Implementation and effects of Enhanced Recovery After Surgery for hip and knee replacements and fractured neck of femur in New Zealand orthopaedic services

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ABSTRACT

AIM: The National Orthopaedic Enhanced Recovery After Surgery (ERAS) Collaborative was launched in November 2013 to implement ERAS protocols for hip and knee total joint arthroplasty (TJA) and fractured neck of femur (NOF) in participating district health boards (DHBs) by December 2014. This paper reports on the results.

METHOD: ERAS protocols were developed for hip and knee TJA and fractured NOF. Breakthrough Series collaborative methodology was used to implement the ERAS protocols in 18 DHBs. We collected monthly data on compliance with protocols and average length of stay (ALOS). Data were analysed using run charts and Shewhart control charts.

RESULTS: The national percentage of ERAS components achieved across all DHBs rose from 33% to 75% on the elective knee TJA pathway, from 31% to 78% on the elective hip TJA pathway and from 29% to 51% on the acute fractured NOF pathway. The ALOS for knee TJA reduced from 5.4 days to 4.5 days. The ALOS for hip TJA reduced from 5.1 days to 4.3 days. There was no change in the ALOS for fractured NOF.

CONCLUSION: The National Orthopaedic ERAS Collaborative increased uptake of ERAS protocols across all three pathways and decreased ALOS for the elective pathways among participating DHBs. There was no decrease in ALOS for the fractured NOF pathway. Collaborative improvement methodology can be used successfully to implement orthopaedic ERAS across New Zealand DHBs.

Orthopaedic services in New Zealand traditionally struggle to achieve waiting time requirements set by the Ministry of Health.1 Furthermore, there is considerable variation among district health boards (DHBs) in intervention rates, length of stay and 28-day acute readmission rates associated with orthopaedic surgical procedures.2 Demand for orthopaedic services is expected to rise as the population ages.

In 2012, an orthopaedic expert advisory group convened by the Ministry of Health recommended developing a national programme to promote the adoption of Enhanced Recovery After Surgery (ERAS) for hip or knee total joint arthroplasty (TJA) and internal fixation of fractured neck of femur (NOF) in New Zealand DHBs. The members of this group included orthopaedic surgeons, anaesthetists, clinical nurse leaders, orthopaedic nurse specialists and gerontologists.

ERAS comprises an evidence-based, multimodal, patient-centred rehabilitation programme that has been shown to reduce mortality and length of stay in patients having total hip or knee arthroplasty, as well as improving functional outcomes and cost-effectiveness.2-10
ERAS can be difficult to implement because it requires all members of a multidisciplinary peri-operative team to adopt a high number of interventions. To our knowledge, there are few studies that describe a methodology for implementing ERAS protocols, and none that use collaborative improvement methodology.

We report on the results of using collaborative improvement methodology to implement ERAS for hip or knee replacement and fractured neck of femur across New Zealand orthopaedic services in the National Orthopaedic Enhanced Recovery After Surgery Collaborative.

Challenges

The New Zealand health system is configured into 20 DHBs. All DHBs deliver orthopaedic services.

New Zealand DHBs had experience of cross-organisational collaborative learning through Target CLAB Zero, a national improvement collaborative to reduce the incidence of central line-associated bacteraemia in intensive care units. However, this experience did not extend to orthopaedic services. Orthopaedic services at each DHB functioned autonomously, and apart from professional development groups only a limited amount of knowledge sharing and process improvement occurred.

In addition, there was no shared database suitable for capturing data on quality improvement measures.

Methods

The aim of the National Orthopaedic Enhanced Recovery After Surgery Collaborative was for all patients needing hip and knee replacement, and all patients with acute neck of femur fracture, to be managed according to ERAS principles by December 2014 in participating DHBs.

The Ministry of Health established a project team and sought improvement advisor expertise from Ko Awatea, a health system improvement and innovation centre with experience in leading national improvement campaigns.

The national project team included a project manager, information management expert, consumer advisor, communications advisor, improvement advisors and a clinical lead. This team managed and advised on the day-to-day operation of the National Orthopaedic ERAS Collaborative by conducting site visits, on-site meetings and teleconferences with local teams from participating DHBs. The national project team used these mechanisms to ensure local teams had adequate support, to mitigate challenges, to provide information and data, and to connect local teams with each other for sharing experiences and approaches to overcoming barriers. In addition, the team developed standardised information booklets and a video for local teams to provide to patients.

Expert clinical faculty led the development and delivery of improvement content, measurement strategies and resources that supported the transformational effort. Expert faculty comprised specialists in orthopaedic ERAS and experts in improvement methodology.

Eighteen DHBs participated in the collaborative and two opted out. Each participating DHB nominated an improvement team comprising a project manager, a clinical lead and frontline staff from disciplines involved in the ERAS care pathway (nurses, anaesthetists and physiotherapists). The two DHBs that opted out did so because they had received funding to adopt ERAS pathways from the Elective Services Productivity Programme prior to the collaborative being established, and were already implementing ERAS using internal quality improvement methods.

The Ministry of Health recruited DHBs to participate through teleconferences and site visits with clinicians and service managers in orthopaedic services. The Ministry also provided partial funding for ERAS to participating DHBs as an incentive.

The intervention

The orthopaedic expert advisory group developed protocols for elective total joint arthroplasty and acute fractured neck of femur. Primary sources of evidence for protocol development were advice from the expert faculty, the Australian and New Zealand Guideline for Hip Fracture Care and a how-to guide developed by the Welsh 1,000 Lives Plus campaign. Additional secondary sources were also used.

For the elective total joint arthroplasty change package, drivers and interventions were grouped into protocols for: primary care; pre-admission; pre-operative; peri-operative; post-operative; discharge and follow-up (Figure 1).
Figure 1: Driver diagram: elective primary total hip and knee joint arthroplasty.

**Content area**

- **Patients undergoing knee/hip replacement surgery will be managed according to ERAS principles**

**Drivers**

- **Primary care**
  Maximising physical and functional status

- **Pre-operative assessment**
  Maximising physical and functional status while preparing patients for surgery

- **Peri-operative care**
  Includes one week prior to admission and including time in theatre
  Reducing the stress response to surgery and promoting homeostasis

- **Post-operative care**
  Patient-centred and goal-orientated specialist care following surgery

- **Discharge and follow-up care**
  Timely discharge planning that supports the patient in a safe discharge and monitors care post-operatively to detect potential complications

**Interventions**

- **Optimisation of fitness**
  - ‘Fit for List’ health screen
  - Smoking cessation
  - Nutritional assessment
  - Healthy living advice as required
  - Management of comorbidities
  - Education and decision support

- **Anaesthetic fitness for surgery assessment**
- **Compliance with protocols for management of anticoagulation and platelets**
- **Discuss discharge plans/needs including predicated date of discharge**
- **Multidisciplinary team (MDT) assessments and referrals completed as required**
- **Multidisciplinary patient educational sessions (four to six weeks before surgery)**

- **Day of surgery admission**
  - Confirm all discharge arrangements with patient including transport home
  - Establish and ensure compliance with standardised protocols for:
    - Analgesia, anaesthesia, nausea and vomiting
    - Anti-deep vein thrombosis protocol
    - Adequate hydration
    - Limited use of drains and catheters
    - Maintenance of normothermia

- **Early planned mobilisation within 24 hours**
- **Cohorting of patients where possible**
- **Discharge needs confirmed with family/social services within 24 hours following surgical intervention**
- **Oral nutrition as soon as patient able to tolerate, or within 12 hours of surgery**
- **Establish and ensure compliance with protocols for assessment and management of pain and post-operative nausea and vomiting (PONV)**
  - 7 day per week health cover for physiotherapy

- **Criteria-based discharge**
  - Agreed communication processes for:
    - Follow-up contact by nominated health professional within 48 hours post-discharge
    - Patient initiated follow-up post discharge
    - Appropriate MDT follow-up post discharge
Figure 2: Driver diagram for acute fractured neck of femur.

**Content area**

**Drivers**

- **Pre-hospital – ambulance**
  Managing physical and functional status

- **Pre-operative assessment**
  Managing physical and functional status while preparing patients for surgery

- **Peri-operative care**
  Reducing the stress response to surgery and promoting homeostasis

- **Post-operative care**
  Patient-centred and goal-orientated specialist care following surgery

- **Discharge and follow-up care**
  Timely discharge planning that supports the patient in a safe discharge and monitors care post-operatively to detect potential complications

**Interventions**

- **Plan to provide surgery as soon as possible (ASAP), within 24–48 hours**
- **Establish rapid assessment process by Emergency, Orthopaedics, Specialist Medical/Geriatrics and Anaesthesia**
- **Multidisciplinary team assessment, management and optimisation of pre-existing co-morbidities, including anti-coagulation detection and risk management**
  - Mental health/dementia /delirium screening
  - Falls risk assessment
  - Medication reconciliation
  - Nutritional screening
  - Pressure area assessment
  - Discuss discharge plans /needs with the patient and their family

- **Surgery ASAP (within 24–48 hours) (aim where possible to achieve full weight bearing ASAP)**
- **Ensure senior anaesthetists and surgeons provide care for the patient**
- **Agree and implement standardised protocols for peri-operative management of:**
  - anaesthesia, analgesia, nausea and vomiting
  - anti-deep vein thrombosis protocol
  - adequate hydration
  - limited use of drains and catheters
  - maintenance of normothermia

- **Early planned mobilisation within 24 hours**
- **Oral nutrition as soon as patient is able to tolerate or within 12 hours of surgery**
- **Effective opioid-sparing analgesia to facilitate early mobilisation as per agreed protocol**
- **Regular assessments of pain control and post-operative nausea and vomiting (PONV)**
- **Ensure collaboration with orthopaedic as early as possible**
- **Confirm all discharge arrangements with patient/family/social services including transport home**

- **Criteria-based discharge**
- **Agreed communication processes for:**
  - follow-up contact by nominated health professional within 48 hours post-discharge
  - patient initiated follow-up post discharge
  - Appropriate MDT follow-up post discharge
For the acute fractured neck of femur change package, they were grouped into: pre-hospital and emergency department; pre-operative; peri-operative; post-operative; discharge and follow-up (Figure 2).

We adopted Breakthrough Series Collaborative Model (BTS) methodology as an approach to implementing the change packages. The BTS was structured as learning sessions interspersed with action periods. Improvement teams attended learning sessions every four to six months.

Teams learned how to use driver diagrams and the Model for Improvement at the learning sessions. Driver diagrams provide a visual representation of the factors needed for a system to achieve its aim. Teams used the diagrams as a framework to learn what did and did not improve care. Under the Model for Improvement, teams set specific aims and measures, then develop and test change ideas using plan, do, study, act (PDSA) cycles. Teams applied this model during action periods to adapt change ideas to their local setting.

Learning sessions enabled teams to share experiences and learn from each other, to receive individual and team coaching, and to solve problems.

In between learning sessions, the national project team made site visits and held teleconference calls with teams to monitor progress and provide clinical coaching and feedback.

**Measures**

We measured practice change by compliance with seven identified ERAS components on the elective hip and knee TJA pathway and five identified ERAS components on the acute fractured NOF pathway (Table 1). We collected and analysed data on compliance with each component. Overall compliance with all components was measured by percentage. Patients who had all components correctly completed were counted as managed according to the ERAS protocol.

Average length of stay was measured for patients undergoing all three types of procedure (Table 1).

**Data collection and analysis**

Teams collected weekly data on the number of patients managed according to the ERAS protocols. Procedure type, total number of discharges, total length of stay and correct completion of criteria for compliance with the ERAS protocols were collected.

The Ministry of Health commissioned a centralised database to collect and compile data. DHBs submitted data to the database monthly. DHBs were provided with data collection guidelines and were expected to submit their data 10–14 days after the end of each month.

Data were analysed using run charts to detect forms of non-random variation that might indicate a change in performance. Ultimately, data for each individual DHB and all DHBs in aggregate were analysed using Shewhart control charts to further assess whether any improvements in compliance to the ERAS bundle components had been achieved, and the impact on ALOS.

**Results**

All 18 DHBs reported data on all pathways from November 2013. The majority of DHBs worked on the elective TJA pathway first. All 18 DHBs implemented protocols on the elective TJA pathways in November 2013. DHBs started work on the acute fractured NOF pathway at different times. Most DHBs started work on the NOF pathway after April 2014, some as late as October 2014.

Baseline data on compliance was measured at the start of the collaborative. However, we are able to present earlier data for ALOS because the Ministry of Health collects this data as a performance indicator.

**Elective hip and knee total joint arthroplasty**

Overall DHB compliance to ERAS components on the elective hip and knee TJA pathway increased for six components (Table 2). The seventh component, Day of Surgery Admission, was already well-established before the collaborative and compliance remained between 90% and 100% throughout the collaborative.
Table 1: Measures, measure definitions and data collection methods for ERAS protocols.

<table>
<thead>
<tr>
<th>Measure</th>
<th>Collection method</th>
<th>Measure definition</th>
</tr>
</thead>
</table>
| Percentage of patients managed according to the ERAS protocol          | Manual            | **Elective primary total hip and knee arthroplasty**  
1. Pre-op education – The patient received oral and written education regarding the enhanced recovery protocol prior to admission.  
2. Pre-op discharge planning – Prior to admission, a predicted date of discharge was given to the patient and discharge needs (such as support, equipment or home adaptations) were explicitly assessed and documented in the patient record.  
3. Day of surgery admission – The elective patient was admitted on the day of surgery (i.e., the procedure date is equal to the day of admission).  
4. Standard anaesthetic and analgesic regimen – A locally agreed standardised anaesthetic and analgesic protocol has been agreed for the procedure that the patient has undergone and the protocol was followed and charted for this patient.  
5. Nausea and vomiting protocol – A locally agreed standardised protocol has been agreed for the procedure that the patient has undergone and the protocol was followed and charted for this patient.  
6. Mobilisation within 24 hours of surgery – Patient was active weight bearing (with appropriate walking aid) within 24 hours from the end of the operation.  
7. Criteria-based discharge – Standardised discharge criteria have been agreed for the procedure and the protocol was followed and charted for this patient.  

**Acute fractured neck of femur**  
1. Standard anaesthetic regimen – A standardised anaesthetic protocol has been agreed for the procedure that the patient has undergone and the protocol was followed and charted for this patient.  
2. Nausea and vomiting protocol – A standardised protocol has been agreed for the procedure that the patient has undergone and the protocol was followed (and charted) for this patient.  
3. Mobilisation within 24 hours of surgery – Patient was active weight bearing (with appropriate walking aid) within 24 hours from the end of the operation.  
4. Criteria-based discharge – Standardised discharge criteria have been agreed for the procedure and the protocol was followed (and charted) for this patient.  
5. Patient was operated on within 48 hours of presentation to hospital.  
   Operation start time is within 48 hours of presentation to hospital. |
| Average length of stay in hospital system                                | DHB information system extract | Numerator – the total bed days from hospital admission to discharge from DHB-funded care in the reporting week. DHB funded care includes not just the hospital stay but also any DHB-funded rehabilitation facility or extended step-down or residential care facility.  
   Denominator – the total number of discharges in the reporting week. |
Table 2: Summary of compliance to ERAS components on the knee TJA pathway.

<table>
<thead>
<tr>
<th>Component</th>
<th>Mean percent compliance November 2013 to June 2014</th>
<th>Mean percent compliance July 2014 to November 2014</th>
<th>Percent increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard anaesthetic regime</td>
<td>23%</td>
<td>42%</td>
<td>19%</td>
</tr>
<tr>
<td>Standard nausea protocol</td>
<td>0</td>
<td>63%</td>
<td>63%</td>
</tr>
<tr>
<td>Mobilisation within 24 hours</td>
<td>20%</td>
<td>70%</td>
<td>50%</td>
</tr>
<tr>
<td>Criteria-based discharge</td>
<td>20%</td>
<td>56%</td>
<td>36%</td>
</tr>
<tr>
<td>Pre-operative education</td>
<td>51%</td>
<td>65%</td>
<td>14%</td>
</tr>
<tr>
<td>Pre-operative discharge planning</td>
<td>40%</td>
<td>80%</td>
<td>40%</td>
</tr>
</tbody>
</table>

Table 3: Summary of compliance to ERAS components on the hip TJA pathway.

<table>
<thead>
<tr>
<th>Component</th>
<th>Mean percent compliance November 2013 to June 2014</th>
<th>Mean percent compliance July 2014 to November 2014</th>
<th>Percent increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard anaesthetic regime</td>
<td>25%</td>
<td>45%</td>
<td>19%</td>
</tr>
<tr>
<td>Standard nausea protocol</td>
<td>5%</td>
<td>62%</td>
<td>57%</td>
</tr>
<tr>
<td>Mobilisation within 24 hours</td>
<td>25%</td>
<td>72%</td>
<td>47%</td>
</tr>
<tr>
<td>Criteria-based discharge</td>
<td>29%</td>
<td>59%</td>
<td>30%</td>
</tr>
<tr>
<td>Pre-operative education</td>
<td>20%</td>
<td>63%</td>
<td>43%</td>
</tr>
<tr>
<td>Pre-operative discharge planning</td>
<td>40%</td>
<td>77%</td>
<td>37%</td>
</tr>
</tbody>
</table>

Figure 3: National percentage of ERAS components achieved for elective knee TJA: compliance by week.
The overall percentage of ERAS components that patients received gradually rose to 80% for elective knee TJA (Figure 3).

For hip TJA, the overall percentage of ERAS components that patients received increased to 75% (Figure 4). This is an increase of 44% over a 12-month period.

At baseline, the mean ALOS for knee TJA was 5.4 days. There was a special cause decrease in ALOS before the collaborative started. This can be attributed to burgeoning evidence in support of ERAS and efforts made during 2012 and 2013 to promote the ERAS model of care. This resulted in early adoption of some of the ERAS components by some DHBs. A second special cause decrease was noted for the period of the collaborative, November 2013 to December 2014, indicating a special cause reduction of 0.9 days, from a baseline mean of 5.4 days to 4.5 days (Figure 5). The ALOS at September 2015 was 4.2 days.
The number of patients who received knee TJA rose from 2,917 for the period January to September 2013, before the collaborative began, to 3,420 for January to September 2014, an increase of 503 cases. From January to September 2015, 3,244 patients received knee TJA. This is less than the 2014 increase but still 327 more cases than in 2013.

For hip TJA, the mean ALOS was 5.1 days at baseline. This reduced to a mean of 4.3 days for the period November 2013 to December 2014, indicating a special cause reduction of 0.8 days. As with knee TJA, there was a special cause decrease in ALOS between April 2012 and September 2013, before the start of the collaborative. The collaborative enhanced the decrease. The downward trend continued after the collaborative ended to a mean of 4.1 days for September 2015 (Figure 6).

The number of patients who received hip TJA rose from 3,138 for the period January to September 2013 to 3,387 for January to September 2014, an increase of 277. There were 3,310 hip TJA patients for the same period in 2015—although less than in 2014, this remains an increase of 172 cases compared with 2013.

**Acute fractured NOF**

Overall DHB compliance to ERAS components on the acute fractured NOF pathway increased for all five components (Table 4).

**Table 4: Summary of compliance to ERAS components on the acute fractured NOF pathway.**

<table>
<thead>
<tr>
<th>Component</th>
<th>Mean percent compliance June 2014</th>
<th>Mean percent compliance July to December 2014</th>
<th>Mean percent increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard anaesthetic regime</td>
<td>15%</td>
<td>30%</td>
<td>15%</td>
</tr>
<tr>
<td>Standard nausea protocol</td>
<td>19%</td>
<td>36%</td>
<td>17%</td>
</tr>
<tr>
<td>Mobilisation within 24 hours</td>
<td>23%</td>
<td>33%</td>
<td>11%</td>
</tr>
<tr>
<td>Criteria-based discharge</td>
<td>23%</td>
<td>37%</td>
<td>14%</td>
</tr>
<tr>
<td>Surgery within 48 hours of admission</td>
<td>72%</td>
<td>80%</td>
<td>8%</td>
</tr>
</tbody>
</table>

![Figure 6: Aggregated national ALOS for hip TJA.](image)
The overall percentage of ERAS components that patients received increased to about 50% (Figure 7). The lower overall percentage increase compared with the elective hip and knee TJA pathways is explained by most DHBs starting work on the NOF pathway after April 2014.

There were no special cause changes detected in the mean ALOS for fractured neck of femur for the period that most participants focused on this acute pathway (April to December 2014). For the period of May to September 2015, the ALOS is below the mean but still does not show any special cause (Figure 8). The decrease in ALOS every January is probably related to reduction in the volume of cases during the holiday period.

Figure 7: National percentage of ERAS components achieved for fractured neck of femur: compliance by week.

Figure 8: Aggregated national ALOS for acute fractured neck of femur.
Discussion

The National Orthopaedic ERAS Collaborative shows that collaborative improvement methodology can be used to implement orthopaedic ERAS across New Zealand DHBs.

The collaborative increased uptake of ERAS protocols among all participating DHBs. Overall, compliance increased to 80% for knee TJA, 75% for hip TJA and 50% for fractured neck of femur. Putting these protocols in place increased standardisation across the country. Care became more consistent across DHBs, with less variation in the quality of care and education patients received. Consistent care underlies the improvement in patient outcomes described in the ERAS literature. Studies show that ERAS is associated with important benefits to patients, including better functional outcomes, reduced short-term complication and mortality rates, and reduced length of stay in hospital.6–8

The greatest reductions in ALOS were in the elective knee and hip TJA pathways. This compares with results of a study by Christelis et al of patients undergoing elective hip or knee arthroplasty, which showed a reduction in mean length of stay from 5.3 days to 4.9 days for patients in the ERAS phase.9 Data from the Musculoskeletal Audit in Scotland also shows shorter post-operative length of stay with ERAS protocols.3 The reduced ALOS increased system capacity, enabling a greater volume of patients to be treated. Although this ALOS reduction of 0.9 days does result in a direct reduction in the number of bed days used for this group of patients, it would be difficult to claim a reduction in bed days used overall for this time period. Bed days saved by this group of patients do not equate to actual bed days saved because the beds are used for patients on the waiting lists for these elective procedures. As noted, there was a volume increase of 780 cases for patients who underwent TJA for hips and knees.

The reduction in ALOS on the elective pathways was sustained after the collaborative ended. However, our findings for the fractured NOF pathway concur with those of Macfie et al, who found no significant difference in length of hospital stay between patients undergoing conventional care and those undergoing care optimised by ERAS protocols.23 We saw no change in the ALOS for fractured NOF during the period that most DHBs focused on this pathway.

The National Orthopaedic ERAS Collaborative reinforces existing evidence that BTS methodology can be used to implement quality improvement initiatives across multiple DHBs.12 In the National Orthopaedic ERAS Collaborative, BTS methodology provided a vehicle for change across 18 DHBs regardless of size, demographics of the population, socio-economic climate, organisational culture and previous experience in the implementation of ERAS protocols. DHB teams were able to learn from one another about the application of improvement science, and to share change ideas, clinical expertise and experience. Informal leaders emerged who were able to influence and support those who experienced challenges implementing the protocol related to DHB size, demography, organisational culture or geographical location. For example, the larger DHBs faced the challenge of spreading the protocol across all the required health professionals. In the case of one large DHB, 90 anaesthetists were involved in the agreement and implementation of their protocol. In contrast, the small DHBs were constrained by the number of people available to work on the project, as their absence from day-to-day work could not be covered by other personnel. The ability to share skills, knowledge and resources, and to access support and advice to solve problems, resulted in accelerated adoption, use and proficiency in the protocol.

The National Orthopaedic ERAS Collaborative developed national measurement capability from a quality improvement perspective. Although volume-based data was already being collected by the Ministry of Health, the national database used in the National Orthopaedic ERAS Collaborative was a new database created for quality improvement measures. The database helped teams to stay on target, review their data and identify areas that needed more work.

Another implication of the collaborative is building capability within New Zealand DHBs to apply improvement methodology to address deficiencies in healthcare. It
developed skills in improvement methodology among diverse stakeholders: the improvement team at each DHB included a representative from each discipline involved in the ERAS care pathway, as well as a clinical lead and a project manager.

The successful use of improvement collaboratives across multiple DHBs in differing clinical contexts suggests that the approach could generalise to address other deficiencies in the quality of healthcare. In our experience, multi-DHB improvement collaboratives are feasible where there is an existing body of international evidence for best practice that has already been proven applicable to the New Zealand context through a local pilot at one or more DHBs.

**Limitations**

In our results, we present ALOS data from before, during and after the collaborative period. ALOS data from the collaborative period was collected weekly. However, data from before and after the collaborative period was collected monthly. For this reason, our results represent all ALOS data monthly. This does not affect the validity of the data, as the monthly data reflects cumulative weekly data.

This collaborative did not include any data collection or analysis on the impact of the day of the week that the surgery occurred.

**Conclusion**

The National Orthopaedic ERAS Collaborative increased uptake of ERAS protocols among participating DHBs and decreased ALOS on the elective hip and knee TJA pathways. There was no decrease in ALOS for the fractured NOF pathway. Collaborative improvement methodology can be used successfully to implement orthopaedic ERAS across New Zealand DHBs.

**Competing interests:**

We declare that Ko Awatea was funded by the Ministry of Health to provide improvement advisor expertise for the National Orthopaedic ERAS Collaborative.

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