Original Research

Exploring discrepancies in clinical coding between rural and urban hospitals in Aotearoa New Zealand in patients who underwent interhospital transfer

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Abstract

Introduction: The agreement of clinical coding between rural and urban hospitals in Aotearoa New Zealand (NZ) is unknown, and data from comparable international health systems is scarce, dated or inconclusive. There is a reliance upon administrative datasets that store clinically coded information to complete numerous rural–urban health analyses, which inform health policy and resource allocation decisions. Anecdotally, clinical coding in NZ

rural hospitals is often performed by clinicians or reception staff without formal coding training; in urban NZ hospitals this would usually be completed by formally trained clinical coders. This study aimed to determine whether discrepancies existed between the primary diagnosis codes assigned in the National Minimum Dataset (hospital events) (NMDS) of hospital discharges by NZ's publicly funded hospitals, for patients who underwent an

interhospital transfer from a rural to an urban hospital.

Methods: This was a retrospective observational study using the NMDS. NZ's publicly funded hospitals were classified into three categories: rural hospitals, hospitals in small urban centres and hospitals in large urban centres. Interhospital transfers were identified by bundling events in the NMDS into healthcare encounters. The primary diagnosis codes assigned at discharge from the rural hospital were compared against the codes assigned at discharge from the urban hospital, and corresponding diagnosis groups based on the WHO chapter definitions were assigned to each code. The number and percentage, with 95% confidence intervals (CIs), of encounters where there was discordance between primary diagnosis codes from the rural and urban hospitals were calculated.

Results: The study included 31,691 patients, from 54 publicly funded hospitals, who underwent an interhospital transfer from an NZ rural to an urban hospital between 1 January 2015 and 31 December 2019. There were discrepancies in 64.1% (95%CI 63.5–64.6%) of the primary diagnosis codes assigned between the rural and urban hospitals, and in 32.1% (95%CI 31.6–32.6%) of broader diagnosis groups. In both cases, higher discrepancies existed for transfers to hospitals in small urban centres compared to hospitals in large urban centres. The most frequently assigned diagnosis group at discharge from rural hospitals was the non-specific group 'other', constituting 24.4% of all diagnosis groups assigned by a rural hospital. For 4.8% of all healthcare encounters, a specific diagnosis group assigned on discharge from the rural hospital was subsequently changed to 'other' at the urban transfer hospital. This reassignment to 'other' following interhospital transfer occurred within every diagnosis group assigned at a rural hospital.

Conclusion: Two-thirds of primary diagnosis codes and one-third of diagnosis groups were discordant after transfer from rural to urban hospitals in NZ. Further investigation is needed into why these discrepancies are occurring.

Introduction

Approximately one-fifth of the population of Aotearoa New Zealand (NZ) population lives in rural areas[1]. When people who live in these rural areas require hospital treatment, roughly half will present to a rural hospital in the first instance[2]. An agreed international definition of a rural hospital does not exist; however, geographical location, long travel distance to urban hospitals, generalist practice and limited access to specialist services are factors used to identify NZ rural hospitals[2-4]. Compared with hospitals in major urban areas, rural hospitals tend to include catchments that have higher proportions of Māori (NZ's Indigenous population), people who are older, and people who have higher levels of socioeconomic deprivation[2]. There is considerable variation in the size, models of care used and resource availability between rural hospitals in NZ[1,3-5]. Interhospital transfers from rural to urban hospitals are essential and required largely to access diagnostic investigations or specialist care that is unavailable rurally[1]. All NZ rural hospitals are geographically distant from their urban referral hospitals, requiring 45 minutes to 4.5 hours of road travel to reach the nearest referral hospital[1,5]. While interhospital transfers are vital for safe and effective patient care, there are many associated challenges including cost and time constraints, multiple or out-of-region transfers, separation of patients from their community and social supports, transport difficulties and the potential for patient harm[1,5].

The Geographic Classification for Health (GCH) categorises geographical areas of NZ into one of five rural–urban categories (U1, U2, R1, R2 and R3), from major urban areas (U1) to the most rural areas (R3), for health research and policy purposes. The use of this taxonomy has recently unmasked worse health outcomes for rural NZ[6,7]. Higher rates of amenable mortality (potentially preventable deaths given effective healthcare delivery in people younger than 75 years) and lower rates of healthcare utilisation for rural dwellers compared with those who live in urban areas have been demonstrated, particularly for Māori, who are more likely than non-Māori to live in NZ's most rural areas[2,4,8]. These findings rely on clinical information within NZ's routinely collected datasets.

NZ has a single public healthcare system that assigns a unique identifier to every health service user, allowing NZ's well-maintained national administrative health datasets to be linked. Clinical information is coded using the International statistical classification of diseases and related health problems, 10th revision, Australian modification (ICD-10-AM)[9], and then stored in the datasets. Accurate clinical coding is essential for the interpretation and validity of analyses, including rural–urban differences in health outcomes[2,4,8]. Anecdotally, clinical coding is often performed by clinicians or reception staff without formal coding training in many NZ rural hospitals[10]. However, in urban NZ clinical coding is performed by a designated hospital clinical coding team with university or subtertiary coding training who read patient discharge notes and assign corresponding ICD-10-AM diagnosis codes[11,12]. No NZ literature was found comparing the accuracy of clinical coding between rural and urban hospitals, and studies from comparable international health systems are scarce, dated or inconclusive[2,4,8,13-22]. This study aimed to determine whether any discrepancies existed between the primary diagnosis codes assigned in the National Minimum Dataset (hospital events) (NMDS) for patients who underwent an interhospital transfer from a rural to an urban hospital.

Methods

This was a retrospective observational study of all patients who underwent an interhospital transfer from a publicly funded NZ rural hospital to an urban hospital between 1 January 2015 and 31 December 2019.

Setting

Publicly funded NZ hospitals were classified into three hospital categories: rural hospitals, hospitals in small urban centres and hospitals in large urban centres (Table 1). The classification is consistent with recent NZ literature[2,10].

Rural hospitals were categorised based on the Medical Council of New Zealand definition: features of NZ rural hospitals include substantial geographical distance to reach urban and specialist healthcare services, a generalist workforce, and offering acute and inpatient care with limited specialist care[1-3,5]. Hospitals in small

urban centres were grouped due to their location in smaller regional cities (U2), and their ability to offer some specialist-level care while still experiencing resource constraints. Hospitals in large cities (U1), typically with ready access to tertiary or subspecialist level care, were classified as hospitals in large urban centres[6,10].

Table 1: Classification of New Zealand publicly funded hospitals into rural hospitals, hospitals in small urban centres and hospitals in large urban centres

Group		Hospitals
Rural hospitals		Ashburton; Bay of Islands; Buller Health (Westport); Clutha Health First; Dannevirke Community; Dargaville; Dunstan; Golden Bay Community Health; Gore; Hawera; Hokianga Health – Rawene Clinic; Kaikoura; Kaitaia; Lakes District; Maniototo Health Services; Oamaru; Reefton Health Services; Taumarunui Community; Taupo; Te Kuiti Community; Te Nikau Grey; Te Whare Hauora O Ngati Porou – Te Puia Springs; Thames; Tokoroa; Wairoa Hospital and Health Centre
Urban hospitals	Hospitals in small urban centres	Gisborne; Hawkes Bay; Nelson; Palmerston North; Pukekohe; Rotorua; Southland (Kew); Taranaki Base; Timaru; Wairarapa (Masterton); Wairau (Blenheim); Wanganui; Whakatane; Whangarei
	Hospitals in large urban centres	Auckland City; Auckland Spinal Rehabilitation Unit; Burwood; Christchurch; Dunedin; Ellesmere; Hutt; Kenepuru; Middlemore; North Shore; Tauranga; Waikato; Waitakere; Wakari; Wellington

Participants

All patients who presented to a rural hospital and were transferred to a publicly funded urban hospital in NZ between 1 January 2015 and 31 December 2019 were included. Patients were excluded if they presented to or were transferred to a primary birthing unit, private hospital, mental health facility, aged care or inpatient palliative care unit, or if no facility was assigned. Additionally, patients were excluded if clinical discharge information from either the rural or the urban hospital was unavailable. A formal sample size was not obtained and a power calculation was not performed as all patient records in the allotted time period were included.

Data sources and data collected

The NMDS of hospital discharges, which is maintained by Te Whatu Ora (Health NZ) and Manatū Hauora (NZ Ministry of Health) was used as the data source for this project. The NMDS is a routinely collected administrative dataset that records patient discharge information from both NZ public and private hospitals[23]. Demographic information and clinical data (coded using the ICD-10-AM) are stored for each patient discharge event. Each discharge event has a primary (principal) diagnosis code relevant to the presenting complaint, and up to 98 secondary diagnosis codes for associated findings[24]. The primary diagnosis is defined as 'the diagnosis established after study to be chiefly responsible for the episode of care'[24]. Only the ICD-10-AM codes for the primary diagnosis were used for this study.

Transfers were identified by bundling related discharge events in the NMDS into healthcare encounters[25]. Consecutive events where the discharge and admission dates were less than one day apart were grouped together. NZ's publicly funded hospitals were identified in the NMDS using their New Zealand Ministry of Health (Manatū Hauora) assigned facility code (Appendix I). Hospitals were subsequently categorised based on the groupings defined in Table 1: rural, small urban and large urban.

Patient demographic information collected from the NMDS included date of birth, sex at birth (male or female), prioritised ethnicity, domicile code, and event end date and time for health encounters. Age at discharge as both a continuous variable and a 5-year group was derived using each patient's date of birth and discharge date[24]. In the NMDS, patients can identify as more than one ethnicity, so a prioritisation process was used[26]. Where a patient's recorded ethnicity in any of the three fields included Māori, they were categorised as Māori. All other patients, including those with missing data in all three ethnicity fields, were categorised as non-Māori[26].

Patients were assigned to one of five GCH categories: three rural categories (R1, R2, R3) and two urban categories (U1, U2). The domicile:GCH concordance file was used to match each patient's domicile code (a small area measure associated with the patient's National Health Index and address) to the GCH category[6]. The NZDep2013 is a composite measure of socioeconomic deprivation ranging from decile 1 to decile 10. It combines variables from the 2013 Census to reflect relative socioeconomic deprivation per geographic area of the NZ population. Decile 1 reflects the 10% of the NZ population who live in areas classified as having the least relative socioeconomic deprivation, and decile 10 reflects the areas with the highest levels of socioeconomic deprivation[27]. Each patient's domicile code was used to determine the NZDep2013 decile using a concordance file[27]. NZDep2013 was further categorised into quintiles, with quintile 1 containing the areas with the least socioeconomic deprivation (deciles 1 and 2) and quintile 5 the most (deciles 9 and 10).

The ICD-10-AM primary diagnosis codes assigned at the rural and urban hospitals for the same patient health encounter were also collected from the NMDS. One of 15 corresponding diagnosis groups such as 'respiratory system' or 'musculoskeletal and rheumatological' based on the WHO chapter definitions was assigned to each ICD10-AM code[28]. The 'other' category was used where an ICD-10-AM category did not map to a diagnosis group and largely contained the code prefixes R ('symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified'), U ('codes for special purposes'), and Z ('factors influencing health status and contact with health services'). A list of the ICD-10-AM codes included for each diagnosis group is provided in Appendix II.

Outcomes

The primary outcome measure was the percentage of discrepancies between the clinical diagnosis codes assigned in the NMDS for patients who underwent an interhospital transfer from a rural to an urban hospital. A secondary objective was to identify the clinical conditions in which these discrepancies occurred.

Data analysis

All data management and analysis was performed in R v4.3 (R Foundation for Statistical Computing; https://www.R-project.org) using the R-Studio Integrated Development Environment[29,30].

Where the facility codes in the first event of an encounter matched that of a rural hospital, and the subsequent event contained a facility code for an urban hospital, the primary diagnosis codes were compared. Where multiple interhospital transfers occurred, only the first transfer between a rural and urban hospital was considered.

The number and percentage (with a 95% confidence interval (95%CI)) of encounters where there was a discrepancy between the primary diagnosis codes from the rural and urban hospitals were calculated. Analysis was performed separately for clinical codes and within the broader diagnosis groups. Subgroup analysis was performed for transfers between rural hospitals and hospitals found in small urban (U2) and large urban (U1) areas.

The frequency and percentage of the common conditions that contributed to the discrepancies between the rural and urban hospitals were also calculated. The 95%CIs were estimated using the 'exact' method in the 'prop.tests' package in the R package[31].

Uncertainty was assessed using 95% confidence intervals rather than formal statistical tests (eg χ^2 or Mann–Whitney U-test). This approach provided a more intuitive measure of precision that clearly communicates the plausible range of values.

Ethics approval

Ethics approval for this study was sought and approved by the University of Otago Human Ethics Committee (reference HD19/069).

Results

There were 260,525 admissions to rural hospitals for 146,623 patients between 1 January 2015 and 31 December 2019. Of these admissions, 31,691 (12.2%), for 27,264 patients, resulted in an interhospital transfer from a rural to an urban hospital. There were 18,326 (57.8%) transfers to a hospital in a large urban centre, and 13,365 (42.2%) transfers to a hospital in a small urban centre. The mean age of transferred patients was 53.6 years (standard deviation (SD) 25.2 years), approximately half of the patients were female (51.9%), and one-quarter were Māori (25.8%). Most patients who were transferred lived in GCH categories R1 and R2 (86.6%), and areas considered to have high levels of socioeconomic deprivation (quintiles 4–5, 65.0%) as shown in Table 2.

Table 2: Characteristics of patients who presented to a rural hospital and were transferred to an urban hospital[†]

Characteristic		Overall n (%)	Referral hospital classification	
			Large urban n (%)	Small urban n (%)
		(31,691 admissions)	(18,326 admissions, 57.8%)	(13,365 admissions, 42.2%)
Age (years)	Mean±SD	54±25	56±24	51±26
	<5	1747 (5.5)	810 (4.4)	937 (7.0)
	≤16	2859 (9.0)	1394 (7.6)	1465 (11.0)
	17–64	15,348 (48.4)	8556 (46.7)	6792 (50.8)
	≥65	13,484 (42.5)	8376 (45.7)	5108 (38.2)
Sex	Female	16,438 (51.9)	9228 (50.4)	7210 (53.9)
	Male	15,253 (48.1)	9098 (49.6)	6155 (46.1)
Ethnicity	Māori	8161 (25.8)	3311 (18.1)	4850 (36.3)
	Non-Māori	23,530 (74.2)	15,015 (81.9)	8515 (63.7)
Geographical Classification for Health	U1	1359 (4.4)	976 (5.4)	383 (2.9)
	U2	556 (1.8)	189 (1.0)	367 (2.8)
	R1	12,890 (41.4)	7659 (42.3)	5231 (40.1)
	R2	14,103 (45.2)	8617 (47.6)	5486 (42.0)
	R3	2263 (7.3)	675 (3.7)	1588 (12.2)
	(Missing)	520	210	310
NZDep2013 measure	Quintile 1	2429 (7.8)	1626 (9.0)	803 (6.2)
	Quintile 2	2965 (9.5)	1749 (9.7)	1216 (9.4)
	Quintile 3	5494 (17.7)	3625 (20.1)	1869 (14.4)
	Quintile 4	8322 (26.8)	5619 (31.1)	2703 (20.8)
	Quintile 5	11,850 (38.2)	5438 (30.1)	6412 (49.3)
	(Missing)	631	269	362

[†] Over the study period, 3289 patients had at least two admissions that resulted in an interhospital transfer. Each admission was included and therefore these patients may appear more than once. SD, standard deviation.

Results by clinical code

Overall, there were discrepancies in 64.1% (20,303/31,691; 95%CI 63.5–64.6%) of the primary diagnosis codes assigned between the rural and urban hospitals (Table 3). Discrepancies existed in 67.5% (9021/13,365; 95%CI 66.7–68.3%) of the primary diagnosis codes assigned for patients who were transferred to a hospital in a small urban centre, and in 61.6% (11,282/18,326; 95%CI 60.9–62.3%) of the primary diagnosis codes assigned for patients who were transferred to a hospital in a large urban centre.

Results by diagnosis group

There were discrepancies in 32.1% (10,168/31,691; 95%CI 31.6–32.6%) of the assigned diagnosis groups between rural and urban hospitals (Table 3). For transfers to hospitals in small urban centres, there were discrepancies in 34.2% (4576/13,365; 95%CI 33.4–35.1%) of the diagnosis groups, and in 30.5% (5592/18,326; 95%CI 29.8–31.2%) of the diagnosis groups for transfers to hospitals in large urban centres.

Table 3: Discrepancies in primary diagnosis clinical codes and diagnosis groups assigned in the National Minimum Dataset at rural hospitals compared to all urban, small urban centre and large urban centre hospitals

Code/group		For transfers to all urban hospitals (31,691 admissions)	For transfers to hospitals in small urban centres (13,365 admissions)	For transfers to hospitals in large urban centres (18,326 admissions)
Primary diagnosis clinical codes	Discrepancies, *n*, %, 95%CI	20,303 64.1 (63.5–64.6)	9021 67.5 (66.7–68.3)	11,282 61.6 (60.9–62.3)
	Concordance, *n*, %, 95%CI	11,388 35.9 (35.4–36.5)	4344 32.5 (31.7–33.3)	7044 38.4 (37.7–39.1)
Diagnosis groups	Discrepancies, *n*, %, 95%CI	10,168 32.1 (31.6–32.6)	4576 34.2 (33.4–35.1)	5592 30.5 (29.8–31.2)
	Concordance, *n*, %, 95%CI	21,523 67.9 (67.4–68.4)	8789 65.8 (64.9–66.6)	12,734 69.5 (68.8–70.2)

CI, confidence interval.

Secondary outcome

Figure 1 depicts the diagnosis groups that were coded at discharge from the rural hospitals (*y*-axis) and those groups coded at discharge from the urban hospitals (*x*-axis) after transfer. The highest rates of clinical coding concordance between rural and urban hospitals occurred for the following diagnosis groups assigned at discharge from the rural hospital: 'pregnancy, childbirth and the puerperium' (97.9%), 'injury related diagnoses' (92.0%), 'circulatory diseases' (82.4%), and 'digestive system' (80.3%). Conversely, the diagnosis groups with the highest clinical coding discrepancies were 'other' (65.5%), 'infection' (56.5%), and 'nervous system' (50.2%).

The most frequently assigned diagnosis group at discharge from rural hospitals was 'other', constituting 24.4% of all diagnosis groups assigned by a rural hospital. When this was assigned by a rural hospital, it was discordant with the diagnosis group assigned by the urban hospital in 65.5% of healthcare encounters, with 14.5% reassigned to a 'digestive system' code and 10.5% to 'circulatory diseases'.

In 4.8% of all healthcare encounters, a specific diagnosis group assigned on discharge from the rural hospital was subsequently changed to 'other' at the urban transfer hospital. For example, 12.7% of encounters coded as 'nervous system' by the rural hospitals were reclassified as 'other' following transfer to an urban hospital.
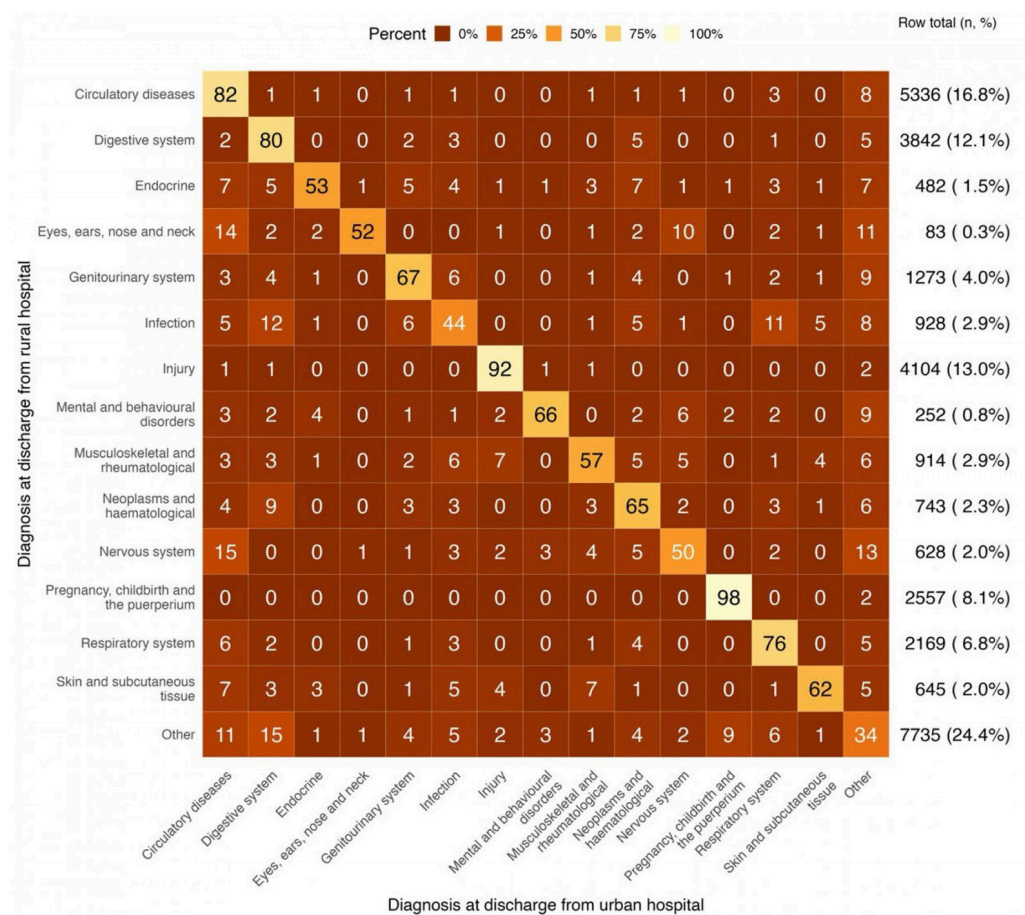
Figure 1: Clinical coding discrepancies by assigned discharge diagnosis groups at publicly funded hospitals in Aotearoa New Zealand between 1 January 2015 and 31 December 2019.

Diagnosis at discharge from rural hospital	Circulatory diseases	Digestive system	Endocrine	Eyes, ears, nose and neck	Genitourinary system	Infection	Injury	Mental and behavioural disorders	Musculoskeletal and rheumatological	Neoplasms and haematological	Nervous system	Pregnancy, childbirth and the puerperium	Respiratory system	Skin and subcutaneous tissue	Other	Row total (n, %)
Circulatory diseases	82	1	1	0	1	1	0	0	1	1	1	0	3	0	8	5336 (16.8%)
Digestive system	2	80	0	0	2	3	0	0	0	5	0	0	1	0	5	3842 (12.1%)
Endocrine	7	5	53	1	5	4	1	1	3	7	1	1	3	1	7	482 (1.5%)
Eyes, ears, nose and neck	14	2	2	52	0	0	1	0	1	2	10	0	2	1	11	83 (0.3%)
Genitourinary system	3	4	1	0	67	6	0	0	1	4	0	1	2	1	9	1273 (4.0%)
Infection	5	12	1	0	6	44	0	0	1	5	1	0	11	5	8	928 (2.9%)
Injury	1	1	0	0	0	0	92	1	1	0	0	0	0	0	2	4104 (13.0%)
Mental and behavioural disorders	3	2	4	0	1	1	2	66	0	2	6	2	2	0	9	252 (0.8%)
Musculoskeletal and rheumatological	3	3	1	0	2	6	7	0	57	5	5	0	1	4	6	914 (2.9%)
Neoplasms and haematological	4	9	0	0	3	3	0	0	3	65	2	0	3	1	6	743 (2.3%)
Nervous system	15	0	0	1	1	3	2	3	4	5	50	0	2	0	13	628 (2.0%)
Pregnancy, childbirth and the puerperium	0	0	0	0	0	0	0	0	0	0	0	98	0	0	2	2557 (8.1%)
Respiratory system	6	2	0	0	1	3	0	0	1	4	0	0	76	0	5	2169 (6.8%)
Skin and subcutaneous tissue	7	3	3	0	1	5	4	0	7	1	0	0	1	62	5	645 (2.0%)
Other	11	15	1	1	4	5	2	3	1	4	2	9	6	1	34	7735 (24.4%)

Diagnosis at discharge from urban hospital

Percent ■ 0% ■ 25% ■ 50% ■ 75% ■ 100%

Discussion

Main findings

This study identified discrepancies in approximately two-thirds (64.1%) of the ICD-10-AM primary diagnosis codes assigned in the NMDS between the rural and urban hospitals following interhospital transfer. Discrepancies were found for slightly more patients who were transferred to a hospital in a small urban centre (67.5%) than for patients who were transferred to a hospital in a large urban centre (61.6%). When considered by the broader diagnosis groups, which cluster related ICD-10-AM codes together, 32.1% of the diagnosis groups were different between rural and urban hospitals. Again, there was a higher percentage of discrepancies for transfers to hospitals in small urban centres (34.2%) compared to transfers to hospitals in large urban centres (30.5%).

The diagnosis groups with the lowest rates of clinical coding discrepancies were for 'pregnancy, childbirth and the puerperium' (97.9%), 'injury' (92.0%), 'circulatory diseases' (82.4%) and 'digestive system' (80.3%). In these instances, this may be due to the presentation and mechanism of illness being more obvious, earlier in the health encounter, increasing the consistency of the clinical coding between rural and urban hospitals[12].

The most frequent primary diagnosis codes assigned by a rural hospital were the group assigned as 'other'. This group comprised non-specific codes including those attributed to symptoms, signs, and abnormal clinical and laboratory findings. In two-thirds of cases (65.5%) where a primary diagnosis code fell into this group

after discharge from a rural hospital, it was reassigned to a more specific diagnosis at the urban hospital. Conversely, a small percentage (4.8%) of admissions were initially assigned to a specific diagnostic group at discharge from a rural hospital and subsequently reassigned to the non-specific 'other' at discharge from the urban hospital. While this phenomenon was persistent across all diagnostic groups, this occurred in 13% of patients discharged from a rural hospital with 'neurological disorders' and 8% of 'circulatory diseases'.

Some variability between the primary diagnosis codes assigned at discharge from a rural hospital before transfer and that assigned at discharge from an urban hospital is expected. Compared with urban hospitals, NZ's rural hospitals have a relative shortage of resources and diagnostic investigations[1,9,32]. Most lack access to CT scanning and some do not have on-site laboratory services[1]. In these settings, a non-specific diagnostic code that falls within the 'other' group may be used by the rural hospital, which is then changed to better represent that illness or injury after reassessment with the required investigations and the passage of time. Alternatively, a working diagnosis is assigned that is then updated on further review. Variation may also be attributed to a patient's clinical condition changing over the course of the health encounter[13].

No examples in the NZ literature that we were aware of compared the diagnostic codes between rural and urban hospitals using administrative datasets, and only a few studies examined the accuracy of the coding, with mixed results. Clinical audits in Canada and at six small rural hospitals in Australia have shown high levels of accuracy[12,14]. No significant associations in clinical

coding error rates between rural and metropolitan hospitals were demonstrated in Australia, or in North America, with rural hospitals shown to have higher coding accuracy than major urban hospitals[13,15,16]. In contrast, high levels of coding errors and omissions have been demonstrated in multiple clinical settings within NZ and internationally[17-19]. High work volume, tight time constraints, inadequate training and workforce shortages may affect coding quality[9]. These are issues currently faced by NZ rural hospitals, and ICD-10-AM coding that would normally be completed by a dedicated and trained workforce in urban hospitals may be performed by administrative staff that have other duties and lack formal coding training in the rural setting[1,6]. A lack of trained clinical coders may contribute to the differences between rural and urban hospitals. Intercoder variability has also been demonstrated, even among well-trained clinical coders[20,21].

Strengths and limitations

All interhospital transfers from a rural to a publicly funded urban hospital in NZ over 5 years were included in this study, resulting in a large sample size. The use of the NMDS is a particular strength of this study. The NMDS is one of NZ's largest routinely collected administrative datasets and contains information on all hospital discharge events[22,23].

As this was a retrospective observational study and there was no access to the clinical record, the reason for the discrepancies in clinical coding between rural and urban hospitals cannot be determined. The accuracy of clinical coding at NZ rural hospitals is therefore unknown. A study that audits clinical notes to determine the accuracy of coding at both rural and urban hospitals is required to understand this. It is also possible that there was variation in the clinical coding practice within each of the three hospital groups, with larger variation expected in rural hospitals, especially where different clinical groups (eg midwives and doctors) might independently code clinical events.

Only interhospital transfers were considered in this study. It is possible that this unique subset of patients that are managed by both rural and urban hospitals is, by nature, a group with higher degrees of diagnostic uncertainty and might be subject to different coding practices. It is also possible that discrepancies are different across different age groupings, sex and ethnicities. These factors also need further investigation.

This study only used data from the NMDS up to 2019, so it does not account for clinical coding practices at NZ public hospitals since then. Also, any patients who did not have full clinical records or were seen at private hospitals, birthing units, aged care, or mental health facilities were excluded, so important data may have been missed. The effect is probably minimal as, anecdotally, there are few transfers from rural hospitals to these facilities.

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Only the first interhospital transfer was examined in this study. Further diagnosis code changes in subsequent intra- or interhospital transfers may have occurred. Additionally, only primary diagnosis codes were considered; using all secondary diagnosis codes, such as is recommended when acute coronary syndrome is the diagnosis of interest, may result in different findings[33].

Policy implications

Many population level rural–urban health analyses depend on quality clinical coding within administrative datasets, even though these datasets are rarely collected for research purposes[34]. If the clinical coding within these datasets is inaccurate, especially if it is more inaccurate at one type of facility, the magnitude and direction of any disparities might be incorrectly reported. This has implications for rural health funding and policy, which often rely on data derived from administrative datasets.

It is important that researchers carefully consider which discharge event the diagnostic code of interest should be taken from. Our study found that in 32.1% of cases, the diagnosis chapter or group changed completely after interhospital transfer. Which event (initial, final or any occurrence of the code(s) of interest within the encounter) is the best or correct might depend on the research questions being asked.

While a focus in NZ has been on improving the rural clinical workforce, it is clearly important to ensure a well-trained administrative workforce (including clinical coders) so that the correct information is entered into administrative datasets[35].

A study that includes reviewing the clinical record to determine the accuracy of clinical coding for both rural and urban hospitals is required to understand the findings of this study.

Conclusion

This study demonstrated discrepancies in nearly two-thirds of the primary diagnosis codes assigned between the NZ rural and urban hospitals, and in approximately a third when analysed by broader diagnosis groups. Further investigation is needed into why these differences in clinical coding are occurring.

Funding

Conflicts of interest

The authors declare no conflicts of interest.

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Appendix I: New Zealand's publicly funded hospitals with their Ministry of Health (Manatū Hauora) assigned facility code

Hospital name	Category	Facility code
Auckland City	Large Urban	3260
Christchurch	Large Urban	4011
Dunedin	Large Urban	4211
Hutt	Large Urban	5812
Middlemore	Large Urban	3214
Nelson	Large Urban	3911
North Shore	Large Urban	3215
Tauranga	Large Urban	4911
Waikato	Large Urban	5311
Waitakere	Large Urban	3216
Wellington	Large Urban	5811
Gisborne	Small Urban	3411
Hawkes Bay	Small Urban	3612
Palmerston North	Small Urban	4311
Rotorua	Small Urban	5312
Southland (Kew)	Small Urban	4511
Taranaki Base	Small Urban	4711
Timaru	Small Urban	4411
Wairarapa (Masterton)	Small Urban	5511
Wairau (Blenheim)	Small Urban	3811
Wanganui	Small Urban	5711
Whakatane	Small Urban	3311
Whangarei	Small Urban	4111
Ashburton	Rural	3111
Bay of Islands	Rural	4114
Buller Health (Westport)	Rural	5918
Clutha Health First	Rural	8569
Dannevirke Community	Rural	8561
Dargaville	Rural	4113
Dunstan	Rural	5111
Golden Bay Community Health	Rural	3918
Gore	Rural	8597
Hawera	Rural	4712
Hokianga Health - Rawene Clinic	Rural	4115
Kaikoura	Rural	4021
Kaitaia	Rural	4112
Lakes District	Rural	4513
Maniototo Health Services	Rural	3722
Oamaru	Rural	5611
Taumarunui Community	Rural	4811
Taupo	Rural	5329
Te Kuiti Community	Rural	5313
Te Nikau Grey	Rural	5911
Te Whare Hauora O Ngati Porou – Te Puia Springs	Rural	8629
Thames	Rural	5011
Tokoroa	Rural	5323
Wairoa Hospital and Health Centre	Rural	3613

Codes available from https://www.tewhatuora.govt.nz/for-health-professionals/data-and-statistics/nz-health-statistics/data-references/code-tables/common-code-tables#facility-code-table-download [https://www.tewhatuora.govt.nz/for-health-professionals/data-and-statistics/nz-health-statistics/data-references/code-tables/common-code-tables#facility-code-table-download]

Appendix II: The 'chapters' and their *International Statistical Classification of Diseases and Related Health Problems 10th edition* **(ICD-10) used to classify the primary diagnosis for each admission**

Chapter	ICD code range
Infection	A00-B99
Neoplasms	C00-C96, D00-D49
Haematological	D50-D89
Endocrine	E00-E99
Mental and behavioural disorders	F01-F99
Nervous system	G00-G99
Eyes, ears, nose and neck	H00-H99
Circulatory diseases	I00-I99, R074, R073
Digestive system	K00-K00
Skin and subcutaneous tissue	L00-L99
Musculoskeletal and rheumatological	M00-M99
Genitourinary system	N00-N99
Pregnancy, childbirth and the puerperium	O00-P99
Injury†	S00-Y99
Respiratory system	J00-J99
Other	All codes not otherwise assigned

†Codes associated with injury, poisoning and external causes of morbidity and mortality.