

High level of capture of coronary intervention and associated acute coronary syndromes in the all New Zealand acute coronary syndrome quality improvement cardiac registry and excellent agreement with national administrative datasets (ANZACS-QI 25)

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ABSTRACT

BACKGROUND: The All New Zealand Acute Coronary Syndrome Quality Improvement (ANZACS-QI) registry was designed to collect data on all coronary angiograms and percutaneous coronary interventions (PCI) in New Zealand, and all acute coronary syndromes (ACS) associated with these procedures. This study compares the completeness of capture in ANZACS-QI of coronary procedures and ACS admissions with those recorded in the National Hospitalisation Dataset and evaluates data quality by assessing agreement in ACS diagnoses and coronary procedures between datasets.

METHODS: The national dataset, which included all New Zealand public hospital admissions in 2015 (n=962,700 episodes), was anonymously linked with the ANZACS-QI CathPCI (n=14,649 coronary angiogram episodes) and ACS cohorts (n=8,141 episodes) for 2015. Total numbers of coronary angiogram, PCI and ACS admissions were used as denominators and calculated by combining unique episodes from both data sources.

RESULTS: Of all coronary angiogram episodes (n=15,377) and all PCI episodes (n=5,711), 92% were captured in both datasets, 5% in the national dataset only and 3% in ANZACS-QI only. Overall, 95% of coronary angiogram and PCI episodes were captured in ANZACS-QI. Of ACS episodes with associated coronary angiography (n=8,237), 85% were captured. Overall, 54% of all ACS episodes (n=15,167) were captured, including 71% in <70-year-olds. Seventy-five percent of all ST-elevation myocardial infarctions (STEMI) were captured. Ninety percent of ACS diagnoses in ANZACS-QI had a matching diagnosis in the national dataset. There was excellent agreement in recorded gender, date of birth and ethnicity (>99%). Sub-type of ACS was also highly concordant for STEMI and non-STEMI diagnoses (92% and 89% agreement, respectively).

CONCLUSIONS: Consistent with its aim, the ANZACS-QI registry captured almost all New Zealand public hospital coronary angiography and PCI procedures including those associated with an ACS diagnosis. The high level of agreement between the registry and national dataset supports the use of both datasets for ongoing quality improvement reporting and research.

The All New Zealand Acute Coronary Syndrome Quality Improvement (ANZACS-QI) programme is primarily designed to support secondary care clinicians to implement evidence-based guidelines and meet national performance targets for New Zealand cardiac patients.¹ The registry was designed to collect data regarding all coronary angiograms and percutaneous coronary interventions (PCI), and acute coronary syndromes (ACS) associated with these procedures.

The programme utilises two complementary data sources:

1. The ACS-CathPCI Registry cohort, generated using web-based software that enables secondary care clinicians to systematically collect data on ACS patients, coronary angiography and PCI procedures in all public hospitals.
2. National Hospitalisation Dataset where ACS admissions and coronary procedures are coded using ICD10-AM codes.

ANZACS-QI has National Cardiac Network and New Zealand Ministry of Health (MOH)-endorsed targets to complete CathPCI data entry for all patients having coronary angiography and PCI procedures, and a specific ACS dataset for patients with suspected ACS who undergo angiography. Many, but not all, centres also complete ACS datasets for patients not referred for coronary angiography.

Registry completion is facilitated by monthly reporting of registry completion rates and on-demand completion reports to identify incomplete forms. These completion rates are built into the annual MOH reporting requirements of each of the four national cardiac regions. In the ANZACS-QI registry set-up phase, each site was visited, and systems established to optimise patient capture in the registry. Each site is visited, and its systems re-evaluated, at least annually by a visiting audit nurse.

Data quality is facilitated by having a mandatory dataset, in-form definition statements, in-form automatic validation rules, automatic data capture from source datasets on demographics and laboratory results, standardised user training and regular audit. Each participating hospital is audited as part of the annual visit, with 20 randomly

selected CathPCI and ACS forms compared to medical charts, including all data used for key performance indicator reporting.

There is an additional opportunity to evaluate both ANZACS-QI registry completion and data quality by assessing the concordance with data items held in common with the National Hospitalisation Dataset. All New Zealand patients accessing the public hospital have a unique National Health Index (NHI) number. The two data sources are able to be linked anonymously using an encrypted NHI number.

The aims of this study are to:

1. Describe the completeness of capture in the ANZACS-QI registry of coronary procedures and ACS admissions in public hospitals compared with the number of coronary procedures and ACS admissions recorded in the National Hospitalisation Dataset.
2. Describe the degree of agreement between the ANZACS-QI dataset and the National Hospitalisation Dataset for demographic data and ACS diagnoses.

Methods

Cohorts: The national dataset included all public hospital admissions in New Zealand from 1 January to 31 December 2015 for patients ≥ 18 years of age ($n=962,700$ episodes for 637,081 patients.) The ANZACS-QI dataset included all coronary angiograms reported on ANZACS-QI CathPCI forms ($n=14,649$ episodes for 13,871 people) and all ACS diagnoses reported on ANZACS-QI ACS forms ($n=8,141$ episodes for 7,803 people) in 2015 for patients ≥ 18 years of age. For these analyses, the primary focus was on episodes of care (EoC) rather than individual patients.

Details regarding the ANZACS-QI implementation, data collection and cohorts have been previously published.¹

Definitions

Episode of care: In the national dataset, all hospital admissions associated with an ACS diagnosis and/or coronary procedure that were separated by no more than a day were 'bundled' together into a single EoC to avoid double counting due to inter-hospital transfers for a single clinical event.

In ANZACS-QI, any contiguous hospital admissions associated with an ACS event are captured under a single EoC as part of data capture. EoCs in the two datasets were defined as matching if the episodes temporally overlapped.

Coronary procedures: Coronary angiography and PCI procedures were identified in the national dataset using the following ICD10-AM codes: Coronary angiography (3821500, 3821800–3821802); PCI (3530400, 3530500, 3531000–3531002, 3830000, 3830300, 3830600–3830602, 3830900, 3831200, 3831201, 3831500, 3831800). The national dataset does not record multiple procedures of the same type within an EoC, therefore, only one of each procedure was counted per EoC. The ANZACS-QI registry captures both coronary angiography and PCI, and for this analysis only one of each procedure was counted per EoC to be compatible with the national data. The denominators for all coronary angiograms and all PCI procedures were created by combining procedures from either data source, so they represent a procedure recorded in the national data and/or in ANZACS-QI.

ACS: In national data, the following ICD10-AM codes were used to identify ACS admissions: ST-elevation myocardial infarction (STEMI; I21.0–I21.3, I22.0, I22.1, I22.8, I22.9); non-ST elevation MI (NSTEMI; I21.4); MI unspecified (I21.9); unstable angina (USA; I20.0). Where more than one ACS type was recorded in an episode, the following prioritisation was applied: STEMI > NSTEMI > USA. Both primary and secondary diagnosis codes were used. The ANZACS-QI registry records ACS events as one of STEMI, NSTEMI or USA for each EoC according to standard definitions.^{2,3} As for the coronary procedures above, the denominator for all ACS was created by combining ACS episodes recorded in either the national dataset and/or ANZACS-QI.

Analyses: The ANZACS-QI registry and the National Hospitalisation Datasets are anonymously linked at an individual patient level via a patient-specific encrypted NHI number. The completeness of capture of coronary procedures and ACS admissions in ANZACS-QI is reported as the n (%) captured in ANZACS-QI relative to the appropriate denominator. The overlap between the

ANZACS-QI and national data is displayed using Venn diagrams. For coronary procedures and ACS admissions, the completion rates are shown by age band, gender, ethnicity and ACS subtype. Agreement between the two datasets was evaluated using the 7,338 patients who were recorded as having ACS in both ANZACS-QI and the national dataset. The following data items were assessed: age, gender, ethnicity, ACS sub-type, coronary procedure.

Ethics: ANZACS-QI is part of the wider Vascular Informatics, Epidemiology and the Web (VIEW) study. The VIEW study was approved by the Northern Region Ethics Committee Y in 2003 (AKY/03/12/314), with subsequent amendments to include the ANZACS-QI registries, and with annual approvals by the National Multi-region Ethics Committee since 2007 (MEC07/19/EXP).

Results

Coronary angiogram procedures (Table 1, Figure 1)

Of all coronary angiogram episodes (n=15,377), 92% were captured in both datasets, 5% in the national dataset only and 3% in ANZACS-QI only. Overall, 95% of coronary angiogram episodes were captured in ANZACS-QI. Capture ranged from 96% to 99% in all but one of the country's 11 catheter laboratories. In the one outlier, 20% of coronary angiograms were missed.

PCI procedures (Figure 2)

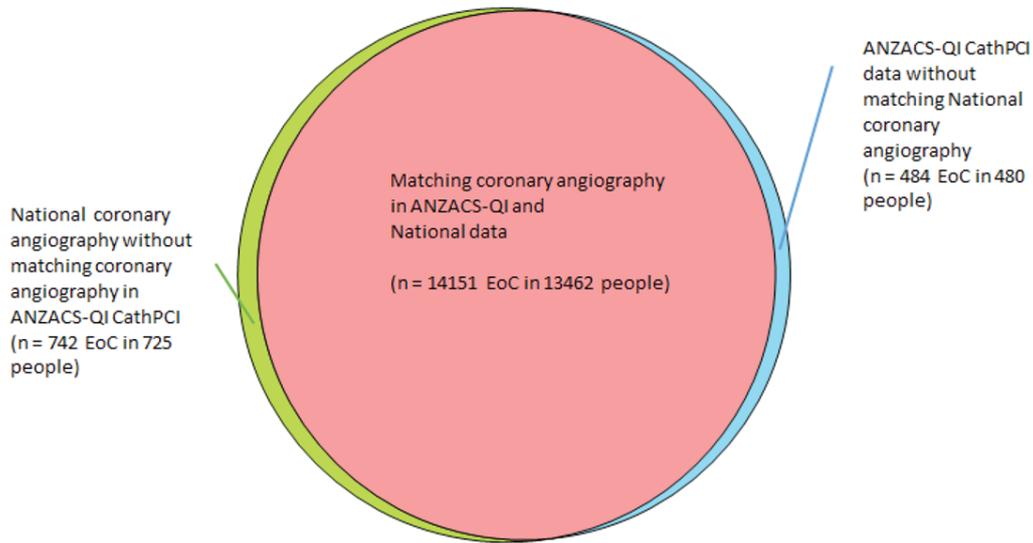
Of all episodes with PCI (n=5,711), 92% were captured in both datasets, 5% in the national dataset only and 3% in ANZACS-QI only. Overall 95% of PCI episodes were therefore captured in ANZACS-QI.

ACS cohort (Table 2, Figure 3)

Overall, there were 15,157 EoCs with a diagnosis of ACS in at least one of the two datasets in 2015. Of these, 48.4% were captured in both datasets, 46.4% in the national dataset only and 5.2% in ANZACS-QI only. Overall, 53.6% of ACS episodes were captured in ANZACS-QI.

Of the 8,141 ACS episodes recorded in ANZACS-QI, 90% were also coded as ACS in the national dataset. Of the 803 ANZACS-QI ACS episodes that had no matching ACS records in national data, there were 759 episodes with a matching national hospi-

Figure 1: Venn diagram showing the overlap in coronary angiography admissions captured in both the National Hospitalisation Dataset and the ANZACS-QI registry (pink), the National Hospitalisation Dataset alone (green) and ANZACS-QI registry alone (blue).



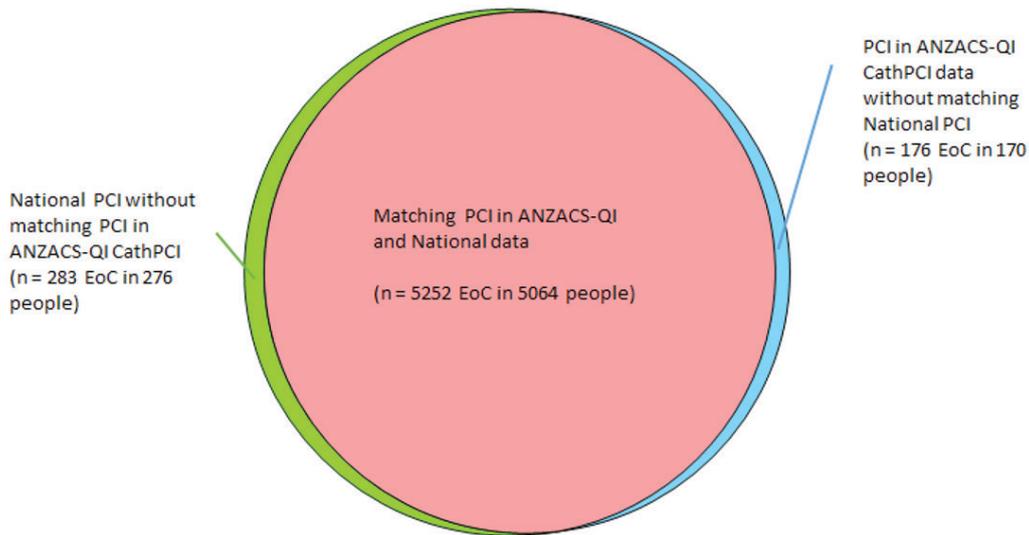
Abbreviations: ANZACS-QI, All New Zealand Acute Coronary Syndrome Quality Improvement; EoC, episodes of care.

Table 1: Comparison of coronary angiography episodes captured in ANZACS-QI and all coronary angiography.

	All coronary angiography* (National + ANZACS-QI) n (column %)	ANZACS-QI coronary angiography n (row %)
n	15,377	14,635
Age, year		
<40	312 (2.0)	263 (84.3)
40–49	1,278 (8.3)	1,213 (94.9)
50–59	3,168 (20.6)	3,044 (96.1)
60–69	4,709 (30.6)	4,477 (95.1)
70–79	4,351 (28.3)	4,140 (95.2)
80+	1,559 (10.1)	1,498 (96.1)
Gender		
Female	5,001 (32.5)	4,771 (95.4)
Male	10,376 (67.5)	9,864 (95.1)
Ethnicity		
Māori	1,591 (10.4)	1,507 (94.7)
Pacific	837 (5.4)	799 (95.5)
Indian	537 (3.5)	521 (97.0)
Chinese/Other Asian	491 (3.2)	475 (96.7)
European/Other	11,582 (75.3)	11,011 (95.1)
Unknown	339 (2.2)	322 (95.0)

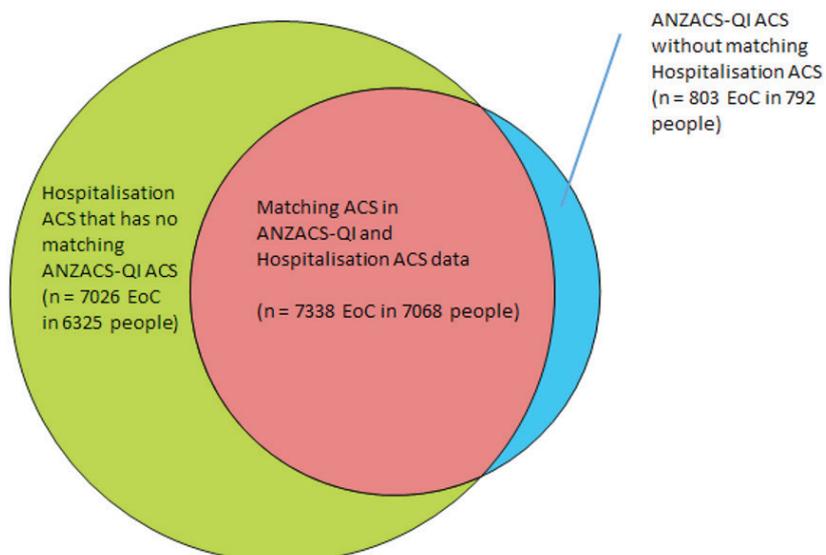
*All variables are defined using national data, with ANZACS-QI used for the 484 episodes not in national data. Abbreviations: n = number; ANZACS-QI, All New Zealand Acute Coronary Syndrome Quality Improvement.

Figure 2: Venn diagram showing the overlap in percutaneous coronary intervention admissions captured in both the National Hospitalisation Dataset and in the ANZACS-QI registry (pink), the National Hospitalisation Dataset alone (green) and the ANZACS-QI registry alone (blue).



Abbreviations: PCI, percutaneous cutaneous interventions; ANZACS-QI, All New Zealand Acute Coronary Syndrome Quality Improvement; EoC, episodes of care.

Figure 3: Venn diagram showing the overlap in acute coronary syndrome admissions captured in both the National Hospitalisation Dataset and the ANZACS-QI registry (pink), the National Hospitalisation Dataset alone (green) and the ANZACS-QI registry alone (blue).



Abbreviations: ACS, acute coronary syndrome; ANZACS-QI, All New Zealand Acute Coronary Syndrome Quality Improvement; EoC, episodes of care.

Table 2: Comparing all ACS to those captured in ANZACS-QI.

	All ACS (National + ANZACS-QI) n (column %)	ANZACS-QI ACS n (row %)
n	15,167	8,141
Age, years		
<40	163 (1.1)	105 (64.4)
40–49	878 (5.8)	674 (76.8)
50–59	2,224 (14.7)	1,604 (72.1)
60–69	3,408 (22.5)	2,275 (66.8)
70–79	3,877 (25.6)	2,194 (56.6)
80+	4,617 (30.4)	1,289 (27.9)
Gender		
Female	5,830 (38.4)	2,624 (45.0)
Male	9,337 (61.6)	5,517 (59.1)
Ethnicity		
Māori	1,421 (9.4)	840 (59.1)
Pacific	848 (5.6)	456 (53.8)
Indian	461 (3.0)	304 (65.9)
Chinese/Other Asian	348 (2.3)	205 (58.9)
European/Other	11,832 (78.0)	6,169 (52.1)
Unknown	257 (1.7)	167 (65.0)
Type of ACS*		
STEMI	2,537 (16.7)	1,916 (75.5)
NSTEMI	8,532 (56.3)	4,668 (54.7)
USA	3,585 (23.6)	1,557 (43.4)
MI Unspecified	513 (3.4)	0 (0)
Coronary angiography	8,237 (54.3)	7,023 (85.3)
PCI	4,489 (29.6)	4,046 (90.1)

*Defined using ANZACS-QI data, with national data used for the 7,026 episodes not in ANZACS-QI.

Abbreviations: n, number; ACS, acute coronary syndrome; ANZACS-QI, All New Zealand Acute Coronary Syndrome Quality Improvement; STEMI, ST-elevation myocardial infarction; NSTEMI, non-ST-elevation myocardial infarction, USA, unstable angina; MI, myocardial infarction; PCI, percutaneous coronary interventions.

talisation episode. Of these 759 episodes, 47% were coded as non-ACS coronary heart disease, 14% as chest pain and 13% as atherosclerotic heart disease. Only 134 episodes (18%) had no cardiac-related ICD10-AM code.

Over 70% of all ACS that occurred among people younger than 70 years of age were captured in ANZACS-QI, but this fell with increasing age to under 30% in those over 80 years. A higher proportion of the episodes that occurred among men were recorded in ANZACS-QI than those that

occurred among women (59% vs 45%). There was variability in capture of ACS admissions across the 20 district health boards (DHBs), ranging from as low as 40% to as high as 69% (data not shown).

Capture in ANZACS-QI also varied by ACS diagnosis with three-quarters of all STEMI patients captured, but just over half the NSTEMI patients. Eighty-five percent of all ACS patients undergoing coronary angiography and 90% receiving PCI after ACS were captured in the ANZACS-QI ACS registry.

Table 3: Agreement between ANZACS-QI and National Hospitalisation Dataset.

	Total	Agreement
Date of birth	7,338	99.9%
Gender		100%
Female	2,345	
Male	4,993	
Ethnicity	7,338	99.6%
DHB	7,338	95.2%
Type of ACS		
STEMI	1,863	92.2%
NSTEMI	4384	89.0%
USA	1,091	78.9%
Coronary angiography	6,410	97.9%
PCI	3,828	97.9%

Abbreviations: ACS, acute coronary syndrome; DHB, district health board; STEMI, ST-elevation myocardial infarction; NSTEMI, non-ST-elevation myocardial infarction, USA, unstable angina; PCI, percutaneous coronary interventions.

Agreement between ANZACS-QI and National Hospitalisation Dataset

There were 7,338 EoCs with an ACS diagnosis in both ANZACS-QI and the national dataset. For those records there was excellent agreement on recorded date of birth, gender, ethnicity and DHB of residence (Table 3). Type of ACS was also highly concordant with 92% agreement on STEMI and 89% agreement on NSTEMI diagnoses.

Discussion

The ANZACS-QI registry was designed to collect data on all coronary angiograms and PCI in New Zealand, and all ACS associated with these procedures. In 2015 the ANZACS-QI registry captured a complete dataset on 95% of all New Zealand patients undergoing coronary angiography and PCI procedures in New Zealand public hospitals. Of all ACS episodes with associated coronary angiography, 85% were captured and of the total ACS episodes, 54% were captured, including 71% of those under 70 years of age and 75% of those with STEMI. There was excellent agreement between ANZACS-QI and the National Hospitalisation Dataset with 90% percent of ACS diagnoses in ANZACS-QI having a matching diagnosis in the national dataset. There was also

excellent agreement in recorded gender, date of birth and ethnicity (>99%). Sub-type of ACS was also highly concordant for STEMI and NSTEMI diagnoses (92% and 89% agreement, respectively).

Agreement between ANZACS-QI and national dataset

There was excellent agreement regarding ACS diagnosis. In most cases where there was disagreement, the national data was coded as related non-ACS coronary heart disease. In this study using anonymised patient data we were unable to assess which diagnosis was correct, but in an ANZACS-QI sub-study involving two hospitals we have shown that the diagnostic error rate in patients undergoing coronary angiography with an ICD10-coded ACS event in the national dataset was approximately 10%, suggesting most of the disagreement is due to error in the national dataset coding (in press, Chan et al, Heart, Lung and Circulation). Potential diagnostic error in the registry is minimised by in-form definitions of ACS and its subtypes, clinical staff entering data and annual random checks of data entry accuracy against source data. There was some variation in the degree of agreement between the 20 DHBs (data not shown). This ranged from 84% to 97%, suggesting that the accuracy of ACS coding by clinical coders and users of the registry

needs to be reviewed in DHBs with the greatest disagreement as part of ongoing data quality audit.

For episodes where there was agreement between the ANZACS-QI registry and national dataset regarding an ACS diagnosis, there was close to perfect agreement on key demographic data including age, gender and ethnicity. There was also a reassuringly high level of agreement on key ACS diagnostic subtypes. The only prior studies assessing the accuracy of NZ national administrative dataset coding of MI were in patient cohorts from the 1980s, well before the current troponin-based diagnostic criteria for MI.^{4,5}

The high levels of agreement between the ANZACS-QI registry and national dataset diagnoses of ACS and its sub-types provide strong support for other recent New Zealand studies which have used the national datasets to describe trends in ACS incidence and outcomes.^{6,7} This New Zealand wide validation is particularly important in view of prior international studies that have reported variable accuracy of secondary care ICD coding of myocardial infarction ranging from 76% to 100% between jurisdictions, and even greater inaccuracy in the coding of myocardial infarction sub-types.^{8,9}

It is also reassuring that there was a very high degree of agreement between recording of coronary angiography in the registry and the national dataset, supporting the use of the national datasets for reporting of coronary angiography trends and variation.¹⁰

Variation in ANZACS-QI registry capture

Capture of angiograms was virtually complete except in one participating hospital. This comparison of ANZACS-QI and national datasets has identified the deficiency in registry capture at that hospital, which has now been addressed.

Compared with the virtually complete coronary angiography capture, just over half of all New Zealand ACS patients are captured in ANZACS-QI. However, at least 85% of those ACS patients undergoing coronary angiography were captured. The true percentage is likely to be higher because, as discussed above, a small percentage of those having angiography may have an incorrect diagnosis of ACS in the national

datasets and are therefore not recorded in ANZACS-QI ACS. This is consistent with the agreed national completion target which stipulates the capture of all suspected ACS patients referred for coronary angiography, but due to the difficulties in comprehensively capturing all ACS patients across busy and structurally diverse hospital systems, capture of other ACS patients is left to the discretion of individual DHBs.¹ Nationally, half of all ACS patients undergo angiography.¹⁰ There is inter-DHB variation in ACS capture in the ANZACS-QI registry ranging from 40 to 70%, which is due to both to variation in angiography rates between DHBs and variation in capture of ACS patients not receiving coronary angiography.¹¹ The registry focus on capturing patients receiving coronary angiography means that groups of patients with a higher burden of comorbidity and more frequent contraindications to coronary angiography such as the elderly are under-represented. The incomplete capture of ACS patients not receiving coronary angiography is therefore an important consideration in the design and interpretation of any data reporting or research using ANZACS-QI registry datasets.

Advantages and disadvantages of each data source and future directions

The two datasets are complementary. Because the National Hospitalisation Dataset is routinely collected, the ANZACS-QI registry comes at an incremental cost. However, the ANZACS-QI registry collects an in-depth dataset on virtually all patients undergoing coronary angiography and PCI. As an example, this allows for comprehensive risk adjustment when comparing coronary intervention rates and outcomes, and the reporting of time delays to reperfusion therapy and coronary angiography, which are not possible using the national datasets alone.¹²⁻¹⁴ The national datasets facilitate reporting of post-discharge outcomes and pharmaceutical dispensing, and this will facilitate the reporting of quality measures in the nearly half of patients not captured in the ANZACS-QI registry.

ANZACS-QI registry completion continues to be an indicator that DHBs are required to report quarterly to the MOH. Since the preparation of the current report a similar methodology was used, with 2016

data, to develop a national ANZACS-QI report (Completeness of Acute Coronary Syndromes and Coronary Procedure Capture in the ANZACS-QI Registries and Agreement with National Administrative Datasets 2016) released to DHBs in mid-2018. With improved streamlining of data extracts, management and analysis it is intended that future annual reports will be made available with no more than a one year lag.

As we have shown in this paper, the registry can be used to validate the accuracy of reporting using the national datasets. In time, we envisage that as data items common to both data sources are validated, and as other national routinely collected data becomes available for linkage, the burden of data collection within the registry will be reduced.

Limitations

The datasets in this analysis are anonymised, which precludes any comparison with source medical records to determine whether the observed disagreements are due to inaccuracy in one or other dataset.

The current study found that around 10% of ACS episodes captured in ANZACS-QI were potentially under-counted in the National datasets as non-ACS. However, from the current study we are unable to assess the extent of over-diagnosis of ACS in the National datasets. This requires further study.

Patients sometimes have more than one coronary angiogram or PCI in a single hospital admission (or episode). While these individual procedures are recorded in ANZACS-QI, they are not distinguished in the national datasets, which record only whether a procedure occurred at least once. Because of this we chose to assess agreement on a per episode level as opposed to a per procedure level. Coronary angiogram and PCI procedures performed in private hospitals were not included in this analysis. Further work is needed to establish the extent of capture of these procedures in the ANZACS-QI registry and national datasets.

Conclusions

Consistent with its aim, the ANZACS-QI registry captured almost all New Zealand public hospital coronary angiography and PCI procedures in 2015, including those associated with ACS admissions. Registry completion reporting and targets have remained unchanged and similar or better performance should be observed in more recent years. While the observed discrepancies between the datasets are a target for data quality improvement for individual DHBs, the overall high level of agreement between the registry and national datasets supports the use of both datasets for future analyses, and, specifically, supports the reporting of quality measures in the nearly half of ACS patients not captured in the ANZACS-QI registry.

Competing interests:

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