

Sensitivity of Administrative Coding for Heart Disease in Pregnancy

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Purpose: Heart disease complicating pregnancy is a major contributor to maternal morbidity and mortality worldwide, yet its true burden remains underexplored. Electronic medical records may help address this gap. However, the accuracy of the data that can be obtained needs to be established before undertaking estimations. This study evaluates the sensitivity of administrative coding in identifying pregnancies complicated by heart disease during childbirth admissions in a tertiary Australian setting.

Patients and Methods: Using a prospectively maintained clinical database of 155 women who received specialized cardio-obstetric care, we compared ICD-10-AM codes recorded in hospital administrative data related to their delivery admission against a cardiologist-adjudicated reference standard. Case and individual code-level comparisons were undertaken.

Results: The sensitivity of administrative coding for detecting any cardiac disease was 66.5%. Only 25.2% of cases were completely matched to the clinical diagnosis, and 41.3% mismatched (partial or incorrect). Notably, 33.5% of cases were not coded with any cardiac-related code. At the individual code level, sensitivity varied widely across disease categories: the lowest sensitivity (19%) was shown for arrhythmias. Congenital heart disease, the most common etiology in this cohort, was frequently not coded, particularly when surgically corrected.

Conclusion: In addition to incorrect coding, findings reflect the structure of ICD-10-AM, which captures only diagnoses requiring active management during the hospital encounter. As most cardio-obstetric care is delivered antenatally, mainly to prevent peripartum complications, well-managed conditions with uncomplicated delivery may not be coded, leading to underestimation that is independent of the severity of the cardiac condition and associated risk. While exact estimates of coding sensitivity may vary by context, most of the identified issues would be common across Australia and the world. Epidemiological studies and service planning based on ICD-10-AM data should consider enhanced case-ascertainment strategies, including patient-level data linkage and diagnostic look-back periods, to improve accuracy.

Keywords: ICD-10, Australia, obstetric cardiology, sensitivity, arrhythmia, congenital heart disease

Introduction

Heart disease in pregnancy is an inclusive term for conditions that impair maternal cardiac function during pregnancy and the postpartum period. Heart disease in pregnancy has a diverse etiology, including congenital heart diseases and acquired diseases, such as rheumatic heart disease, arrhythmias, ischemic heart disease, and cardiomyopathies.^{1,2} These conditions can predate the pregnancy or be diagnosed in the pregnancy or puerperium. Heart diseases complicating pregnancies have been reported since the time of Hippocrates.³ Despite substantial advances, heart disease in pregnancy has risen to become the major cause of non-obstetric (or indirect) maternal mortality, especially in countries with good maternal health care.⁴ The contribution to maternal morbidity is even more pronounced.^{5,6}

The health system resource requirements and resultant costs for the management of heart diseases to ensure optimal evidence-based care during pregnancy and puerperium remain largely unknown. The burden of heart disease in pregnancy is expected to continue increasing due to improved treatment and survival of women with congenital heart disease, the earlier onset of noncommunicable diseases and their risk factors, coupled with increased maternal age at conception.^{2,6–8} Rheumatic heart disease also remains prevalent in many countries due to continued health inequalities.⁹

In the absence of accurate population estimates, the prevalence of heart disease in pregnancy is uncertain, with commonly cited estimates of 0.2–4% of all pregnancies representing a 20-fold variation. Studies to fill these evidence gaps are timely and needed to prepare health systems to cater to the growing burden of optimizing the health of pregnant women with heart diseases and their children. A potential solution would be to draw on data generated at different healthcare touchpoints as individuals access care. The digitization of health records and administrative data related to episodes of care has paved the way for large patient databases to be used for studying various aspects of patient care, including epidemiology, outcomes, service utilization and costs. In the digital space, disease diagnoses and procedures are often stored using alphanumeric clinical coding systems, such as the International Classification of Diseases (ICD). In Australia, hospitals use ICD 10th Revision Australian Modification (ICD-10-AM) codes to record the diagnosis-related data of a hospital encounter. These codes, along with other routinely collected data from episodes of hospitalization, also determine the diagnosis-related group (DRG) used for hospital cost estimation and reimbursement from the funding provider.¹⁰ The accuracy of information that can be obtained from these databases, whether for research or administrative purposes, depends heavily on the sensitivity and specificity of the data in identifying patients or records with the relevant disease or condition. While studies have been conducted on the prevalence and outcomes of pregnancies complicated with heart diseases utilizing hospital or health system-based databases and data linkage, an estimation of the accuracy, sensitivity, or specificity of heart disease coding in pregnant women could not be found in the global literature.^{11–13}

Therefore, it remains unclear whether the sensitivity of coding is sufficient to support estimates of the prevalence of heart disease in pregnancy, risk estimates for different complications, and appropriate hospital reimbursement for maternity and neonatal care provided to high-risk women with heart conditions. Quantification of the sensitivity of disease coding when interpreting information from these sources is important, as low sensitivity will lead to an underestimation of prevalence, distortion of risk estimates, and underrepresentation of healthcare resource utilization for the management of heart conditions in pregnancy.

This study evaluates the sensitivity of administrative coding of pregnant women with known heart disease admitted to the hospital for delivery in a tertiary Australian setting.

Materials and Methods

Setting

Data from a prospectively maintained clinical database documenting cardiac diagnoses and pregnancy outcomes of a cohort of pregnant women with cardiac disease attending a dedicated obstetric-cardiology clinic at a tertiary referral center were used for the study. The center provides public hospital pregnancy care for women, including those with complex pregnancies, from a broad catchment area spanning Queensland and Northern New South Wales. Management is individualized according to the woman's condition, but high-risk pregnancy care usually involves increased intensity of medical care in the antenatal, delivery, and postpartum periods. During childbirth and the immediate postpartum period, this often includes additional considerations regarding timing, duration, and mode of delivery as well as modifications in the use of medications, analgesia, and anesthesia.

All participants provided written informed consent for inclusion in the cohort (Ethics approval number: HREC/10/QRBW/400). The database was updated with the cardiac condition at the time of childbirth. Women who were admitted to this specific referral center for childbirth were included in this analysis. All participants in the cohort received at least one antenatal cardio-obstetric clinic consultation and a documented care plan for the pregnancy, including childbirth.

Diagnostic Coding

During the study period, the ICD-10-AM, 12th edition, was used for the diagnostic coding at the centre.^{14,15} Two types of ICD-10-AM codes are used simultaneously to code a heart disease complicating pregnancy: codes for the cardiac Diseases and codes for maternal diseases complicating pregnancy, childbirth and the puerperium. ICD-10-AM codes indicating cardiac diagnoses include I00-I99, Q00-Q99, Z87.7, Z86.7, and Z99 (Table 1). Codes for maternal diseases classifiable elsewhere but complicating pregnancy, childbirth, and the puerperium that are relevant include O99.4 and O99.8. These are used in conjunction with the codes for cardiac disease. If diseases of the circulatory system complicate pregnancy, childbirth, and the puerperium, or if the pregnancy affects the condition, this is coded with O99.4. If the underlying condition affecting pregnancy is a congenital heart disease, O99.8 is used.^{15,16}

Index Coding

The ICD-10-AM codes documented in the hospital record for each participant's childbirth admission were extracted. From them, ICD codes for cardiac diagnoses and accompanying codes for maternal diseases complicating pregnancy, childbirth and the puerperium were selected as the index code for this analysis. Standalone codes for maternal diseases complicating pregnancy, childbirth, and the puerperium (O99.8 without accompanying cardiac disease codes) were not included. This was because it could not be determined whether the code represents heart disease or another comorbid condition in the woman. It is rare for pregnant women with heart disease to receive inpatient care during pregnancy, and the point at which they are most likely to encounter hospital admission is childbirth. Admission related to childbirth was selected for this reason.

Clinical Reference Standard

The ICD-10-AM coding of the patient's heart condition/conditions, according to the cardiologist at the time of admission for childbirth, was used as the clinical reference standard. The cardiologist's diagnosis in the lexical format was coded by

Table 1 ICD-10-AM Codes Used for Coding Cardiac Diseases Complicating Pregnancy

Codes for the Cardiac Diseases		Codes for Maternal Diseases Classifiable Elsewhere but Complicating Pregnancy, Childbirth and the Puerperium	
Present or past ischemic heart disease	I20–I25	Diseases of the circulatory system (conditions classifiable to I00–I99) complicating pregnancy, childbirth and the puerperium.	O99.4
Arrhythmias	I44–I49	Other specified diseases and conditions (conditions classifiable to Q00–Q99) complicating pregnancy, childbirth and the puerperium.	O99.8
Prosthetic Heart Valves	Z95.2–Z95.8		
Other Prosthetic Devices	Z95.0–Z95.1		
Cardiomyopathy	I42.x		
Non-Congenital Valve Disease Codes	I05–I08, I34–I39		
Dilatation of the Aorta	I71.2		
Congenital Heart Disease Codes	Q00–Q99		
Marfan's syndrome	Q87.4		
Personal history of diseases of the circulatory system (Conditions classifiable to I00–I99)	Z86.7		
Personal history of (corrected) congenital malformations (conditions classifiable to Q00–Q89 that have been repaired or corrected)	Z87.7		

a second physician using the ICD-10-AM 12th edition. Each condition was coded to the fourth-character level, while providing as much specific clinical detail as possible with the available data. The senior cardiologist also independently coded 20% of the records for quality assurance. The inter-rater agreement was 93% (2 minor disagreements out of 30 cases that did not impact on the categorization used for the primary analysis; see [Appendix 1](#)). The aim of this study was to holistically understand how accurately the current diagnostic coding captures the epidemiological burden and resource use associated with pregnancies complicated by chronic heart disease. Therefore, instead of using the diagnosis recorded in the patient's admission record as the gold standard for this study, we used the cardiologist-adjudicated diagnosis of the heart condition.

Analysis

The set of cardiac disease-related ICD codes recorded for each participant's childbirth admission was identified as a "case". The main cardiac diagnosis category of the cases was determined based on the clinician's adjudicated diagnosis. When cases had multiple cardiac conditions that belonged to different cardiac disease categorizations, the case was assigned to the group that best represented the origin or order of occurrence. For example, congenital valvular defects, either untreated or replaced with prosthetic valves, were categorized into congenital heart conditions. This was undertaken case by case, and further details are provided in [Appendix 2](#). The overall severity of the condition was determined using the modified World Health Organization 2.0 classification of maternal cardiovascular risk (mWHO 2.0).⁴

The index coding was compared with the clinical coding standard at the case level and the individual code level. The outcome of the cardiac disease coding comparison at the case level was categorized into three. If all the diagnostic codes of a case matched perfectly, it was identified as a "complete match". If the administrative codes of a case did not include at least one code that indicated the presence or history of a cardiac disease, it was identified as "not coded". If the administrative coding of a case includes codes indicating a cardiac disease, but one or more codes are missing or coded differently compared to the gold standard, it was categorized as "mismatched" ([Figure 1](#)).

To better assess the sensitivity of administrative coding in identifying different types of heart conditions, individual ICD codes (rather than cases) were categorized into disease categories. For calculating sensitivity, only ICD codes with an exact match to the fourth-character level were deemed correctly identified.

Results

The database included records of 155 pregnant women with heart disease who received specialized cardio-obstetric care. In this cohort, most of the heart diseases complicating the pregnancy were congenital conditions ($n = 87$, 56%) or arrhythmia ($n = 32$, 21%). Maternal cardiovascular risk of the included pregnancies varied between mWHO 2.0 categories I to IV.

Comparison of the Index Coding with the Clinical Coding Standard at the Case Level

The sensitivity of administrative codes for identifying a pregnancy complicated with a cardiac disease was 66.5% ($n = 103$, 95% CI 59%–74%). Of these, 25.2% completely matched the adjudicated diagnosis, and 41.3% showed a mismatch ([Table 2](#)). O99.4 code was present in 47 (30%), and O99.8 code was present in 39 (25%) records, all of which included other ICD codes indicating current or past cardiac diseases.

Not Coded Cases

In 33.5% of the cases, administrative coding for the childbirth-related hospitalization did not include any diagnostic code indicative of a cardiac-related diagnosis. Of these, 52% had congenital heart disease, and 33% had arrhythmias. Overall, 53% ($n=17$, 95% CI 36%–70%) of cases with arrhythmias, 31% ($n=27$, 95% CI 22%–41%) of cases with congenital heart diseases, and 24% ($n=4$, 95% CI 9%–47%) of cases with cardiomyopathies did not include a diagnostic code indicative of a cardiac disease ([Figure 2](#)). Out of the 59 cases with repaired congenital heart disease (included in the congenital heart disease category), 19 (32%) had not been coded. This represented 70% of the congenital heart disease cases that were not coded. Half of the cases that did not include any cardiac-related diagnosis belonged to the mWHO 2.0 categories II–III or above.

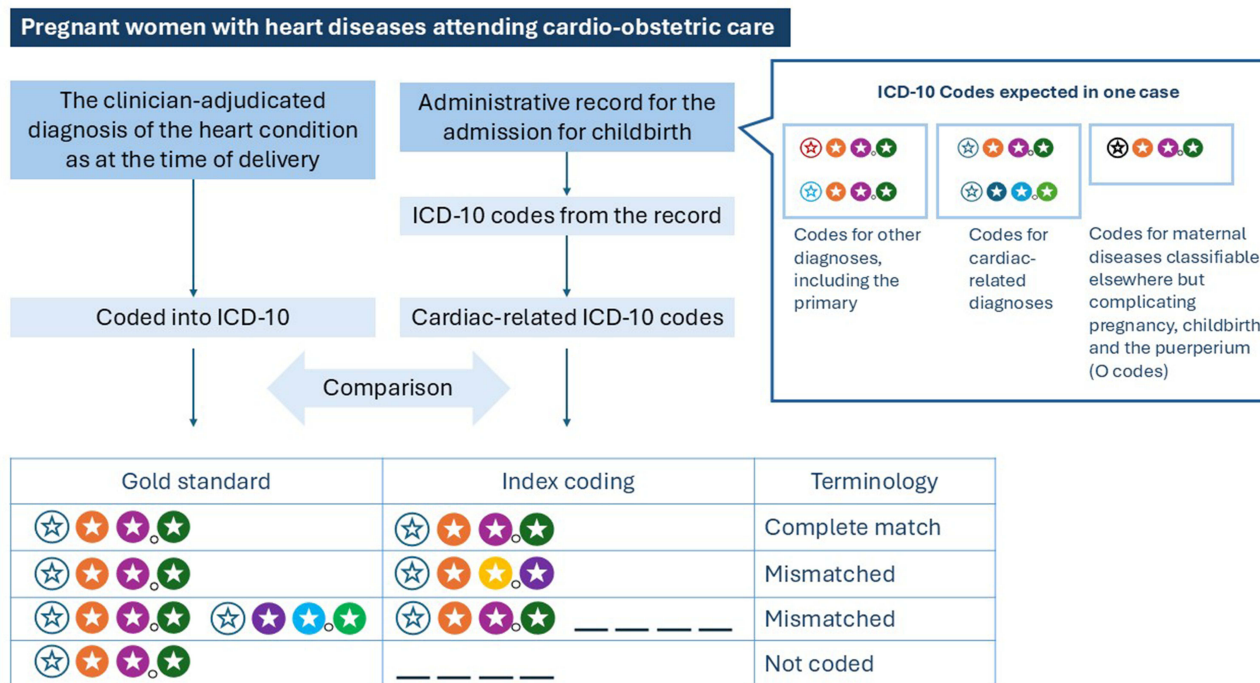


Figure 1 Methods used to compare the cardiac disease-related coding.

Mismatched Cases

Of the cases with a coding discrepancy between administrative codes and adjudicated diagnosis, 61% had congenital heart conditions, and 14% had arrhythmias (Figure 2). Some cases ($n = 28$, 44% of mismatched cases) were only partially coded and missed some, but not all, of the relevant codes for the diagnosis. Ten cases (16% of the mismatched cases) had additional codes indicating conditions not recorded in the adjudicated diagnosis. Other discrepancies often involved using codes of a similar condition (eg., coded as a different type of arrhythmia), misattributing the etiology of the condition (eg., congenital valvular stenosis coded as rheumatic valvular stenosis), or coding to less specific categories (eg., SVT coded as unspecified arrhythmia, I49.9). Repeated patterns of error could also be noted (eg., Q22.1, congenital pulmonary valvular stenosis, was always ($n=3$) coded as Q25.6, pulmonary artery stenosis). Seven cases identified as mismatched differed only in the fourth character of the ICD code. Therefore, when codes were compared at the three-character level, 29.7% of cases (compared with 25.2% at the fourth-character level) were completely matched.

Comparison of the Index Coding with the Clinical Coding Standard at the Code Level

The Sensitivity of Administrative Coding in Identifying Different Heart Conditions

Administrative codes showed the least sensitivity for correctly identifying arrhythmias in pregnant women (19%, 95% CI 10%–33%) (Table 3). While the sensitivity to correctly identify congenital conditions and syndromes was 42%, only 38%

Table 2 Results of Comparing the Index Coding with the Clinical Coding Standard at the Case Level

Cases	N	% (95% CI of %)
Not coded	52	33.5% (26.5%–41.2%)
Coded		
Complete matched	39	25.2% (18.8%–32.4%)
Mismatched	64	41.3% (33.8%–49.1%)

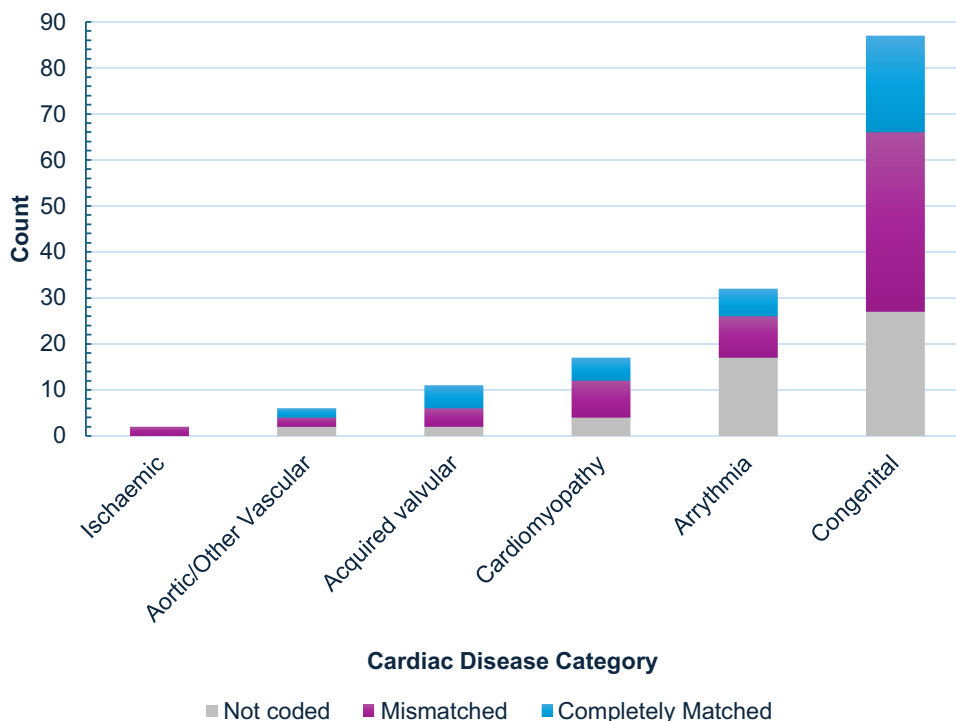


Figure 2 Comparing diagnostic codes in the administrative data with the clinically adjudicated cardiac diagnosis.

of the repaired congenital abnormalities were identifiable using administrative coding. Administrative codes showed the best sensitivity (67%) for the presence of prosthetic valves. However, caution needs to be exercised when interpreting results, as confidence intervals are considerably wide in some categories (Table 3).

Further Analysis of How Corrected Congenital Heart Diseases are Coded in Administrative Data

Figure 3 shows a detailed analysis of how cases that had undergone a procedure for congenital heart conditions were coded in administrative data. Out of the 59 cases, the corrected condition was coded as a personal history (Z86.7 or Z87.7) in 16, and as the original congenital cardiac condition in 8 cases. The remaining cases did not have an indication of having any past or present congenital cardiac condition. None of the cases that had Z86.7 or Z87.7 codes as cardiac conditions in administrative codes had a corresponding O99 code.

Table 3 Sensitivity of Administrative Coding to Identify Cardiac Diseases Complicating Pregnancy

Cardiac Disease Category	Total Number of Related Diagnosis*	Accurately Coded Diagnoses (n)	Sensitivity for Identifying Cases from Administrative Coding (95% CI)	Mismatched Diagnoses (n)	Mismatched Diagnoses %	Not Coded Diagnoses (n)	Not Coded Diagnoses %
Corrected congenital heart diseases	68	26	38%(28%–50%)	12	18%	30	48%
Other congenital heart diseases	26	11	42%(26%–61%)	7	27%	8	32%
Arrhythmias	43	8	19%(10%–33%)	12	28%	23	68%
Aortic and other vascular pathologies	21	7	33%(16%–55%)	2	10%	12	63%
Prosthetic heart valves	18	12	67%(44%–84%)	0	0%	6	33%
Cardiomyopathies	18	10	56%(34%–75%)	2	11%	6	40%
Valvular conditions (non-congenital)	10	4	40%(14%–71%)	2	20%	4	40%
Implanted cardiac pacemaker/ defibrillator	9	4	44%(19%–73%)	0	0%	5	56%
Ischemic heart disease	3	1	33%(2%–89%)	2	67%	0	0%
Total	216	83	38%(32%–45%)	39	18%	94	44%

Notes: *The total number of diagnoses exceeds the total number of included cases, as one case could have more than one diagnosis.

	Corrected Congenital Heart Disease Coded as					
	Personal history of congenital heart disease		Original congenital heart disease		Not coded	
	+ O99	No O99	+ O99	No O99	+ O99	No O99
Coexisting condition	7	1	1	1	13	3
No coexisting condition		8	5	1		19

O99 – code indicating disease complicating pregnancy

Figure 3 ICD-10-AM coding in administrative data for cases with corrected congenital heart diseases complicating pregnancy.

Discussion

We examined the administrative coding of 155 hospital admissions for childbirth in pregnancies with coexisting heart disease. Administrative coding captured a fraction (65.5%) of pregnancies complicated with heart disease. Of the cases not captured through administrative coding, 52% had congenital heart disease, and 33% had arrhythmias. Partial or inaccurate cardiac diagnoses were recorded in 41.3% of cases. In 25.2% of cases, coding completely matched the clinical diagnosis. To the best of our knowledge, this study is the first to examine the sensitivity of administrative coding for cardiac diseases in pregnancy, and its findings suggest that large administrative datasets underestimate the true burden of cardiac disease in pregnancy.

The administrative codes related to childbirth admission in pregnant women with heart diseases who had been referred to receive cardio-obstetric care at the tertiary hospital during their antenatal period were examined during this study. Since only 66.5% of these cases were coded with cardiac disease as additional diagnoses, administrative coding will substantially underestimate the prevalence of cardiac disease in pregnancy and, in turn, the measures of associations such as relative risk estimates for different complications. It is important to recognize that ICD-10-AM coding only records diagnoses requiring treatment or intervention *at the time of the hospital encounter*. According to the ICD-10 coding standards, childbirth would be recognized as the principal diagnosis at the hospitalization for delivery, other conditions that affect care are coded as additional diagnoses.¹⁵ To meet the criteria for coding of an additional diagnosis, the condition must lead to either the commencement, alteration, or adjustment of therapeutic treatment, diagnostic interventions, or increased clinical care during the encounter, evidenced by a clinical consultation and a care plan.¹⁷ However, in heart diseases complicating pregnancy, care is typically delivered in the ambulatory setting during the antenatal period, to reduce the risk of perinatal complications requiring additional care. Therefore, heart disease in pregnancy that is well managed in the antenatal period may not require any additional care during the hospital encounter for delivery. In such situations, cardiac disease may not be coded as an additional diagnosis, as it did not require intervention during the hospital encounter for delivery. This substantially limits the value of ICD-10 AM data to investigate cardio-obstetric care because of the underestimation of the prevalence.

Most of the cases that would be missed if administrative coding is used to identify pregnancies complicated with heart diseases had congenital heart disease or arrhythmias. This is a considerable issue because congenital heart diseases have become the predominant etiology of heart disease in pregnancy and are increasing in prevalence in women of child-bearing age.^{2,18} The majority of the congenital heart disease cases in the not coded group had surgically corrected congenital heart diseases. However, most congenital heart diseases, even when surgically corrected, have a level of residual risk^{19,20} and are known to be associated with an increased risk for maternal–fetal morbidity and mortality in pregnancy.^{21–23} In fact, half of the cases of “corrected” congenital heart disease that the administrative data set did not

recognize as cases with heart disease complicating pregnancy, belonged in the mWHO 2.0 class II–III or above.⁴ This meant they are considered to have intermediate or higher increased risk for maternal mortality and a moderate to severe increased risk for maternal morbidity and are recommended to receive cardio-obstetric care during childbirth.⁴ This shows the significant maternal–fetal risks that would not be recognized if studies used administrative data codes for childbirth admission to identify the cardiac diseases complicating pregnancy.

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Current study noted that the sensitivity of administrative data to recognize someone with congenital heart disease as having a heart disease complicating pregnancy (ICD codes completely or partially matched) was 60%. Previous studies have suggested that ICD-10 codes in administrative data are reasonably sensitive for identifying adult congenital heart diseases, specifically when the admission was to a cardiac specialist unit (81%–99%), but not when the admission was to a non-cardiac specific unit.^{24–26} According to an Australian study, ICD-10-AM codes showed reduced sensitivity and accuracy for identifying congenital heart diseases in administrative data, especially in non-specialty admissions (sensitivity 31% vs 14%, accuracy 13% vs 8% in admissions under cardiovascular specialties, and non-cardiovascular specialties, respectively).²⁷ It was also interesting to note that, in contrast to ICD-10 and ICD-10-Clinical Modification (ICD-10-CM) codes, ICD-10-AM codes were seen to have poorer sensitivity and accuracy with more complex diseases.²⁷ This was attributed to the inherent complexity and heterogeneity of congenital cardiac disorders, as well as problems related to the system used for generating discharge codes in Australian hospitals.²⁸

We also identified several other practical issues in using the ICD-10-AM classification for coding congenital heart diseases complicating pregnancy. Usually, acquired heart disease in pregnant women will be coded with the O99.4 code alongside the codes used to code the cardiac condition, indicating its impact on pregnancy or vice versa.¹⁵ However, when a congenital malformation is the cause of heart disease, instead of the O99.4 code, the O99.8 code (other specified diseases and conditions complicating pregnancy, childbirth, or puerperium) is used. It is not possible to distinguish if this code indicates a condition related to the cardiovascular system that is affecting the pregnancy.¹⁵ Moreover, when the cardiac condition is coded as a personal history, O99.x codes (indicating a non-obstetric condition is complicating the pregnancy) were not used in administrative codes. This means that O99.x codes would not be useful in identifying congenital heart diseases, especially corrected congenital heart diseases, in ICD-10-AM coded hospital datasets. We also noted that ICD-10-AM may be less specific than other ICD-10 modifications, such as ICD-10-CM, in documenting the cardiac relevance and severity of congenital malformations or syndromes.²⁹ For example, ICD-10-AM does not distinguish between Marfan’s syndrome with and without aortic dilatation; two conditions with different maternal morbidity and mortality risk levels.⁴

Given that the cardiac disease codes and O99.x codes at the delivery-related admissions are limited in their ability to identify the records of pregnant women with cardiac diseases in administrative databases, the possibility of improving the case identification through additional measures, such as patient-level data linkage with additional datasets, and using a look-back period with patient-level linkage, should be explored in future research.^{30,31} The limitations in case identification were largely due to the inherent nature of disease coding rather than issues localized to an institution or country. In an era where “big data” is frequently used to understand disease epidemiology, there may be value in considering revisions to disease coding frameworks to ensure they more accurately capture the clinical complexity and

health system impact of heart disease in pregnancy. At the same time, the importance of targeted policy action to strengthen the quality of administrative data, including investment in improving coding guidance for pregnancy-related cardiac conditions, cannot be ignored.

Limitations

This study was conducted in a single center, and we have examined only admissions for childbirth and not other admissions that may have occurred during pregnancy or the postpartum period, which may be due to other cardiac or obstetric indications. Nevertheless, our focus on the primary importance of this admission is based on the known association between cardiac disease and maternal and perinatal outcomes. Our findings may not be generalizable to all settings. However, this center is a state-wide referral center for obstetric cardiac care, so the co-existence of pregnancy and cardiac disease is common in this setting, and clinical coders are likely to be more familiar with coding cardiac disease complicating pregnancy. Given that the number of pregnancies complicated with heart disease is higher compared to other institutions, our observations may represent an optimistic view of the accuracy of coding compared to settings where complex pregnancy is less frequently seen. The sensitivity of coding may be further reduced if the coders are less familiar with the condition. Given the small sample size, the precision of subgroup estimates can be limited, as reflected by the wide confidence intervals. The analysis is limited to sensitivity. Specificity and overall accuracy were not examined and are important avenues for further research.

Conclusion

We identified substantial limitations in using the administrative coding to quantify the prevalence of cardiac diseases in pregnancy, with 33.5% of the cases not including any cardiac disease-related code. This limits the value of administrative datasets to monitor disease trends, allocate resources, and inform maternal health policy. Further studies from diverse contexts, using larger sample sizes and assessing the overall accuracy of the coding data, including specificity and predictive values, are important for a comprehensive understanding on this topic. The possibility of improving the case identification through additional data-driven methods should be considered. Revising administrative coding frameworks should be considered, and strengthening the coding quality within health systems is essential for evidence-based planning and improved outcomes for women and neonates challenged with maternal cardiac conditions during pregnancy.

Abbreviations

ICD-10-AM – International Classification of Diseases –10 – Australian Modification.

Data Sharing Statement

The data are not publicly available due to ethical and legal restrictions. De-identified data may be obtained from the corresponding author upon reasonable request, subject to ethics and data custodian approval.

Ethics Approval and Informed Consent

All participants provided written informed consent for inclusion in the cohort. This study was approved by the Metro North Human Research Ethics Committee (Ethics approval number: HREC/10/QRBW/400).

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Disclosure

The authors report no conflicts of interest in this work.

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