NATIONAL BLOOD AUTHORITY
AUSTRALIA

PREOPERATIVE BLEEDING RISK ASSESSMENT TOOL

Guidance for Australian Health Providers

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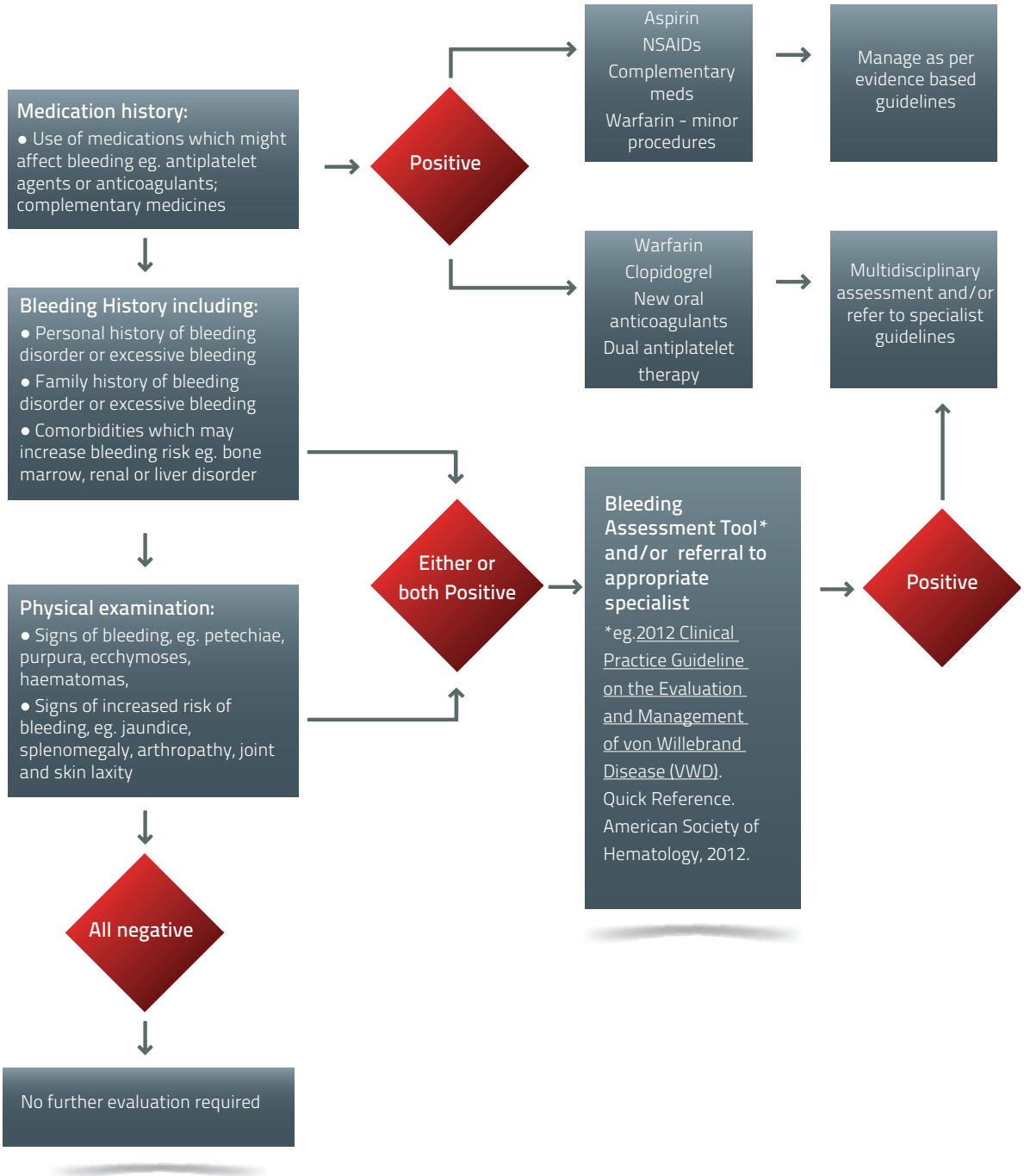
Acknowledgement
The NBA has commissioned the development of a suite of patient blood management (PBM) tools by various stakeholders as outlined by the PBM Guideline Implementation Strategy. The tools are intended to be used as a resource for health professionals to use in implementing the recommendations and practice points in the PBM Guidelines.
The Preoperative Bleeding Risk Assessment and Intervention Resource is intended to assist healthcare professionals in assessing and managing the risk of bleeding in a preoperative patient. Assessment of bleeding risk is a key component of patient blood management strategies to minimise blood loss. Patients may be at increased risk of bleeding for a number of reasons, including hereditary or acquired bleeding disorders, medical conditions such as liver disease, and medications including complementary medicines.

This resource was project managed by the Transfusion Practice and Education Team at the Blood Service.

> PREOPERATIVE BLEEDING RISK ASSESSMENT AND INTERVENTION RESOURCE:
QUICK REFERENCE GUIDE



> PREOPERATIVE BLEEDING RISK ASSESSMENT AND INTERVENTION RESOURCE:

QUICK REFERENCE GUIDE SUMMARY

Assessing and managing the risk of bleeding in a preoperative patient can be achieved by following the key steps:

1. Review medications, including complementary therapies:
   - Manage as per evidence based guidelines, including specialist guidelines, local protocols or referral where appropriate;
2. Perform initial bleeding history including personal and family history of bleeding disorder or excessive bleeding; and comorbidities which may increase bleeding risk:
   - If positive use a Bleeding Assessment Tool (BAT) consisting of a standardised bleeding questionnaire and bleeding score and/or refer for further assessment;
3. Perform a physical examination:
   - If positive for signs of bleeding or comorbidities associated with increased risk of bleeding use a BAT and/or refer for further assessment;
4. If all initial screens are negative, no further evaluation is required – routine preoperative coagulation screening is not recommended;
5. Neither preoperative point-of-care (POC) global coagulation assays nor POC INR measurement predict bleeding tendency;
6. Refer for specialist and/or multidisciplinary assessment and management, patients:
   - undergoing high risk procedures;
   - with haemostatic abnormalities associated with comorbid illness;
   - on multiple antiplatelet and/or anticoagulant therapy; and those
   - with known congenital bleeding disorders.

Details regarding these steps are outlined in the following pages. Considerations for incorporation of bleeding risk assessment into clinical practice using clinical practice improvement (CPI) methodologies can be found in Appendix 1.

Table of Contents

> BACKGROUND

Assessment of bleeding risk is a key component of patient blood management strategies to minimise blood loss. Patients may be at increased risk of bleeding for a number of reasons, including:

- advanced age[1]
- decreased preoperative red blood cell volume (small body size and/or preoperative anaemia)[1]
- medications affecting haemostasis including complementary medicines
- medical conditions causing haemostatic defect including both hereditary bleeding disorders, and acquired medical conditions such as chronic kidney or liver disease, and
- type of surgery

Preoperative assessment of bleeding risk consists of administering a structured bleeding questionnaire which, in conjunction with physical examination, will guide laboratory testing. In the vast majority of cases a positive bleeding history will require referral for specialist assessment and management. Conversely, a negative initial screen and examination may exclude patients from further evaluation. Routine coagulation screening prior to surgery or other invasive procedures to predict postoperative bleeding in unselected patients is not recommended.[2] The key recommendations from the British Committee for Standards in Haematology (BCSH) Guidelines on the assessment of bleeding risk prior to surgery or invasive procedures,[1] and from the European Society of Anaesthesiology Management of severe perioperative bleeding: guidelines.[3] are outlined in Tables 1 and 2. Figure 1 demonstrates the key components of preoperative assessment of bleeding risk.

Table 1: British Committee for Standards in Haematology recommendations on the assessment of bleeding risk prior to surgery or invasive procedures[a]

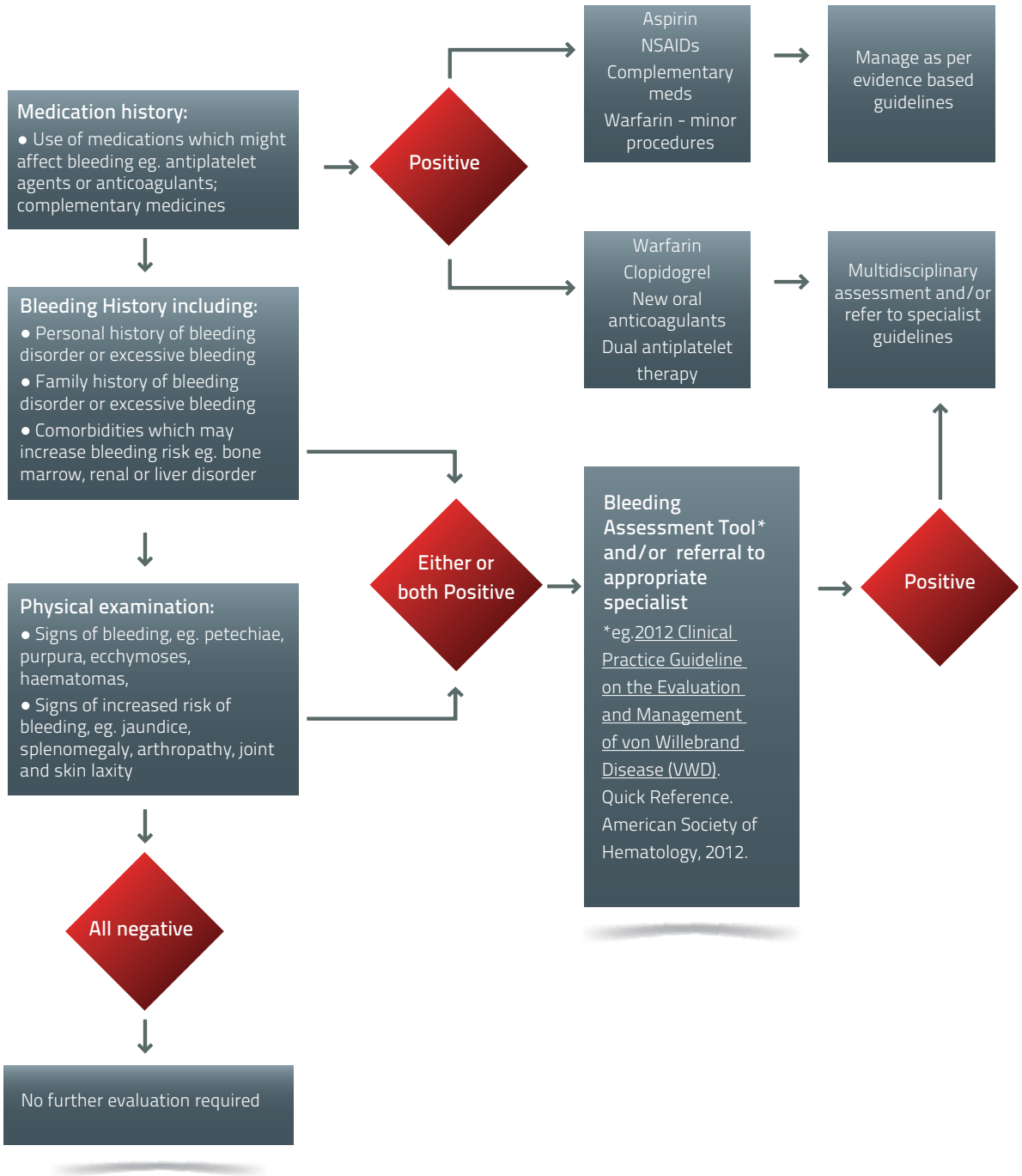
1.	Indiscriminate coagulation screening prior to surgery or other invasive procedures to predict postoperative bleeding in unselected patients is not recommended. (Grade B, Level III).
2.	A bleeding history including detail of family history, previous excessive post-traumatic or postsurgical bleeding and use of anti-thrombotic drugs should be taken in all patients preoperatively and prior to invasive procedures. (Grade C, Level IV).
3.	If the bleeding history is negative, no further coagulation testing is indicated. (Grade C, Level IV).
4.	If the bleeding history is positive or there is a clear clinical indication (e.g. liver disease), a comprehensive assessment, guided by the clinical features is required. (Grade C, Level IV).

[a] For classification of evidence and recommendation levels see Appendix 2a.

Table 2: Management of severe perioperative bleeding: guidelines from the European Society of Anaesthesiology
Evaluation of coagulation status: ▪ We recommend the use of a structured patient interview or questionnaire before surgery or invasive procedures, which considers clinical and family bleeding history and detailed information on the patient's medication. 1C ▪ We recommend the use of standardised questionnaires on bleeding and drug history as preferable to the routine use of conventional coagulation screening tests such as a PTT, PT and platelet count in elective surgery. 1C

[b] For grades of recommendation - GRADES system see Appendix 2b.

Figure 1: Preoperative assessment of bleeding risk



> MEDICATION ASSESSMENT

Numerous medications and complementary therapies may affect haemostasis so a comprehensive list of what the patient is taking is required. For information on discussing the use of complementary medicines with patients, refer to the NHMRC resource: Talking with your patients about Complementary Medicine – a Resource for Clinicians.[4] The management of antiplatelet agents including non-steroidal anti-inflammatory agents, aspirin and clopidogrel; and anticoagulant therapy including warfarin, heparin and the new oral anticoagulants (NOAC) will need to be tailored for each patient to balance the risk of bleeding and thrombotic events. The management plan needs to take into consideration the indications for the medications, the nature of the procedure and its risk of bleeding. A multidisciplinary team approach, involving surgeon, anaesthetist, cardiologist, haematologist, preadmission staff, clinical nurse consultant and pharmacist may be necessary to develop a management plan appropriate for the patient.

Some guidance regarding management of patients on anticoagulant and antiplatelet agents is provided in the PBM guidelines: Module 2 – Perioperative[5] as outlined in Table 3. The Australian Society of Thrombosis and Haemostasis (ASTH) have published practical guidance on the management of patients taking NOAC in the perioperative period.[6] Figure 2 outlines the ASTH suggested management of patients receiving NOAC requiring urgent surgery and Table 4 includes a suggested management approach for preoperative interruption of NOAC. A summary of additional relevant medication guidance from the European Society of Anaesthesiology is available in Appendix 3.

Additional sources to assist management include:

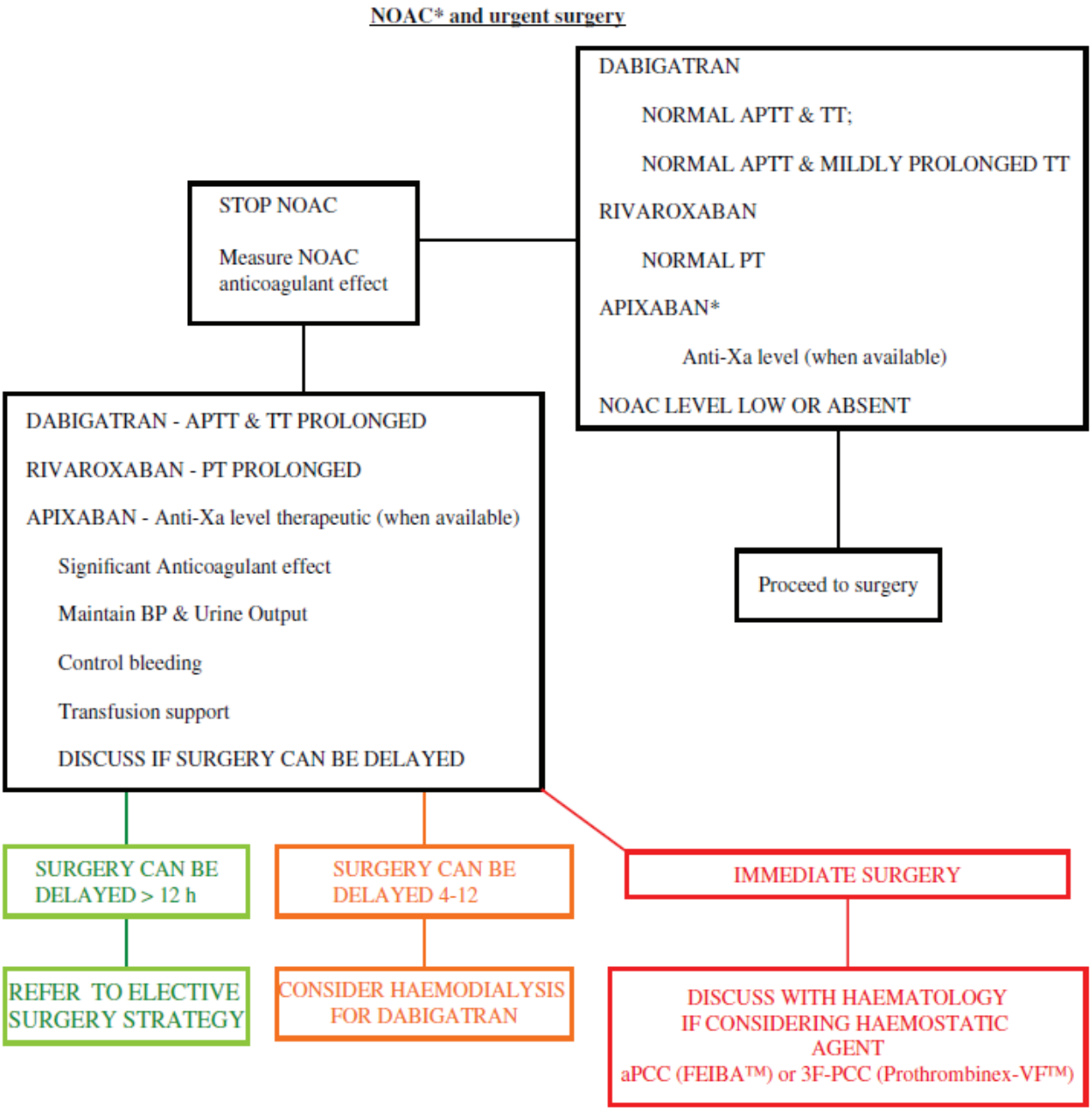
- Consensus guidelines for warfarin reversal: Australasian Society of Thrombosis and Haemostasis, 2013;[7]
- The perioperative management of antithrombotic therapy: American College of Chest Physicians Evidence-Based Clinical Practice Guidelines (8th Edition), 2008;[8]
- New oral anticoagulants: a practical guide on prescription, laboratory testing and peri-procedural/bleeding management: Australasian Society of Thrombosis and Haemostasis, 2014;[6]
- Management of severe perioperative bleeding: guidelines from the European Society of Anaesthesiology, 2013;[3] and
- Guideline on the management of bleeding in patients on antithrombotic agents: British Committee for Standards in Haematology, 2008;[9]
- 2011 update to the Society of Thoracic Surgeons and the Society of Cardiovascular Anesthesiologists blood conservation clinical practice guidelines. Society of Thoracic Surgeons Blood Conservation Guideline Task Force, 2011.[1]

Table 3: Guidance regarding cessation of medications - Patient Blood Management Guidelines: Module 2 Perioperative

Medication	Recommendation (R)/Practice point (PP)	Reference
Aspirin	In patients undergoing noncardiac surgery, it is reasonable to continue low dose aspirin therapy. This may require specific evaluation in neurosurgery and intraocular surgery (Grade C).	R8
	In patients undergoing cardiac surgery, aspirin may be continued until the time of surgery.	PP8
Non-steroidal anti-inflammatories (NSAIDs)	In patients undergoing elective orthopaedic surgery, NSAID therapy should be ceased preoperatively to reduce blood loss and transfusion. The timing of the cessation should reflect the agent's pharmacology (Grade C).	R9
Clopidogrel	In patients undergoing CABG either with or without CPB (OPCAB), clopidogrel therapy should be stopped, where possible, at least 5 days before surgery (Grade C).	R7
	In patients receiving clopidogrel who are scheduled for elective noncardiac surgery or other invasive procedures, a multidisciplinary approach should be used to decide whether to cease therapy or defer surgery, balancing the risk of bleeding and thrombotic events. Specific evaluation is required for patients who had a recent stroke, or received a drug-eluting stent within the last 12 months or a bare metal stent within the last 6 weeks. If a decision is made to cease therapy preoperatively, this should occur 7–10 days before surgery.	PP9
Warfarin	In patients undergoing minor dental procedures, arthrocentesis, cataract surgery, upper gastrointestinal endoscopy without biopsy or colonoscopy without biopsy, warfarin may be continued (Grade B).	R10
	In patients receiving warfarin who are scheduled for elective noncardiac surgery or other invasive procedures (excluding minor procedures - see Recommendation 10); specific management according to current guidelines is required (e.g. guidelines from the American College of Chest Physicians and the Australasian Society of Thrombosis and Haemostasis).	PP10

[c]For explanation of terminology for Recommendation and Practice point refer to Appendix 2c.

Figure 2: Suggested management of patients receiving NOAC requiring urgent surgery[4]
(Reproduced with permission)



aPCC –activated prothrombin complex concentrate

3F-PCC – three factor prothrombin complex concentrate

Table 4: Preoperative interruption of new oral anticoagulants: a suggested management approach[4] (Reproduced with permission)

Table 6 Preoperative interruption of new oral anticoagulants: a suggested management approach[21–24]

Drug (doses)†	Renal function	Low bleeding risk surgery‡ (2 or 3 drug half-lives between last dose and surgery)	High bleeding risk surgery§ (4 or 5 drug half-lives between last dose and surgery)
Dabigatran (150 mg twice daily)			
Half-life, 12–17 h	Normal or mild impairment (CrCl ≥ 50 mL/min)	Last dose: 24 h before surgery	Last dose: 48–72 h before surgery
Half-life, 13–23 h	Moderate impairment (CrCl 30–49 mL/min)	Last dose: 48–72 h before surgery	Last dose: 96 h before surgery
Rivaroxaban (20 mg once daily)			
Half-life, 5–9 h (healthy)	Normal or mild impairment (CrCl ≥ 50 mL/min)	Last dose: 24 h before surgery	Last dose: 48–72 h before surgery
Half-life, 9–13 h	moderate impairment (CrCl 30–49 mL/min)	Last dose: 48 h before surgery	Last dose: 72 h before surgery
Apixaban (5 mg twice daily)			
Half-life, 7–8 h	Normal or mild impairment (CrCl ≥ 50 mL/min)	Last dose: 24 h before surgery	Last dose: 48–72 h before surgery
Half-life, 17–18 h	Moderate impairment (CrCl 30–49 mL/min)	Last dose: 48 h before surgery	Last dose: 72 h before surgery

†Estimated half-life based on calculated renal clearance using the Cockcroft–Gault equation. ‡Aiming for mild to moderate residual anticoagulant effect at surgery (<12–25%). §Aiming for no or minimal residual anticoagulant effect (<3–6%) at surgery. CrCl, creatinine clearance.

BLEEDING HISTORY

The use of a structured patient interview or questionnaire before surgery or invasive procedures to assess bleeding risk has been recommended in international guidelines.[2,3] This should include personal and family bleeding history, including previous excessive post-traumatic or postsurgical bleeding; history of comorbidities which may increase bleeding risk such as renal or liver disorders; and detailed information on the patient's medication including complementary medications.[2,3] A number of Bleeding Assessment Tools (BATs) are available for this purpose and are outlined in Table 5.

WHAT IS A BLEEDING ASSESSMENT TOOL (BAT)?

The evaluation of bleeding symptoms is a well-recognised challenge for both patients and physicians because the reporting and interpretation of bleeding symptoms is subjective.[10,11] Mild bleeding events are commonly reported by patients both with and without inherited bleeding disorders.[11] Additionally, there are diagnostic limitations with available laboratory testing for mild bleeding disorders.[10] As a result, bleeding assessment tools (BATs) have been developed and studied in a variety of clinical settings in an attempt to standardise and quantify bleeding symptoms. The goal of a BAT is to:

- improve diagnostic accuracy and thereby avoid unwarranted laboratory testing;
- predict the risk of bleeding in an individual patient;
- describe the symptom severity; and
- inform treatment.[10]

BATs consist of a clinician administered, standardised bleeding history questionnaire and a bleeding score. The worst episode of each symptom is graded according to the bleeding score table. The final bleeding score is the total of all values. The higher the bleeding score, the greater the likelihood of a bleeding disorder.

> WHAT BLEEDING ASSESSMENT TOOLS ARE AVAILABLE?

Both adult and paediatric BATs are available, as well as a newer combined tool developed by the International Society of Thrombosis and Haemostasis (ISTH) in an effort to consolidate the available tools.[12] All the tools stem from a set of provisional criteria for the diagnosis of von Willebrand Disease (VWD) type 1, published in 2005.[13] The tools are referenced in Table 5.

In addition to the tools there are two excellent articles which provide an overview of the available BATs:

Rydz N and James PD. The evolution and value of bleeding assessment tools. Journal of Thrombosis and Haemostasis, 2012; 10: 2223–2229. (This article includes a Comparison of Scoring Systems).[10]

O'Brien S. Bleeding scores: are they really useful? Hemaotology. Am Soc Hematol Educ Program, 2012;2012:152-156.[11]

Table 5: Bleeding Assessment Tools		
Tool	**Reference and links to questionnaire and bleeding score**	**Estimated completion time3**
ASH evaluation and management of VWD	2012 Clinical Practice Guideline on the Evaluation and Management of von Willebrand Disease (VWD). Quick Reference. American Society of Hematology, 2012.[14]	5-10 mins
SIMTI evaluation of haemorrhagic risk	Liumbruno GM, Bennardello F, Lattanzio A, Piccoli P, Rossetti G. Italian Society of Transfusion Medicine and Immunohaematology (SIMTI) Working Party. Recommendations for the transfusion management of patients in the peri-operative period. I. The pre-operative period. Blood Transfus, 2011; 9:19–40.[15]	40 mins
International Society of Thrombosis and Haemostasis (ISTH) -BAT	Rodeghiero F, Tosetto A, Abshire T, Arnold D, Coller B, et al. and On Behalf Of The ISTH/SSC Joint VWF And Perinatal/Pediatric Hemostasis Subcommittees Working Group. ISTH/SSC bleeding assessment tool: a standardized questionnaire and a proposal for a new bleeding score for inherited bleeding disorders. Journal of Thrombosis and Haemostasis, 2010; 8: 2063–2065.[12] ISTH questionnaire and bleeding score.	20 mins
Paediatric Bleeding Questionnaire	Bowman M, Riddel J, Rand ML, Tosetto A, Silva M, and James PD. Evaluation of the diagnostic utility for von Willebrand disease of a pediatric bleeding questionnaire. J Thromb Haemost, 2009;7:1418–1421.[16] Paediatric questionnaire and bleeding score	20 mins
Condensed MCMDM-1 VWD	Bowman M, Mundell G, Grabell J, et al. Generation and validation of the Condensed MCMDM-1VWD Bleeding Questionnaire for von Willebrand disease. J Thromb Haemost, 2008; 6:2062–2066.[17] Condensed MCMDM-1 VWD questionnaire and bleeding score	5-10 mins
European Molecular and Clinical Markers for the Diagnosis and Management of type 1 VWD (MCMDM-1 VWD)	Tosetto A, Rodeghiero F, Castaman G, et al. A quantitative analysis of bleeding symptoms in type 1 von Willebrand disease: results from a multicenter European study (MCMDM-1 VWD). J Thromb Haemost, 2006;4:766–773.[18] MCMDM-1 VWD Questionnaire and Bleeding score	40 mins
Vincenza bleeding score	Rodeghiero F, Castaman G, Tosetto A, Batlle J, Baudo F, et al. The discriminant power of bleeding history for the diagnosis of type 1 von Willebrand disease: an international, multicenter study. J Thromb Haemost, 2005; 3:2619-26.[19] Vincenza questionnaire and bleeding score	40 mins

USE OF BATS IN THE CLINICAL SETTING

BATs have been predominantly used and validated as research tools to identify patients with VWD. More studies of their use for diagnoses of mild bleeding disorders other than VWD are required.[1] Platelet function disorders present a particular challenge due to a lack of a standardised approach to interpretation of platelet function testing.[10,11] BATs have never been intended for use in severe bleeding disorders such as haemophilia.[10,11] The instruments are designed to be administered by trained clinicians – further study would be required to assess the applicability of self-reporting of symptoms.[10] An exact cut-off for an abnormal score has not been established and appears to vary depending on patient age, gender and the clinical setting.[11]

The clinical utility of bleeding scores lies in their ability to summarise a great deal of clinical information about a patient to aid communication between clinicians and to assist in the prioritisation of laboratory testing. In the primary care and even haematology settings, the greatest clinical utility lies in their high negative predictive value and perhaps the greatest value is in the identification of patients for whom VWF testing is not necessary.[11]

It is important to note that bleeding history may be negative in paediatric patients due to lack of haemostatic challenges. Therefore, if a positive family history exists, some laboratory workup will be required to confirm or exclude a bleeding disorder.[11]

The ASH 2012 updated Quick Reference. Clinical Practice Guideline on the Evaluation and Management of von Willebrand Disease VWD[14] is an example of the use of a BAT in clinical practice. It starts with three initial broad screening questions. If a positive result is obtained, the Condensed MCMDM-1 VWD Bleeding Questionnaire and Bleeding score are administered. Physical examination is required and if either history or examination is positive an assessment algorithm provides guidance on testing.

APPLICATION OF BATS IN THE PREOPERATIVE SETTING

The British Committee for Standards in Haematology recommends a bleeding history be taken in all patients preoperatively and prior to invasive procedures.[2] The European Society of Anaesthesiology specifically recommends the use of a structured patient interview or questionnaire before surgery or invasive procedures. Both recommendations state the need for both clinical and family history of bleeding, and details of medications which may impact on bleeding.[3]

> PATIENTS WITH CONGENITAL BLEEDING DISORDERS

Pre-operative assessment and surgery in patients with known or suspected Von Willebrand disease, platelet defects, Haemophilia A and B or other rare bleeding disorders should whenever possible be undertaken in a hospital with a Haemophilia Treatment Centre or in close consultation with a haematologist in a Haemophilia Treatment Centre.

> PATIENTS WITH COMORBIDITIES INVOLVING HAEMOSTATIC DERANGEMENT

Specialist guidelines or haematology advice should be sought for at-risk patients with severe thrombocytopaenia or coagulopathy.[5] The European Society of Anaesthesiology (ESA) suggest that patients with haemostatic derangements associated with systemic, metabolic and/or endocrine diseases should be managed perioperatively in collaboration with a haematologist.[3]

> PHYSICAL EXAMINATION TO ASSESS BLEEDING RISK

Physical examination should be performed as a second step, focusing on signs of bleeding and diseases which may cause haemostatic failure (e.g. liver disease).[3] Gender, body mass index and comorbidities including arterial hypertension, diabetes mellitus and renal dysfunction are independent risk factors for bleeding and transfusion.[3]

Evidence of bleeding or anaemia, including size, location, and distribution of ecchymoses, haematomas, and petechiae should be sought.[14] Evidence of risks of increased bleeding such as jaundice or spider angiomata, splenomegaly, arthropathy, joint and skin laxity, and telangiectasia should also be assessed.[14]

> TYPE OF SURGERY

When assessing bleeding risk the type of surgery requires consideration (Table 6).

Table 6: Type of surgery and bleeding risk

Type of surgery	Considerations	Suggested action
Thoracic or abdominal procedures	Carry particular risks if: • lasting >2 hours • blood loss >500 mL	May require laboratory analysis for bleeding risk stratification[3]
Intracranial, intraocular and neuraxial procedures	Severe bleeding with the need for allogeneic blood transfusion is relatively uncommon in neurosurgery. However, haematoma growth has a major impact on neurological outcomes and mortality in patients with intracerebral haemorrhage (ICH).	Specialist guidelines or haematology advice should be sought for at-risk patients[5] Treat ICH early.[3]
Cardiovascular surgery	Complex cardiovascular surgery may be accompanied by major blood loss, which can lead to loss and consumption of coagulation factors and haemodilution Coagulopathy in cardiac surgery patients may be exacerbated by concurrent antithrombotic therapy, extracorporeal circulation, hypothermia and volume replacement using crystalloids/colloids.[3] Failure to restore haemostasis and restrict perioperative bleeding increases the risk of re-exploration, transfusion requirements, ICU length of stay, morbidity and mortality.[3]	Multidisciplinary assessment and/or referral to specialist guidelines
Gynaecological cancer surgery	Tendency to increased blood viscosity and fibrinogen concentrations, and perioperative transfusion >2 L increases the risk of postoperative venous thromboembolism.	Perioperative haemostatic monitoring and intervention is critical.[3]
Obstetric surgery	Obstetric patients with conditions that are likely to result in surgery will require multidisciplinary assessment and management.	Refer to Patient Blood Management Guidelines: Module 5 – Obstetrics

COAGULATION ASSESSMENT

Traditionally, perioperative coagulation monitoring has relied on clinical judgement and standard laboratory tests (SLTs). However, many SLTs were designed to test for coagulation factor deficiencies, not for predicting risk of bleeding or guiding haemostatic management. Moreover, utility of SLTs in emergency situations is limited by slow turnaround times due to sample transport and plasma preparation requirements.[3]

Routine coagulation testing to predict perioperative bleeding risk in unselected patients prior to surgery or other invasive procedures is not recommended.[2,3] Coagulation tests may suggest increased bleeding risk, but they cannot predict intraoperative or postoperative bleeding caused by exogenous factors.[3]

Selective laboratory testing is advised because it is more cost-effective and more evidence based. Preoperative assessment of aPTT, PT, INR, fibrinogen and platelet count is warranted in patients with bleeding disorders, a history of bleeding or a clear clinical indication (e.g. HELLP syndrome [haemolysis, elevated liver enzymes and low platelets], liver disease or leukaemia).

Platelet function screening, eg with a Platelet Function Analyser (PFA-100®, Siemens, Tarrytown, NY) may be useful preoperatively in patients with a positive bleeding history or taking antiplatelet medication.[3]

POINT-OF-CARE COAGULATION ASSESSMENT

Point-of-care (POC) coagulation assays such as thrombelastography (TEG; Haemoscope Inc., Niles, IL) and thromboelastometry (ROTEM; TemInternationalGmbH, Munich, Germany), enable rapid intraoperative diagnosis of the cause of bleeding[3] but are not practical to use in pre-operative bleeding risk assessment and may not predict bleeding risk.

Indiscriminate preoperative coagulation monitoring using POC assays is unlikely to be cost-effective, but it may be warranted in combination with standard laboratory testing in patients with bleeding disorders such as VWD, factor XII deficiency, and haemophilia A with dysfibrinogenaemia.[3] Consideration for use in cardiac surgery is recommended.[4]

Similarly, there is currently little evidence to support additional, routine application of point-of-care INR testing in the preoperative setting to predict bleeding tendency, despite the fact that many recent devices provide results which are comparable with laboratory testing.[3]

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> APPENDIX 1:

PREOPERATIVE BLEEDING RISK ASSESSMENT AND INTERVENTION – CONSIDERATIONS FOR ORGANISATIONS WANTING TO IMPROVE CLINICAL PRACTICE

Assessment and management of bleeding risk is a key component of PBM strategies to minimise blood loss. In order to incorporate preoperative bleeding risk assessment and intervention into routine practice, the use of clinical practice improvement methodology is recommended. Identifying a lead clinician or clinicians (eg. anaesthetist, haematologist, high risk preoperative physician/anaesthetist or general physician with an interest in the area or role in the management of surgical patients) is an important starting point.

Clinical practice improvement (CPI) is the overarching name for a series of methodologies that can be taken to plan, implement and assess the impact of changes in the delivery of health services. Clinical practice improvement is not a one-off event but a continuing cycle of improvement activities. CPI methodology is described in detail in the Easy Guide to Clinical Practice Improvement, and many organisations offer training courses that are based around the participant undertaking a project.

Key steps of the CPI process are outlined below with specific examples given for a project centred on incorporating preoperative bleeding risk assessment and intervention into routine preoperative care in cardiac surgery patients.

- Form a guidance team: Gain support from relevant hospital heads including cardiothoracic surgery, anaesthetics, haematology, nursing and safety and quality.
- Collect baseline data: Undertake an audit of the frequency and current management of preoperative bleeding risk assessment in cardiac surgery patients.
- Establish a multidisciplinary project team consisting of the team leader and people with fundamental knowledge of the process; for example this could include: cardiac surgery clinical nurse consultant, cardiac surgery nurse coordinator, cardiac surgeon, cardiac surgery registrar, cardiac surgery resident medical officer, cardiac surgery physiotherapist, high-risk peri-operative physician, anaesthetist overseeing pre-admission clinic, general practitioner (GP), GP liaison nurse, haematologist, transfusion nurse consultant and a consumer. Include a quality improvement facilitator.
- Develop an aim or mission statement that is SMART, ie Specific, Timely, Measurable, Appropriate, Result oriented and Time scheduled. (eg. To increase the percentage of patients on the cardiac surgery waiting list with bleeding risk assessed and managed prior to surgery by 75% by MM/YY)
- Diagnostic phase: Map (flow-chart) current hospital processes for cardiac surgery patients preoperatively (starting with initial referral), conduct a brainstorming session of the barriers and enablers to improvement with the project team, construct a cause and effect diagram and prioritise the causes in a Pareto chart.

- Intervention phase: Achieve consensus within the team on where to focus improvement energy. Use a plan-do-study-act (PDSA) framework for improvement cycles. Customisation of the suggested flowchart by local experts may be required to tailor it to the patient group and hospital resources/referral pathways. The team will also need to determine the most appropriate bleeding assessment tool for their local setting.
- Impact and implementation phase: measure the impact of changes in order to be sure the intervention has resulted in an improvement, and to provide the evidence required to justify permanent implementation of these changes. Measure the number of cardiac surgery patients with bleeding risk assessed and managed in advance of surgery with each improvement cycle.
- Sustaining improvement phase: Mechanisms, such as standardisation of existing systems and process, documentation of associated policies, procedures, protocols and guidelines, training and education of staff, and ongoing measurement and review, need to be established to sustain the improvement.

> APPENDIX 2:

CLASSIFICATION OF EVIDENCE LEVELS AND GRADES OF RECOMMENDATIONS

a) Classification of evidence levels and grades of recommendations – British Committee for Standards in Haematology Guidelines on the assessment of bleeding risk prior to surgery or invasive procedures

Classification of evidence levels

Ia Evidence obtained from meta-analysis of randomised controlled trials.

Ib Evidence obtained from at least one randomised controlled trial.

IIb Evidence obtained from at least one well-designed controlled study without randomisation.

IIb Evidence obtained from at least one other type of well-designed quasi-experimental study*.

III Evidence obtained from well-designed non-experimental descriptive studies, such as comparative studies, correlation studies and case studies.

IV Evidence obtained from expert committee reports or opinions and/or clinical experiences of respected authorities.

*refers to a situation in which implementation of an intervention is out with the control of the investigators, but an opportunity exists to evaluate its effect.

Classification of grades of recommendations

A Requires at least one randomised controlled trial as part of a body of literature of overall good quality and consistency addressing specific recommendation. (Evidence levels Ia, Ib).

B Requires the availability of well conducted clinical studies but no randomised clinical trials on the topic of recommendation. (Evidence levels IIa, IIb, III).

C Requires evidence obtained from expert committee reports or opinions and/or clinical experiences of respected authorities. Indicates an absence of directly applicable clinical studies of good quality. (Evidence level IV).

b) Grades of recommendation – GRADE system – Management of severe perioperative bleeding: guidelines from the European Society of Anaesthesiology

	Clarity of benefit	Quality of supporting evidence	Implications
1A Strong recommendation. High quality evidence	Benefits clearly outweigh risk and burdens, or vice versa	Consistent evidence from well performed randomised, controlled trials or overwhelming evidence of some other form. Further research is unlikely to change our confidence in the estimate of benefit and risk.	Strong recommendation, can apply to most patients in most circumstances without reservation.
1B Strong recommendation. Moderate quality evidence	Benefits clearly outweigh risk and burdens, or vice versa.	Evidence from randomised, controlled trials with important limitations (inconsistent results, methodological flaws, indirect or imprecise), or very strong evidence of some other form. Further research (if performed) is likely to have an impact on our confidence in the estimate of benefit and risk and may change the estimate.	Strong recommendation, likely to apply to most patients.

1C Strong recommendation. Low quality evidence	Benefits appear to outweigh risk and burdens, or vice versa.	Evidence from observational studies, unsystematic clinical experience, or from randomised, controlled trials with serious flaws. Any estimate of effect is uncertain.	Relatively strong recommendation; might change when higher quality evidence becomes available.
2A Weak recommendation. High quality evidence.	Benefits closely balanced with risks and burdens.	Consistent evidence from well performed, randomised, controlled trials or overwhelming evidence of some other form. Further research is unlikely to change our confidence in the estimate of benefit and risk.	Weak recommendation, best action may differ depending on circumstances or patients or societal values.
2B Weak recommendation. Moderate quality evidence.	Benefits closely balanced with risks and burdens, some uncertainty in the estimates of benefits, risks and burdens.	Evidence from randomised, controlled trials with important limitations (inconsistent results, methodological flaws, indirect or imprecise), or very strong evidence of some other form. Further research (if performed) is likely to have an impact on our confidence in the estimate of benefit and risk and may change the estimate.	Weak recommendation, alternative approaches likely to be better for some patients under some circumstances.
2C Weak recommendation. Low quality evidence.	Uncertainty in the estimates of benefits risks and burdens; benefits may be closely balanced with risks and burdens.	Evidence from observational studies, unsystematic clinical experience, or from randomised, controlled trials with serious flaws. Any estimate of effect is uncertain.	Very weak recommendation; other alternatives may be equally reasonable.

c) Recommendations and Practice points – Patient Blood Management Guidelines

The Patient Blood Management Guidelines contain both recommendations and practice points to guide clinical practice. Recommendations are based on evidence from systematic review of the literature using the National Health and Medical Research Council (NHMRC) grades of recommendations definitions; and the practice points are based on consensus decision-making, where insufficient high-quality data was available.

Grade	
A	Body of evidence can be trusted to guide practice
B	Body of evidence can be trusted to guide practice in most situations
C	Body of evidence provides some support for recommendation(s) but care should be taken in its application
D	Body of evidence is weak and recommendations must be applied with caution

> APPENDIX 3:

EUROPEAN SOCIETY OF ANAESTHESIOLOGY (ESA) GUIDANCE REGARDING CESSATION OF MEDICATIONS (EXTRACT)[2]

Note: Whilst the ESA guidelines provide guidance regarding aspirin, warfarin, and NOAC, it is recommended that Australasian guidelines and references be consulted in the first instance.

ESA guidance regarding cessation of medications	
Medication	Recommendation/suggestion
Dual antiplatelet therapy	We recommend discontinuing dual antiplatelet therapy before urgent intracranial neurosurgery. A risk-benefit analysis is required for the continuation of aspirin monotherapy during neurosurgery. 1B
	We suggest that urgent or semi-urgent surgery should be performed under aspirin/clopidogrel or aspirin/prasugrel combination therapy if possible, or at least under aspirin alone. 2C
Metal or drug-eluting stent	We recommend against performing orthopaedic surgery during the first three months after bare metal stent implantation or during the first twelve months after drug-eluting stent implantation. 1C
	We recommend postponement of elective surgery following coronary stenting (at least 6 to 12 weeks for bare metal stent and one year for drug-eluting stents). 1C
Selective serotonin reuptake inhibitor (SSRI)	We suggest that selective serotonin reuptake inhibitor (SSRI) treatment should not be routinely discontinued perioperatively. 2B
Antiepileptic agents	We suggest individualised perioperative discontinuation of antiepileptic agents, such as valproic acid, which may increase bleeding. 2C
Complementary medicines	We do not recommend discontinuation of Gingko biloba extracts. 1B


NATIONAL BLOOD AUTHORITY
AUSTRALIA