**Report prepared for the Health Quality & Safety Commission**

# Evaluation of the surgical site infection improvement programme
# Final (summative) report

*Julie Artus, Gary Blick and Michael Ryan*

28th August 2018

sapere research group

# About Sapere Research Group Limited

Sapere Research Group is one of the largest expert consulting firms in Australasia and a leader in provision of independent economic, forensic accounting and public policy services. Sapere provides independent expert testimony, strategic advisory services, data analytics and other advice to Australasia's private sector corporate clients, major law firms, government agencies, and regulatory bodies.


| | | |
|---|---|---|
| **Wellington**<br>Level 9, 1 Willeston St<br>PO Box 587<br>Wellington 6140<br>Ph: +64 4 915 7590<br>Fax: +64 4 915 7596 | **Auckland**<br>Level 8, 203 Queen St<br>PO Box 2475<br>Auckland 1140<br>Ph: +64 9 909 5810<br>Fax: +64 9 909 5828 | |
| **Sydney**<br>Level 14, 68 Pitt St<br>Sydney NSW 2000<br>GPO Box 220<br>Sydney NSW 2001<br>Ph: +61 2 9234 0200<br>Fax: +61 2 9234 0201 | **Canberra**<br>GPO Box 252<br>Canberra City ACT 2601<br>Ph: +61 2 6267 2700<br>Fax: +61 2 6267 2710 | **Melbourne**<br>Level 8, 90 Collins Street<br>Melbourne VIC 3000<br>GPO Box 3179<br>Melbourne VIC 3001<br>Ph: +61 3 9005 1454<br>Fax: +61 2 9234 0201 |

For information on this report, please contact:

| | |
|---|---|
| Name: | Julie Artus |
| Telephone: | +64 4 915 7590 |
| Mobile: | +64 21 206 6667 |
| Email: | jartus@srgexpert.com |

# Contents

## Appendices



## Tables

## Figures

# Glossary

| | |
|---|---|
| ACC | Accident Compensation Corporation |
| DHB | District health board |
| HAI | Healthcare associated infection |
| HQSC | Health Quality & Safety Commission (the Commission) |
| IPC | Infection prevention and control |
| MoH | Ministry of Health |
| NMDS | National Minimum Data Set |
| QI | Quality improvement |
| QIC | Quality Improvement Committee |
| QSM | Quality and safety marker |
| SIPCAG | Strategic Infection Prevention and Control Advisory Group |
| SSI | Surgical site infection |
| SSII programme | Surgical site infection improvement programme |

# Executive Summary

## Purpose

The Commission engaged Sapere Research Group ('Sapere') to undertake an evaluation of the Surgical Site Infection Improvement Programme (SSII programme or 'the programme'). The overall aim of the evaluation is to assess the effectiveness of the programme against the purpose and objectives articulated over time since the SSII programme was established formally in 2012.

In December 2017, we completed an interim (formative) evaluation report in which we identified key insights and learnings to help shape the design and planning of the next phase of programme activity.

In this final evaluation report, we present our summative findings. We have focussed our assessment on performance against the primary aim of the programme, whether there has been a reduction in SSI rates as a result of the programme interventions on the basis of orthopaedic and cardiac programme data. We present also results of a Cost Benefit Analysis (CBA) completed to assess the value-for-money of investment in the SSII programme and a brief update on findings reported in the interim evaluation against other programme objectives and evaluation areas.

## Does the programme achieve its goal of reducing SSI rates?

### Key findings from analysis of orthopaedic SSI data

#### Uptake of programme interventions

- Uptake of interventions has steadily increased over time, on rolling four-quarter average basis, from 66 per cent at 2014q2 to 96 per cent at 2017q3.

#### Outcome analysis

We completed a series of analytical tests to build our understanding of the data and to establish the following key findings:

- Using the run chart 'shift' rule, the Commission has reported a shift (decrease) in the median SSI rate per 100 procedures from a rate of 1.18 per 100 procedures up to August 2015 to a rate of 0.93 for August 2015 to September 2017. The difference in the proportion of procedures with an infection before and after the shift point is statistically significant (p-value < 0.01). Our analysis validated this result.
- There has been a decrease of 18 per cent in the orthopaedic SSI rate between financial years 2013/14 and 2016/17. However, this decrease is not statistically significant at the 90 and 95 per cent confidence level (z=1.457, p-value=0.144), most likely due to the increased rate in 2016/17. However, including the most recent quarter of data, the decrease in rate for the four quarters of data from 2016q4–2017q3 compared with the

equivalent baseline from 2013q4–2014q3 is a statistically significant at the 95 per cent confidence level (z=3.001, p-value=0.003).

Our findings point to the increasing uptake of the bundle of interventions as being a probable driver of the decreasing rate. We found that the decrease in the SSI rate is not caused by a decrease in the overall risk profile of patients, as the average risk per procedure remains reasonably stable over time. However, the odds of an SSI occurring in a procedure that received all three programme interventions were 43 per cent lower than one that has not (statistically significant at the 95 per cent confidence interval (OR 0.57, [0.39–0.85])).

## Key findings from analysis of cardiac SSI data

Data on compliance has been collected from the five participating DHBs and reported by the Commission on a quarterly basis from 2016q3. Further time series data are required to assess the significance of any emergent trends.

### Uptake of programme interventions

- The proportion of cardiac procedures receiving all three programme interventions averaged 94.1 per cent in 2016/17, slightly below the level of compliance for orthopaedic procedures over the same period (95.3 per cent).
- The proportion of cardiac procedures receiving all three programme interventions has shown some variation across quarters, ranging from 93.3–95.5 per cent.
- System-level compliance with programme interventions has been relatively high for cardiac procedures from the outset; however, there is scope for further improvement towards 100 per cent.

### Outcome analysis

- SSI rate per 100 cardiac procedures averaged 4.9 per cent in 2016/17, ranging between 4.4–5.8 per cent on a quarterly basis.
- The SSI rate for cardiac data is approximately 4–5 times higher than for the orthopaedic data. (This rate is not unexpected and is broadly in line with comparative jurisdictions overseas.)

# Does the programme deliver value for money?

## Results for the high- and low-benefit scenarios

From our cost benefit analysis of the orthopaedic data, we present the results, using a start-point of 2012/13 looking out to 2027/28, using two sets of benefit assumptions (reflecting the fact that there is no definitive baseline for SSI rates prior to the start of the programme):

- **Low-benefit scenario (conservative perspective):**
  The cumulative net benefit (present value) of $1.812 million delivers a benefit-cost ratio of 1.12 meaning that the benefits of the programme would be at least equal to the costs, representing a break-even position.

- **High-benefit scenario (optimistic perspective):**
  The programme achieves a cumulative net benefit (present value) of $34.538 million with a benefit-cost ratio of 3.21 meaning that the benefits would be three times as high as the costs.

Against this, we highlight that from a retrospective viewpoint (looking back from the end of 2017/18 to the start of the programme) under the high-benefit scenario, this impact is $5.274 million (benefit-cost ratio of 1.65) and under the low-benefit scenario, there is actually a negative result of -$3.428 million (benefit-cost ratio of 0.58). This illustrates that it takes time for a programme of this nature (with significant up-front investment in building infrastructure) to deliver a return on investment.

Finally, it is important to note that we believe there is a reasonable case for favouring a counterfactual towards the higher end of this range of results (as the low-benefit assumption of the observed SSI rate in 2012/13) is likely to include effect of the programme. This means that the 'real' outcome is likely be to somewhere towards the top of the range of results.

### Additional scenario – impact of the 'anti-staph bundle'

We modelled a further, more positive scenario whereby the 'anti-staph bundle' contributes to the SSI rate being further reduced from 2018/19 onwards. We applied a conservative assumption of a further 10 per cent reduction in the SSI rate.

As we would expect, this additional scenario delivers an improved result, with the impacts under prospective view (i.e. looking out to 2027/28) as noted below:

- Under the high benefit assumption, the net benefit improves from $34.538 million to $39.462 million with the benefit-cost ratio being 3.21 to 3.52.
- Under the low benefit assumption, the net benefit improves from $1.812 million to $6,736 million with the benefit-cost ratio being 1.12 to 1.43.

These results show the material improvement in the net benefit of the programme that would be delivered from a relatively conservative assumption about the positive impact of this set of interventions.

### Valuing benefits to patients

We recognised that within the limited scope of our evaluation, we did not fully reflect the significant and potentially devastating impact that experiencing an SSI may have on a patient, in terms of both additional time (spent recovering and dealing with on-going health impacts) and experiencing pain, suffering and reduced quality of life.

In an attempt to take better account of this, we explored the impact of the programme as measured by DALYs. On the basis of the same approach used by the Commission, but using results from our CBA, we estimate that for the low benefit scenario 34 SSIs are avoided on an annual basis and for the high benefit assumptions 97 SSIs, equating to an annual estimated avoided DALY value of between $3.06 million and $8.73 million.

## Concluding comments

The results we have presented here are positive, reflecting a programme that prospectively, on net present value basis, at minimum breaks even and at best delivers a threefold return on

investment. The result gives a validation that over time, the effort and resource invested across the sector pays off; dissemination of these results this may help to strengthen further belief of clinicians and other DHB staff in the value that their contribution is delivering.

We have concluded also that the programme is well run and achieves all its implementation objectives. However, continued effort will be required to ensure quality is maintained (in terms of consistency and accuracy of data, supported by robust systems or processes) to ensure that the potential value is delivered.

The long duration of this programme offers rich learnings about the design and implementation approach of national quality initiatives. We recognise the importance of a programme such as this maintaining a strong, enduring vision and sense of purpose, whilst also having the ability to adapt approaches to adjust to changes in the strategic context over time.

In terms of key directions for future priorities for the programme, we suggest it would be timely following completion of this evaluation for the Commission to review and reconfirm the strategic direction for the programme. There is an opportunity to refine goals and objectives to reflect the progress achieved to date and to use that as a platform to build further success.

# 1. Introduction

## 1.1 Context

Surgical site infections (SSIs)[1] are a major burden on patients and on health sector resources. SSIs are costly to treat, are associated with increased mortality and have an impact on quality of life.

Surveillance programmes have been in place in most comparable international jurisdictions for some time. Numerous studies have demonstrated the effectiveness of surveillance systems, particularly for reducing surgical wound infections, since as far back as the 1980s.[2]

Following many decades of policy debate in New Zealand, in June 2011 the Health Quality & Safety Commission ('the Commission') Board decided to establish the national SSI improvement programme[3] ('SSII programme' or 'the programme') in New Zealand, proceeding with a phased approach to implementation.

## 1.2 Purpose of this evaluation

### 1.2.1 Our brief

The Commission engaged Sapere Research Group ('Sapere') to undertake an evaluation of the Surgical Site Infection Improvement Programme (SSII programme or 'the programme').

The overall aim of the evaluation is to assess the effectiveness of the programme against the purpose and objectives articulated over time since the SSII programme was established formally in 2012. Some key outcomes the Commission sought to achieve through the evaluation process were:

- to understand and document the evolution of the programme (so that the evaluation was positioned appropriately against the changing strategic context);
- to inform the on-going implementation of the SSII programme, including sustainability and potential spread of good practice; and
- to identify any learnings which might be applicable to the Commission's other quality improvement programmes.

---

1 The SSII programme employs the US Centres for Disease Control and Prevention (CDC) National Healthcare Safety Network (NHSN) definitions of SSIs, with some minor adaptations. We have provided the definitions in Appendix 1 on page 79.

2 Haley RW, Culver DH, White JW, et al., The efficacy of infection surveillance and control programs in preventing nosocomial infections in US hospitals, Am J Epidemiol 1985; 121:182-205.

3 In 2012, the Commission established the Surgical Site Infection (SSI) programme. In 2014, the Commission changed the title to the SSII programme, to reflect the focus on using surveillance data to support quality improvement.

### 1.2.2 Scope of the interim and final evaluation reports

#### Interim (formative) report

In October 2017, we completed an interim (formative) evaluation report that the Commission published in December 2017.[4] The key purpose of the report was to identify key insights and learnings to help shape the design and planning of the next phase of programme activity (with information gathered primarily from review of documentation and stakeholder interviews). The report:

- described why the programme was established and how it has developed;
- assessed the success of the programme against key quadrants of performance; and
- identified learnings to inform on-going implementation of the SSII programme and other Commission quality improvement programmes.

At that stage, our quantitative analysis focussed only on programme data from the orthopaedic work-stream (relating to hip and knee arthroplasty procedures).

#### Final (summative) evaluation report

##### Inclusions

This final report concludes our evaluation of the SSII programme and presents our summative findings. The report includes:

- a brief background to the SSII programme including: programme aims and objectives; an update on key implementation progress since the interim report; and specifically the background and key developments in implementation of the cardiac work-stream, which was not covered in the interim report (provided in section 2 on page 9);
- our assessment of performance against the primary aim of the programme i.e. whether there has been a reduction in SSI rates as a result of the programme interventions on the basis of our updated analysis of orthopaedic and cardiac programme data (provided in section 3 on page 16);
- an overview of the approach to and the results from a Cost Benefit Analysis (CBA) completed to assess the value-for-money of investment in the SSII programme (provided in section 4 on page 38); and
- a brief update on findings reported in the interim evaluation against other programme objectives and evaluation areas not covered in the previous two sections, with a particular commentary relating to the cardiac work-stream (provided in section 4 on page 38); and
- our final reflections on our evaluation of the programme (provided in section 6 on page 72).

[4] https://www.hqsc.govt.nz/our-programmes/infection-prevention-and-control/publications-and-resources/publication/3159/

**Exclusions**

We note that the following items were **not** included in our brief for this final report:

| | |
|---|---|
| **Review of Accident Compensation Corporation (ACC) data** | Analysis of treatment injury claims and the interface between ACC and National Monitor data. |
| **Analysis of cardiac data** | Given the relatively small size of the cardiac dataset and the limited time period covered we were not required to undertake the following aspects of analysis completed on the orthopaedic dataset:<br>• cross sectional perspective – examination of how the SSI rate varies between the procedures that included all three interventions and those that did not;<br>• equity perspective; and<br>• modelling approach – application of the logistic regression model to control for possible changes in the patient risk profile over time. |

# 1.3 Our approach

## 1.3.1 Overview of our evaluation framework

We developed an evaluation framework structured around assessment of the effectiveness and success of the programme against four key quadrants of performance, as outlined below:

1. **Benefits realisation:** How well has it delivered on intended outcomes?
2. **Strategic fit:** How well does the programme align with strategic goals?
3. **Value for money:** Has there been a worthwhile return on investment in terms of the level of benefit secured?
4. **Evidence and lessons learned:** Does the programme deliver improved quality and safety? How does this inform the future shape of this and other quality improvement initiatives?

## 1.3.2 Methodology

In summary, we employed a multi-methods approach to the evaluation in order to assess data from a range of sources and to triangulate findings across them. Our process was organised into two key work-streams:

- **Our qualitative research work-stream** included review and analysis of documentation, over 50 stakeholder interviews; four site visits; and a DHB perception survey.
  - In the **interim report,** qualitative assessment against the key research questions was a significant focus of our formative evaluation. The majority of stakeholder

interviews, all site visits and the DHB perception survey took place during data collection for this phase of work.

- In this **final report**, our emphasis has been on any key areas of change or development since the conclusions reached in our last assessment. We focused attention on the cardiac work-stream (which was not assessed in the interim report).

Appendix 2 on page 81 provides further detail on the data collection methods employed for our qualitative research.

- **Our quantitative work-stream** focussed on analysis of data extracted from the National Monitor.
  - In the **interim report**, we assessed orthopaedic procedure (hip and knee arthroplasty) data for the period from 2013q3 to 2016q4.
  - In this **final report**, we assess data for orthopaedic procedures for the period from 2013q3 to 2017q3; and cardiac procedures for the period from 2016q3 to 2017q2.

    We note that our analysis of orthopaedic procedure data includes an equity perspective in which we examine the outcomes for Māori relative to non-Māori populations.

  There are further notes on data sources included in Appendix 2.

### 1.3.3 Review processes

Within Sapere, we tested our analysis and findings within our internal peer review and quality assurance processes.

For both reports, there was extensive external review of drafts, from Commission staff and Programme stakeholders with subject matter expertise and/or technical knowledge of method. We received a vast range of comments and suggestions to improve or clarify the analysis or our interpretation of findings, which we duly considered and incorporated as appropriate.

# 2. Programme overview and implementation update

## 2.1 Purpose and approach

### 2.1.1 Programme goals and objectives

#### Rationale

Prior to the establishment of the SSII programme, DHBs were adopting individual approaches to SSI surveillance. There were no agreed definitions, disparate manual and electronic data collection processes, and no consistency in the range of surgical procedures monitored. This resulted in a situation where:

- limited data was available on the extent of the problem, either locally or nationally;
- inter-hospital or DHB comparisons were not possible; and
- the resource invested by DHBs in SSI surveillance was fragmented, so the potential for gains in patient safety and improved quality of care were diminished.

#### Overarching goal

The SSII programme fits under the umbrella of the Infection Prevention and Control (IPC) Programme. IPC is considered to be an 'enduring' or long term programme, as it an area of high harm and cost. The programme has the following overarching goal:

> *"To improve patient outcomes by prevention and control of Healthcare Associated Infections (HAIs) in the NZ Health and Disability Sector."*[5]

#### Programme objectives

In the interim report, we traced changes in the articulated programme objectives over time; although there were some amendments, the general intent and themes have remained constant, as outlined below:

1. Consistent approach to the monitoring of SSIs.
2. Accurate outcome/process measurement and reporting for SSIs.
3. Lead quality improvement activities through the use of high quality data.
4. Drive the required culture and behaviour change (including multidisciplinary working and front line ownership) through reporting back to clinical teams.

[5] Health Quality & Safety Commission. (2016). Infection Prevention & Control Programme Three-year plan July 2016 –30 June 2019. Wellington: Health Quality & Safety Commission.

### 2.1.2 Phased implementation

The SSII programme charter for 2014/15 documented the phased approach to implementation, with an initial focus on orthopaedic procedures, followed by cardiac procedures and then potentially caesarean sections:

> *"Over the next one to two years the SSII programme will focus on sustaining the improvement in the process measures by encouraging adherence to quality interventions in orthopaedic procedures; implement surveillance and quality interventions in cardiac and develop the proposition for a third procedure, possibly caesarean sections[6]."*

### 2.1.3 Funding arrangements

By June 2018, the Commission will have provided $5.3 million in funding for the IPC programme, $4 million of which will specifically have been invested in the SSII programme. (In addition, DHBs have been contributing funding for the national SSI monitor data repository since 2015/16 and by June 2018, will have provided $0.730 million in funding.)

In February 2016, ACC agreed to contribute $1.114 million to support the completion of implementation of the programme to the public sector over three years 2015/16, 2016/17 and 2017/18 (as specified in the funding agreement between the Commission and ACC, executed on 19th February 2016).

### 2.1.4 Key areas of activity

In the interim report, we outlined key steps in the design, development and implementation of the SSII programme since the decision by the Commission Board to establish the programme in 2011. In overview, the core components of the programme approach include those outlined below.[7]

#### IT system development, data collection and reporting

- **Selection of ICNet as the software platform for the collection of surveillance data**

  ICNet is a clinical surveillance software package that can be used as a decision support tool. The 'full' ICNet system sits across relevant hospital systems and integrates information from laboratory/pathology, theatre management and patient management systems.

- **Development of the National Monitor**

  The programme has the Commission has a contract with Canterbury DHB (CDHB) on behalf of DHBs, to host and provide technical support for the programme. The vendor of ICNet was contracted at the outset to develop a bespoke system (the National Monitor) based on the standard ICNet system but adapted to meet the data collection, storage and reporting functionality required for the SSII programme. CDHB holds a

---

6 Health Quality and Safety Commission (2014), SSII programme Project Charter 2014–2015.

7 There are many facets to programme delivery and the support provided by the Commission, particularly in relation to clinical leadership; this is a high-level list of core components only. We provide further detail on programme activities is provided later in this report and in the interim evaluation report.

contract with Baxter[8] (the Vendor) and work continues to refine and develop the National Monitor.

- **SSII programme reporting**

  The Commission publishes a range of national reports and provides tools and training to support DHBs in the interpretation and use of information to support local quality improvement initiatives.

  For orthopaedic procedures, public reporting commenced in April 2014 (with all 20 DHBs participating in the programme. For cardiac procedures, full public reporting (with all five relevant DHBs providing data) commenced in March 2017 with the publication of results for 2016q3.

## The 'bundle' of SSI interventions

There are three programme interventions that each has one of the Commission's quality and safety markers (QSMs) associated with them:

- **Antibiotic timing –** Antibiotic administered in the right time – an antibiotic should be administered in the hour before the first incision ('knife to skin'), or two hours if receiving vancomycin. The QSM target is 100 per cent compliance against this measure.
- **Right antibiotic in the right dose –** Delivering the right antibiotic, in the right dose is an effective preventative measure for SSIs. The recommended antibiotic is cefazolin (2 grams or more), or cefuroxime (1.5 grams or more) as an alternative. The QSM target is 95 per cent compliance against this measure.
- **Skin preparation –** Appropriate skin antisepsis in surgery using alcohol/chlorhexidine or alcohol/povidone iodine. The QSM target is 100 per cent compliance against this measure (though we note this is no longer mandatory for orthopaedic data collection).

Furthermore, in July 2017, the Commission launched a collaborative in relation to reducing *Staphylococcus aureus* SSIs (also referred to as the 'anti-staph bundle'). We provide further information on that initiative in the implementation update (see section 2.2) and in our consideration of value for money (see section 4.4.1 on page 49).

## Building capability

In the early days of the programme, building capability was focused on building clinical leadership for the programme.

More recently, the programme has increased focus on a range of activities to support capability building. We provide further commentary on this in our assessment of developments against the performance quadrants (see section 4 on page 38).

8 Baxter acquired the ICNet group in August 2015.

## 2.2 Implementation update

### 2.2.1 Key implementation steps since the last report

In Table 1 below, we have provided an update on key implementation steps that have occurred since January 2017.

In the interim report, we included in this form the detail of developments that occurred from 2011–2016. However, the content for 2017 was somewhat light (given that data collection concluded in May and the report was drafted in June/July) and included planned dates for implementation. We have repeated the 2017 calendar year with a fuller description of key events and actual dates of implementation.

**Table 1: Key steps in implementation of the programme since January 2017**

| Date | | Programme management and implementation | Programme reporting |
|---|---|---|---|
| 2017 | Jan | | |
| | Feb | Strategic Infection Prevention and Control Advisory Group endorsed the core interventions that make up a national preoperative anti-staph bundle. | |
| | Mar | Feedback summary on discussion paper and next steps for anti-staph bundle collaborative published. | National SSII reports for orthopaedic surgery and first cardiac surgery report published (2016q3). |
| | Apr | | |
| | May | Invitation to DHBs/NZ Private Surgical Hospital Association to help develop and test a standardised national preoperative anti-staph bundle.<br><br>Completion of the Review of the SSI National Monitor[9]. | |
| | Jun | Celebration day for the IPC quality improvement facilitators (QIF) programme held on 29 June. | National SSII reports for orthopaedic surgery and cardiac surgery published. (2016q4) |
| | Jul | Launch of anti-staph collaborative. | |
| | Aug | First learning session for anti-staph collaborative held on 17 August in Auckland. | |

[9] Pollock, M. (May, 2017). Review of the SSI National Monitor. Report to the NZ Health Quality and Safety Commission.

| Date | | Programme management and implementation | Programme reporting |
|---|---|---|---|
| | Sep | DHBs given access to a suite of reports in the national monitor to support local data review. | National SSII reports for orthopaedic surgery and cardiac surgery published. (2017q1) |
| | Oct | Completion of interim formative evaluation report. | |
| | Nov | | |
| | Dec | Publication of interim (formative) evaluation report.<br><br>Completion of historic data cleaning. | National SSII reports for orthopaedic surgery and cardiac surgery published. (2017q2) |
| 2018 | Jan | | Released the new format draft SSI report template to simplify data review process. |
| | Feb | | |
| | Mar | | National SSII reports for orthopaedic surgery and cardiac surgery published. (2017q3) |

### 2.2.2 Implementation of the cardiac work-stream

In our interim report, we traced the design of the programme and implementation of the orthopaedic work-stream, the first set of procedures to be included in the programme. Here, we trace briefly the background and key implementation steps for the cardiac work-stream.

#### Background

***National Cardiac Surgery Clinical Network established in 2009***

In 2009 (prior to development of the SSII programme) New Zealanders needing cardiac surgery faced lengthy and distressing delays. There was a lack of confidence in the health system's ability to care for those in need.

The National Cardiac Surgery Clinical Network (the Network) was formed with support from the Ministry of Health, in order to lead and oversee reform of the New Zealand cardiac surgical system and improve the delivery of cardiac surgery. Membership included cardiac surgeons and clinical directors, as well as a director of nursing, an anaesthetist, an intensivist, a national co-ordinator and a DHB Chief Executive.

The initial focus of the Network was on improving access to surgery through reduced waiting times and equitable regional access. It managed work through a number of initiatives and then monitored through national targets. In 2011, the Network reported significant

progress against its objectives, including increases in delivery of cardiac surgeries and reduced waiting times.[10]

### *Reformed into the National Cardiac Surgery Clinical Network in 2011*

In 2011, the Network was reformed to incorporate the regional cardiac networks and broader representation such as the Cardiac Society, the Heart Foundation and primary care. The group had a mandate to capitalise on the gains achieved through work of the previous Network, to drive improvements across the entire spectrum of cardiac care, to increase access and to ensure better services for those who need them.

### *Launch of two cardiac registries in 2014*

In March 2014, the Government announced the launch of two new cardiac registries that were developed in collaboration with the DHBs, National Cardiac Network and Cardiac Society.[11] These were:

- the New Zealand National Cardiac Surgery Register, covering cardiac surgical procedures; and
- the All New Zealand Acute Coronary Syndrome Quality Improvement (ANZACS), a clinical registry of patients with acute coronary syndrome and other cardiac problems admitted to hospitals across New Zealand.

Further commentary on the differences between these registries and the SSII programme data collection for cardiac procedures is included under section 5.3.3 below.

## Establishment of the SSII programme cardiac work-stream

### *Purpose*

The overarching objective of the SSII programme in relation to cardiac procedures was articulated in the first version of the cardiac surgery implantation manual[12] as:

> *"The overarching objective of the SSII programme is to improve the quality of patient safety and care. It will also provide cardiac surgery units with a robust reporting system of infection rates, which can be made available to the appropriate team members. Such a mechanism of feedback has been shown to lead to improvements in performance (Haley, Culver, White et al, 1985). National data will also enable consistency in measurements and comparison between DHBs."*

### *Key steps in the implementation process for the cardiac surgery work-stream*

Initially, the scope proposed by the Commission for the cardiac work-stream was to collect data on cardiac bypass grafting procedures only. However, DHBs requested that the scope was extended to cover any cardiac heart procedures (including valves and septum). Additional data points were also proposed and added such as post-operative glucose control.

---

10 Ministry of Health. (2011). *National Cardiac Surgery Update: and the formation of the New Zealand Cardiac Network.* Wellington: Ministry of Health.

11 https://www.beehive.govt.nz/release/technology-improve-heart-disease-treatment

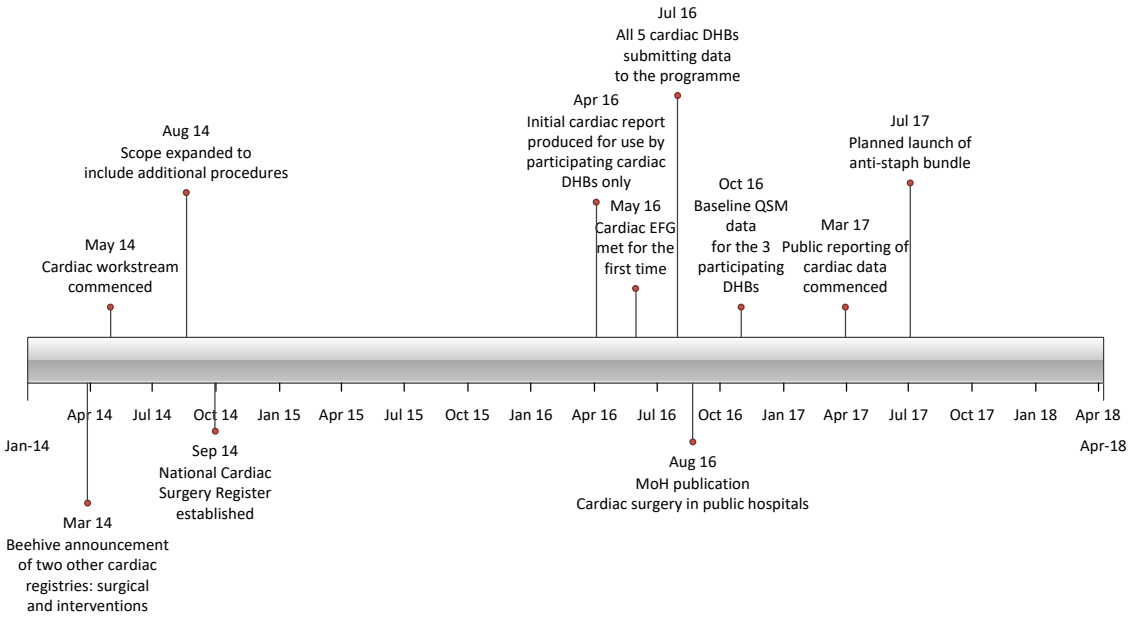
12 Health Quality and Safety Commission (2014), SSII Cardiac Surgery Implementation Manual, v0.3), p8.

Furthermore, there were still issues with automated data collection for two DHBs. In order to progress the roll-out, the SSII programme team agreed to trial a simplified data collection process with Auckland and Canterbury DHBs, while Southern DHB continued with a manual process. The other two DHBs would delay supplying data until the data collection issues were resolved.

There are five district health boards performing cardiac surgery in New Zealand: Auckland; Waikato; Capital and Coast; Canterbury; and Southern DHBs. All five have been submitting data to the national programme since July 2016 (including the national paediatric and congenital cardiac service as part of Auckland DHB for paediatric cardiac surgery). The first national cardiac surgery report was published in April 2017.

Key steps in the implementation process are outlined below in Figure 1.

**Figure 1: Timeline of cardiac work-stream development**



# 3. Does the programme achieve its goal of reducing SSI rates?

## 3.1 High level summary of our findings

We have used a series of analytical tests to explore programme data on hip and knee surgery, in order to offer different insights and build up a picture of understanding.

### 3.1.1 Our findings from analysis of orthopaedic SSI data

**Key messages – orthopaedic SSI data**

**Uptake of programme interventions**

- **Uptake of interventions has steadily increased over time**, on rolling four-quarter average basis, from 66 per cent at 2014q2 to 96 per cent at 2017q3.

**Outcome analysis**

***Time series perspective:***

- Using the run chart 'shift' rule, **the Commission has reported a shift (decrease) in the median SSI rate per 100 procedures from a rate of 1.18 per 100 procedures up to August 2015 to a rate of 0.93 for August 2015 to September 2017**. The difference in the proportion of procedures with an infection before and after the shift point is **statistically significant** (p-value < 0.01). **Our analysis validated this result.**
- There has been a **decrease of 18 per cent in the orthopaedic SSI rate between financial years 2013/14 and 2016/17**. However, this decrease is **not statistically significant** at the 90 and 95 per cent confidence level (z=1.457, p-value=0.144), most likely due to the increased rate in 2016/17.
- However, including the most recent quarter of data, **the decrease in rate for the four quarters of data from 2016q4–2017q3 compared with the equivalent baseline from 2013q4–2014q3 is a statistically significant** at the 95 per cent confidence level (z=3.001, p-value=0.003).

***Testing whether programme interventions have a causal effect:***

- **Our findings point to the increasing uptake of the bundle of interventions as being a probable driver of the decreasing rate of orthopaedic SSIs**:
  - The odds of an SSI occurring in a procedure that received all three programme interventions were 43 per cent lower than one that has not received all three interventions. The odds ratio shows that this difference is statistically significant at the 95 per cent confidence interval (OR 0.57, [0.39–0.85]).
  - The decrease in the SSI rate is not caused by a decrease in the overall risk profile of patients, as the average risk per procedure remains reasonably stable over time.

*(continued)*

## Key messages – orthopaedic SSI data *(continued)*

***Equity perspective:***

We emphasise that extreme caution is needed with interpretation of this analysis as the number of Māori patients identified in National Monitor data is small. Furthermore, when the SSII programme was established, the strategic priorities for the newly founded Commission did not at that time include a focus on reducing inequities; as such, the SSII programme design did not incorporate a strong emphasis on this. As the National Monitor dataset does not include an ethnicity field, a matching exercise with the National Minimum Data Set (NMDS) has been completed to source this.

- **The proportion of patients identifying as Māori has been fairly stable over time**, ranging from between 9.6 and 10.2 per cent across the four financial years of programme data. This is lower than the approximately 15 per cent of the NZ population identifying as Māori. There could be bias in the selection of patients for surgery or coding/data issues leading to potential undercount of the population of Māori represented in the dataset.
- SSI rates for Māori have fluctuated across the years since the programme has been established. The **annual SSI rate per 100 procedures for Māori patients has reduced from 2.53 in 2013/14** (95% CI [1.77, 3.28]) **to 1.08 in 2016/17** (95% CI [0.74, 1.42]). This difference is **statistically significant** at the 95 per cent confidence level (and this result remains consistent when we include the most recent quarter of data from 2017q3).
- **In contrast, the reduction in rates for non-Māori for both equivalent time periods was not significant** (i.e. being from 1.04, 95% CI [0.83, 1.25] in 2013/14 to 1.00, 95% CI [0.90, 1.10] in 2016/17). However, the confidence intervals are wide (due to the small number of **Māori** patients featured in the dataset) and we must re-emphasise the need for caution around interpretation of these results. We recommend that these differences are re-tested as further data is collected.
- Considering the differences between the two groups within each year, **the SSI rate was higher at a statistically significant level for Māori than non-Māori patients in 2013/14 only** (being 2.53, 95% CI [1.77, 3.28] for Māori and 1.04, 95% CI [0.83, 1.25] for non- Māori).

We have noted that there are potentially broader questions to be explored (such as data capture of ethnicity coding, potential bias in selection of patients for surgery and whether there is a change in the relative risk profile of Māori patients featured within National Monitor specifically) but it is beyond our evaluation scope to tease these issues out further. However, this will be an important aspect of work for the Commission to take forward into future monitoring and analysis.

### 3.1.2 Analysis of cardiac SSI data

**Key messages – cardiac SSI data**

Data on compliance has been collected from the five participating DHBs and reported by the Commission on a quarterly basis from 2016q3. Further time series data are required to assess the significance of any emergent trends.

**Uptake of programme interventions**

- The proportion of cardiac procedures receiving all three programme interventions averaged 94.1 per cent in 2016/17, slightly below the level of compliance for orthopaedic procedures over the same period (95.3 per cent).
- The proportion of cardiac procedures receiving all three programme interventions has shown some variation across quarters, ranging from 93.3–95.5 per cent.
- System-level compliance with programme interventions has been relatively high for cardiac procedures from the outset; however, there is scope for further improvement towards 100 per cent.

**Outcome analysis**

- SSI rate per 100 cardiac procedures averaged 4.9 per cent in 2016/17, ranging between 4.4–5.8 per cent on a quarterly basis.
- The SSI rate for cardiac data is approximately 4–5 times higher than for the orthopaedic data. (This rate is not unexpected and is broadly in line with comparative jurisdictions overseas.)

## 3.2 Key parameters of our approach

### 3.2.1 Data assessed

In this final report, we have assessed data for:

- orthopaedic procedures (hip and knee arthroplasty) for the period from 2013q3 to 2017q3; and
- cardiac procedures for the period from 2016q3 to 2017q2

(For orthopaedic procedure data, we refer back to the results published in our interim report, in which we assessed data for the shorter time period from 2013q3 to 2016q4.)

### 3.2.2 Outline of methodology

Details of the qualitative methodology applied are provided at Appendix 2 on page 81.

#### Analysis of orthopaedic data

We use a range of approaches to examining the orthopaedic data, each offering a different insight which allows us to build up a more complete picture.

1. **System perspective on update of interventions**

   Examine the system uptake of the three programme interventions, as measured by the three process quality and safety markers:

- **Process measure 1**: Antibiotic administered in the right time – an antibiotic should be administered in the hour before the first incision ('knife to skin'). The threshold is set at 100 per cent for primary procedures.
- **Process measure 2**: Right antibiotic in the right dose – the antibiotic of cefazolin (2 grams or more) or cefuroxime (1.5 grams or more) as an alternative. The threshold is set at 95 per cent for all procedures.[13]
- **Process measure 3**: Appropriate skin antisepsis in surgery using either alcohol/chlorhexidine or alcohol/povidone iodine. The threshold is set at 100 per cent for all procedures.

2. **Analysis of the rate of SSIs**

   Next we assess the outcome marker (the rate of SSIs per 100 procedures) from multiple perspectives:

   - **a time series perspective** – to examine how the SSI rate has changed over time;
   - **a cross sectional perspective** – to examine how the SSI rate varies between the procedures that included all three interventions and those that did not;
   - **a modelling approach** – developing a logistic regression model to control for possible changes in the patient risk profile over time; and
   - **an equity perspective** – to examine the outcomes for Māori relative to non-Māori.

### Analysis of orthopaedic data

The cardiac data has been collected and reported for four quarters only. We have presented an overview of SSI rates for cardiac procedures and within that, examined the rates for paediatric cases. However, we have concluded that data points are too few in number to draw any conclusions as to the significance of any emergent trends; further time series data are required before a more complete analysis can be undertaken.

## 3.3 Has the SSI rate changed for orthopaedic procedures?

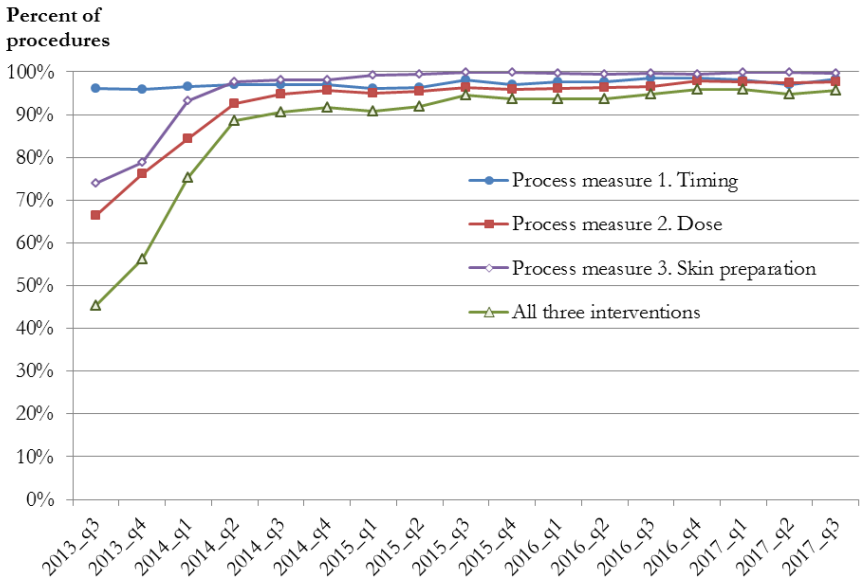
### 3.3.1 System perspective on uptake of interventions – orthopaedic work-stream process measures

The proportion of procedures where all three programme interventions were undertaken has steadily increased over time. Uptake increased from 45 per cent at 2013q3 to 91 per cent at 2014q3 and remained above 90 per cent thereafter. On a rolling four-quarter average basis, the uptake has increased from 66 per cent at 2014q2 to 96 per cent at 2017q3.This upward

[13] In quarter 1, 2015, 1.5 g or more of cefuroxime was accepted as an alternative agent to 2g or more of cefazolin for routine antibiotic prophylaxis for hip and knee replacements. This change led to a material improvement in the results of this process measure for two DHBs (i.e. MidCentral and Southern).

trend is visible in Figure 2 which shows the proportion of procedures receiving all three programme interventions in each quarter and the individual trend for each intervention.

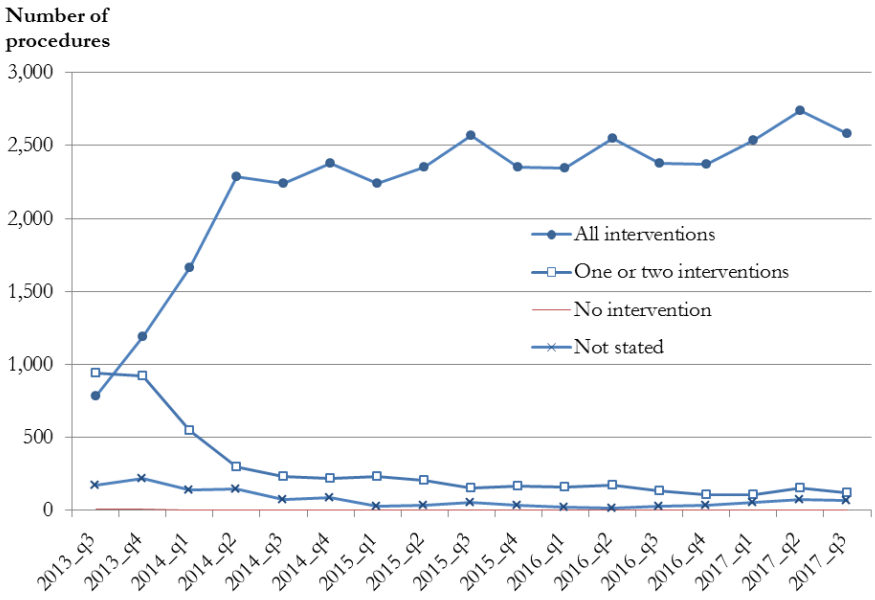
**Figure 2: Proportion of orthopaedic procedures with three interventions**




**Source:** Extract of National Monitor data, 2013q3–2017q3; Sapere analysis

In terms of absolute numbers, Figure 3 shows that the number of procedures receiving only one or two of the programme interventions has steadily decreased as the uptake of all three interventions has increased. There are very few procedures not accompanied by at least one of the three programme interventions in the initial period – and virtually none since 2014q4.

**Figure 3: Count of orthopaedic procedures with three interventions**




**Source:** Extract of National Monitor data 2013q3–2017q3; Sapere analysis

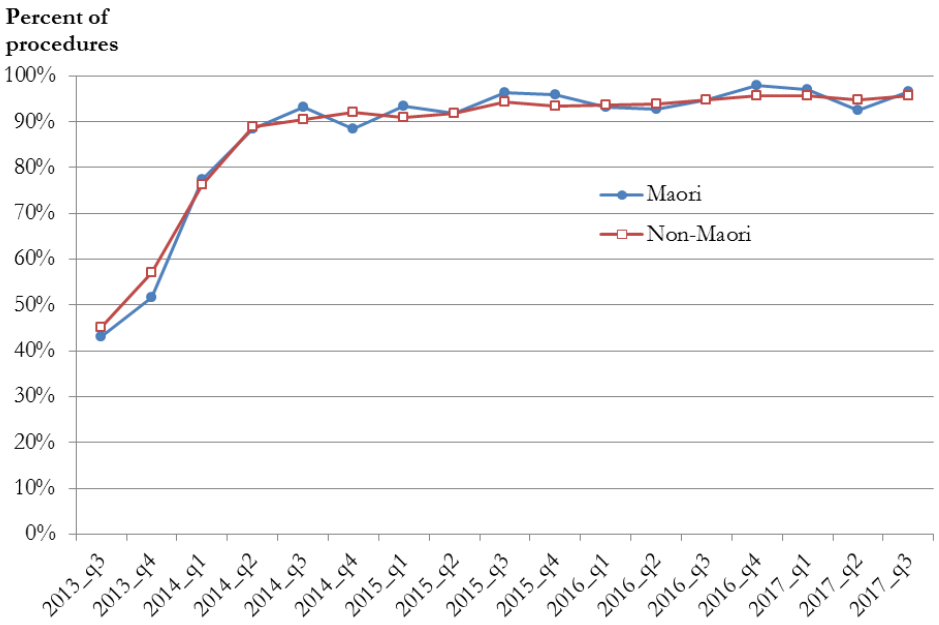
***Equity perspective – on uptake of interventions***

The evidence points to Māori patients and non-Māori patients as having had broadly similar access to the programme interventions.

**Figure 4** below shows the proportion of procedures receiving all three interventions from 2013q3 to 2017q3. Access for Māori and non-Māori patients has been similar on a quarterly basis.

Table 2 shows that access rates for Māori and non-Māori to all three interventions were also similar on an annual basis in 2014/15, 2015/16 and 2016/17. Although the proportion of Māori patients receiving all three interventions was lower than for non-Māori in 2013/14 (65.2 per cent compared with 66.8 per cent), this was not statistically different (Odds ratio (OR) 0.98, 95% CI [0.87-1.10] p = 0.734).

**Figure 4: Orthopaedic procedures with three interventions, Māori and non-Māori**




**Source:** Extract of National Monitor data 2013q3–2017q3; Sapere analysis on prioritised ethnicity

**Table 2: Orthopaedic procedures with three interventions, Māori and non-Māori**

| Year | Māori | Non-Māori | Difference |
|---|---|---|---|
| 2013/14 | 65.2% | 66.8% | -1.6% |
| 2014/15 | 91.7% | 91.3% | 0.5% |
| 2015/16 | 94.6% | 93.8% | 0.8% |
| 2016/17 | 95.5% | 95.2% | 0.3% |

**Source:** Extract of National Monitor data 2013q3–2017q3; Sapere analysis on prioritised ethnicity

**Note**: Māori patients comprise 9.6–10.2 per cent of all patients in each of these years, as per Table 6.

### 3.3.2 Time series perspective

The Commission reports on the rate of SSIs per month using a run chart – a simple way to display data that is commonly used to monitor quality improvement programmes. The horizontal axis shows the time scale (months, in this case) and the vertical axis represents the quality measure (the SSI rate).

The median data point in the baseline period is defined as the chart's centreline and is used for applying probability-based rules to interpret whether a shift in the median or a new trend subsequently occurs.[14]

The Commission has reported a shift in the median SSI rate per 100 procedures in its quarterly reporting by using the run chart 'shift' rule, which states that six consecutive points one side of the median line represents a sustained shift having taken place. At this point a new median is drawn until another shift takes place.

The Commission identified such a shift in its report of September 2017 – a decrease in the median SSI rate per 100 procedures from 1.18 per 100 procedures up to August 2015 to a rate of 0.93 for August 2015 to September 2017. In support of this, the Commission tested the difference in the proportion of procedures with an infection before and after the apparent shift point to be statistically significant (p-value < 0.01).[15]

Figure 5 recreates the run chart of the SSI rate per 100 procedures on a monthly basis and the fitted median before and after the identified shift. We note two key observations at this point.

- We can see that the SSI rate per 100 procedures is highly volatile on a monthly basis. The SSI rate is sensitive to small changes in the number of infections in a given month, which is to be expected, given that these are rare events (i.e. there are generally between 20 and 30 SSI cases detected per quarter).
- While the run chart is a useful monitoring tool for detecting signs of change in a process over time, it is less suitable for determining what the drivers of change might be.

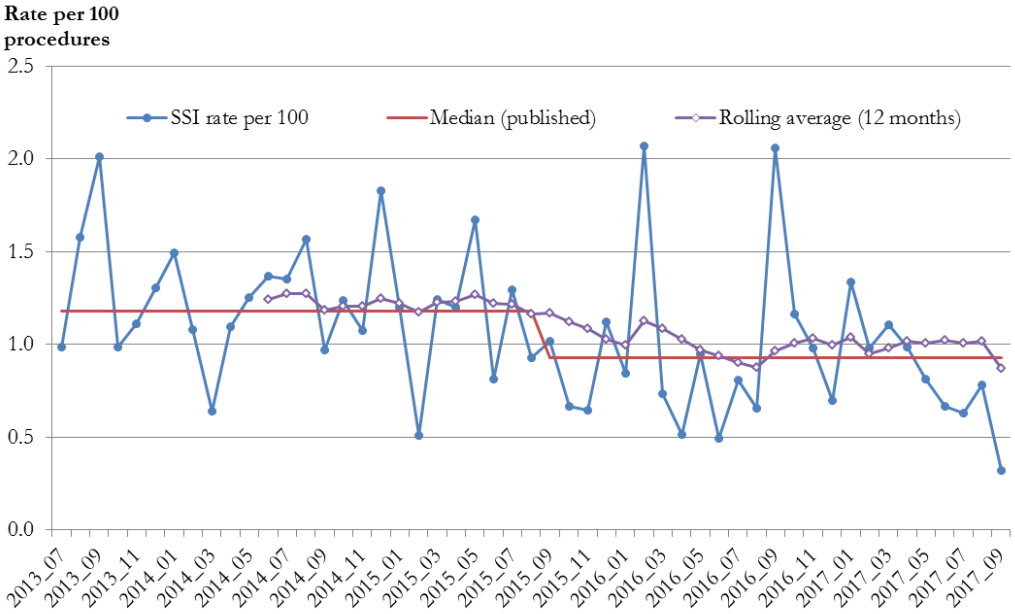
A simple next step is to add a rolling 12-month average of the SSI rate per 100 procedures to the run chart to smooth some of this volatility. The purpose is to provide a visual reference to help guide the next analytical steps. (Note that the results of statistical tests on the change in SSI rates using the year-on-year data are presented later in this section.) Figure 5 shows that this rolling average reveals a gradual trend down in the SSI rate from mid-2015. Figure 6 presents the SSI rate on a quarterly basis with a rolling 4-quarter average. This aggregation reduces some volatility and also reveals a downward trend from mid-2015.

---

14 See Perla et.al. *BMJ Qual Saf* 2011; 20:46-51 and Anhoj and Olesen *PLOS One,* 2014:9(11).

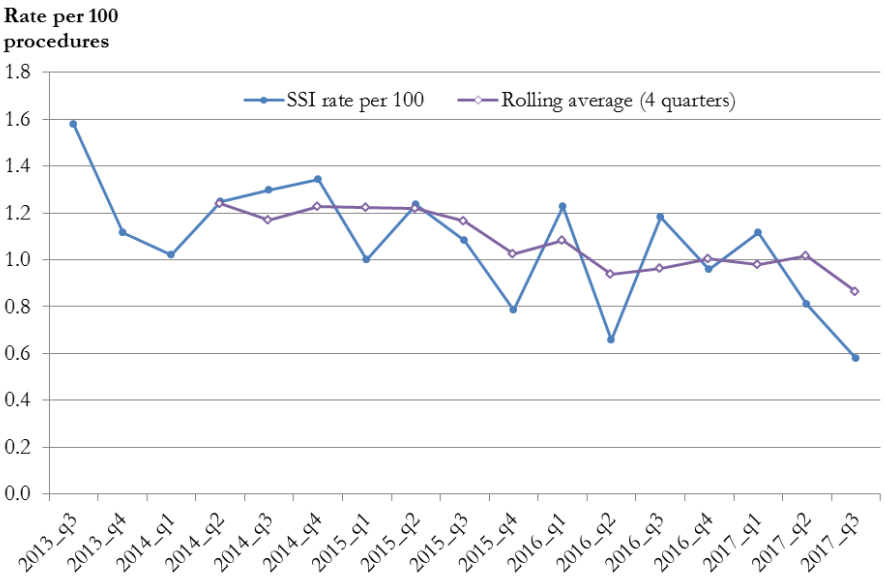
15 Health Quality & Safety Commission (2017) *National Orthopaedic Surgery Report April to June 2017,* p.11.

**Figure 5: SSI rate per month for orthopaedic procedures with rolling average**




**Source:** Extract of National Monitor data 2013q3–2017q3; Sapere analysis

**Figure 6: SSI rate per quarter for orthopaedic procedures with rolling average**



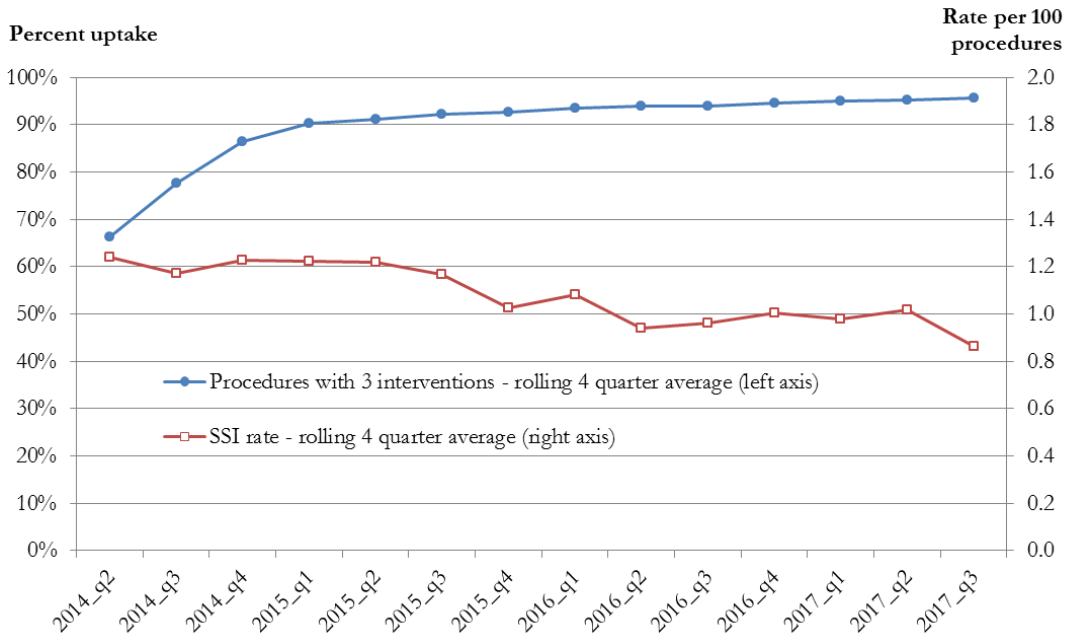

**Source:** Extract of National Monitor data 2013q3–2017q3; Sapere analysis

Figure 7 plots the rolling four-quarter average of the SSI rate per 100 procedures (right vertical axis) alongside the proportion of procedures with all three programme interventions (left vertical axis), also as a rolling average over four quarters. This comparison shows an inverse relationship in that:

- the proportion of procedures receiving all three interventions reached an average of 91 per cent in 2015q2 (i.e. across 2014/15) and then increased to 94 per cent in 2016q2 (i.e. across 2015/16) and to 95 per cent in 2017q2 (i.e. across 2016/17); and
- the decrease in the SSI rate becomes noticeable from 2015q3 onwards.

Taken together, this analysis shows that it is plausible that the increase in the uptake of all three interventions has contributed to the decrease in the SSI rate, as measured on a rolling four-quarter average basis. As the programme records SSIs that occur up to 90 days post procedure, it is plausible also that this time lag contributes to the delay between the higher uptake of all three programme interventions and the reduction in the rolling SSI rate. Alongside this comparison, we must remain cognisant of the fact that the underlying SSI rate per quarter has considerable volatility, in part due to the number of SSI cases per quarter being relatively small in absolute terms.

**Figure 7: Comparison of intervention uptake and SSI rate for orthopaedic procedures**




**Source:** Extract of National Monitor data 2013q3–2017q3; Sapere analysis

Another simple step is to look at the annual change in the number of SSIs and in the SSI rate per 100 procedures. This provides an additional perspective on changes in the SSI rate over time. Table 3 presents the number of procedures, the number of SSIs and the SSI rate for the four consecutive financial years of 2013/14, 2014/15, 2015/16 and 2016/17. The data shows that the annual SSI rate per 100 procedures reduced from 1.23 in 2013/14 and 1.22 in 2014/15 to 0.94 in 2015/16 before increasing to 1.01 in 2016/17.

Overall, this represents a reduction in the SSI rate of nearly 18 per cent between 2013/14 and 2016/17. This level of reduction is approaching the target objective initially set for the programme of an eventual 25 per cent reduction in the SSI rate.

The change in the annual SSI rate can be tested for statistical significance, using the accepted z score statistical test to compare two population proportions.[16] This test shows that the difference in the SSI rate between 2013/14 (1.23 per 100 procedures) and 2015/16 (0.94 per 100 procedures) is statistically significant at the 95% confidence level (z=1.979, p-value=0.048). This finding, that there has been a statistically significant decrease in the SSI rate between 2013/14 and 2015/16, is consistent with the run chart and the rolling averages of the SSI rate – which also point to a shift downwards in the SSI rate per 100 procedures.

An increase in the SSI rate for 2016/17 (i.e. to 1.02 per 100 procedures) means that the decrease in the SSI rate between 2013/14 and 2016/17 is not statistically significant at the 95 per cent confidence level or at the 90 per cent confidence level (z=1.457, p-value=0.144).

We should note, however, that this financial year-by-year analysis does not include the most recent quarter of data of 2017q3 (i.e. the first quarter of 2017/18), in which the SSI rate was 0.58 per 100 procedures. To include this most recent quarter of data, we have compared the four quarters of data from 2016q4–2017q3 with the equivalent baseline of the four quarters of data from 2013q4–2014q3. In this instance, the decrease in the SSI rate (from 1.19 to 0.87 per 100 procedures) is statistically significant at the 95 per cent confidence level (z=3.001, p-value=0.003).

Overall, this time series analysis points to a decrease in the SSI rate. This approach does have limitations – for example, it does not consider the effectiveness of the interventions or possible changes in the risk profile of the patients who have had these procedures. These issues are explored in subsequent sections below.

**Table 3: Annual change in SSIs and SSI rate for orthopaedic procedures**

| Year | Procedures | SSIs | SSI rate per 100 procedures |
|---|---|---|---|
| 2013/14 | 9,302 | 114 | 1.23 |
| 2014/15 | 10,304 | 126 | 1.22 |
| 2015/16 | 10,578 | 99 | 0.94 |
| 2016/17 | 10,702 | 108 | 1.02 |
| Per cent change from 2013/14 to 2016/17 | | | -17.7% |

**Source:** Extract of National Monitor data 2013q3–2017q3; Sapere analysis

16 Using a z score test for two population proportions

$$\frac{(\bar{p}_1 - \bar{p}_2) - 0}{\sqrt{\bar{p}(1 - \bar{p})\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}$$

## Cross sectional perspective

This component of our analytical process allows us to explore a first hypothesis about why the SSI rate has decreased over time, namely: that the programme interventions have a causal effect and are contributing to a reduction in the incidence of SSIs. (The results can also be considered alongside the results of the next analytical approach – which enables us to test an alternative hypothesis: that the mix of patients is changing in a way that reduces the risk of SSIs occurring.)

To do this, we analyse the data retrospectively to categorise the procedures into those with an SSI and those without an SSI and to then analyse them on the basis of a possible causal attribute – i.e. receiving or not receiving all three programme interventions. The gradual uptake of the interventions provides something of a natural experiment. We can look at the outcomes (SSI or not) differentiated on the basis of whether the procedures:

- received all three programme interventions (forming an 'exposed' group); and
- did not receive all three interventions i.e. receiving one, two or no interventions (referred to here as the 'not exposed' group).

In this way, we can compare the SSI rate per 100 procedures for the exposed group that received all three interventions with the not exposed group (i.e. those that did not receive all three interventions. Table 4 summarises the results of this analysis for two periods: 2013q3 to 2017q3 and 2013q3 to 2014q2.

For the period of 2013q3 to 2017q3, the SSI rate per 100 procedures for the exposed group (1.02) is lower than that for the not exposed group (1.34). Although the odds ratio test shows that this difference is statistically significant, i.e. OR 0.76, 95% CI [0.58–0.98], the test may suffer from low power given: (a) the small size of the not exposed group (being only 11 per cent of all procedures) and (b) the small difference between the SSI rates (i.e. a difference of 0.32 between rates). This low power means it is not possible to be completely confident in the finding of this test.

Instead, we apply this test to the period of 2013q3 to 2014q2, when the not exposed group forms a larger proportion (31 per cent) of procedures. In this period, the SSI rate per 100 procedures for the exposed group (0.98) is lower than that for the not exposed group (1.70). The odds ratio shows that this difference is statistically significant, i.e. OR 0.57, 95% CI [0.39–0.85]. This means the odds of an SSI occurring in a procedure that received all three programme interventions were 43 per cent lower than the odds of an SSI for a procedure that has not received all three interventions. The confidence interval means we can be 95 per cent confident that this difference lies within the range of being 61 to 15 per cent lower.

**Table 4: Cross sectional perspective – SSI rates and odds ratios**

| Period | Group | Number of procedures | Number of SSIs | SSI rate per 100 procedures | Odds ratio 95% CI p value |
|---|---|---|---|---|---|
| 2013q3 to 2017q3 | Exposed | 37,555 | 382 | 1.02 | OR 0.76 95% CI [0.58–0.98] p-value=0.034 |
| | Not exposed | 4,843 | 65 | 1.34 | |
| 2013q3 to 2014q2 | Exposed | 5,866 | 58 | 0.98 | OR 0.57 95% CI [0.39–0.85] p-value=0.005 |
| | Not exposed | 2,663 | 46 | 1.70 | |

**Note:** The 'exposed' group received all three interventions whereas the 'not exposed' group did not

**Source:** Extract of National Monitor data 2013q3–2017q3; Sapere analysis

In conclusion, this cross sectional perspective finds that a procedure that receives the three programme interventions is less likely to develop an SSI than a procedure that did not receive all three interventions. Given this effect, it is probable that the increased uptake of the three interventions over time has contributed to the reduction in the SSI rate per 100 procedures, as detected earlier.

## Controlling for patient risk factors – a logistic model

This component of our analytical process allows us to explore a second hypothesis about why the SSI rate appears to be decreasing, namely: that the mix of patients is changing in a way that reduces the risk of SSIs occurring. Accordingly, this test controls for other covariates (a collection of patient risk factors) that may increase the probability of an SSI.

For the analysis presented in the interim report, we developed a logistic regression model to estimate the impact on the probability of an SSI in the period 2013q3 to 2014q2 of: (1) a set of patient risk factors; and (2) all three interventions being received (relative to cases where all three interventions are not received).[17] [18]

[17] A logistic model is a regression model where the dependent variable is categorical; in this case, a binary dependent variable *"Has SSI criteria been met for this procedure?"* that has two values, "no" and "yes".

[18] Estimating the marginal effect of an intervention is difficult here because of the issue of multi-collinearity. Where two or more predictor variables are highly correlated, a logistic regression model may not give valid results about an individual predictor, or about which individual predictor may be redundant.

We have refined the original model (developed for our interim report) as part of updating the analysis for this final report. Applying a model selection procedure, we obtain the following parsimonious model specification.[19]

SSI ~ Procedure.Category + Māori + ASA.Score + Weight.kg. + current_smoker + treat_ind[20]

Table 5 shows the variables used in the model, selected on the basis of empirical significance. The variables relate to the presence of all three interventions – patient weight, patient smoking status, patient ethnic group (i.e. being Māori or not), patient physical status (ASA score) and the type of procedure. The odds ratios for each variable are reported.

It is notable that the presence of all three programme interventions is statistically significant in terms of a lower probability of an SSI occurring. The odds ratio for this variable within the model is 0.54, 95% CI [0.34, 0.82] – pointing to an SSI being less likely by between one-fifth and two-thirds where all three interventions are undertaken, all else being equal. This finding is similar to that obtained in the cross sectional analysis above.

The 'Area Under the Curve' (or 'AUC') is used as a measure of the robustness for this type of model. The result of 0.70 obtained for this analysis is strong and is similar to results obtained in our previous predictive risk models developed in other clinical areas.

This model can be used to test whether a change in the overall risk profile of patients is a factor in the decrease in the SSI rate over time. To estimate the risk profile, we use the model to predict the probability of an SSI in each procedure between 2014q3 and 2017q3 by assuming that all three interventions were not delivered. All other variables specific to the procedure are unchanged. We then create an aggregate measure of the probability of SSI occurring in each quarter by summing the risk scores for each procedure in that quarter.

---

[19] In the original modelling variables were selected on the ability of the model to discriminate between actual and predicted infection cases (using the AUC criteria). Our refined methodology is informed by the Akaike information criterion (AIC), which promote parsimonious model specification (i.e. avoiding use of lots of variables/parameters that do not add to the 'fit' of the model). The revised model starts by including all candidate variables and sequentially drops variables until a model is found which minimises the AIC (i.e. it identifies the most parsimonious model specification). The general model included all the variables in the parsimonious model, plus the patient's age group, diabetes status, BMI and gender, as well as the DHB where the operation took place and the surgeon grade.

[20] Where SSI takes a value of '0' if there was no SSI and '1' where there was an SSI. Other variables are:

- Procedure.category –the site of the procedure (hip or knee) and whether it is a revision or not;
- Māori – a binary variable indicating if the patient is Māori or not;
- ASA.Score – a score developed by the American Society of Anaesthesiologists that assesses the physical status of a patient before the procedure and we have modelled as categorical;
- Weight.kg – the patient's weight;
- Current_smoker – indicating if the patient was a smoker at the time of the procedure; and
- treat_ind – takes a value of 1 if the patient received all three interventions, 0 otherwise.

**Table 5: Variables in the logistic model**

| Variable name | Relative to the case of | Odds ratio estimate | Odds ratio statistically different from 1 at 5% level |
|---|---|---|---|
| Treatment indicator – all interventions | Not having all three interventions | 0.54 | Y |
| ASA score – 2 | ASA score – 1 | 1.29 | |
| ASA score – 3 | ASA score – 1 | 2.56 | N (significant at 10%) |
| ASA score – 4 | ASA score – 1 | 3.00 | |
| ASA score –5 | ASA score – 1 | 13.7 | Y |
| ASA score – 6 | ASA score – 1 | 2.25 | |
| Smoking status | Relative to not being a smoker | 2.25 | Y |
| Patient weight | Every extra kg of weight increases | 1.01 | Y |
| Non Māori | Being Māori | 0.54 | Y |
| Hip Revision | Hip Procedures | 3.3 | Y |
| Knee Procedures | Hip Procedures | 0.83 | |
| Knee Revision | Hip Procedures | 1.87 | |

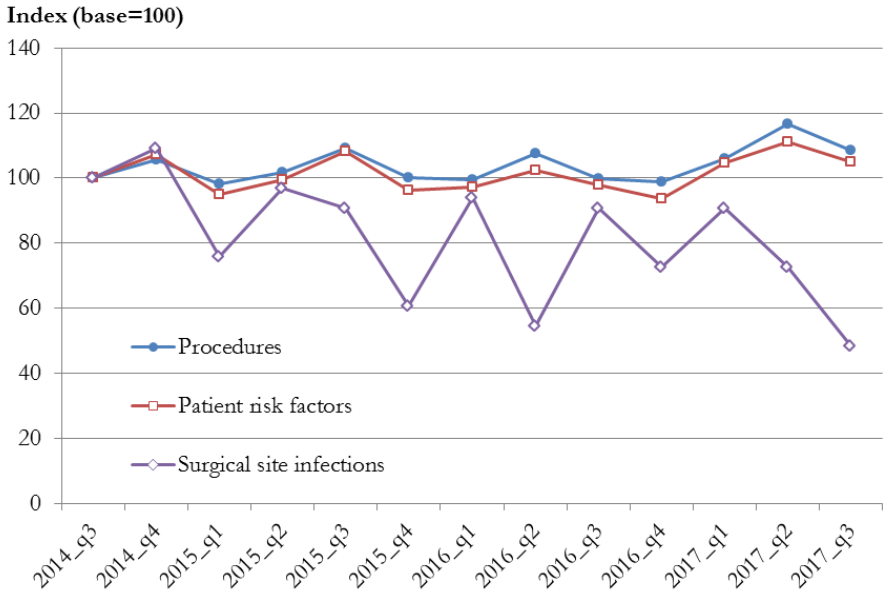
**Source:** Extract of National Monitor data 2013q3 – 2014q2; Sapere model

**Note**: Our revised modelling adopted the protocol used in the original modelling. Observations with missing values are dropped rather than attempting to interpolate the missing data

Figure 8 plots this aggregate risk score along with infections and procedures, indexed to 100 in 2013q3. We make the following observations.

- The aggregate risk score can change between quarters due to an increase or decrease in the number or the average risk profile of the procedures.
- The risk index and the number of procedures grow at the same rate, indicating that the average risk per procedure is reasonably stable. There is no indication that the mix of patients has been changing in a way that reduces the overall probability of SSIs occurring.
- The decrease in the SSI rate – detected in the year-on-year analysis above – is not caused by a decrease in the overall risk profile of patients. This finding points to the increasing uptake of the interventions as being the probable driver of a decreasing rate of SSIs, rather than any material change in the patient risk profile.

**Figure 8: Infections, procedures and modelled risk – indexed through time**




**Source:** Extract of National Monitor data; Sapere model

### 3.3.3 Equity perspective

In our interim report, we highlighted that when the SSII programme was established, the strategic priorities for the newly founded Health Quality and Safety Commission did not include a focus on reducing inequities. (This emphasis has since been included in the organisation's strategic direction.). Hence, it is important for us to keep in mind that the programme design did not incorporate a strong emphasis on equity. As noted under our methodology (described section 3.2.2 on page 18), the SSII programme dataset does not include an ethnicity field and it has been necessary for a data-matching exercise with the National Minimum Data Set (NMDS) to be completed to source this.

In terms of the analysis presented below, we also emphasise that extreme caution is needed when drawing comparisons between Māori and non-Māori patients represented within programme data, as the number of Māori patients is small.

#### What proportion of patients identifying as Māori are captured in the SSII programme data?

Table 6 summarises the numbers of procedures and SSIs for Māori and non-Māori patients. The proportion of patients who identify as Māori, as captured in the data, has been fairly stable over time, ranging from between 9.6 and 10.2 per cent across the four financial years of programme data. We note that these proportions are lower than what we might expect to see, as approximately 15 per cent of the New Zealand population in total identifying as

Māori. This could be a result of bias in the selection of patients for surgery[21] or coding/data issues (as ethnicity data has been obtained by matching SSII programme data with the National Minimum Data Set) leading to potential undercount of the actual population of Māori captured in the orthopaedic procedure dataset.

Table 6 summarises the numbers of procedures and SSIs for Māori and non-Māori patients.

**Table 6: Procedures, SSIs and SSI rates for Māori and non-Māori**

| | Māori | | | Non-Māori | | | Māori as % of total |
|---|---|---|---|---|---|---|---|
| Year | Procedures | SSIs | SSI rate | Procedures | SSIs | SSI rate | Procedures |
| 2013/14 | 831 | 21 | 2.53 | 7,850 | 82 | 1.04 | 9.6% |
| 2014/15 | 927 | 18 | 1.94 | 8,651 | 101 | 1.17 | 9.7% |
| 2015/16 | 969 | 7 | 0.72 | 8,870 | 89 | 1.00 | 9.8% |
| 2016/17 | 1,019 | 11 | 1.08 | 8,983 | 90 | 1.00 | 10.2% |

**Source:** Extract of National Monitor data 2013q3–2017q3; Sapere analysis on prioritised ethnicity

## Have the SSI rates for Māori patients changed over the duration of the programme?

SSI rates for Māori and non-Māori are provided in Table 6 above. There has been some variation in SSI rates for Māori across the years since the programme has been established, most likely due to the number of Māori patients being relatively small. SSIs tend to be low in incidence, and so the small size of the Māori patient group means that one or two fewer (or additional) SSIs in a year can make a material difference to the SSI rate per 100 procedures.

The data shows that the annual SSI rate per 100 procedures for Māori patients has reduced from 2.53 in 2013/14 (95% CI [1.77, 3.28]) to 1.08 in 2016/17 (95% CI [0.74, 1.42]). As these confidence intervals do not overlap, we can conclude that there is a statistically significant difference in the rates for the two years at the 95 per cent confidence level.

As a test of sensitivity, we repeated this analysis with the inclusion of the most recent quarter of 2017q3, so that the comparison was based on the four quarters of data from 2016q4–

[21] Jamie Lee Rahiri, Z. A. (2017). Systematic review of disparities in surgical care for Māori in New Zealand. ANZ Journal of Surgery.

This study reported consistent findings of disparities in different aspects of surgical care between Māori and New Zealand European populations. In particular, disparities in the receipt of surgical treatment for several cancers were observed for Māori and remained after adjustment for socioeconomic variables and extent of disease. While these specific results relate to oncology surgery, given the evidence for disparities across different procedures provided in the review, it is plausible that there is a selection bias evident within the orthopaedic specialty.

2017q3 (0.77, 95% CI [0.50, 1.04]) with the equivalent baseline of the four quarters of data from 2013q4–2014q3 (1.96, 95% CI [1.15, 2.77]). This result is consistent with that obtained above.

However, we note that these confidence intervals are wide, due to the small number of patients involved. We must emphasise caution around our interpretation of this result and we recommend that this difference is re-tested as further data is collected.

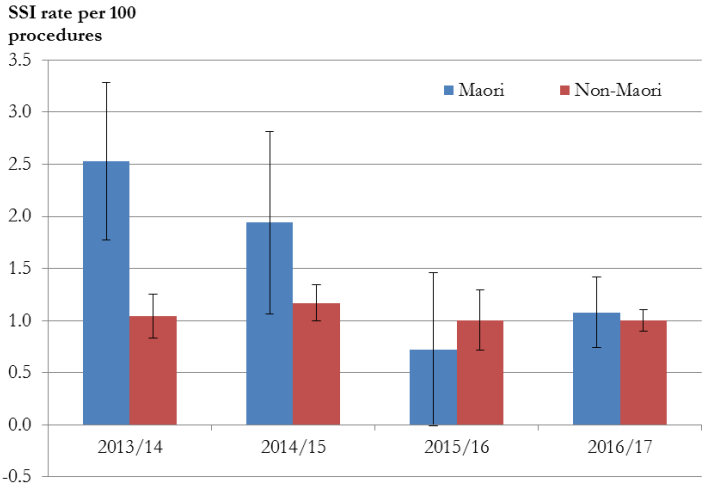
## How do the SSI rates for Māori patients differ from those for non-Māori?

To test whether differences in the SSI rate for Māori and non-Māori are statistically significant, we have calculated average SSIs for each financial year for Māori and non-Māori. A population standard deviation is derived to produce a 95 per cent confidence interval in relation to the difference between rates for each group. Figure 9 presents the results from 2013/14 to 2016/17.

In contrast to the detected reduction in the SSI rate for the Māori group, the change in non-Māori patients was not statistically significant (i.e. being from 1.04, 95% CI [0.83, 1.25] in 2013/14 to 1.00, 95% CI [0.90, 1.10] in 2016/17). This result holds when the most recent quarter of 2017q3 is included in the analysis, as above.

Considering the differences between the two groups within each year, the SSI rate was higher at a statistically significant level for Māori than non-Māori patients in 2013/14 only (being 2.53, 95% CI [1.77, 3.28] for Māori and 1.04, 95% CI [0.83, 1.25] for non- Māori). However the overlapping confidence intervals for these two groups in 2014/15, 2015/16 and 2016/17, as shown in the chart below, means that there was no statistically significant difference in the SSI rate per 100 procedures for Māori and non-Māori patients in those years.

**Figure 9: Average annual SSI rate for Māori and non-Māori, 2013/14–2016/17**




**Source:** Extract of National Monitor data 2013q3–2017q3; Sapere analysis

As we have noted, there are potentially broader questions relating to data capture of ethnicity coding (given the need for this to be sourced from a data-match with NMDS), any bias in

selection of Māori patients for surgery and whether there is a change over the years in the relative risk profile of the Māori population featured within the SSII programme specifically.

It is beyond our scope to tease these issues out further within this evaluation. However, this will be an important aspect of work for the Commission to take forward into future monitoring and analysis (as mentioned in section 5.3.6 on page 69, where we consider the Commission's strategic priority of improving health equity).

# 3.4 Has the SSI rate changed for cardiac procedures?

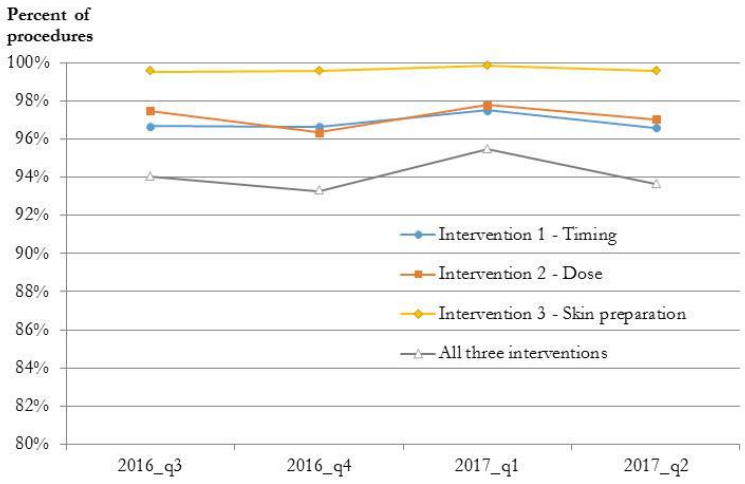
## 3.4.1 System perspective on uptake of interventions – cardiac work-stream process measures

Data on compliance has been collected from the five participating DHBs and reported by the Commission on a quarterly basis from 2016q3.

Figure 10 presents the four quarters of data available for this evaluation and shows the proportion of cardiac procedures that received each of the three interventions as well as the proportion that received all three programme interventions.

- Process measures 1 (right timing) – has averaged 96.9 per cent over the four quarters, with a high of 97.5 per cent in 2017q1. Although this represents a high level of compliance, it is still below the threshold of 100 per cent set for this QSM.
- Process measure 2 (right dose) – has averaged 97.2 per cent over the four quarters, with a high of 97.8 per cent in 2017q1. Compliance has consistently been above the threshold of 95 per cent for this QSM.
- Process measure 3 (appropriate skin antisepsis) – had the highest level of compliance – averaging 99.6 per cent over the four quarters, with a high of 99.9 per cent in 2017q1. These results are almost reaching the threshold of 100 per cent set for this QSM.

**Figure 10: Proportion of cardiac procedures with three interventions, 2016q3 – 2017q2**

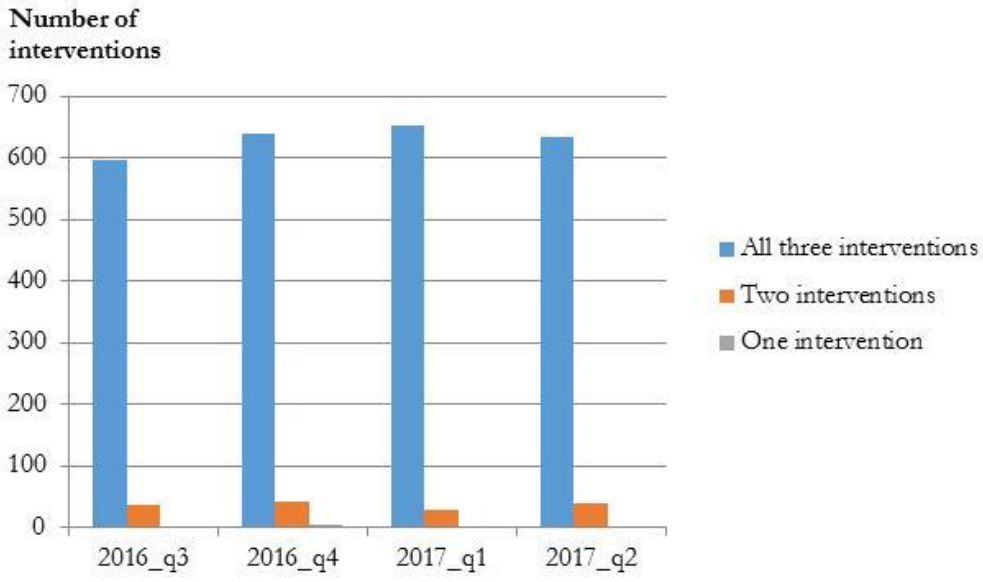



**Source:** Extract of National Monitor data; Sapere analysis

Overall, the proportion of cardiac procedures receiving all three programme interventions has averaged 94.1 per cent over the four quarters from 2016q3 to 2017q2. The proportion of cardiac procedures receiving all three programme interventions has shown some variation over time rather than showing a clear trend, being 94.0 per cent in 2016q3, followed by 93.3 per cent in 2016q4 and then an increase to 95.5 per cent in 2017q1. The final data point of 94.1 per cent in 2017q2 was similar to that observed in the first data point (2016q3). While the rates shown here are high, we recognise that they are not at 100 per cent so there is scope for improved process compliance.

Figure 11 shows the absolute number of cardiac procedures for each quarter. Of the procedures that did not receive all three procedures, the majority received two procedures with very few receiving only one intervention.

**Figure 11: Count of cardiac procedures with three interventions, 2016q3 – 2017q2**




**Source:** Extract of National Monitor data; Sapere analysis

### 3.4.2 Analysis of the rate of SSIs – cardiac work-stream outcome measures

For the cardiac work-stream, the average rate of SSIs per 100 procedures for 2016/17 was 4.9 per cent.

The data has been reported on a quarterly basis. The rate of SSIs was 4.9 in 2016q3 and 5.8 in 2016q4, followed by slightly lower rate of 4.4 in 2017q1 and 4.6 in 2017q2. Looking within the quarters, Figure 13 presents the data on a monthly basis with the addition of a rolling three-month average of the SSI rate.

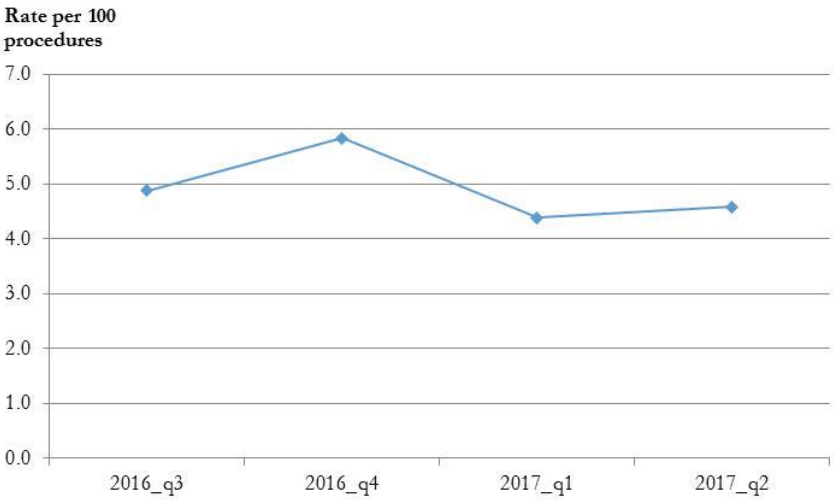
Overall, the data points are too few in number to draw any conclusions and further quarters of data are required before a clearer picture emerges.

However, it is noticeable that compared with the orthopaedic data, the cardiac data tends to have a higher SSI rate per 100 procedures – approximately 4–5 times higher. We note that

this rate is not unexpected and is broadly in line with comparative jurisdictions overseas. (The Annual Epidemiological Report for 2016 produced by the European Centre for Disease Prevention and Control published results for 2013/15 for 16 countries[22]. For coronary artery bypass grafts (CABGs), the average percentage of SSIs was 3.0 per cent, with an inter-country range from 2.4 to 6.7 per cent. It was noted that since 2011 there had been a significant decrease in incidence of SSIs for CABGs.)

We considered undertaking a cross sectional perspective along the lines of the analysis undertaken on the orthopaedic data set. However, the high compliance with the programme interventions at the outset means that there are very few cardiac procedures that did not receive all three interventions meaning that the 'not exposed group' is too small for us to employ this approach.

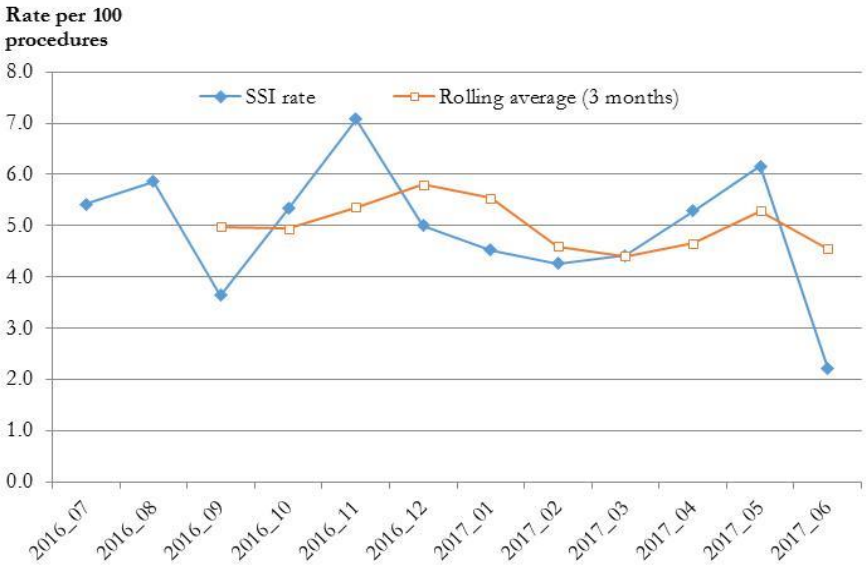
**Figure 12: SSI rate per quarter for cardiac procedures with rolling average**




**Source:** Extract of National Monitor data; Sapere analysis

22 European Centre for Disease Prevention and Control, Annual Epidemiological Report 2016 – Surgical site infections. Stockholm: ECDC; 2016.
https://ecdc.europa.eu/en/publications-data/surgical-site-infections-annual-epidemiological-report-2016-2014-data

**Figure 13: SSI rate per month for cardiac procedures with rolling average**



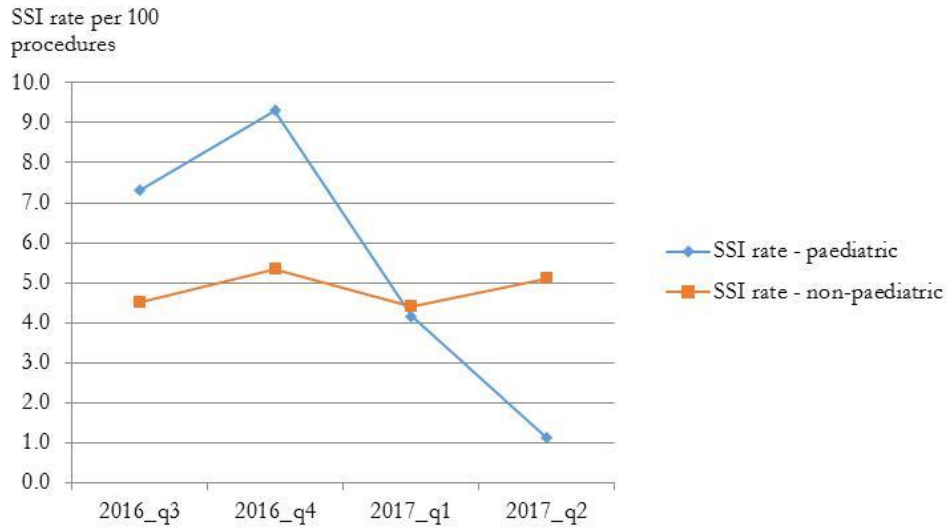

**Source:** Extract of National Monitor data; Sapere analysis

## Compositional analysis

Paediatric patients comprise about 12 per cent of cardiac patients in this period at between 72 and 89 patients per quarter.

It is notable that the SSI rate for paediatric patient was higher than that for non-paediatric patients in 2016q3–q4 and then has decreased in the following periods of 2017q1–q2. The rate for non-paediatric patients has remained relatively stable. This may be due to the smaller number of paediatric patients; the programme Clinical Lead has highlighted also that there is some potential variance in the data as superficial SSIs can be 'called' by surgeons on the basis of their clinical judgement. Further quarters of data are required before any trend can be identified with confidence.

**Figure 14: SSI rate for paediatric and non-paediatric patients**



It is clear that system-level compliance with the programme interventions has been relatively high for cardiac procedures from the outset.

It is not possible to draw any conclusions about the impact of the programme on SSI rates at this stage. (We note that preliminary analysis and testing does not yet indicate any significant trend. Also, the absence of a pre-programme baseline of data and a natural control group hinder our ability to detect change.)

The cardiac data has been collected and reported for four quarters only. Further time series data are required to assess the significance of any emergent trends.

# 4. Does the programme deliver value for money?

## 4.1 High level summary of our findings

**Key messages: Value for money – results of our CBA**

**Identification of costs and benefits**

- **There are two sources of cost –** those incurred centrally by the programme and an estimate of time taken by DHB staff to implement and operate the programme**.**
- **The benefits arise from SSIs that are avoided** as a result of the programme interventions. We compare a post-implementation SSI rate (the average of rates achieved during the two years 2015/16 and 2016/17) with two different counterfactual assumptions about what the SSI rate may have been in the absence of the programme (representing high- and low- benefit scenarios). We then consider the avoided cost of treating SSIs in hospital and the value to patients of avoided time spent in hospital for treatment of an SSI.

**Results for the high- and low-benefit scenarios from two time perspectives**

**We present results from two time perspectives** – a retrospective view of the programme to date (2012/13 to 2017/18) and a prospective view, comprising the period covered by the retrospective view and an additional 10-year projection period to 2027/28.

- For the retrospective view, the net benefit of the programme at the end of 2017/18 ranges from -$3.428 million to $5.274 million, with a benefit-cost ratio of 0.58 to 1.65 (depending on whether the low- or high-benefit counterfactual SSI rate assumptions are used).
- For the prospective view, from 2012/13 to 2027/28, the net benefit ranges from $1.812 million to $34.538 million, with the benefit-cost ratio ranging from 1.12 (breakeven) to 3.21. This more positive result is due to the cumulative effect of the estimated incremental annual benefits being higher than those of annual costs across the period.

**Interpretation of results – the programme at least reaches break-even and at best delivers good value for money**

We focus on the results over the prospective period (from 2012/13 to 2027/28):

- **Low-benefit scenario** – the results mean that the benefits of the programme would be at least equal to the costs, representing a break-even position.
- **High-benefit scenario** – under the high benefit scenario, it is clear that the programme provides good value for money with the benefits to the health system and to patients being materially higher than the costs of the programme. The programme achieves a cumulative net benefit (present value) of $34.5 million over the period to 2027/28, with benefits over three times as high as the costs.

There is a reasonable case for favouring a counterfactual leading to results towards the higher end of this range. We recognise also that there are a number of potential opportunities for the Commission and the DHBs to strengthen the value for money delivered by the programme in future years, explored further in our reflections presented at the end of this report.

## 4.2 Our approach

We assess the economic value of the programme by weighing up the relative costs and benefits attributed to programme activities, considered from a societal perspective Our approach to analysis is informed by the New Zealand Treasury guidance on methods and assumptions for completing social CBAs.[23]

### 4.2.1 Scope

#### Inclusions

We have quantified and compared in monetary terms the impact of cost and benefits on the health system and on patients.

**Costs:**

On the cost side of the evaluation, there are two areas of focus relating to:

- costs incurred by the Commission directly; and
- costs incurred by DHBs in implementing the Programme.

For the counterfactual scenario, in the absence of the Programme, we have assumed that these costs would not have been incurred.

**Benefits:**

The benefits arise from SSIs that are avoided as a result of the programme interventions; on this side of the evaluation, we consider:

- for the system, the avoided cost of treatment of SSIs in hospital; and
- for patients, the avoided time spent in hospital for treatment of an SSI.

#### Exclusions

Our scope relates only to the orthopaedic work-stream because, as indicated in section 3, it is too soon to make a reliable assessment of outcomes for the cardiac surgery work-stream.

### 4.2.2 Key modelling parameters

#### Result measures

The metrics developed to express our results are the net benefit (present value basis) and benefit-cost ratio of the programme.

#### Time horizon

The time-period for our analysis comprises the years in which programme costs were incurred, that is year 1 (2012/13) to year 6 (2017/18). Recognising that there were some

[23] New Zealand Treasury (2015) *Guide to Social Cost Benefit Analysis* .

significant costs incurred upfront, for example, those relating to development of programme infrastructure and processes, we look forward 10 years to consider the on-going stream of benefits alongside costs. We do this by holding constant the incremental cost and benefits identified in the most recent year of data.

### Discounting

As per the New Zealand Treasury guidance, we have used the public sector discount rate of 6 per cent to determine present value of the projected incremental costs, benefits and net benefit. This means that the cost and benefits, monetised and projected over the 10-year period from 2018/19 to 2027/28, are discounted at a rate of 6 per cent per year to bring them to a present value (i.e. today's money). This step reflects the time value of money (i.e. a dollar is typically worth more today than it would be a year from now) and effectively means that we give costs or benefits occurring later less weight than those that occur sooner. We then aggregate the annual costs and benefits (on a present value basis) so that we can subtract total costs from total benefits to give a net benefit (present value).

### Cost of raising public funds

Consistent with the Treasury guidance, to allow for the economic cost of raising taxation to provide funds for public expenditure, we apply an additional 20 per cent to all costs.

## 4.2.3 Identification and treatment of costs

In order to complete analysis of costs, we need to determine the level of expenditure invested in the programme rather than thinking from funding perspective. We acknowledge that in terms of funding, the expenditure identified below by the Commission includes the annual funding contributions made by ACC in the three years from 2015/16 to 2017/18, as well as the contributions levied from DHBs for the software licences over the same period.

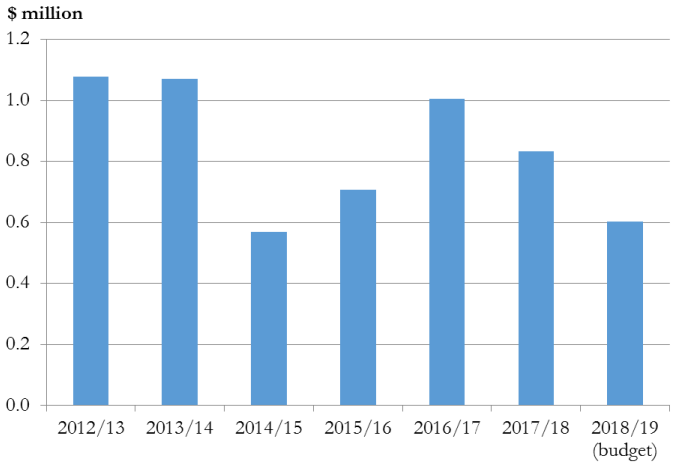
### Costs incurred by the programme directly

As a starting point, all costs incurred by the Commission since the programme started are potentially within scope, including work in 2012/13 prior to the launch of the programme. Figure 15 shows the direct costs incurred by the Commission, from 2012/13 to 2017/18. Over this period, the direct costs totalled $5.264 million, with the major components being:

- a contract with Canterbury DHB for overseeing development and implementation of the National Monitor database (33 per cent);
- Commission staffing costs (29 per cent); and
- a contract with Auckland DHB, primarily for clinical leadership (22 per cent) and initially, some additional project management support (which at a later stage was transferred in-house to the Commission).

Together, these components comprise 84 per cent of the costs incurred by the Commission. The remainder comprise a series of smaller components such as research, further clinical input, additional training and evaluation activities.

**Figure 15: Direct costs incurred by the Commission (raw data)**




**Source:** Health Quality & Safety Commission

Two steps are necessary to refine the estimate of the costs incurred by the Commission to support the orthopaedic stream of the programme.

Firstly, these direct costs are scaled-up by 20 per cent to reflect the corporate overhead costs of the Commission (this being the standard assumption used at the Commission).

Secondly, we must separate out the proportion of cost relevant to the orthopaedic work-stream. This is not straightforward given that a significant proportion of the upfront cost in the first two years related to building the programme infrastructure and processes that could support the cardiac surgery and other work-streams planned to follow later. For simplicity, we have allocated costs on the relative proportion of procedures captured for each specialty within the only full year of data for both work-streams (2016/17). This gives a ratio of 80 per cent to the orthopaedic stream and 20 per cent to the cardiac stream.

Table 7 summarises these steps and the resulting estimates of the annual cost incurred by the Commission. We use the budget set for the current year (i.e. $0.603 million in 2018/19) as the value for the annual on-going cost over the 10-year projection period.

**Table 7: Deriving costs incurred by the programme for the orthopaedic work-stream**

| Element | 2012/13 | 2013/14 | 2014/15 | 2015/16 | 2016/17 | 2017/18 | 2018/19 (budget) |
|---|---|---|---|---|---|---|---|
| Direct costs (orthopaedic and cardiac streams) | $1078,000 | $1,071,000 | $570,000 | $707,575 | $1,004,686 | $832,638 | $603,438 |
| Direct costs scaled-up by 20 per cent for overheads | $1,293,600 | $1,285,200 | $684,000 | $849,090 | $1,205,623 | $999,166 | $724,126 |
| Allocation of 80 per cent to orthopaedic stream | $1,034,880 | $1,028,160 | $547,200 | $679,272 | $964,499 | $799,333 | $579,300 |

**Source:** Health Quality & Safety Commission; Sapere analysis

## Costs incurred by DHBs

To gain an understanding of the costs incurred locally by DHBs in implementing the programme, we surveyed the DHB SSIIP champions about the resources typically allocated to the orthopaedic stream of the programme, in terms of time committed by staff members on a regular basis. We asked about the number of staff members involved, their position and time commitments (on either a monthly or a quarterly basis) for the following activities:

- data management – time usually spent on collecting, entering and checking data;
- case review – screening and analysis to determine if the definition for an SSI is met; and
- reporting – internal reporting, validation, discussion and actions taken.

We received responses from 15 out of 20 of the DHBs; the results were scaled-up to account for those that did not respond. We matched each missing DHB with a peer that is roughly equivalent in terms of the annual volume of procedures delivered.

The scaled-up results show that data management tends to incur the most time (at an average of 27 hours per month), followed by case review (at an average of 10 hours per month) and then reporting (at an average of 3 hours per month).

In terms of the people involved in these activities, we grouped the positions into four broad categories: administrator; registered nurse; clinical nurse specialist/clinical nurse manager; and senior medical officer. The time incurred by each group of staff was valued by applying an annual salary that could be considered 'typical' for the role, as per the reference sources detailed in Table 8 below.

We scaled-up the resulting direct costs by a factor of 20 per cent to allow for DHB corporate overheads (as these were not captured in the survey responses).

**Table 8: Position categories and monetary values**

| Position category | Annual salary | Source |
|---|---|---|
| Administrator | $41,300 | Pay scale website; average for a New Zealand hospital administrator role. |
| Registered nurse | $66,000 | NZNO MECA for 2017; grade 5 (out of 5) for registered nurses – assumes a senior nurse. |
| Clinical nurse manager/ clinical nurse specialist | $90,000 | NZNO MECA for 2017; grade 5 (out of 8) for senior nurses – assumes a relatively senior nurse. |
| Senior medical officer | $220,000 | ASMS MECA for 2017; grade 13 out of 13 for medical specialists – assumes a senior clinician. |

**Source:** NZNO and ASMS MECAs for 2017; Sapere analysis

We also need to consider what surveillance activity would have looked like in DHBs if the programme did not exist, to enable us to assess how much of the cost base identified above should be attributed to programme activity. Based on responses from DHBs prior to the launch of the programme, we have assumed that 80 per cent of the data management activities and 50 per cent of both case review and reporting activities are required as a result

of the presence of the programme. These assumptions acknowledge that there was some surveillance activity occurring among DHBs prior to the programme.

Under these assumptions, the estimate of the incremental cost collectively incurred by DHBs is $0.278 million per year. For simplicity, this assumption is applied for all years in which the programme has operated to date, and is carried forward into future years.

Table 9 summarises how we derived this incremental cost.

**Table 9: Incremental annual costs incurred by DHBs, by activity**

| Item | Data management | Case Review | Reporting | Total |
|---|---|---|---|---|
| Total cost for 20 DHBs including overheads | $260,400 | $105,876 | $33,287 | $399,593 |
| Proportion of cost attributable programme | 80% | 50% | 50% | 70% |
| Incremental cost of the programme | $208,344 | $52,938 | $16,643 | $277,925 |

**Source:** Survey of DHB SSIIP champions; Sapere analysis

## Summary of derived values for incremental costs

The estimates of the incremental costs attributable to the programme are summarised in Table 10 below:

**Table 10: Summary of incremental costs, by cost element**

| Cost element | Values used |
|---|---|
| Costs incurred by the programme | • Estimate of actual total costs incurred for the orthopaedic stream from 2012/13 ($1.035 million) to 2017/18 ($0.799 million). The figure applied for the projection of future years ($0.579 million) is based on the 2018/19 budget. |
| Costs incurred by DHBs | • $0.278 million per annum, based on the survey completed in 2018. This is assumed to be constant for the period of 2012/13 to 2017/18 and into the projection period. |
| Economic cost of taxation | • Adds 20 per cent to all costs, to account for the cost of raising revenue to fund public expenditure, as per the NZ Treasury guidance for cost benefit analysis. |

**Source:** Sapere analysis

### 4.2.4 Identifying and valuing benefits

## Impact of the programme on SSI rates

This evaluation has shown that the SSI rate per 100 hip and knee arthroplasty procedures has decreased over time, since implementation of the programme, from 1.23 in 2013/14 to 0.94 in 2015/16 and 1.01 in 2016/17. In addition, our findings point to the increasing uptake of the bundle of programme interventions as being a probable driver of the decreasing rate of orthopaedic SSIs.

Establishing a counterfactual (i.e. what would happen in the absence of the programme) is necessary to determine our estimate of the number of SSIs avoided as a result of the programme. Prior to the implementation of the SSIIP, we had no means of determining the rates of SSIs within New Zealand. We therefore consider two plausible scenarios, employing the assumptions outlined below.

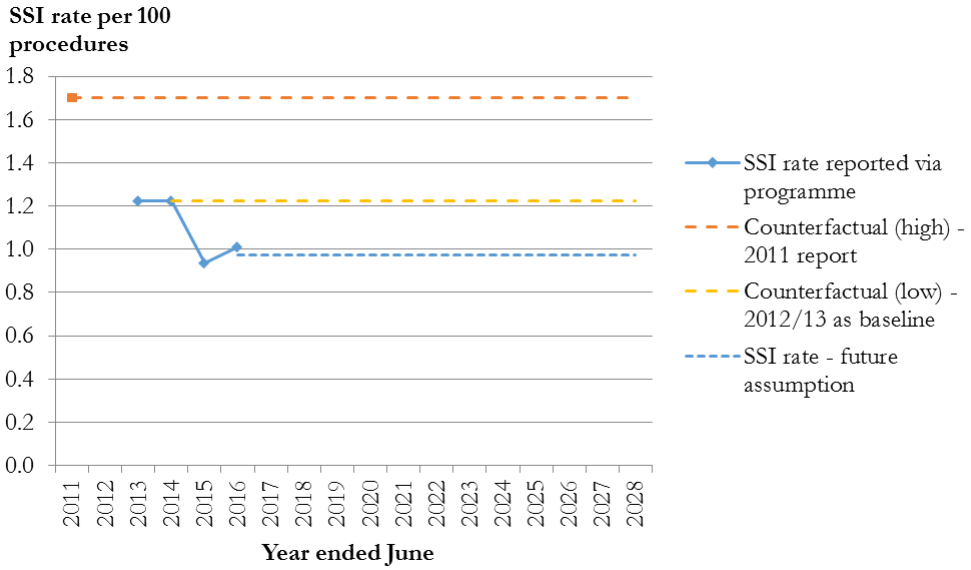
- **High benefit assumption** – the counterfactual is an SSI rate of 1.70 per 100 procedures, an assumption taken from an earlier Sapere report (2011) to the Commission. The report assessed the potential impact of establishing a national surveillance programme and, on the basis of a sample of data collected from some DHBs, this was the estimated rate of SSIs for orthopaedic joint procedures in New Zealand used as an assumption for the CBA completed at the time.[24]
- **Low benefit assumption** – the counterfactual is an SSI rate of 1.23 per 100 procedures, as observed in 2013/14, the first full year of data collection for the programme. This is a more conservative assumption, given that that programme had already started (particularly as for some DHBs, the roll-out of the programme had begun some months prior, in early 2013). Therefore, this rate may include an effect from the increased take-up of the programme interventions.

These counterfactual assumptions are set alongside the SSI rate achieved for two years of the programme (2015/16 and 2016/17) during which time there was an average rate of 0.97 per 100 procedures. This results in an annual reduction in the SSI rate, as a result of the programme, of between 0.73 per 100 procedures (43 per cent lower) for the high benefit assumption and 0.27 per 100 procedures (21 per cent lower) for the low benefit assumption. Figure 16, below, plots these assumptions about the counterfactual and future SSI rate.

These rates equate to between 34 and 97 SSI cases being avoided annually by 2027/28, depending on whether the low benefit or high benefit assumption is used.

[24] M Hefford et el (2011) *Cost benefit analysis of the proposed national surgical site infection surveillance and response programme,* Sapere Research Group.

**Figure 16: Assumptions about the SSI rate**




**Source:** Extract of National Monitor data; M Hefford et el (2011; Sapere analysis)

## Valuing the benefits – avoided SSI costs

To value the benefits to the health system of avoided SSI treatment costs, we draw on a recent study from Auckland Hospital in 2016 that determined a mean excess cost of $40,121 per SSI for hip or knee joint arthroplasty which is applied to each SSI case avoided.[25] This is similar to estimates obtained in other surgical infection-related studies in New Zealand.[26]

To value the benefit to patients of avoiding an SSI, we employ two key assumptions. Firstly, the mean number of excess bed days (41.9) resulting from a hip or knee joint arthroplasty as determined in the Auckland Hospital study cited above. Each patient's time (in terms of avoided time spent in hospital) is then valued, with the logic being that time in hospital would mean a lost opportunity for other activities, including work and leisure. We use a simple approach to derive a minimum monetary value for this time, using an hourly rate of $25.13, drawn from the Treasury's database of recommended value for one hour of an individual's time (which uses the average net income per hour for New Zealanders as a proxy).[27] This value is applied using an assumption of 16 waking hours per day.

---

25 Gow et al (2016) "Excess cost associated with primary hip and knee joint arthroplasty surgical site infections" in *NZMJ,* 1 April 2016, Vol. 129 No. 1432.

26 For example, Barnacle et al (2018) "Excess cost and inpatient stay of treating deep spinal surgical site infections" in NZMJ, 18 May 2018, Vol. 131 No. 1475, found a mean excess cost of $51,434 for spinal SSIs at Wellington Regional Hospital.

27 A study into the value that patients place on time spent in a hospital setting in the Netherlands found a comparable result, being €13.32 per hour (NZ $24.71) see: van den Berg et al (2013) "Attributing a Monetary Value to Patients' Time…" University of York, Centre for Heath Economics, CHE Research Paper 90.

### Summary of modelling assumptions regarding benefits

Table 11 summarises the assumptions used in modelling the incremental benefits

**Table 11: Summary of benefit assumptions**

| Assumption | Values used | Source |
|---|---|---|
| SSI rate from 2016/17 onwards (i.e. rate achieved after programme effect) | 0.97 | Average rate observed across 2015/16 and 2016/17 |
| Counterfactual SSI rate (i.e. in absence of programme) | High: 1.70<br>Low: 1.23 | High – 2011 Sapere report<br>Low – SSI rate in 2013/14 (from Programme data) |
| Reduction in SSI rate (on-going) | 0.73 - 0.27 | Difference between observed and counterfactual SSI rate |
| Future annual growth in procedure volumes | 2.0% | Increase in procedure volumes, from 2015/16 to 2016/17 |
| Mean excess cost per SSI | $40,121 | Gow et al (2016) |
| Mean excess bed days per SSI | 41.0 | Gow et al (2016) |
| Monetary value for an hour of patient time | $25.13 | Treasury CBAX database |
| Waking hours per day in hospital | 16.0 | assumption |

**Source:** Various, as stated; Sapere analysis

## 4.3 Our findings

### 4.3.1 Summary of results

The metrics by which we present our results (summarised in Table 12 below are the net benefit (present value basis) and benefit-cost ratio of the programme. We present these results from two different time perspectives:

- **a retrospective view**, comprising the period of programme operation to date (2012/13 to 2017/18); and
- **a prospective view**, comprising the period of programme operation to date and including an additional 10-year projection period out to 2027/28.

**Table 12: Summary of costs benefit analysis results**

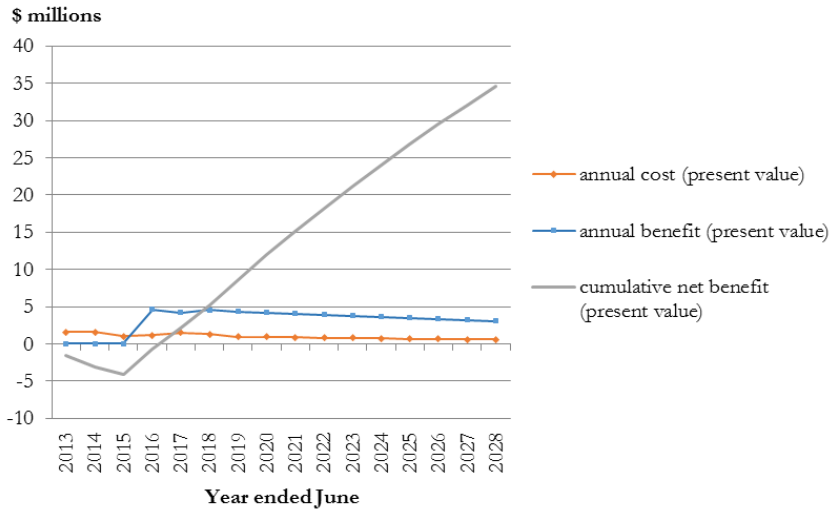
| Assumption | Retrospective view 2012/13 to 2017/18 | Prospective view 2012/13 to 2027/28 |
|---|---|---|
| **Net benefit (present value)** | | |
| High benefit scenario | $5.274 million | $34.538 million |
| Low benefit scenario | -$3.428 million | $1.812 million |
| **Benefit-cost ratio** | | |
| High benefit scenario | 1.65 | 3.21 |
| Low benefit scenario | 0.58 | 1.12 |

## 4.3.2 What do these results mean?

### Interpreting the metrics presented

Under the high benefit assumption, the net benefit of the programme at the end of 2017/18 is positive, being $5.274 million with a benefit-cost ratio of 1.65. This suggests that society is better off following implementation of the programme, with the benefits valued as being almost one-and-a-half times as high as the costs. For the prospective view to 2027/28, the net benefit is significantly higher at $34.538 million with the benefit-cost ratio being 3.21, indicating that the benefits are more than three times as high as the costs in that timeframe. This more positive result is due to the cumulative effect from the estimate of the incremental annual benefits being higher than the incremental annual costs across the 10-year projection period from 2017/18 onwards.

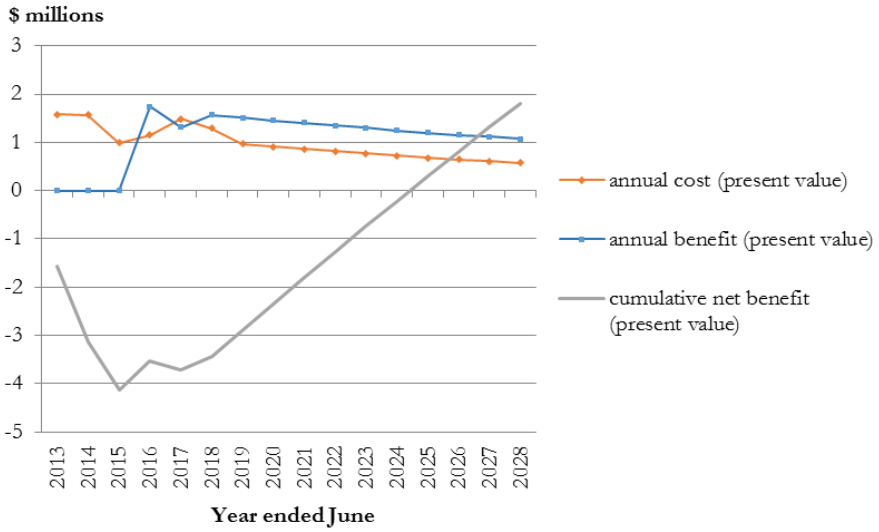
**Figure 17: Cost benefit analysis results – high benefit scenario**




**Source:** Sapere analysis

Under the low benefit assumption, the net benefit is negative at -$3.428 million at the end of 2017/18, with the benefit cost ratio being 0.58 – i.e. the benefits equate to just over half of the costs. For the prospective view, the net benefit is positive at $1.812 million in 2027/28 with the benefit-cost ratio being 1.12. This result means that under this low benefit assumption, the programme would reach breakeven (i.e. begin to pay for itself) by 2024/25, with the benefits being 12 per cent higher than the costs by 2027/28.

**Figure 18: Cost benefit analysis results – low benefit scenario**




**Source:** Sapere analysis

## The range of results indicates that at minimum the programme reaches break-even and at best delivers good value for money

Overall, when we consider the results of this cost benefit analysis over the prospective period (from 2012/13 to 2027/28) from a conservative view (under the low benefit scenario) we see that benefits delivered by the programme would be at least equal to the costs incurred. This represents a break-even position.

Under the high benefit scenario, it is clear that the programme provides good value for money with the benefits to the health system and to patients being materially higher than the costs of establishing and running the programme. The programme achieves a cumulative net benefit (present value) of $34 million over the period to 2027/28, with benefits being three times as high as the costs.

The spread in the results is driven by the difference between the low and high assumptions about the counterfactual SSI rate, that is, the extent to which patients avoid SSIs due to the interventions they receive as part of the programme. Using this range acknowledges that there is some uncertainty in the absence of a comprehensive baseline prior to the programme.

Alongside this, there is a reasonable case for favouring a counterfactual SSI rate towards the higher end of this range. This is because the lower counterfactual assumption, based on the observed SSI rate in 2012/13, is likely to include some effect of the programme from the

roll-out of interventions starting from the beginning of 2013 and the increased focus and awareness of best practice in the lead up to the programme launch.

We recognise also that there are a number of potential opportunities for the Commission and the DHBs to strengthen further the value for money delivered by the programme in future years. We explore this potential further in our concluding reflections presented in section 6 at the end of this report.

## 4.4 Further exploration of our results

### 4.4.1 Additional scenario – impact of the 'anti-staph bundle'

Data collected on SSIs shows that approximately 30 per cent of SSIs associated with hip and knee arthroplasty procedures are due to the bacterium, staphylococcus aureus (S. aureus). The Commission asked the Royal Australasian College of Surgeons to conduct a meta-analysis of interventions used internationally to reduce the risk of SSI in patients that are colonised with S. aureus. The College concluded that there was potential for further reduction in the SSI rate, by up to 50 per cent, from implementing an additional set of pre-theatre interventions.

Following this, six DHBs and three private hospitals participated in an 'anti-staph' quality improvement collaborative during 2017/18 that involved a set of preoperative interventions known as the 'anti-staph bundle' (relating to screening, skin decolonisation and nasal decolonisation).

On this basis, we have modelled a further, more positive scenario for this cost benefit analysis in which the 'anti-staph bundle' contributes to the SSI rate being further reduced from 2018/19 onwards. The Evaluation Steering Group determined that we should apply a conservative assumption of a further reduction of the SSI rate by 10 per cent (i.e. the SSI rate reduces from 0.97 to 0.88 per 100 procedures).

As we would expect, this additional scenario delivers an improved result, with the impacts under prospective view (i.e. looking out to 2027/28) as noted below:

- Under the high benefit assumption, the net benefit improves from $34.538 million to $39.462 million with the benefit-cost ratio being 3.21 to 3.52.
- Under the low benefit assumption, the net benefit improves from $1.812 million to $6,736 million with the benefit-cost ratio being 1.12 to 1.43.

These results show the material improvement in the net benefit of the programme that would be delivered from a relatively conservative assumption about the positive impact of the 'anti-staph bundle'.

### 4.4.2 Limitations of a CBA approach

#### Potential benefits regarding practice change not captured within our scope

Cost benefit analysis is often applied within economic evaluation of health care interventions. The methodology is straight forward to implement and easy to interpret, as the all costs and benefits captured are converted to monetary values. It can be helpful to support prioritisation when choices must be made in the face of limited resources and to help understand differences in access to or benefits from health care received by different groups.

However, we recognise that the scope for the CBA adopted in this evaluation may not have captured fully the range of feasible benefits from the programme. We acknowledge that there are other potential benefits less easy to measure that may also have had a beneficial effect.

- The bundle of Programme interventions are now in place for all orthopaedic procedures, so there may have been similar reductions in SSI rates for other procedures though the SSI data is not captured.
- As many orthopaedic surgeons work across both the public and private sectors (with about 50 per cent of all hip and knee replacements in NZ performed in the private sector) there may also have been a transfer of best practice to the private surgical hospital sector. Any reductions in SSIs relating to private procedures would benefit the public system as all SSIs are treated in DHB funded hospitals.
- Similarly, there is likely to have been a wider spread of best practice to other specialties that will not have been accounted for under our scope.

#### Valuing benefits to patients

Within the limited scope of our evaluation and resource available, we did not have time available to collect data directly from patients and we were limited to using what was already available. However, we recognise that measuring the number of hours spent in hospital on average by patients, and valuing that time through an informed but notional value for an hourly rate, is a relatively crude method. There is little doubt that this under-estimates the significant and potentially devastating impact experiencing an SSI may have on a patient, in terms of both additional time (spent recovering and dealing with on-going health impacts) and experiencing pain, suffering and reduced quality of life.

Further, patients do not leave hospital and return straight back to the workforce; there will be on-going DHB-funded community-based treatment for many and on-going loss of income for the individual.

In an attempt to take better account of the impact on patients experiencing SSIs, in a recent article published in the NZ Medical Journal,[28] members of the Programme team explored the impact of the programme as measured by Disability Adjusted Life Years (DALYs).

[28] Morris, A. J. (2018). The New Zealand Surgical Site Infection Improvement (SSII) Programme: a national quality improvement programme reducing orthopaedic surgical site infections. . NZMJ, 45-56.

The DALY combines the likely shortening of life (years of life lost) with the loss of quality of life (years of life disabled) to measure the effect on individuals and populations of specific illnesses and harms. In a European study completed in 2016, experiencing an SSI was estimated to cost a patient 0.5 disability adjusted life years.[29]

The Commission used this value, along with the estimated Value of a Statistical Life (VOSL) in New Zealand[30], to determine that each avoided SSI represented a value of $90,000 per patient. As stated in the NZMJ article, the 55 SSIs for hip and knee replacements avoided from August 2015 to June 2017, represented avoided DALYs worth NZD$5 million in total to the patients concerned.

Subsequently, in the June 2018 publication of 'Open for Results',[31] the Commission estimated that on the basis of a further six-months National Monitor data (through to December 2017), a total of 77 SSIs had been avoided at an estimated DALY value of $6.5 million.

On the basis of this same method of calculation, using the results obtained from our CBA we estimate that for the low benefit scenario 34 SSIs are avoided on an annual basis and for the high benefit assumptions 97 SSIs, equating to an annual estimated avoided DALY value of between $3.06 million and $8.73 million.

---

29 Cassini A, Plachouras D, Eckmanns T, et al. Burden of Six Healthcare-Associated Infections on European Population Health: Estimating Incidence-Based Disability-Adjusted Life Years through a Population Prevalence-Based Modelling Study. PLoS Med. 2016 Oct 18;13(10):e1002150.

30 VSOL and adjustment for annual value per patient sourced from: O'Dea D, Wren J. 2010. NZ Estimates of the total social and economic costs of "all injuries" and the six priority areas respectively, at June 2008 prices: technical report prepared for NZIPS, Evaluation. ACC: Wellington.

31 https://www.hqsc.govt.nz/assets/Health-Quality-Evaluation/PR/Open4ResultsJune2018_final.pdf

# 5. Update against other areas of the evaluation framework

In this section, we update findings from our qualitative research as to the effectiveness of the programme against its objectives and provide a summative assessment of performance against aspects of the four quadrants of our evaluation framework (as summarised in section 1.3.1 on page 7).

## 5.1 Preface

### 5.1.1 Positioning of our updated findings

Qualitative assessment against the key research questions was a significant focus of our formative evaluation. For this final report, our emphasis has been on any key areas of change or development since the conclusions reached in our last assessment. We provide an update on specific issues raised in the formative evaluation that have been addressed subsequently by the Commission,

In particular, in our previous report we did not examine the cardiac work-stream in any detail (given that during our data collection process the design and establishment was still underway).

### 5.1.2 Process

We note that our qualitative process at this stage has not involved such extensive direct engagement across DHBs as completed for our formative evaluation. Our focus has been on review of programme documentation and discussions with key programme staff. We have completed also a range of interviews with stakeholders involved in the cardiac programme (including Arthur Morris, the SSII programme clinical lead) and we provide specific commentary in relation to this work-stream where applicable.

## 5.2 How well does the SSII programme deliver on objectives?

The over-arching goal of reducing SSI rates (assessed in section 3) is supported by four programme objectives. As outlined below, we have found evidence of incremental progress towards each of them.

### 1. Consistent approach to the monitoring of SSIs

The programme has delivered standardised definitions, a national data repository and consistent reporting of SSIs in two surgical areas.

Although there is not yet a consistent approach as to how the DHBs enter the data into the national system, the Commission has a focus on supporting DHBs with options to reduce

reliance on manual data entry (which remains the key barrier to further expansion of the programme coverage).

## 2. Accurate outcome/process measurement and reporting for SSIs

The programme has led to the collection of standardised, nationally comparable data in relation to SSIs on the selected orthopaedic and cardiac procedures in the National Monitor. Process and outcome measures are in place for selected procedures.

In the interim report, we noted that most orthopaedic surgeons and clinical directors from DHBs interviewed expressed the view that the dataset was clean and accurate. Since then, there has been a significant programme of work on cleansing and validating historic data, as well as putting in place mechanism to support local DHBs in on-going validation of the accuracy of data.

## 3. Lead quality improvement through the use of high quality data

When the programme was established, the initial priority for the Commission team (which was relatively small at the time) was to develop the infrastructure, systems and processes, including designing and building the National Monitor, in order to get data collection and reporting processes up and running.

As time has gone on, the focus has moved towards supporting DHBs to use SSI data to support quality improvement. In our last report, we signalled this remained 'work in progress', as the programme team was developing ways to help develop build capability across the sector.

During this final stage of our evaluation, we have seen evidence of a range of tools and events put in place by the Commission to help build the quality improvement and analytical skills needed by DHB staff to use local and national data. We note that initiatives such as the reducing *Staphylococcus aureus* SSI collaborative have targeted both orthopaedic and cardiac work-streams. Our process for this stage has not allowed us re-test perceptions of staff across all DHBs directly (as we have engaged only with clinicians involved in the cardiac work-stream). However, we have a sense that while the orthopaedic work-stream has reached a state of relative maturity, with DHB staff able to access and use available data (which now covers over four years of activity), the Commission has not yet won 'hearts and minds' of all cardiac teams in relation to the value and potential of the programme. As we explore further in section 5.3.5 below, some DHB stakeholders question the potential value of the programme for cardiac procedures, particularly given that there is already high compliance with the bundle of interventions. We recognise that there is currently only a limited time series of national data available[32]; as was the case with the orthopaedic stream, it is probable that once the richness of the dataset deepens, perceptions as to the value of the programme may change.

[32] Individual DHBs can access their local data from when they started entering it on National Monitor.

### 4. Drive culture and behaviour change through reporting back

Studies conducted in the 1980s showed that 'surveillance and infection control programmes that included the collection, analysis and feedback of data on infection rates to surgeons were associated with significant reductions in rates of SSI'.[33]

During the past year, the programme team has undertaken work to improve the quality and relevance of SSI reports provided to DHBs and to develop tools to support the use of local data.

The SSII programme Clinical Lead has attended meetings of regional networks (where they are active) to present on risk factors for SSI and regional SSI data.

## 5.3 Update for other evaluation quadrants

### 5.3.1 Implementation approach

#### How well has the SSII programme been implemented?

***Full participation in the national SSII programme has been sustained and compliance with recommended clinical interventions is increasingly high***

Since late 2013 for orthopaedic procedures and July 2016 for cardiac, all DHBs have been submitting data to the programme. Given the competing pressures on DHB resources and time, this is a significant achievement and indicator of effective implementation.

Furthermore, compliance with recommended interventions is improving for orthopaedic procedures. For cardiac procedures, the proportion receiving all three programme interventions has been relatively high from the outset, though it has fluctuated slightly by quarter. It is too early for assessment of trends.

We note that the clinical intervention guidelines for orthopaedic and cardiac are currently under review; we understand that there are no major changes anticipated but that there is an intention to improve operations manuals to make them more user-friendly.

***There were some delays in the planned implementation of the cardiac work-stream – primarily as a result of on-going issues with National Monitor data collection***

It took some time and effort for the Commission to achieve full participation by the five relevant DHBs. There were discussions with DHBs about the scope of procedures and coverage of data-points. The primary cause for delay related to on-going problems with manual data collection. All five DHBs have been submitting data since July 2016.

[33] https://www.ncbi.nlm.nih.gov/books/NBK53724/

## Were the resources available to support the SSII programme appropriate?

***Staff within several DHBs are mindful of the extra burden of work associated with the cardiac work-stream (with no additional staffing resource provided to support local implementation)***

The programme developed a range of resources to support DHBs in implementing the cardiac programme and provided support to help streamline the data collection process.

However, as was the case with roll-out of the orthopaedic work-stream, staff within a number of DHBs raised concern about the lack of additional staffing resource to cover the additional workload associated with local data collection. There were already data collection requirements on DHBs to support the National Cardiac Surgery Register. DHBs were aware that the SSI programme had different definitions and requirements; this may have influenced their views on the extra burden work.

## What have been the key barriers/enablers at a local level?

The most frequently reported barriers to local implementation were lack of engagement by surgeons and manual data collection systems.

# 5.3.2 Fostering practice change

## To what extent does the SSII programme contribute towards practice change?

***There is evidence of changed practice showing improvement in compliance over time on the process measures for orthopaedic procedures***

Compliance with recommended interventions is improving for orthopaedic procedures. Uptake of all three interventions has increased from 66 per cent at 2014q2 to 96 per cent at 2017q3. As we noted in the interim report, in the early days of the orthopaedic work-steam many clinicians reported that they were already using the proposed interventions but early baselines indicated that this was not the case.

***For cardiac procedures, compliance rates have been high from the outset***

Overall, the proportion of cardiac procedures receiving all three of the programme interventions has averaged 94.1 per cent over the four quarters from 2016q3 to 2017q2. In comparison, at for the orthopaedic work-stream, compliance with all three interventions started out at only 45 per cent for the first quarter (2013q3), moving to above 90 per cent within a year and staying above that point thereafter.

***Given high compliance, some clinicians questioned the value of monitoring the programme interventions for cardiac surgery – however, there has been some volatility across the quarters and there is some potential for further standardisation of practice towards 100 per cent***

Some staff within DHBs had reservations about whether the effort in monitoring compliance with programme interventions was worthwhile, suggesting they are already part of standardised clinical practice for cardiac surgery.

It is beyond the scope of our mandate to make any judgement as to whether these are an appropriate and relevant set of interventions for cardiac surgery.

However, we note that while overall compliance rates are high, there has been some volatility of performance across quarters meaning that there is some potential for further standardisation of practice to move the average towards the 100 per cent level.

Furthermore, the programme team highlighted that given the delays experienced for the cardiac work-stream (as a result of data collection difficulties), some DHBs commenced earlier than others – by the time the first report was published (on the basis of data from all five participating DHBs) there may well have been some early improvement in compliance secured already. While informal practice spread is positive, it is not feasible to test this retrospectively and there may not be a real baseline to facilitate understanding of impact of the programme on infection rates.

We also recognise that the risk of potential SSI tends to be much higher for cardiac than orthopaedic procedures; while improvement in process compliance is constrained, there is a greater potential scale of improvement in the infection rate. Close monitoring of the relationship between compliance and the rate of SSIs over time will enable the programme to test whether the interventions are appropriate to reduce SSI rates for cardiac procedures.

***Another surgeon recognised the value of the national dataset, the opportunity for further improvement in compliance with the three interventions and having in place a process to support standardised introduction of new interventions in the future***

Another surgeon we spoke with emphasised the devastating potential impact of SSIs for cardiac patients and supported any potential actions that will reduce the level of risk of incidence. On an individual basis, it was important for surgeons to be aware of any infections that occur once the patient has returned home and systems need to be in place to ensure that always happens. At a system level, there was need to identify and monitor clusters of infections and identify if wider action is required.

Looking to the future, the fact that the programme in place provides a platform to support efficient introduction of other interventions identified as best practice. Indeed, the programme team pointed to other potential interventions within cardiac surgery such as monitoring of temperature, glucose levels, obesity and length of stay in hospital. However, as these would be more difficult to introduce, the initial focus was to establish the programme and to embed data collection and monitoring processes, before attempting to extend the range of interventions further.

## How likely is practice change to spread to other surgical areas?

***Programmes such as the IPC QIF programme support the spread of good practice to other surgical areas***

The Commission established the IPC QIF programme as a sector capability building initiative. As well as transferring valuable skills to participants, through the project-based approach it also supports the spread of good practice to surgical areas beyond the scope of the SSII data collection process. For example, recent initiatives included projects: to reduce SSI rates for caesarean sections (in four DHBs); to reduce SSIs post umbilical hernia repair; and to reduce ventilator associated pneumonia.

The programme clinical leads have suggested that the cardiac work-stream provides another example of informal spread, in that anaesthetists began to adopt the bundle of interventions before programme came on board officially.

***There are no firm plans to roll-out the SSII programme formally to any other specialties/procedures – the continuation of manual data collection for many DHBs is the primary barrier to expansion***

As we reported in the interim evaluation, the continuation of manual data collection for many DHBs is a clear limiting factor on expansion of the programme. (In section 5.3.3, we cover initiatives and plans to address the reliance on manual data collection for some DHBs further.)

## How effective are the SSII programme's capability building activities?

***Commission led interactive capability building programmes (such the QIF and consumer co-design programmes delivered by Ko Awatea) have been well received by DHB participants***

Informal feedback from DHB participants on the value of participating in these programmes has been positive. There was no formal evaluation of the consumer co-design programme (though the Commission reviewed copies of completed workbooks by participants) and the evaluation of the QIF programme completed by the Commission was not available at the time of writing this report.

***Analysis of pre and post assessment scores from Quality Improvement Facilitators Programme (QIF) illustrate a positive impact on knowledge, skills and belief in the ability of IPC nurses to lead change and make a positive difference in their day to day work***

Participants on the QIF Programme (2016–2017) reported significant post assessment improvement in knowledge and skills. In addition, IPC nurses had greater confidence in their ability to lead change and make a positive difference in their day-to-day work. The Australian Commission of Safety and Quality in Health Care has shown some interest in adopting the QIF model.

***Capability building is now a key focus area for the programme; this strongly aligns with the current strategic direction of the Commission***

In early days of the programme, the primary focus of work had to be on building the systems, procedures and processes to establish the infrastructure and mechanisms for establishing a national dataset.

Though work continues to refine and develop the programme infrastructure, there is now a clear focus on capability building in quality improvement skills and knowledge across the sector to support DHBs locally in using and learning from SSII programme data.

This aligns strongly with the current strategic direction of the Commission and the organisation's approach to system change. As stated in the 2017–2021 statement of intent, that approach:

> *"…relies on using the combined influence of our improvement programmes, the measurement and evaluation we create and interpret, and building quality improvement capability in the sector. These factors increase the momentum for positive transformation and greater value."*

***Clinical leaders and programme staff have increasing presence on national/international stage, reflecting the perceived value and interest in learning from the New Zealand experience of SSII***

Some examples of this include:

- Dr Arthur Morris published an article in the December 2017 edition of New Zealand Anaesthesia magazine, *Surgical antibiotic prophylaxis: getting it right.*
- There have been two articles published in the New Zealand Medical Journal relating to the programme in:
  - April 2016, regarding excess cost associated with primary hip and knee joint arthroplasty surgical site infections: a driver to support investment in quality improvement strategies to reduce infection rates; and
  - September 2017, regarding BMI as a key risk factor for early periprosthetic joint infection following total hip and knee arthroplasty.
- Dr Arthur Morris presented on the SSII programme at the IPC Nurses Conference in in Auckland (16 October 2017). He focused on the programme's success and risk factors. Nikki Grae followed with an update on the work to reduce *Staphylococcus aureus* related SSIs.
- Nikki Grae presented a poster on the SSII programme at the International Consortium for Prevention & Infection Control (ICPIC) conference in Geneva (June 2017).
- Dr Sally Roberts presented on the SSI programme at the NZ Orthopaedics Association's annual meeting (17 October 2017).
- Dr Sally Roberts gave presentations in the UK as follows:
  - Public Health England – Centre for Infectious Diseases Surveillance and Control (6th June 2017)
  - Health Protection Scotland Healthcare-associated Infection and Infection Control Service (26th June 2017)

- Lynette Drew and Nikki Grae presented at the Australasian College for Infection Prevention and Control (ACIPC) conference in Canberra on the IPC Quality Improvement Facilitator (QIF) programme.

***The programme is developing new and innovative ways of working, such as the 'work with the willing' approach to implementation of the reducing Staphylococcus aureus SSI initiative***

The Commission has adopted a new 'work with the willing' approach to the reducing *Staphylococcus aureus* collaborative. Rather than requiring participation from all DHBs, only those with an interest in participating have taken part. The approach to testing and refining the initiative has been a highly collaborative, group-based way of working.

Though there are no formal evaluation results yet available, this new model of working appears to be useful. There is good buy-in, with six DHBs actively participating at present. There is potential for further expansion of coverage with another tranche of activity. Furthermore, for the first time private hospitals (including Southern Cross Hospital, Hamilton and Accurity Health – Bowen and Wakefield, Wellington) are participating in the initiative. This may offer a new model of working for application in other Commission quality improvement initiatives.

***The Commission has taken opportunities to develop a range of tools to support practice change and has demonstrated a commitment to sharing learnings/best practice***

The programme has demonstrated a commitment to supporting and sharing learnings proactively across DHBs. For example, on the reducing *Staphylococcus aureus* SSI collaborative, the national team is currently collecting an inventory of current progress and materials, to help determine how they can best support hospital teams further. Training, education, and compliance documents, as developed by teams, will be shared across collaborative participants to reduce duplication of work.

### 5.3.3 Data and systems update

## Were the data collection process and systems appropriate?

***The SSII programme team has taken a proactive approach to improving national reporting and tools available to support DHBs in understanding and using data***

There have been a range of changes (developed in consultation with DHB representatives) to the standard reports produced by the programme team. These have included examples such as producing a briefer quarterly draft report for review by DHBs. This report focuses on QSMs and other relevant data for the current period of review. It also refers the reader to the relevant report in the national monitor to review the data and drill down further (including information only relevant to a specific DHB). The programme team is planning a more detailed annual report (including analysis of trends and a potential focus on risk factors).

Further potential developments include an intention to produce an SSII programme dashboard and to seek further DHB feedback on useful changes or additions via a survey.

***Discussions are underway to agree a prioritised programme of work with Baxter to address on-going issues and to further develop the National Monitor***

As outlined further below, the Commission now has a more direct relationship with Baxter, the ICNet and National Monitor vendor.

Over the last 12 months, there have been some minor developments to improve usability of the system by DHBs. For example, Baxter has developed a new report for use by the programme that can extract the full dataset or a specified sub-section in a matter of seconds. Previously it would take a couple of hours to extract the full data set.

Discussions are underway to agree a prioritised programme of work with Baxter to address on-going issues and to develop the National Monitor further.

One possible development is to identify how DHBs (or groups of DHBs) could submit SSI data in relation to any surgical specialty/procedure (e.g. such as creating a generic data collection form). This would enable DHBs to focus and analyse local information on priority areas locally. Discussions are underway with Baxter as to the changes that would be required to the form; further consultation with DHBs is required.

***For the cardiac work-stream specifically, there were particular issues with data collection initially, given manual processes were still in place***

For the cardiac work-stream specifically, there were particular issues with data collection initially, given that there was still a need to collect data manually when the cardiac SSII programme began.

In addition, data definitions were different for the SSII programme and the National Cardiac Surgery Register (a system mandated by the Ministry of Health). The main difference is the follow up surveillance period; this is 30 days for the National Cardiac Registry and 90 days for the SSII programme. This added to the sense of the additional burden of work by DHBs associated with data collection for cardiac procedures.

***All DHBs (not just those participating directly in the cardiac surgery programme) need to monitor admissions to local hospitals following cardiac procedures undertaken in tertiary units***

As a tertiary service the five DHBs that perform cardiac surgery will be treating patients from across the country. This raises other issues in terms of surveillance.

DHBs that are not direct participants of the cardiac programme, are contributing to the programme through surveillance of readmissions of their resident patients locally following cardiac surgery in the tertiary unit. Each 'Cardiac DHB' has a process in place to check with referring DHBs for readmissions due to an infection. The programme team has advised that the number of cases per referring DHB is small.

Despite this, some DHBs had the perception that this was an additional burden on the IPC teams; unless the referral is in the same region and the DHBs have ICNet, as these cases cannot be identified electronically.

***DHBs use other cardiac data registries that employ different definitions (for example for the surveillance period) and processes. This may influence the perceptions of***

***some DHB staff about the additional burden of work from the cardiac work-stream (as they are already collecting data)***

**Dendrite**

The Cardiac Surgery Register uses Dendrite Clinical Systems of databases and registries. The Ministry of Health mandated use of this system. Auckland DHB was not using it at time of our first report but is due to change to Dendrite in the near future.

The Cardiac Registry dataset requires different items and uses different definitions. One of the main differences is the surveillance period (as Dendrite uses a 30-day surveillance period and the SSII programme 90 day).

EFG members noted that a data matching process between the two databases was explored, with Capital and Coast DHB undertaking a trial. We understand that a gap analysis has been completed and discussions are underway about developing a local module that would work across the two systems. The New Zealand Cardiac Surgery National Report 2015[34] (p. 6, 2016) outlines the intention of NZCS to develop a module that will allow the on-going monitoring of the SSII programme

There have been competing demands between the needs of the Network and the SSII programme. The implementation of Dendrite was not as simple as expected. Additional local servers in each unit were required, which was unexpected, followed by an upgrade which has meant the additional SSII programme needs have been put to one side. This has been a significant factor in delaying progress on the programme.

**Association for European Paediatric and Congenital Cardiology**

Data relating to paediatric and congenital cardiac procedures (which are only performed at Starship Children's Hospital, (or Auckland City Hospital for adult patients with a congenital heart condition) Auckland District Health Board) has been submitted to the National Monitor since January 2016. The national paediatric and congenital cardiac service also submits data to the Association for European Paediatric and Congenital Cardiology (AEPC) to enable international benchmarking for paediatric cardiac surgery, which is important due to the small volumes in New Zealand. However, as a national service, there is sufficient administration support available to support data entry across two databases.

## How is the programme supporting DHBs to reduce manual data collection in the National Monitor?

***The Commission has a clear focus on finding ways to reduce manual data collection in the National Monitor (with support for DHBs, development of tools and roll-out of ICNet)***

In the interim report, one of the key concerns highlighted by staff in some DHBs was frustration about reliance on manual rather than automated data collection for National

[34] The New Zealand Cardiac Surgery National Report 2015

Monitor. (This was in part associated with the limited roll-out of full ICNet system across DHBs.)

Review of programme documentation (and our recent discussions with members of the SSII programme team) showed that identifying and implementing initiatives to address these limitations is a clear area of focus. We provide some examples below:

- The programme has funded a part-time Business Analyst (working out of CDHB) over the past 18 months. This function included working with DHBs to improve the ease of submitting data and their ability to use the data at a local level.
- With support from the business analyst, Southland Hospital tested a CSV data upload process; they now have semi-automated data collection for around 90 per cent of the orthopaedic surgery data fields. CDHB are now working with Dunedin hospital to replicate the process. This will be shared as a case study with other DHBs.

At the time of producing this report, approximately one third of DHBs have some form of automation in place:

- Canterbury, West Coast and Taranaki DHBs now use the local ICNet system to populate the SSII data;
- Auckland and Counties Manukau DHBs have automated data collection and upload via a CSV file;
- Southland Hospital has automated their orthopaedic data collection; and
- Waikato DHB has automated their cardiac data collection and is in the process of automating orthopaedic data collection.

We understand the Capital and Coast DHB have experienced some delays in automating their cardiac data collection.

***ACC is providing seed investment in the ICNet Platform Project to encourage expanded and nationally consistent use of ICNet by DHBs***

This initiative, established and funded by the ACC Treatment Injury Prevention programme, is engaging with all DHBs, with an aim for five additional DHBs to get business case approval for the use of ICNet. Members of senior staff from the Commission are contributing to the project as members on working groups and the Leadership Group, which includes identifying linkages between the local ICNet rollout project and the National Monitor.

## How was the quality of data assured?

***Data cleaning and validation of historical data has been completed***

Since September 2017, the SSII programme has undertaken work on data cleaning and validation, as part of a process to reconcile the SSI reports with the original SSI forms and data held in the National Monitor.

This process led to changes such as deletion of duplicate records and those relating to out of scope procedures, and addition of those within scope excluded incorrectly. The national quarterly SSI rates were unchanged except for the October–December 2013 quarter, during which the SSI rate dropped from 1.3 per cent to 1.1 per cent. These changes are now

reflected in all published reports on the Commission website and are included within the analysis presented in this report.

***DHBs are supported in efforts to cleanse and validate current data***

The Commission has instigated a range of tools and procedures to support DHBs in efforts to cleanse and validate data. It is encouraging champions to ensure they are reviewing their National Monitor data thoroughly and on a continuous basis. Examples include:

- development of a suite of reports in the National Monitor to support data checking, including distribution of short video clips demonstrating the new reports and their potential application;
- validation alerts to support checking and correction of anomalies;
- redesign of a more focussed draft report to streamline the DHB data review process; and
- undertaking a survey of users to improve the report format further.

Furthermore, the SSII programme clinical lead has been engaging with the NZ Joint Registry to explore the potential for an additional validation check on data quality and to look at revisions for infection in more depth. The data matching exercise will enable the programme team to investigate risk for SSI more comprehensively. The programme will start by reviewing matched data for a specific procedure over a defined period e.g. hips for one quarter before undertaking a full match.

### 5.3.4 Governance and programme management

## Are the governance structures and processes 'fit for purpose'?

***There has always been a strong, clearly articulated purpose for the programme and the long-standing commitment of lead clinicians has provided continuity and direction***

There has always been a strong, clearly articulated purpose for the programme enabling the Commission Board and the wider sector to take a long-term view on continued investment.

Clinical leadership of the programme remains strong and clinical leaders are well integrated into governance structures and processes. The long-standing commitment of lead clinicians had provided continuity and direction to the programme.

***Governance arrangements for the programme are clear and appear to work smoothly and effectively – the governance structure is more streamlined, following the dis-establishment of the SSII programme steering group***

In the interim report, we noted some overlap of roles between groups and potential redundancy within the governance framework. Since then, the SSII programme steering group has been dis-established. SIPCAG (the Strategic Infection Prevention and Control Advisory Group) and the EFGs provide advice and guidance to the programme. Removal of the Steering Group has helped to streamline governance structures and to clarify roles and responsibilities.

The streamlined governance arrangements for the programme are clear and in broad terms, appear to work effectively. The programme way of working is highly collaborative and the arrangements allow significant opportunities for sector stakeholders to provide advice and guidance. Decision rights regarding the future strategic direction of the programme remain with the primary funders (the Commission Board, supported by the Programme team) working in conjunction with other funding contributors (such as ACC and the DHBs through their local investment).

***There are potential improvements to the way in which EFGs function within the governance structure (particularly for the cardiac EFG which has had poor attendance)***

As outlined further below, some members of the cardiac EFG expressed concern about the effectiveness and value of the cardiac EFG. We note, however, that attendance at meetings has been poor, which inevitably has an impact on how effectively a group can function.

***Clinical leaders are well integrated into governance structures and processes***

Dr Sally Roberts, national IPC clinical lead, and Dr Arthur Morris, national SSII programme clinical lead, provide expert advice and leadership to the programme and the sector. Sally and Arthur both participate in the SIPCAG meetings and represent the Commission at various stakeholder meetings.

***Members of the ACC Treatment Injury Team are involved in governance arrangements***

The joint ACC/HQSC SSII programme steering group has met four times in the last 12 months. The meetings provide an opportunity for the Commission to update ACC on the progress of the SSII programme against the service delivery schedule, share programme highlights as well as providing an opportunity for further discussion/questions relating to the programme.

Bridget Goggin, Senior Injury Prevention Specialist, attends the IPC meetings as part of the 'operational working group'. This provides an opportunity to discuss SSII programme activity and to communicate relevant ACC activities and plans to the Commission. Bridget is invited regularly to SSII programme activities, such as the anti-staph bundle collaborative workshops and regional IPC meetings. Nick Kendall and Bridget Goggin also attend SIPCAG meetings.

## Were the contracting mechanisms for management, surveillance and software appropriate and managed well?

***Bringing the programme management function in house began to address many of the problems caused by early out-sourcing arrangements; this approach remains appropriate and adds value today***

In the interim report, we highlighted many problems that had resulted from the early approach adopted by the Commission for out-sourcing core aspects of programme management and delivery to contracted lead agencies. This way of working (very much influenced by the limited capacity and capability available within the organisation in the early days following its establishment) resulted in many significant problems. For the Commission, there were issues such as: diminished control of the programme; limited opportunities to

engage with and be responsive to the needs of DHBs; and lost opportunity to build capability and capacity within the Commission, and to connect and learn across different national programmes. For the programme, there were negative impacts, such as insufficient strategic guidance and early framing of the programme as a 'surveillance' rather than 'quality improvement' initiative (despite the Commission pushing for a repositioning to a patient safety and quality improvement programme). This may have made it difficult for DHBs to connect with the programme in early days.

The Commission's decision (in July 2015) to bring the SSII programme management function in house began to address many of the problems. DHBs have been positive about their experience of this change, which has enabled the Commission to improve the connection and leverage from other programmes. This approach remains appropriate and adds value today.

***The Commission has developed a direct relationship with Baxter to facilitate a more developmental/strategic partnership***

Similarly, in the interim report, we pointed to some significant problems resulting from the contractual arrangements in relation to oversight of ICNet and National Monitor provision and development. The Commission was distanced from the relationship (as oversight was sub-contracted to CDHB who managed the interface with the vendor Baxter).

Despite the positive impacts of having brought programme management in-house, there was still insufficient connection and influence over system developments to the National Monitor (from a DHB perspective, probably the key area of concern about implementation of the programme).

In the review of the SSII National Monitor completed by Malcolm Pollock in May 2017[35], the Commission was advised to:

- retain CDHB as the provider of services (i.e. that CDHB should continue to be contracted to provide hosting services and to have day-to-day oversight of the vendor relationship for ICNet); and
- develop a more strategic relationship directly with the supplier, Baxter, to shorten the lines of communication in respect to the opportunities and issues associated with the development of the software.

The Commission has agreed to both recommendations.

Discussions are underway with CDHB regarding the potential terms of arrangements once the current contract expires on 30 June 2018.

The Commission has developed a more direct relationship with Baxter to facilitate a more developmental/strategic partnership. They have introduced more structure to the way of working, formalised some of the meetings and introduced a process whereby issues are escalated jointly by the Commission and CDHB to Baxter leading to agreed workout plans.

---

[35] Pollock, M., (May, 2017, Review of the SSI National Monitor., Report to the NZ Health Quality and Safety Commission.

## What is the extent of stakeholder engagement in governance of the programme?

***Governance arrangements offer multiple options for sector stakeholders to provide advice and guidance to the SSII programme***

The Commission established SIPCAG to provide stewardship to the Commission's national IPC programme. Membership is drawn from individuals/agencies actively involved in the health sector with a specific focus on infection prevention and control safety and quality improvement.

EFGs provide opportunity for participants with expertise in relation to particular surgical specialties to provide advice and guidance to the SSII programme.

Also, the collaborative way of working through the SSII programme opens opportunities for stakeholder engagement and influence in the design and implementation of specific initiatives.

***There will need to be on-going support from clinical leaders and the programme team to ensure that the EFGs are functioning well and adding value – it may be necessary to tailor the way of working to fit the requirements of individual surgical specialties at different times in the process of implementation***

Arthur Morris chairs the orthopaedic and cardiac surgery expert faculties. Members include surgeons from the relevant specialty, infectious disease physicians, and perioperative and IPC nurse representatives. The Commission's IPC specialist also attends meetings.

As the cardiac programme focuses on tertiary cardiac procedures there are only five DHBs involved directly in the SSII programme; three of the five are represented on the EFG.

While the EFGs include wide representation, some members (particularly in relation to the cardiac programme), have suggested that the format of the meeting is generally focused on seeking agreement to a set agenda of quite specific items. They say there is limited opportunity to reflect on programme strategy and direction in a broader sense. Perhaps this is indicative of the current early stage of the cardiac programme; once there is a richer data-set available there may be greater opportunity to influence strategic direction.

Furthermore, again in relation to the cardiac EFG, we have been advised by DHB members that attendance has been poor and that given the size of the group, things can feel driven by individual perspectives rather than from a coherent group viewpoint. The Commission has attempted to encourage clinicians to attend but despite this, there has been no significant improvement. We understand that attendance at orthopaedic EFG meetings remains strong; it is likely that clinical staff on the cardiac network are 'voting with their feet' as to their perceptions about the value of investing their time versus dealing with clinical demands of their practice.

We recognise the inherent difficulty in managing clinical engagement processes. There is always a need to balance expectations and demands placed upon a group against the many competing priorities clinicians are juggling constantly. It is often difficult to ensure continuity of membership, to sustain commitment and to keep people invested in the outcomes of programmes once their particular areas of interest or concern have been addressed.

Given these constraints, the Commission may need to tailor ways to improve the way in which individual EFGs function, depending on the requirements of individual surgical specialties at the relative time in the implementation process. Given the relatively recent establishment of the cardiac versus the orthopaedic work-stream, it seems that there is still appetite for engaging in development of strategic directions for the future of the programme. This may be achieved by the EFG engaging with wider associated bodies, such as the Cardiac Network (though we understand that repeated efforts to meet with the Network have yet to be successful).

***The programme maintains linkages with relevant professional associations and colleges, both via EFG representation and directly***

The benefits and successes of the programme have been promoted at various meetings and conferences nationally and internationally. The programme maintains strong links with the relevant colleges via the EFG and directly as necessary.

***Regional IPC forums provide a useful opportunity to explore SSI data in more detail at a local and regional level***

The SSII programme team has attended regional IPC meetings. This has provided a useful opportunity to explore the SSII programme data in more detail at a regional and local level and to discuss how the data can be used locally to support quality improvement. Regions have an opportunity to request specific topics for discussion e.g. SSI risk factors and the programme team will arrange for tailored analysis to be completed.

We note that there is still no SSI regional network in place within the South Island. Although the regional groups provide a useful forum, the Commission recognises that the region needs to make judgements on the priority areas for collective regional action, given the pressure on resources and competing pressures (such as Canterbury redevelopment following the earthquakes).

### 5.3.5 Value for money

We have addressed the question of whether the programme delivers value for money in section 4 on page 38, where we present the results from our economic evaluation. In this section, we provide some brief commentary on the perceptions reported by staff we spoke with in DHBs.

#### Perceptions of DHBs stakeholders and feedback from funders about value of the SSII programme

***The views of DHB staff on value of the programme appear to become more positive over time, once there is a good base of data available and the focus moves from implementation/data collection processes to use of information to support quality improvement***

In our interim report, we noted that staff from a number of DHBs involved in implementation of the orthopaedic work-stream had expressed reservations about the value of the programme. This view was particularly prevalent within DHBs reliant on manual data processes – people expressed concerns about the level of time and resource they needed to

invest in data collection processes and, at the time, saw this aspect of being the focus of the programme rather than it being centred on quality improvement.

Some of the clinicians we spoke with about implementation of the cardiac work-stream echoed this negative view about the focus on data collection processes. This was influenced further by the reservations some held that the programme interventions were already standard practice within cardiac surgery (see section 5.3.2 on page 55 for further exploration of that perception). This view caused them to question whether there might be greater potential value in addressing a surgical specialty or procedures with less standardisation, such as general surgery or caesarean sections. (This was not a universal view, but it was the perception of the majority of the six people we interviewed in relation to the cardiac surgery work-stream.)

The constraints of our research process for this final report have not allowed us to go back to all DHBs to re-test perceptions about the orthopaedic work-stream. However, within our interim report findings we noted that many staff within DHBs recognised the value of the outputs of the programme (such as the availability of nationally consistent standard definitions and a core dataset) and were positive about the opportunities that were beginning to come on board for training and capability development. In this final report, we have identified many examples of initiatives and tools that are now available to the sector to support the use of data to support quality improvement. DHB staff have given these a positive reception.

While we recognise that these capability-building initiatives target both orthopaedic and cardiac data, there is a limit to how far the quality improvement processes can be implemented for cardiac before a richer time series of data is available.

It is possible that in the course of time, as seems to have happened with the orthopaedic work-stream, that more of the clinicians involved in the cardiac work-stream will recognise the value of the programme.

However, it is also apparent that experience of extending the programme coverage is likely to be different across every specialty. Continued input from the programme team will be required to support implementation and to address specific concerns and issues that arise.

***The next surgical area to be addressed should be selected on the basis of current evidence – share findings and run a transparent selection process***

In relation to this, we note that selection of the next surgical area for roll-out will be important for the Commission. Work on the original design of the SSII programme (which included the intention for a phased implementation of orthopaedics, then cardiac, then caesarean work-streams) is now several years old.

We would recommend that there should be a comprehensive assessment of international evidence, to identify which surgical areas have delivered highest levels of improvement and/or value. It will be necessary to contextualise results for New Zealand and to test whether there is likely to be the same degree of potential improvement here. It will be important to be transparent with DHBs and potentially to involve them in selection of the next areas for national roll-out.

### 5.3.6 Strategic alignment

## To what extent does the SSII programme align with and support current key sector priorities?

***There are points of intersection between the aims of the SSII programme and some of the key strategic priorities of the health sector***

In the interim report, we identified some of key strategic priorities of the health sector as articulated in the NZ Health Strategy (2016), Digital Health 2020 and the New Zealand Triple Aim. We noted that there was strong alignment with the aims of the SSII programme, in areas such as the focus on a preventative approach, promotion of multidisciplinary team working and delivering value through high performing systems.

***There is particularly strong alignment with the sector goal of improved antimicrobial stewardship***

The SSII programme aligns strongly with global efforts around antimicrobial resistance and stewardship through guidelines that ensure appropriate use, dose and timing of antibiotics, thereby ensuring their efficient and effective use. It provides a solid platform for the Commission to play a significant role in the New Zealand health sector efforts.

Recently, a new HAI Governance Group has been established to provide cross sector oversight of HAI-related initiatives; both Janice Wilson and Karen Orsborn are members of the group. The group will be discussing a proposed whole-of-sector approach to HAIs in New Zealand. Consideration of a national strategy for the collection and use of IPC data would be part of the proposed approach[36].

## To what extent the SSII programme is aligned with the Commission's strategic priorities?

At the time of the interim report, we assessed the extent to which the SSII programme was aligned with a new set of strategic priorities that had been developed as part of the process of updating the Statement of Intent for 2017–2021. Since that time, the four strategic priorities (as outlined below) have been adopted formally:

- Priority 1: Consumer engagement
- Priority 2: Improving health equity
- Priority 3: Reducing harm and mortality
- Priority 4: Reducing unwarranted variation in patterns of care

In our last report, we noted the strong conceptual alignment between the programme and last two of these priorities: reducing harm (given the inherent prevention focus); and

[36] We note that this was one of the recommendations by Malcom Pollock, in the review he was contracted to complete by the Commission in 2017; *"Collaborate with the Ministry of Health and other stakeholders to develop a national strategy for the collection and use of IPC data, with the objectives of prioritising initiatives, optimising investment and maximising beneficial outcomes."*

unwarranted variation in patterns of care (given the standardisation of definitions and clinical practice delivered by the programme). We have made no further comment in this report on those two priorities but report below on the changing position in relation to priorities one and two.

## Priority one: Improving consumer/whānau experience

***Increasing focus (since the last report) on consumer involvement in the programme***

In the interim report, we highlighted that when the programme was established back in 2011 there was less pronounced emphasis within the health sector on the importance of consumer involvement. We observed that in line with this, during the early years of the programme, on the whole consumer/whānau engagement had not been a key feature, noting that around three quarters of DHBs indicated in the perception survey that they had not involved consumers in their local SSI programme initiatives. However, we did signal that some examples of related initiatives were beginning to develop, such as the consumer co-design course that Ko Awatea was commissioned to run in 2016–17.

Over the past eighteen months, the focus on consumer involvement within the SSII programme has increased.

Notably, the co-design course mentioned above has focused on meeting the needs of consumers and their families and whānau as a central rationale (rather than as a by-product). A number of the projects selected by participants are likely to have a sustained impact in this area. For example, on the West Coast where the focus was to improve patient education for wound care, a questionnaire for patients was developed, to check they receive all required information and to invite suggestions for further improvement. As part of a cardiothoracic initiative, Waikato DHB, worked with consumers to ascertain the impact of SSI from a patient perspective, in both the social and hospital context.

Furthermore, the SSII programme team has called upon the growing expertise and experience of the Commission's Partners in Care programme – for example, the consumer network has provided advice on the development of videos (produced in English, Te Reo and Samoan) as part of the suite of tools to support the anti-staph bundle. DHBs are encouraged to involve consumers in the programme and hyperlinks can be made available on websites for patients to access videos and information at home. The consumer brochure for preventing SSIs has been updated and made available to public and private hospitals.

## Priority two: Improving health equity

***The programme should develop a monitoring framework with agreed timeframes for ethnicity breakdown of SSII programme process and outcome measures (now that DHB privacy concerns have been addressed)***

As mentioned in section 3.3.3, when the SSII programme was established, the strategic priorities for the newly founded Commission did not at that time include a focus on reducing inequities.

Consequently, the SSII programme design did not incorporate a strong emphasis on inequality and the National Monitor dataset does not include an ethnicity field. (To address this, a matching exercise with NMDS must be undertaken to source ethnicity data. It was

necessary to obtain authorisation from DHBs to ensure that privacy considerations around matching datasets via NHI were addressed. This is now complete and all DHBs have agreed to annual data matching to take place, starting in 2018.)

Although this matching process provides a work around solution to addressing this gap, arguably it would be simpler if ethnicity were included in the SSI data collection.

In the absence of this, the programme should develop a coherent, on-going monitoring framework with agreed timeframes for data matching to support development of improved understanding of differences between experiences and outcomes of Māori and non-Māori groups. This will help to determine the focus of future programme efforts to support improvements in health equity, as signalled in the Commission priorities:

> *"We will contribute to a stronger understanding of health equity through our measurement and evaluation reporting and tools, and will make improving equity part of our improvement initiatives, where possible. This priority will help us to deliver the broader objective of achieving value and high performance from health spending."*[37]

[37] Health Quality and Safety Commission – Statement of intent 2017-2022

# 6. Final reflections

## 6.1 Summing up - a positive bottom line

In essence, the crux of this evaluation is to take a view on efficacy of the SSI programme (to identify if it has delivered the desired impact) and to weigh up from an efficiency perspective whether the effort and investment taken to achieve that impact been worthwhile (the value-for-money).

Based on the orthopaedic data, our results indicate a positive position in relation to both aspects of the evaluation. This is an encouraging outcome for the Commission and sector staff involved in implementation of the programme.

### 6.1.1 Does the programme achieve the goal of reducing SSI rates?

In terms of reducing the SSI rate, we validated analysis presented by the Commission showing a statistically significant shift (decrease) in the median SSI rate per 100 procedures from a rate of 1.18 per 100 procedures up to August 2015 to a rate of 0.93 for August 2015 to September 2017. Also, using the most recent four quarters of data available, the decrease in rate from 2016q4–2017q3 compared with the equivalent baseline from 2013q4–2014q3 is a statistically significant at the 95 per cent confidence level (z=3.001, p-value=0.003).

Our findings point to the increasing uptake of the bundle of interventions as being a probable driver of the decreasing rate. We found that the decrease in the SSI rate is not caused by a decrease in the overall risk profile of patients, as the average risk per procedure remains reasonably stable over time. However, the odds of an SSI occurring in a procedure that received all three programme interventions were 43 per cent lower than one that has not (statistically significant at the 95 per cent confidence interval (OR 0.57, [0.39–0.85])).

### 6.1.2 Does the programme deliver value for money?

#### Summary of our CBA results

From our cost benefit analysis, we determined that the programme at least reaches break-even and at best delivers good value for money. We present the results, using a start-point of 2012/13 looking out to 2027/28, using two sets of benefit assumptions (reflecting the fact that there is no definitive baseline for SSI rates prior to the start of the programme):

- **Low-benefit scenario** (conservative perspective):

  The cumulative net benefit (present value) of $1.812 million delivers a benefit-cost ratio of 1.12 meaning that the benefits of the programme would be at least equal to the costs, representing a break-even position.
- **High-benefit scenario** (optimistic perspective):

  The programme achieves a cumulative net benefit (present value) of $34.538 million with a benefit-cost ratio of 3.21 meaning that the benefits would be three times as high as the costs.

Against this, we highlight that from a retrospective viewpoint (looking back from the end of 2017/18 to the start of the programme) under the high-benefit scenario, this impact is $5.274 million (benefit-cost ratio of 1.65) and under the low-benefit scenario, there is actually a negative result of -$3.428 million (benefit-cost ratio of 0.58). This illustrates that it takes time for a programme of this nature (with significant up-front investment in building infrastructure) to deliver a return on investment.

Finally, it is important to note that we believe there is a reasonable case for favouring a counterfactual towards the higher end of this range of results (as the low-benefit assumption of the observed SSI rate in 2012/13) is likely to include effect of the programme. This means that the 'real' outcome is likely be to somewhere towards the top of the range of results.

## Additional scenario – impact of the 'anti-staph bundle'

We modelled a further, more positive scenario whereby the 'anti-staph bundle' contributes to the SSI rate being further reduced from 2018/19 onwards. We applied a conservative assumption of a further 10 per cent assumption (i.e. the SSI rate reduces from 0.97 to 0.88 per 100 procedures[38]).

As we would expect, this additional scenario delivers an improved result, with the impacts under prospective view (i.e. looking out to 2027/28) as noted below:

- Under the high benefit assumption, the net benefit improves from $34.538 million to $39.462 million with the benefit-cost ratio being 3.21 to 3.52.
- Under the low benefit assumption, the net benefit improves from $1.812 million to $6,736 million with the benefit-cost ratio being 1.12 to 1.43.

These results show the material improvement in the net benefit of the programme that would be delivered from a relatively conservative assumption about the positive impact of this set of interventions.

## Valuing benefits to patients

We recognised that within the limited scope of our evaluation, we did not fully reflect the significant and potentially devastating impact that experiencing an SSI may have on a patient, in terms of both additional time (spent recovering and dealing with on-going health impacts) and experiencing pain, suffering and reduced quality of life.

In an attempt to take better account of this, we explored the impact of the programme as measured by DALYs. On the basis of the same approach used by the Commission, but using results from our CBA, we estimate that for the low benefit scenario 34 SSIs are avoided on an annual basis and for the high benefit assumptions 97 SSIs, equating to an annual estimated avoided DALY value of between $3.06 million and $8.73 million.

[38] The small discrepancy is due to rounding of numbers to two decimal places.

## 6.2 Opportunities for strengthening the value delivered

As commented in section 4.3.2, we recognise also that there are a number of potential opportunities for the Commission and the DHBs to strengthen further the value for money delivered by the programme in future years.

### 6.2.1 Changing the balance of costs and benefits

In terms of inputs to the cost benefit analysis, a more positive impact can be achieved either by reducing the level of investment required on the cost side or broadening the scope of the benefits achieved and measuring their impact.

#### Reducing the costs of the programme

In terms of the assumptions and inputs behind our analysis, there may be opportunities to reduce the day-to-day costs of running the programme further.

We assumed that the level of costs associated with running the programme in 2018/19, as incurred by the Commission and DHBs will remain constant over the next ten years. It is quite feasible that some of these costs will reduce over time with no adverse impact on the outcomes achieved. As an example, some responses to the DHB cost survey cited the potential for efficiency gains from the automation of their data management processes.

As for any large-scale intervention, it will be important for the Commission to retain a focus on increasing efficiency of the way the programme is implemented in a 'business as usual' environment to maximise the value secured through investment. A key priority would be to support DHBs in achieving automation of data entry through ICNet.

#### Getter a better handle on valuing the benefits

When completing a cost benefit analysis in relation to health sector interventions, it is often more challenging to determine how to measure and value the benefits side of the equation.

For this CBA, we had a clear start point in terms of understanding the impact on the SSI rate, given that there is available data and that there has been significant focus on understanding what that data shows. Further, we had available a recent, local study that enabled us to quantify the potential cost saving from avoided hospital treatment of SSIs.

Valuing benefits to patients is more difficult. As we have noted, the limited scope of our evaluation and resource available, did not allow us to collect data directly from patients and we were limited to using what was already available.

Developing a measure of the value of DALYs avoided by patients (through avoiding experience of an SSI) attempts to compensate for this limitation, using the disability weighting for experiencing an SSI developed from international studies. However, we note that there are validated mechanisms available to collect data directly from NZ patients to support better understanding of the value that patients place on these experiences (such as using tools to measure patient experience and the direct impact on of quality of life).

Given the Commission's increasing focus on consumer involvement from a strategic perspective, the opportunity to build in a patient experience/quality of life study within the

programme framework with a sample of patients could be of value. The nature of the programme and the clear set of outcomes data would lend itself well to this kind of approach. This would have the potential to add significantly both to understanding of the benefits secured through the SSIIP specifically with learnings that could be applied to and inform the understanding of national quality initiatives more generally.

### 6.2.2 Maximising and broadening the impact of the Programme

The new HAI Governance Group (which as noted previously in section 5.3.6 has been established to provide cross sector oversight of HAI-related initiatives) is discussing a proposed whole-of-sector approach to HAIs in New Zealand. This includes consideration of how the package can adjust over time to reflect an increased level of maturity (for instance, by further determining risk factors and other variables, and looking at the frequency and nature of data collection). The group is also considering potential for expanding the scale and spread of the current programme, and for extending to other surgical procedures/specialties. This consideration will build on discussions by the SIPCAG about potential new areas for focus.

Given that a relatively high level of programme expenditure has been invested in the upfront development of the supporting infrastructure (in particular, the design and implementation of the National Monitor system, the programme offers significant potential to realise further economies of scale in order to deliver increased value for money.

There is a now a set of tools and processes available that the Commission can roll-out efficiently in new surgical areas. Furthermore, as experience develops the programme is learning how to adapt existing tools and processes to tailor support to the needs of clinicians in new specialties.

As the programme is maturing, there are increases in the breadth of data available, the depth of understanding in relation to potential value and the support of a growing pool of local programme champions with the capability to use information to support quality improvement. These steps forward provide the Commission with a compelling case to 'sell' expansion of the programme into other clinical specialities, potentially decreasing the effort needed to bring clinicians on board in their understanding of and commitment to the value offered by the programme.

If there is further expansion of the programme coverage, it will be interesting to compare the experience of implementing the programme within the next surgical area chosen to that of the cardiac surgery work-stream (where we have observed the significant on-going effort required to secure buy-in from across the group of clinicians).

## 6.3 Concluding comments

We have had opportunity to review the SSII programme over an extended period of time, with the publication of a formative report (identifying insights and learnings to help shape the future design and planning of the programme activity) and this final report, with its focus on evaluating the impact and value for money delivered.

The results we have presented here are positive, reflecting a programme that prospectively, on net present value basis, at minimum breaks even and at best delivers a threefold return on investment. The result gives a validation that over time, the effort and resource invested across the sector pays off; dissemination of these results this may help to strengthen further belief of clinicians and other DHB staff in the value that their contribution is delivering.

We have concluded also that the programme is well run and achieves all its implementation objectives. However, continued effort will be required to ensure quality is maintained (in terms of consistency and accuracy of data, supported by robust systems or processes) to ensure that the potential value is delivered.

The long duration of this programme offers rich learnings about the design and implementation approach of national quality initiatives. We recognise the importance of a programme such as this maintaining a strong, enduring vision and sense of purpose, whilst also having the ability to adapt approaches to adjust to changes in the strategic context over time. From our analysis of the orthopaedic work-stream, we have seen how over the years the focus of work has moved from developing and implementing infrastructure and systems, to building capability within the sector to use available data to support local quality improvement initiatives. As this work-stream has matured, we sense growing buy-in from staff within DHBs as they recognise the value of the deepening data-set available.

In terms of key directions for future priorities for the programme, we suggest it would be timely following completion of this evaluation for the Commission to review and reconfirm the strategic direction for the programme. There is an opportunity to refine goals and objectives to reflect the progress achieved to date and to use that as a platform to build further success.

As part of this, we believe there would be value in updating the programme objectives to better reflect the current priorities of the Commission. For example, we have highlighted the emergence of programme activities over the past two years around themes such as achieving equity and consumer engagement. We believe that both of these areas would benefit from development of specific work-plans, incorporating initiatives such as development of an equity monitoring framework.

A reassessment would also offer opportunity for some 'big picture thinking' about the future of the programme, focussed on how best to capitalise on the value already achieved and to direct resource to best support delivery of future potential. This would involve looking at options to realise economies of scale in the investment to date by extending potential coverage of the programme. Actions may include addressing barriers to expansion, such as continuing support to some DHBs to remove the reliance on manual data collection.

# 7. References


Artus, J., & Whelan, C. (2014). *Surgical site infection improvement programme - the case for continued investment in ICNet.* Wellington: Sapere Research Group.

Auckland District Health Board and Canterbury District Health Board. (2012). *Project Plan Lead Agency for the Surgical and Procedural Site Infection Surveillance Programme* .

Cassini A, P. D. ( 2016 ). Burden of Six Healthcare-Associated Infections on European Population Health: Estimating Incidence-Based Disability-Adjusted Life Years through a Population Prevalence-Based Modelling Study. . *PLoS Med.*

Controller and Auditor-General. (2003). *Management of hospital-acquired infection - Volume One of Two.* Wellington: Office of the Auditor General.

Haley RW, C. D. (1985). The efficacy of infection surveillance and control programs in preventing nosocomial infections in US hospitals. *Am J Epidemiol* , 182-205.

Halliday, P. (2013). *Year One Report Surgical Site Infection Surveillance Programme.* Wellington: Health Quality & Safety Commission.

Hay, S. (2011). *Surgical Site Infections Project plan (draft v.3).* Wellington: Health Quality & Safety Commission.

Health Protection Agency. (2012). *Surveillance of Surgical Site Infections in NHS Hospitals in England 2011/12.* London: Health Protection Agency.

Health Quality & Safety Commission. (2014). *Statement of Intent 2014 – 2018.* Wellington: Health Quality & Safety Commission New Zealand.

Health Quality & Safety Commission. (2014). *Surgical Site Infection Improvement Programme - Year Two annual summary report 1 July 2013 - 30 June 2014.* Wellington: Health Quality & Safety Commission.

Health Quality & Safety Commission. (2015). *SSII Programme Year Three Annual Report 1 July 2014 - 30 June 2015.* Wellington: Health Quality & Safety Commission.

Health Quality & Safety Commission. (2015). *Surgical Site Infection Improvement Programme Orthopaedics Surgery Implementation Manual.* Wellington: Health Quality & Safety Commission.

Health Quality & Safety Commission. (2016). *Infection Prevention & Control Programme Three-year plan July 2016 - 30 June 2019.* Wellington: Health Quality & Safety Commission.

Health Quality & Safety Commission. (2017). *Surgical Site Infection Improvement Programme Orthopaedic and Cardiac Clinical Director and Surgeon Perception Survey.* Wellington: Health Quality & Safety Commission.

Health Quality & Safety Commission. (2017). *Surgical Site Infection Improvement Programme Perception Survey.* Wellington: Health Quality & Safety Commission.

Hill, R. (2014). *Surgical Site Infection Improvement Programme Project Charter*. Health Quality & Safety Commission.

Jamie Lee Rahiri, Z. A. (2017). Systematic review of disparities in surgical care for Māori in New Zealand. *ANZ Journal of Surgery*.

Morris, A. J. (2018). The New Zealand Surgical Site Infection Improvement (SSII) Programme: a national quality improvement programme reducing orthopaedic surgical site infections. . *NZMJ*, 45-56.

National Cardiac Surgery Clinical Network (NCSCN). (2016). *New Zealand Cardiac Surgery National Report 2015*. Wellington: New Zealand Ministry of Health.

National Quality Improvement Programme (NQIP). (2010). *Recommendations for a National Surgical and Procedural Site Infection Programme*. Wellington: Ministry of Health .

NICE Clinical Guidelines No. 74. (2008). *Surgical Site Infection: Prevention and Treatment of Surgical Site Infection*. National Collaborating Centre for Women's and Children's Health (UK). London: The Royal College of Obstetricians and Gynaecologists Press.

Pollock, M. (May, 2017). *Review of the SSI National Monitor*. Report to the NZ Health Quality and Safety Commission.

Standards New Zealand Paerewa Aotearoa. (2008). Health and Disability Services (Infection Prevention and Control) Standards NZS 8134.3:2008. *New Zealand Standard*. Ministry of Health.

The New Zealand Joint Registry. (2016). *Seventeen Year Report January 1999 to December 2015*. New Zealand Orthopaedic Association.

# Appendix 1 – Definition of SSIs

The SSII programme employs the US Centres for Disease Control and Prevention (CDC) National Healthcare Safety Network (NHSN) definitions of SSIs, with some minor adaptations. These are outlined in Figure 19 below.

**Figure 19: Definition of SSIs (extracted from the programme implementation manual)**

| SSII programme – definitions of SSI |
|---|
| **Superficial**<br>A superficial incisional SSI must meet the following criteria:<br>Infection occurs within **30 days** after the operative procedure (where day 1 = the procedure day).<br>**AND**<br>Involves only skin and subcutaneous tissue of the incision.<br>**AND**<br>The patient has at least one of the following:<br>a) Purulent drainage from the superficial incision.<br>b) Organisms isolated from an aseptically obtained culture of fluid or tissue from the superficial incision.<br>c) Superficial incision that is deliberately opened by surgeon and is culture-positive or not cultured<br>**and**<br>Patient has at least one of the following signs or symptoms: pain or tenderness, localised swelling, redness or heat. A culture negative finding does not meet this criterion.<br>d) Diagnosis of superficial incisional SSI by the surgeon or attending physician. |
| **Deep**<br>A deep incisional SSI must meet the following criteria:<br>Infection occurs within **90 days** after the operative procedure (where day 1 = the procedure day).<br>**AND**<br>Involves deep soft tissues of the incision (e.g. fascia and muscle layers).<br>**AND**<br>The patient has at least one of the following:<br>a) Purulent drainage from the deep incision.<br>b) A deep incision that spontaneously dehisces or is deliberately opened by a surgeon or attending physician and is culture positive or not cultured<br>**and**<br>The patient has at least one of the following signs or symptoms: fever (>38oC) localised pain or tenderness. A culture-negative finding does not meet this criterion.<br>c) An abscess or other evidence of infection involving the deep incision that is found on direct examination, during invasive procedure or by histopathologic or imaging test.<br><br>Classify infection that involves both superficial and deep incision sites as deep incisional SSI. |

**SSII programme – definitions of SSI**

**Organ/space**
An organ/space SSI must meet the following criteria:
Infection occurs within 90 days after the operative procedure (where day 1 = the procedure day).
**AND**
Infection involves any part of the body, excluding the skin incision, fascia or muscle layers that is opened or manipulated during the operative procedure.
**AND**
The patient has at least one of the following:
a) Purulent drainage from a drain that is placed into the organ/space.
b) Organisms isolated from an aseptically obtained culture of fluid or tissue in the organ/space.
c) An abscess or other evidence of infection involving the organ/space that is found on direct examination during invasive procedure or by histopathologic examination or imaging test

**and**
Meets at least one criterion for a specific organ/space infection. For this orthopaedic SSII programme this means osteomyelitis or joint infection.

Source: Orthopaedics Surgery Implementation Manual Version 1.4 Date Updated December 2015

# Appendix 2 – Methodology

## Qualitative work-stream

Our qualitative across the two stages of the evaluation has involved the activities outlined below. In total, across the two stages of the evaluation we completed interviews with over fifty key stakeholders including: surgeons; microbiologists/infectious disease physicians; clinical directors; quality improvement staff; SSII programme staff; and senior managers from the Commission.

| | |
|---|---|
| **Review of relevant documentation** | Review of programme documentation, Commission Board papers and minutes of meetings, DHB documentation and relevant local and international literature since previous reviews. |
| **Interviews with programme leaders/advisors** | Mix of face-to-face and telephone interviews with key leads within the Commission and DHBs. |
| **Perception survey of DHB stakeholders** | Some specific questions were included in the Commission's annual perception survey for the SSIIP (for the interim report only). |
| **Site visits (to Auckland and Canterbury as lead agencies)** | In-depth interviews across key stakeholders within the two DHBs (to understand their lead agency role, particularly in relation to initial implementation of the programme). |
| **Telephone interviews** | Telephone interviews to develop in depth feedback from four DHBs (interim report only).<br><br>For evaluation of the cardiac work-stream (covered in this report) we completed telephone interviews with six stakeholders, including five Cardiac EFG members. This included four cardiac surgeons, one anaesthetist and a microbiologist.<br><br>We also re-interviewed the EFG Chair/Clinical Lead for the SSII programme. |
| **Interviews with Commission staff regarding equity issues** | Interviews with key Commission staff to inform our consideration of equity issues in relation to the programme and a meeting with Te Roopu Māori to receive their advice on future directions for the programme (interim report).<br><br>A final draft of this evaluation report was given to Te Roopu Māori for review but no specific feedback was provided. |
| **Workshops on key findings with Evaluation Steering Group members** | The Evaluation Steering Group reviewed drafts of both the interim and final evaluation reports, we held workshops to discuss findings and we incorporated feedback as appropriate prior to publication. |

## Data sources

Data on orthopaedic procedures has been reported by the Commission on a quarterly basis since 2013q3. The orthopaedic analysis in the interim evaluation report was based on an extract of data from the National Monitor for the period 2013q3 to 2016q4. The event-level, anonymised data includes key information about the interventions and the presence of an SSI as well as information about the patient, procedure, DHB and the facility (hospital). This data was provided by the Commission.

This extract was matched with records in the NMDS to add information about patient ethnicity. The timing of the final evaluation report enabled the period of analysis to be extended to 2017q3 – bringing three more quarters of data. As the data is maintained in a live database, some of the earlier results have changed slightly in places as a result of records being updated.

The collection and reporting of data on cardiac procedures began in 2016q3, which meant that only four quarters of data, from 2016q3 to 2017q2, were available for analysis. As the data was not matched with NMDS records, no data about patient ethnicity was available.

## Method

The method for the orthopaedic analysis was developed in the interim evaluation report and then refined for the final report, which also included three more additional quarters of data.

The first step was to examine the system uptake of the three programme interventions, as measured by the three process quality and safety markers.

This is followed by an analysis of the outcome maker (the rate of SSIs per 100 procedures) from multiple perspectives:

- a time series perspective – to examine how the SSI rate has changed over time;
- a cross sectional perspective – to examine how the SSI rate varies between the procedures that included all three interventions and those that did not;
- an equity perspective – to examine the outcomes for Māori relative to non-Māori; and
- a modelling approach – developing a logistic regression model to control for possible changes in the patient risk profile over time.

Each of these approaches has different strengths and offers a different insight into the changes in the SSI rate – thereby building up a more complete picture.

The method for analysing data on cardiac procedures was limited by the relatively short period for which data was available for analysis. Therefore, the focus has been on a time series perspective to examine the level and direction of change in the uptake of the three programme interventions and the rate of SSIs per 100 procedures.