (Table 1). The Iranian Ministry of Health and Medical Education Official statistics reports show that 39% of deaths in

Table 1: Cardiovascular diseases subgroups classification based on ICD-10 codes

Abbreviation	ICD-10 disease sub-group	ICD-10 code	Abbreviation	ICD-10 disease sub-group	ICD-10 code
ARF	Acute rheumatic fever	I00-I02	OFHD	Other forms of heart disease	I30-I52
CRHD	Chronic rheumatic heart diseases	I05-I09	CD	Cerebrovascular diseases	I60-I69
HD	Hypertensive diseases	I10-I15	DAAC	Diseases of arteries, arterioles and capillaries	I70-I79
IHD	Ischemic heart diseases	I20-I25	DVLL	Diseases of veins, lymphatic vessels and lymph nodes, not elsewhere classified	I80-I89
PHDDPC	Pulmonary heart disease and diseases of pulmonary circulation	I26-I28	OUDCS	Other and unspecified disorders of the circulatory system	I95-I99

Table 2: The characteristics of the study samples

		Total N (%)	LOS $\bar{X}$±SD	AGE $\bar{X}$±SD	Agreement N (%)	Disagreement N (%)	kappa	95% CI
Sex	Men	58254 (55)	126.1±247.5	56.6±15.2	49516 (85)	8738 (15)	0.77	0.77-0.78
	Women	47649 (45)	114.7±148.8	60.5±17.4	38884 (81/6)	8765 (18/4)	0.74	0.74-0.75
Married statue	Married	103099 (97.4)	120.6±206.3	64.4±13.7	85779 (83/2)	17320 (16/8)	0.75	0.75-0.76
	Single	2804 (2.6)	98±143.5	25.6±16.3	2621 (93/5)	183 (6/5)	0.91	0.89-0.92
sum		105903 (100)	119.9±204.1	58.1±17.1	88400 (83/5)	17503 (16/5)	0.76	0.75-0.77

N-Number; LOS – length of stay; $\bar{X}$– mean; SD – standard deviation; CI – confidence intervals

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Iran and 42% in Zanjan province, Iran, were due to CVDs in 2017 (7-9) The results of recent researches have shown that CVDs does not occur under a specific condition; many conditions involved and the main causes of CVDs still remain unclear. In addition, the symptoms of CVDs are similar to each other, which makes it hard for physicians to make an appropriate decision about the AD_X. The AD_X is very important and vital in some conditions like Ischemic heart diseases which require accurate diagnosis and quick treatment (10).

Achieving a high degree of diagnostic agreement in medical settings is important. This reflects the physician's professional competence and can affect the patient-care quality. Misdiagnosis or disagreements between AD_X and DD_X can lead to irreversible consequences. Therefore, the aim of this study was to determine the discrepancy between the AD_X and DD_X of CVDs.

Methods

This was a longitudinal and descriptive-analytical study conducted at Zanjan University of Medical Sciences. The study sample included admitted patients with CVDs problem in the period of March 20, 2012 to March 22, 2019. The data were gathered from the eight hospital information system (HIS) databases. These hospitals included Ayatollah Mousavi-e Zanjan, Valiasr-e Zanjan, Alghadir-e Abhar, Emdadi-e Abhar, Isar-e Ijrood, Amiralmomenin-e Khodabandeh, Shoahady-e Tarom, and Boalisina-e Khoramdareh. The ICD-10 codes between I00 and I99 were selected as cardiovascular diseases. The records with AD_X or DD_X missing were excluded. CVDs were classified into 10 subgroups by using the International Classification of Diseases, 10th revision (ICD-10) (Table 1). The discrepancy was measured by comparing the ICD-10 codes of the AD_X and DD_X; if these two codes did not match accurately at the terminal digit, they were classified as a discrepancy or mismatch. Data were analyzed using R (v3.6.0) and Rstudio (v1.2.1335) software. The analysis of the diagnostic agreement according to the CVDs subgroups was conducted using Cohen's Kappa statistic and 95% of the confidence interval. In the case of perfect matching, the value of the Kappa coefficient is 1. If the value of the Kappa coefficient is close to 0, it means that matching is coincidental, and if it is less than 0, the probability of matching is even less than coincidental (11). The Chi Square statistic was used to test the relationships between variables such as the length of stay (LOS), age, gender and marital statue.

Result

From the total of 515273 patient records, in 126874 cases the ICD-10 codes of AD_X or DD_X were between I00 and I99. 20971 (16.5%) case lacked AD_X or DD_X and were excluded. By analyzing only the complete ICD-10 codes of AD_X and DD_X, a total of 105903, there was a discrepancy in 17503 (16.5%) records. The value of the Kappa coefficient in the specified period of time was κ=0.76 (0.75–0.77) (Table 2). The kappa coefficients in men (0.77) and single ones (0.99) were higher than women (0.74) and married ones (0.75) (Table 2). The result of this study showed that the

Table 3: Cardiovascular diseases subgroups information

CVDs subgroup	Total N (%)	sex		Married statue		LOS $\bar{X}$±SD	AGE $\bar{X}$±SD	Agreement N (%)	Disagree-ment N (%)	Kappa	95% CI
		Men N (%)	Women N (%)	Married N (%)	Single N (%)						
ARF	16 (0.02)	6 (37.5)	10 (62.5)	3 (18.8)	13 (81.3)	111.4±91.7	24±25.4	14 (87.5)	2 (12.5)	0.93	0.84-1
CD	14425 (13.6)	6893 (47.8)	7532 (52.2)	14230 (98.6)	195 (1.4)	164.6±489.8	68.5±14.8	12716 (88.2)	1709 (11.8)	0.85	0.84-0.85
CRHD	1066 (1)	679 (63.7)	387 (36.3)	1042 (97.7)	24 (2.3)	162.4±314.6	60.8±15	261 (24.5)	805 (75.5)	0.34	0.31-0.37
DAAC	1685 (1.6)	586 (34.8)	1099 (65.2)	1614 (95.8)	71 (4.2)	119.8±184.6	61.8±17	841 (49.9)	844 (50.1)	0.58	0.56-0.60
DVLL	7939 (7.5)	2957 (37.2)	4982 (62.8)	6700 (84.4)	1239 (15.6)	83.8±124.6	46.5±19.5	7247 (91.3)	692 (8.7)	0.9	0.89-0.90
HD	10445 (9.9)	6167 (59)	4278 (41)	10270 (98.3)	175 (1.7)	63.1±129.3	64.6±13.4	8010 (76.7)	2435 (23.3)	0.74	0.73-0.75
ISD	50619 (47.8)	20713 (40.9)	29906 (59.1)	50079 (98.9)	540 (1.1)	85.9±112.6	62.2±12.8	45887 (90.7)	4732 (9.3)	0.78	0.77-0.78
OUCS	428 (0.4)	167 (39)	261 (61)	407 (95.1)	21 (4.9)	111.3±198.3	61.8±18.7	208 (48.6)	220 (51.4)	0.51	0.46-0.55
OFHD	17044 (16.1)	8336 (48.9)	8708 (51.1)	16612 (97.5)	432 (2.5)	115.9±165.2	67.2±15.4	11839 (69.5)	5205 (30.5)	0.67	0.66-0.67
PHDAP	2236 (2.1)	1145 (51.2)	1091 (48.8)	2142 (95.8)	94 (4.2)	181.2±230.7	63.6±18.6	1377 (61.6)	859 (38.4)	0.63	0.61-0.64
Sum	105903 (100)	47649 (45)	58254 (55)	103099 (97.4)	2804 (2.6)	119.9±204.1	58.05± 17.01	88400 (83.5)	17503 (16.5)	0.76	0.75-0.77

N-Number; LOS – length of stay; $\bar{X}$– mean; SD – standard deviation; CI – confidence intervals

Table 4: Top 10 ICD-10 codes of cardiovascular diseases

Numb	Disease name	ICD-10 Codes	Total N (%)	Agreement N (%)	Disagreement N (%)	Kappa	95% CI
1	Atherosclerosis	I25.1	30623 (28.9)	28243 (92.2)	2380 (7.8)	0.62	0.61-0.62
2	Unstable angina	I20.0	10420 (9.8)	9462 (90.8)	958 (9.2)	0.56	0.55-0.56
3	Essential (primary) hypertension	I10	10408 (9.8)	7991 (76.8)	2417 (23.2)	0.74	0.73-0.75
4	Stroke, not specified as hemorrhage or infarction	I64	10318 (9.7)	9088 (88.1)	1230 (11.9)	0.76	0.75-0.76
5	Congestive heart failure	I50.0	5584 (5.3)	4001 (71.7)	1583 (28.3)	0.57	0.55-0.58
6	Atrial fibrillation and flutter	I48	3250 (3.1)	2387 (73.4)	863 (26.6)	0.58	0.56-0.59
7	Acute myocardial infarction, unspecified	I21.9	2855 (2.7)	2470 (86.5)	385 (13.5)	0.48	0.46-0.49
8	Other venous embolism and thrombosis	I80.2	2619 (2.5)	2157 (82.4)	462 (17.6)	0.77	0.76-0.78
9	Chronic ischemic heart disease, unspecified	I25.9	1855 (1.8)	1341 (72.3)	514 (27.7)	0.44	0.41-0.45
10	Heart failure, unspecified	I50.9	1710 (1.6)	1148 (67.1)	562 (32.9)	0.47	0.44-0.49

N-Number; CI – confidence intervals

values of the Kappa coefficient range were varied between κ=0.34 for CRHD subgroup and κ=0.93 for ARF subgroup (Table 3). The prevalence of CVDs subgroup was IHD (47.8%) with the value of kappa coefficient κ=0.78. The DVLL subgroup had the highest (91.3%) and CRHID subgroup had the lowest (24.5%) rate of diagnostic agreement (Table 3).

The result of this study showed that there was a relationship between the discharge type and the diagnostic agreement (P<0.004). In diagnostic agreement, 85.5% of patients were discharged in the planned discharge and 4.3% of them died, while in diagnostic disagreement, 81.4% of the patients were discharged in the planned discharge type and 8% of them died. Discrepancy between the AD_X and DD_X was associated with 34% longer LOS (P<0.001), translated into a 35-hour increase. Atherosclerosis (I25.1) was the most prevalent CVDs (28.9%). The analysis of 10 common ICD-10 codes showed that the values of the Kappa coefficient were varied between κ=0.44 for I25.9 and κ=0.77 for I80.2 (Table 4).

CVDs admission rates were increased during 2012-2019. (Figure 1) For example, the IHD subgroup increased from 5,000 patients in 2012 to more than 8,000 patients in 2019. In gender-specific prevalence rates, men had a higher quantity than women in all subgroups of CVDs with Kappa coefficient value of (κ=0.77). In addition, men (85%) had the highest

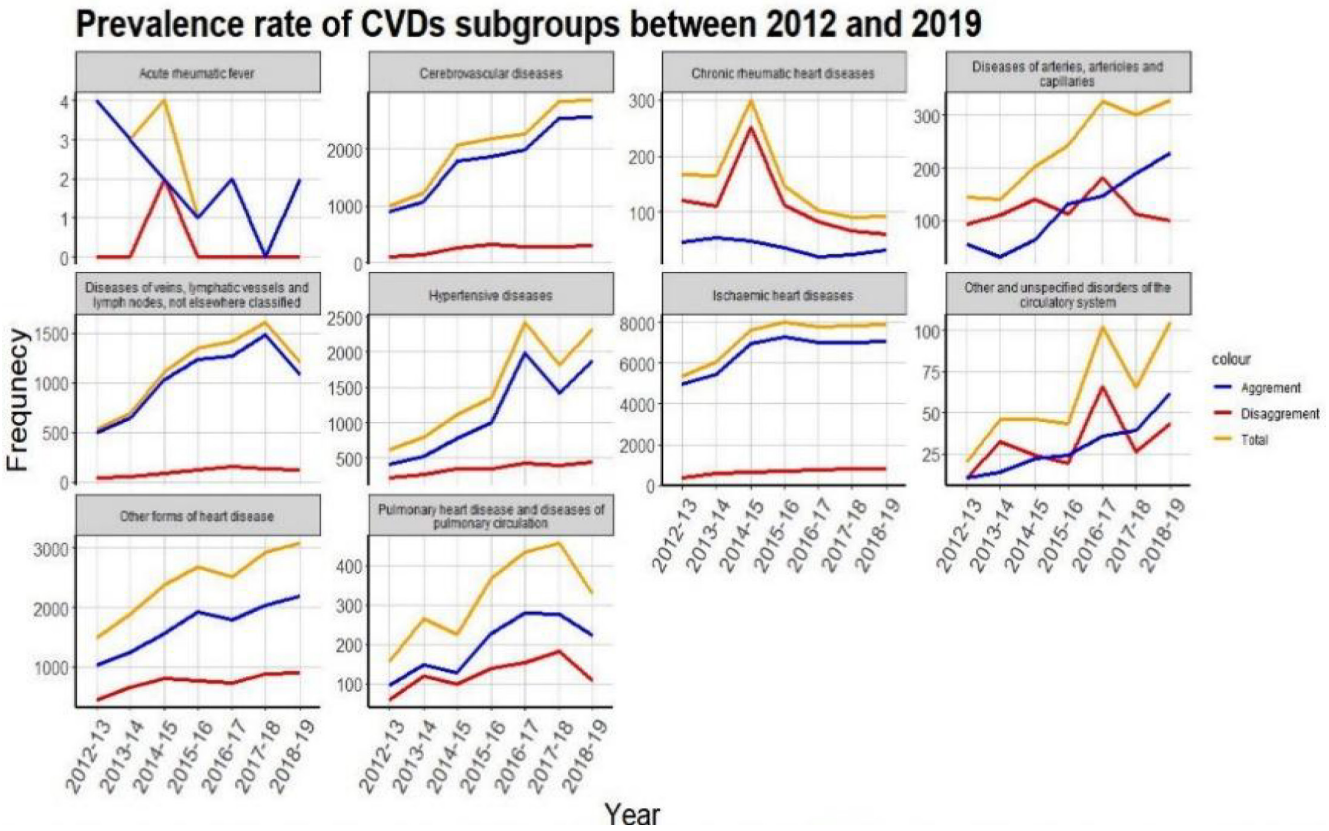

Figure 1: CVD prevalence and diagnostic agreement rate

diagnosis agreement, compared to women (81%). (P<0.001)

The results of this study showed a significant relationship between the incidence of CVDs and age (P<0.0004). The IHD subgroup incidence rate was the highest for the age group of 50-70 years. Meanwhile, in the DVLVLN subgroup, CVDs were more common in the age group of 30-40 years (Figure 2). The findings showed that the DVLL subgroup had the highest agreement rate of ADx and DDx (91.3%), while CRHD subgroup had the lowest (24.5%). (Table 5)

Discussion

The results of this study showed that the agreement of AD_X and DD_X for the CVDs subgroups was satisfying (κ=0.76), but there was a significant discrepancy in some subgroups even though some disagreement was expected. Similarly, the result of a study conducted in Brazil on 20,422 patients showed that the value kappa coefficient for CVDs was κ=0.61 (0.58 to 0.64). The value kappa coefficient for the IHD subgroup (0.57) and HD subgroup (0.33) was lower than that of this study (5). The results of a research conducted on 13,803 hospitalization reports in Canada in 2006 showed that the ADx and DDx were the same in 9,328 (67.6%) cases, while in 4475 (32.4%) cases there was a discrepancy between them. The value of the Kappa coefficient for 50 most common diagnostic groups was κ=0.81 (0.70 to 0.87). The value of the kappa coefficient for CVDs (0.86) was higher than the result of this study (12). In a research that examined the cost and quality implication of discrepancies between ADx and DDx in Chicago, USA in 2010, it was found that 175 (55%) out of 317 patients who were admitted to the general internal medicine unit of Rush University Medical Center (RUMC) had the diagnostic agreement, while the agreement rate of this study was 83.5% (13.) The result of the research conducted in Chicago, USA, in July 2005 and June 2006, showed that the diagnostic discrepancy in patients with cardiac arrest was 6%, which was more than the results of this study (14). The results of the study carried out in the Republic of Ireland in 2010 which examined the agreement between AD_X and DD_X in patients with or without diabetes and with below-knee amputation showed that the diagnostic group agreement with diabetic patients who had an amputation was κ=0.82 (0.75–0.89) (15). The results of another research conducted in Tehran, Iran, in 1996 showed that in 1,090 patients record, there was 71% agreement between the AD_X and DD_X, and the agreement between DD_X and autopsy result was 72% (16). The result of some studies was similar to that of the present study, while some of them are different.

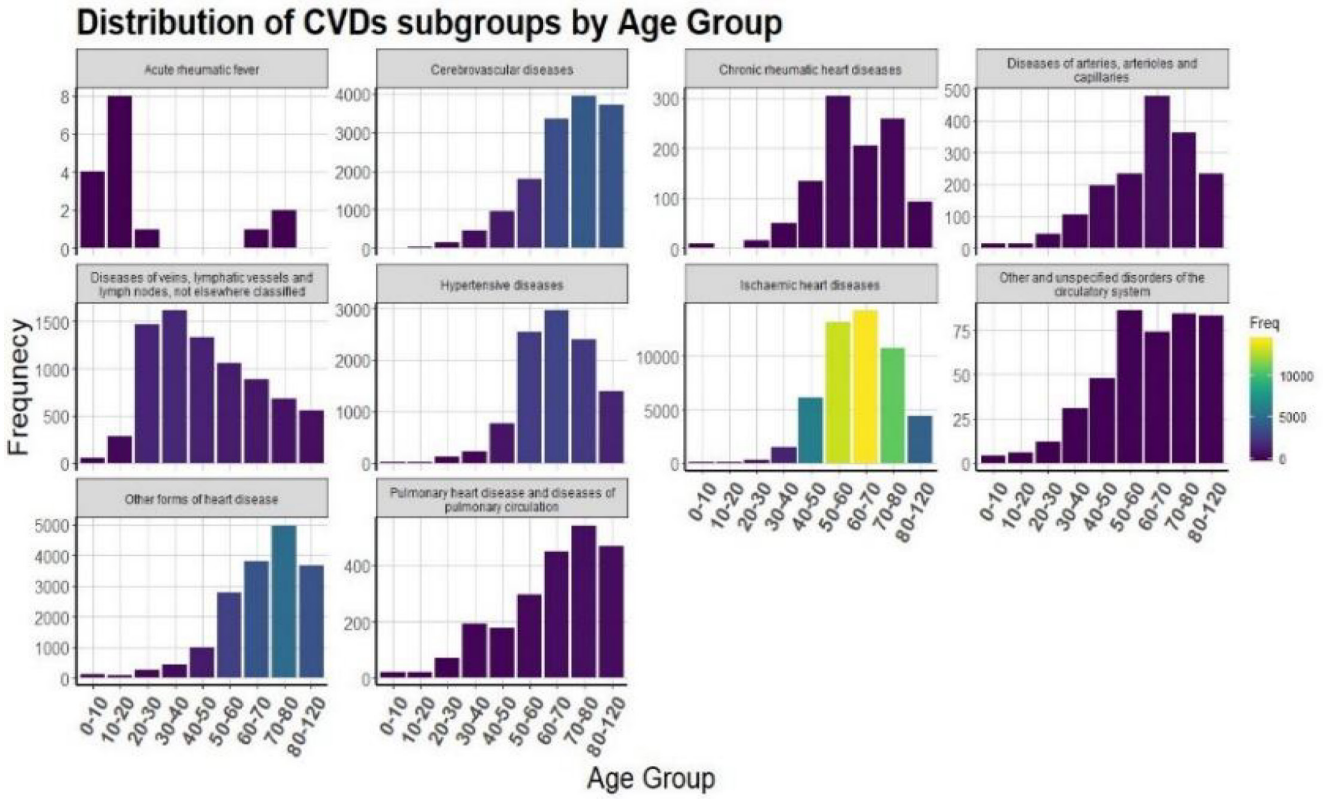

Figure 2: Distribution of CVDs subgroups by age group

Table 5: Diagnostic agreement and discrepancy between the cardiovascular diseases subgroups

ADx / DDx	ARF	CD	CRHD	DAAC	DVLL	HD	IHD	OUCS	OFHD	PHDAPC
ARF N (%)	**14 (87.5)**	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (6.3)	0 (0)	1 (6.3)	0 (0)
CD N (%)	0 (0)	**12716 (88.2)**	8 (0.1)	38 (0.3)	133 (0.9)	405 (2.8)	669 (4.6)	18 (0.1)	383 (2.7)	55 (0.4)
CRHD N (%)	0 (0)	26 (2.4)	**261 (24.5)**	3 (0.3)	7 (0.7)	31 (2.9)	331 (31.1)	0 (0)	395 (37.1)	12 (1.1)
DAAC N (%)	0 (0)	73 (4.3)	0 (0)	**841 (49.9)**	58 (3.4)	82 (4.9)	480 (28.5)	34 (2)	94 (5.6)	23 (1.4)
DVLL N (%)	0 (0)	153 (1.9)	5 (0.1)	50 (0.6)	**7247 (91.3)**	72 (0.9)	157 (2)	15 (0.2)	116 (1.5)	124 (1.6)
HD N (%)	0 (0)	486 (4.7)	4 (0)	52 (0.5)	78 (0.7)	**8010 (76.7)**	1400 (13.4)	37 (0.4)	342 (3.3)	36 (0.3)
ISD N (%)	0 (0)	664 (1.3)	32 (0.1)	99 (0.2)	134 (0.3)	1314 (2.6)	**45887 (90.7)**	37 (0.1)	2276 (4.5)	176 (0.3)
OUCS N (%)	0 (0)	29 (6.8)	4 (0.9)	26 (6.1)	15 (3.5)	34 (7.9)	65 (15.2)	**208 (48.6)**	37 (8.6)	10 (2.3)
OFHD N (%)	0 (0)	583 (3.4)	116 (0.7)	49 (0.3)	181 (1.1)	403 (2.4)	3579 (21)	25 (0.1)	**11839 (69.5)**	269 (1.6)
PHDAPC N (%)	0 (0)	72 (3.2)	6 (0.3)	8 (0.4)	148 (6.6)	41 (1.8)	270 (12.1)	11 (0.5)	303 (13.6)	**1377 (61.6)**

The result also showed that the mean LOS of CVDs was 119.9±204 hours, and the mean age was 58.1±17.1 years. The mean LOS for the patients with angina pectoris in England was 120±72 hours and the mean age was 67 years (17). The result of this study showed that there was a significant relationship between the marriage state, LOS, sex, age and the incidence of CVDs. While the discrepancy between the AD_X and DD_X was consistently associated with increase in LOS, the underlying reasons are not yet understood. This study can only show the reasons for this association, and further research is needed to analyze these hypotheses. The similarities between the symptoms of CVDs can be one of the reason of

this variation. There are several possible explanations for discrepant cases: (1) poorer documentation at the time of admission, (2) more complexity in terms of the diagnostic task, and (3) less thorough diagnostic workup at the time of admission.

The results of various studies show that medical diagnosis is the first and most important issue in treatment approach at clinical practice. Diagnostic agreement not only decreases the LOS and cost, it can also provide an adequate treatment immediately for a patient without unnecessary waste of time (5). Despite improving the quality of diagnostic technologies, the rate of diagnostic and medical errors has not significantly decreased. Based on the findings of this study, it is suggested that educational programs in hospitals and collages can help to improve the quality and accuracy of disease diagnosis and reduce the diagnostic errors. To reduce these inconsistencies, we need to examine the patients carefully and avoid any inappropriate or inadequate actions on admission.

Conclusion

The results of this study showed that there was a significant difference between ADx and DDx and the values of Kappa coefficient were not same in different CVDs subgroups. Improving the agreement rate of ADx and DDx is very important in healthcare, and discrepancies between them can affect the patients' safety because immediate and accurate ADx are necessary in patients with acute CVDs, like IHD and HF. This study examined the mismatches between ADx and DDx in the CVDs subgroups, and defining the factors which cause the discrepancy in ADx and DDx can be the subject of a new research.

In summary, there is a definite need for improvement of diagnostic accuracy, especially in regard to CVD cases with acute condition. Finally, the authors suggest that good clinical assessment techniques, including history taking and physical examination, using clinical decision support systems and using the results of these studies, can be a rewarding diagnostic tool in improving the quality of diagnostic accuracy for physicians.

Limitations

This study had two limitations. First, it was conducted on CVDs patients admitted to the Zanjan University Medical Sciences hospitals in the province of Zanjan, Iran. Thus, the patients may not be representative of all patients with CVDs at Zanjan hospitals. The patients of two Social Security Organization's (Tamin Ejtemaee) hospitals were not included in this study. Furthermore, we were unable to examine and compare the agreement of ADx and DDx among the hospitals. Second, in this study we examined the agreement of ADx and DDx for the province of Zanjan, Iran, while comparing and analyzing them between hospitals or counties can help to define the factors which cause the discrepancy of ADx and DDx.

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Ethical Approval and Consent to Participate

This study was approved by the Ethics Committee of ZUMS. (Code IR.ZUMS.REC.1398.056)

Availability of Data and Material

The datasets generated and/or analyzed during the current study are not publicly available due to the use of these data for other research studies not yet published, but are available from the corresponding author on reasonable request.

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Conflict of Interest: None declared.

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