Surgical Site Infections following Coronary Artery Bypass Grafting/Cardiac Procedures (CARDIAC) Protocol

Approved by Provincial IPC Surveillance Committee: May 2014
Revised: April 2025

Alberta Health Services
Infection Prevention & Control

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Introduction

Hospital-acquired infections are infections that are an adverse event resulting from an admission to an acute care setting (Klevens et al., 2007). About 20% of Hospital-acquired Infections are surgical site infections (SSIs) (D. J. Leaper, 2010). Rates vary between surgeons, by facility and between countries (David J. Leaper et al., 2004). They are costly to the healthcare system and many can be prevented through surveillance activities (Plowman et al., 2001). The incidence of SSI following cardiovascular procedures (excluding transplant) ranged from 3.2% to 8.2% (Jonkers et al., 2003; Lepelletier et al., 2005).

Surveillance for SSIs that involve Infection Control Professionals (ICPs) and feedback to stakeholders have been shown to be associated with reductions in rates of SSIs (Brandt et al., 2006; Gaynes et al., 2001).

In conjunction with the Coronary Artery Bypass Grafting (CABG)/Cardiac Procedure surveillance protocol, there are five supporting documents to assist in the interpretation and practical use of this protocol:

- General Surveillance Definitions (Appendix A)
- A list of included CABG and Cardiac procedures (Appendix B)
- Casefinding process (Appendix C)
- ICD-10-CA code used in the casefinding process (Appendix D)
- SSI User Guide (Alberta Health Services, 2018).

Goal

To decrease rates of SSIs following CABG and Cardiac procedures in Alberta Health Services (AHS) facilities.

Objectives

1. To determine provincial and facility SSI rates.
2. To provide useable data leading to interventions aimed at reducing the rate of SSIs.
3. To investigate increases or significant SSI rates.
4. To establish quarterly and annual SSI incidence rates for trend analysis over time and to compare with internal and external benchmarks.

Methodology

Patient population

All adult hospitalized patients of AHS/Covenant Health acute care facilities, where inpatient care is provided 24 hours/day, 7 days a week and where CABG or Cardiac procedures are performed. Acute and acute tertiary rehabilitation facilities will be referred as the “facilities under surveillance” in this protocol for simplicity. Please refer to Appendix A: General Surveillance Definitions for facilities that would be included under this term.

Case definition

According to the Centre for Disease Control/National Healthcare Safety Network (NHSN) (2024) SSIs are divided into three categories:

1. Superficial incisional SSI
2. Deep incisional SSI
3. Organ/Space SSI.

Surveillance for CABG/Cardiac SSIs will be performed for all included procedures until 90 days after the date of the surgical procedure even if the patient has been discharged. Superficial incisional SSI will not be reported in the provincial CABG/Cardiac SSI surveillance.

Once a possible case is detected, the ICP will review it and determine whether the case meets the criteria for either a deep or organ/space infection.

Inclusion criteria

- Surgeries that are performed at an Alberta acute care facility that include eligible cardiovascular procedures: open coronary artery bypass graft replacements (CABG) and repairs or replacements of heart valves (VALVE) – see Appendix B. NOTE: the term “open” infers that the sternum was opened (including minimally invasive sternotomy)

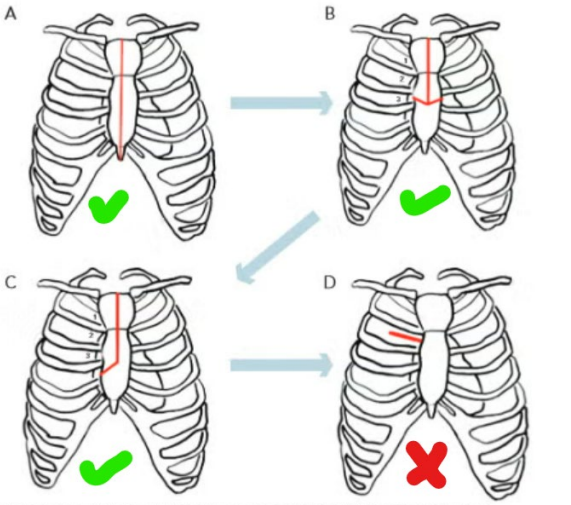
NOTE: this includes surgeries in which the patient may have had past endocarditis and/or has active endocarditis at the time of the surgery

- Deep incisional or organ/space SSI
- Reoperations – refer to SSI attribution as per NHSN.

Exclusion criteria

- Procedures in patients under 18 years of age
- Procedures in which the patient died within 24 hours
- Procedures performed via minimally invasive thoracotomy
- Reoperations via same incision within 24 hours are excluded from the denominator; however, the initial procedure is still followed for the development of an SSI
- Transplants
- Transcatheter valve insertions
- Valve-sparing aortic root procedures unless there is evidence that the valve itself was repaired, replaced or reconstructed
- Infections identified from the donor site.

Figure 1: Step Wise Reduction of Sternal Trauma



A: Full sternotomy incision; B: Hemi upper sternotomy with 'T' incision; C: Upper hemisternotomy with 'J' incision; D: Non-sternal incision – right anterior mini-thoracotomy. 1,2,3 intercostal spaces.

(Boix-Garibo 2015)

Other considerations - Identifying SSIs

Possible cases may be detected at these three points in time, but are not limited to:

1. While admitted in an AHS facility following CABG or Cardiac procedures.
2. When seen in the emergency department or readmitted to an AHS/Covenant Health facility following discharge from the surgery stay.
3. Surgeon reports following CABG or Cardiac procedures.

Case detection while in an AHS/Covenant Health facility can involve review of any of the following:

- microbiology laboratory results
- patient charts (including observation of the incision, physician notes and diagnostic imaging reports)
- re-operation records
- readmissions
- emergency visit records
- clinic visit records
- administrative discharge data review.

SSI attribution as per NHSN

Attributing SSI to a NHSN procedure when several are performed on different dates: If a patient has several NHSN operative procedures performed on different dates prior to an infection, attribute the SSI to the operative procedure that was performed most closely in time prior to the infection date, unless there is evidence that the infection was associated with a different operation (Centers for Disease Control and Prevention (CDC, 2025).

Example #1: A patient has a coronary bypass followed by a tricuspid repair a month later. If the SSI happened after the tricuspid repair it would be attributed to that surgery unless there was evidence to associate the infection with the coronary bypass.

Example #2: A patient has a coronary bypass in 2020 and another one in 2023 - if the SSI occurred after 2023, the SSI would be attributed to the procedure in 2023 (that is, we would NOT exclude the procedure from 2023 because they already had a procedure performed in 2020).

***Attributing SSI after CABG and Cardiac procedures are performed during a single trip to the OR*:** If a CABG and a cardiac procedure are performed through a single incision / laparoscopic site during a single trip to the operating room, and an SSI develops, it should be attributed to the dual procedure.

Data collection and data entry

Mandatory data entry

- Deep and organ-space SSIs meeting the NHSN SSI definition following a CABG or Cardiac procedures are mandatory data entry.
- Each ICP or Infection Prevention and Control (IPC) designate will be responsible for timely entry of the surveillance data into the provincial surveillance platform. It is expected that the minimum data set is collected and entered in a timely manner after factoring in follow-up time, initial case detection, work-up and distribution to infection control ICPs and/or IPC offices. As a recommendation, data entry should be completed by an ICP or IPC designate within 1-2 weeks of identifying an SSI.

For more information contact ipcsurvstdadmin@ahs.ca

Minimum case information

Basic demographic, facility and possible microbiological data will be collected for cases, including:

- Name
- Date of birth
- Gender
- Alberta Personal Healthcare Number (PHN) or Unique Lifetime Identifier (ULI)
- Connect Care Medical Record Number (MRN)
- Admission date to reporting facility
- Reporting Zone and facility name
- Culture date, laboratory name, accession number and cultured site (if applicable)
- Date of surgery and facility where procedure performed
- Type of surgery (CABG, Cardiac)
- Infection type (Deep incisional or Organ/space)
- Classification (wound class)
- Presence of past endocarditis or current active endocarditis at the time of the surgery.

Denominator data

Surveillance team will extract routine data from Connect Care Reports including:

- A list of patients who had an eligible cardiac surgery – see Appendix B
- Patients discharged due to death in the 24 hours following eligible procedures, patients under 18 years of age and reoperations via same incision within 24 hours are excluded from denominator calculations
- If a Cardiac and CABG are performed during the same operative session, it is counted once in the denominator as a dual procedure.

Rate calculation

Rates	Calculations
Infection rates (per 100 procedures)	$\frac{\text{Number of infections}}{\text{Number of procedures}} \times 100 \text{ procedures}$

NOTE: Only complex SSI (deep incisional and organ/space) will be reported.

Comparator rates

Internal rates are used as comparators. The internal rates are the historical rates for the province or facility from the previous fiscal year.

Reporting

Communication and dissemination of surveillance reports is an integral part of surveillance to inform IPC practice within AHS and Covenant Health facilities and provide support for interventions that improve the quality of patient care delivered. Responsibility for compiling, reporting, and disseminating data and reports is shared between provincial IPC Surveillance and Standards and the provincial IPC program. Formal reports are generated quarterly using reconciled and validated data, although data from the most recent reporting quarter should be interpreted with caution as case validation using administrative data has a one-quarter delay. The

reports contain information on the facility and provincial level and are presented to the provincial IPC Surveillance, Evaluation, Quality Improvement and Research committee for approval. Operational reports are created by local ICPs or their designate and may or may not consist of reconciled and validated data, as they are often created with real-time, as is, data.

Data quality

The purpose of evaluating the quality of data is to ensure that SSI-related events are being monitored efficiently and effectively. The evaluation should involve the assessment of the program (i.e., the protocol and reporting) and system (i.e., electronic data collection tool) attributes, including relevance, simplicity, flexibility, data quality, acceptability, consistency, representativeness, timeliness and stability. Additionally, with the increasing use of technology, informatics concerns for surveillance systems need to be addressed. These include evaluating hardware and software, using a standard user interface, applying standard data formatting and coding, performing quality checks and adhering to confidentiality and security standards.

A standardized approach is used to reconcile and validate the data provincially. The first component of data reconciliation and validation of data in the provincial surveillance platform ensures that demographic data is valid and reliable. The second component entails ensuring that the SSI-related events are entered in a manner that is consistent with the protocol definitions. At this latter stage, outliers are identified, and requests are sent to the ICP to verify that the data was correctly entered, and the definitions were consistently applied according to the provincial surveillance protocol. Final designation of cases is a collaborative effort between the facility-based ICPs and the epidemiologists/analysts of the IPC Surveillance and Standards team.

Algorithms are continuously being updated and added to ensure capture of as many discrepancies as possible. In addition to this current process of data review, there will be data audits using external data sources to determine the validity and reliability of the data in the provincial surveillance platform – see Appendix C. The data will also serve to inform decisions made by the IPC Surveillance and Standards team to improve surveillance processes and methodologies.

Data quality working group

The IPC Surveillance Data Quality Working Group reports to the IPC Surveillance, Evaluation, Quality Improvement and Research committee and is responsible to develop, review and update indicator protocols to include the precise methodology for data collection to ensure consistency. Decisions from the Data Quality Working Group on specific protocol questions are communicated to provincial ICPs through the Data Quality Forum and will be included in the protocol User Guide. These decisions will be considered to be supplemental to the protocol and will be incorporated into the protocol when revised.

For more information contact ipcsurvstdadmin@ahs.ca

Protocol revision history

Date	Details
May 2014	Protocol approved by Surveillance Committee.
May 2018	Revision to exclude superficial infections, risk stratification and update casefinding process.
March 2019	Addition of SSI attribution section, clarification that only complex SSIs are mandatory data entry, protocol style updated, reference style changed to APA).
Spring 2020	• Clarification that reoperations are included, donor site infections and infections from clean/contaminated procedures are excluded and that the denominator includes clean/contaminated procedures because ASA score is not available in the administrative data extract • Updated to new template and reposted to web page.
April 2021	Updated references.
March 2022	Updated references.
March 2023	• Added four (4) new infection codes to case-finding process (I330, I339, I38 and I398) • Changed reporting process from IPC Surveillance Committee to IPC Surveillance, Evaluation, Quality Improvement and Research Committee • Revised denominator data section to be more reflective of all exclusion criteria • Removed 1.HP.53 from denominator (Implantation of internal device, ventricle) • Updated case-finding dates to reflect quarterly review cycles • Updated long term care definition • Updated references.
July 2024	• Reference to supporting documentation in the “Introduction” changed to a bulleted list • Removed reference to ProvSurv – used “provincial surveillance platform” • Clarification that patients with a history of endocarditis or active endocarditis at the time of surgery are included in surveillance • Added Transplants to exclusion criteria, for better alignment with CNISP protocol • Revised procedure list for CABG procedures to specify that an Open approach must be used • Revised procedure list for Cardiac procedures to only include those procedures classified as “open” AND from a valve repair or valve excision/reconstruction • Specified in the inclusion criteria that this protocol follows procedures that are performed at Alberta acute care facilities • Specified that open procedures involve procedures in which the sternum is opened • Clarified that reoperations are included unless performed within 24 hours of each other • General and specific definitions updated • References updated.
March 2025	• Removed reference to LTC and replaced with Continuing Care Home Type A – updated definition and added link to continuing care website for source of truth • Updated definition for patient admissions denominator

	• Updated inclusion criteria to specify that minimally invasive sternotomy procedure are included. Updated exclusion criteria to specify that the following procedures are excluded: • Procedures performed via minimally invasive thoracotomy • Transcatheter valve insertions • Valve-sparing aortic root procedures unless there is evidence that the valve itself was repaired, replaced or reconstructed. Revised this section: ***Attributing SSI after CABG and Cardiac procedures are performed during a single trip to the OR*:** If a CABG and a cardiac procedure are performed through a single incision / laparoscopic site during a single trip to the operating room, and an SSI develops, it should be attributed to the dual procedure. • (Previously it was: If a CABG and a cardiac procedure are performed through a single incision / laparoscopic site during a single trip to the operating room, and an SSI develops, it should be attribute the SSI to the procedure that is thought to be associated with the infection. If a patient develops an SSI after a single trip to the operating room in which both a CABG and a cardiac procedure were performed, and the source of the SSI is not apparent, assign the SSI to the CABG procedure.) • Updated denominator section to reflect that Connect Care will be used as source of truth, instead of CCI codes from Analytics. This change was also updated in Appendix B – included CABG/Cardiac/ surgical procedures • Updated case-finding process • Added the following statement to the "Data Reports" section: Formal reports are generated routinely (usually quarterly) using reconciled and validated data, **although data from the most recent reporting quarter should be interpreted with caution as case validation using administrative data has a one-quarter delay**.

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Appendix A: General surveillance definitions

Terms	Definitions
Encounter types	Type of AHS/Covenant Health healthcare location or facility where the patient is located at the time of identification. The following encounter types are referred to in acute care surveillance protocols (Government of Alberta, 2008; Government of Alberta, 2025). • **Inpatient acute care:** Refers to a General Hospital: According to the Hospitals Act, a general hospital is defined as a "hospital providing diagnostic services and facilities for medical or surgical treatment in the acute phase for adults and children and obstetrical care" (Government of Alberta, 2025). General hospitals have several functional centres. Each functional centre is associated with inpatient, outpatient, or diagnostic and therapeutic services. • **Inpatient mental health/rehab**: A designated mental health facility providing diagnosis and treatment for mental illness and addiction in the acute phase for adults and children. Inpatient services refer to a person admitted to and assigned a bed in a facility by order of a physician for provision of diagnostic and/or treatment services. They would have a patient/group room in which inpatient services are provided within the patient's room or within a common group room within the designated mental health facility. AHS facility examples include Glenrose Rehabilitation Hospital, Centennial Centre for Mental Health and Brain Injury.
Infection prevention and control baseline	A comparator rate created for each acute care facility in the IPC Surveillance on-line dashboards and reporting modules, to guide efforts to reduce healthcare-associated infections. The IPC baseline is based on reported monthly rates for the previous fiscal year. The calculation excludes the monthly rates higher than 1 Standard Deviation above the 12-month average but includes all rates where the site had optimal performance. This calculation method biases the IPC baseline rate towards zero, to focus on the best patient safety outcomes.
Continuing Care Home (CCH) Type A (formerly Long Term Care)	This environment provides onsite RN and/or registered psychiatric nurse (RPN) care, assessment and/or treatment 24-hours a day. Licensed practical nurses (LPNs) may also be onsite in addition to onsite personal care and support provided by health care aides (HCAs). CCH Type A may also have a secure space. Some sites may have specialized programs and services available for residents with complex clinical or complex functional care requirements (e.g., rehabilitation) (Alberta Health Services, 2025). To identify if a facility has CCH Type A beds refer to this website: https://www.albertahealthservices.ca/cc/page15328.aspx where you can search by Name and identify what type of beds the facility has.
Patient admission (aka inpatient admission)	A person admitted to and assigned a bed in a hospital by the order of a physician, for the provision of diagnostic or treatment services or both. Includes any time in the emergency department if assigned a bed in hospital, regardless of whether the patient was transferred to an inpatient unit and patients who are directly admitted to an inpatient unit. This is the denominator used for non-hospital-acquired rates (see Rate Calculation Section) (Government of Alberta, 2025).
Patient days (aka inpatient days)	As defined by AHS, this is used to create the denominator for hospital-acquired or hospital-identified cases. The total is equal to midnight census with patients admitted and discharged on the same day counted as a one day stay. It includes patients out on a pass. Day of admission is counted but the day of separation (discharge, death or transfer out of hospital) is not counted. Patient-days are included for inpatient encounters where discharge date is not recorded in the data source. Inpatient totals exclude the time patients are waiting in the emergency department for an inpatient bed (time from decision to admit to discharge from emergency department).

Terms	Definitions
Emergency department inpatient days (EDIP)	As defined by AHS, denominators for provincial surveillance modules include these figures in the total patient-days. Includes the number of acute care inpatient patient-days utilized in the emergency department during the reporting period. The figures reflect the time from emergency department discharge (i.e. decision to admit) to emergency department departure for patients admitted to an acute care hospital. It is calculated as [(emergency department departure date and time – emergency department discharge date and time) ÷ 60 ÷ 24]. Figures exclude cases where the emergency department discharge date and time or emergency department departure date and time were not provided, or the value has a negative number.

Appendix B: Included CABG/cardiac surgical procedures

This list is based on the primary procedure description in Operative Notes in Connect Care:

CABG procedures:
CABG (CORONARY ARTERY BYPASS GRAFT)
CABG, 1 TO 2 VESSELS
CABG, 3 TO 4 VESSELS
CABG, USING RADIAL ARTERY GRAFT
CABG, WITH ASCENDING AORTA HEMIARCH REPAIR OR REPLACEMENT
CABG, WITH MAZE PROCEDURE
CABG, WITH VENTRICULAR ANEURYSM REPAIR
CABG, WITHOUT CARDIOPULMONARY BYPASS
REVISION, CABG
Cardiac procedures:
ANNULOPLASTY, MITRAL VALVE
BENTALL PROCEDURE
REOPERATION, WITH AORTIC VALVE REPAIR OR REPLACEMENT
REPAIR OR REPLACEMENT, AORTA, HEMIARCH
REPAIR OR REPLACEMENT, AORTIC AND MITRAL VALVES
REPAIR OR REPLACEMENT, AORTIC VALVE, MITRAL VALVE, TRICUSPID VALVE, OR ANY COMBINATION, BY STERNOTOMY
REPAIR OR REPLACEMENT, MITRAL AND TRICUSPID VALVES
REPAIR OR REPLACEMENT, MITRAL VALVE
REPAIR OR REPLACEMENT, MITRAL VALVE, WITH MAZE PROCEDURE
REPAIR OR REPLACEMENT, PULMONARY VALVE
REPAIR OR REPLACEMENT, TRICUSPID VALVE
REPAIR, AORTIC DISSECTION, STERNOTOMY APPROACH
REPAIR, AORTIC ROOT
REPAIR, MITRAL VALVE, OPEN
REPAIR, TRICUSPID VALVE
REPLACEMENT, AORTIC AND MITRAL VALVES
REPLACEMENT, AORTIC ROOT AND ASCENDING AORTA
REPLACEMENT, AORTIC VALVE
REPLACEMENT, AORTIC VALVE, AND ASCENDING AORTA
REPLACEMENT, AORTIC VALVE, HEMISTERNOTOMY APPROACH
REPLACEMENT, AORTIC VALVE, USING ROSS PROCEDURE
REPLACEMENT, ASCENDING AORTIC ROOT, WITH REPAIR OR REPLACEMENT, MITRAL VALVE
REPLACEMENT, MITRAL VALVE

REPLACEMENT, PULMONARY VALVE
REVISION, ASCENDING AORTIC ROOT REPLACEMENT, WITH REPAIR OR REPLACEMENT, MITRAL VALVE
REVISION, BENTALL PROCEDURE
REVISION, MITRAL VALVE REPAIR OR REPLACEMENT
REVISION, REPAIR OR REPLACEMENT, MITRAL VALVE
REVISION, REPAIR OR REPLACEMENT, MITRAL VALVE, WITH MAZE PROCEDURE
REVISION, REPAIR OR REPLACEMENT, PULMONARY VALVE
REVISION, REPLACEMENT, AORTIC VALVE
REVISION, TRICUSPID VALVE REPAIR
Dual (CABG and Cardiac) procedures:
CABG, WITH AORTIC AND MITRAL VALVE REPAIR OR REPLACEMENT
CABG, WITH AORTIC VALVE REPLACEMENT
CABG, WITH AORTIC VALVE REPLACEMENT OR REPAIR
CABG, WITH AORTIC VALVE REPLACEMENT OR REPAIR AND ABLATION, RADIOFREQUENCY
CABG, WITH ASCENDING AORTIC ROOT REPLACEMENT
CABG, WITH MITRAL AND TRICUSPID VALVE REPAIR OR REPLACEMENT
CABG, WITH MITRAL VALVE REPAIR
CABG, WITH MITRAL VALVE REPAIR OR REPLACEMENT
CABG, WITH MITRAL VALVE REPLACEMENT AND MAZE PROCEDURE
CABG, WITH REPAIR OR REPLACEMENT OF AORTIC, MITRAL, OR TRICUSPID VALVE
REVISION, CABG, WITH AORTIC VALVE REPLACEMENT
REVISION, CABG, WITH MITRAL VALVE REPAIR OR REPLACEMENT
REVISION, CABG, WITH MITRAL VALVE REPLACEMENT
REVISION, CABG, WITH REPLACEMENT OF MITRAL OR AORTIC VALVE

Please note that the primary procedure is based on the planned procedure and may not always align with the actual procedure performed. For each case, the complete procedure description is reviewed to determine whether it meets the criteria for inclusion or exclusion.

Appendix C: Surveillance team casefinding process

Diagnosis and procedure codes for 90 days following the patients CABG/Cardiac procedures are used to identify potential surgical site infection cases. This case-finding process repeats every 90 days. Medical charts of patients with potential surgical site infections were reviewed by an ICP at the acute care facility where the patient was identified with a diagnosis or procedure code.

Activity	Steps	Timelines for Quarter 3 procedures
Surveillance data range	Six months of patient procedures reviewed in this cycle, including procedures in timeframe under review, and repeat review for last quarter.	Jul-Dec 2024
Data request to Analytics	Analytics query – use denominator (data extract obtained through Connect Care report) and request Analytics to link to ICD-10-CA diagnosis codes (see Appendix D) for 90 days following last procedure date.	May 2025
Surveillance analysis	Run pre-written R script to exclude cases already entered in the provincial surveillance platform (known SSI cases), and records reviewed in the previous casefinding cycle. Send list of patients with suspicious readmissions to epidemiologist for manual review/exclusion of obvious non-SSI related infections prior to sending to infection control professionals at FMC and MAZ.	May 2025
Results to infection control professionals	Send patients with suspicious readmissions to infection control professionals at FMC and MAZ, cc Senior Consultants and Directors;	(5 months following end of surveillance quarter) May 2025
Casefinding back from infection control professionals	Responses received indicating investigation and response for all patients.	(4 weeks after receiving cases for review) Jun 2025
Data entry into the provincial surveillance platform	Infection control professionals to enter confirmed SSI cases into the provincial surveillance platform. For SSI cases identified by infection control professionals at a facility that did not perform the original CABG/Cardiac procedure, the infection control professional identifying the SSI must contact the procedure facility infection control professional prior to entering the case	June 2025
Surveillance SSI report date	Update SSI rates based on new numerator information.	(7 months following end of surveillance quarter) July 2025 (or next report date)

Appendix D: ICD-10-CA Codes used in the casefinding process

ICD-10-CA	Description
I330	• Acute and subacute infective endocarditis
I339	• Acute endocarditis, unspecified
I38	• Endocarditis, valve unspecified
I398	• Endocarditis, valve unspecified, in diseases classified elsewhere
T814	• Infection following a procedure, not elsewhere classified includes: ○ abscess ○ wound postprocedural ○ sepsis postprocedural • Excludes infection due to: ○ infusion, transfusion and therapeutic injection (T80.2) ○ prosthetic devices, implants and grafts (T82.6-T82.7) (T83.5-T83.6) (T84.5-T84.7) (T85.7) ○ obstetric surgical wound infection (O86.0) ○ specified infections classified elsewhere such as: ▪ cholangitis (K83.02) ▪ pneumonia (J12-J18) ▪ surgical wound infection of amputation stump or reattached body part (T87.0-, T87.1-, T87.201), (T87.4-)
T826	Infection and inflammatory reaction due to cardiac valve prosthesis
T827	Infection and inflammatory reaction due to other cardiac and vascular devices, implants and grafts
T857	Infection and inflammatory reaction due to other internal prosthetic devices, implants and grafts

(Canadian Institute for Health Information, 2022)