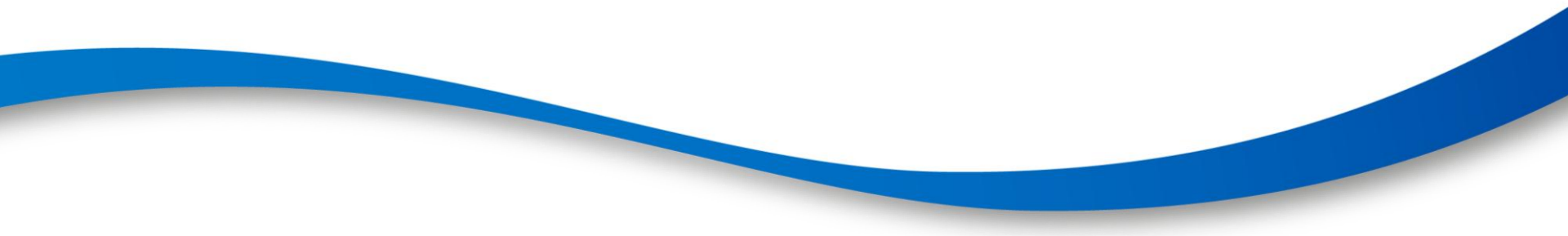# FBC Interpretation and Transfusion Triggers

Presented by the North East & Yorkshire
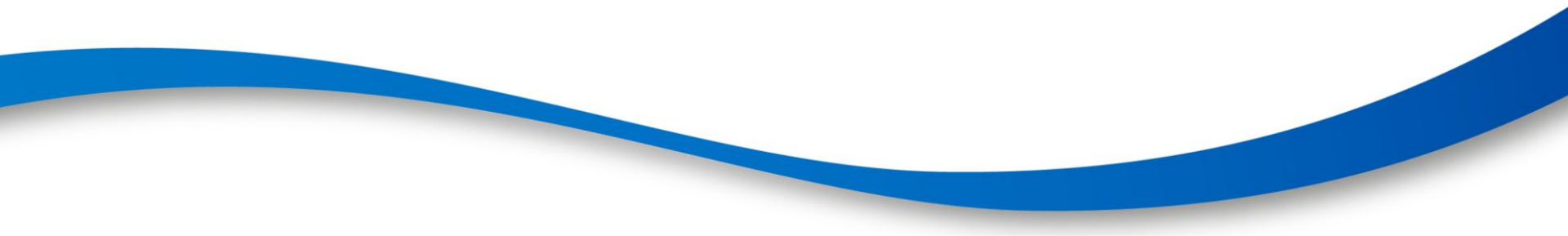Non-Medical Authorisation working group

Learning objectives

- Indicate the normal ranges for full blood count and explain what each measurement means

- Recognise how to detect abnormal results and interpret possible causes

- Give tools to help decision making around transfusing blood products (red cells and platelets)
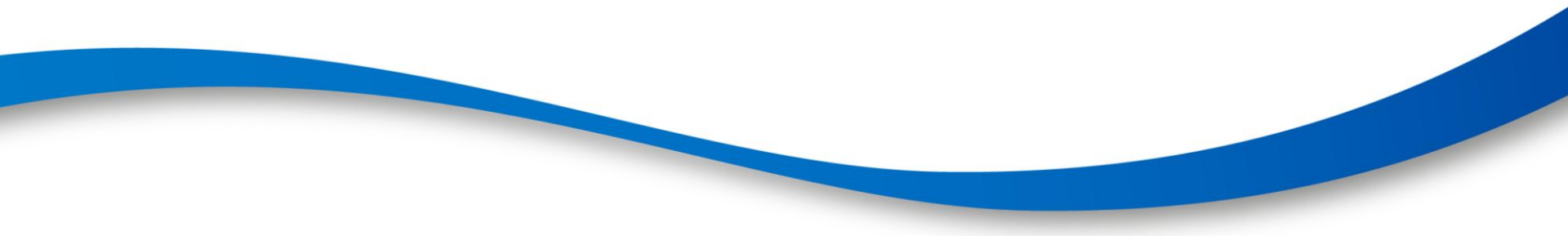
Full blood count

Parameter	Male	Female
Haemoglobin g/l	135 - 180	115 - 160
WBC x109/L	4.00 - 11.00	4.00 - 11.00
Platelets x109/L	150 - 400	150 - 400
MCV fL	78 - 100	78 - 100
MCH pg	27.0 - 32.0	27.0 - 32.0
Neutrophils	2.0 - 7.5	2.0 - 7.5
Lymphocytes	1.0 - 4.5	1.0 - 4.5
Monocytes	0.2 - 0.8	0.2 - 0.8
Eosinophils	0.04 - 0.40	0.04 - 0.40
Basophils	< 0.1	< 0.1

Interpretation of Results

- FBCs, like all lab results, are like photos

- They are only valid for the time at which they were taken

- GIGO principle (Garbage In, Garbage Out)

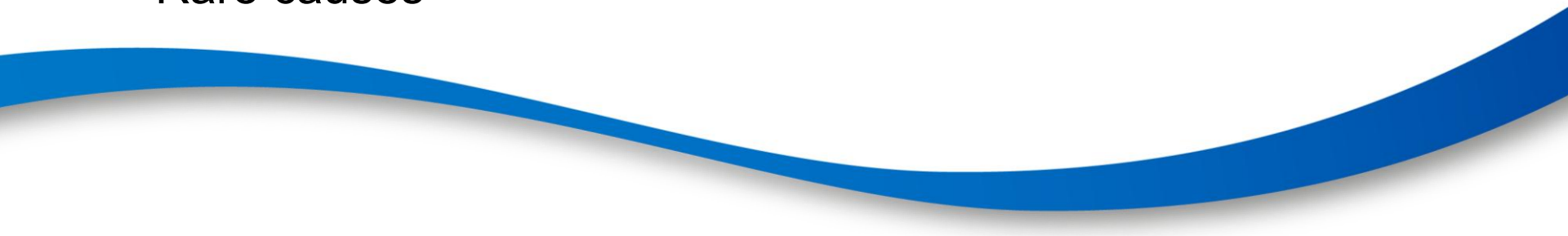 – If the sample was not taken properly and handled correctly, the results may be inaccurate

Interpretation of Results

- If a result looks strange and does not fit the way the patient looks, check again!

- (presuming it is not urgent)

- And tell the lab you think it might be wrong
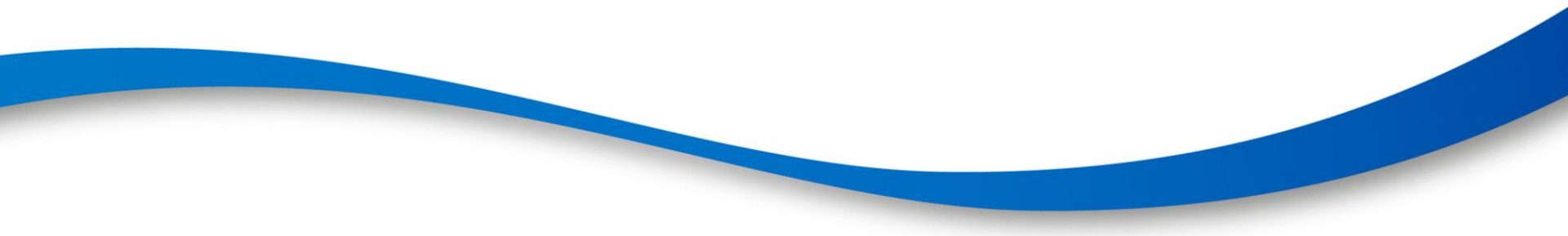
Abnormal Results - Haemoglobin

- Focussing on interpretation of results that have relevance for transfusion skills

- Low – anaemia

    – Is this a haemorrhage situation?
    – If not…look at the size of the red cells (MCV)
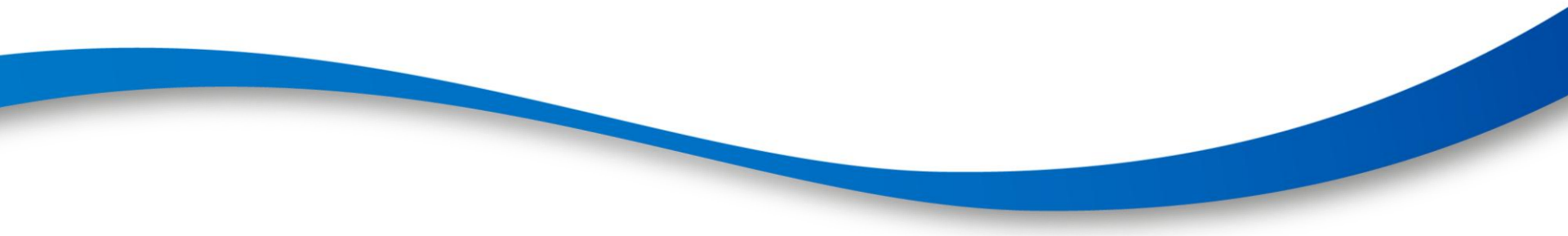
Anaemia

- Low MCV (small red cells)

  - Iron deficiency (by far the likeliest cause)
    - Dietary
    - Bleeding (GI, FCBP)
  - Haemoglobinopathy (thalassaemias mainly) – these people can also be iron deficient
  - Anaemia of chronic disease
  - Thyroid abnormalities
  - Rare causes
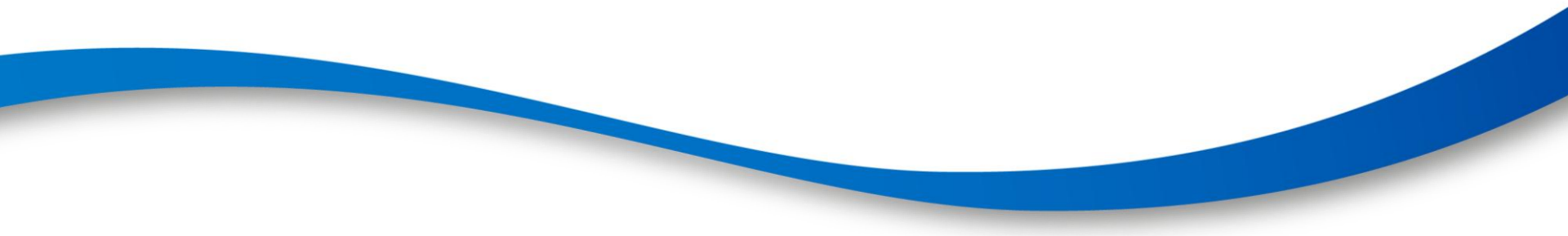
Anaemia

- High MCV (enlarged red cells)

  - B12 / folate deficiency
  - Excessive alcohol intake (chronic)
  - High red cell turnover (eg haemolysis, bleeding)
  - Myelodysplastic Syndrome (MDS)
  - Certain drugs (eg hydroxycarbamide, azathioprine)
  - Thyroid abnormalities
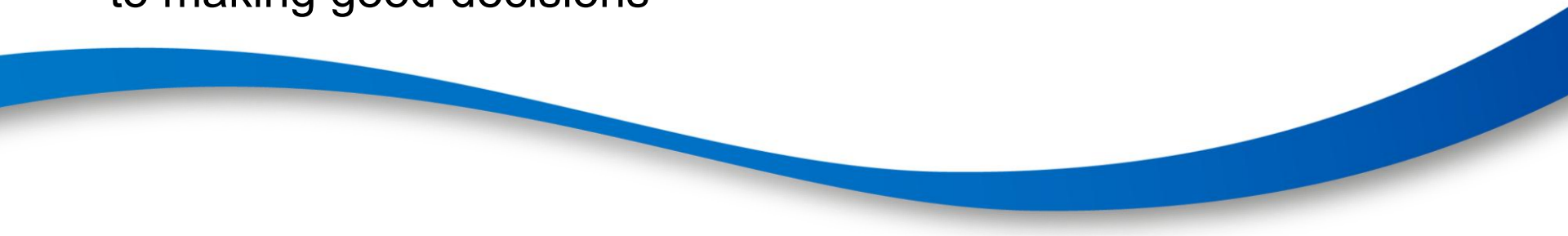
Anaemia

- Normal MCV (red cell size normal on average)

  - Can happen with any of the previous causes
  - 'Mixed' picture of low/high MCV
  - Traditionally said to be likeliest with 'anaemia of chronic disease' or 'renal anaemia'
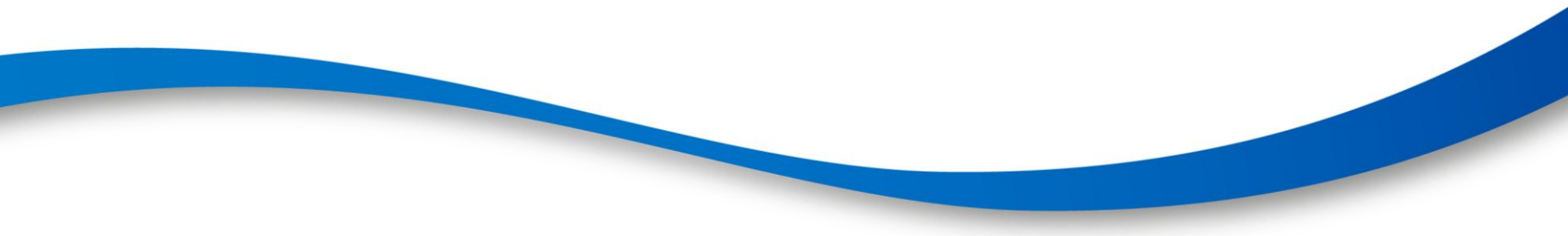
Anaemia

- Other (possibly) useful investigations:

    – Ferritin, B12, folate levels

    – U&Es, LFTs, TFTs

    – Blood film

    – Reticulocyte count (and haemolysis screen)

- Always look for the trend – is this new or old? Is it falling quickly or slowly?

Anaemia

- Patients may tolerate extremely low Hb levels if it has fallen slowly and they have had time to compensate

- Conversely, rapidly falling Hb levels can make people feel ill even at moderately low levels

- So history and examination / clinical picture is critical to making good decisions

Transfusion Dependent Patients

- These patients behave slightly differently to 'acute' or 'chronic' anaemia from other causes

- Decisions to transfuse tend to be based on a particular Hb threshold established over time by the patient and their caring team

- Some patients see marked benefit from transfusion, others very little

What triggers would you use?
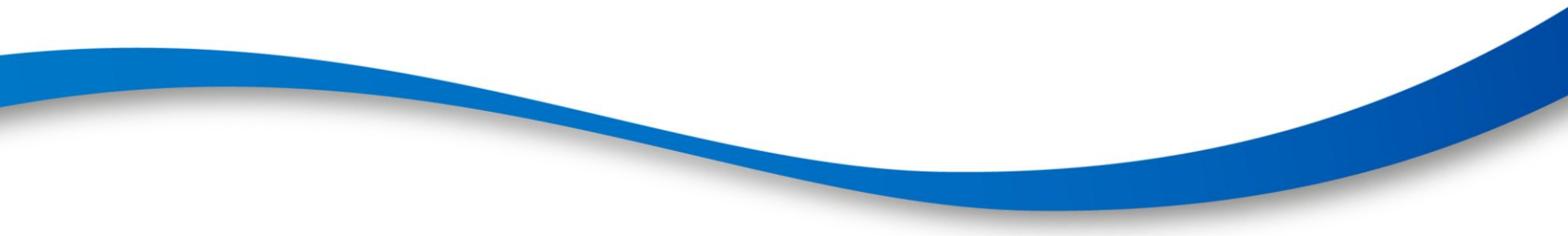
Mortality (%) in patients with very low postoperative haemoglobin levels who decline blood transfusion
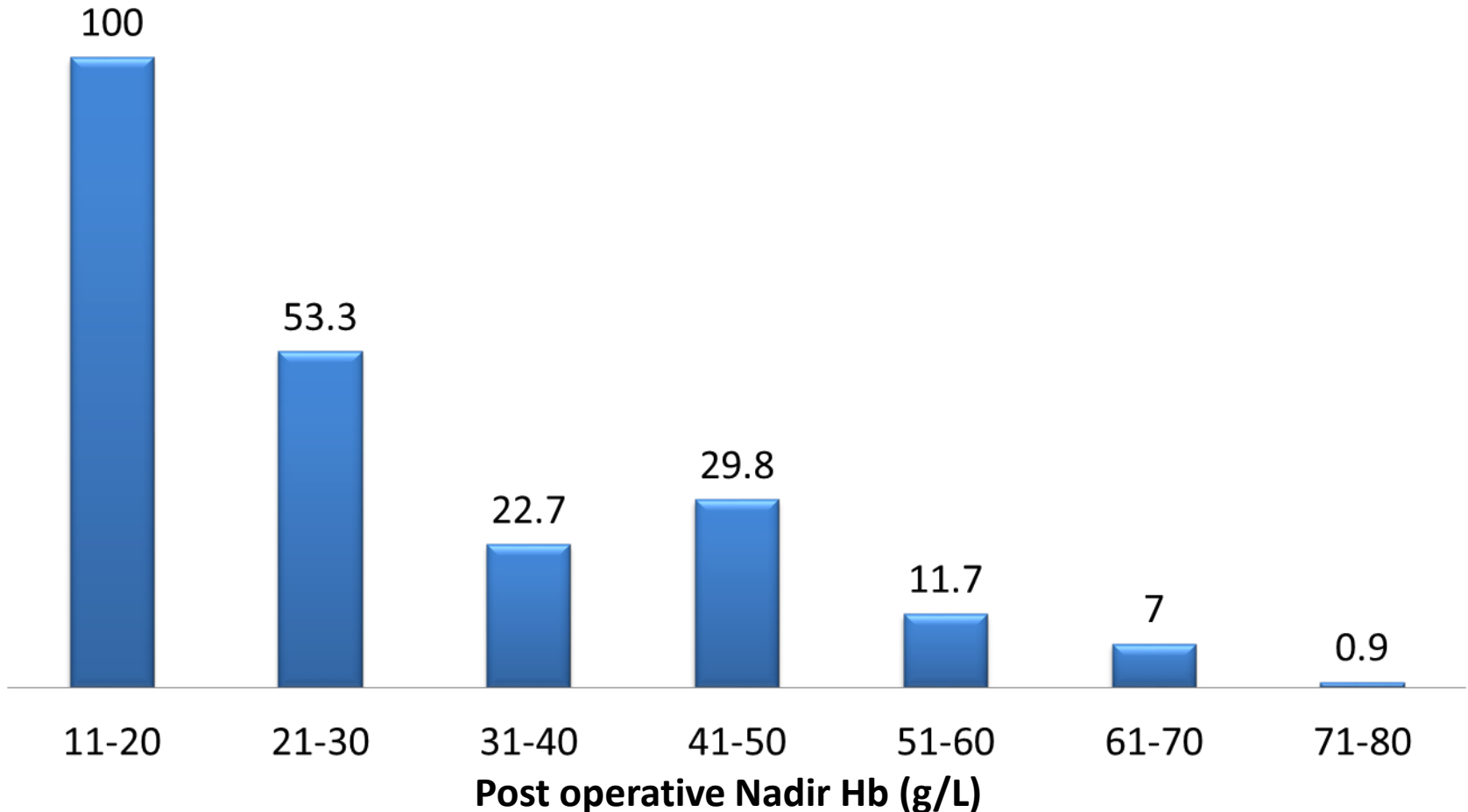
Post operative Nadir Hb (g/L)

What triggers would you use?

Red cells - Transfusion Triggers
TRICC Transfusion Requirements in Critical Care

Hebert PC et al.1998 Crit Care Med 1998 26(3):482-7

Hb 70g/dl vs Hb 100g/dl, 30 day mortality similar
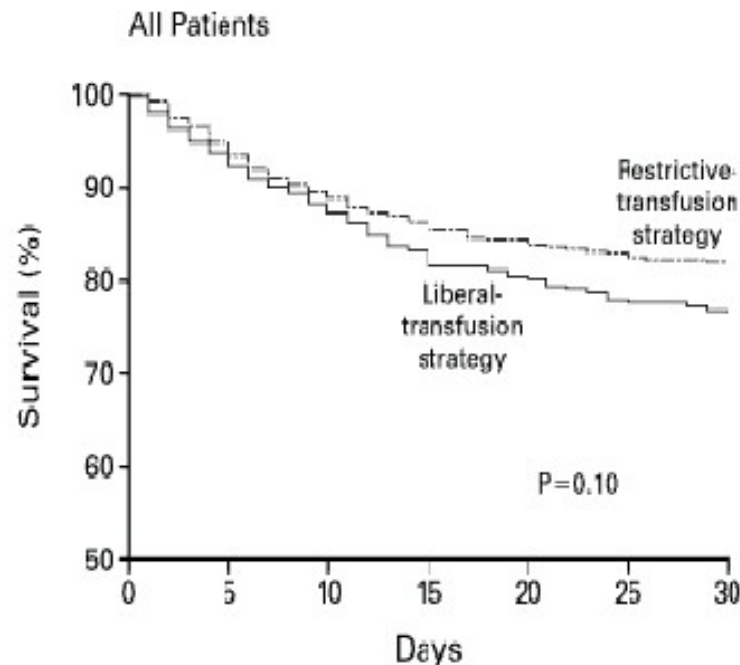
Transfusion Thresholds

Hb 70-80g/L

except:

- **Symptomatic patients**
- **Patients with acute coronary syndrome**
- **Patients with major haemorrhage**

NICE Guideline NG24, 2015

'For every complex problem there is an answer that is clear, simple, and wrong'

H.L. Mencken

Figure 1. A suggested approach to transfusion in critical care

Is the patient anaemic and haemodynamically stable?

YES

Is the Hb >90 g/l?

YES

NO

DO NOT TRANSFUSE

Does the patient have acute coronary syndrome, severe sepsis or a neurological injury?

YES

NO

SEVERE SEPSIS

Early (<6h from onset) and evidence of tissue hypoxia
- Target Hb 90 – 100 g/l
Late (>6h from onset)
- Target Hb >70 g/l

NEURO CRITICAL CARE

Traumatic brain injury and/or cerebral ischaemia
- Target Hb 90 g/l
Subarachnoid haemorrhage
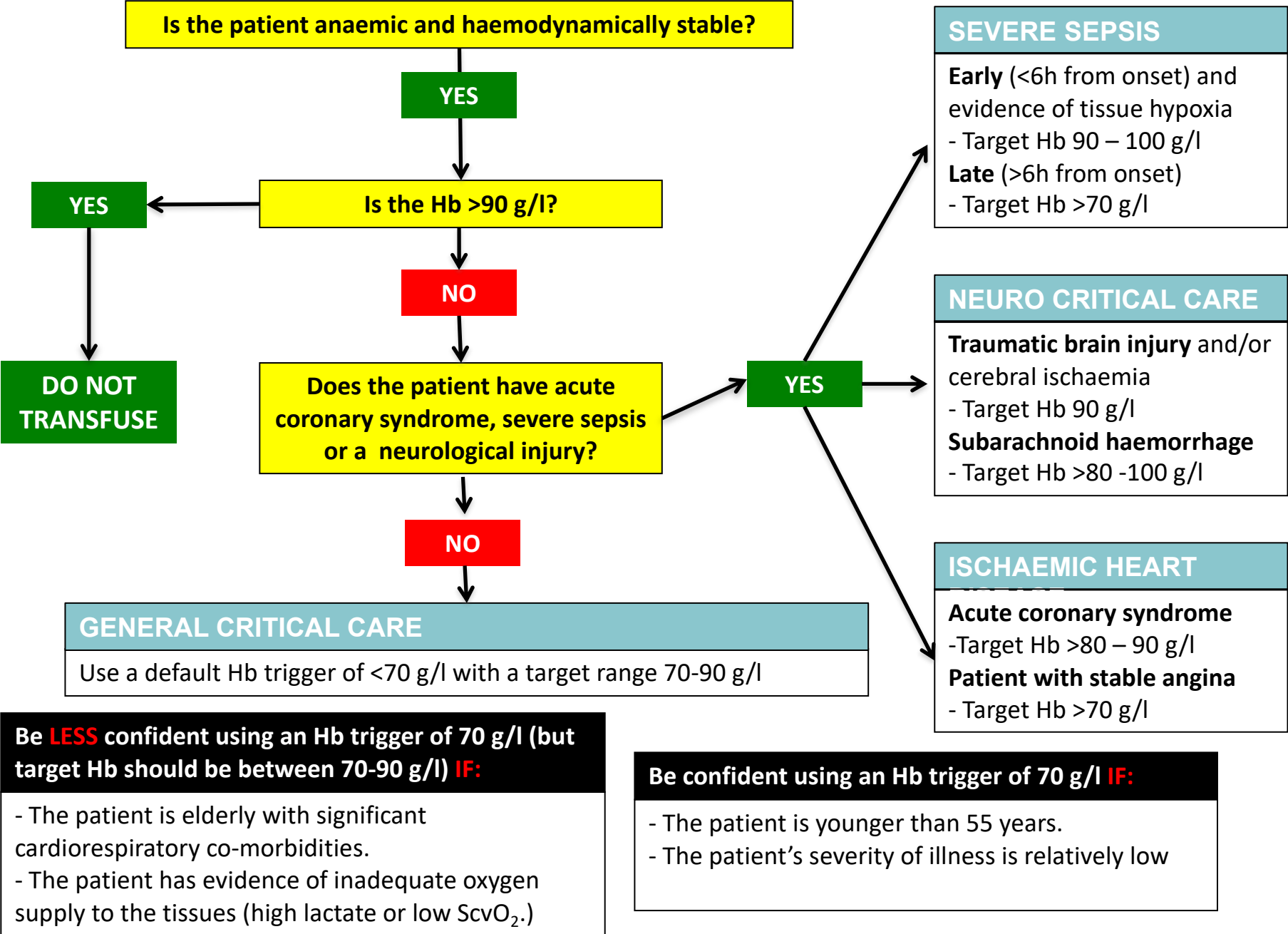- Target Hb >80 -100 g/l

ISCHAEMIC HEART

Acute coronary syndrome
-Target Hb >80 – 90 g/l
Patient with stable angina
- Target Hb >70 g/l

GENERAL CRITICAL CARE

Use a default Hb trigger of <70 g/l with a target range 70-90 g/l

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Be **LESS** confident using an Hb trigger of 70 g/l (but target Hb should be between 70-90 g/l) **IF:**

- The patient is elderly with significant cardiorespiratory co-morbidities.
- The patient has evidence of inadequate oxygen supply to the tissues (high lactate or low $ScvO_2$.)

Be confident using an Hb trigger of 70 g/l **IF:**

- The patient is younger than 55 years.
- The patient's severity of illness is relatively low

*BSH Guideline 2016

Guidelines on transfusion for fetuses, neonates and older children

Helen V. New,[1,2] Jennifer Berryman,[3] Paula H. B. Bolton-Maggs,[4] Carol Cantwell,[2] Elizabeth A. Chalmers,[5] Tony Davies,[6] Ruth Gottstein,[7] Andrea Kelleher,[8] Sailesh Kumar,[9] Sarah L. Morley[10] and Simon J. Stanworth,[11] on behalf of the British Committee for Standards in Haematology

[1]NHS Blood and Transplant, [2]Imperial College Healthcare NHS Trust, London, [3]University College Hospitals NHS Trust, London, [4]Serious Hazards of Transfusion, NHS Blood and Transplant, Manchester, [5]Royal Hospital for Sick Children, Glasgow, [6]NHS Blood and Transplant, [7]St. Mary's Hospital, Manchester/University of Manchester, Manchester, [8]Royal Brompton Hospital, London, UK, [9]Mater Research Institute, University of Queensland, Brisbane, Australia, [10]Addenbrookes Hospital/NHS Blood and Transplant, Cambridge, and [11]Oxford University Hospitals NHS Trust/NHS Blood and Transplant, Oxford, UK

The guideline is a revision of the 2004 British Committee for Standards in Haematology (BCSH) guideline on transfusion in neonates and older children (BCSH, 2004). Although there has been little evidence on which to base paediatric clinical transfusion decisions in the past, there have been a number of studies and national audits published over recent years that contribute to decision-making in this area. In addition there have been changes to other guidance, including the management of neonatal jaundice National Institute for

which was subsequently revised by consensus following comment by members of the Transfusion Task Force of the BCSH and by a sounding board including UK haematologists, paediatricians/neonatologists. The 'GRADE' system was used to quote levels and grades of evidence (http://www.bcshguidelines.com/BCSH_PROCESS/EVIDENCE_LEVELS_AND_GRADES_OF_RECOMMENDATION/43_GRADE.html). Recommendations entirely extrapolated from evidence from adult studies have been given a lower grade for children.

The objective of this guideline is to provide healthcare professionals with clear guidance on the management of

https://b-s-h.org.uk/guidelines

*BSH Guideline 2016

* Infants and Children:
  * Red cells
    * Evidence often extrapolated from adult studies
    * TRIPICU (Lacroix, NEJM, 2007)
    * Restrictive (70g/L) vs Liberal (90g/L)
    * Mean restrictive (87g/L) non-inferior to liberal (108g/L)
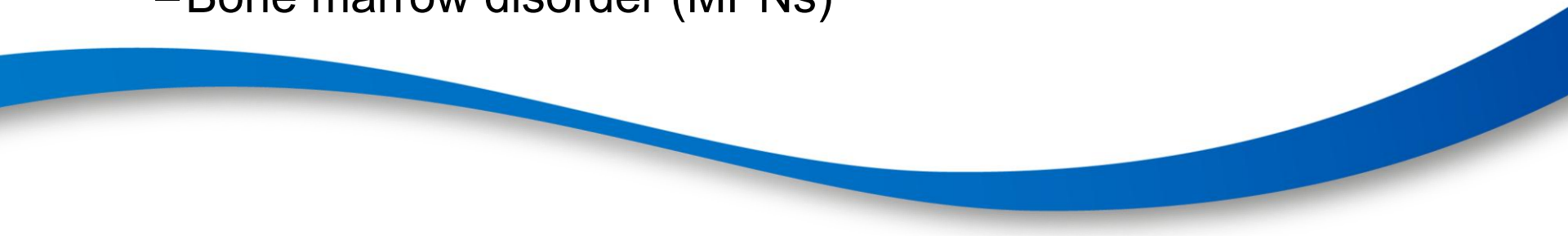   * In stable, non-cyanotic patients

Table 1 Risk of NP/MODS: Subgroup Analyses of the TRIPICU Study

TRIPICU Subgroup	Planned Analysis	Patients Number	Absolute Risk Reduction (95% confidence interval)
All patients in TRIPICU		637	0.4% (−4.6 to +5.5)
PRISM score	Yes		
0 (1st quartile)		128	+1.5% (−6.3 to +9.4)
1-4 (2nd quartile)		239	−0.3% (−7.9 to +7.4)
5-7 (3rd quartile)		121	−2.2% (−13.0 to +8.7)
≥8 (4th quartile)		149	+1.5% (−6.3 to +9.4)
Cases of sepsis	Yes	137	+0.3% (−12 to +14)
Pediatric noncardiac surgery	Yes	124	+1.1% (−8.9 to +11)
Cardiac surgery (noncyanotic)	Yes	125	+6.3% (−4 to +16.5)
Respiratory dysfunction	No	480	+0.1%
Acute lung injury	No	73	−6.3%
ARDS	No	48	−2.8%
Neurological dysfunction	No	40	−10.6%
Severe head trauma	No	30	+2.3%
Severe trauma	Yes	40	−5.8%

ARDS, acute respiratory distress syndrome; CI, confidence interval; NP/MODS, new or progressive multiple organ dysfunction syndrome; PRISM, pediatric risk of mortality score;[1,5] TRIPICU, transfusion requirements in pediatric intensive care units.[3]

Lacroix, Seminars in Perinatology, 2012
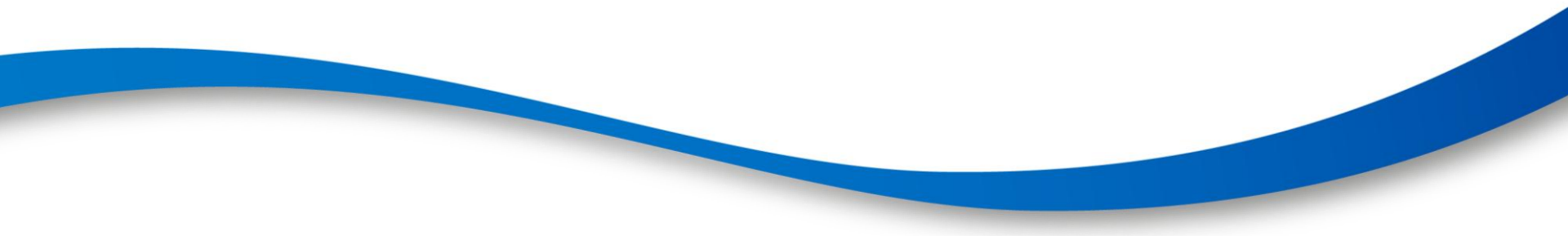
Abnormal Results - Platelets

- High (thrombocytosis)

  – Reactive / Secondary
    - Infection
    - Inflammation
    - Hyposplenism
    - Iron deficiency anaemia
    - Malignancy
  – Primary
    - Bone marrow disorder (MPNs)

Abnormal Results - Platelets

- Low (thrombocytopenia)

  - Failure of production
    - Infection
    - Malignancy
    - Haematinic deficiency
    - Liver failure / alcohol / big spleen
    - Medications / Chemo
  - Destruction
  - Mechanical (eg bypass / dialysis / CVVH etc)
  - Idiopathic thrombocytopenic purpura (ITP)
  - Disseminated intravascular coagulation (DIC)
  - Thrombotic thrombocytopenic purpura (TTP – rare)
  - Heparin induced thrombocytopenia (HIT)
  - Vaccine-induced thrombosis and thrombocytopenia (VITT)
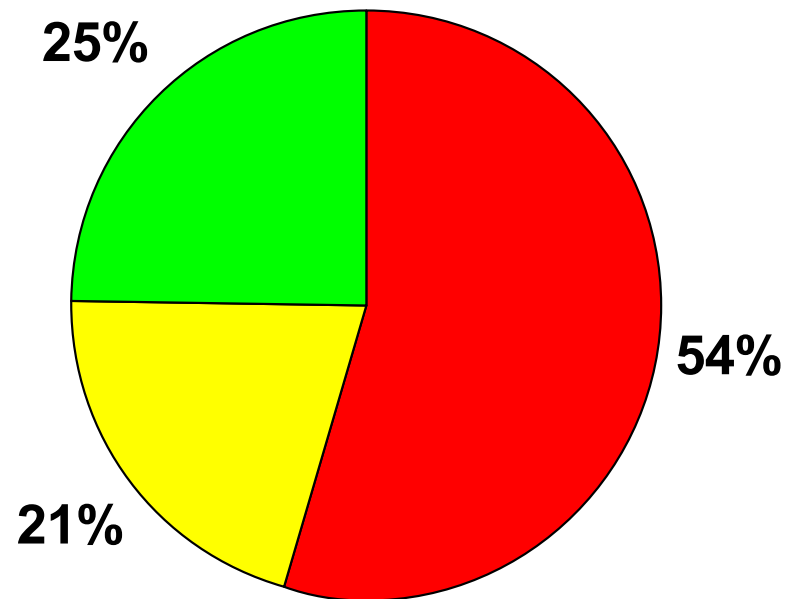
Further Investigations

- Check trend – has it always been low?

- Revisit history and examination

- Investigate for underlying cause

- Blood film is always useful!

Where do platelets go?

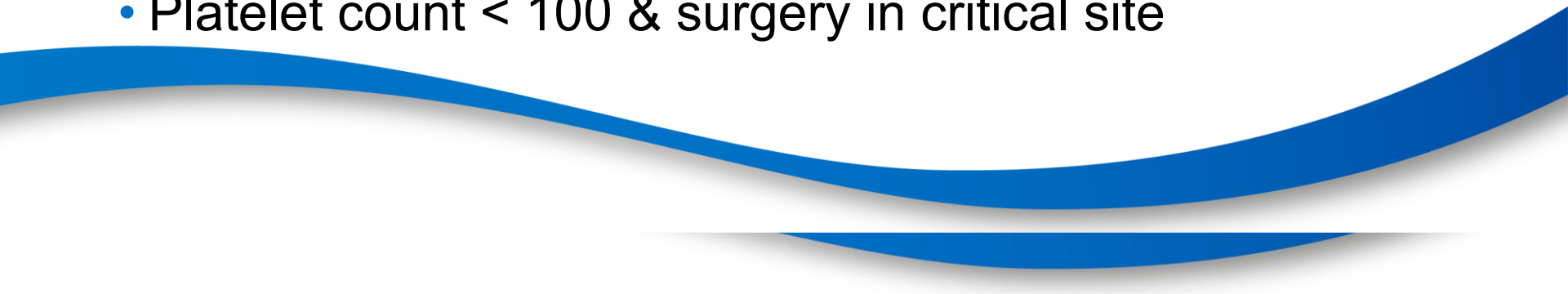Tinegate et al 2012 NE England

N= 1937 units

25%

54%

21%

■ Haematology 1055 ■ Other medical 402 ■ Surgical 479

When would you transfuse platelets?

Triggers for platelet transfusion BSH 2016 Platelet Guidelines

- Platelet count < 10 reversible BM failure, Critical illness

- Platelet count < 20 & additional defect e.g. sepsis and central venous line

- Platelet count < 40 Lumbar puncture

- Platelet count < 50 & invasive procedure and severe bleeding

- Platelet count < 80 Epidural anaesthesia

- Platelet count < 100 & surgery in critical site

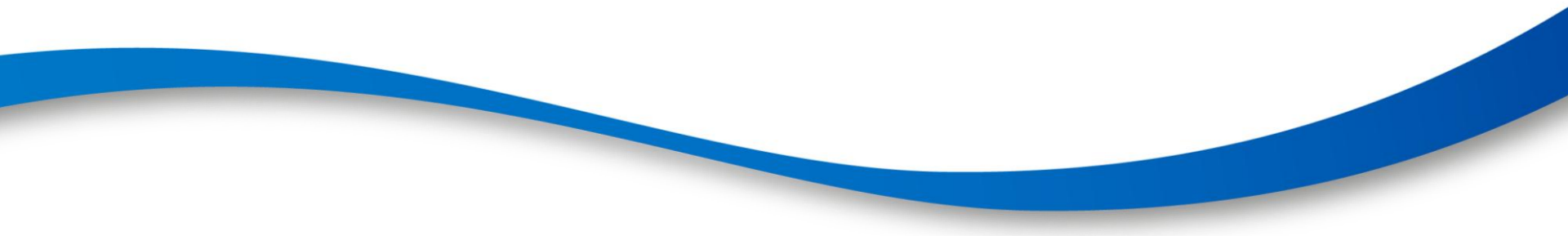# *BSH Guideline 2016

*Infants and Children:

  * Platelets

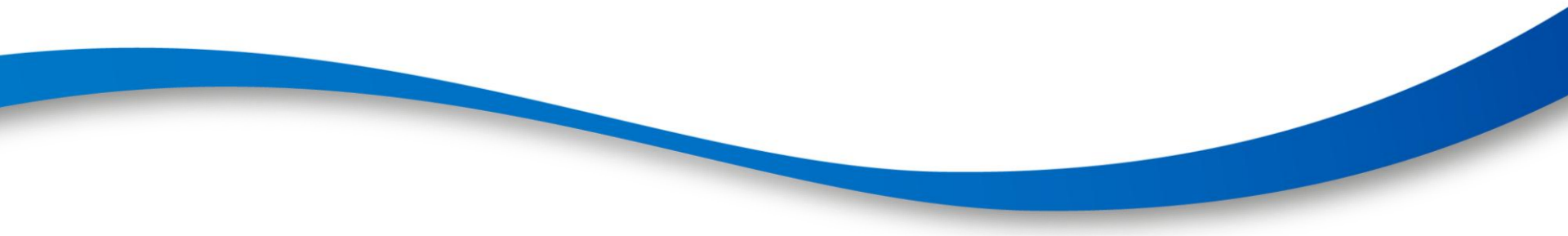   * Evidence often extrapolated from adult studies

Table III. Suggested thresholds of platelet counts for platelet transfusion in children.

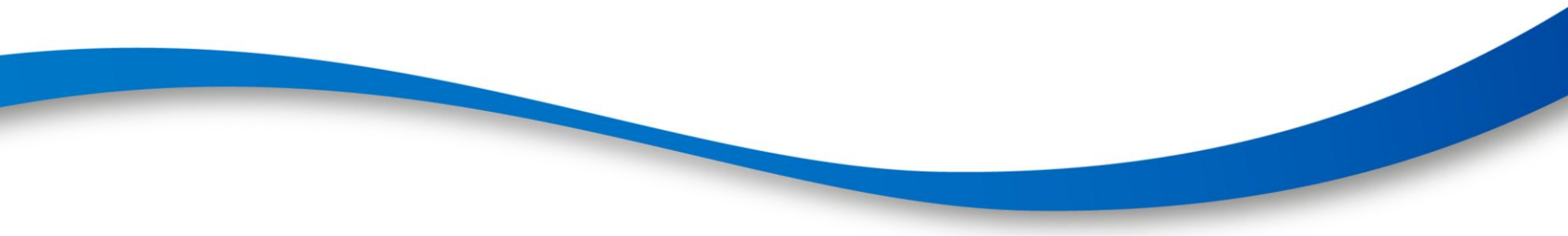| Platelet count ($\times 10^9$/l)	Clinical situation to trigger platelet transfusion
<10	Irrespective of signs of haemorrhage (excluding ITP, TTP/HUS, HIT)
<20	Severe mucositis
	Sepsis
	Laboratory evidence of DIC in the absence of bleeding*
	Anticoagulant therapy
	Risk of bleeding due to a local tumour infiltration
	Insertion of a non-tunnelled central venous line
<40	Prior to lumbar puncture†
<50	Moderate haemorrhage (e.g. gastrointestinal bleeding) including bleeding in association with DIC
	Surgery, unless minor (except at critical sites)
	• including tunnelled central venous line insertion
<75–100	Major haemorrhage or significant post-operative bleeding (e.g. post cardiac surgery)
	Surgery at critical sites: central nervous system including eyes

Case 1

- A 24 year old woman is admitted to MAU after attending her GP with tiredness and having a FBC check:

- Hb 64g/L, MCV 62 (80-100), WCC 7, Plts 500 (150-450)

- What is the likeliest cause of her anaemia?

- What other blood tests should be done?

- What other questions should you ask her?

Case 1b

- You are asked to authorise a 2u red cell transfusion as she feels very tired, a bit breathless on climbing stairs, and has 3 young children to care for at home

- How would you respond?

- What are the options for treating her?

Case 2

- A 78 year old man is an inpatient on the gastro ward in your hospital, with weight loss and not eating or drinking - ? a possible upper GI malignancy. He has his routine FBC done one morning and Hb has dropped from 123g/L (2 days ago) to 55g/L this morning

- You rush to see him

- He says he doesn't feel well overall

Case 2b

- Once you have established his ABC are ok and observations are normal, what should you look at next?
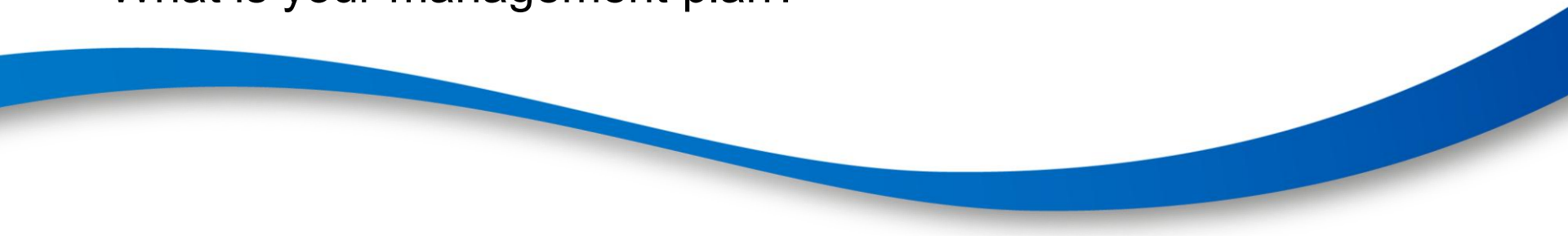
Case 2

- FBC today:
    - Hb 55g/L
    - MCV 82
    - MCH 20
    - Plts 127
    - WCC 2.2
    - Neuts 1.8

- FBC 2 days ago:
    - Hb 123g/L
    - MCV 97
    - MCH 34
    - Plts 400
    - WCC 8.4
    - Neuts 3.3

What is the likeliest cause?
What should you do next?

Case 3

- A 60 year old AML patient is 3 weeks out from induction chemo and attends the Day Unit for routine check FBC:

- Hb 80g/L, Plts 11, Neuts 0.2

- It's Friday afternoon and the Day Unit isn't open again until Monday

- Is there anything else you want to know?

- What is your management plan?

Learning objectives

- Indicate the normal ranges for full blood count and explain what each measurement means

- Recognise how to detect abnormal results and interpret possible causes

- Give tools to help decision making around transfusing blood products (red cells and platelets)