Perioperative mortality in New Zealand related to hip and knee replacement surgery: comparing administrative and registry data

P Hider, C Frampton, J-C Theis, L Wilson, A Rothwell

ABSTRACT

INTRODUCTION: Perioperative mortality is of considerable importance, but few national assessments are available. New Zealand has a clinical registry and an administrative dataset that both capture national information about hip and knee arthroplasties. National perioperative mortality rates were compared between the two data sources.

METHOD: Data related to all patients undergoing an elective hip or knee replacement procedure (primary or revision) between 1 January 2007 and 31 December 2011 were separately extracted from the New Zealand Joint Registry and the National Minimum Dataset. The procedure date was used to define the occurrence of an event and dates were compared between datasets plus or minus 3 days. Date of death information was obtained from the National Mortality Collection and used to estimate 30 day mortality rates.

RESULTS: No statistically significant differences in perioperative mortality were evident between comparisons from the two data sources although more deaths were recorded among Registry-only procedures.

CONCLUSIONS: Estimates of 30 day perioperative mortality related to hip and knee arthroplasty procedures in New Zealand 2007–2011 are very similar regardless of data source. These data, coupled with perioperative mortality review using structured reports obtained from clinicians, could be used to develop a surveillance system to promote surgical safety.

Perioperative mortality is of pressing importance to consumers, practitioners and policy makers, and provides a focus for assessing the safety of new interventions, undertaking performance assessment and completing quality improvement initiatives.\(^1\) Websites, such as Dr Foster (http://www.drfosterhealth.co.uk/) in the UK, now publicly report perioperative mortality rates for specific hospitals, and international comparisons have been described.\(^2\) While practitioners and organisations can usefully assess their own perioperative mortality rates by auditing their clinical records, the completeness of these data are limited to information about deaths that have occurred within their institution.\(^3,4\) To obtain accurate information about mortality rates across all institutions that also include those deaths that occur after discharge, national assessments of perioperative mortality must be undertaken using specially designed clinical registries or harvested from existing databases. Each of these approaches has inherent strengths and weaknesses.\(^5\)

Clinical registries include customised clinical information focused on particular procedures or settings and are often well supported by professional organisations and clinicians.\(^6,7\) However, they are resource...
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intensive to develop and maintain, and can include information that is recorded in ways that make comparisons difficult.\textsuperscript{8,10} Existing large administrative databases have the advantages that the data are already collected and have been coded in a standardised manner according to an international system.\textsuperscript{1,8,11} Despite these advantages, some researchers and clinicians remain wary of administrative data.\textsuperscript{10,12}

Hip and knee arthroplasty are effective procedures that can reduce pain, improve morbidity and enhance quality of life related to arthritis.\textsuperscript{13} Utilisation numbers are forecast to rapidly increase with ageing populations in developed countries, including New Zealand.\textsuperscript{14,15} However, hip and knee arthroplasty procedures are significant surgical operations and perioperative mortality rates have been of international concern over many years.\textsuperscript{16} Increasing age and male gender are established risk factors for perioperative mortality following arthroplasty surgery.\textsuperscript{17,18} New interventions have been developed with a view to improving mortality and morbidity,\textsuperscript{19} and purpose-designed clinical registries have been established to help track improvements.\textsuperscript{20} Despite the development of these repositories, national estimates of perioperative mortality following hip or knee arthroplasty are rare.\textsuperscript{21}

New Zealand has the unique advantage of a clinical registry (New Zealand Joint Registry (NZJR)) and an administrative dataset (National Minimum Dataset (NMDS)) that both capture national information about hip and knee arthroplasty procedures. The main aim of this study was to compare estimates of perioperative mortality following hip or knee arthroplasty using both administrative data and clinical registry information at a national level to assess their suitability for surveillance of perioperative mortality.

Methods

The NZJR was established in 1998 by the New Zealand Orthopaedic Association initially to record technical information about total hip and knee surgery performed in New Zealand, although data collection has expanded to include shoulder, elbow, elbow and spinal disc replacements.\textsuperscript{22} Demographic and joint replacement information are obtained from clinical staff at the time of operation using a purpose-designed form.\textsuperscript{22} The NMDS is maintained by the Ministry of Health and began in 1998 with public hospital discharge data dating back to 1988.\textsuperscript{23} Data are obtained electronically from public hospitals within 21 days of discharge, and from some private institutions. Data collection includes demographic information and the occurrence of up to 100 diagnoses and procedures coded according to ICD-10-AM and Australian Classification of Health Interventions standards.\textsuperscript{23} Data from the NMDS were collated for the Perioperative Mortality Review Committee as part of their ongoing assessment of perioperative mortality in New Zealand.\textsuperscript{24}

Data from the NZJR were collated in relation to all patients undergoing either a hip or a knee full replacement procedure (primary or revision) between 1 January 2007 and 31 December 2011. Information was extracted from the NMDS for all people undergoing hip or knee arthroplasty procedures over the same period. The following ICD-10-AM ACHI Procedure Codes, Version 3, were used: hip arthroplasty, Blocks 1489 and 1492; and knee arthroplasty, Blocks 1518, 1519, 1523 and 1524. Mortality information was sourced from the NMC and as recorded in the NMDS. The following information was separately obtained from both sources: gender, age, admission date, procedure date, discharge date, type of procedure, hospital type (private or public). The NZJR excludes acute procedures so the data obtained from both sources were restricted to elective (waiting list) events. Ethnicity and domicile information were not included as they were not available from the NZJR. Comparisons were made between the data sets in relation to demographic characteristics and procedure data. The procedure date was used to define the occurrence of an event. When the procedure dates were consistent between the two data sets, the event was recorded as having occurred in the NMDS and the NZJR. An allowance of plus or minus 3 days was permitted for the comparison of procedure dates. Data about procedures included in one dataset that were not recorded in the other dataset were collated as NZJR-only or NMDS-only events. Available National Health Index and demographic data
Table 1: Comparison of 30-day mortality for NZJR and NMDS cases of hip and knee arthroplasty in New Zealand 2007–2011.

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
<th>30-day Mortality</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>n</td>
<td>%</td>
<td>95% CI</td>
</tr>
<tr>
<td>Primary knees</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Source</td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>NZJR</td>
<td>28,391</td>
<td>46</td>
<td>0.16%</td>
<td>0.12–0.21%</td>
</tr>
<tr>
<td>NMDS</td>
<td>25,337</td>
<td>44</td>
<td>0.18%</td>
<td>0.13–0.24%</td>
</tr>
<tr>
<td>After combining</td>
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<td></td>
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</tr>
<tr>
<td>NZJR alone</td>
<td>6,056</td>
<td>6</td>
<td>0.10%</td>
<td>0.00–0.18%</td>
</tr>
<tr>
<td>NMDS alone</td>
<td>1,235</td>
<td>3</td>
<td>0.24%</td>
<td>0.03–0.52%</td>
</tr>
<tr>
<td>Both +/-7 days</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NZJR</td>
<td>22,335</td>
<td>40</td>
<td>0.18%</td>
<td>0.12–0.24%</td>
</tr>
<tr>
<td>NMDS</td>
<td>22,335</td>
<td>40</td>
<td>0.18%</td>
<td>0.12–0.24%</td>
</tr>
<tr>
<td>Revision knees</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Source</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NZJR</td>
<td>2,095</td>
<td>10</td>
<td>0.48%</td>
<td>0.18–0.77%</td>
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<td>NMDS</td>
<td>1,430</td>
<td>4</td>
<td>0.28%</td>
<td>0.00–0.55%</td>
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<tr>
<td>After combining</td>
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</tr>
<tr>
<td>NZJR alone</td>
<td>836</td>
<td>6</td>
<td>0.72%</td>
<td>0.15–1.29%</td>
</tr>
<tr>
<td>NMDS alone</td>
<td>171</td>
<td>0</td>
<td>0.00%</td>
<td>0.00–0.00%</td>
</tr>
<tr>
<td>Both +/-7 days</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NZJR</td>
<td>1,259</td>
<td>4</td>
<td>0.32%</td>
<td>0.00–0.63%</td>
</tr>
<tr>
<td>NMDS</td>
<td>1,259</td>
<td>4</td>
<td>0.32%</td>
<td>0.00–0.63%</td>
</tr>
<tr>
<td>Primary hips</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Source</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NZJR</td>
<td>35,118</td>
<td>88</td>
<td>0.25%</td>
<td>0.20–0.30%</td>
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<tr>
<td>NMDS</td>
<td>28,209</td>
<td>49</td>
<td>0.17%</td>
<td>0.13–0.22%</td>
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<tr>
<td>After combining</td>
<td></td>
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</tr>
<tr>
<td>NZJR alone</td>
<td>8,079</td>
<td>42</td>
<td>0.52%</td>
<td>0.36–0.68%</td>
</tr>
<tr>
<td>NMDS alone</td>
<td>1,168</td>
<td>3</td>
<td>0.26%</td>
<td>0.00–0.55%</td>
</tr>
<tr>
<td>Both +/-7 days</td>
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<td></td>
</tr>
<tr>
<td>NZJR</td>
<td>27,039</td>
<td>46</td>
<td>0.17%</td>
<td>0.12–0.22%</td>
</tr>
<tr>
<td>NMDS</td>
<td>27,039</td>
<td>46</td>
<td>0.17%</td>
<td>0.12–0.22%</td>
</tr>
<tr>
<td>Revision hips</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Source</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NZJR</td>
<td>5,192</td>
<td>24</td>
<td>0.46%</td>
<td>0.28–0.65%</td>
</tr>
<tr>
<td>NMDS</td>
<td>3,071</td>
<td>15</td>
<td>0.49%</td>
<td>0.24–0.74%</td>
</tr>
<tr>
<td>After combining</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>NZJR alone</td>
<td>2,399</td>
<td>12</td>
<td>0.50%</td>
<td>0.22–0.78%</td>
</tr>
<tr>
<td>NMDS alone</td>
<td>278</td>
<td>3</td>
<td>1.08%</td>
<td>0.01–2.29%</td>
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<tr>
<td>Both +/-7 days</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NZJR</td>
<td>2,793</td>
<td>12</td>
<td>0.43%</td>
<td>0.18–0.67%</td>
</tr>
<tr>
<td>NMDS</td>
<td>2,793</td>
<td>12</td>
<td>0.43%</td>
<td>0.18–0.67%</td>
</tr>
</tbody>
</table>
were used to validate the comparisons. Date of death information was obtained from the National Mortality Collection (NMC) administered by the Ministry of Health. Using dates of procedure recorded in either data source and date of death information provided by the NMC mortality rates within 30 days of procedure, regardless of inpatient status, were calculated for both data sources.

Results

Across all four arthroplasty procedures the total number of operations recorded in the NZJR was consistently higher than the total number recorded by the NMDS (Table 1). The biggest difference in the total number of procedures recorded by the two datasets related to primary hip operations, where the NZJR listed 35,118 procedures compared with 28,209 in the NMDS. Related to these differences, some 6,056 primary knee replacements and 8,079 primary hip replacements were present in the NZJR data, but not in the NMDS, compared with 1,235 and 1,168 replacements solely recorded in the NMDS.

Most operations were recorded in both datasets for all four procedures. Between 88–96% of the four procedures recorded in the NMDS were identified in both datasets. Although a smaller proportion (54–79%) of NZJR procedures were captured by both datasets, the percentage of primary hip or knee operations that were described in both was relatively higher (77% and 79% respectively).

In relation to the four types of operations, the age and gender characteristics of the patients undergoing those procedures that were only included in one database remained very similar to those represented in both data repositories. A slightly higher proportion of patients undergoing primary hip or knee replacement surgery were female and slightly more males underwent revision procedures. For all procedures, most patients were aged between 65–79 years and revision procedures were more common among those aged over 79 years.

Across all four procedures most operations occurred in public hospitals. Relatively few hip revision procedures were undertaken in private hospitals. Primary hip or knee procedures that were only recorded by the NZJR were considerably more likely to be undertaken at a private hospital. More than 92% of the 6,056 primary knee replacement procedures only identified by the NZJR were carried out at private hospitals.

Thirty-day mortality rates were consistently low (<1.1%) and similar across all procedures, regardless of data source. No statistically significant differences were evident between results obtained from the two databases. With the exception of hip revision procedures, mortality rates associated with NMDS alone procedures were either the same or slightly lower than those obtained for patients included in only the NZJR. Using the data from both datasets, the mortality rate for primary knee procedure was 0.16% and primary hips was 0.25%. Although mortality rates were similar when compared between NZJR only (0.5%) and NMDS only procedures (0.3%), 42 additional deaths were recorded in relation to NZJR-only procedures compared with just three associated with NMDS only data. Similarly, NZJR-only data included an additional 12, and six deaths related to either hip or knee revision procedures respectively. Across all procedures, most deaths recorded in the NZJR-only data related to public hospital events.

Conclusions

NZJR data included more procedures than the NMDS in relation to hip and knee arthroplasty procedures in New Zealand between 2007 and 2011. A small number of procedures were solely identified by the NMDS. Most primary procedures were captured in both databases. The demographic characteristics of the patients who underwent the procedures were generally similar, regardless of whether they were included in just one database or both for each of the four types of arthroplasty procedures. Estimates of the 30-day perioperative mortality rate related to each of the arthroplasty procedures were very similar when based on either NMDS or NZJR data. Thirty-day perioperative mortality rates following hip or knee arthroplasty in New Zealand are generally low (<1%). Revision procedures have higher mortality than primary operations, and hip arthroplasty has a higher mortality
than knee procedures. More deaths occur at public facilities compared with private hospitals, but this is likely to be due to differences in volumes and casemix. Public facilities include about half the proportion of ASA 1 patients and almost double the percentage of ASA 3 patients compared with private hospitals. Increasing ASA scores are highly associated with greater perioperative mortality. Thirty-day perioperative mortality rates across New Zealand hospitals, whether calculated from registry or administrative data, are consistent with international estimates. A recent meta-analysis reported a 30-day perioperative mortality rate of 0.3% related to hip arthroplasty based on 15 studies, although only two involved national data. Results from this study, whether generated by NMDS or NZJR data, are also consistent with other reports that have suggested there may be a higher perioperative mortality rate following revision procedures compared with primary operations, and following hip rather than knee arthroplasty procedures.

The findings from this study are also consistent with those obtained by a previous comparison of data from the Swedish hip arthroplasty register and a national administrative database. Like our study, the Scandinavian report confirmed that most procedures were recorded in both databases and there were no significant discrepancies in the characteristics or mortality outcomes associated with those procedures that were recorded in either one database or both. Likely explanations proposed by the Swedish researchers for events not being recorded in both databases are relevant to this study. Some of the discrepancies were attributed to missing data or data input errors in either collection, while others related to differences in the definitions used by each database for the procedures.

This study restricted its analysis to elective procedures and total arthroplasty procedures (partial procedures were excluded) in an attempt to improve the reliability of the data comparison. The NZJR primarily includes elective procedures so it is more efficient to compare results between the NZJR and the NMDS, excluding acute events. It is unlikely that any discrepancies between the databases would be due to the misclassification of acute events as elective procedures. A possible source of error relates to the identification of revision procedures. NZJR data were captured using a purpose-designed form completed by clinicians at the time of operation. This information is likely to be more accurate than that obtained retrospectively by coders from the clinical record. In this study considerably more revision procedures were identified for both hip and knee arthroplasties (for example, 278 revision hip procedures were solely present in the NMDS compared with 2,399 in the NZJR). While patients may be included in the dataset related to undergoing left- or right-sided procedures, it is unlikely that more than one elective procedure would have been undertaken during the same inpatient stay or within a short period of time after an admission.

Administrative data in New Zealand includes all episodes of care at publicly funded providers in a repository that has already been collected and can be readily analysed. However, clinical registries offer key advantages too, especially when their coverage extends to including private providers whose data are not captured by the administrative resource. While clinical registries remain focused on a particular specialty and narrow collection of procedures administrative data includes the full range of procedures. Extending coverage of administrative data to all providers would enhance the dataset. The more detailed procedure and device information available only in clinical registries further enhances their advantage. In future, it may be useful to explore the possibility of establishing some ongoing linkage between the datasets if the protected quality assurance activity status related to the Registry data could be extended.

NMDS data appears adequate for the purposes of surveillance to monitor trends in mortality risk associated with procedures identified by the NMDS. Either dataset could be used to generate risk-adjusted performance data to enable hospitals to compare their perioperative mortality risk. However, the information currently included in either of the datasets are not sufficient for quality improvement activities. To be suited for this purpose these
Data need to be supplemented by more clinical information related to processes of care that are directly obtained from the practitioners involved with the care of the patient. The National Surgical Quality Improvement Programme (NSQIP) in the US provides the current surgical benchmark related to data collection to foster quality improvement and performance monitoring. Data is collected by nurse researchers from clinicians and detailed information related to patient characteristics, procedures, and complications are collated. Such a system has been associated with major benefits related to reduced complication rates and overall cost savings for participating hospitals in the US. However, significant resources are required to establish and maintain the programme. Importantly, NSQIP’s impact on mortality has been modest. With relatively low rates of death for many operations significant gains have been hard to accrue. An alternative option would be to foster the development of perioperative mortality review along the lines of initiatives in Australia and the UK. Information is collected from clinicians about perioperative deaths using structured reports. Participation is supported by professional colleges and recertification requirements. Data collection would need to be extended to non-fatal cases to focus on key areas for improvements. Coupled with a surveillance system that examines trends in risk-adjusted mortality, perioperative mortality review could promote New Zealand as a world leader in surgical safety.

Competing interests:
Nil

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URL:

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mortality after modern
total hip arthroplasty.
Clinical Orthopaedics
and Related Research.


