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Characteristics of national and major regional percutaneous coronary intervention registries: a structured literature review

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KEYWORDS

- clinical research
- clinical trials
- miscellaneous

Abstract

Aims: Clinical registries have a growing role in the assessment of healthcare quality and safety. It is unclear, however, how many countries utilise registries for patients who receive percutaneous coronary intervention (PCI). The aim of this review was to provide an overview of the characteristics of PCI registries from around the world.

Methods and results: A systematic search of the published and online grey literature was undertaken to identify currently active national PCI registries. In countries without a national PCI registry, the three largest regional registries were included. Thirty registries in 26 countries that met inclusion criteria were identified, of which 24 (80%) are national registries and six (20%) are regional registries. Fourteen registries (47%) collect 30-day mortality rates while 11 registries (37%) collect 12-month mortality rates. Nine registries (30%) provide risk-adjusted mortality rates and 16 registries (53%) report bleeding outcomes, utilising a variety of bleeding definitions. Thirteen registries (43%) publicly report key quality metrics.

Conclusions: There is substantial geographic variation in the distribution of PCI registries. Comparison across registries is challenging due to varying data definitions and collection time points. Public reporting of outcomes data is being increasingly implemented by PCI registries, but risk-adjustment models remain underutilised.

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Abbreviations

NCDR	National Cardiovascular Data Registry
PCI	percutaneous coronary intervention
RCT	randomised controlled trial

Introduction

Worldwide, there has been an increasing emphasis by healthcare regulators on measuring and improving the quality of medical care. While results from randomised controlled trials (RCTs) provide the highest level of evidence regarding the efficacy of interventions, they have well recognised limitations. RCTs may not always reflect "real-world" medical settings and often underrepresent significant portions of the community, such as women and the elderly[1]. Clinical registries have consequently emerged as a powerful tool to assess healthcare effectiveness and safety and improve quality of care, as well as to inform on the real-world impact of new interventions or medications outside the confines of RCTs[2]. Over the last two decades, there has been a substantial growth in national and major regional percutaneous coronary intervention (PCI) registries, predominantly in developed countries. However, many countries, particularly low- and middle-income countries, have been slow to adopt large-scale multicentre clinical registries, potentially due to concerns about costs and a lack of a clearly defined utility and benefit[3]. Health regulators and funding agencies have also placed greater emphasis on public reporting of hospital and/or operator outcomes, particularly in the area of PCI, to assess performance and clinical quality[4]. This has led to several concerns including misinterpretation of data by healthcare users, leading to avoidance of so-called low-performing hospitals[5]. In addition, it may potentially lead to provider "risk-averse behaviour" whereby PCI may not be offered to the most high-risk patients who may paradoxically have the most to gain from timely treatment.

In the current environment of demand for big data and an evolving role for registries, it is appropriate to examine the current status of PCI registries. This review, therefore, aims to provide an overview of the distribution and characteristics of active PCI registries from around the world, and to describe the associated PCI registry concepts including their approach to clinical outcome measurement, risk adjustment and public reporting.

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Methods

A structured literature review was performed by searching the PubMed database in January 2018 using the keywords "percutaneous coronary intervention" and "registry" **(Figure 1)**. Our search was restricted to manuscripts published in English.

For the purposes of article selection, a PCI registry was defined as a dedicated multicentre database systematically collecting information on clinical and procedural details of patients undergoing PCI[2]. Only registries currently actively collecting data at either a major regional or national level, for all-comers undergoing PCI were included. We considered a registry to be "national" if it was reported as the accepted countrywide system for data collection on PCI and had published reports or publications. In countries without a national PCI registry, up to three of the largest regional registries were included. One author (S. Biswas) reviewed the titles and abstracts of all articles to identify suitable registries. If there were any uncertainties regarding whether an article or registry met inclusion criteria, a full article review was conducted. All selected articles and included registries were then subsequently verified by a second author (D. Stub).

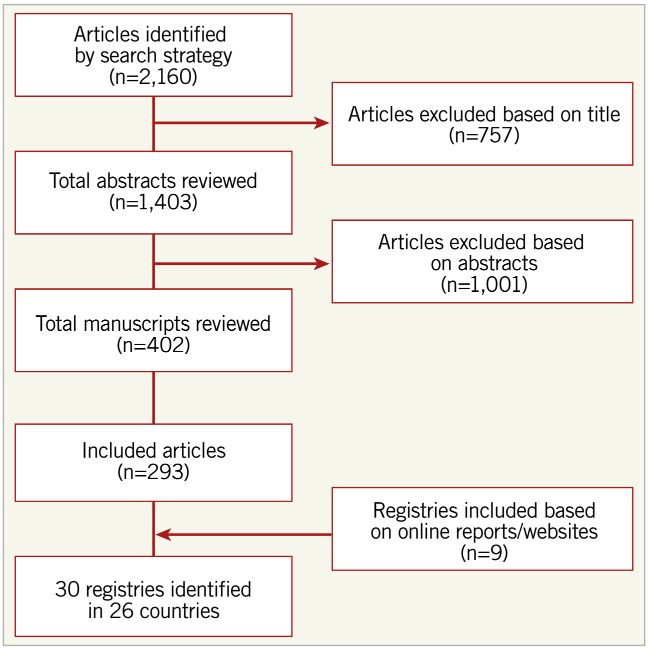

Figure 1. *Flow diagram illustrating literature search strategy.*

An additional internet search of webpages was conducted in January 2018, using the Google Advanced Search facility with the term "percutaneous coronary intervention registry". Also, the names of all United Nations member countries with the term "percutaneous coronary intervention registry" were searched for in Google. In countries where no national PCI registry was identified, a second search was performed with the name of the capital city and the term "percutaneous coronary intervention registry", to identify any major regional registries. Any registries identified using this strategy that met the inclusion criteria were included. Additional information on identified registries was also obtained by using the name of the registry as the search term. Two authors (S. Biswas, D. Stub) then reviewed the results to ensure that no eligible registries were missed. As not all registries had published protocol papers or websites available in English, the information on their data sets may not be representative of the complete set of variables collected. Further information about search criteria can be found in **Supplementary Appendix 1**.

For each registry that was identified as meeting the inclusion criteria, data were collected on whether registry participation was voluntary or mandatory, the time points at which mortality data were collected, as well as the definition of bleeding used. Furthermore, whether the registries provided public reporting of outcomes at either a hospital or operator level (both identified and deidentified) was also ascertained. All identified registries were also contacted by email to complete a pre-specified questionnaire to confirm our data, out of which 10 registries (33%) provided a response.

This review has been registered with PROSPERO (registration no. CRD42018090574).

Results

The literature search identified 30 PCI registries that met the inclusion criteria located in 26 countries: 24 (80%) are national registries and six (20%) are regional registries **(Figure 2)**[6-21]. In Australia and Canada, there are no national PCI registries; therefore, only major regional registries in these countries were included[22-27]. While the earliest PCI registry was established in 1990, 22 out of the 30 registries (73%) were established in or after 2000 **(Figure 3)**. In total, our conservative estimate indicates that over 20 million patients undergoing PCI have been included in PCI registries across the world to date. Overall, 12 registries (40%) collect data on PCI procedures only, while 18 registries (60%) also collect data on patients undergoing diagnostic coronary angiography without PCI **(Table 1)**. Estimated case coverage is variable but is generally more complete where participation is mandated by government compared to when participation is voluntary. Fifteen registries (50%) are associated with a government organisation, while the other 15 registries (50%) are associated with a national society of cardiology **(Supplementary Table 1)**. All but three registries (the National Interventional Council Registry of India, the Austrian National Cathlab Registry and the Swiss Working Group of Interventional Cardiology PCI survey) prospectively collect individual patient-level data[13,28,29].

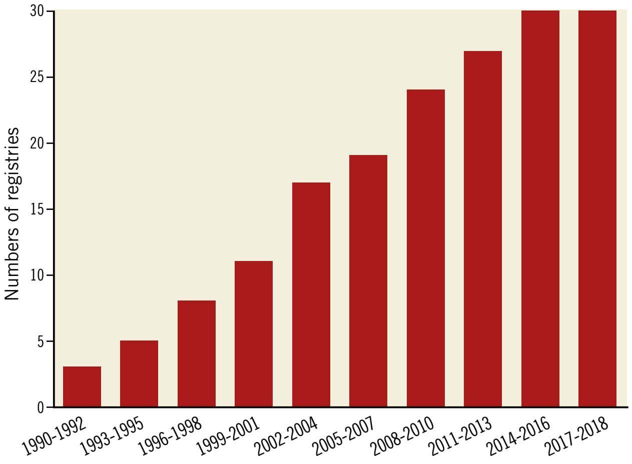

Figure 3. *Growth of percutaneous coronary intervention registries over time.*

Figure 2. *Map of national- and regional-level percutaneous coronary intervention registries.*

Twenty-nine registries (97%) collect in-hospital mortality rates which range from 0.5% to 2.5% for all PCI **(Figure 4)** and from 2.5% to 6.9% for PCI in ST-elevation myocardial infarction **(Supplementary Figure 1)**. Fourteen registries (47%) collect

Table 1. Description of included registries.

PCI registry name	Location	Year commenced	Includes diagnostic coronary angiography data?	Time points for mortality data collection
National registries				
Spanish Cardiac Catheterization and Coronary Intervention registry	Spain	1990	Yes	In-hospital
Austrian National Cathlab Registry (ANCALAR)	Austria	1992	Yes	In-hospital
Arbeitsgemeinschaft Leitende Kardiologische Krankenhausärzte (ALKK) Registry	Germany	1992	Yes	In-hospital
Quality Oriented Electronic Registration of Medical Implant Devices (QERMID) Belgian PCI Registry	Belgium	1996	No	In-hospital, 30-day
Swedish Coronary Angiography and Angioplasty Registry (SCAAR)	Sweden Iceland	1998	Yes	In-hospital, 30-day, 12-month
National Cardiovascular Data Registry (NCDR) CathPCI	United States of America	1998	Yes	In-hospital
Danish Heart Register	Denmark	2000	Yes	In-hospital, 30-day
Singapore Cardiac Data Bank Cath/PCI module	Singapore	2000	Yes	In-hospital, 30-day, 12-month
British Cardiovascular Intervention Society (BCIS) registry	United Kingdom	2000	No	In-hospital, 30-day, 12-month
Portuguese National Registry of Interventional Cardiology (RNCI)	Portugal	2002	No	In-hospital
Lebanese Interventional Coronary Registry (LICOR)	Lebanon	2002	Yes	In-hospital
ORPKI registry	Poland	2004	Yes	In-hospital
ONACI registry	France	2004	Yes	In-hospital
Italian National Registry of Interventional Cardiology	Italy	2004	Yes	No outcome data
National Interventional Council Registry	India	2006	No	In-hospital
Malaysian National Cardiovascular Disease Database-PCI registry	Malaysia	2007	No	In-hospital, 30-day, 12-month
Japan-PCI (J-PCI) Registry	Japan	2008	No	In-hospital
Netherlands Heart Registry	Netherlands	2008	No	In-hospital, 30-day, 12-month
Integrated PCI Data System in Brazil (ICP-BR) Registry	Brazil	2009	No	In-hospital
Ministry of Health Cardiovascular Intervention Online Registry	China	2009	No	In-hospital
All New Zealand Acute Coronary Syndrome Quality Improvement (ANZACS-QI) CathPCI registry	New Zealand	2010	Yes	In-hospital, 30-day, 12-month
Norwegian Registry for Invasive Cardiology (NORIC)	Norway	2012	Yes	In-hospital
Swiss Working Group of Interventional Cardiology PCI survey	Switzerland	2014	Yes	In-hospital
Korea PCI (K-PCI) registry	Korea	2015	No	In-hospital
Regional registries				
British Columbia Cardiac Registry	British Columbia, Canada	1994	Yes	In-hospital, 30-day, 12-month
Alberta Provincial Project for Outcome Assessment in Coronary Heart Disease PCI registry (APPROACH)	Alberta, Canada	1995	Yes	In-hospital, 30-day, 12-month
Cardiac Care Network of Ontario	Ontario, Canada	2003	No	In-hospital, 30-day, 12-month
Victorian Cardiac Outcomes Registry (VCOR)	Victoria, Australia	2012	No	In-hospital, 30-day
Coronary Angiogram Database of South Australia (CADOSA)	South Australia, Australia	2012	Yes	In-hospital, 30-day, 12-month
Queensland Cardiac Outcomes Registry (QCOR)	Queensland, Australia	2014	Yes	In-hospital, 30-day, 12-month

mortality rates at 30 days, while 11 registries (37%) collect mortality rates at 12 months following the index PCI **(Table 1)**. The majority of registries utilise individual record review for all variables, including mortality data at follow-up **(Supplementary Table 2)**. Eleven registries (37%) obtain mortality data through linkage with national administrative or mortality databases[30-33]. Nine registries (30%) provide risk-adjusted mortality rates, although the covariates used in risk models vary[22,23,34,35]. Sixteen registries (53%) report bleeding outcomes, with a variety of bleeding definitions utilised **(Supplementary Table 1)**[14,23,36].

Thirteen registries (43%) provide publicly available reports of their data at hospital or operator level. Two of these registries (Victorian Cardiac Outcomes Registry and Spanish Cardiac Catheterization and Coronary Intervention Registry) anonymise all data such that no hospital can be individually identified **(Supplementary Figure 2)**[6,27]. Six registries (20%) publicly report mortality data which are identifiable to an individual hospital, while the British Cardiovascular Intervention Society registry publicly reports mortality data that are identifiable to an individual operator. Four registries (13%) publicly report quality measures

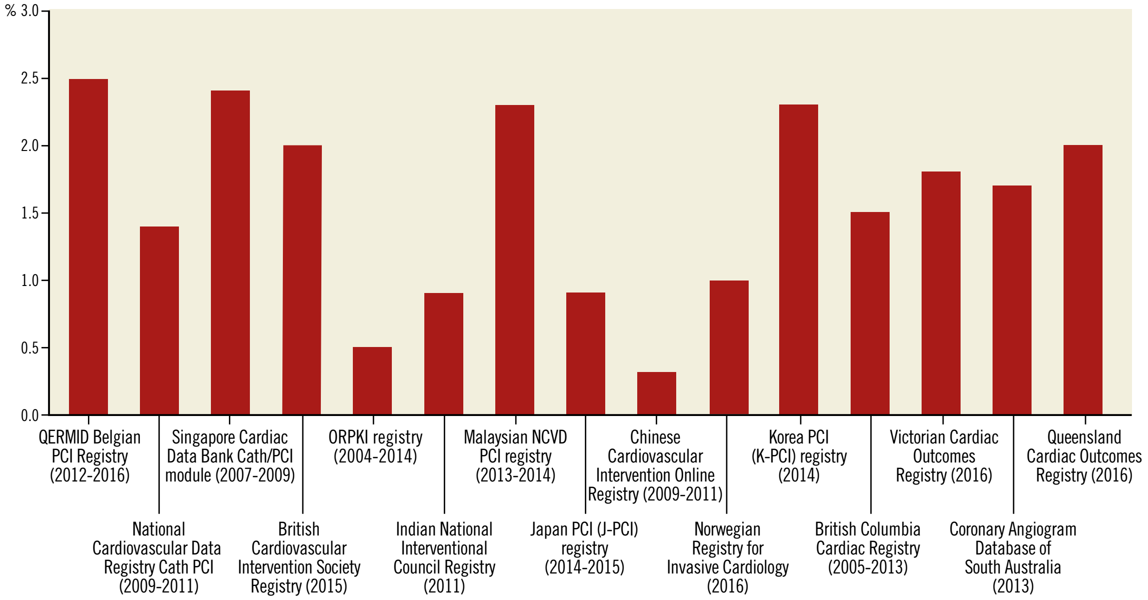

Figure 4. *In-hospital mortality rate after percutaneous coronary intervention across the registries.*

other than mortality that are identifiable to a hospital such as case mix, door-to-balloon time and prescription of guideline-directed secondary prevention therapy[15,29,30,37,38].

Discussion

Over the last two decades, there has been a substantial increase in the number of PCI registries. While nearly all PCI registries collect in-hospital mortality data, a much smaller proportion collect 30-day and 12-month mortality data. Bleeding complications are only reported by just over half of all PCI registries; a variety of bleeding definitions is used. Public reporting of key quality metrics and outcome data is being increasingly implemented but risk-adjustment models appear to be underutilised by PCI registries.

ROLE AND UTILITY OF CLINICAL REGISTRIES

The growth of cardiac registries over the last two decades has been in parallel with the steady development of clinical quality metrics in cardiovascular diseases since the early 1990s when a national effort to measure the quality of care for American patients with acute myocardial infarction was initiated[39]. Clinical registries are able to collect comprehensive data systematically on large numbers of patients in real-world practice, and therefore may be used to measure achievement of quality standards and adherence to guidelines[40].

However, the impact of clinical registries on hard clinical outcomes, such as survival, has been mixed. The establishment of lung and colon cancer registries in Denmark and Manchester, England, respectively, was found to be associated with improved survival of patients with those conditions, probably due to better quality of care after the introduction of the registries[41,42]. Similarly, a reduction in trauma-related mortality was noted following introduction of systematic data collection and monitoring in the Victorian Statewide Trauma Registry in Australia[43]. However, a registry established to monitor acute stroke care in Germany did not demonstrate any improvement in mortality from stroke over time[44]. On the other hand, the impact of registries on improving systems of care or adherence to guidelines has been largely positive. Participation in heart failure registries in America has been shown to be associated with increased use of evidence-based heart failure therapies, shorter length of stay for patients hospitalised with heart failure and reduced in-hospital morbidity and mortality at both patient and hospital level[45,46].

DATA STANDARDISATION

With the rapid growth in PCI registries operating across the world, the opportunity to compare outcomes of patients treated with PCI in different countries has been of particular interest[20]. As a result, some newer PCI registries, such as the Coronary Angiogram Database of South Australia registry, have been designed based on other large registries to facilitate this comparison and international benchmarking[25]. However, our review highlights that there is large variation in the outcomes measured and definitions of outcomes across the registries worldwide, which limits international comparisons[2].

To address this issue, a number of expert committees have been formed to develop standard definitions and outcome measures[47,48]. The overall consensus has been that survival should be assessed at 30 days post discharge, as well as annually up to five years after the index event. They also recommended collection of patient-reported outcome measures which are currently performed by only a very few registries. Despite this, our analysis indicates that only about a third of all registries report outcomes beyond 30 days post PCI.

PUBLIC REPORTING AND RISK ADJUSTMENT

It has been proposed that public reporting of procedural outcomes will provide more transparency and accountability of healthcare providers, as well as provide poorly performing hospitals or operators with an incentive to improve their performance[49]. Following the introduction of public reporting of risk-adjusted mortality after coronary artery bypass graft surgery in the late 1980s in New York, a study comparing 30-day mortality between 1994 and 1999 among New York and non-reporting states showed that patients in non-reporting states were 52% more likely to experience short-term mortality, after adjusting for preoperative illness severity[50]. However, while most studies have shown a positive association between public reporting and improvement in key quality metrics, several studies have reported that the use of PCI in patients with myocardial infarction was lower in states with public reporting compared with non-reporting states, especially in the highest risk patients such as those with cardiogenic shock and post-cardiac arrest[51,52]. Surveys performed on interventional cardiologists have also confirmed that the knowledge that their PCI mortality rates will be made public affects their decision to perform PCI[53]. Therefore, public reporting has the potential to become counterproductive in improving outcomes after PCI as it may be increasing operator risk-averse behaviour and withholding of PCI from the highest risk patients who also potentially stand to gain the most benefit from it[54].

One suggested strategy to minimise the potential adverse impact of public reporting of outcomes has been to report risk-adjusted mortality rates only, to account for high-risk patients in whom outcomes after PCI are often poor due to high preprocedural risk[5]. However, the present review found that less than one third of all PCI registries report risk-adjusted mortality rates. There is also significant variability in the nature and complexity of the risk-adjustment models used by the different registries[55]. In an analysis of six different risk models used in patients undergoing high-risk PCI with haemodynamic support, all models were found to have poor predictive ability for mortality[55]. While adding in variables such as frailty may improve model validity, it is important to accept that no risk-adjustment model will be perfect[5]. Therefore, changing the focus from risk-adjusted mortality rates to reporting more process-oriented measures such as guideline-recommended medication prescription on discharge, as is done currently by the NCDR Cath/PCI registry, should be considered in the future.

Limitations

The present review has a number of limitations. First, all searches were performed in English. While a broad search strategy was used to minimise publication bias, it is possible that some registries may have been missed. In addition, many registries only published online reports in their native language, thereby potentially affecting interpretation of their key characteristics. To mitigate this risk, all individual registries were contacted to confirm the findings on their key characteristics. Finally, based on the pre-specified focus of the review to include national or the three largest regional registries only, a number of high-quality regional registries were not included in the analysis.

Conclusions

Our review demonstrates that the global distribution of PCI registries is patchy, with the highest concentration of registries in Europe. Clinical PCI registries have a key role to play in improving the quality of local cardiovascular care, but comparison across regions and countries may be challenging due to varying registry definitions and data collection time points. While public reporting of key quality metrics may help to improve processes and outcomes, registries must consider how to avoid risk-averse behaviour with appropriate and sophisticated risk adjustment.

Impact on daily practice

PCI registries have a key role to play in improving the quality of cardiovascular care, but there is significant geographic variation in their use. Standardisation of data definitions may help to enhance their role in the future, particularly for international comparisons. Public reporting of key quality metrics may help to improve outcomes, but registries must be cautious that public reporting does not encourage operator risk-averse behaviour by avoiding treatment of high-risk patients who stand to gain the most benefit from intervention.

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Conflict of interest statement

The authors have no conflicts of interest to declare.

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Supplementary data

Supplementary Appendix 1. Methods.

Supplementary Figure 1. Approach to public reporting of outcomes by different registries.

Supplementary Figure 2. In-hospital mortality post PCI for STEMI across the registries.

Supplementary Table 1. Organisational data for included registries.

Supplementary Table 2. Outcomes data collection in included registries.

Supplementary data

Supplementary Appendix 1. Methods

Search strategy

The search strategy used to identify publications from Pubmed was as follows:

(percutaneous coronary intervention[Title/Abstract] AND registry[Title/Abstract]) AND English[Language] AND "humans"[MeSH Terms]

Websites accessed for this review

ALKK registry, Germany: http://www.alkk.de

QERMID Belgian PCI registry: http://overlegorganen.gezondheid.belgie.be/sites/default/files/documents/the_qermid_belgian_pci_registry.pdf

Swedish Coronary Angiography and Angioplasty Registry (SCAAR): http://www.ucr.uu.se/swedeheart/99-scaar/forskning-scaar

National Cardiovascular Data Registry (NCDR) Cath/PCI: https://cvquality.acc.org/NCDR-Home/

Singapore Cardiac Data Bank Cath/PCI module: https://www.nhcs.com.sg/nhris/Pages/Research/ResearchCores/ClinicalSciencesandStatisticsCore.aspx

British Cardiovascular Intervention Society (BCIS) registry: http://www.bcis.org.uk

Portuguese National Registry of Interventional Cardiology (RNCI): http://www.spc.pt/RegistosNacionaisSPC (in Portuguese)

Italian National Registry of Interventional Cardiology: http://www.gise.it

National Interventional Council Registry, India: http://nicregistry.org/nic_registry.html

Japanese J-PCI registry: http://www.cvit.jp (in Japanese)

Malaysian National Cardiovascular Disease Database PCI registry: http://www.acrm.org.my

Dutch Heart Registry: http://www.nederlandsehartregistratie.nl/index.html (in Dutch)

Ministry of Health Cardiovascular Intervention Online registry, China: http://www.mta.org.cn (in Chinese)

All New Zealand Acute Coronary Syndrome Quality Improvement (ANZACS-QI) CathPCI registry:
https://www.fmhs.auckland.ac.nz/en/soph/about/our-departments/epidemiology-and-biostatistics/research/view-study/research/anzacs-qi-register.html

Norwegian Register of Invasive Cardiology (NORIC):
https://www.kvalitetsregistre.no/resultater/hjerte-og-kar/norsk-register-for-invasiv-kardiologi-noric (in Norwegian)

Swiss Working Group of Interventional Cardiology PCI survey: http://www.ptca/ch

Alberta Provincial Project for Outcome Assessment in Coronary Heart Disease PCI registry: http://www.approach.org

Cardiac Care Network Ontario: http://www.ccn.on.ca

Victorian Cardiac Outcomes Registry (VCOR): http://www.vcor.org.au

Queensland Cardiac Outcomes Registry (QCOR):
https://www.health.qld.gov.au/improvement/projects/cardiac-outcomes-registry

Google search

The following countries were identified as United Nations member countries from http://www.un.org/en/member-states/index.html. Each country was entered into a Google search with the term “percutaneous coronary intervention registry” to identify national registries. In countries where no national registry was identified, a further Google search was performed with the name of the capital city and the term “percutaneous coronary intervention registry” to identify any large regional registries:

Afghanistan
Albania
Algeria
Andorra
Angola
Antigua and Barbuda
Argentina
Armenia
Australia
Austria
Azerbaijan
Bahamas
Bahrain
Bangladesh
Barbados
Ghana
Greece
Grenada
Guatemala
Guinea
Guinea-Bissau
Guyana
Haiti
Honduras
Hungary
Iceland
India
Indonesia
Iran
Iraq
Papua New Guinea
Paraguay
Peru
Philippines
Poland
Portugal
Qatar
Republic of Korea
Republic of Moldova
Romania
Russian Federation
Rwanda
Saint Kitts and Nevis
Saint Lucia
Saint Vincent and the Grenadines

Belarus
Belgium
Belize
Benin
Bhutan
Bolivia
Bosnia and Herzegovina
Botswana
Brazil
Brunei Darussalam
Bulgaria
Burkina Faso
Burundi
Cabo Verde
Cambodia
Cameroon
Canada
Central African Republic
Chad
Chile
China
Colombia
Comoros
Congo
Costa Rica
Côte d'Ivoire
Croatia
Cuba
Cyprus
Czech Republic
Democratic People's Republic of Korea
Democratic Republic of the Congo
Denmark
Djibouti
Dominica
Dominican Republic
Ecuador
Egypt
El Salvador
Equatorial Guinea
Eritrea
Estonia
Ireland
Israel
Italy
Jamaica
Japan
Jordan
Kazakhstan
Kenya
Kiribati
Kuwait
Kyrgyzstan
Lao People's Democratic Republic
Latvia
Lebanon
Lesotho
Liberia
Libya
Liechtenstein
Lithuania
Luxembourg
Madagascar
Malawi
Malaysia
Maldives
Mali
Malta
Marshall Islands
Mauritania
Mauritius
Mexico
Micronesia (Federated States of)
Monaco
Mongolia
Montenegro
Morocco
Mozambique
Myanmar
Namibia
Nauru
Nepal
Netherlands
New Zealand
Samoa
San Marino
Sao Tome and Principe
Saudi Arabia
Senegal
Serbia
Seychelles
Sierra Leone
Singapore
Slovakia
Slovenia
Solomon Islands
Somalia
South Africa
South Sudan
Spain
Sri Lanka
Sudan
Suriname
Swaziland
Sweden
Switzerland
Syrian Arab Republic
Tajikistan
Thailand
The Former Yugoslav Republic of Macedonia
Timor-Leste
Togo
Tonga
Trinidad and Tobago
Tunisia
Turkey
Turkmenistan
Tuvalu
Uganda
Ukraine
United Arab Emirates
United Kingdom of Great Britain and Northern Ireland
United Republic of Tanzania
United States of America
Uruguay
Uzbekistan

Ethiopia
Fiji
Finland
France
Gabon
Gambia
Georgia
Germany
Nicaragua
Niger
Nigeria
Norway
Oman
Pakistan
Palau
Panama
Vanuatu
Venezuela
Viet Nam
Yemen
Zambia
Zimbabwe

Supplementary Table 1. Organisational data for included registries.

PCI registry name	Hospital participation	Estimated case coverage by number of participating centres	Organisational linkage
Spanish Cardiac Catheterization and Coronary Intervention registry	Voluntary	*	Spanish Society of Cardiology
Austrian National Cathlab Registry (ANCALAR)	Voluntary	100%	Austrian Society of Cardiology
Arbeitsgemeinschaft Leitende Kardiologische Krankenhausärzte (ALKK) Registry	Mandatory	100%	German Cardiac Society
Quality Oriented Electronic Registration of Medical Implant Devices (QERMID) Belgian PCI Registry	Mandatory	100%	National health authorities
Swedish Coronary Angiography and Angioplasty Registry (SCAAR)	Mandatory	100%	Swedish government and Swedish Heart-Lung Foundation
National Cardiovascular Data Registry (NCDR) CathPCI	Voluntary	94%	American College of Cardiology
Danish Heart Register	Mandatory	All government funded centres only	Danish Health Authority
Singapore Cardiac Data Bank Cath/PCI module	Voluntary	All government funded centres only	Ministry of Health, Singapore
British Cardiovascular Intervention Society (BCIS) registry	Mandatory	100%	British Cardiovascular Intervention Society
Portuguese National Registry of Interventional Cardiology (RNCI)	Voluntary	100%	Portuguese Society of Cardiology
Lebanese Interventional Coronary Registry (LICOR)	Voluntary	69%	Lebanese Society of Cardiology

ORPKI registry	Mandatory	100%	Polish Association of Cardiovascular Interventions / Polish Cardiac Society
ONACI registry	Voluntary	*	French Society of Cardiology
Italian National Registry of Interventional cardiology	Voluntary	97%	Italian Society of Interventional Cardiology
Indian National Interventional Council Registry	Voluntary	*	Cardiological Society of India – National Interventional Council
Malaysian National Cardiovascular Disease Database-PCI registry	Voluntary	15 PCI centres as of 2014	Ministry of Health, Malaysia
Japan-PCI (J-PCI) Registry	Mandatory	85%	Japanese Association of Cardiovascular Intervention and Therapeutics
Netherlands Heart Registry	Mandatory	100%	Dutch Society for Cardiology
Integrated PCI Data System in Brazil (ICP-BR) Registry	Voluntary	*	Ministry of Science / Ministry of Health, Brazil
Ministry of Health Cardiovascular Intervention Online Registry, China	Mandatory	100%	Chinese Ministry of Health
All New Zealand Acute Coronary Syndrome Quality Improvement (ANZACS-QI) CathPCI registry	Mandatory	All government-funded centres	Ministry of Health
Norwegian Registry for Invasive Cardiology (NORIC)	Mandatory	100%	Norwegian government
Swiss Working Group of Interventional Cardiology PCI survey	Voluntary	100%	Swiss Society of Cardiology
Korea PCI (K-PCI) registry	Voluntary	61%	Korean Society of Cardiology / Korean Society of Interventional Cardiology
British Columbia Cardiac Registry	Voluntary	100%	Cardiac Services BC / Provincial Health Services Authority

Alberta Provincial Project for Outcome Assessment in Coronary Heart Disease PCI registry	Voluntary	100%	Alberta Health Services
Cardiac Care Network Ontario	Mandatory	100%	Ontario Ministry of Health and Long-term Care
Victorian Cardiac Outcomes Registry (VCOR)	Voluntary	100%	Department of Health and Human Services, Victoria
Coronary Angiogram Database of South Australia (CADOSA)	Voluntary	65%	Department of Health, South Australia
Queensland Cardiac Outcomes Registry (QCOR)	Voluntary	All government funded centres only	Queensland Statewide Cardiac Clinical Network

***** = Information unavailable

Supplementary Table 2. Outcomes data collection in included registries.

PCI registry name	Method of ascertaining mortality data	Risk adjustment performed for mortality data?	Bleeding definition used	Provides public reporting of data?
Spanish Cardiac Catheterization and Coronary Intervention registry	Individual medical record review	No	Bleeding data not collected	Yes; deidentified data by hospital on case mix but not outcomes
Austrian National Cathlab Registry (ANCALAR)	Individual medical record review	No	Bleeding requiring transfusion	No
Arbeitsgemeinschaft Leitende Kardiologische Krankenhausärzte (ALKK) Registry	Individual medical record review	No	Bleeding data not collected	No
Quality Oriented Electronic Registration of Medical Implant Devices (QERMID) Belgian PCI Registry	Linkage with administrative database	No	TIMI major bleeding	No
Swedish Coronary Angiography and Angioplasty Registry (SCAAR)	Linkage with administrative database	No	TIMI major and minor bleeding	Yes; identified outcomes data by hospital
National Cardiovascular Data Registry (NCDR) CathPCI	Linkage with administrative database	Yes; for age, STEMI presentation, comorbidities like renal impairment and chronic liver disease, cardiogenic shock, cardiac arrest and presence of heart	Bleeding data not collected	Yes; identified data by hospital on guideline-recommended discharge medications. Mortality data by hospital/operator available in some states

		failure/left ventricular dysfunction		
Danish Heart Register	Linkage with administrative database	No	Bleeding data not collected	Yes; outcomes data at hospital level; unknown if hospital is identifiable
Singapore Cardiac Data Bank Cath/PCI module	Individual medical record review	No	Bleeding requiring transfusion only	Yes; identifiable outcomes data by hospital
British Cardiovascular Intervention Society (BCIS) Registry	Linkage with administrative database	Yes; for age, gender, PCI indication and urgency, cardiogenic shock, comorbidities like renal impairment, diabetes and previous MI or stroke	TIMI major bleeding	Yes; identified outcomes data by operator
Portuguese National Registry of Interventional Cardiology (RNCI)	Individual medical record review	No	Bleeding data not collected	No
Lebanese Interventional Coronary Registry (LICOR)	Individual medical record review	*	*	No
ORPKI registry	Individual medical record review	No	Bleeding requiring transfusion only	No
ONACI registry	Individual medical record review	No	Haematoma at puncture site	No
Italian National Registry of Interventional cardiology	Individual medical record review	No	Bleeding data not collected	*
Indian National Interventional Council Registry	Individual medical record review	No	TIMI major bleeding	No
Malaysian National Cardiovascular Disease Database-PCI registry	Individual medical record review	No	TIMI major and minor bleeding	No

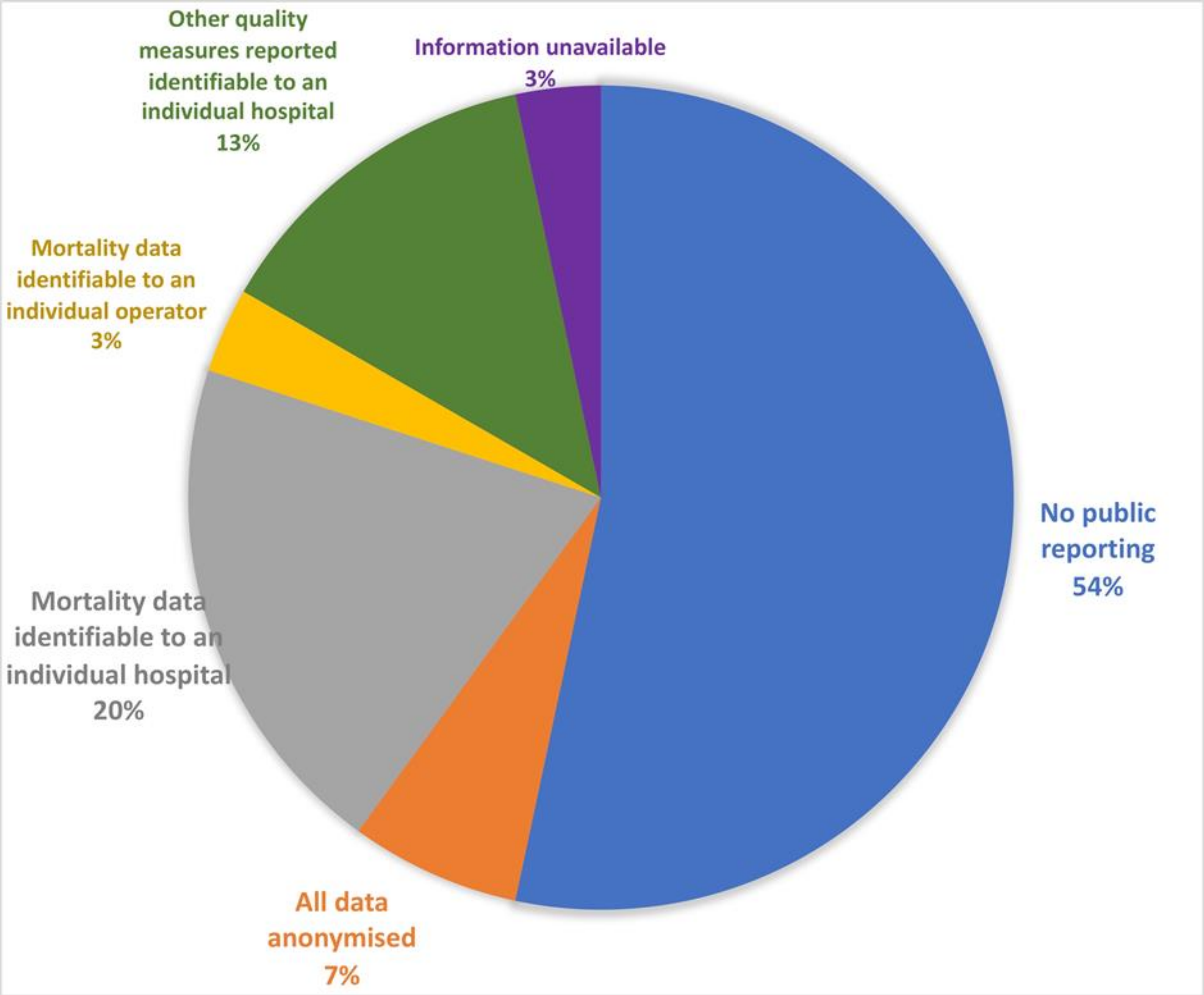
Japan-PCI (J-PCI) Registry	Individual medical record review	No	Bleeding requiring transfusion only	No
Netherlands Heart Registry	Individual medical record review	Yes; for age, comorbidities like renal impairment and diabetes, cardiogenic shock/cardiac arrest at presentation	Bleeding data not collected	Yes; identified data by hospital on patient characteristics and risk-adjusted outcomes (however public reporting is voluntary)
Integrated PCI Data System in Brazil (ICP-BR) Registry	Individual medical record review	No	Bleeding data not collected	No
Ministry of Health Cardiovascular Intervention Online Registry, China	Individual medical record review	*	*	No
All New Zealand Acute Coronary Syndrome Quality Improvement (ANZACS-QI) CathPCI registry	Linkage with administrative database	Yes; for age, gender, ethnicity, comorbidities like smoking, diabetes, prior CABG, creatinine>150 mmol/L and Killip class	BARC 1-5 bleeding	Yes; outcomes data by identified hospital
Norwegian Registry for Invasive Cardiology (NORIC)	Linkage with administrative database	No	*	Yes; identified data by hospital on 4 quality indicators: completeness of in-hospital complications reporting, proportion of NSTEMI patients undergoing angiography within 72 hours, antiplatelet therapy and statin prescription on discharge

Swiss Working Group of Interventional Cardiology PCI survey	Individual medical record review	No	Bleeding data not collected	Yes; identified data by hospital of PCI volumes and patient characteristics including indication for PCI
Korea PCI (K-PCI) registry	Individual medical record review	No	Bleeding data not collected	No
British Columbia Cardiac Registry	Linkage with administrative database	Yes; for age, cardiogenic shock, comorbidities like dialysis-dependent kidney disease and left ventricular systolic dysfunction	*	No
Alberta Provincial Project for Outcome Assessment in Coronary Heart Disease PCI registry	Linkage with administrative database	No	TIMI major bleeding	No
Cardiac Care Network Ontario	Linkage with administrative database	Yes; for age, cardiogenic shock, comorbidities like dialysis-dependent kidney disease, history of previous PCI/CABG	Bleeding requiring transfusion only	Yes; identified outcomes data by hospital
Victorian Cardiac Outcomes Registry (VCOR)	Individual medical record review	Yes; for age >80 years, PCI indication, renal function, left ventricular ejection fraction, cardiogenic shock, culprit artery	BARC 1-5 bleeding	Yes; deidentified outcomes data by hospital
Coronary Angiogram Database of South Australia (CADOSA)	Linkage with administrative database	Yes; for age, gender, GRACE risk score	Bleeding requiring transfusion only	No

Queensland Cardiac Outcomes Registry (QCOR)	Individual medical record review	Yes; for age >80 years, PCI indication, renal function, left ventricular ejection fraction, cardiogenic shock, culprit artery	Bleeding requiring transfusion and minor bleeds	Yes; identified data by hospital on outcomes and process measures such as door-to-balloon time

***** = Information unavailable.
BARC: Bleeding Academic Research Consortium; TIMI: Thrombolysis In Myocardial Infarction

Supplementary Figure 1. Approach to public reporting of outcomes by different registries.



Supplementary Figure 2. In-hospital mortality post PCI for STEMI across the registries.