Intravenous Unfractionated Heparin Infusion

Summary This Guideline outlines an evidence-based approach for safe and effective intravenous unfractionated heparin infusion management in NSW Health facilities. It provides standardised guidance to NSW Health staff on the safe prescribing, administration and monitoring of heparin infusions.

Document type Guideline

Document number GL2025_009

Publication date 21 November 2025

Author branch Clinical Excellence Commission

Branch contact (02) 9269 5500

Review date 21 November 2030

Policy manual Patient Matters Manual for Public Health Organisations

File number D25/892

Status Active

Functional group Clinical/Patient Services - Medical Treatment, Surgical
Corporate Administration - Governance, Records
Population Health - Pharmaceutical

Applies to Ministry of Health, Public Health Units, Local Health Districts, Board Governed Statutory Health Corporations, Chief Executive Governed Statutory Health Corporations, Specialty Network Governed Statutory Health Corporations, Affiliated Health Organisations, NSW Health Pathology, Public Health System Support Division, Cancer Institute, Government Medical Officers, NSW Ambulance Service, Public Hospitals

Distributed to Ministry of Health, Public Health System, Divisions of General Practice, Government Medical Officers, NSW Ambulance Service, Private Hospitals and Day Procedure Centres, Tertiary Education Institutes

Audience NSW Health Clinicians

NSW Health

Guideline

Intravenous Unfractionated Heparin Infusion

Guideline summary

This Guideline outlines an evidence-based approach for safe and effective intravenous unfractionated heparin infusion ("heparin infusion") management in NSW Health facilities. It provides standardised guidance to NSW Health staff on the safe prescribing, administration and monitoring of heparin infusions, aiming to reduce clinical variation, mitigate risks associated with the use of a high-risk medicine and improve patient outcomes.

Key principles

Heparin infusions are for the treatment and prevention of thromboembolic events. This Guideline includes weight-based dosing protocols for Standard and Higher Bleeding Risk indications, along with monitoring requirements, using activated partial thromboplastin time (aPTT) or anti-Xa activity, to guide infusion rate adjustments. It also provides guidance on complications such as heparin induced thrombocytopenia, bleeding, and heparin resistance, and outlines periprocedural considerations.

The Guideline is intended to support safe and effective anticoagulant practice.

Use of this Guideline

This Guideline applies to NSW Health staff managing patients 16 years old and over who are receiving a heparin infusion for an indication listed in section 2.2 *Indications for heparin infusion*.

Heparin infusion management should be documented using the appropriate NSW Health Intravenous Unfractionated Heparin Infusion Order (NH701269 or NH701268), or the heparin infusion management functionality within an electronic Medication Management (eMM) system.

Revision history

Version	Approved By	Amendment Notes
GL2025_009 November-2025	Deputy Secretary, System Sustainability and Performance	New Guideline.

Contents

1. Background

Unfractionated heparin (UFH) is a parenteral anticoagulant. It acts indirectly (via antithrombin III) by inactivating thrombin (factor IIa), factor Xa and to a lesser extent factors XIIa, XIa and IXa (Garcia et al. 2012).

UFH is a high-risk medicine with a narrow therapeutic window; over or under dosing can result in significant adverse patient outcomes. When UFH is administered as an intravenous infusion ("heparin infusion") there are additional risks as the dosing and monitoring requirements add further complexity.

Some examples of incidents involving heparin infusion include:

- incorrect protocol use resulting in inadvertent administration of the incorrect dose
- unintentional duplication of anticoagulant therapy, for example heparin infusion with simultaneous therapeutic or prophylactic enoxaparin
- incomplete or incorrect documentation, for example, using an estimated body weight to calculate the starting dose of heparin resulting in administration of an inappropriate dose
- failure to adjust the dose due to activated partial thromboplastin time (aPTT) results not being reviewed, actioned or being misinterpreted
- infusion stopped without documentation resulting in subtherapeutic dosing
- incorrect concentration being administered
- failure to ensure appropriate perioperative anticoagulation.

1.1. About this document

This Guideline outlines a standardised approach for intravenous heparin infusion management in NSW Health facilities. It provides guidance to NSW Health staff regarding prescribing, administering and monitoring heparin infusions, and aligns with the NSW Health Policy Directive *Medication Handling* (PD2022_032), NSW Health Policy Directive *High-Risk Medicines Management* (PD2024_006) and the Anticoagulants Standard. Standardisation of heparin infusion management aims to reduce unwarranted variation in care processes and thereby reduce the risks of harm associated with over or under anticoagulation.

This Guideline was developed in collaboration with the NSW Anticoagulant Medicines Working Party, a multidisciplinary group of expert clinicians working across a range of NSW Health facilities. In developing the Guideline, the Working Party considered current best practice, peer-reviewed literature and expert opinion from within the Working Party.

1.2. Scope

This Guideline applies to NSW Health staff managing patients 16 years old and over who are receiving a heparin infusion for an indication listed in section 2.2 *Indications for heparin infusion*.

1.3. Key definitions and acronyms

4Ts score	A clinical tool used to assess the probability that a patient's thrombocytopenia is due to the presence of pathogenic platelet-activating HIT antibodies. It is calculated prior to undertaking immunological assays (pre-test).
Activated partial thromboplastin time (aPTT)	A measure of clotting time and can measure the effectiveness of heparin.
Anti-Xa activity	A test to measure the inhibition of activated factor X (factor Xa), which is a measure of the effectiveness of heparin (or other factor Xa inhibiting anticoagulants).
Authorised prescriber	A person approved by the facility to prescribe medications, but only in accordance with any practice conditions imposed by the person's place of employment and the endorsements, notations, and conditions on the person's health practitioner registration, these include: • Medical practitioner • Nurse practitioner • Endorsed midwife • Podiatrist • Dentist • Midwife practitioner • Optometrist. *Note:* For this Guideline 'authorised prescriber' does not relate to a medical practitioner approved under the *Therapeutic Goods Act 1989* (Commonwealth) to prescribe a Special Access Scheme medication or to prescribe Pharmaceutical Benefits Scheme medications under the *National Health Act 1953* (Commonwealth).

Bridging	Temporary use of heparin (or another short-acting anticoagulant) when a patient's regular anticoagulant is paused, usually for surgery or an invasive procedure. It provides continuous anticoagulation during the period when the regular medication is stopped and is used until the regular anticoagulant can be safely restarted.
Clinician	In the context of this Guideline, a clinician is a health care professional registered with the Australian Health Practitioner Regulation Agency (AHPRA) who, within their scope of practice, can prescribe, administer and/or monitor heparin infusions.
Critical high aPTT (or anti-Xa)	An aPTT result of greater than 120 seconds or an anti-Xa activity level of greater than 1.0.
Drug and Therapeutics Committee (DTC)	The Committee with delegated responsibility for the governance and quality of the medication management system and for ensuring the appropriate, safe, effective, and cost-effective use of medicines in the health facility, Local Health District or Specialty Health Network under their jurisdiction.
Heparin infusion	In the context of this Guideline, a heparin infusion refers to an intravenous infusion of unfractionated heparin.
Heparin induced thrombocytopenia (HIT)	HIT is an uncommon but life-threatening complication of heparin therapy. It is an adverse reaction mediated by the immune system, and despite presenting as a thrombocytopenia there is a strong association with risk of thrombosis.
High-risk medicine	Medicines that have a high risk of causing injury or harm if they are misused or used in error. Error rates with these medications are not necessarily higher than with any other medicines, but when problems occur, the consequences can be more significant.
Must	Indicates a mandatory action requiring compliance.
Proceduralist	A clinician who is performing or assisting in a procedure. There may be more than one proceduralist involved in a procedure. The senior proceduralist takes overall responsibility.

Should	Indicates a recommended action that is best followed unless there are sound reasons for taking a different course of action.
Therapeutic window	The blood concentration range for a medicine in which it is effective without causing harmful side effects. For heparin, staying within the therapeutic window is important to prevent both clotting and excessive bleeding.
Venous thromboembolism (VTE)	The blocking of a blood vessel by a blood clot. Includes both deep vein thrombosis and pulmonary embolism.

1.4. Related documents

This Guideline should be read in conjunction with the following documents:

Table 1: Related NSW Health policy documents

NSW Health policy document	
PD2022_032	*Medication Handling*
PD2024_006	*High-Risk Medicines Management*
Consent Manual	*Consent to Medical and Healthcare Treatment Manual*

Table 2: Other related documents

Organisation	Document title
NSW Government Office of the Children's Guardian	*Guide to the Child Safe Standards*
Australian Commission on Safety and Quality in Health Care	*National Standard for User-applied Labelling of Injectable Medicines Fluids and Lines*
Clinical Excellence Commission	*DOAC (Direct Oral Anticoagulants) Guidelines*
Clinical Excellence Commission	*Guidelines on Periprocedural Management of Anticoagulant and Antiplatelet Agents*

2. Indications for heparin infusion

Heparin infusion is rarely the first anticoagulant therapy of choice. For most patients, a low molecular weight heparin (LMWH) or a direct oral anticoagulant (DOAC) is an appropriate anticoagulant choice.

2.1. Heparin infusion as a method of anticoagulation

Use heparin infusion as a method of anticoagulation for patients where:

- creatinine clearance (CrCl) is less than 15 mL/min
- rapid onset and/or offset of anticoagulant effect is required, for example:
    - before, during or after some procedures or surgeries,
    - critically ill patients who are haemodynamically unstable.

2.2. Indications for heparin infusion

If a clinician determines that a heparin infusion is an appropriate method of anticoagulation, the following indications can be considered:

- treatment of venous thromboembolism (VTE), including pulmonary embolism (PE) and deep vein thrombosis (DVT)
- treatment of acute coronary syndromes (ACS):
    - ST elevation myocardial infarction (STEMI)
    - intermediate to high-risk non-ST elevation acute coronary syndromes (NSTEACS)
- treatment of arterial thromboembolism, including peripheral arterial occlusion
- prevention of thrombosis in atrial fibrillation (AF) when bridging with warfarin
- prevention of thrombosis with mechanical heart valves when bridging with warfarin.

Heparin can be used during pregnancy and breastfeeding and is appropriate in certain circumstances under the guidance of an obstetrician and any other relevant specialists (TG 2023; AMH 2024).

2.3. Out of scope indications for heparin infusion

There may be other acceptable indications for the use of heparin infusion. These are often associated with specific medical or surgical interventions where blood is exposed to non-biological surfaces and/or mechanical stress which increases the risk of thrombosis. Some of these interventions include:

- continuous renal replacement therapy (CRRT)

- extracorporeal membrane oxygenation (ECMO)
- some interventional radiological vascular procedures, for example, arterial angiography and catheter-directed thrombolysis (Favaloro 2024).

Use of heparin infusions for other indications must be in accordance with a locally approved Drug and Therapeutics Committee (DTC) protocol. NSW Health Policy Directive *High-Risk Medicines Management* (PD2024_006) and the associated Anticoagulant Standard outlines the minimum requirements for locally approved heparin infusion protocols.

3. Roles and responsibilities

NSW Health facilities must establish clearly defined roles and responsibilities for all clinicians involved in the management of heparin infusions. These should align with the requirements of the NSW Health Policy Directive *Medication Handling* (PD2022_032). For example, independent second person checks and standing orders for dosage adjustments.

Each NSW Health facility must ensure that clinicians involved in heparin infusion management are appropriately trained and that their scope of practice is clearly defined in accordance with organisational policies and procedures.

4. Clinical settings for managing heparin infusion

Clinicians should only prescribe and administer heparin infusions at NSW Health facilities with timely access to pathology services and where blood coagulation tests can be performed at appropriate intervals.

Heparin infusions are only to be administered in areas where there are clinical staff with sufficient knowledge and experience to manage the heparin infusion safely. Clinicians may need to consider transferring patients to another ward, department or facility where staff can manage the infusion.

5. Contraindications and precautions to heparin therapy

5.1. Contraindications

Heparin is contraindicated in patients with the following conditions:

- known hypersensitivity to heparin or pork products
- history of heparin induced thrombocytopenia (HIT) within the last 3 months
- severe thrombocytopenia (absolute platelet count is below 50 x 10^9/L)
- uncontrolled active bleeding (Pfizer Australia 2021).

Clinicians should not prescribe or administer heparin infusion where blood coagulation tests cannot be performed at appropriate intervals.

See the Product Information and the Australian Medicines Handbook for an extensive list of contraindications.

5.2. Precautions

Caution is required when using heparin in the following conditions:

- history of HIT beyond 3 months
- severe hypertension (systolic over 180 mmHg or diastolic over 110 mmHg)
- recent stroke or intracerebral haemorrhage
- before, during or after neuraxial procedures, including lumbar punctures, insertion or removal of spinal and/or epidural catheters
- major surgery especially those involving the brain, eye or spinal cord
- gastric or duodenal ulcers
- sub-acute bacterial endocarditis
- liver disease with impaired haemostasis
- haemophilia, thrombocytopenia, Von Willebrand's disease or platelet dysfunction
- haematuria
- concomitant use of anti-platelet agents (for example, aspirin, clopidogrel, dipyridamole, prasugrel, ticagrelor). However, it may be appropriate to continue or start these agents concurrently with heparin infusion for certain clinical conditions (for example, treatment of acute coronary syndrome).

See the Product Information and the Australian Medicines Handbook for an extensive list of precautions.

5.3. Concomitant administration of anticoagulants

Clinicians should avoid concomitant use of anticoagulants except when using heparin infusion while transitioning to or bridging with warfarin. Clinicians should undertake this transition with caution due to the high risk of bleeding (Douketis et al. 2022).

5.4. Transitioning between anticoagulants

For information regarding transitioning between direct oral anticoagulants (DOACs) and heparin infusion see section 4 of the *DOAC (Direct Oral Anticoagulants) Guidelines*.

For information regarding transitioning between warfarin and heparin infusion see section 3.1.3 of the *Guidelines on Periprocedural management of Anticoagulant and Antiplatelet Agents*.

6. Discuss heparin therapy with the patient and/or family or carer

Patients and/or their family or carer must be given the opportunity to discuss their therapy with a member of the health care team, including use of professional health care interpreters for patients who are culturally and linguistically diverse (CALD) or hearing impaired.

Clinicians must provide patients and/or their family or carer with information on heparin therapy. To enable all patients to participate in decision making about heparin therapy, information must be communicated in a way that is tailored to individual circumstances (including people under 18 years of age who fall under the scope of the Child Safe Standards). This includes considering health literacy, level of understanding, background and additional accessibility or support needs (NSW Government Office of the Children's Guardian 2023).

6.1. Religious, cultural and ethical considerations

Heparin is derived from a porcine (pig) source, which may be a concern to some patients for religious, cultural, ethical or other personal reasons (Queensland Health 2025). Clinicians should ensure patients have sufficient, appropriate and relevant information to enable them to make an informed decision regarding their therapy (NSW Health 2023).

For further information refer to Queensland Health Medicines / pharmaceuticals of animal origin.

6.2. Documentation requirements

Clinicians must record the provision of heparin therapy information in the patient's health care record. The information should include the indication, expected monitoring requirements and signs of bleeding.

7. Before starting heparin infusion

Before starting a heparin infusion, clinicians should carry out the following actions in line with their roles and responsibilities and their scope of practice.

7.1. Order baseline blood tests

Clinicians should collect and review the following baseline blood tests before starting a heparin infusion:

- full blood count (FBC), including platelet count and haemoglobin
- activated partial thromboplastin time (aPTT)*
- prothrombin time (PT)
- international normalised ratio (INR) if the patient was previously using warfarin, is being transitioned to warfarin or if liver impairment is suspected
- electrolytes, urea and creatinine (EUC)
- liver function tests (LFT).

In time-sensitive cases, clinicians may need to administer heparin therapy prior to the above results being available, for example, ST elevation myocardial infarction patients requiring emergency revascularisation.

Seek haematologist advice if the baseline aPTT is abnormal and heparin therapy is required for anticoagulation. Clinicians may need to adjust heparin doses based on anti-Xa activity instead of aPTT in some cases, see section 10.1 *Anti-Xa activity monitoring.*

*A normal baseline aPTT (25 to 37 seconds) is a requirement for using aPTT to monitor heparin therapy. An abnormal baseline aPTT may be due to inherited or acquired clotting factor deficiency (factors VIII, IX, XI and XII), coagulopathies such as disseminated intravascular coagulation (DIC), clotting inhibitors such as lupus anticoagulants and other anticoagulant medicines such as direct oral anticoagulants (DOACs).

7.2. Record actual body weight

Heparin infusion protocols dose heparin according to a patient's actual body weight (Garcia et al. 2012; TG 2023; AMH 2024; Raschke et al. 1993). It is important that clinicians measure and record the current actual body weight to facilitate correct heparin dosing.

Critical incidents have occurred when clinicians did not confirm the estimated patient weight or incorrectly recorded the weight, leading to incorrect heparin dosing and patient harm.

Clinicians must measure and record the patient's actual body weight in kilograms (kg). Where practical, clinicians should also record the patient's height using the appropriate units, that is centimetres (cm) or metres (m).

Clinicians should only use estimated body weight in exceptional circumstances (for example, an unconscious, intubated patient). If clinicians use an estimated weight, the patient must be weighed at the earliest opportunity.

Clinicians must record the patient's actual body weight in the patient's health care record, including paper heparin infusion order forms if used by the NSW Health facility (CEC 2024).

7.3. Review allergies, adverse drug reactions, current medications, contraindications and precautions

Clinicians should review the following information before prescribing a heparin infusion:

- allergies
- prior adverse drug reactions, including if there is a history of heparin induced thrombocytopenia (HIT)
- current medications, including checking for other anticoagulants and anti-platelet agents which may be prescribed on other medication charts or in an electronic Medication Management (eMM) system
- contraindications and precautions.

There have been incidents where this information has not been reviewed prior to starting heparin therapy, resulting in patient harm. For example, patients with a prior history of HIT being administered heparin or unintentional duplication of anticoagulants.

7.4. Select Standard Bleeding Risk or Higher Bleeding Risk protocol

The authorised prescriber must determine the indication for heparin infusion, as this will inform the "bleeding risk" and subsequent heparin infusion protocol to prescribe.

There are 2 heparin infusion protocols available to use. These have been named to align with the risk of bleeding.

The use of standardised heparin infusion protocols, which include evidence-based guidance on heparin dose calculation, will ensure consistency of practice and reduce the risks associated with over or under anticoagulation. This Guideline uses weight-based dosing to guide management of heparin infusions (Raschke et al. 1993; Cruickshank et al. 1991).

The **Standard Bleeding Risk** protocol uses a heparin bolus and initial infusion rates to achieve therapeutic anticoagulation. It is used for the following indications:

- treatment of venous thromboembolism (VTE), including pulmonary embolism (PE) and deep vein thrombosis (DVT)
- treatment of arterial thromboembolism, including peripheral arterial occlusion
- prevention of thrombosis in atrial fibrillation (AF) when bridging with warfarin

- prevention of thrombosis with mechanical heart valves when bridging with warfarin.

The **Higher Bleeding Risk** protocol derives from studies of patients with acute coronary syndrome (ACS) treated with dual antiplatelet therapy, where an elevated risk of bleeding is observed (Ryan et al. 1996; Braunwald et al. 2000). The bolus and initial infusion rates are lower to reduce the likelihood of exceeding the therapeutic range. It is indicated in the treatment of ACS, including ST elevation myocardial infarction (STEMI) and non-ST elevation acute coronary syndrome (NSTEACS).

The Higher Bleeding Risk protocol may also be used in other conditions when the risk of bleeding needs to be minimised, for example, stroke patients, cerebrovascular neurosurgical patients or patients with known bleeding risk factors. In these cases, clinicians must thoroughly assess the risks associated with both the potential delay in achieving therapeutic anticoagulation and the risk of thromboembolism.

8. Documentation of heparin infusion management

Clinicians should document heparin infusion management using the appropriate NSW Health Intravenous Unfractionated Heparin Infusion Order (NH701269 or NH701268), or the heparin infusion management functionality within an electronic Medication Management (eMM) system. This documentation is to be kept as part of the patient's health care record and accessible to all clinicians involved in heparin infusion management.

Use of these standardised tools will support safe and effective heparin infusion management.

9. Heparin products

Areas in which heparin infusions are managed should have access to the following heparin products:

- For the intravenous bolus dose use heparin sodium 5,000 units in 5 mL ampoules.
- For the continuous heparin infusion use a commercially prepared pre-mixed infusion bag of heparin 25,000 units in 250 mL sodium chloride 0.9% (100 units per mL).

Clinicians should use commercially prepared pre-mixed heparin sodium solutions wherever possible. Clinicians should use these products for both the Standard and Higher Bleeding Risk protocols.

9.1. Administration of heparin infusion

Clinicians should administer heparin infusions using a dedicated intravascular access device (IVAD). Heparin should not be infused with any other intravenous (IV) medications, except in

emergency situations where there is limited IV access and compatible IV medications may be infused together with heparin (AIDH 2023).

Clinicians are to label IV lines in accordance with the Australian Commission on Safety and Quality in Health Care's *National Standard for User-applied Labelling of Injectable Medicines Fluids and Lines*.

An independent second person check, including checking the rate selection on the infusion device is required for administration of heparin infusion in accordance with NSW Health Policy Directive *Medication Handling* (PD2022_032).

Clinicians are to administer heparin infusion bags by a volumetric pump.

Heparin has a short half-life and stopping a heparin infusion, even for a short period, for example 30 to 60 minutes, will lead to decreased anticoagulant effect (Garcia et al. 2012). Adverse patient outcomes have occurred when clinicians have inappropriately stopped a heparin infusion. Clinicians should **not** disconnect patients from their heparin infusion for activities of daily living such as mobilising to the toilet or showering.

10. Blood test monitoring while receiving heparin infusion

Clinicians must collect and review the following blood tests for the duration of a heparin infusion.

Table 3: Blood test monitoring while receiving heparin infusion

Test	Frequency	Comments
aPTT	**Every 4 to 6 hours** after starting the infusion until within the therapeutic range for 2 consecutive results, then once daily. Revert to every 4 to 6 hours following infusion rate adjustments or if the infusion is stopped. More frequent blood tests may be required in some cases, for example, every 2 hours if the aPTT is greater than 120 seconds.	Before taking a blood sample ensure the infusion has been running for at least 4 hours and not stopped or paused (with the exception when the aPTT is greater than 120 seconds, where a blood test is every 2 hours). Do not take blood samples from the same limb being used for the infusion. Check results within 1 to 2 hours of collection and record them appropriately. aPTT results greater than the therapeutic range indicate an increased risk of bleeding. Medical review is required if the aPTT does not reach therapeutic range within 24 hours.

Test	Frequency	Comments
Platelet count	At minimum **every 2 days** while on heparin infusion	Monitor platelet count to screen for heparin induced thrombocytopenia (HIT). Seek haematologist advice if thrombocytopenia develops or the platelet count falls more than 30 to 50 per cent below the patient's own baseline.
Haemoglobin	At minimum **every 2 days** while on heparin infusion	Monitor haemoglobin for potential bleeding. If the haemoglobin drops the possibility of bleeding is to be investigated as a priority.

10.1. Anti-Xa activity monitoring

In certain patient groups where the aPTT may not indicate anticoagulant effect accurately, clinicians may need to adjust heparin doses based anti-Xa activity instead of aPTT (Garcia et al. 2012; Olsen et al. 1998).

Anti-Xa activity and aPTT are not equivalent measures, clinicians should monitor only one parameter to guide heparin dose adjustments.

Clinicians should seek haematologist advice when choosing to monitor anti-Xa activity.

Anti-Xa monitoring instead of aPTT monitoring is recommended for patients with the following:

- lupus anticoagulant positive (LAC)
- antiphospholipid antibody syndrome (APS)
- inherited or acquired factor VIII, IX, XI and XII deficiencies
- if the patient is not responding as expected to heparin doses based on the aPTT (Olsen et al. 1998). See section 16 *Heparin resistance.*

Clinicians must specify "unfractionated heparin" on the pathology request for anti-Xa activity.

The Guideline provides advice on infusion rate adjustments based on anti-Xa activity in Appendix A *Heparin infusion rate adjustments based on anti-Xa activity*.

11. Managing Standard Bleeding Risk heparin infusions

The Standard Bleeding Risk protocol uses a heparin bolus and initial infusion rates to achieve therapeutic anticoagulation. It is used for the following indications:

- treatment of venous thromboembolism (VTE), including pulmonary embolism (PE) and deep vein thrombosis (DVT)
- treatment of arterial thromboembolism, including peripheral arterial occlusion
- prevention of thrombosis in atrial fibrillation (AF) when bridging with warfarin
- prevention of thrombosis with mechanical heart valves when bridging with warfarin.

Heparin infusion management should be documented using the NSW Health Intravenous Unfractionated Heparin Infusion Order, Standard Bleeding Risk (Adult) (NH701269), or the heparin infusion management functionality within an electronic Medication Management (eMM) system.

11.1. Standard Bleeding Risk initial bolus dose

A bolus is usually required when starting a heparin infusion. A bolus may be omitted in patients already therapeutically anticoagulated with another agent and transitioning to heparin.

If a bolus is required, clinicians should apply the following weight-based dosing:

- Patient < 60 kg: heparin 80 units/kg intravenously.
- Patient ≥ 60 kg: heparin 5,000 units intravenously.

Clinicians should flush the intravenous line with 5 to 10 mL of sodium chloride 0.9% pre and post administration of the prescribed bolus. The dose should be administered undiluted over 3 to 5 minutes (AIDH 2023).

11.2. Standard Bleeding Risk initial infusion rate

Table 4: Standard Bleeding Risk initial bolus and initial infusion rate

Maximum bolus dose **5,000 units** Initial infusion rate based on **18 units/kg/hour** Using heparin **25,000 units in 250 mL** sodium chloride 0.9% infusion Maximum initial infusion rate **2,000 units per hour**			
Weight [a] (kg)	**Bolus (units)**	**Infusion rate (units per hour)**	**Infusion pump rate [b] (mL per hour)**
30	2,400	540	5
35	2,800	630	6
40	3,200	720	7
45	3,600	810	8
50	4,000	900	9
55	4,400	990	10
60	5,000	1,080	11
65	5,000	1,170	12
70	5,000	1,260	13
75	5,000	1,350	14
80	5,000	1,440	14
85	5,000	1,530	15
90	5,000	1,620	16
95	5,000	1,710	17
100	5,000	1,800	18
105	5,000	1,890	19
110 or greater	5,000	1,980	20

[a] Rounded to the nearest 5 kg. The initial infusion pump rate is calculated per kilogram in the electronic Medication Management system.

[b] Rounded to the nearest whole number.

11.3. Standard Bleeding Risk infusion rate adjustments based on aPTT

Table 5: Standard Bleeding Risk infusion rate adjustments based on aPTT

aPTT (seconds)	Bolus (units)	Stop infusion	Infusion rate change	Repeat aPTT Due from the time the infusion rate was continued, changed or paused
Inform medical officer if aPTT is not therapeutic after 24 hours				
Less than 40	Repeat bolus [a]	No	**Increase** 2 mL/hr (200 units/hr) from current rate	4 to 6 hours
40 - 49	No	No	**Increase** 1 mL/hr (100 units/hr) from current rate	4 to 6 hours
50 – 90 [b]	**Continue** current rate Therapeutic range			4 to 6 hours After 2 consecutive therapeutic results, then daily aPTT (if results within therapeutic range)
91 - 105	No	No	**Decrease** 1 mL/hr (100 units/hr) from current rate	4 to 6 hours
106 - 120	No	1 hour	**Restart** and **reduce** previous rate by 2 mL/hr (200 units/hr)	4 to 6 hours after restarting
Greater than 120	**1. Stop infusion** • check patient for bleeding • check patient weight, infusion rate calculations, pump settings and time of blood sample • contact the Medical Officer immediately. **2. Repeat aPTT 2 hours after stopping the infusion:** a. If the repeat aPTT is **less than 120 seconds** and there is no evidence of bleeding, decrease the rate by 3 mL/hour (300 units/hour) from the previous rate and repeat the aPTT 4 to 6 hours after restarting. An aPTT after a critical high result is to be reviewed in context. **DO NOT re-bolus.** b. If the repeat aPTT is **greater than 120 seconds:** • continue to withhold the infusion for another 2 hours • check the blood sample had been taken correctly and not too close to the heparin line • contact the Medical Officer and seek urgent haematology advice.			

[a] Repeat bolus is to be calculated based on 80 units/kg (maximum 5,000 units).

[b] the aPTT therapeutic reference range (TRR) of 50 to 90 seconds was established following harmonisation of coagulation testing across NSW Health Pathology laboratories in 2021. The TRR of 50 to 90 seconds is equivalent to UFH concentrations (and anti-Xa activity) of 0.3 to 0.7 units/mL (Favaloro et al. 2021).

12. Managing Higher Bleeding Risk heparin infusions

The Higher Bleeding Risk protocol is recommended in the treatment of acute coronary syndromes (ACS), including ST elevation myocardial infarction (STEMI) and non-ST elevation acute coronary syndrome (NSTEACS). It may also be used in other conditions when the risk of bleeding needs to be minimised, for example, stroke patients, cerebrovascular neurosurgical patients or patients with known bleeding risk factors.

Heparin infusion management should be documented using the NSW Health Intravenous Unfractionated Heparin Infusion Order, Higher Bleeding Risk (Adult) (NH701268), or the heparin infusion management functionality within an electronic Medication Management (eMM) system.

12.1. Higher Bleeding Risk initial bolus dose

Consider if a bolus dose is required when starting a heparin infusion. A bolus may be omitted for some patients such as acute stroke patients, patients who have had recent surgery or are already therapeutically anticoagulated with another agent and transitioning to heparin.

If a bolus is required, clinicians should apply the following weight-based dosing:

- Patient < 60 kg: heparin 60 units/kg intravenously.
- Patient ≥ 60 kg: heparin 4,000 units intravenously.

Clinicians should flush the intravenous line with 5 to 10 mL of sodium chloride 0.9% pre and post administration of the prescribed bolus. The dose should be administered undiluted over 3 to 5 minutes (AIDH 2023).

12.2. Higher Bleeding Risk initial infusion rate

Table 6: Higher Bleeding Risk initial bolus and initial infusion rate

Maximum bolus dose **4,000 units** Initial infusion rate based on **12 units/kg/hour** Using heparin **25,000 units in 250 mL** sodium chloride 0.9% infusion Maximum initial infusion rate **1,000 units per hour**			
Weight [a] (kg)	**Bolus (units)**	**Infusion rate (units per hour)**	**Infusion pump rate [b] (mL per hour)**
30	1,800	360	4
35	2,100	420	4
40	2,400	480	5
45	2,700	540	5
50	3,000	600	6
55	3,300	660	7
60	4,000	720	7
65	4,000	780	8
70	4,000	840	8
75	4,000	900	9
80	4,000	960	10
85 or greater	4,000	1,000	10

[a] Rounded to the nearest 5 kg. The initial infusion pump rate is calculated per kilogram in the electronic Medication Management system.

[b] Rounded to the nearest whole number.

12.3. Higher Bleeding Risk infusion rate adjustments based on aPTT

Table 7: Higher Bleeding Risk infusion rate adjustments based on aPTT

aPTT (seconds)	Bolus (units)	Stop infusion	Infusion rate change	Repeat aPTT Due from the time the infusion rate was continued, changed or paused
Inform medical officer if aPTT is not therapeutic after 24 hours				
Less than 40	Repeat bolus [a]	No	**Increase** 2 mL/hr (200 units/hr) from current rate	4 to 6 hours
40 - 49	No	No	**Increase** 1 mL/hr (100 units/hr) from current rate	4 to 6 hours
50 – 90 [b]	**Continue** current rate Therapeutic range			4 to 6 hours After 2 consecutive therapeutic results, then daily aPTT (if results within therapeutic range)
91 - 105	No	No	**Decrease** 1 mL/hr (100 units/hr) from current rate	4 to 6 hours
106 - 120	No	1 hour	**Restart** and **reduce** previous rate by 2 mL/hr (200 units/hr)	4 to 6 hours after restarting
Greater than 120	**1. Stop infusion:** • check patient for bleeding • check patient weight, infusion rate calculations, pump settings and time of blood sample • contact the Medical Officer immediately. **2. Repeat aPTT 2 hours after stopping the infusion:** a. If the repeat aPTT is **less than 120 seconds** and there is no evidence of bleeding, decrease the rate by 3 mL/hour (300 units/hour) from the previous rate and repeat the aPTT 4 to 6 hours after restarting. An aPTT after a critical high result is to be reviewed in context. **DO NOT re-bolus.** b. If the repeat aPTT is **greater than 120 seconds:** • continue to withhold the infusion for another 2 hours • check the blood sample had been taken correctly and not too close to the heparin line • contact the Medical Officer and seek urgent haematology advice.			

[a] Repeat bolus is to be calculated based on 60 units/kg (maximum 4,000 units).

[b] the aPTT therapeutic reference range (TRR) of 50 to 90 seconds was established following harmonisation of coagulation testing across NSW Health Pathology laboratories in 2021. The TRR of 50 to 90 seconds is equivalent to UFH concentrations (and anti-Xa activity) of 0.3 to 0.7 units/mL (Favaloro et al. 2021).

13. Heparin induced thrombocytopenia (HIT)

Heparin induced thrombocytopenia (HIT) is an uncommon but life-threatening complication of heparin therapy. It is an adverse reaction mediated by the immune system, and despite presenting as a thrombocytopenia, there is a strong association with risk of thrombosis (Joseph et al. 2019).

Clinicians should perform a baseline platelet count as per section 7.1 *Order baseline blood tests* and then at minimum every 2 days while on heparin therapy (as per section 10 *Blood test monitoring while receiving heparin infusion*) to monitor for the development of HIT.

Typically, if thrombocytopenia develops or the platelet count falls more than 30 to 50 per cent below the patient's own baseline over a 5-to-10-day period HIT may be suspected. Clinicians should withhold the heparin infusion and seek urgent haematologist advice. The 4Ts score can be used to predict the risk of HIT. The haematologist will provide advice on further investigations and if heparin therapy needs to cease and an alternative non-heparin anticoagulant commenced (AMH 2024; Joseph et al. 2019).

The use of UFH or LMWH within 3 months of HIT occurring is contraindicated. The use of heparin or LMWH beyond 3 months of HIT occurring should be done with caution and requires haematology advice (Joseph et al. 2019).

For further information refer to the NSW Health Pathology Diagnostic Algorithm for Suspected HIT clinician information.

14. Monitoring for bleeding

Clinicians must monitor patients receiving heparin infusions for signs of bleeding.

For minor bleeding, clinicians should review the heparin dose, aPTT results and risks. Given the short half-life of unfractionated heparin (UFH) [approximately 60 to 90 minutes], the aPTT will rapidly return to normal levels within 2 to 3 hours of stopping the heparin infusion.

Clinicians should perform a full blood count at minimum every 2 days during heparin infusion therapy, to monitor platelet count for the development of HIT and to monitor haemoglobin for potential bleeding.

Clinicians should consider the possibility of a retroperitoneal bleed in the absence of another identified cause of pain in the back, flank, abdomen or thighs. Clinicians should perform and review a full blood count as soon as possible, along with urgent medical assessment and imaging of the abdomen.

If the patient is actively bleeding, clinicians should not restart the infusion until bleeding is resolved, and haematology has been consulted.

15. Reversal of heparin

Clinicians should seek haematology advice if a patient requires reversal of heparin. For potentially life-threatening bleeding, administration of intravenous protamine may be appropriate (Garcia et al. 2012; TG 2023; AMH 2024; Pfizer Australia 2021).

Protamine has a rapid onset (5 minutes) and offset of action (half-life of approximately 7 minutes) (Garcia et al. 2012). As the half-life of heparin is 60 to 90 minutes, only heparin therapy given during the preceding 3 hours needs to be considered when calculating the required dose of protamine. If it has been more than 3 hours since heparin was last given, it may be unnecessary to give protamine as the heparin has been metabolised (AMH 2024).

For more information on the dosing of protamine in heparin reversal see the Therapeutic Guidelines: *Cardiovascular*.

16. Heparin resistance

Heparin resistance is often defined as a minimal change in aPTT results despite the patient receiving large doses of unfractionated heparin (for example, 35,000 or more units per day).

Clinicians may suspect heparin resistance when a therapeutic aPTT is not reached within 24 hours of heparin infusion.

Critically ill patients will often have increased levels of heparin-binding molecules such as acute-phase reactants, factor VIII and fibrinogen, which can reduce heparin bioavailability. Other causes of heparin resistance include inherited or acquired antithrombin deficiency and increased heparin clearance, such as splenomegaly in liver disease. Some patients may exhibit heparin resistance due to a combination of these factors.

Interventions that use extracorporeal circuits such as cardiopulmonary bypass (CPB) or extracorporeal membrane oxygenation (ECMO) are also associated with heparin resistance. Activated clotting time is routinely used to monitor anticoagulation at the point of care in CPB (Garcia et al. 2012; Levy and Connors 2021; Smythe et al. 2016).

If clinicians suspect heparin resistance, they should seek specialist advice.

Most patients with heparin resistance will have an anti-Xa assay recommended:

- If anti-Xa activity is in the therapeutic range, monitoring of anti-Xa activity should continue and the dose titrated based on the appropriate rate adjustment nomogram, see Appendix A *Heparin infusion rate adjustments based on anti-Xa activity*.
- If anti-Xa activity is subtherapeutic, an alternative anticoagulant is to be considered in consultation with a specialist (Garcia et al. 2012; Smythe et al. 2016).

17. Periprocedural management of heparin infusion

The treating proceduralist, anaesthetist and physician should develop a pre and post procedural plan for anticoagulant therapy, which should be documented in the patient's health care record (Douketis et al. 2022; Schug et al. 2020).

17.1. Ceasing heparin infusion prior to procedure

If the aPTT is within the therapeutic range, heparin is usually ceased **4 to 6 hours prior to a procedure or surgery.** If the aPTT is above the therapeutic range, a longer delay may be required (Douketis et al. 2022; Schug et al. 2020).

There may be some cases where a heparin infusion will continue during a procedure, for example certain vascular procedures and with specific patient groups such as those with antiphospholipid antibody syndrome, however, this will be managed by the proceduralist and anaesthetist.

17.2. Recommencing heparin infusion following a procedure

The time required to wait before recommencing a heparin infusion after a procedure will depend on the procedural bleeding risk and the risk of thromboembolism. The *Guidelines on Periprocedural Management of Anticoagulant and Antiplatelet Agents* provides guidance on estimating these risks.

The proceduralist should advise when the heparin infusion can be recommenced postoperatively.

Generally, the following is recommended:

For patients with a high risk of thromboembolism, for example, patients with a mechanical heart valve:

- recommence the heparin infusion (without bolus) **6 to 8 hours** after the procedure.

For patients with a high bleeding risk:

- recommence the heparin infusion **24 to 48 hours** after the procedure (Douketis et al. 2022; Schug et al. 2020).

In most cases the infusion rate when recommencing should be the same rate the heparin infusion was being infused in the pre procedural period before pausing the heparin infusion.

17.2.1. When to take the first aPTT post procedure

Given the pre and post procedure time off the heparin infusion, any repeat aPTT will yield a low aPTT. Clinicians should not repeat an aPTT in the initial post procedural period, unless specified by a specialist in the treating team.

The aPTT should be repeated 4 to 6 hours after recommencement of the heparin infusion.

17.3. Management of patients requiring neuraxial procedures

Neuraxial procedures include lumbar puncture and insertion or removal of a spinal and/or epidural catheter. In general, neuraxial procedures for therapeutically anticoagulated patients are not recommended due to the risk of spinal or epidural haematoma formation. The anaesthetist should be consulted for patients receiving a heparin infusion who require neuraxial procedures (Schug et al. 2020).

Traumatic or repeated puncture increases the risk of spinal or epidural haematoma. Spinal or epidural catheters increase the risk of spinal or epidural haematoma and these should be avoided in patients requiring therapeutic anticoagulation.

The *Guidelines on Periprocedural Management of Anticoagulant and Antiplatelet Agents* provides information on recommended time intervals to wait when withholding and recommencing anticoagulants during neuraxial procedures. The relevant heparin infusion guidance appears in table 8 below.

Table 8: Management of heparin infusion during neuraxial procedures [a]

Before needle or catheter insertion	While catheter in place	Prior to catheter removal	After needle or catheter removal
Withhold infusion for **at least 6 hours** before catheter insertion. **AND** check the **aPTT** is within the normal range (if not a longer time will be needed).	Do not administer until **at least 1 hour** post catheter insertion. Wait 24 hours if the procedure yielded blood.	Withhold infusion for **at least 6 hours** prior to catheter removal.	Recommence infusion (without bolus) **at least 1 hour** after catheter removal

[a] This table is based on the Australian and New Zealand College of Anaesthetics and Faculty of Pain Medicines: Acute Pain Management: scientific evidence (Schug et al. 2020) and expert opinion from within the Anticoagulant Medicines Working Party. Timings and directions may differ from the approved Product Information.

Reprinted with adaptation from Schug SA, Palmer GM, Scott DA, Alcock M, Halliwell R, Mott JF; APM:SE Working Group of the Australian and New Zealand College of Anaesthetists and Faculty of Pain Medicine (2020), Acute Pain Management: Scientific Evidence. 5th edition, ANZCA and FPM, Melbourne, with permission from ANZCA and FPM.

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19. Appendix A: Heparin infusion rate adjustments based on anti-Xa activity

Table 9: Standard Bleeding Risk infusion rate adjustments based on anti-Xa activity

Anti-Xa (units per mL)	Bolus (units)	Stop infusion	Infusion rate change	Repeat anti-Xa Due from the time the infusion rate was continued, changed or paused
Inform medical officer if anti-Xa activity is not therapeutic after 24 hours				
Less than 0.2	Repeat bolus [a]	No	**Increase** 2 mL/hr (200 units/hr) from current rate	4 to 6 hours
0.2 – 0.29	No	No	**Increase** 1 mL/hr (100 units/hr) from current rate	4 to 6 hours
0.3 – 0.7	**Continue** current rate Therapeutic range			4 to 6 hours After 2 consecutive therapeutic results, then daily anti-Xa (if results within therapeutic range)
0.71 – 0.79	No	No	**Decrease** 1 mL/hr (100 units/hr) from current rate	4 to 6 hours
0.8 – 1.0	No	1 hour	**Restart** and **reduce** previous rate by 2 mL/hr (200 units/hr)	4 to 6 hours after restarting
Greater than 1.0	**1. Stop infusion** • check patient for bleeding • check patient weight, infusion rate calculations, pump settings and time of blood sample • contact the Medical Officer immediately. **2. Repeat anti-Xa 2 hours after stopping the infusion:** a. If the repeat anti-Xa activity is **less than 1 unit/mL** and there is no evidence of bleeding, decrease the rate by 3 mL/hour (300 units/hour) from the previous rate and repeat the anti-Xa activity 4 to 6 hours after restarting. An anti-Xa after a critical high is to be reviewed in context. **DO NOT re-bolus.** b. If the repeat anti-Xa activity is **greater than 1 unit/mL:** • continue to withhold the infusion for another 2 hours • check the blood sample had been taken correctly and not too close to the heparin line • contact the Medical Officer and seek urgent haematology advice.			

[a] Repeat bolus is to be calculated based on 80 units/kg (maximum 5,000 units).

Table 10: Higher Bleeding Risk infusion rate adjustments based on anti-Xa activity

Anti-Xa (units per mL)	Bolus (units)	Stop infusion	Infusion rate change	Repeat anti-Xa Due from the time the infusion rate was continued, changed or paused
Inform medical officer if anti-Xa activity is not therapeutic after 24 hours				
Less than 0.2	Repeat bolus [a]	No	**Increase** 2 mL/hr (200 units/hr) from current rate	4 to 6 hours
0.2 – 0.29	No	No	**Increase** 1 mL/hr (100 units/hr) from current rate	4 to 6 hours
0.3 – 0.7	**Continue** current rate Therapeutic range			4 to 6 hours After 2 consecutive therapeutic results, then daily anti-Xa (if results within therapeutic range)
0.71 – 0.79	No	No	**Decrease** 1 mL/hr (100 units/hr) from current rate	4 to 6 hours
0.8 – 1.0	No	1 hour	**Restart** and **reduce** previous rate by 2 mL/hr (200 units/hr)	4 to 6 hours after restarting
Greater than 1.0	**1. Stop infusion** • check patient for bleeding • check patient weight, infusion rate calculations, pump settings and time of blood sample • contact the Medical Officer immediately. **2. Repeat anti-Xa 2 hours after stopping the infusion:** a. If the repeat anti-Xa activity is **less than 1 unit/mL** and there is no evidence of bleeding, decrease the rate by 3 mL/hour (300 units/hour) from the previous rate and repeat the anti-Xa activity 4 to 6 hours after restarting. An anti-Xa after a critical high is to be reviewed in context. **DO NOT re-bolus.** b. If the repeat anti-Xa activity is **greater than 1 unit/mL:** • continue to withhold the infusion for another 2 hours • check the blood sample had been taken correctly and not too close to the heparin line • contact the Medical Officer and seek urgent haematology advice.			

[a] Repeat bolus is to be calculated based on 60 units/kg (maximum 4,000 units).