Using the Surgical Site Infection(SSI) Orthopaedic Monitoring Tool (VLAD report)

Learning resource for SSI champions

Health Quality & Safety Commission New Zealand
Kupu Taurangi Hauora o Aotearoa

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Purpose of the report

- Developed as a HQSC requirement for moving to orthopaedic light surveillance
- A tool to monitor orthopaedic surgical site infections (SSIs) in your DHB
- Provides SSI risk information in addition to the quarterly SSIIP and QSM dashboard reports
- A trigger tool that helps detects an increase in SSI risk
- Displays a visual coloured status box which reflects the current risk of an increase in SSI for each DHB

How to access the SSI orthopaedic monitoring tool

- The report is accessed through the following URL https://reports.hqsc.govt.nz/ssi-ortho-tool/
- To view the chart for your DHB
  - Select your DHB
  - Enter your DHB's unique password and click 'Show chart'
- Contact your local SSI Champion for access

Report components

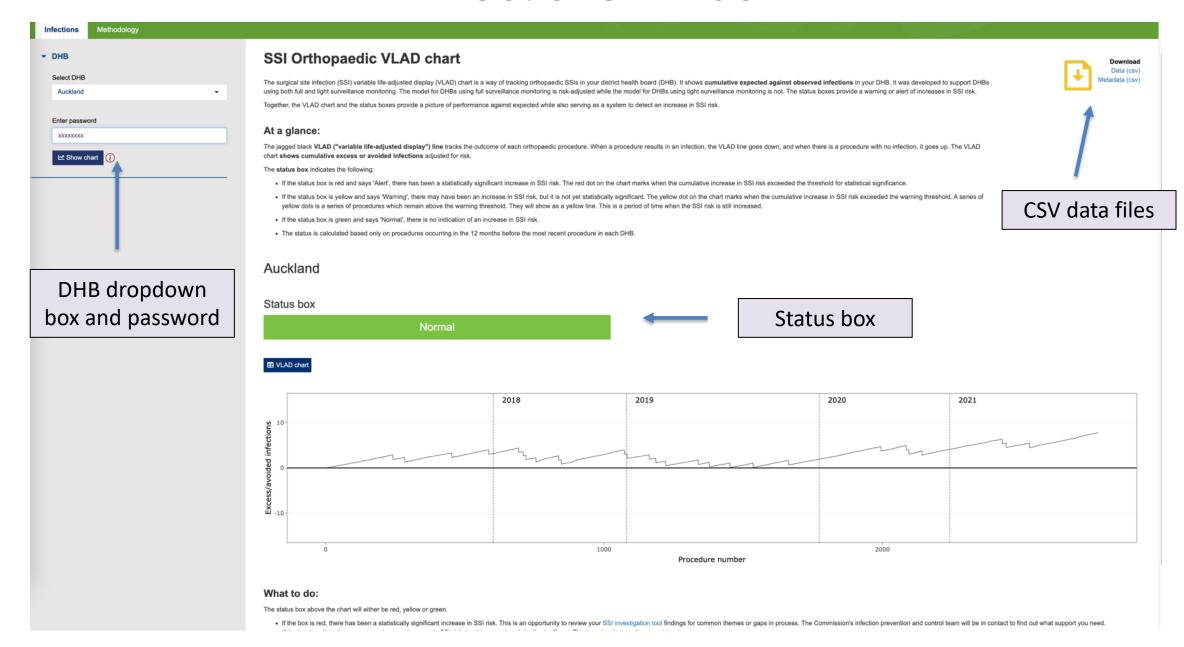- The report is called the **SSI orthopaedic VLAD chart**
- It consists of two windows:

Infections

- DHB drop-down panel on the left
- Brief 'at a glance' explanation of the chart
- VLAD chart and coloured status box with 'what to do' section
- CSV data download files

Methodology (three tabs)

- Overview of how the chart works
- Technical notes – a detailed description of the statistical methodology
- Related publications

Infections window

Methodology pages - Overview

Overview

What is the variable life adjusted display (VLAD) chart?

The VLAD chart is used for monitoring on a procedure-by-procedure basis; the line tracks the outcome of each orthopaedic procedure. The chart displays the cumulative sum of the expected minus observed infections and can show an increase in the SSI risk at an early stage. When a procedure results in an infection, the VLAD line goes down, and when there is a procedure with no infection, it goes up. A run of SSIs is represented by a persistently downward trend and a run without SSIs by a line that is persistently upward.

Its calculation is set out in Sherlaw-Johnson (2004).

What is the alert box?

The alert box can tell you whether there has been an increase in the risk of an SSI within your district health board (DHB). If the box is red, this increase is very likely to be statistically significant. If the box is yellow, the SSI risk increase is not yet statistically significant. If the box is green, there is no indication of an increase. The alert is calculated based on procedures occurring in the 12 months before the most recent procedure in each DHB.

Why are the alerts displayed with the VLAD chart?

The VLAD approach does not easily lend itself to setting useful control limits, only its overall scale. The problem is that the VLAD chart can build up credit and be a long way from the relevant control limit when the performance changes, thus failing to quickly detect the change. In order to allow this, we have calculated the alerts using a variant of cumulative sum (CUSUM) which derives control limits from the sequential probability ratio test (SPRT). For more information, see the Technical notes tab.

Risk adjustment model

The risk of an SSI is calculated using a risk adjustment model. The model for full surveillance DHBs is adjusted for BMI and total surgical risk score. The model for light surveillance DHBs could not adjust for these factors, so it is based on total procedures.

The model is calculated using data from the period 1 January 2017 – 31 December 2018. We chose this modelling period for two reasons:

- to ensure it does not include data occurring during the COVID-19 pandemic,
- to display some data after the modelling period but before the pandemic.

Alert threshold

The threshold for the model is a 50 percent increase in the risk of SSI. The choice of threshold is somewhat arbitrary. A threshold of 50 percent is a statistical convention which has been used elsewhere.

SSI definitions

See SSIIP orthopaedic surgery implementation manual pp 9 – 11.

References

Sherlaw-Johnson C. 2004. A method for detecting runs of good and bad clinical outcomes on variable life-adjusted display (VLAD) charts. *Health Care Management Science* 28: 61-65. https://doi.org/10.1007/s10729-005-5217-2

Rogers CA, Ganesh JS, Banner NR, et al. 2005. Cumulative risk adjusted monitoring of 30-day mortality after cardiothoracic transplantation: UK experience. *European Journal of Cardio-thoracic Surgery* 27: 1022-1029. https://doi.org/10.1016/j.ejcts.2005.02.033

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Sidebar

- Overview
- Technical notes
- Related publications

Related publications
SSIIP orthopaedic surgery implementation manual

Methodology pages – Technical notes

Infections | **Methodology**

Overview

Technical notes

Related publications

Technical notes

VLAD

Purpose

- To provide a visual representation for the outcome of each procedure ie. SSI vs. no SSI.
- To display increasing or decreasing trends which suggest either better or worse performance than expected.

Construction

- A procedure that results in an infection is given a score of 1 and a procedure without an infection scores 0.
- After each procedure, the predicted probability of infecton (p) is subtracted from the procedure score and the value obtained is added to the cumulative total. So, if the procedure results in an infection, the cumulative sum is decreased by (1-p) and if the procedure does not result in an infection, the sum is increased by p.
- The cumulative sum obtained is the cumulative difference between observed and expected infections.
- The predicted probabilities of infection (p) are calculated as described in the Risk adjustment section below.

Interpretation

- If the performance is acceptable (i.e. as expected), the chart should oscillate about the horizontal axis.
- If a point on the plot is below the horizontal axis, then overall performance up until then has been worse than expected, and better than expected if it is above the axis.
- A run of SSIs is represented by a persistently downward trend and a run without SSIs by a line that is persistently upward.

Status calculation

The status is calculated using a one-sided statistical test where normal is defined as the SSI risk remaining the same. If the SSI risk increases, then an alert or warning is triggered. The status is calculated based only on procedures occurring in the 12 months before the most recent procedure in each DHB. Historical alerts or warnings are important to note for reference, but it is assumed these have already been investigated. See Rogers (2005) for more details

Parameters

The parameters used in the status calculations are set out below. These parameters set the threshold for statistical significance. Therefore we can interpret any alert to mean that the SSI risk is now 1.5 times as high as the beginning of 2017. This increase has less than a 5 percent probability of being by chance: the tolerance of risk of a false signal.

- Acceptable degree of variation from the modelling period (Odds Ratio): 1.5
- Tolerance of risk of false positive and negative parameters: 'Alert' error rate: 0.05
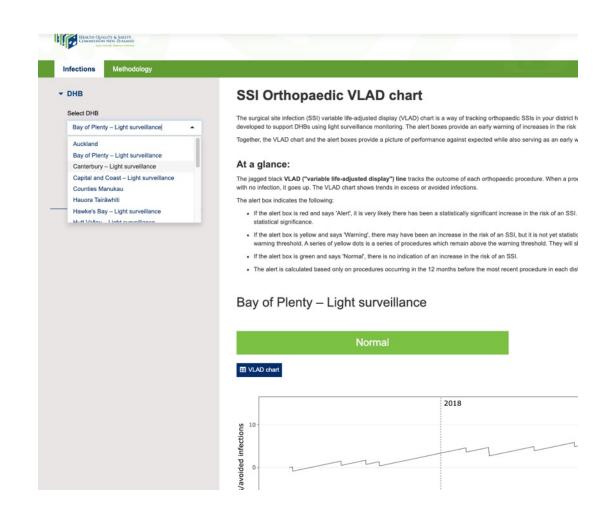- Tolerance of risk of false positive and negative parameters: 'Warning' error rate: 0.1

Related publications
SSIIP orthopaedic surgery implementation manual

Viewing your DHB VLAD chart

- Click on 'Infections' if login has not opened in this window
  - Choose your DHB from the drop-down box on the left-hand panel
  - Enter the password and click on the blue box under password 'show chart'
- Your DHB chart will appear
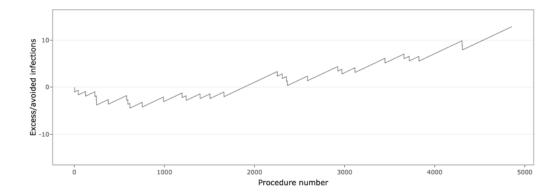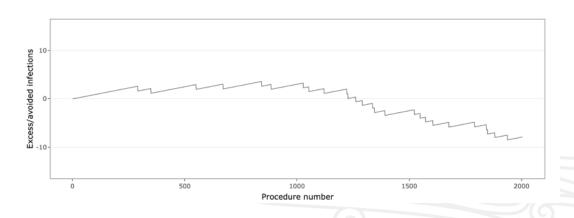 - You can also download a CSV file of the data (top right hand corner of the page)

The VLAD chart: overview

- The surgical site infection (SSI) variable life-adjusted display (VLAD) chart is a way of tracking orthopaedic SSIs in your district health board (DHB)

- It shows **cumulative expected against observed infections** in your DHB

- It was developed to support DHBs using both full and light surveillance monitoring

- The model for DHBs using full surveillance monitoring is risk-adjusted while the model for DHBs using light surveillance monitoring is not

- The status boxes provide a warning or alert of increases in SSI risk.

The VLAD chart: overview

- The jagged black **VLAD ("variable life-adjusted display") line** tracks the outcome of each orthopaedic procedure.

- When a procedure results in an infection, the VLAD line goes down, and when there is a procedure with no infection, it goes up.

- The VLAD chart shows he VLAD chart **shows cumulative excess or avoided infections**.

- The VLAD chart uses a 'CUmulative SUM' (CUSUM) chart to trigger the warnings and alerts which are displayed as a coloured status box.

The VLAD chart: warnings and alert boxes

- Status box is red ('Alert'): it is very likely the SSI risk has statistically significantly increased
  - A red dot represents the procedure that exceeded the threshold for statistical significance
- Status box is yellow ('Warning'): risk of an SSI may have increased but is not yet statistically significant
  - A yellow dot represents the procedure that exceeds the warning threshold
  - A yellow line is a series of procedures that remains above the warning threshold. This is a period of time where the risk of an SSI is still increased
- Status box is green ('Normal'): no indication of an increased risk of an SSI
- The status is based only on procedures occurring in the 12 months before the most recent procedure in each DHB
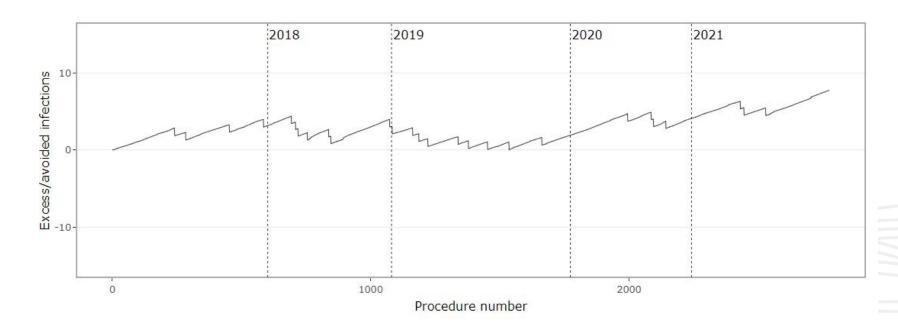
Interpreting the chart

Each point on the jagged line is a procedure. If the line goes up the procedure has not resulted in an infection – if it goes down, an infection occurred.
In this example the jagged line stays mostly around the centre and a green 'normal' status box is displayed.
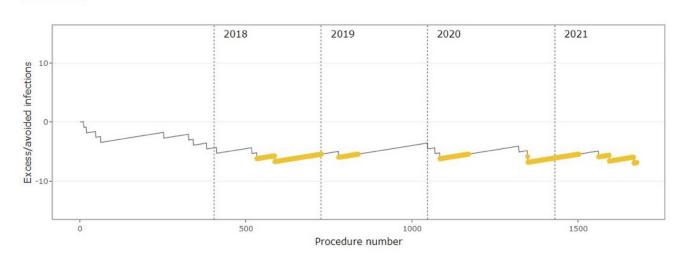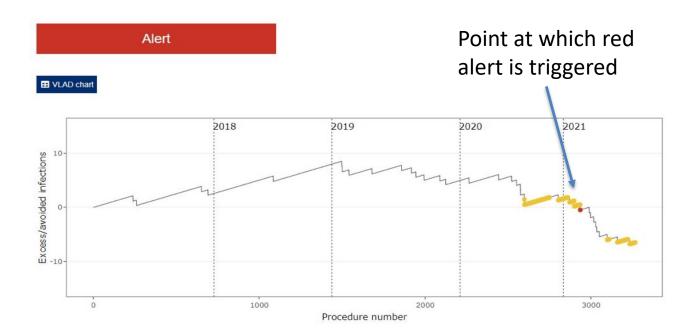
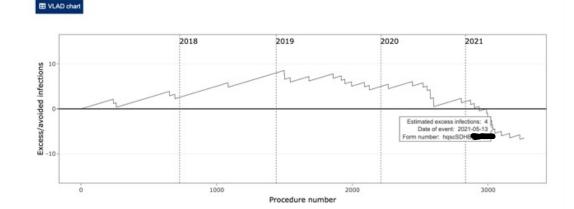Normal

⊞ VLAD chart

Warnings and alerts

Warning

When the downward trend on the jagged line reaches a pre-determined point for that DHB, a **warning** is triggered and is shown visually as a yellow status box.

Alert

Point at which red alert is triggered

If the jagged line continues to track down after an amber warning, at a pre-determined point for that DHB, the warning becomes an **alert** and is shown visually as a red status box.

Viewing the form ID of specific procedures

- Enter the password provided to you
  - Provided to you by your DHB SSI champion, or by the Health Quality & Safety Commission
- Click 'Show chart'
- Hover over points on the char - they will now show the form ID

What action should I take?

- View the chart each quarter and check what colour the box is above the graph.

- If the box is green, the numbers of SSI are "within normal limits", there is no indication of an increase for SSI.

- If the box is yellow, there may have been an increase in SSI compared with the baseline. This is a signal to monitor your data closely.

Alerts (red status box)

- If the box is red, the risk of SSI has increased by 50% or more compared with the baseline.

- This is an opportunity to review your SSI investigation tool findings for common themes or gaps in process.

- The Commission's infection prevention and control team will be in contact to find out what support you need.

More information

- If you would like more training or information about this report, you can contact an IPC specialist - IPC@hqsc.govt.nz
- The following references describe the methodology that underpins this type of reporting

1. Sherlaw-Johnson C. 2004. A method for detecting runs of good and bad clinical outcomes on variable life-adjusted display (VLAD) charts. *Health Care Management Science* 28: 61-65. https://doi.org/10.1007/s10729-005-5217-2
2. Rogers CA, Ganesh JS, Banner NR, et al. 2005. Cumulative risk adjusted monitoring of 30-day mortality after cardiothoracic transplantation: UK experience. *European Journal of Cardio-thoracic Surgery* 27: 1022-1029. https://doi.org/10.1016/j.ejcts.2005.02.033