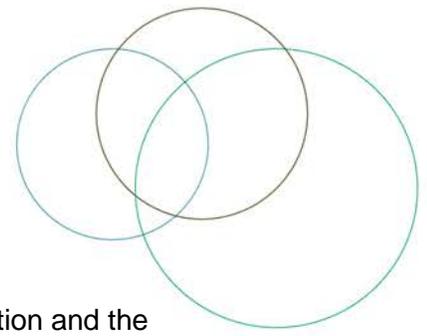


HOSPITAL HARM IMPROVEMENT RESOURCE

Infusion, Transfusion and Injection Complications



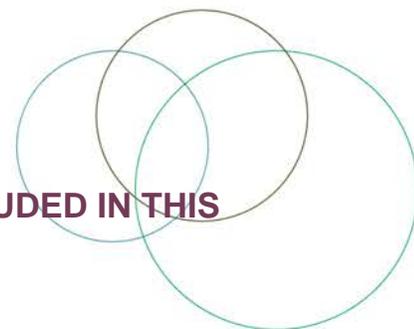
ACKNOWLEDGEMENTS



The Canadian Institute for Health Information and the Canadian Patient Safety Institute have collaborated on a body of work to address gaps in measuring harm and to support patient safety improvement efforts in Canadian hospitals.

The Hospital Harm Improvement Resource was developed by the Canadian Patient Safety Institute to complement the Hospital Harm measure prepared by the Canadian Institute for Health Information. It links measurement and improvement by providing resources that will support patient safety improvement efforts.



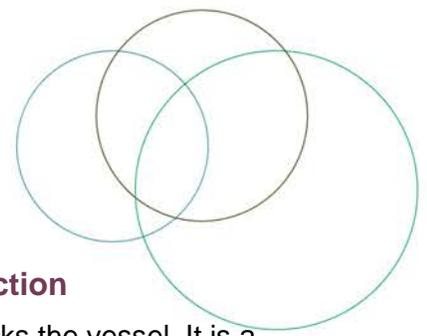


DISCHARGE ABSTRACT DATABASE (DAD) CODES INCLUDED IN THIS CLINICAL CATEGORY:

A11: Infusion, Transfusion and Injection Complications

Concept	Complications from infusions, transfusions and injections, including those related to therapeutic substances or procedures.
Selection criteria	
T80.0 T80.1 T80.2 T80.3 T80.4 T80.5 T80.6 T80.8 T80.9	Identified as diagnosis type (2)
Codes	Code descriptions
T80.0	Air embolism following infusion, transfusion and therapeutic injection
T80.1	Vascular complications following infusion, transfusion and therapeutic injection
T80.2	Infections following infusion, transfusion and therapeutic injection
T80.3	ABO incompatibility reaction
T80.4	Rh incompatibility reaction
T80.5	Anaphylactic shock due to serum
T80.6	Other serum reactions
T80.8	Other complications following infusion, transfusion and therapeutic injection
T80.9	Unspecified complication following infusion, transfusion and therapeutic injection





OVERVIEW AND IMPLICATIONS

Air embolism following infusion, transfusion and therapeutic injection

An air embolism is a bubble that becomes trapped in a blood vessel and blocks the vessel. It is a rare but potentially fatal event. The seriousness of the blockage depends on which part of the body the affected blood vessel supplies blood to, and the size of the air bubble. For example, an air embolism in the arteries leading to the brain may cause a decreased level of consciousness, dizziness, slurred speech, seizures, and/or a stroke. An air embolism that travels to the coronary arteries may cause a myocardial infarction or an arrhythmia. An air embolism that travels to the lungs may cause a pulmonary embolism (Gordy & Rowell 2013; National Health Service 2015).

Vascular complications following infusion, transfusion and therapeutic injection

Phlebitis refers to inflammation of the vein and it may be a complication of peripheral cannulation. Phlebitis may be painful, and it compromises future venous access. Other symptoms include warmth, tenderness, erythema or palpable venous cord. If it is bacterial and untreated, it may lead to a bloodstream infection. Phlebitis may be localized to the insertion site or travel along the vein. It may occur during catheterization or up to 48 hours after cannula removal (Ray-Burrue et al. 2014).

ABO incompatibility reaction

Acute hemolytic transfusion reaction is a possible complication of a blood transfusion. It may be associated with **ABO-incompatibility, other blood group incompatibilities** (there are 29 blood group systems, in addition to ABO, that may cause incompatibility), and with rare cases when group O platelets with high titers of anti-A and/or anti-B are transfused to a non-group O recipient (Callum et al. 2016; Fung et al. 2007).

ABO-incompatibility is the most common cause of morbidity from RBC transfusion. The reaction is often due to a clerical error, or an error in patient identification. Half of all errors are due to administering properly labelled blood to the wrong patient, while other errors are the result of improper labelling of samples or testing errors. One in 38,000 red cell transfusions are ABO-incompatible due to transfusing the wrong blood to a patient, and less than 10 per cent of ABO-incompatible transfusions result in a fatal outcome. The risk of death correlates with the amount of incompatible blood transfused (Callum et al. 2016).

Symptoms of hemolytic reaction include back pain, bloody urine, chills, fainting or dizziness, fever, flank pain and flushing of the skin (National Heart Lung and Blood Institute 2011; Transfusion reaction 2016).

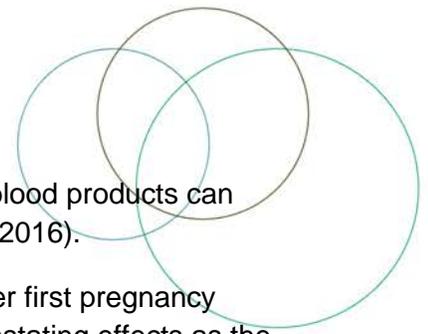
Rh incompatibility reaction

Rh is known as the D antigen. Less than 15 per cent of the population do not have this antigen expressed on their red blood cells and are typed as D negative, more commonly known as Rh negative. If an Rh negative person is exposed to Rh positive blood, either by a blood transfusion or their fetus during pregnancy, a small percentage will form an antibody to the D antigen (Anti-



HOSPITAL HARM IMPROVEMENT RESOURCE

Infusion, Transfusion and Injection Complications



D). If the patient does develop anti-D, subsequent exposures to Rh positive blood products can produce a hemolytic reaction (Ontario Regional Blood Coordinating Network 2016).

In the case of pregnancy, if an Rh negative mother develops Anti-D during her first pregnancy with an Rh positive baby, her second or subsequent babies could suffer devastating effects as the anti-D in her plasma may attack the D-antigen on the surface of the baby's red cells causing hemolysis. This is a known cause of hemolytic disease of the fetus and newborn (HDFN). An infant with HDFN may show signs of anemia, jaundice, hypotonia, lethargy, or in some cases, brain damage or even death can occur. The administration of Rh Immune globulin (Rhogam) during prenatal care can reduce the likelihood of developing Anti-D, which would affect future pregnancies (Ontario Regional Blood Coordinating Network 2016).

Anaphylaxis to serum

Anaphylactic shock can result from a blood transfusion. It is the most severe form of allergic reaction and accounts for approximately three per cent of transfusion associated fatalities (Food and Drug Administration, 2009). The occurrence rate for anaphylaxis is rare at one in 40,000. The vast majority of anaphylactic reactions are unexplained (Callum et al. 2016).

Anaphylactic/anaphylactoid reactions usually begins within one to 45 minutes of the start of the infusion and are associated with cutaneous reactions (urticaria), hypotension, hypoxia, hoarseness, stridor, wheezing, chest pain, dyspnea, anxiety, feelings of impending doom, gastrointestinal symptoms (nausea, vomiting) and rarely death (Callum et al. 2016).

Other serum reactions

Urticaria may present as one lesion or be widespread lesions. Urticaria may be associated with pruritus, erythema, flushing or mild upper respiratory symptoms (cough, wheezing), nausea, vomiting, abdominal cramps or diarrhea (Callum et al., 2016). Minor allergic reactions affecting the skin with occurrence of hives, rash, and urticaria are far more common occurring at a rate of one in 100 blood products transfused (Callum et al., 2016).

GOAL

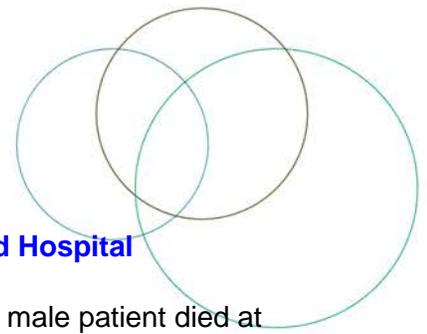
Reduce the incidence of complications following infusion, transfusion and therapeutic injection.

IMPORTANCE FOR PATIENTS AND FAMILIES

Air embolism is an uncommon, but potentially catastrophic, event that occurs as a consequence of the entry of air into the vasculature (O'Dowd & Kelley 2019)

Patients experiencing acute hemolytic transfusion reactions most often present with fever, chills and hemoglobinuria. Less common symptoms are pain, hypotension, nausea/vomiting, dyspnea, renal failure and disseminated intravascular coagulation (Callum et al. 2016).





Patient Story

Blood on their hands: man dies after transfusion mix-up at Coney Island Hospital

“There’s bad blood at Coney Island Hospital — and it’s deadly. A 40-year-old male patient died at the city-run hospital last week after receiving the wrong type blood during a transfusion, The Post has learned. Transfusions that don’t match a patient’s blood type — giving Type-A to a person who is Type-B, for example — causes the body to attack the new red blood cells, a violent and painful reaction that can lead to shock and a fatal kidney shutdown. “The blood was mislabeled in the lab. It wasn’t a nursing issue,” said one hospital professional who spoke yesterday on condition of anonymity. “It shouldn’t have happened; it’s just carelessness. It’s a huge problem,” he added. A source said the fatal error occurred in the hospital’s sixth-floor lab, where blood drawn from patients is screened and ‘typed’. A technician labeled the patient’s blood as the wrong type, and the patient was given the wrong blood during a transfusion.”

(Italiano 2013)

CLINICAL AND SYSTEM REVIEWS, INCIDENT ANALYSES

Given the broad range of potential causes of complications from infusions, transfusions and injections, clinical and system reviews should be conducted to identify latent causes and determine appropriate recommendations.

Occurrences of harm are often complex with many contributing factors. Organizations need to:

1. Measure and monitor the types and frequency of these occurrences.
2. Use appropriate analytical methods to understand the contributing factors.
3. Identify and implement solutions or interventions that are designed to prevent recurrence and reduce risk of harm.
4. Have mechanisms in place to mitigate consequences of harm when it occurs.

To develop a more in-depth understanding of the care delivered to patients, chart audits, incident analyses and prospective analyses can be helpful in identifying quality improvement opportunities. Links to key resources for [conducting chart audits](#) and [analysis methods](#) are included in the [Hospital Harm Improvement Resources Introduction](#).

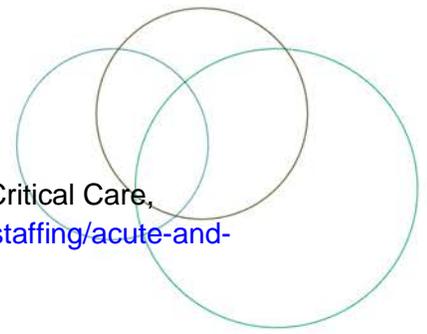
If your review reveals that your events are linked to specific processes or procedures, you may find these resources helpful:

- Canadian Blood Services, Professional Education www.transfusionmedicine.ca
- Choosing Wisely Canada: Transfusion Medicine <http://www.choosingwiselycanada.org/recommendations/transfusion-medicine/>
- [Infusion Nursing Standards of Practice](#)



HOSPITAL HARM IMPROVEMENT RESOURCE

Infusion, Transfusion and Injection Complications



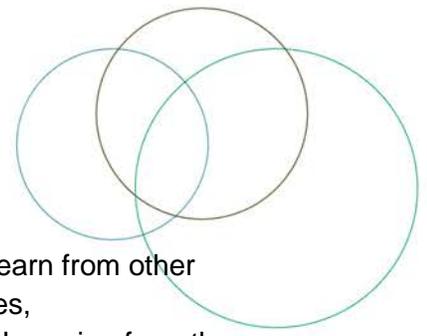
- National Institute for Health and Care Excellence (NICE), Acute and Critical Care, <https://www.nice.org.uk/guidance/service-delivery--organisation-and-staffing/acute-and-critical-care>
- National Institute for Health and Care Excellence (NICE), Hospitals <https://www.nice.org.uk/guidance/settings/hospitals>
- Norfolk D (Ed). *Handbook of Transfusion Medicine, 5th Ed.* United Kingdom Blood Services. 2013. <http://www.transfusionsguidelines.org/transfusion-handbook>
- Ontario Regional Blood Coordinating Network www.transfusionontario.org
 - Callum JL, Pinkerton PH, Lima A, et al. *Bloody Easy 4: Blood transfusions, blood alternatives and transfusion reactions. A guide to transfusion medicine. Fourth Edition.*
 - Ontario Regional Blood Coordinating Network; 2016. http://transfusionontario.org/en/documents/?cat=bloody_easy
 - Ontario Regional Blood Coordinating Network (ORBCoN). Resources for midwives. ORBCoN; 2016. <http://transfusionontario.org/en/documents/?cat=resources-for-midwives>

MEASURES

Vital to quality improvement is measurement, and this applies specifically to implementation of interventions. The chosen measures will help to determine whether an impact is being made (primary outcome), whether the intervention is actually being carried out (process measures), and whether any unintended consequences ensue (balancing measures). In selecting measures, consider the following:

- Whenever possible, use measures you are already collecting for other programs.
- Evaluate your choice of measures in terms of the usefulness of the final results and the resources required to obtain them; try to maximize the former while minimizing the latter.
- Try to include both process and outcome measures in your measurement scheme.
- You may use different measures or modify the measures described below to make them more appropriate and/or useful to your particular setting. However, be aware that modifying measures may limit the comparability of your results to others.
- Posting your measure results within your hospital is a great way to keep your teams motivated and aware of progress. Try to include measures that your team will find meaningful and exciting (IHI, 2012).





GLOBAL PATIENT SAFETY ALERTS

[Global Patient Safety Alerts](#) (GPSA) provides access and the opportunity to learn from other organizations about specific patient safety incidents including alerts, advisories, recommendations and solutions for improving care and preventing incidents. Learning from the experience of other organizations can accelerate improvement.

Recommended search terms:

- Air Embolism
- Pulmonary Embolism
- Blood Products/Transfusion
- Transfusion Reaction
- Phlebitis

INFUSION, TRANSFUSION AND INJECTION COMPLICATIONS SUCCESS STORIES

Sunnybrook Health Sciences Centre

Patient blood management has been defined as any intervention that helps decrease the patient's likelihood of needing a blood transfusion during their hospital stay. Fairly liberal transfusion practice for anemic patients was the standard of care throughout the world. However, in the last decade there is evidence of many adverse outcomes associated with blood transfusion, especially when given during or immediately after a surgical intervention.

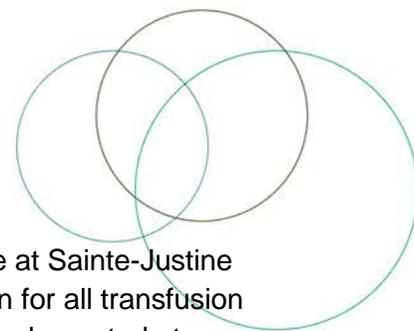
The greatest predictor of whether a patient will need a transfusion is their preoperative hemoglobin level. The Holland Centre at Sunnybrook performs over 3,000 orthopaedic surgical procedures annually. In 2011, it introduced routine CBC (complete blood count) preoperative screening of all surgical candidates to identify anemic patients, manage potential anemia and refer high risk patients to the Blood Conservation Clinic for anemia optimization before surgery.

All preoperative patients are given oral iron for one month. If patients are anemic, they are referred to the Blood Conservation Clinic (BCC) four to six weeks preoperatively for consideration of IV iron or Eprex. The project involved an interprofessional team that included Anesthesia, Hematology, Nursing, and Orthopaedic Surgeons. A preoperative blood conservation algorithm was designed and broad staff education was conducted. Patient education materials were also developed. Transfusion rates during the study period were 3.6 per cent compared to 5.1 per cent previously. The estimated cost-savings associated with fewer transfusions in this patient population was \$75,000 (Health Standards Organization 2013).



HOSPITAL HARM IMPROVEMENT RESOURCE

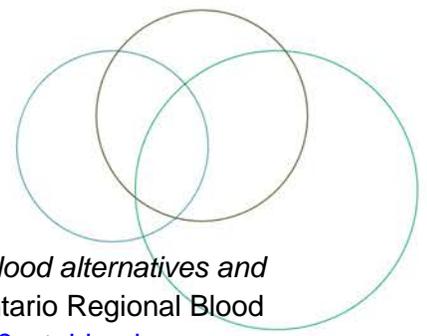
Infusion, Transfusion and Injection Complications



Sainte-Justine UHC, Quebec

With a focus on providing quality care, the Transfusional Medicine Committee at Sainte-Justine UHC put forth a recommendation to introduce transfusion practice certification for all transfusion staff. Thereby, a transfusion practice training and certification program was implemented at Sainte-Justine UHC in 2005. Sainte-Justine is the first hospital centre to have implemented a certification of such calibre. The program seeks to decrease the number of transfusion accidents and promote professional development among nursing staff. Certification applies to nurses, transfusion inhalotherapists, perfusionists and phlebotomists. Licensed Practical Nurses will be included next. With recertification taking place every two years, an internal study was conducted to evaluate the suitability of maintaining this program within the organization (Health Standards Organization 2012).





REFERENCES

- Callum JL, Pinkerton PH, Lima A, et al. *Bloody Easy 4: Blood transfusions, blood alternatives and transfusion reactions. A guide to transfusion medicine. Fourth Edition.* Ontario Regional Blood Coordinating Network; 2016. http://transfusionontario.org/en/documents/?cat=bloody_easy
- Food and Drug Administration (FDA). *Fatalities reported to FDA following blood collection and transfusion: Annual summary for fiscal year 2009.* FDA; 2012. <http://www.fda.gov/BiologicsBloodVaccines/SafetyAvailability/ReportaProblem/TransfusionDnationFatalities/ucm204763.htm>
- Fung MK, Downes KA, Shulman IA. Transfusion of platelets containing ABO-incompatible plasma: a survey of 3156 North American laboratories. *Arch Pathol Lab Med.* 2007;131(6):909-916. <http://www.archivesofpathology.org/doi/full/10.1043/1543-2165%282007%29131%5B909%3ATOPCAP%5D2.0.CO%3B2>
- Gordy S, Rowell S. Vascular air embolism. *Int J Crit Illn Inj Sci.* 2013;3(1):73-76 doi:10.4103/2229-5151.109428. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3665124/>
- Health Standards Organization (HSO) *Best practice in patient blood management in a surgical patient population.* Health Standards Organization 2013. <https://healthstandards.org/leading-practice/best-practice-in-patient-blood-management-in-a-surgical-patient-population/>
- Health Standards Organization (HSO) . *Transfusion practice certificate at Sainte-Justine UHC.* Health Standards Organization 2012. <https://healthstandards.org/leading-practice/transfusion-practice-certificate-at-sainte-justine-uhc/>
- Institute for Healthcare Improvement (IHI). *How-to Guide: Prevent harm from high-alert medications.* Cambridge, MA: IHI;2012. <http://www.ihl.org/resources/Pages/Tools/HowtoGuidePreventHarmfromHighAlertMedications.aspx>
- National Health Service. *Air embolism.* 2015. <http://www.nhs.uk/Conditions/Air-embolism/Pages/Introduction.aspx>
- National Heart, Lung and Blood Institute. *What is Rh Incompatibility?*National Institutes of Health; 2011. <https://www.nhlbi.nih.gov/health/health-topics/topics/rh>
- O'Dowd LC, Kelley MA. *Air Embolism.* Up to Date; 2019. <https://www.uptodate.com/contents/air-embolism#H1>
- Ontario Regional Blood Coordinating Network (ORBCoN). *Resources for midwives.* ORBCoN; 2016. <http://transfusionontario.org/en/documents/?cat=resources-for-midwives>
- Ray-Barruel G, Polit DF, Murfield JE, Rickard CM. Infusion phlebitis assessment measures: a systematic review. *J Eval Clin Pract.* 2014;20(2):191-202doi:10.1111/jep.12107. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4237185/>

