ABSTRACT BOOK

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Abstracts of the 22nd Annual NATA Symposium
on Patient Blood Management, Haemostasis and Thrombosis

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Abstracts of the 22nd Annual NATA Symposium
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Speaker Abstracts

PBM – from new kid on the block to standard of care

S1

PBM – a global definition

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Several patient blood management (PBM) initiatives are being developed and implemented across the globe. While most agree on the general principles of PBM, lack of a clear, widely accepted definition could affect consistent implementation of PBM in a variety of clinical settings.

A definition is "a statement expressing the essential nature of something." It enables us to have a common understanding of the subject and for all to be on the same page when discussing or reading about an issue. The purpose of a definition is to explain the meaning of a term that may be obscure or difficult, using terms that are commonly understood. Definitions and terms serve as descriptors of care, and can help shape practice, education, and research. As a diverse group with a common interest in PBM, our efforts in the field of interest have been hampered by the use of various terms and definitions, often used to emphasize one aspect in particular of PBM or a specific therapeutic intervention. Such intervention focused definitions are limited in contributing to improved practice and patient outcomes. Therefore, an inclusive but concise definition will provide exact statements that can be used to define practice and lead to benchmarking and performance enhancement.

To address this, an expert group representing several PBM organizations, from the International Foundation for Patient Blood Management (IFPBM), the Network for the Advancement of Patient Blood Management, Haemostasis and Thrombosis (NATA), the Society for the Advancement of Patient Blood Management (SABM), the Western Australia Patient Blood Management (WAPBM) Group, and ONTraC (Ontario Nurse Transfusion Coordinators), convened under the Global Definition Group, have been working to develop a global definition of PBM. SABM and NATA produced an initial draft that was discussed in person and by e-mail with the IFPBM, WAPBM and ONTraC groups. Once all had submitted suggestions and agreed on the proposed definition, endorsement by other relevant PBM organizations was sought.

The group worked cohesively to create the Global Definition of PBM as endorsed by NATA, SABM, IFPBM, WAPBM, the American Society of Anesthesiologists' (ASA) Committee on PBM, the Asia-Pacific Society for Patient Blood Management (ASPBM), the Chinese Society for Patient Blood Management (CSPBM), the Korean Society for Patient Blood Management (KPBM), the Korean Society of Anesthesiologists (KSA), the Malaysian Society of Haematology (MSH), the Canadian Ontario Nurse Transfusion Coordinator (ONTraC) Program, the South African National Blood Service (SANBS), National Association of Patient Blood Management Specialists Russia Federation (NAS PBM), the American Society of Extracorporeal Technology (AmSECT), the Anemia Working Group Spain (AWGE), and the Society of Cardiovascular Anesthesiologists (SCA) reads as follows:

"Patient blood management is a patient-centered, systematic, evidence-based approach to improve patient outcomes by managing and preserving a patient's own blood, while promoting patient safety and empowerment." and e-published in A&A e-pub earlier in 2022.

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All you ever wanted to know about iron, EPO, folates

S5

EPO, iron, vitamin B12, folates: a must for preoperative preparation

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Anaemia is common in surgical populations. In a large cohort of major elective procedures (n = 3,342), overall prevalence of anaemia (Hb <13 g/dL) was 36%, with marked differences between genders and procedures.[1] As for non-elective procedures, up to 75% of patients undergoing hip fracture repair surgery (n = 1,004) presented with anaemia.[2] Preoperative anaemia is an independent risk factor for perioperative blood transfusion, morbidity, and mortality,[3] and absolute or functional iron deficiency is its leading cause.[1] Non-anemic deficiencies of iron, folic acid and vitamin B12, as well as suboptimal iron stores, are also prevalent and may hamper preoperative haemoglobin optimization and/or recovery from postoperative anaemia.[1] These deficiencies could be expected to increase during the COVID-19 pandemic due to changes in diet and lifestyle, aggravated by a reduced purchasing power and decreased incomes.[4]

As modifiable risk factors, anaemia and micronutrient deficiencies should be detected and corrected prior to major surgical procedures.[5] Appropriate therapy should be guided by an accurate diagnosis of the aetiology.[5] As with preoperative anaemia, treatment of postoperative anaemia should be treated in the perioperative period.[6] Thus, a clear perioperative management pathway for these conditions should be implemented in every hospital performing major elective and non-elective surgical procedures.[5-7]

Regarding iron replacement, alternate-day oral iron salts (80-100 mg elemental iron) may have a role in mild-to-moderate anaemia, provided there is sufficient time (6–8 weeks; waiting list) and adequate tolerance. [5,7] Newer oral iron formulations with enhanced absorption and gastrointestinal tolerability, such as ferric maltol or sucrosomial iron, should be considered.[4,7] Postoperative oral iron is of little value and rife with gastrointestinal adverse events, and is therefore not recommended.[6,7]

Intravenous iron should preferentially be used in cases of moderate-to-severe iron deficiency anaemia, concomitant use of erythropoiesis-stimulating agents, short time to surgery or non-elective procedures, and for postoperative anaemia management.[5-7] Minor infusion reactions to intravenous iron may occur, resolve without intervention and should not be misconstrued or treated as anaphylaxis.[8] The incidence of severe anaphylactic reactions is extremely low ($\approx$ 1 in 250,000 administrations), and there is no increase in infections with intravenous iron.[9] Currently available, intravenous iron formulations allowing administration of large single doses are preferred.[5-7]

As for maturation factors, low serum folic acid and vitamin B12 concentrations do not accurately reflect their intracellular concentrations, and blood levels of homocysteine and/or methylmalonic acid are believed to be more reliable indicators.[10] In the absence of clinically relevant symptomatology or macrocytosis, combined supplementation with folic acid (5 mg/day, p.o.) and vitamin B12 (1 mg, i.m.) might offer a solution to simplify preoperative management.

In Europe, epoetin-α (a short-acting erythropoiesis stimulating agent [ESA]) is licensed for improving preoperative Hb levels and reducing transfusion rates elective orthopaedic surgery. However, after case-by-case consideration of the risks and benefits, off-label administration of an ESA should also be considered for patients with anaemia and inflammation or not adequately responding to intravenous iron, if no contraindications are present and adequate pharmacological thromboembolic prophylaxis is provided.[7]

Similarly, elderly patients with anaemia of unknown aetiology, kidney diseases, or mild/moderate myelodysplastic syndrome often have good responses to ESA administration, although adequate iron supplementation should always be ensured, preferably via the intravenous route.[7]

To allow time for a response to therapy, at least 4 weeks prior to surgery has been suggested as the optimal time-frame for evaluation.[5,7] However, shorter time-frames such as in the case of urgent or emergent surgery should not preclude evaluation and initiation of treatment. A benefit in transfusion rate reduction has been observed in most studies in which very short-term perioperative epoetin-□, with or without intravenous iron, folic acid and vitamin B12, was administered to patients undergoing lower limb arthroplasty, hip fracture repair, or cardiac surgery ("opportunity approach") (see online suppl. Table 5, in ref. 7). However, some guidelines do not support the off-label use of this agent.

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Avoid bleeding and blood loss, but how?

S6

Reversal of DOACs – therapeutic cornerstone or pure luxury?

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Reversal of direct oral anticoagulants (DOACs) may be needed, but it is still a matter of debate in 2022. Non-specific agents or techniques have been tested and two antidotes have been approved. However, both raise several questions.

Non-specific agents:
Activated charcoal: Wang et al. reported that activated charcoal decreased the mean half-live of apixaban to 5 hours when charcoal (50g) was administered within 6 hours after the ingestion of the drug[1,2]. Others have shown comparable data with dabigatran.
Prothrombin Complex Concentrates (PCC) and activated Prothrombin Complex Concentrates (FEIBA®) have been tested with various doses and conflicting results in different animal models[2,3] and healthy volunteers[4], and they are now used by clinicians in bleeding patients on a non-evidence-based basis, and with a variable efficacy. Several recent series report a somehow good efficacy (around 70%) with PCC and intermediate doses (25UI/kg) [5,6]. Some physicians have also reported favorable results in infusing PCC before surgery in DOACs treated patients undergoing an emergent procedure[7,8].

Specific antidotes:
Three of them have already performed phase II and/or phase III studies:
- Idarucizumab (Praxbind®) is a fully humanized antibody fragment (Fab) which binds to the thrombin binding site of dabigatran hence inactivating the molecule. In healthy young and older volunteers, idarucizumab was associated with immediate, complete, and sustained reversal of dabigatran-induced anticoagulation[9]. It was well tolerated with no unexpected or clinically relevant safety concerns. The phase III study (REVERSE-AD) has been now completed, including bleeding patients who have serious bleeding, or patients who require an urgent procedure. The results including 503 patients show a complete reversal of the anticoagulant effect of dabigatran within minutes…and 18% mortality (mainly unrelated to the antibody)[10]. Even if the European (EMA) and US (FDA) regulators have granted an approval for this compound, we need further studies and a much larger number of patients to be fully reassured. Nevertheless, this antibody may save lives.
- Andexanet alpha (Ondexxya®) is a recombinant modified human factor Xa protein that binds factor Xa inhibitors. This specific reversal agent is designed to neutralize the anticoagulant effects of both direct and indirect factor Xa inhibitors. Its half-life is short (less than 90 minutes) and the bolus has to be combined with a continuous IV infusion. Andexanet appears to be effective in healthy volunteers on a biological standpoint11. The ANNEXA-4 study has evaluated 352 patients who had acute major bleeding within 18 hours after administration of a factor Xa inhibitor (either apixaban or rivaroxaban)[12]. The patients received a bolus of andexanet, followed by a 2-hour infusion. Excellent or good hemostasis occurred in 204 of 249 patients (82%) who could be evaluated. Within 30 days, death occurred in 49 patients (14%) and a thrombotic event in 34 (10%). However, it has to be emphasised that the definition of an excellent or good haemostasis was debatable and that the very high thrombotic event rate was worrying. Furthermore, no data are available with a longer infusion period. Andexanet is effective, no doubt, but many undesirable side effects have led the FDA to issue a black box warning on thromboembolic risks, ischemic risks, cardiac arrest, and sudden death: "Treatment with the agent has been associated with serious and life-threatening adverse events, including arterial and venous thromboembolic events, cardiac arrest, sudden deaths, and ischemic events, such as myocardial infarction and ischemic stroke." Is this what we expect from a specific reversal agent? Since, a study with a small number of patients has shown a lack of benefit of andexanet[13] and a meta-analysis of studies on PCC,

idarucizumab and andexanet has shown that the three agents developed the same efficacy for a comparable death toll but with a much higher thrombotic rate for andexanet (10.7% as compared to 4.3% for PCC and 3.8% for Idarucizumab)[14]. A large study is ongoing, comparing andexanet to standard of care (mainly PCC). Results are awaited in 2023.

- Ciraparantag (PER977) is a small, synthetic, water-soluble, cationic molecule that is designed to bind « specifically » to unfractionated heparin, low-molecular-weight heparin, and to the new oral factor Xa inhibitors (xabans)[15]. Ciraparantag directly binds to DOACs and to enoxaparin through non-covalent hydrogen bonds and charge–charge interactions Only phase 2 data are available for the moment. Ciraparantag provides a dose-related reversal of anticoagulation induced by steady-state dosing of apixaban or rivaroxaban. All doses of ciraparantag were well tolerated. The slow development of this compound probably relates to the almost impossibility to quantify his effect with conventional biological tests (aPTT, PT, antiXa level) because ciraparantag binds to the sodium citrate used for blood collection and to the reagents used to trigger clotting in these tests. In the reported studies, the anticoagulant effect of apixaban and rivaroxaban at steady state was assessed with the whole blood clot time (WBCT)[16]. Therefore, the quality of data is still weak and further studies with patients are needed.

As DOACs are very effective and increasingly popular, more and more patients are shifting from VKA treatments to DOACs. As a result, the number of DOACs treated patients undergoing an emergency procedure, a trauma or an overdose is increasing steadily and the need for long lasting, safe, user-friendly and cheap antidotes will increase[17].

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S7

PCC, fibrinogen, factor XIII – what at which time point?

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Goal-directed bleeding management is the answer to this question: Give what is missing in the bleeding patient and stop bleeding fast!

Goal-directed bleeding management is among the key messages in the Guidelines of the European Society of Anaesthesiology and Intensive Care (ESAIC) on severe perioperative bleeding management, which are in fact the European guidelines on perioperative Patient Blood Management[1].

In hypofibrinogenaemia defined in the ESAIC guidelines as a fibrinogen levels <1.5-2 g/l and/or indicative signs in viscoelastic haemostatic assays (VHA) fibrinogen concentrate is recommended. Dose estimation for clinical practice: fibrinogen concentrate [g] = (target FIBTEM A5 [mm] – actual FIBTEM A5 [mm]) x body weight [kg]/140.

If coagulation factors of the prothrombin complex are reduced and thrombin generation deteriorated in bleeding, prothrombin complex concentrate (PCC) is proposed. If bleeding is due to vitamin K antagonist-induced anticoagulation, PCC plus vitamin K is proposed. PCC dose estimations for clinical practice: 20 IU/kg if INR < 4; 30 IU/kg if INR 4-6; 40 IU/kg if INR >6.

A late phenomenon in coagulopathic bleeding is factor XIII deficiency. The cut-off values for intervention vary but 60% factor activity may be a pragmatic target for concentrate use.

Goal-directed use of coagulation factor concentrates assists in avoiding allogeneic plasma transfusion which carries transfusion-related risks and is less efficacious in bleeding control[1].

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S8

Cold stored platelets – a game changer in trauma bleeding?

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The 20th edition of the Guide to the Preparation, Use and Quality Assurance of Blood Components, (EDQM, 2020), indicates that platelets must be stored at 20-24 °C, under constant agitation[1]. This mandatory prescription is based on several decades of consolidated clinical practice mainly applied to the prophylaxis of hemorrhage in onco-hematological patients, which has demonstrated its validity for this indication and this category of patients[2] as it allows a prolonged in vivo survival of transfused platelets[3]. However, this 'must' has been called into question by the need to reduce the risk of bacterial proliferation in platelets stored at room temperature and by recent clinical studies performed with platelets stored at 4 °C, transfused to patients with acute bleeding and undergoing massive transfusion[4,5]. In these cases it is not very important to preserve the survival of the transfused platelets in the patient's circulation for a few days, but to ensure their prompt reactivity, a condition promoted by cold platelet storage. These new observations, corroborated by recent sophisticated laboratory investigations[6], will likely lead to a review of the storage conditions of platelets and of the transfusion indications for prophylactic or therapeutic purposes[7,8]. Efforts will be needed to optimize the inventory management of room temperature and cold stored platelets[9].

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PBM – new ideas

S10

PBM implementation – what about environmental benefits?

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The environmental impact of healthcare is of increasing concern.[1] Healthcare in Australia is a rapidly growing sector reaching 10% of Gross Domestic Product in 2015. Carbon dioxide emissions from energy usage in public hospitals alone, is estimated to be 3.2 megatons per year, this has increased by 150% over the last 20 years.[2]

The healthcare sector in Australia and worldwide needs to move to a more sustainable model by actively reduce carbon emissions and its' environmental impact.[3,4]

The implementation of Patient Blood Management (PBM) has led to significant reduction of transfusion in many settings. The production of blood products is complex and possibly energy intensive. It is of interest if PBM can make a significant contribution to decarbonizing the health care sector.

Life cycle assessment (LCA) is a standardized method of evaluating the impact, or 'footprint', of a product or process.[5] LCA can be performed for the entire lifecycle of a product and has not been performed for blood products. A team of Australian researchers will quantify the environmental impact of packed red blood cells (PRBC) (CO_2e, water use, pollution, etc) from donation, processing and modification, packaging, storage and transportation through to the patient's bedside and product disposal.

The primary aim of this study is to determine the environmental impact of a unit of PRBC through LCA.

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S11

Haemotherapist as a new European medical speciality – futile, worthwhile or even urgently needed?

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Background: Following a considerable change after the AIDS transmission by blood products, modern hemotherapy has become a process of safe donation, safes products, safe supply in many European countries. However, based on the most recent SHOT report and other hemovigilance systems, administration and documentation of blood use still suffers from human errors, low knowledge levels and an overuse despite restrictive guidelines.
Unnecessary transfusions and unsafe transfusion practice increase risks of serious adverse transfusion reactions, transfusion-transmissible infections and reduce the availability of blood products for patients who are in need. By 2018, WHO recommended the development of systems, such as hospital transfusion committees and hemovigilance, to monitor and improve the safety of transfusion processes. After an analysis of the current error frequency in many countries, the hypothesis can be constructed, that the effectiveness of a change will depend on the frame work in which hemotherapists have to perform.

Research: In Germany, after two decades of a structure change towards a quality control system including transfusion committees, commissionars and officers in every department, administration of blood did not reach sufficient safety levels. The system is dependent on the personal engagement in hemotherapy since the task has to be done during over hours activity without reward and reimbursement. Since 2020, in the UK NIH trusts, so called "Transfusion Practitionars" have been employed in part or full time. The working condition and job description of physicians in such a frame work should increase evidence based practice together with patient safety. Dedicated hemotherapists should have specific knowledge of the multiple scientific aspects of hemotherapy, networking abilities for interdisciplinary communication, special organizing and coordination methods from a dedicated post doc curriculum. Transfusion medicine, drug development, diagnostic methods develop to current change and adoption into clinical practice. The European establishment of a dedicated hemotherapist promises to improve guideline adherence and patient safety, adequate resource allocation towards better national transfusion systems.

Content: In this presentation, the known facts of insufficient administration safety and guideline adherence from various European systems are presented. The effectiveness of the UK "Transfusion Practitionar" will be investigated. Factors for the full employment character versus an included task in the physician's discipline are weighed. A post doc curriculum "hemotherapy" will be introduced.

Conclusion: The urgent need to improve the quality of hemotherapy at the administration end, requires experienced and knowledgeable, interdisciplinary trained hemotherapists.

PBM beyond surgery

S14

PBM in obstetrics – anaemia and iron deficiency

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Introduction: Patient Blood Management (PBM) is a new interdisciplinary, multimodal and patient-centered strategy. Anaemia is frequent during the pregnancy, its prevalence is 48.7 % in the Southeast Asian region, compared with 46.3% in the African region and 25.8 % in the European region. The World Health Organisation (WHO) defines anaemia in pregnancy as a haemoglobin concentration of <11gr/dL, whereas large studies in Caucasian have found a range between 10,4 gr/dL and 13,5 g/dL in early third trimester in women received iron supplementation. Anaemia is the most common indirect cause of adverse maternal outcomes, including maternal mortality. Iron Deficiency Anaemia (IDA) is also common in the pregnancy and in the postpartum period and it has been associated with decreased physical performance, increased risk of urinary tract infections (UTI), impaired lactation, reduced cognitive abilities, emotional instability and depression. Low Hb concentrations, it has been associated with increased risk of premature delivery, child mortality and infectious disease.

Methods: From the second-third trimester of pregnancy, it's necessary to carry out the diagnostic tests (full blood count, reticulocytes, iron, ferritin, transferrin, transferrin saturation TSAT %) to identify early iron deficiency state. Clinical symptoms and signs of iron deficiency anemia in pregnancy are usually nonspecific unless the anaemia is severe. Fatigue is the most common symptom. Patients may complain of pallor, weakness, headache, palpitations, dizziness, dyspnoea and irritability. The beginning of the therapy must be carried only after a timely diagnosis of the etiology that determines the condition of anaemia. Oral iron is an effective, cheap, and safe way to replace iron. The recommended dose of elemental iron for treatment of iron deficiency is 100-200mg daily. Parenteral iron therapy is indicated when there is absolute non-compliance with, or intolerance to, oral iron therapy or proven malabsorption. Several authors have now reported on their experience with use of parenteral iron therapy, with faster increases in Hb and better replenishment of iron stores .

Conclusions: The multidisciplinary approach in this context is very important and therefore the elaboration of a clinical path for the diagnosis and the treatment of anemia in pregnancy is relevant for the improvement of the maternal and newborn prognosis and outcome.

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Autologous transfusion

S16
Cell salvage in obstetrics

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Introduction
Using cell salvage for caesarean sections has reduced the administration of allogeneic blood products in Royal Cornwall Hospital with no clinical safety concerns.[1] Unfortunately, barriers still exist to the routine use of cell salvage for caesarean section. Expanding cell salvage practice to include vaginal blood collection could significantly reduce allogeneic blood administration in obstetrics.

Cell salvage for caesarean section
Common barriers to the routine use of cell salvage for caesarean sections include concerns about amniotic fluid embolism (AFE), alloimmunisation, cost and sustainability.[2]
- AFE: There are no reported cases of AFE related to cell salvage in medical literature. At Royal Cornwall Hospital, where practice is to use a single suction for collection, over 2000 women have received an autologous transfusion without AFE. At present, the risk of AFE is entirely theoretical.
- Maternal alloimmunisation: A distinction needs to be drawn between women who have an episode of feto-maternal haemorrhage, and those who develop clinically significant antibodies. 1014 women who received autologous blood have been tested for antibodies 3-6 months post partum. Antibody formation has occurred in 0.84% (clinically significant antibodies 0.31%).
- Cost and sustainability: reduction in cost is achieved by using a single suction, avoiding routine use of a leucocyte depletion filter, and only proceeding to processing after sufficient amount of blood has been collected. Insitu cell salvage avoids the environmental impact of transport and refrigeration.

Vaginal cell salvage
The evidence that vaginally collected blood is safe to re-infuse is limited but promising. Blood collected from vaginal birth and processed through a cell salvage machine has been shown to have a level of bacterial contamination similar to that found at caesarean section.[3] Two women have successfully received transfusions of vaginal blood at Royal Cornwall Hospital with no adverse incidents. Two published case series from the USA has shown 46 women successfully received vaginally salvaged blood without complications.[4,5]

Conclusions
Routine cell salvage for caesarean section can be cost effective and environmentally sustainable. There have been no recorded cases of AFE. The risk of alloimmunisation appears to reflect the background risk in all pregnancies. Cell salvage is not a substitute for maternal anaemia optimisation as it relies on a sufficient concentration of red cells to make processing viable. Future research should concentrate on vaginal cell salvage feasibility.

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New guidelines

S19

Anticoagulation and regional anaesthesia – the new ESAIC guideline

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Bleeding is a potential complication after regional anaesthesia. The risk is increased in patients on antithrombotics. This lecture aims to function as an appetizer for reading the new guidelines[1]

Key messages of the 40 recommendations will be summarized: For regional anaesthesia with bleeding risk (neuraxial manipulation or deep peripheral nerve blocks) a complete return of haemostatic competence is targeted. The time required for this target is not only determined by $t\frac{1}{2}$ of the antithrombotic drug but varies between and within individuals. In low drug doses, $2 \times t\frac{1}{2}$ is proposed as the time interval of withdrawal. In high drug doses, 4-5 $\times t\frac{1}{2}$ may be proposed but to circumvent the imprecision of $t\frac{1}{2}$-based withdrawal calculations we propose that the residual biological effect is assessed by sensitive drugs measurement. In contrast, in low bleeding risk peripheral nerve blocks (superficial, compressible) the new guidelines proposes neither time intervals nor drug measurements.

Pharmacological and technical aspects modifying time intervals before high bleeding risk interventions will be discussed. They may be performed in emergencies once dabigatran (idarucizumab) or vitamin K-antagonists (prothrombin complex concentrate and vitamin K) is fully and specifically reversed. Ultrasound guidance do not modify the time intervals.

Finally, remarks on the detection of haematoma manifestations, including health care team awareness and patient education, will round up the presentation.

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S20

Transfusion in the bleeding critically ill patient – the new ESICM guideline

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The European Society of Intensive Care Medicine (ESICM) has developed evidence-based clinical practice recommendations regarding transfusion practices in non-bleeding, critically ill adults. These recommendations have resulted in the first international transfusion guideline specific for non-bleeding critically ill adults.[1] A task force involving 13 international experts and 3 methodologists used the GRADE approach for guideline development. The task force identified four main topics: red blood cell transfusion thresholds, red blood cell transfusion avoidance strategies, platelet transfusion, and plasma transfusion. The panel developed structured guideline questions using population, intervention, comparison, and outcomes (PICO) format. The task force generated 16 clinical practice recommendations (3 strong recommendations, 13 conditional recommendations), and identified 5 PICOs with insufficient evidence to make any recommendation. In this presentation the recommendations will be discussed including the literature involved. Recently the ESICM transfusion guideline part 2 has been published with recommendations to handle transfusion in the bleeding critically ill.[2] Furthermore areas where further research is needed regarding transfusion practices and transfusion avoidance in non-bleeding and been, critically ill adults will be highlighted as well as upcoming trials.

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ASPBM session – PBM: an art of fusion

S24

Working together

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Working together has been always the ideal goal of succeeding Patient Blood Management. We have very dedicated predecessors who went through all the stumbling blocks in order to implement PBM in Malaysia. I must say from complete ignorance to final acceptance of the PBM concept among the doctors was very challenging. The strategies included running courses with wet practical session to teach nurses, paramedics and doctors, convincing all the surgeons, anaesthetists, blood bank, obstetricians and stakeholders regarding the benefit of PBM. The good news is PBM is finally at national policy level and the authority will be planning to do the Clinical Practice Guidelines and training for doctors officially. This also includes the collection of national PBM data across different disciplines in order to measure the outcome of PBM in day to day practice. The implementation of PBM in Malaysia will not only improve patient outcome but also being a cost effective medicine especially in the scarcity of blood supply during this COVID-19 pandemic. We wish that with the government support, there will be multidisciplinary approach of PBM incorporating into all the medical care facilities.

PBM in Africa & the Middle East

S25

The blood bank as driving force in PBM

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The driving force behind PBM for physicians is often reduced length of stay, improved patient outcome and less complications. However, for transfusion medicine specialists PBM is important to protect both the donor and the patient. In low to middle income countries, blood supply remains a major problem. Furthermore, there is a very real concern about donor health and iron deficiency anemia for example is as high as 17.5% in donor populations in South Africa. Lastly the prevention of transfusion related complications is of the utmost importance to the transfusion specialist.

By implementing PBM and making the blood bank the driving force donor health, blood supply and transfusion related complications are addressed. It also gives credibility to the program when the blood bank champions PBM as most physicians have limited knowledge of transfusion medicine and rely heavily on the transfusion medicine specialist to guide them. When the blood bank champions this guidance, adoption is more readily accepted by the physician. I recall a physician once voicing "if the blood bank says PBM is the way to go then it must be correct". Implementation at national level is possible if the countries blood service drives the process through data collection, monitoring and influencing behavior by physician engagement through awareness and education. At hospital level the changing of Blood transfusion committees to PBM committees further improves implementation. By further integrating PBM into hemovigilance, the complete value chain of transfusion medicine is integrated into the PBM quality standard and creates a platform on which a country can build and move forward. From donor too patient, PBM improves the health of both.

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S26

PBM in Morocco – state of affairs and outlooks

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The shortage of blood, especially in times of covid-19, has highlighted the need for PBM in our context, but before setting up protocols, it was necessary to take stock of the state of Affairs.
We conducted an online survey on the state of PBM in Morocco.
Preliminary results
Gender: 54 women and 155 men
Status: 160 specialists and 49 residents
Specialty: 76% anesthesiologists
Length of experience: 80% of participants had more than 12 years of experience
Clinical knowledge:

- 103(49.9%) of participants have an idea about PBM.
- 82% of the 103 participants made a personal effort to develop this clinical knowledge

PBM Implementation Strategy:

- 53% of participants did not include the protocol in their annual plan
- 54.5% of participants do not have a written procedure
- 68.4% of doctors do not have a massive transfusion protocol
- 24.7% of participants' structures detect anemia less than a week before the intervention
- 26.8% of structures require further exploration for anemia below 8 g/dl.
- 34.4% of structures do not use injectable iron to correct anemia.
- 11% of structures use erythropoietin to correct anemia before surgery
- 91.4 of participants use tranexamic acid for patients at risk
- 22.5% of structures include fibrinogen in the massive transfusion algorithm
- 63.3 of the structures consider a hemoglobin of 7g/dl as a postoperative reference below which a transfusion is necessary

Conclusion:
These results testify to the efforts that remain to be made regarding training and the implementation of the PBM protocol.

Keynote lecture – COVID-19 and haemostasis

S28

COVID-19 and haemostasis

B. J. Hunt

Guy's & St Thomas' NHS Foundation Trust & King's College London, London, UK

I will discuss the coagulopathy and thrombotic problems of COVID-19 and modern management.

Here is a list of references all freely downloadable
For an illustrated review of coagulopathy see:

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PBM innovation hub from Latin America

S29

Leucodepleted whole blood – a quest of quality

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In Colombia, trauma is the leading cause of death between 5 and 49 years. About 15% of in-hospital trauma deaths are considered preventable, being hemorrhage responsible for 2/3 of these deaths.

We have performed in-hospital actions to reduce preventable deaths, including the implementation of trauma teams, the design of a massive transfusion protocol (MTP), and the "Whole blood project." (WBP).

In the first part of the WBP, we evaluated 20 units of whole blood (WB) from healthy volunteers, processed by a platelet-sparing leukoreduction filtration system, and stored under refrigeration (1-6°C), without agitation. WB bags were sampled periodically for 21 days. Red blood cells count, and hemoglobin levels remained stable. Platelet count reduced by 50% on day six and remained stable posteriorly. Coagulation factors II-V-VII-X, fibrinogen, and protein C remained within normal ranges. Thromboelastography showed that the reaction time for clot formation was slightly prolonged, but stable clot formation remained unaltered.

In the second part of the WBP, we will perform a randomized controlled clinical trial to compare the standard components reanimation versus WB reanimation in trauma 104 patients with the MTP activation. We will evaluate the blood bank resources consumption, coagulation profile, and mortality.

We expect to document the logistic and biological advantages of the reanimation with WB to implement it in our hospital and the prehospital phase of the care of our patients.

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S30

Getting national authorities involved in PBM – the Mexican experience

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Patient blood management (PBM) initiatives are increasingly adopted around the globe. Having now a unified definition[1] and the World Health Organization Policy Brief publication about the urgent need to implement PBM,[2] are two mayor drivers in achieving this goal.

The program has demonstrated mayor benefits at a clinical and health economics level. However, there is still a barrier in adopting PBM as a standard of care and a lack of awareness among skate holders.

National authorities, including policymakers and decision-makers, should intervene directly, issuing regulatory actions and recommendations and providing resources to implement PBM programmed effectively.

In this matter, Mexico has made progress in having health authorities recognize the importance of implementing a PBM program in the health organization of our different health institutions. The National Academy of Medicine and the Mexican Academy of Surgery organized the first symposium in 2018, where we participated in the presidents of different medical colleges and associations. In 2019 with the coordination of the National Center Technological Excellence in Health (CENETEC) and the participation of different specialities, the PBM Mexican guidelines[3] were realized and published in August 2020, with the National Council of Health, there is a development on PBM hospital certification based in safety and quality projects. Finally, there is a pilot program with ten hospitals of different health institutes.

Involving National Health authorities is mandatory to achieve full PBM implementation.

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S31

Winning the challenge of perioperative anaemia

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Our first step to win this challenge was to stablish a good diagnosis situation
1. 60% of hospitalized patients are for surgical purpose and 90% of it are elective procedures. Cardiovascular, orthopedic, general, oncologic gynecologic and neurosurgery.
2. Institutional resource: Blood Bank (BB) provides 24hs day all Blood Components, Hemostasis Service (HS), it could process Standard Laboratory Coagulation Test 24hs day and began with Rotem (Viscoelastic method) use. It also has a Hematologist on call 24hs day. BB and HS were interested in developing institutional changes walking into a Patient Blood Management Program. At this moment 70% of the elective patients went to BB for Blood reserve for their surgery.
3. All patients have private or semiprivate insurance.

What we need?
Institutional authorities' approval and support. Commitment of all the actors of the health team and of the patient and his family.
How to detect anemic or iron deficiency patients in the perioperative setting.
Treat these patients to avoid unnecessary transfusion, with the insurance approval.

How did we do this?
We needed to know that it would be a very hard work. When the Institutional Authorities stablished their support, we began with an educational campanian for surgeon an anesthesiologist.
We needed their understanding of PBM and that the management of anemia in all the perioperative settings is one of the angular stones to make a difference. We prepare seminars, case presentations and, finally, a small flyer that was delivered every time they received their clothes to enter the operating room for 1 year.
At the same time, we delivered to every patient to enter the Institution for different reasons a little informative brochure on anemia and the importance of knowing the levels of hematocrit, hemoglobin and iron before surgery to avoid receiving transfusions.
The better communication between the group of health professional around a patient using chat system was clearly a big tool to do all this work.
Using IV iron and erythropoietin (EPO) in preoperative when the surgery couldn´t be delay, and oral Iron when the patient had time to reach surgery. Sometimes we combined preoperative and postoperative iron and EPO, avoiding the use of packed red cells.
Finally, we share the results to all the health team in Institutional Seminars and remark that success is because of the participation of everyone and not just on an individual or Service.

What results did we get?
We diminish the use of packed red cells in 60% in all elective surgeries and, also, was a pleasure to show that at the same time we saw near 97% diminish in Platelet and Plasma transfusion.

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Abstracts of the 21st Annual NATA Symposium
on Patient Blood Management, Haemostasis and Thrombosis

Poster Abstracts

Blood Transfusion Services / Risks of Transfusion

P01

Platelets supply and transfusion during SARS-CoV-2 pandemic: the establishment of a frozen platelet biobank

Agnese Razzoli[1,2], Gaia Gavioli[1], Davide Schiroli[1], Barbara Iotti[1], Roberto Baricchi[1], Eleonora Quartieri[3], Lucia Merolle[1] and Chiara Marraccini[1]
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Introduction: Fresh platelet concentrates (PLTs) have a short shelf life (5 days) which makes their collection, distribution, and use, logistically complicated. In Italy, this limitation became extremely problematic during the first wave of SARS-Cov-2 pandemic due to difficulties in recruiting blood donors; given this unique and emergent situation, in our Transfusion Medicine Unit it was necessary to urgently establish a biobank of PLTs. Frozen platelets may represent an alternative to the fresh product and allow long-term storage as they can be maintained at -80°C up to one year. We report the impact of the pandemic on blood donation, on the establishment of a biobank dedicated to the collection of PLTs and their potential use in onco-haematological patients.

Methods: At the end of the first 2020 lockdown, cryopreservation procedures were implemented at the Transfusion Medicine Unit of the AUSL-IRCCS of Reggio Emilia. Platelet donors eligible for plateletpheresis were enrolled and donation procedures were carried out once a week from August to December 2020. After 24 hours from the collection, platelets were treated with DMSO and then frozen at -80°C according to R. Valeri's method. We also performed a retrospective analysis comparing PLTs donation and transfusion data from February to May 2020 with the same period of 2019.

Results: During the lockdown period, we observed a reduction of blood donations. In the short-term, plateletpheresis was increased to allow a constant PLTs supply compensating the buffy-coat-derived platelet units shortages. At the same time, we observed a decrease of PLTs transfusion due to the limitation of surgical and medical procedures. As long-term measure, 50 plateletpheresis procedures were performed and destined to the Transfusion Medicine bank from August to October 2020. The units were destined mainly to onco-haematological patients.

Conclusion: Blood donation during the pandemic has undergone a decrease with an impact on PLTs products availability. To overcome this issue, we increased plateletpheresis during the peak of emergency and subsequently implemented a PLTs bank. According to our experience, cryopreservation and storage of frozen platelets are not technologically demanding and they can be easily thawed and reconstituted. They are cost-effective functional products for the management of bleeding and may guarantee the supply of platelets for future shortages.

P02

In vitro quality of cryopreserved platelets

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Introduction: Platelet transfusions are essential for the treatment of patients with acute bleeding and for prevention of bleeding in severe thrombocytopenia. Frozen platelets may represent an alternative to the fresh product and allow long-term storage as they can be stored at -80°C up to one year.

Although relevant studies showed that platelets can be damaged during the freezing and thawing process, it has not yet been fully clarified whether frozen platelets can be used for the correction of thrombocytopenia of onco-haematological patients or should be avoided. The aim of this study is to determine the impact of cryopreservation on platelets in vitro quality and function.

Methods: We performed a comparative study between fresh liquid platelets and frozen platelets. Three donors were recruited at Casa del Dono in Reggio Emilia and underwent platelet apheresis according to the centre's standard procedures. After 24 hours from the collection, platelets were treated according to the protocol of cryopreservation using DMSO developed by R. Valeri. The following parameters were evaluated by flow cytometry: platelets count, viability, glycoprotein exposure, phosphatidylserine externalization and extracellular vesicles presence. Coagulation efficiency was assessed by thromboelastography (ROTEM).

Results: The platelets conservation at -80°C and their following reconstitution cause an alteration of their functional and viability parameters. Thawed platelets displayed higher mortality and higher extracellular vesicles release and showed higher percentage of intrinsic activation in comparison to the fresh ones. In addition, we found alterations in the thromboelastographic parameters.

Conclusion: According to data collected, freeze-thaw affects both platelet morphology and functionality. Fresh platelets should be preferred to correct thrombocytopenia in onco-haematological patients in need of prophylactic therapy, since the cryopreserved concentrates should be limited to haemorrhagic emergencies, in cases of unavailability of a compatible donor or for non-transfusional use.

P03

Comparison of two alternative procedures to obtain packed red blood cells for β-thalassemia major transfusion therapy

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Introduction: β-thalassemia major (bTM) patients require frequent blood transfusions, with consequences that span from allogenic reactions to iron overload. To minimize these effects bTM patients have to receive packed red blood cells (RBCs) stored for maximum 14 days, leucodepleted and possibly with the highest content of haemoglobin. Herein we compared two routinely performed alternative procedures to prepare the optimal RBC product.

Methods: In method 1, blood was leucodepleted and then separated to obtain packed RBCs, while in method 2 blood was separated and leucodepleted afterwards. 40 blood donors were enrolled in two independent centres; couples of phenotypically matched RBCs were pooled, divided in two units and processed in parallel following the two methods. Biochemical properties, electrolytes and metabolic composition were tested after 2, 7 and 14 days of storage.

Results: Units prepared with both methods were confirmed to have all the requirements necessary for bTM transfusion therapy. Nevertheless, method 1 was more effective in increasing RBCs and haemoglobin content, while method 2 allows the production of P-RBCs with less K^+, iron and storage lesions markers.

Conclusion: Based on these results, both methods should be tested in a prospective clinical study to determine a possible reduction of transfusion-related complications, improving the quality of life of bTM patients, which often need transfusions for the entire lifespan.

P04

Impact of SARS-CoV-2 on the hemotherapy service of an oncology hospital

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Introduction: The pandemic caused by the new coronavirus (SARS-CoV-2) represents great challenges for medicine, including the reduction of the blood supply availability due to the decrease in the number of blood donor's attendance. The aim of this study was analyze the impact of COVID-19 on the use of blood components in an oncology hospital.

Methods: Retrospective cross-sectional of quantitative nature cohort, with comparative analysis of blood component requests by an Oncology Hospital in the city of Juiz de Fora, Minas Gerais, Brazil, in 2019 and 2020.

Results: There was a reduction of 14.36% in the requests for blood components at the Oncology service in 2020 (p-value = 0,002) (Table 1), with a reduction of 27.33% for platelet concentrate (p-value = 0,006) (Figure 1). The rate of attendance of Hemominas to requests for blood components of the oncology hospital was 97.99% in 2019 and 94.36% in 2020.

Conclusion: Restrictive measures adopted by governments, cancellation of blood donation campaigns and donors' fear of being infected by SARS-CoV-2 had an unfavorable impact on the availability of blood components. However, stock deficit had less impact on Oncology services due to cancellation and postponement of elective surgeries and to rational use of existing blood products. Strict monitoring of supply and demand for blood components in hospitals is essential to avoid sudden shortages, and Patient Blood Management (PBM) strategies must be applied to make the best resources' utilization.

Table 1

Table 1 – Request by type of blood component.

		2019	2020	p valor
Blood components	PRBC	1.253	1.098	0,065
	PP	322	234	0,006
	FFP	20	34	0,21
	Total	1.595	1.366	0,002

Caption: PRBC: packed red blood cells; PP: packed platelets; FFP: fresh frozen plasma.

Source: Data obtained through HEMOTE PLUS®.

Figure 1
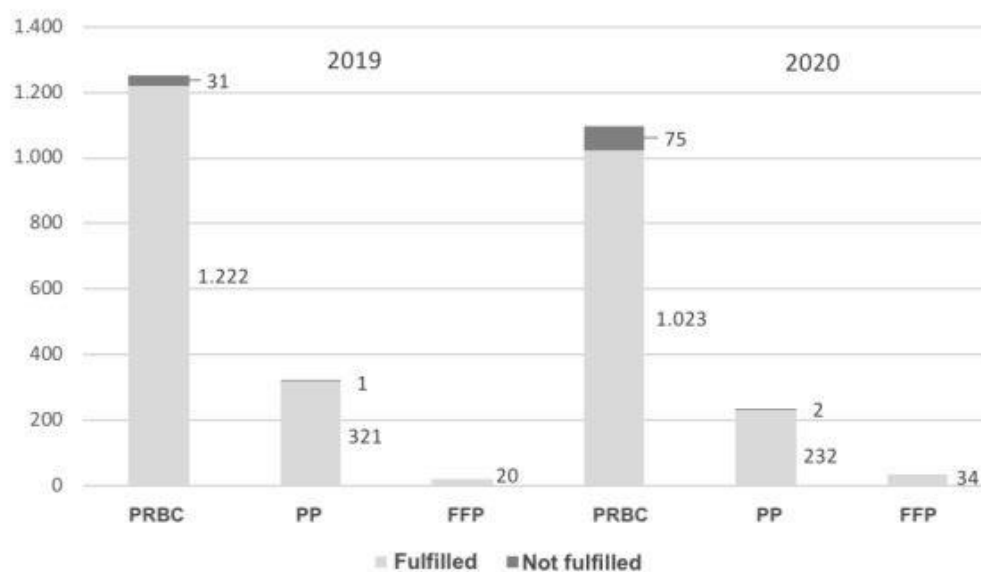
Caption: PRBC: packed red blood cells; PP: packed platelets; FFP: fresh frozen plasma.

Source: HEMOTE PLUS®. Fundação Hemominas.

Figure 1- Rate of requests fulfilled by blood component

References
Stanworth SJ et al. Lancet Haematol 2020;7:e756-e764; Shander A et al. Anesth Analg 2020;131:74-85; Silva-Malta MC et al. Transfus Med. 2021;31:206-212.

P05

Association between ABO blood groups, risk of infection and mortality in COVID-19 patients

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Introduction: Susceptibility to certain viral infections is associated with antigenic determinants of ABO blood groups. SARS-CoV-2 replicates in the respiratory and gastric epithelium, which can synthesize glycan antigens A and B or AB, it is possible that binding of the corresponding antibodies can block the interaction between S-protein and angiotensin-converting enzyme, thereby providing complete or incomplete protection in patients with various groups of the ABO system.

Objective: To study the correlation between ABO blood groups and the frequency of infection and the prognosis of the risks of an unfavourable outcome in persons with confirmed SARS-CoV-2 infection.

Materials and methods: The study included patients (n = 4106) aged from 18 to 94 years old, both sexes, with a confirmed positive PCR test involving nasal and oropharyngeal swabs. Based on the electronic case histories of patients with SARS - CoV-2 from among the surveyed group, sampling of deceased patients with various nosological forms of diseases (according to the ICD system) was carried out. The control group included healthy donors (n = 17967) examined in the period from 2018 to 2020.

Determination by the ABO system was carried out using tsoliclones and group gel cards.

All the obtained data were processed in the SPSS Statistics 19 MedCalc 20.013 system.

Results: According to the results of the combined analysis of the association of ABO blood group and COVID-19, a statistically significant difference in the proportion of COVID-19 infection rate (n = 4106) among people with blood group A (II) was 37.85%, in relation to people with other blood groups 0 (I) - 31.47%, B (III) - 21.09%, AB (IV) - 9.06%. In healthy individuals, the following percentages of group affiliation were obtained: 0 (I) - 33.85%, A (II) - 35.90%, B (III) - 21.35%, AB (IV) - 8.89%.

Based on the results of statistical calculations, we found that people with blood group A (II) had a higher chance of contracting COVID-19. So the statistical significance of the calculations - OR 1.087, is confirmed by the boundaries of 95% CI (1.014-1.166) with an error of $p < 0.05$. The least chances of contracting COVID-19, according to the results of statistical studies, were in persons with 0 (I) blood group, whose OR was 0.889 and was confirmed by the 95% CI in the range 0.827-0.956 with an error of $p < 0.05$.

In the structure of mortality, patients with A (II) constituted the group with the maximum risk of mortality (38.2%), in relation to people with other ABO groups: 0 (I) - 30.57%, B (III) - 21.22%, AB (IV) - 10.01%.

Conclusion: The analysis revealed certain interrelations between the ABO blood group and the clinical outcome of the disease. We found that people with blood type A (II) had a higher risk of contracting COVID-19, while patients with type O (I) blood had a lower risk of contracting COVID-19. According to the results of the study of the outcomes of the disease with Covid-19, the predictive unfavourable risk of outcome is observed in persons with confirmed SARS disease - CoV-2 with blood group A (II) in relation to persons with other blood groups of the ABO system. The above-mentioned data are of high statistical significance.

Transfusion Practice

P06

Anti-jk3 and Anti-jka causing mild haemolytic disease of the foetus and newborn

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Introduction: The Kidd blood group system consists of three antigens: Jka, Jkb and Jk3. Antibodies to the antithetical antigens can cause immediate or delayed transfusion reaction and can cause mild to moderate haemolytic disease of the fetus and newborn (1). Jk (a-b-) is the rare null phenotype commonly found in the Polynesians (2). This rare null phenotype which lacks the high incidence Jk3 antigen can give rise to patients developing Anti-Jk3. Anti-Jk3 may be accompanied by separable anti-Jka and anti-Jkb. The incidence of the JK3 antigen in the Caucasian population is >99.9% which classes it as a high frequency antigen and compatible blood is difficult / impossible to find in the Irish donor population.

Case background: We present a case of 38-year-old Filipino pregnant primigravida lady who gave birth to a male liveborn baby at 36+4 weeks gestation by spontaneous vaginal delivery. At booking the mothers blood group was determined to be Group O Rh D Positive with a negative antibody screen. No further blood transfusion serology was carried out for the remainder of the pregnancy.

Results: The baby's blood group was A Rh D Positive with a 4+ Direct Coombs Test. The baby was jaundiced with a raised bilirubin and haemoglobin = 11.0 g/dl. The baby was transferred to the neonatal intensive care unit for commencement of phototherapy.
A maternal postnatal antibody screen was positive with pan reactivity in both IAT and enzyme panels. The autoantibody screen was negative. Anti-Jk3 and Anti-Jka were identified in the maternal plasma.
Anti-Jk3 and Anti-Jka were detected in an eluate prepared from the baby's red cells; these were most likely maternal in origin.

Conclusion: Fortunately, both mother and baby did not require transfusion support.
This case highlights:
a) The importance to screen all antenatal patients for antibodies at 28-32 weeks as per BCSH guidelines (3).
b) The importance of ethnic origin to focus serological investigations.
c) A pre delivery group and screen sample for all patients for the timely provision of blood for both mother and baby.

References
1. Reid M.E. & Lomas-Francis C., (2007) Blood Group Antigens & Antibodies A Guide to Clinical Relevance and Technical Tips.
2. Daniels G. (2002) Human Blood Groups, 2nd edn. Blackwell Science, Oxford.
3. Guidelines for blood grouping and antibody testing during pregnancy British Committee for Standards in Haematology (BCSH).

P07

Distribution of blood types in patients treated with COVID-19 convalescent plasma

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Introduction: Since the beginning of the pandemic, doctors are facing many challenges, such as treating patients with the SARS-CoV-2 virus (Covid-19) as successfully as possible. According to the treatment protocol of patients with Covid-19 infection, anti-Covid plasma is applied in the first 15 days after the onset of symptoms, in the period before the patient has developed antibodies, in a dose of 400-600 ml divided into two parts. There is also a tendency to identify all potential risk factors that may affect the severity of the clinical picture. Thus, there was interest in whether blood type could affect the severity of the clinical picture and the outcome of the disease.

Material and methods: The data were obtained from the healthcare system of KBC Zvezdara by retrospective counting, and insight into the medical documentation of patients who had received anti-Covid plasma in the period from 01. April 2020 to 26. January 2021.

Results: In the observed period, a total of 4932 patients with moderate and severe clinical picture of SARS-CoV-2 infection were treated at the Zvezdara Clinical Hospital. A total of 488 patients received anti-Covid plasma. The youngest patient was 20 years old, and the oldest was 93 years old. Five patients were between 20 and 30 years old, 15 between 31 and 40 years old, 61 patients between 41 and 50 years old, 89 were in the age group of 51 to 60 years, 137 in the age group of 61 to 70 years, 119 in the group from 71 to 80 years, and 62 patients were over 81 years old. There were 316 men (64.75%) and 172 women (35.25%). Out of 488 patients, 279 (57.17%) were discharged for home treatment, 29 (5.94%) were transferred to other healthcare institutions, and 180 (36.89%) patients had a fatal outcome. Most were A blood group 241 (49.38%), followed by O 141 (28.89%), B blood group 66 (13.52%) and AB 39 (7.99%). There were 406 Rh (D) positive (83.81%) and 81 Rh (D) negative patients (16.59%). In the group of patients who died, blood type A was represented with 96 (53.33%), type O with 50 (27.78%), type B with 17 (9.44%) and type AB with 17 (9.44%) patients, whereas 150 (83.33%) were Rh (D) positive and 30 (16.67%) were Rh (D) negative.

Conclusion: Based on the data obtained, it could be said that blood type may be a predictor of disease outcome, but it should be borne in mind that this study did not include patients with a milder clinical picture and no symptoms.

P08

Transfusion medicine knowledge amongst specialist trainees at Groote Schuur hospital – using the BEST-TEST

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Introduction: Blood product transfusion is the most commonly practiced hospital procedure throughout the world. Transfusion of blood and component therapy is not without risk and cost. The primary aim of this study was to assess knowledge of transfusion medicine amongst specialist trainees at a tertiary level in a South African context. Secondary aims included identifying shortcomings in areas of transfusion knowledge, describing differences therein between subspecialty groups and comparing self-perceived knowledge against a known measured standard.

Method: The Biomedical Excellence for Safer Transfusions test (BEST test) was utilised to assess base knowledge amongst specialist trainees in General Surgery, Orthopaedics, Obstetrics and Gynaecology, Internal Medicine and Anaesthetics at a large tertiary hospital. This is an internationally validated assessment tool of the BEST collaborative by Rasch analysis.1 It was administered on a secure online questionnaire with a basic demographic questionnaire added.

Results: There were 104 responses of 241 eligible specialist trainees, rendering a response rate of 43.2%. The mean score for correct responses of the BEST test was 42.3% (median 40%), which is similar to studies using the BEST test in non-South African contexts, showing poor overall knowledge of transfusion medicine. The overwhelming majority of the specialist trainees thought more training in transfusion was needed (80.8% agreeing or strongly agreeing), and that such training was important (70.2% rating it as very important). Self-perception of transfusion knowledge did not equate with scoring via the BEST test, with similar scores whether the individual rated their knowledge of transfusion medicine as average, above average or insufficient (63.7% rated their knowledge average). As compared to previous studies in contexts outside Africa, respondents were better able to identify the risks of transfusion transmitted infections but had difficulty with the management of warfarin toxicity and the administration of prophylactic platelets. The average scores for the BEST test did not markedly differ between specialities.

Conclusion: Transfusion knowledge amongst specialist trainees in a large, tertiary hospital is deficient, and there is a recognition that further training is required. The standard of transfusion knowledge in this institution is similar to other areas of the globe suggesting that the global knowledge of transfusion medicine is inadequate and requires ongoing training.

Reference
1. Haspel RL et al. Transfusion. 2014;54:1225-30.

P09

Double independent bedside check – development of a how-to video for a healthcare service implementing electronic medical records

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Introduction: The final 'bedside' check of pack and patient details is vital to ensure the right blood is given to the right patient1. In 2019, Australian & New Zealand Society of Blood Transfusion provided clarification regarding the transfusion double independent (DI) check as 2 professionals independently carrying out and taking responsibility for the procedure1. This was a significant change for many health services, including our own, as historical practice was a shared check between 2 staff.

Our health service commenced staged implementation of a state-wide public sector electronic medical record (EMR) from 2016 across multiple facilities. This resulted in significant changes to historical transfusion workflows. The final hospital within our health service to 'go-live' was in March 2020; a week into Australia's first COVID-19 pandemic lockdown.

The combined effect of changed workflows and timing, led to concerns regarding the potential for unsafe workarounds for critical processes, especially in the setting of interruptions, distractions, stress and fatigue. A hospital bedside check audit in 2021 supported these concerns.

Methods: Given the complexities of reaching and engaging with a large workforce in an increasingly unpredictable healthcare environment due to the ongoing COVID-19 pandemic, BloodSafe transfusion practice staff produced a 5-minute video, simulating the process of a DI check using the EMR. This was produced with in-kind support and went live to clinicians within 8 weeks. The video was heavily promoted to clinical staff and a survey conducted.

Results: Survey results:
- 33% of staff had the video recommended to them by a colleague
- 30% of staff watched it multiple times, in groups and formal huddles
- 100% of respondents thought it was easy to follow and understand
- 95% found clarification of DI check helpful
- 64% found EMR specific explanations helpful
- 55% found step through of the DI check process helpful
- 77% of respondents confirmed the video had changed their practice

Conclusion: The video was an effective and engaging method of reaching a large group of staff quickly during uncertain and changing times for frontline workers. Feedback was overwhelmingly positive. It simulated the correct workflow relevant to the EMR in use and is now a state-wide resource given the use of the same EMR across the public sector. It also serves as a 'template' for health services using other EMRs to develop their own resource.

Reference
ANZSBT Guidelines for the Administration of Blood Products, 3rd Edition, 2019, Australian & New Zealand Society of Blood Transfusion

P10

The association between donor-recipient sex and transfusion-related outcomes in critically ill patients

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Introduction: Transfusion of red blood cell (RBC) from female donors has been associated with increased risk of mortality. This study aims to investigate the associations between donor-recipient sex and post-transfusion mortality and morbidity in critically ill patients who received RBC transfusions from either male only donors or from female only donors (unisex-transfusion cases).

Methods: Survival analysis was used to compare 4 groups: female-to-female, female-to-male, male-to-female, and male-to-male transfusion. Multivariate logistic model was used to evaluate the association between donor sex and ICU mortality. Associations between transfusion and acute kidney injury (AKI), acute respiratory distress syndrome (ARDS) and nosocomial infections were assessed.

Results: Of the 6992 patients included in the original cohort study, 403 patients received unisex-transfusion (Figure 1). Survival analysis (Figure 2) and the logistic model (Table 1) showed that transfusion of female RBCs to male patients was associated with an increased ICU mortality compared to transfusion of female RBCs to female patients (OR 2.43; 95% CI 1.02- 5.77; p-value < 0.05). There was a trend towards increased ARDS in patients receiving RBC from female donors compared to those receiving blood from males (p-value = 0.06) while AKI was higher in donor-recipient sex-matched transfusion groups compared to sex-mismatched groups (p-value = 0.05) (Table 2).

Conclusions: Transfusing blood from female donors to male recipients was associated with increased ICU mortality. Both male and female recipients receiving female blood had a trend towards increased risk of ARDS. Limitations of the current study are related to its exploratory nature, potential uncontrolled confounders, and the generalization of the findings. Results warrant further studies investigating biological mechanisms underlying the association between donor sex with adverse outcomes as well as studies on the benefit of matching of blood between donor and recipient.

Figure 1
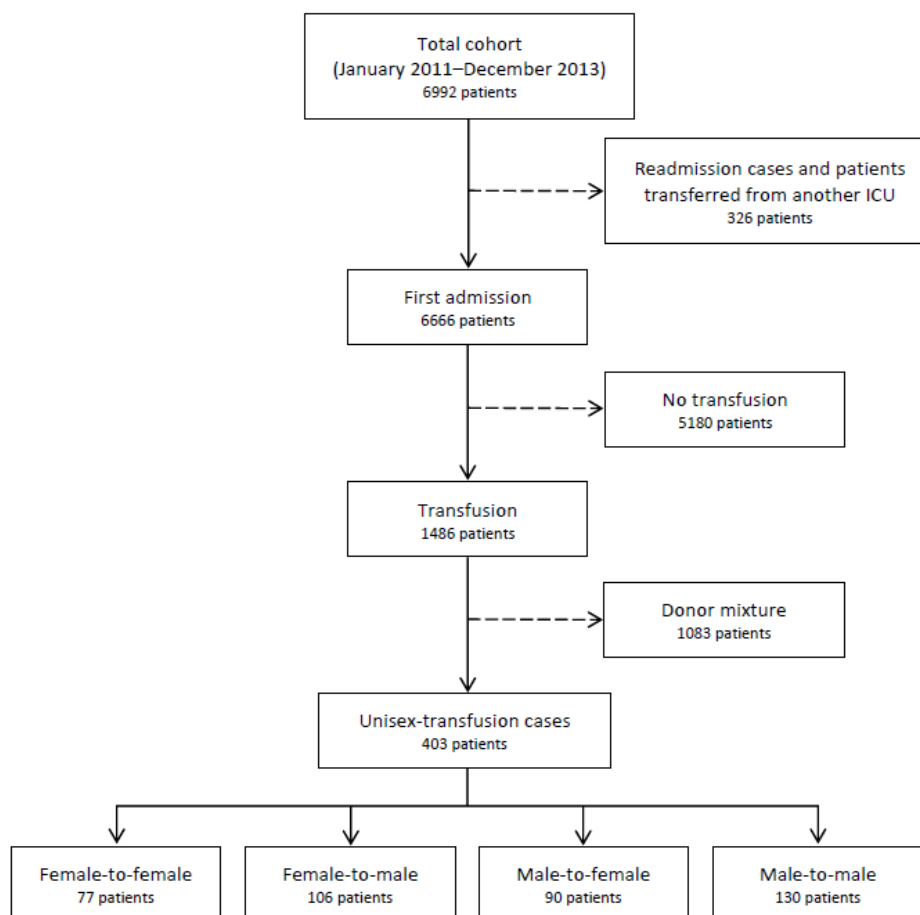
Figure 2
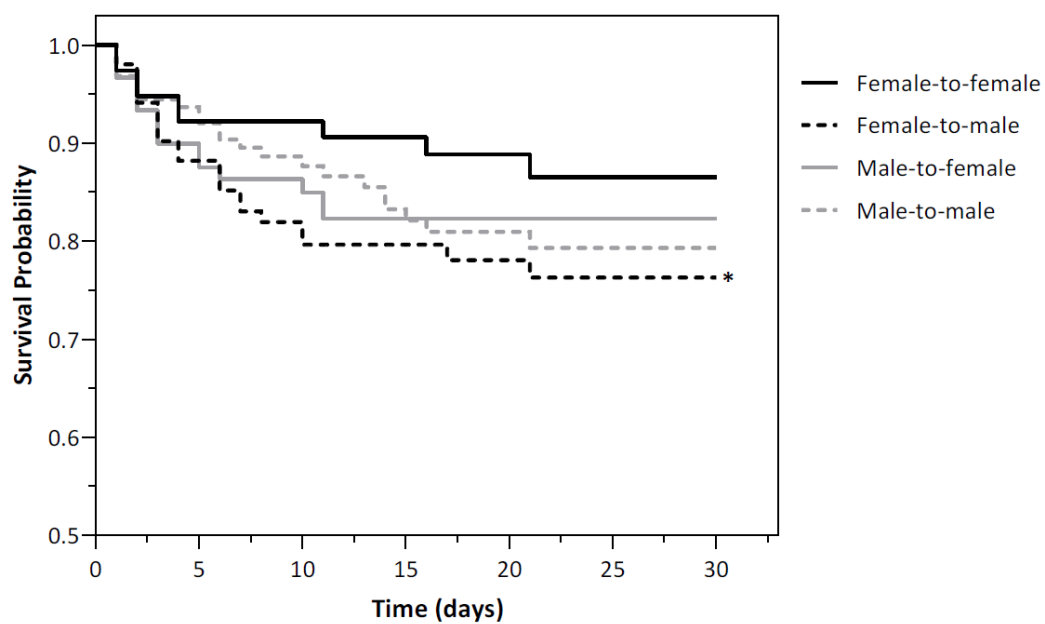
Table 1. The multivariate logistic model predicting ICU mortality

Variable		Descriptive[a]	OR (95% CI)
Donor sex[b]	female (reference)	183 (45.4)	1.52 (0.64, 3.60)
	male	220 (54.6)	
Donor-recipient sex mismatch[c]	sex match (reference)	207 (51.4)	2.43 (1.02, 5.77)
	sex mismatch	196 (48.6)	
Interaction between donor sex and donor-recipient sex mismatch[d]			0.36 (0.11, 1.13)
Patient age		63 (51-72)	1.87 (1.34, 2.63)
Sepsis	no (reference)	240 (59.6)	2.30 (1.35, 3.93)
	yes	163 (40.4)	
Length of ICU stay		6 (3-10)	0.94 (0.89, 0.99)
Number of RBC units		2 (1-2)	1.19 (0.98, 1.43)

[a] frequency (%) for categorical variables and median (IQR) for contentious variables.
[b] equivalent to OR (95% CI) of male-to-male group. [c] equivalent to OR (95% CI) of female-to-male group. [d] OR of male-to-female group can be estimated by multiplying of donor sex variable, donor-recipient sex mismatch variable, and the interaction between donor sex and donor-recipient sex match variable (Supplementary Table 3 and 4).

Table 2. Association of unisex transfusion and ICU-acquired complications

Variable	Female-to-Female (n=77)	Female-to-Male (n=106)	Male-to-Female (n=90)	Male-to-Male (n=130)	p-value
AKI					
Yes, n (%)	5 (6.5)	2 (1.9)	1 (1.1)	10 (7.7)	0.05
ARDS					
Yes, n (%)	6 (7.8)	7 (6.6)	1 (1.1)	3 (2.3)	0.06
Infection					
Yes, n (%)	8 (10.4)	10 (9.4)	7 (7.8)	15 (11.5)	0.83

AKI, Acute Kidney Injury
ARDS, acute respiratory distress syndrome

P11

Impact of cardiopulmonary bypass pump time on blood component transfusion in adult cardiac surgery patients receiving fibrinogen concentrate versus cryoprecipitate

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Introduction: Cardiac surgery with cardiopulmonary bypass (CPB) is frequently associated with coagulopathy, with acquired hypofibrinogenaemia being a leading factor. Hypofibrinogenaemia can be corrected with purified human fibrinogen concentrate (HFC) or cryoprecipitate, which contains additional coagulation factors that may be beneficial after prolonged CPB. The Fibrinogen Replenishment in Surgery (FIBRES) study recently demonstrated non-inferiority of HFC versus cryoprecipitate for the primary outcome of allogeneic blood product transfusions [1]. Here, we examined the interaction of CPB duration with HFC and cryoprecipitate efficacy.

Methods: This was a post-hoc analysis of the FIBRES prospective, multi-centre, randomised, controlled, non-inferiority Phase 3 trial (NCT03037424) comparing the efficacy of HFC versus cryoprecipitate in bleeding adult patients undergoing cardiac surgery [1]. The primary outcome was the total number of allogeneic blood products (ABPs) transfused within 24 hours post-CPB. Secondary outcomes included the total number of units of ABPs given within 7 days of surgery start. In this analysis patients were stratified by CPB duration ($\leq$120, 121–180, >180 minutes).

Results: A total of 735 patients (372 HFC; 363 cryoprecipitate) were included in the primary analysis set: 280 patients with CPB duration of $\leq$120 (median [IQR] CPB time 89 [70–106]) minutes, 220 patients with CPB duration 121–180 (146 [133–164]) minutes, and 235 patients undergoing CPB for >180 (237 [209–275]) minutes. Longer CPB duration was associated with increased bleeding severity, indicated by higher volumes of blood loss and volume of blood collected for cell salvage (Table 1). In addition, transfusion requirements were higher in the groups experiencing longer duration of CPB (Table 2).

In the primary analysis, the total number of ABPs transfused within the first 24 hours post-CPB, there was no interaction between the choice of fibrinogen replacement and CPB duration (p=0.77) (Table 2). When the number of units of each ABP transfused at 24 hours post-CPB was considered separately, there remained no interaction among CPB duration and the choice of fibrinogen product (red blood cells, p=0.59; platelets, p=0.63; plasma, p=0.94). Similar results were seen for the total number of ABPs transfused within 7 days of surgery start (p=0.98; Table 2).

Conclusion: CPB pump time is associated with higher transfusion requirements in patients who received both HFC and cryoprecipitate. The haemostatic efficacy of fibrinogen concentrate is non-inferior to cryoprecipitate irrespective of CPB duration.

Reference
Callum J et al. JAMA. 2019;322:1966-76

Table 1. Cumulative blood loss at 24 hours after CPB and volume of cell salvage blood collected

	HFC		Cryoprecipitate	
	N	Median (IQR)	N	Median (IQR)
Cumulative blood loss at 24 hours after CPB (mL)				
$\leq$120 min	133	790 (510–1280)	146	825 (530–1330)
121–180 min	113	770 (470–1210)	107	776 (500–1300)
>180 min	125	830 (540–1650)	110	868 (570–1530)
Cell salvage blood collected (mL)				
$\leq$120 min	128	375 (0–1200)	137	500 (0–1200)
121–180 min	106	1073 (0–2059)	98	1000 (0–2300)
>180 min	121	2293 (700–4300)	106	2200 (1023–5000)

CPB, cardiopulmonary bypass; HFC, fibrinogen concentrate; IQR, interquartile range

Table 2. Total ABPs transfused within 24 hours post-CPB and within 7 days of surgery start

	HFC		Cryoprecipitate		Unadjusted ratio of LS means (1-sided 97.5% CI)		*P* value
	N	Median (IQR)	N	Median (IQR)			
Primary outcome: Total ABPs transfused within 24 hours after CPB							
≤120 min	134	7.5 (2.0–16.0)	146	10.5 (4.0–17.0)	0.90	(0.00–1.12)	0.004
121–180 min	113	12.0 (7.0–21.0)	107	14.0 (6.0–22.0)	1.00	(0.00–1.22)	0.03
>180 min	125	18.0 (9.0–31.0)	110	21.0 (11.0–32.0)	0.91	(0.00–1.12)	0.005
Secondary outcome: Total ABPs transfused within 7 days after surgery							
≤120 min	134	8.5 (4.0–21.0)	146	11.5 (6.0–21.0)	0.96	(0.00–1.20)	0.03
121–180 min	113	15.0 (8.0–26.0)	107	16.0 (8.0–26.0)	0.97	(0.00–1.19)	0.02
>180 min	125	28.0 (13.0–45.0)	110	27.5 (16.0–45.0)	0.99	(0.00–1.22)	0.03

ABPs, allogenic blood products (red blood cells, frozen plasma, platelets); CI, confidence interval; CPB, cardiopulmonary bypass; HFC, fibrinogen concentrate; IQR, interquartile range; LS, least squares

P12

Tackling increasing transfusion rates in obstetrics at Royal Cornwall Hospital, Truro, UK

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Introduction: 2021 has seen an increase in allogeneic transfusion in the obstetric department at Royal Cornwall Hospital, which has previously maintained a low transfusion rate and excellent obstetric patient blood management programme (figure 1). Reasons for this concerning trend are investigated.

Methods: The notes of all obstetric patients who received blood in 2021 were reviewed. Red blood cell administration was deemed appropriate if the patient's haemoglobin was below 60g/L, or the patient was experiencing symptoms of anaemia. Transfusions of plasma, platelets and cryoprecipitate were justified if guided by coagulation tests (including ROTEM) or specialist advice.

Results: 36 patients received blood products in 2021 compared to 27 in 2020. Patients who received blood products had lower baseline haemoglobin on admission to delivery suite: 101-110g/L in 2021, compared to 120-130g/L in 2020 (figure 2). There has been an increase in operative deliveries: in 2021 39% of patients had an instrumental delivery (forceps or suction cup) and 28% had a caesarean section. In contrast, 56% of women had a normal vaginal delivery in 2020 compared to only 28% in 2021.
Cell salvage was available for all caesarean deliveries, but for 2 patients undergoing caesarean section, too little blood was collected to be re-infused. Both patients were anaemic. 2486mls of salvaged blood was re-infused (which equates to a saving of approximately 10 units of red blood cells).
Despite the increase in number of patients receiving blood products, 69% of transfusions were deemed appropriate in 2021 compared to 52% in 2020. Intravenous iron administration to all women who receive a transfusion has improved from 78% in 2020 to 86% in 2021. There has been a reduction in plasma administration. Only 12 units were given in 2021 compared to 17 units in 2019, despite significantly more patients receiving a red cell transfusion. The majority of patients receiving blood products had a haemoglobin of 70-79g/L following transfusion (figure 3).

Conclusions: Transfusion rates in obstetrics remained low in 2021 (0.89%) but have increased compared to 2020 (0.69%). However, administration of blood transfusions has been more clinically appropriate in 2021 based on current hospital guidelines.
The increase in need for transfusion following operative vaginal delivery suggests that vaginal cell salvage would be a valuable means of blood conservation in obstetrics (1). Two patients have successfully received a re-infusion of vaginally salvaged blood in Royal Cornwall Hospital with no adverse incidents.
The patients receiving blood transfusions in 2021 were more medically complex (2 patients had cardiac disease, 2 had liver disease and 1 had Covid-19 induced coagulopathy) which led to blood being administered on the advice of specialities outside obstetrics and anaesthesia (cardiology, oncology and haematology). Traditionally, haemoglobin thresholds in cardiac patients have been higher than non-cardiac patients. As cardiac disease increases within the obstetric population, there is uncertainty about what constitutes a suitable transfusion threshold for these patients.
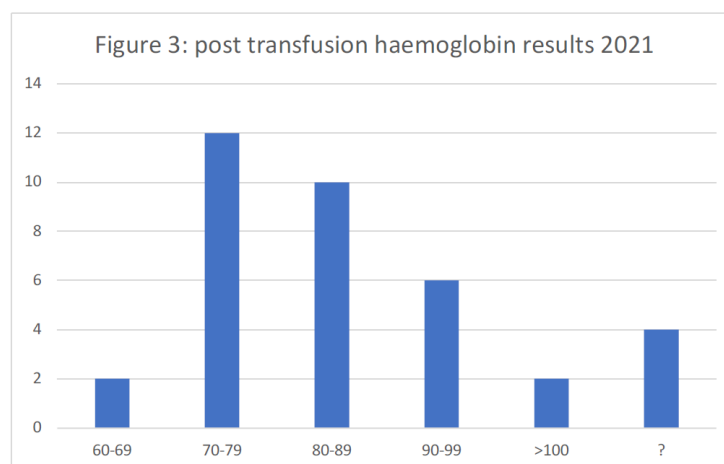The reduction in baseline haemoglobin on admission to delivery suite is a concerning trend and has occurred despite increasing antenatal anaemia treatment targets from 110g/L to 120g/L at booking, and from 105g/L to 110g/L at 28 weeks. This may reflect a difficulty in accessing antenatal care during the Covid-19 pandemic. Administration of fresh frozen plasma has fallen significantly in the last 2 years following introduction of a ROTEM machine, and increased focus on administering cryoprecipitate instead of fresh frozen plasma to maintain fibrinogen levels during postpartum haemorrhage (2).
The majority of transfusions were justified by patients having symptoms of anaemia. Interestingly a Dutch study in 2014 showed no significant difference in symptom burden in anaemic postpartum patients (n=447) whether they had received a transfusion (259 patients) or not (267 patients). This raises the question whether administration of blood products can be justified for symptom relief in the absence of adverse clinical signs (3), when blood products remain a scarce resource with a considerable risk profile.
In summary, obstetric patients at Royal Cornwall Hospital in 2021 were more anaemic at arrival on delivery suite and had more complex co-morbidities than in 2020. This may partially explain the increase in blood transfusion rates. Future work should focus on optimising antenatal haemoglobin levels and continuing research into the safety of vaginal cell salvage. Education regarding ROTEM-guided use of additional blood products has been successful.

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Figure 1: Autologous and Allogeneic Transfusions 2007-2021

Figure 2: Haemoglobin results for patients on admission to delivery suite 2021 who went on to receive blood products

Figure 3: post transfusion haemoglobin results 2021
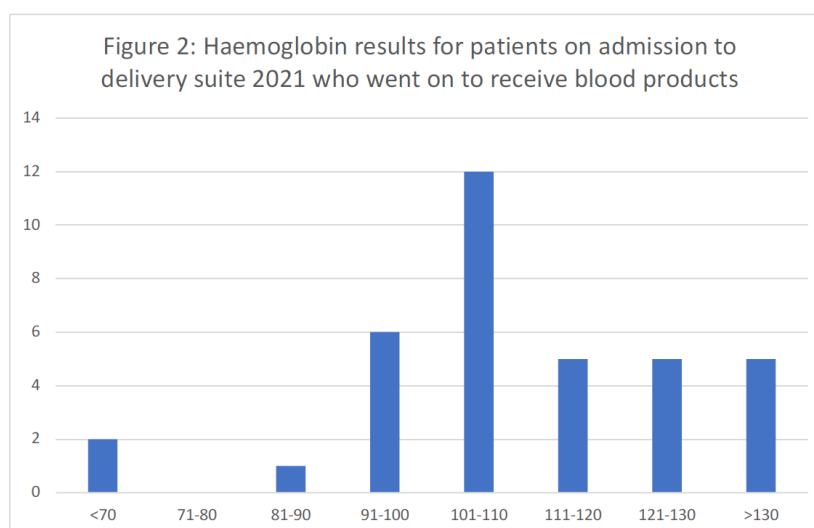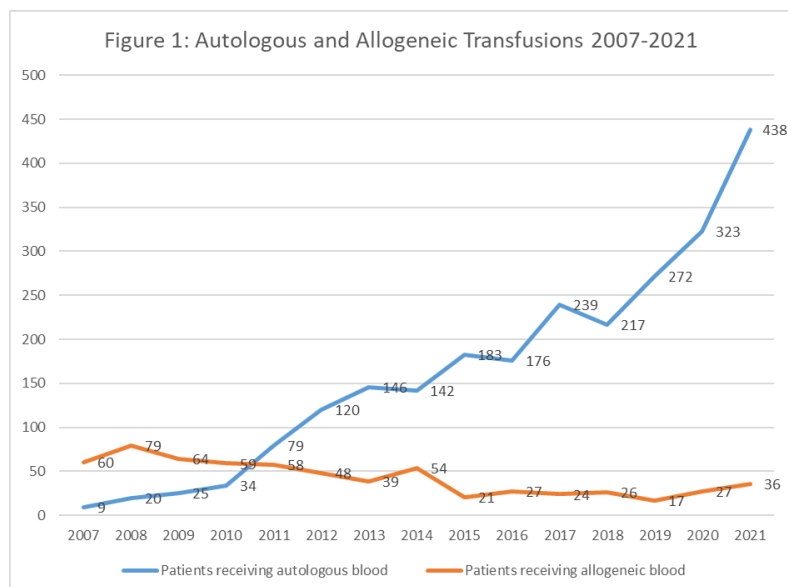
P13

Audit on the use of fresh frozen plasma in a University Hospital in Barcelona

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Background: The administration of fresh frozen plasma (FFP) has been proved to be inappropriate in many hospital settings although there are many guidelines that recommend its use in specific situations.

Objective: To audit the use of fresh frozen plasma (FFP) in our hospital and to establish the need for a different approach on the use of blood components in managing bleeding and acquired coagulopathies.

Methods: Medical records of patients who received FFP in our hospital during 2021 were retrospectively studied. Patients undergoing therapeutic plasma exchange were excluded as well as pediatric ones. The recommendations of the British Committee for Standards in Hematology were used to determine the correct use of plasma.
Indications for transfusion requests were studied and divided into appropriate and inappropriate requests depending on whether guideline recommendations were followed or not.

Results: A total of 291 units were issued in 100 cases (89 unique patients, 21 female and 68 male, mean age 66 years, range 21-95 years).
Bleeding related to surgery in the setting of altered coagulation profile, gastro-intestinal bleeding and trauma represented the most common appropriate indication for use of FFP. ICU (47) and Anesthesiology (40) were the departments with most FFP requests.
Seven units of FFP were used to revert DOACs in 5 patients (3 patients on Apixaban, 1 on Edoxaban and 1 on Rivaroxaban) and 19 units were administered to 11 patients on VKA (5 patients with no bleeding and 6 patients with major bleeding that required urgent reversal of the anticoagulant effect). In 12 patients 34 units of FFP were used to correct the coagulation of patients on LMWH.
After a thorough review only in 49 cases (197 units) the use of plasma was according to the guidelines with an average of 4 units/patient.
In 51 cases (94 units) the use was not based on guidelines recommendations (average of 1.8 units/patient).

Conclusion: In our study we have observed that there is great variability in recommendations and amount of FFP administered. The use of FFP requires a proper understanding of its indications as well as its efficacy since in some situations may even be deleterious, delaying the use of more effective products.
With an important decrease of blood donations, a critical eye should be placed on the use of FFP in managing bleeding as well as its use in non-bleeding patients. There is a great need for training among prescriptors for a better use of plasma.

Table 1

Indications of incorrect use of fresh frozen plasma -51 cases -94 units (average of 1.8 units/patient)		
Reversing DOACs	5 cases	7 units
Reversing VKA	11 cases (5 patients with no bleeding and 6 patients with major bleeding that required urgent reversal of the anticoagulant effect)	19 units
Reversing LMWH	12 cases	34 units
Reversing antiplatelet therapy	2 cases	2 units
Coagulopathy without bleeding or need for invasive procedure	10 cases	17 units
Coagulopathy related to sepsis and need for invasive procedure	8 cases	8 units
Bleeding after systemic fibrinolysis or hyperfibrinolysis	2 cases	6 units
Coagulopathy with intracranial bleeding	1 case	1 unit

P14

Retrospective analysis of current transfusion practices and scope for PBM implementation in a developing country: A multicentric survey report

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Introduction: Patient Blood Management may be the standard of care in the developed world but is still the new kid on the block in India. The healthcare system as well as the Blood Transfusion System in India is decentralized and transfusion decisions vary depending on the clinical judgement of the treating clinician. Before implementation of PBM, it is important to understand the existing grounds for clinical transfusion decisions. This abstract details the results of the baseline transfusion data of the state of Rajasthan which is the largest state in in India.

Methods: Retrospective analysis of data from randomly selected 5555 transfusion requests which correspond to 1% of annual demand for clinical transfusions was collected from 9 major blood centres across the state during the period December 2020 to March 2021 was done. The type and number of components transfused, indication as ascertained by clinical supportive data and laboratory investigations on the request forms was used to identify the common indications, demographic details of the recipients and identify the gaps for implementation of PBM across the state and prepare the guidelines for PBM for the state.

Results: Of the request forms evaluated, 4391 requests which were received for adults (age>18 years) were evaluated. These patients received 6907 blood components of which 5377 were red blood cell (RBC) units, 618 platelets [570 random donor platelets (RDP) 48 single donor apheresis platelets (SDAP)], 888 fresh frozen plasma (FFP) and 24 cryoprecipitate (CRYO) units. About 47% transfusion were done without any indications mentioned on the requisition forms. Of the rest, 43% of RBC transfusion were for anemic patients and 21% of whom were female of age group 18-30 years. Only 34% of the Platelet and 24% of plasma transfusions were according to established guidelines. Inadequate dosage of platelet FFP and cryoprecipitate was also common. Therefore 67% of these transfusions were likely to be irrational. Preoperative anemia was present in 83% of the patients of which 32% had a hemoglobin of less than 7g/dl.

Conclusion: For the multimodal approach to PBM in the state of Rajasthan, management of nutritional anemia especially in the women of reproductive age group and preoperative patients, physician sensitization towards indications, thresholds, dosage of blood components, use of pharmacological hemostatic agents, ensuring data adequacy in transfusion requests, increase use of cryoprecipitate especially in postpartum hemorrhage and massive transfusions have been identified for implementation.

P15

Improving trend of single unit transfusion during the COVID-19 pandemic

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Introduction: Patient Blood Management (PBM) to improve patients' outcome has become routine clinical practice in many developed countries. To achieve a bigger impact, adherence to transfusion appropriateness and single unit transfusion (SUT) should also be adhered. Though the COVID-19 pandemic has posed a particular challenge and significant difficulties to the health care system and blood supply, blood shortage could be an opportunity for PBM implementation and practice. Therefore, PBM experts and recently WHO had been calling for a wider and urgent PBM implementation since the pandemic. A retrospective analysis is then conducted to look at the transfusion activities, SUT trend, and adherence to transfusion threshold at public hospitals during the pandemic.

Methods: Transfusion activities of year 2020 and 2021 from electronic database of public hospitals were retrieved for the study. The number of episodes of transfusion request, number of red cell units issued per episode, their pre transfusion haemoglobin level were collected and analysed. No clinical information nor patients' demographics were obtained. Descriptive statistics were used.

Results: There were 306,395 transfusion episodes studied with 151,225 in year 2020 and 155,170 in 2021 resulting in 159,767 and 163,769 units of red cells issued to patients respectively. An average of 57.8% transfusion episodes was found to be SUT which increased to 69.6% when a pre-transfusion haemoglobin of 6 – 9 gm/dl as threshold was used. Overall, a rising trend of SUT was seen from 52.4% in January 2020 to 61.1% by December 2021. When the same threshold was applied, the proportion of SUT was increasing from 62.9% to 73.7% during these 24 months.
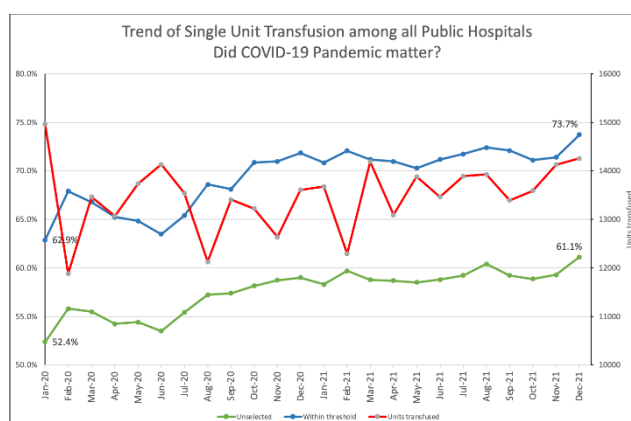
Conclusions: Despite under heavy pressure from COVID-19 pandemic, demand for red cells transfusion was not changed significantly. However, an increasing trend of applying SUT was noted which might be explained partially by low blood supply and also by PBM with increasing awareness of SUT. As a feedback loop, these findings should be disseminated among all frontline clinicians to foster the PBM practice.

P16

Transfusing Wisely – Avoidable transfusions for patients with haematinic deficiencies reported to SHOT 2016-2020

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Introduction: The Serious Hazards of Transfusion (SHOT) scheme collects information on adverse reactions and events related to transfusion leading to recommendations for avoiding harm, including prevention of unnecessary transfusions. Deficiency of vitamins and minerals essential for normal erythropoiesis results in anaemia, becoming severe if not recognised and managed promptly. Iron, vitamin B12 and folate deficiencies are the most common. Patients at risk, for example women of childbearing age and patients with gastrointestinal problems, should be screened for anaemia as necessary and managed appropriately.

Every year SHOT receives reports of avoidable red cell transfusions to patients with anaemia secondary to haematinic deficiency. Inappropriate and excessive transfusion may result in transfusion-associated circulatory overload (TACO) causing serious harm or death.

Methods: SHOT data from 2016 to 2020 were reviewed for reports of transfusion in patients with haematinic deficiency submitted as avoidable transfusion with or without TACO.

Results: There were 56 cases identified (including 6 obstetric and 1 paediatric), 46/56(82.1%) avoidable transfusions without TACO and 10/56(17.9%) avoidable transfusions where the patient developed TACO. Iron deficiency accounted for 44/56(78.6%) reports, B12 deficiency 7/56(12.5%), folate deficiency 3/56 (5.3%) and 2/56(3.6%) with combined deficiencies. In 44/56(78.5%) the patient's Hb was >50g/L with no evidence of bleeding or cardiac compromise but the patient still received a transfusion.
Red blood cells were transfused in 55/56(98.2%) reports. In 1/56(1.8%) case a patient with folate deficiency was transfused multiple components when the major haemorrhage protocol was inappropriately activated with no evidence of bleeding. Where patients developed TACO, on 2/10(20.0%) occasions a pre-transfusion TACO checklist was used; not used in 2/10(20.0%), unknown in 6/10(60.0%). In 54/56(96.4%) the patients fully recovered but 1/56(1.8%) required transfer to the high dependency unit for non-invasive ventilation and treatment of circulatory overload. In 1/56(1.8%) case of TACO, the patient died possibly related to the transfusion complication.

Conclusions: Early diagnosis of haematinic deficiency and appropriate treatment with haematinics will prevent both unnecessary transfusion and TACO. Timely management includes reviewing trends in the patient's blood results, particularly the haemoglobin level and mean cell volume (low in iron deficiency, raised in B12 or folate deficiency). Blood components are a precious resource and excessive/inappropriate use of transfusions in patients with haematinic deficiencies carries significant risk, transfusion decisions must be individualised. Recipients of blood can no longer donate blood in the UK, another reason why it is important to avoid unnecessary transfusions.

P17

Need of packed red blood transfusion before and after the inclusion of intraoperative continuous non-invasive hemoglobin monitoring technology in a real-life setting in a developing country

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Introduction: The use of intraoperative continuous non-invasive hemoglobin monitoring (ICNHM) has demonstrated its effectiveness in reducing the need of packed red blood transfusion in developed countries. The objective of this study is to compare the need for transfusion of packed red blood and other blood products before and after the inclusion of ICNHM technology in a real-life setting in a developing country.

Methods: This is a retrospective cohort of pregnant women presenting with obstetric hemorrhage between 2013 and 2020. Groups were divided by the use of ICNHM (Radical-7 pulse CO-oximeter [Masimo Corp, USA]) which started in 2015, meaning that all women before 2015 did not have ICNHM available. Descriptive and inferential statistics were used. The number of obstetric hemorrhages packed red blood cells, platelet concentrates, cryoprecipitates, and fresh frozen plasma were analyzed by year using a quadratic fit analysis.

Results: A total of 1,479 pregnant women presented with obstetric hemorrhage during the study period, 399 (27%) before 2015 and 1,080 (73%) after 2015 and therefore after the use of ICNHM. There was no significant difference on the median number of cases before and after the use of ICNHM (Figure 1). However, there was a significant difference on the median number of packed red blood cells used (317 vs 95; p=0.004), fresh frozen plasma (136 vs. 23; p=0.002), platelet concentrates (62 vs. 13; p=0.026), and cryoprecipitates (47 vs. 9; p=0.001) used after initialization of ICNHM technology. Table 1 shows the calculations for each blood product.

Conclusions: In a real-life setting in a developing country, the introduction of ICNHM does not reduce the number of obstetric hemorrhages but significantly decreases the requirement of packed red blood, fresh frozen plasma, platelet concentrates, and cryoprecipitates transfusion.

P18

Improvement in critical care medicine transfusion practice after implementation of an organized Patient Blood Management program

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Introduction: Patient Blood Management (PBM) programs have been shown to reduce healthcare costs while improving patient outcomes. Results demonstrate that transfusion related decision making improves with active participation in an organized PBM program that incorporates extensive clinical education, evidence-based guidelines, aligned electronic medical record/order entry, and meaningful data and analytics of provider transfusion practice.
Critical Care Medicine providers play an important role in PBM programs. Historically, decisions regarding transfusion in non-hemorrhaging patients were closely connected to simple correction of hemoglobin values and often ordered in a multi-unit fashion. The proportion of red blood cell transfusions ordered as single units can serve as an indication of improved transfusion related decision making. The evidence-based recommendation for non-bleeding patients is a hemoglobin threshold of <7g/dl. The percentage of transfusions that occur as single units, for pre-transfusion hemoglobin of <7g/dl as well as for hemoglobin >8g/dl are therefore important quality markers.

Methods: RBC transfusion ordering patterns were collected from 117 individual hospitals across the US, encompassing data on 1,783 critical care clinicians. Nurse practitioners, physician assistants, and physicians from academic and non-academic centers were included. Adult critical care data from one full baseline year was compared to four Memorial Healthcare (Florida, USA) hospitals (55 licensed providers), measuring transfusions in patients with pre-transfusion hemoglobin levels <7 g/dl, >8 g/dl, and single unit transfusion orders for 12 months after program implementation.

Results: All MHS institutions' critical care providers showed change in these metrics over the first year of program implementation. For patients with pre-transfusion Hb>=8 g/dl, the Memorial group had a decrease of 13%, while the non-Memorial group had an average decrease of 8% in the first year. For single unit transfusion orders, non-Memorial group averaged an increase of 8% in the first year, while the Memorial group had an 17% increase. For patients who had pre-transfusion Hb levels <7g/dl, the non-Memorial averaged a 10% increase in the first year, while the Memorial group had an 17% increase. Improvement in transfusion metrics decreased blood spend by $490K US (acquisition costs only) in the first year.

Conclusion: Implementing a systematic patient blood management program leads to improvement in blood component ordering practices, decreased acquisition costs, and increased patient safety.
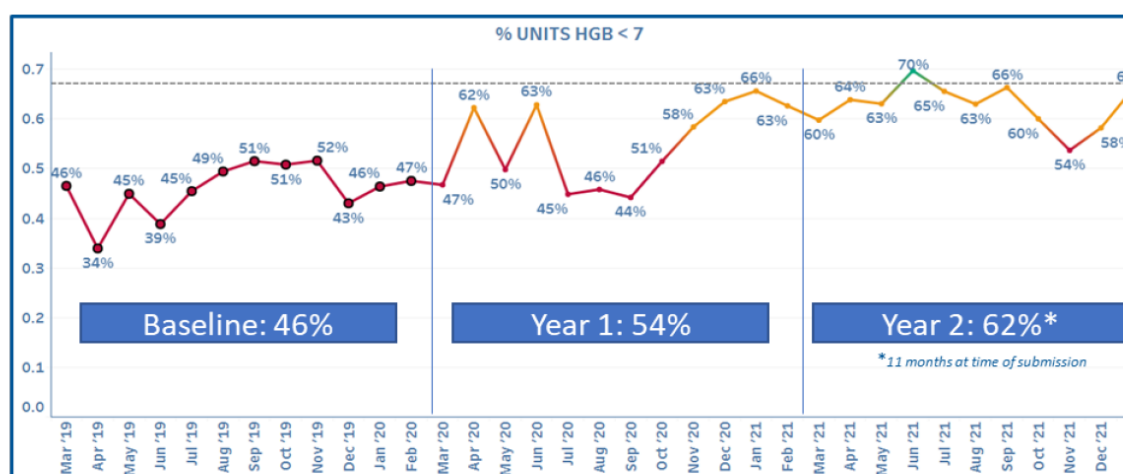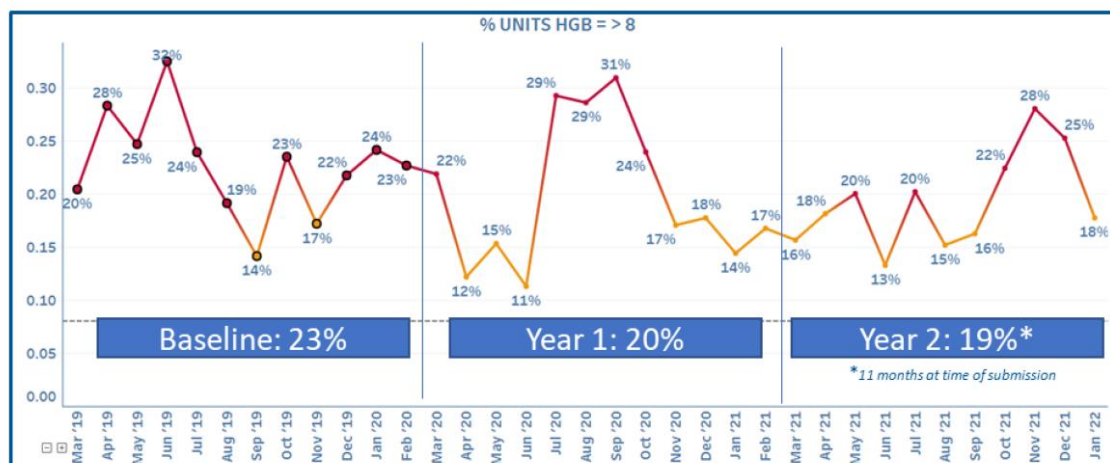
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P19

Transfusion rate cut down in patients with gynecological cancer treated with primary surgery during introduction of patient blood management (PBM)

Anna Norbeck[1], Jesper Bengtsson[3], Mihaela Asp[1], Alba Plana[1], Susanne Malander[2], Jens Kjeldsen-Kragh[3] and Päivi Kannisto[1]
Departments of [1]Obstetrics and Gynecology, [2]Oncology and Pathology and [3]Laboratory Medicine, Skane University Hospital, Lund, Sweden

Introduction: Macroscopic radicality is the golden standard in advanced cases of endometrial, tuboovarian and peritoneal cancer through midline incision (du Bois et al 2009). The level of complexity of the surgery enhances risks for complications and a need of interventions. Anemia, iron deficit and inflammation can impair the postoperative recovery (Weiss and Goodnough 2005, Madeddu et al 2018) which is a prerequisite of carrying out postoperative chemotherapy. The transfusion habits have been investigated before and after introduction of patient blood management (PBM) in advanced gynecologic cancer.
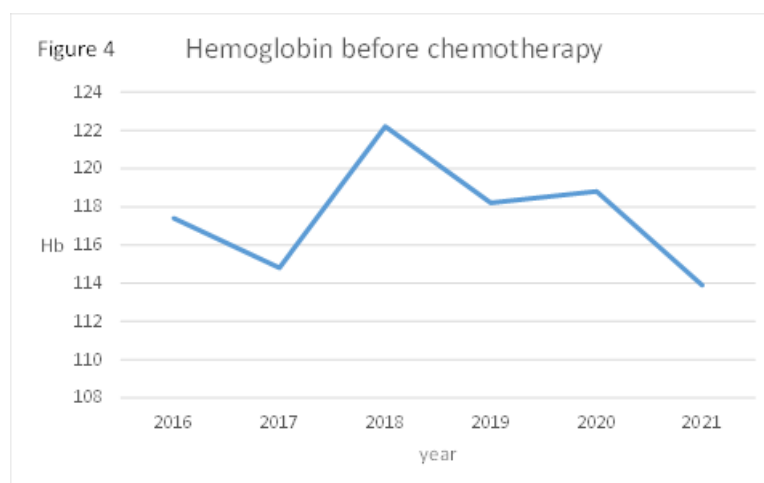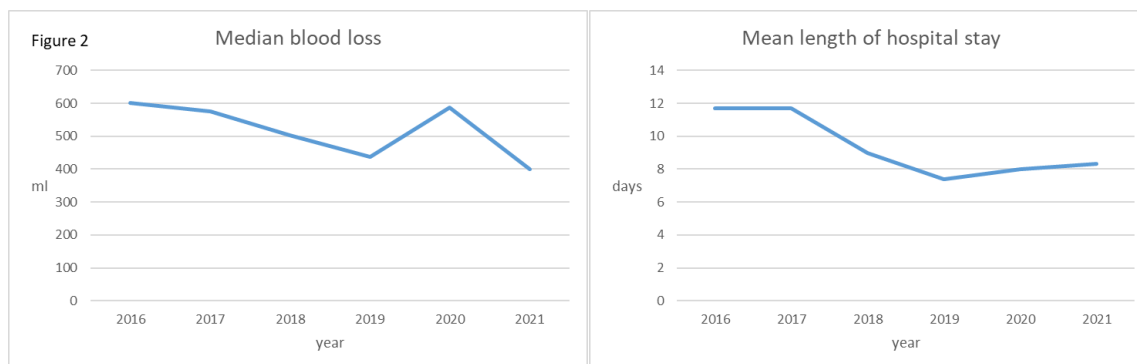
Methods: Patients (n=596) underwent elective surgery for gynecologic cancer. Omental surgery and curative intention were the inclusion criteria for the entrance in the study. Number of transfusions/patient/year were registered. Surgical variables registered were tumor rest, duration of the surgery, blood loss, length of hospital stay and hemoglobin levels before the surgery, the lowest postoperative value prior the discharge and shortly before first chemotherapy treatment. Structural measures were as follows: 1) IV injection of 1g Tranexamic acid (TXA) was given to all gynecological cancer patients (start January 2018); 2) The highest perioperative level of Hb where transfusion was recommended remained at 70g/L (start March 2020); 3) IV injection of iron was given as first treatment July2019). Research question was if Hb values could be maintained towards chemotherapy start when iron injections were given rather than blood transfusion.

Results: The number of perioperative and postoperative transfusions decreased over time (2.35 units/ patient 2016 to 1.04 units/patient 2021) Fig1. The length of hospital stay declined over time (11,7 days 2016 to 8.3 days 2021, p<.0003) corresponding the decrease of blood loss during surgery.Fig 2 and 3. The hemoglobin level before start of chemotherapy was maintained over time despite reduction of transfusions Fig 4, Table1. No difference was observed in Hb values preceding chemotherapy in patients who were treated with iron (Monofer) compared to the patients who were supplied with blood transfusions only (112.8 + 11.23 vs 114.5 + 18.25 p=0.595). No adverse events with observed with the iron treatment.

Conclusion: Structural measures over time decreased blood transfusions with no adverse effects for the patients. Complications related to surgery will be investigated.

Hemoglobin levels prior to chemotherapy from 2016-2021

	t	df	Sig. (2-tailed)	Test Value = 0 Mean Difference	95% Confidence Interval of the Difference Lower	Upper
Hb2016	100,581	76	,000	118,935	116,58	121,29
Hb2017	88,273	48	,000	117,143	114,47	119,81
Hb2018	87,500	60	,000	122,262	119,47	125,06
Hb2019	73,696	74	,000	118,173	114,98	121,37
Hb2020	91,813	75	,000	118,487	115,92	121,06
Hb2021	108,718	106	,000	113,869	111,79	115,95

Figure 1 — Erythrocytes/patient and iron injections

Figure 2 — Median blood loss

Mean length of hospital stay

Figure 4 — Hemoglobin before chemotherapy
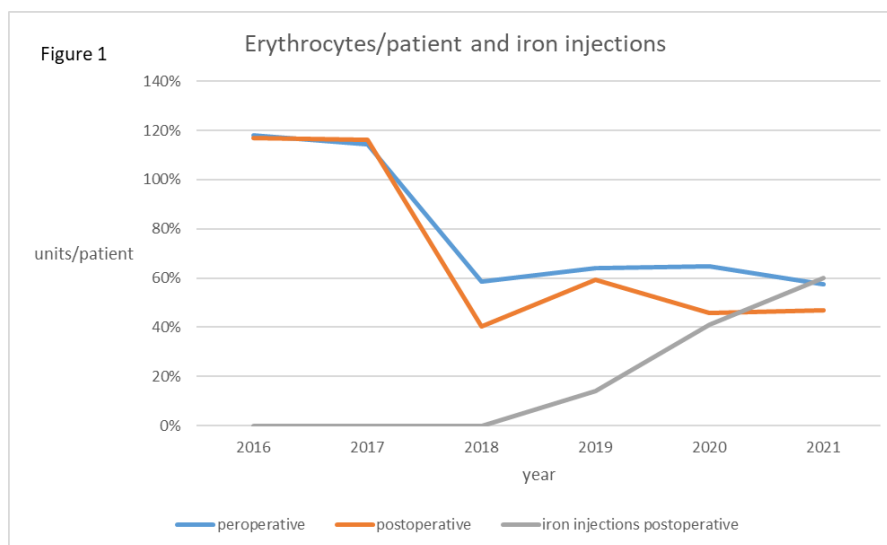
Blood Conservation Strategies / Autologous Transfusion

P20

Patient Blood Management - A blood bank perspective

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Introduction: Patient blood management (PBM) programs proved to be effective in reducing transfusions while maintaining patient outcome. An organized PBM program started in our hospital in 2018, for cardiothoracic surgery patients. The aim of our study was to show the effectiveness of PBM in reducing transfusions and costs.

Methods: Observational retrospective study of the adult patients admitted to cardiothoracic surgery department in 2015 (before PBM implementation) and between 2018 and 2021 (after PBM implementation). In total 16939 patients were included. Univariate analysis was performed with the Mann-Whitney and the chi-square tests.

Results: In 2015, 13% (n=436) of the 3268 patients admitted to cardiothoracic surgery department required transfusions. Of those, 54% (n=236) were men and the median age was 71 years (IQR 14). A total of 2478 blood products were used with a total direct estimated cost of 281734 euros. On the first year of PBM program (2018) 11% (n=379) of the 3515 patients admitted that year required transfusions; 54% (n=203) were men and the median age was 71 years (IQR 14). A total of 2189 blood products were used with a total direct estimated cost of 257018 euros (Table 1 and 2). There was a statistically significant difference between the number of transfused patients before and after the PBM program implementation (p=0.001; OR 0.78; 95% CI 0.68-0.91), which persisted in each of the following years of the PBM program (Table 1). We did not find a statistically significant difference between the first and the last PBM program years (2018 vs 2021; p=0.810). The number of RBC transfusions per patient reduced during the PBM program, with a significantly reduction in 2019 (p=0.005) and 2021 (p=0.04), but without a significantly reduction between the first and the last PBM program years (2018 vs 2021; p=0.116). For all the PBM program years the direct estimated cost for RBC transfusions was lower than in 2015, leading to direct RBC related savings up to 29328 euros (Table 2). We did not find these differences in platelets or plasma transfusions.

Conclusions: Our PBM program seems effective in reducing RBC transfusions and its related costs.

Table 1. Blood products transfused before and after the introduction of the PBM program.					
Variables	2015	2018	2019	2020	2021
	Before PBM	After PBM			
Total Patients admitted - n	3268	3515	3477	3096	3583
Transfused Patients - n (%)	436 (13%)	379 (11%)	376 (11%)	352 (11%)	380 (11%)
p value*	-	0.001	0.002	0.019	<0.001
OR (95% CI)	-	0.78 (0.68-0.91)	0.79 (0.68-0.91)	0.84 (0.72-0.97)	0.77 (0.67-0.90)
Age (years) - median	71 (IQR 14)	71 (IQR 14)	71 (IQR 14)	70 (IQR 15)	71 (IQR 13)
Male sex - n (%)	236 (54%)	203 (54%)	195 (52%)	202 (57%)	216 (57%)
Blood Products Transfused - n	2478	2189	3091	2259	1949
RBC Total units - n	1228	1125	1009	1172	946
Units per patient - median (IQR)	2 (2)	2 (3)	1 (2)	2 (3)	2 (2)
Min./Max. units per patient - n	0/39	0/53	0/46	0/50	0/26
p value*	-	0.736	0.005	0.995	0.04
Pool/ Total units - n	227	215	252	241	197
APC Units per patient - median (IQR)	0 (0)	0 (1)	0 (1)	0 (1)	0 (1)
Min./Max. units per patient - n	0/5	0/18	0/12	0/12	0/8
p value*	-	0.509	0.126	0.018	0.081
FFP Total units - n	1023	849	1830	846	806
Units per patient - median (IQR)	2 (2)	2 (3)	3 (9)	3 (3)	3 (3)
Min./Max. units per patient - n	0/21	0/15	0/68	0/37	0/15
p value*	-	0.863	0.001	0.885	0.869
Abbreviations: APC apheresis platelet concentrates; CI confidence interval; FFP fresh frozen plasma; Max. maximum; Min. minimum; OR odds ratio; PBM patient blood management; RBC red blood cells. *All years after PBM program implementation (2018/2019/2020/2021) were compared with the year before PBM (2015).					

Table 2. Cost data.						
Variables	2015	2018	2019	2020	2021
	Before PBM	After PBM				
Blood Products Transfused - n	2478	2189	3091	2259	1949
Total Costs (all blood product types) - euros	281734	257018	320852	280448	259352
RBC Transfused - n	1228	1125	1009	1172	946
RBC Costs - euros	127712	117000	104936	121888	98384
RBC Unity cost[†]: 104 euros					
Pool Transfused - n	220	204	239	206	101
Pool Costs - euros	42680	39576	46366	39964	19594
Pool Unity cost[†]: 194 euros					
APC Transfused - n	7	11	13	35	96
APC Costs - euros	2618	4114	4862	13090	35904
APC Unity cost[†]: 374 euros					
Pool/APC Transfused - n	227	215	252	241	197
Pool/APC Costs - euros	45298	43690	51228	53054	55498
FFP FFP Transfused - n	1023	849	1830	846	806
FFP FFP Costs - euros	63426	52638	113460	52452	49972
FFP Unity cost[†]: 62 euros					

Abbreviations: APC apheresis platelet concentrates; FFP fresh frozen plasma; PBM patient blood management; RBC red blood cells.
[†]According with our National Health System cost data.

P21

Impact of the COVID-19 pandemic on Patient Blood Management (PBM) in a regional hospital

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Introduction: The epidemiological situation due to COVID-19 has been a challenge worldwide, and regional hospitals has being one of the most affected, because a percentage increase in any small-scale situation, has a greater impact at the level of both, human and material resources. In these extreme situations, PBM programs have the risk of being forgotten or at least relegated to a second priority level. However, a well-structured and consolidated program doesn´t have to involve added work or be weakened.

Methods: The transfusion evolution of the two years affected by the pandemic in relation to the previous two years has been retrospectively analyzed, together with the changes in care activity in a 126-bed regional hospital.

Results: The COVID-19 pandemic has produced a change in the patients treated at the hospital. The number of patients operated on and treated in the emergency room has been reduced, while the number admitted to intensive care has increased (Table 1).
Transfusion activity has increased, despite a lower transfusion threshold, reflecting that the patients attended, despite being fewer, were worse off, with a higher degree of anemia (Table 2).

Conclusions:
- The hospital has a consolidated and continuously improving PBM program, maintaining involvement even during the difficult health situation caused by the COVID pandemic.
- Transfusion has continued with an increasingly strict restrictive criterion, reducing the percentage of over-transfusion.
- The transfusion of two PRBCs per transfusional act was increased at the beginning of the pandemic, due to fear in order to minimize hospital visits and healthcare overload. However, the unitary criterion was returned for greater patient safety.
- During the pandemic, more has been transfused since the patients had more advanced diseases.

Table 1

Hospital activity	2018	2019	2020	2021
Patients treated in Emergency department	23.208	23.483	17.251	20.482
Interventions for General Surgery	1.105	993	723	875
Traumatology interventions	887	954	715	753
Patients treated in Day Hospital	303	356	255	144
Hospitalizations in Internal Medicine	2.265	2.320	2.391	2.214
Hospitalizations in Intensive Medicine	124	130	156	150

Table 2

Transfusion Activity	2018	2019	2020	2021
Units of packed red blood cells (PRBC) transfused	740	500	555	567
% Transfusion 1 PRBC	16	63	51	**68**
% Transfusion 2 PRBC	66	29	45	**23**
% Transfusion >3 PRBC	10	5	4	9
Pre-transfusion hemoglobin(hb) media (g/dl)	7,7	7,6	7,3	**7,1**
Post-transfusion hb media (g/dl)	9,8	9,4	9	**8,6**
% Over-transfusion (Hbpost >=10g/dl)	29	18	7	**6**

P22

Can Patient Blood Management help us achieve zero emissions?

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Introduction: Healthcare leaders and organizations must reduce wasteful consumption, and we have both the responsibility and the opportunity to chart a path to net-zero emissions. Doing so can improve health, protect health care delivery by minimizing disruption, generate economic benefits, and establish the health care sector as a leader on climate action. The Patient Blood Management programs, by reducing unnecessary transfusions, can help us obtain more plasmatic blood derivatives, with less energy consumption. However, we have to take the initiative and implement measures to reduce the carbon footprint. We present the initial results of the possible impact of our PBM program in our community in 2017 to reduce carbon footprint.

Material and methods:
Carbon footprint. The carbon footprint associated with blood donations and apheresis in 2020 has been calculated. To calculate the carbon footprint, the calculation methodology published by the Ministry for the Ecological Transition and the Demographic Challenge of the Government of Spain has been followed. The calculation has been made considering both direct emissions (scope 1) and indirect emissions associated with electricity consumption (scope 2) https://www.miteco.gob.es/es/cambio-climatico/temas/mitigacion-politicas-y-medidas/calculadoras.aspx. Within the section on direct emissions, the consumption of the gas boiler for heating the building and the consumption of diesel from the bus used as a mobile unit for donations outside the premises have been considered. As indirect emissions, the total electrical energy consumed in the building has been accounted for; including both the part of blood extraction, its conservation, and the rest of consumption linked to the merely administrative activity of the center.
Electrical consumption. Finally, the electrical energy produced by the 52.47 kWp photovoltaic plant installed on the roof of the building itself and intended exclusively for energy self-consumption (without dumping surpluses into the network) has also been valued. The data on donation, collection, fractionation and supply of blood components and delivery of plasma to industry were obtained from our management software eDelphyn® version 10 (from Hemasoft SA, Valladolid, Spain).

Results: Since the peak of the historical series in 2016, the total donation has decreased by 3.11%, but the donation of whole blood, due to the reduction in red cell concentrates clinical use (-13.41%), despite the increase in population, decrease 11.8%. Figure 1 shows the evolution blood component use. On the other hand, electricity consumption since the maximum has decreased by 7.14%, but discounting self-production, the reduction in electricity consumption exceeds 23.6% (more than double the consumption of red blood cells). Table 1 shows the evolution of electricity consumption, total donation, whole blood, components obtained. Figure 2 shows external electrical consumptions
Carbon footprint. In 2020 an estimated carbon footprint of 130315.84 kgCO2 has been estimated. With a total of 22,952 donations in 2020 (20,316 blood and 2,636 apheresis), the specific consumption per useful donation has been 25.1 kWh/donation, which has meant a carbon footprint of 5.67 kgCO2/donation. However, it is equivalent to 4.97 Kg per component for clinical use supplied and only 2.79 kg CO2 estimated per component obtained (including sent for industrial fractionation).

Conclusions: PBM programs can help us reduce the consumption of blood products, obtain more plasma to obtain plasmatic blood products and reduce electricity consumption. Our experience shows that almost 25% reduction is possible, however we need to do more to reduce our carbon footprint (even if it is half of what the NHS recently published).

Figure 1

External electrical consumption adjusted to production and consumption
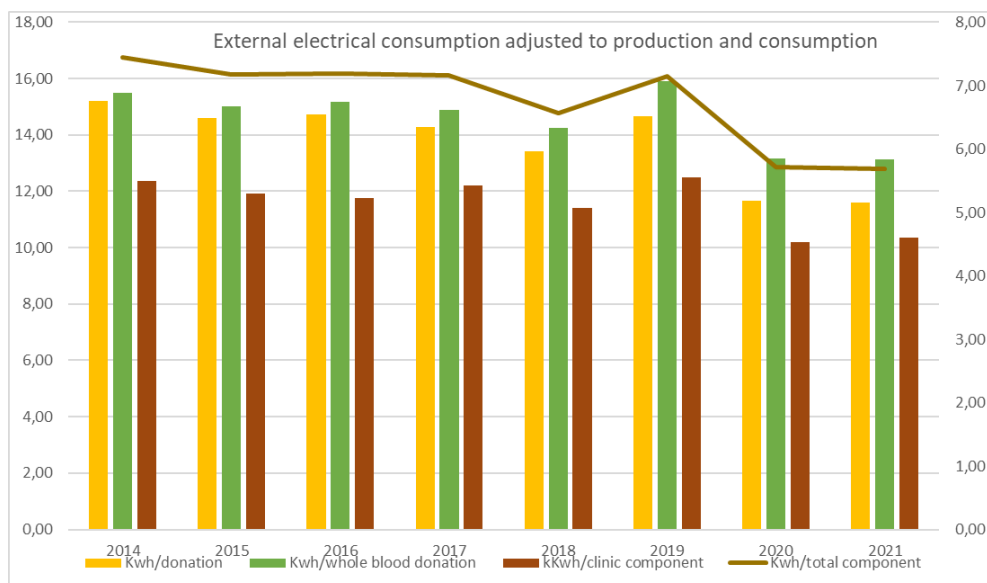
Table 1

	2014	2015	2016	2017	2018	2019	2020	2021
Tolal Electrical Consumption (KwH)	366061,5	373444,382	377081,651	347054,615	323952	351281,37	331118,75	350170,58
External supply consumption	366061,5	373444,382	377081,651	347054,615	323952	350389	267506	287982
Total Donations	24096	25599	25631	24289	24161	23910	22965	24833
Kwh/donation	15,19	14,59	14,71	14,29	13,41	14,65	11,65	11,60
Whole Blood donation	23619	24868	24869	23321	22735	22011	20315	21933
Kwh/whole blood donation	15,50	15,02	15,16	14,88	14,25	15,92	13,17	13,13
Clinical Component use	29582	31344	32059	28430	28376	28078	26239	27771
kKwh/clinic component	12,37	11,91	11,76	12,21	11,42	12,48	10,19	10,37
Total Units Obtained	49198	51988	52389	48463	49352	49000	46750	50612
Kwh/total component	7,44	7,18	7,20	7,16	6,56	7,15	5,72	5,69

Figure 2
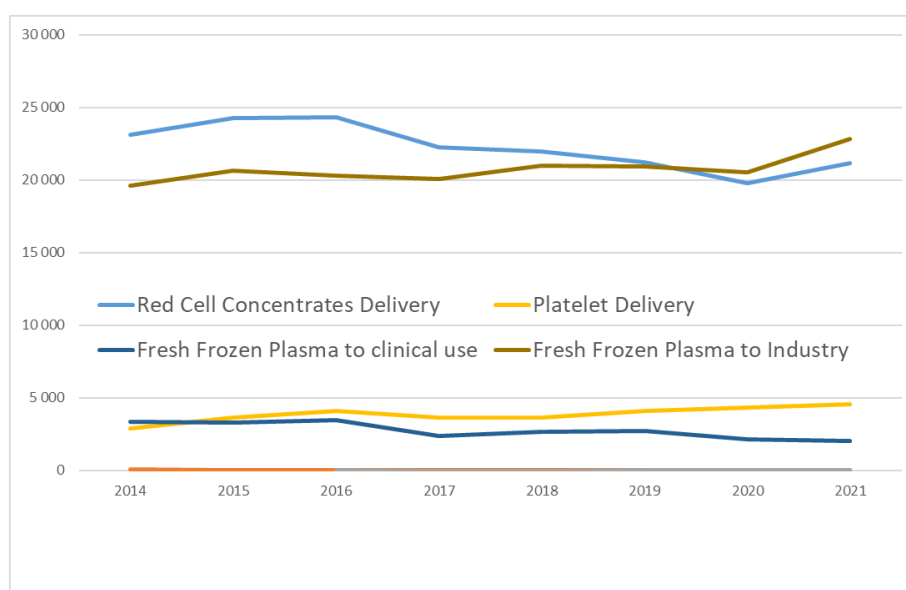
P23

Intraoperative cell salvage in patients undergoing elective open AAA surgery experiencing massive blood loss

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Introduction: Over 50 patients undergo open elective AAA surgery in Oxford per year. We previously showed that an individualised, targeted transfusion management strategy with intraoperative cell salvage (ICS) helped avoid allogeneic transfusion in 171 patients undergoing elective open AAA surgery [1]. We now investigate patients experiencing >50% blood loss during open AAA surgery - which is one definition of 'massive blood loss [2]. We examined whether ICS was effective and the effects on coagulation and blood product usage.

Methods: We analysed data between 2016-2021 on patients undergoing open elective AAA surgery with >50% blood loss. Each patient was discussed pre-operatively by the haemostasis practitioner, anaesthetist & surgeon to determine the management parameters. ICS management typically included 4-8 re-infusions of autologous blood, at specific timepoints. Standard anaesthetic techniques were employed. Point of care testing using thrombelastography (TEG), ACT and ABG analysis were used to determine transfusion needs. Tranexamic acid was administered in response to TEG fibrinolytic changes.

Results: Blood loss ranged from 50-174% (mean 68 ± 27%). Intraoperatively, no patient was transfused blood and 1 patient received FFP, whilst postoperatively 1 patient received allogeneic blood and 1 unit of platelets and cryoprecipitate. Unexpectedly, whilst 20% of our patients for elective open AAA are female, only 1/52 was female in this group. No patients had TEG changes indicative of fibrinolysis or coagulopathy by the end of surgery. Mean fall in Hb from pre-op to end-op was 5 ± 13g/l

Conclusion: In these patients experiencing massive blood loss during elective aortic surgery, we have shown that a dedicated ICS practitioner can influence the outcome of surgery. In particular, the ability to tailor the ICS machine protocols in response to sudden blood loss to facilitate the return of blood to the patient, plus the expertise in monitoring and assisting the anaesthetist in managing the coagulation state, helped to produce these impressive results. Our results also highlight the unexpected maintenance of coagulation in patients with massive blood loss – contradicting current guidelines for the management.

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P24

Impact of COVID 19 pandemic on hospital Patient Blood Management (PBM) programs. Comparative analysis 2019-2020 of 40 hospitals participating in the MAPBM project

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Background: The COVID pandemic has affected the volume of surgical activity, especially in elective surgery. We hypothesize that such impact has not only been in a lower number of procedures, but also in the ability to perform PBM guideline-concordant interventions, since the patients were scheduled with shorter time.
The objective of the study is to evaluate the impact of COVID waves on hospital PBM programs, especially the treatment of preoperative anemia, and on patient outcomes.

Methods: Comparative study of PBM measures across 5 bleeding procedures (hip and knee arthroplasty, colorectal cancer, heart valve, hip fracture surgery, gastrointestinal bleeding) performed between 2019 (pre-COVID) and 2020 (COVID) in 40 Spanish hospitals participating in the annual MAPBM benchmarking program. The measures studied include treatment of preoperative anemia, the incidence of in-hospital COVID, length of stay and mortality.

Results: Annual activity fell by 20% overall, with orthopedic surgery decreasing the most (28-41%), colorectal cancer surgery by 25%, heart valve surgery by 23%, and femur fracture surgery by 7 %, despite being an emergency. The incidence of COVID was 5.2% in patients operated for hip fractur, 10.8% gastrointestinal bleeding and 2.8% in heart valve surgery.
The treatment of preoperative anemia in patients was slightly higher compared to the previous year, except for colorectal cancer, which was reduced by 5%, although it had no impact on the number of patients who arrived anemic at surgery.
Hospital stay was significantly reduced in elective surgery almost 9%. Mortality was significant higher in hip fractures, gastrointestinal bleeding and heart valve surgery patients but significant less in laparoscopic cancer surgery patients.

Conclusions: The most important impact of the pandemic was on the activity carried out during 2020, especially in elective surgery and surprisingly in colorectal cancer. The incidence of Covid 19 had an impact on morbidity and mortality in un-deferred procedures, but minor in elective surgery. The treatment of preoperative anemia was maintained during Covid time despite programming difficulties, although the correction of anemia remains very low and further efforts should be put in place to improve it.

P25

Autotransfusion: Using a patient specific technique may be the critical factor in reducing need for blood transfusion in patients with blood loss greater than 50% of circulating volume

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Introduction: Data from our institute in the last 6 years shows exceptionally low transfusion rates of Blood and coagulation products in patients undergoing AAA open repair with blood loss greater than 50 % of estimated circulatory volume (N=53). We reviewed the technique used by our autotransfusion operators.

Technique: Patient measured weight (adjusted where appropriate) is used to estimate circulating volume (ECV) (Nadler's formula) and using arterial blood gas (ABL) the lowest acceptable haematocrit (HCT) trigger is established. Using the calculation (ECV x (HCTinitial - HCTfinal))/(HCTinitial) an acceptable blood loss tolerance is quantified. The autotransfusion system (Sorin XTRA, Livanova plc) uses an optimal wash quality setting for the greatest return rate. Critically operator uses multiple re-infusions of salvaged blood to maintain Hb/Hct within the established tolerance level, particularly prior to cross-clamp release. Indicative Hb calculations for both blood loss and returns ratio allow for predictive intra-operative Hb alignment (vol $\approx$ g/L $\downarrow\uparrow$) . A baseline thrombelastogram (TEG) is performed to establish a functional haemostasis profile, repeated at operators' discretion. Results are simultaneously displayed in blood bank and guided replacement is jointly undertaken where necessary. Heparin administration between 50-75 IU/Kg is monitored via activated clotting time (Hemochron Signature Elite). After baseline measure is taken, values of 200-240s are expected to establish if heparin response has reached a plasma concentration of 0.6 IU/ml to 0.8IU/ml. These values are repeated at operator discretion and heparin levels adjusted as required.

Results: Pre-operative Hb (g/L) was 136 +/-15.4. Post operative day 1 Hb = 122 +/-16.3. Estimated blood loss was 4122ml +/-1470ml. Autotransfusion blood return was 1975ml +/-780ml. re-infusion frequency was (4.1 +/-1.4). No patients received intra-operative allogenic blood. 1 patient received intraoperative Fresh Frozen Plasma (1.9%). Post-operatively, 1 patient received blood (1.9%), 1 patient received patients received platelet transfusion (3.8%).

Conclusion: We believe that patients benefit from an individualised autotransfusion strategy. We apply a blood tolerance window, recurring to repetitive salvage infusions to avoid acute anaemia and preserve perfusion. Using this technique to maintain endothelial oxygenation and hopefully forestall coagulopathy, alongside monitored weight-adjusted heparin and TEG targeted analysis appears to give improved interventional outcomes.

P26

A service development project to increase the use of intra-operative cell salvage in a district general hospital trust in the UK

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Introduction: The association of anaesthetists recommends that intra-operative cell salvage (IOCS) should be used for surgical procedures where more than 500 mls blood loss is expected. They also recommend a nominated clinical lead and coordinator for cell salvage. We were providing very low numbers of IOCS in our hospitals and aimed to develop this service

Methods: We sought advice from our regional patient blood management group to gain insights into setting up a IOCS service. A standard operating procedure document was developed and new cell salvage machines were purchased. The trust appointed a blood conservation coordinator who trained theatre staff members along with advanced users who could support others. Audit data was collected each time that IOCS was used and the data analysed for the calendar year 2021.

Results: IOCS is now a 24/7 service in our hospitals, covering two maternity and fourteen general theatres for both elective and emergency surgery. In 2021 we used IOCS in collect-only mode on 1,661 occasions and re-infused allogenic blood in 593 of these cases, compared to 2018 where it was used in collect-only mode 37 times and reinfused in 9 cases. During 2021 we re-infused 238,14 2 mls of autologous blood. IOCS was used for four main surgical specialties: Obstetrics accounting for 88% of usage, Trauma & Orthopaedics 4%, Vascular 4% and Urology 3%.

Conclusions: In four years we have established an IOCS service that is re-infusing a large amount of autologous blood. Combined with other blood conservations strategies we have adopted, such as the use of ROTEM, we believe IOCS to be helping our patients by reducing postoperative anaemia and avoiding or reducing allogenic blood transfusion and its associated risks. Despite the costs of implementing and running our IOCS service we still estimate an overall reduction in costs. Collaboration and support through a regional patient blood management group has been extremely helpful in establishing the hospital service rapidly.

Table 1

Surgical speciality	Number of cases ISC collected	Collection/re-infusion ratio (%)
All specialities	**1661**	**36**
Obstetrics	1469	30
Trauma & Orthopaedics	72	72
Vascular	71	93
Urology	33	76
General	5	100
Gynaecology	5	100
Gynae-oncology	4	75
Cardiology	1	

Figure 1
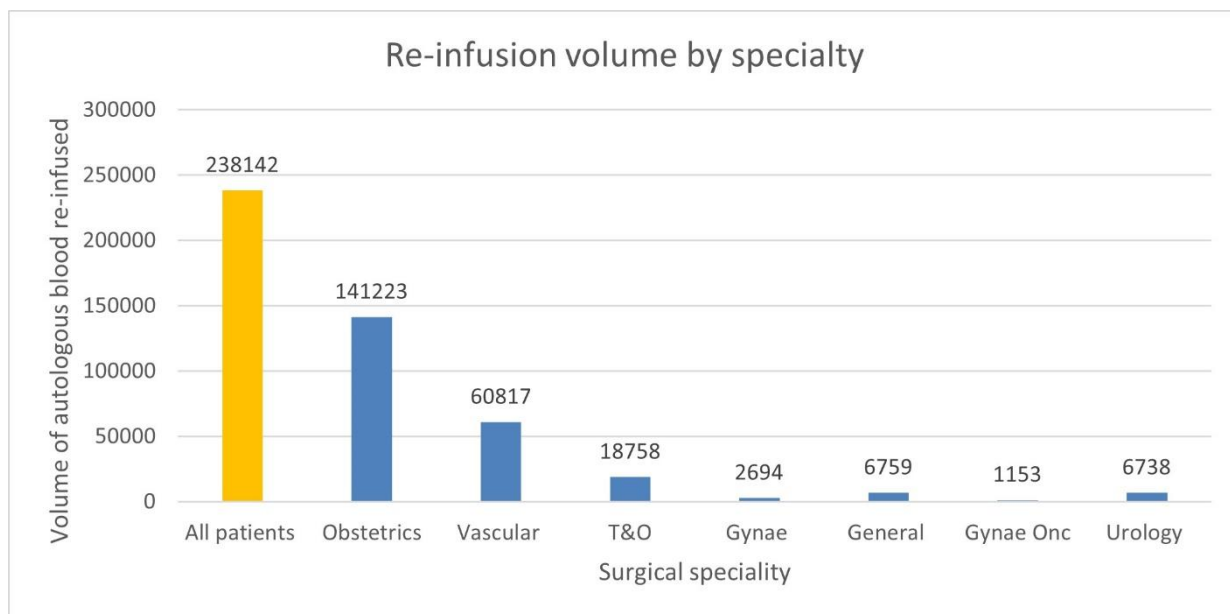
Figure 2
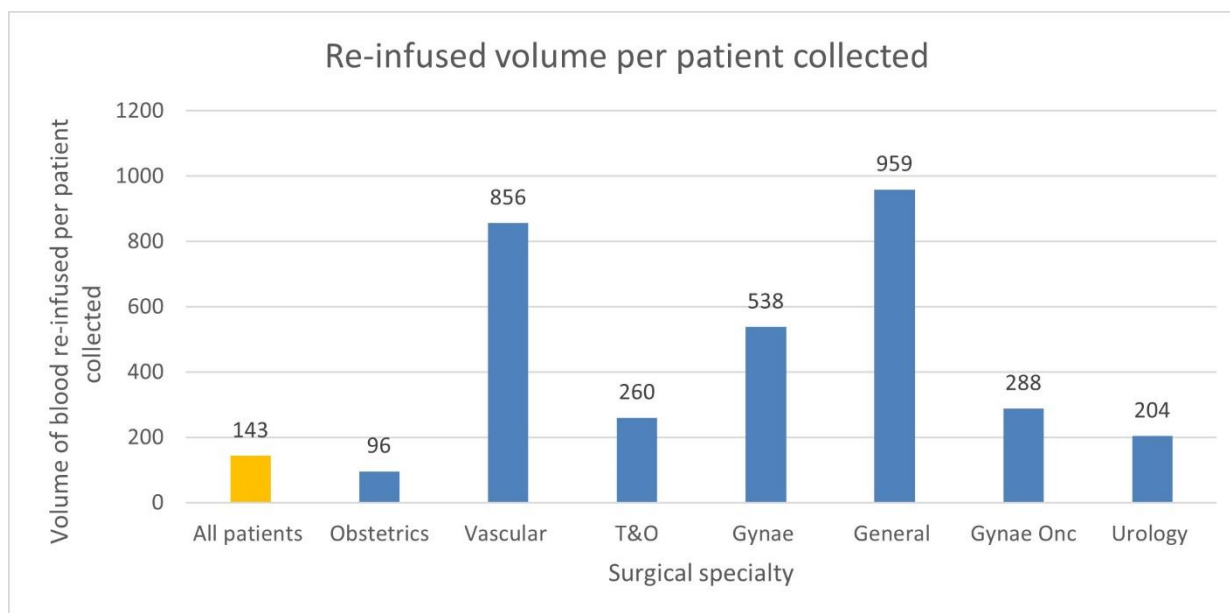
P27

Is global accessibility of cell salvage in obstetric care in sight?

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Introduction: Obstetric haemorrhage remains the leading global cause of death in pregnant women. In the management of obstetric haemorrhage, timely transfusion of blood and blood products plays a crucial role. Various studies have shown that cell salvage effectively reduces the need for donor blood transfusion. Thereby contributing to transfusion safety considering the risks of adverse events and mortality associated with donor transfusion.
Although recommended by the National Institute for Health and Clinical Excellence, the lack of consensus on the procedure's cost-effectiveness has formed a hurdle to global routine use. In the United Kingdom, retrospective studies have shown that cell salvage is an appropriate expenditure to reduce the use of allogeneic blood. The following large SALVO trial found routine cell salvage in caesarean sections unlikely to be considered cost-effective4. We hypothesized that a simple inexpensive filtration technology to cleanse shed blood, recapture viable healthy cells for re-infusion increases cost-effectiveness. Moreover, an accessible salvage system could also unlock broader use of cell salvage in the emerging world.

Methods: The clinical effectiveness of such a system depends upon a number of factors, including speed and ease of usage, cost, effectiveness of removal of solutes as well as maintenance of sterility. As a first step we ran a pilot in our obstetric department, using the system in caesarean sections and vaginal deliveries. As a control for blood quality, a centrifugal cell saver was used in parallel. Blood quality was determined by the haemoglobin concentration, markers for amniotic fluid contamination and haemolysis, fetal red blood cells, albumin, bacterial contamination, heparin, and coagulation profile.

Results: While patient recruitment is still underway, initial results showed that the new filter technology produces blood cells of comparable quality to the centrifugal cell saver. In a caesarean section with blood loss of 1200ml, both systems were used in parallel to process half of the lost blood cells. The starting haemoglobin before processing was 31 g/L. After processing with the filter technology, a haemoglobin of 33 g/L was achieved. The cell saver achieved a haemoglobin of 40 g/. Alpha feto protein concentration – as a marker of amniotic fluid– was reduced by both processing methods. The total load of alpha feto protein after processing with the accessible filter was reduced by 72%, versus 82% with the centrifugal device.

Conclusions: Filtration technology represents a safe alternative for cell salvage in the obstetric setting when centrifugal technology is not available due to lack of cost-effectiveness or other reasons.
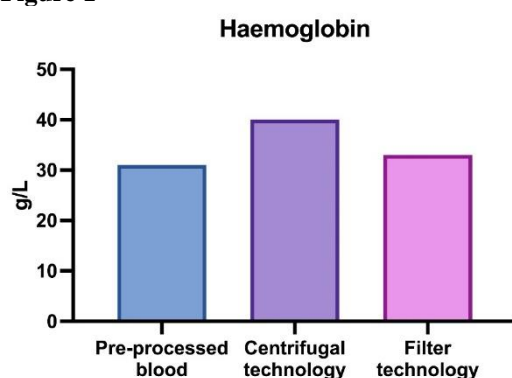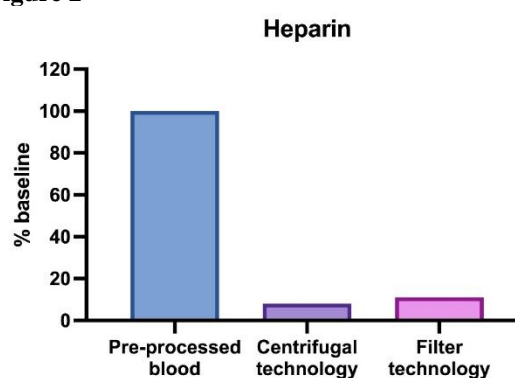
Figure 1

Haemoglobin

Figure 2

Heparin

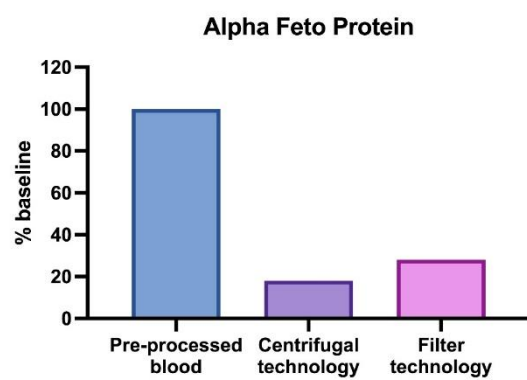**Figure 3**   **Figure 4**

P28

Is surgical smoke a relevant contamination for salvaged autologous blood?

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Introduction: Surgical smoke is a known hazard to staff and potentially even for patients.[1] Surgical smoke contains several toxic substances, cancer cells and even virus particles.[2] In order to remove surgical smoke from the operation field standard surgical suction devices are used . When cell salvaging is applied, surgical smoke is sucked into a reservoir along with the wound blood. The degree of contamination of the wound blood which is later retransfused to the patient after processing with an autotransfusion is still subject to research.

Methods: Two types of lab experiments and a clinical study were conducted. At first 5μg, 15μg and 50μg of the known electrocauterization product toluene[3] were added to ABO-matched banked blood and fresh frozen plasma. In 6 experiments this blood was processed with the autotransfusion device XTRA. The amount of toluene was quantified using a gas chromatograph connected to a flame ionization detector (GC/FID). The elimination rate was calculated. In a second experiment slices of pig skin were cut with an electrocautery at 60W. The emerging smoke was sucked into a cell salvage reservoir followed by a washing process with an autotransfusion device. In 5 experiments samples were taken after 5, 10 and 15 min. The samples from the reservoir and the product were analysed by GC/FID. An averaged elimination rate of the detected features was calculated. In a clinical study, blood samples were collected from 6 patients from the reservoir during cardiac surgery and analysed by GC/FID.

Results: The autotransfusion device XTRA was capable of removing 92% toluene from the processed blood. The detected contaminants from the second type of experiments were removed with an elimination rate of 97.9%. In the clinical study only small amounts of potential contaminants were detected.

Conclusions: Cell salvage devices are capable of reducing the amount of surgical smoke contaminations in wound blood. The risk for the patient even from small contaminations in the product has not been evaluated yet. Therefore, the suction of surgical smoke into the cell salvage reservoir should be avoided.

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P29

Combined platelet and red blood cell recovery using same™ by i-SEP autotransfusion device during on-pump cardiac surgery: the i-TRANSEP study

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Introduction: While centrifugation-based autotransfusion devices can only salvage red blood cells (RBC), the SAME™ device (Smart Autotransfusion for ME, i-SEP, France) is an innovative filtration-based autotransfusion device able to salvage both RBC and platelets without significant impact on cell integrity and function (in vitro data)1.
The objective of this first clinical study was to evaluate the safety and performance of the SAME™ device during on-pump cardiac surgery, with a specific focus on platelet recovery rate and functionality.

Methods: Adult patients without anemia and thrombocytopenia undergoing on-pump elective isolated cardiac surgery were included in this prospective, multicenter, single-arm study. The device was used intraoperatively to treat shed and residual cardiopulmonary bypass blood. Blood samples were collected before treatment, from the blood collection reservoir and after treatment, in the reinfusion bag, for each treatment cycle.
Main safety and performance endpoints were assessed for all treatment cycles (heparin and free hemoglobin washout and cells recovery). Secondary endpoints included platelet recovery, activation state and function (flow cytometric analysis of platelet glycoproteins), transfusion and adverse events up to 30 days.

Results: Study enrolled 50 patients (88% men), of median age 69 (25th-75th - 60-73) years. Cardiac procedures included isolated CABG (35%), valve surgery (53%) and aortic root surgery (12%). Median reinfused blood volume was 527 (372-684) mL corresponding to the treatment of 1755 (1244-2290) mL of salvaged blood during 3 treatment cycles (2-4, min:1, max:9). Treatment processing time was 5.6 (5.0-6.2) min for 500mL of salvaged blood. The RBC yield per cycle was 88.5 (80.8-95.0) % with post-treatment hematocrits of 43.2 (39.4-45.9) %. Removal ratios for heparin and free hemoglobin were respectively of 99.6 (98.0-100.0) % and 93.7(90.6-96.3) %. No adverse device effect was reported.
Median platelet recovery was 52.4 (44.5-59.9)%, with post-treatment whole blood counts of 129±49G/L. Platelet recovery was stable across successive treatment cycles. In patients with ≥4 treatment cycles, the recovered platelets quantity was 91x109 (73x109-121x109). No allogeneic platelet transfusion was needed. Platelet activation state and function, evaluated by flow cytometry, was found unaltered by the device as demonstrated by a limited platelet activation and a strong response to thrombin-pathway stimulation.

Conclusions: The i-TRANSEP study demonstrated the performance and safety of the SAME™ by i-SEP device during on-pump cardiac surgery, with high washing performance, good RBC recovery and a fast-processing time. In addition, half of platelets were recovered without significant impact on their function, allowing further prospective evaluation of the device on perioperative bleeding and transfusion requirements.

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Anaemia Effects and Management

P30

Review of the iron status in a population of pregnant women

Saioa Zalba[1], Juan Rodríguez[2], Elena Martín[3], Idoia Múgica[1], Maite Osinaga[3], Gabriel Cerdán[3] and José Antonio García-Erce[4]
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Introduction: Data on the prevalence of iron deficiency anemia during pregnancy vary depending on the country, from 14% in developed countries to 56% in developing countries. Anemia increases maternal, fetal, and newborn morbidity and mortality. Its effects include intrauterine growth retardation, cognitive and/or psychomotor retardation, higher rates of preterm deliveries and cesarean sections, as well as less tolerance to hemorrhage during childbirth with increased transfusion risk. Due to the high prevalence of iron deficiency anemia and the detrimental effects mentioned, its early detection and approach is essential within the Patient Blood Management (PBM) programs of our health areas. For the correct application of these programs, we believe that an initial prevalence study is necessary that will place us at the starting point.

Methods: The ferrokinetic study per trimester of all pregnant women in a general hospital for one year (July 2020 – June 2021) was collected prospectively. The 147 pregnant women who have carried out the three quarterly check-ups in that period have been analyzed. Hemograms were performed on the Beckman Coulter DxH900 autoanalyzer and ferrokinetics on the Abbott Alinity. The database is extracted from Roche Diagnostics Art program (version 1.2.0). The statistical study is carried out with the IBM SPSS program (v18.0). In our study we have analyzed anemia according to the criteria established by the World Health Organization (WHO: Anemia if Hb<11g/dl in the first and third trimesters of pregnancy and Hb<10.5g/dl in the second trimester) and according to the criteria of Beutler & Waalen (mean Hb-1.65ds). Absolute deficiency was defined according to the classic criteria (ferritin <30) or according to the American Gastroenterology Association (AGA) as ferritin <45.

Results: Results are described in Table 1 and Table 2.

Conclusions: The population studied has a lower rate of anaemia than published series, the prevalence of absolute iron deficiency is also low. The AGA iron deficiency criteria are more sensitive, presenting iron deficiency in more than 50% of anaemic pregnant women, compared to the WHO criteria, which do not reach that percentage in any of the trimesters. These results question a possible underdiagnosis with the most used criteria, which urges us to carry out an extension of the study to look for the own anemia and iron deficiency cut-off points, adapted to our population for an adequate implementation of a PBM program.

Table 1

GESTATION TRIMESTER	**First Trimester: T1**	**Second Trimester: T2**	**Third Trimester: T3**
Mean **Hb** g/dl (IC 95%)	13.05 (12.89-13.21)	11.54 (11.38-11.69)	12.4 (12.22-12.60)
Mean **Ferritin** ng/dl (IC 95%)	47.9 (40.90-54.90)	13.36 (11.35-15.38)	23.75 (21.01-26.49)
TSAT mean (IC 95%)	25.33 (23.53-27.13)	14.53 (13.15-15.91)	17.79 (15.95-19.63)
Absolute Iron Deficiency *Ferritin<30ng/dl*	2.7% (n:4)	4.8% (n:7)	2.7% (n:4)

TSAT: transferrin saturation (%)

Table 2

Trimester	WHO criteria			Beutler & Waalen criteria		
	T1	**T2**	**T3**	**T1**	**T2**	**T3**
Anaemia	3.4% (n:5)	11.6% (n:17)	13.6% (n:20)	4.8% (n:7)	4.8% (n:7)	7.5% (n:11)
Absolute Iron Deficiency*	40% (AGA: 60%)	23.5% (AGA: 58.8%)	20% (AGA: 65%)	42.9% (AGA:57.1%)	42.9% (AGA: 57.1%)	18.2% (AGA: 54.5%)
Statistical significance**	p= 0.005 (p: 0.002)	p= 0,004 (p: 0,002)	p <0.001	p <0.001	p= 0.002 (p: 0.074)	p= 0.028 (p: 0.001)

*percentage of pregnant women with anaemia.
**In the statistical analysis of the contingency tables (comparison of proportions), p was estimated by Fisher´s exact test because the expected theoretical frequencies were less than 5.

P31

Evolution of anaemia in pregnant women before and during the COVID-19 pandemic

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Introduction: In Europe, a 25% prevalence of anaemia is estimated in pregnant women.
Gestational anaemia is defined based on hemoglobin (Hb) and the trimester of pregnancy and the criteria vary depending on the different organizations or societies.
Regardless of the variability of criteria, the pregnant population in our area had a prevalence higher than the European average. Aware that anemia during pregnancy is associated with preterm delivery, perinatal morbidity and mortality, infectious disease and transfusion requirements, it was decided to analyze this circumstance and apply a "Patient Blood Management" (PBM) program to reduce this prevalence.

Material and methods: The analyses carried out from July 2019 to June 2021 have been collected retrospectively, separating two periods: P1 July 2019-June 2020 (prior to the PBM program) and P2 July 2020-June 2021 (post-application of the PBM program and coinciding with the pandemic COVID-19).
The prevalence of anaemia overall and by trimesters has been analyzed and compared by periods according to the criteria of the Spanish Society of Hematology and Hemotherapy (SEHH: anemia if Hb<11g/dl in the first and third trimesters of pregnancy and Hb<10.5g/ dl in the second trimester), the Classic criterion (mean Hb -2 DS) and the Beutler & Waalen criterion (mean Hb -1.6 DS).

Results: Complete follow-up of 231 pregnancies has been obtained, with an overall prevalence of anemia of 23.4% (54 pregnancies) (Table 1). If we analyze the data in the different periods (P1: before the pandemic and P2: during the pandemic), a higher prevalence of anemia is detected in P2 (29.3% vs. 20.5%. X2 p>0.05) (Table 2). The differences observed in the mean Hb between each of the trimesters were significant globally and for each period separately (T Student p<0.05). (Table 3). Regarding the evolution of anemia during pregnancy, we see how during COVID-19 the risk of reaching the third trimester with anemia, having anemia in the first and/or second trimester is greater with any of the three criteria.

Conclusions:
The effect of the COVID-19 pandemic has not allowed the PBM program to be properly applied and has even led to an increase in the prevalence of anemia. It is necessary to complete this study with the clinical and ethnic variables that allow us to rule out or find other factors that may have influenced. Likewise, it is necessary to review the anemia treatment protocol, optimize it and carry out a new comparative study after its reimplantation.

Table 1

	Pregnancies with anaemia					
Gestational Trimester	SEHH criterion		Classic criterion		Beutler&Waalen	
1° trimester (T1)	N: 5	2.2%	N: 7	3%	N: 10	4.3%
2° trimester (T2)	N: 24	10.4%	N: 6	2.6%	N: 11	4.8%
3° trimester (T3)	N: 37	16%	N: 11	4.8%	N: 15	6.5%

Table 2

Period	**P1**			**P2**		
Mean Age (years,IC95%)	32.3 (31-33.7)			32 (31-32.9)		
Trimester	T1	T2	T3	T1	T2	T3
Mean Hb (g/dl, IC95%)	13.0 (12,8-13,2)	11.5 (11,3-11,7)	11.8 (11,6-12,1)	13.1 (12,9-13,2)	11.5 (11,4-11,7)	12.4 (12,2-12,6)

Table 3

Criterion	SEHH		Classic		B&W	
Period	P1	P2	P1	P2	P1	P2
Pregnant women with anemia at T1 and/or T2 who have anemia at T3	0%	37%	8,3%	25%	5,6%	27,8%
Relative Risk of anemia in T3 when you have anemia in T1 and/or T2 (P2 vs P1)			**1** (IC95%: 0.4-2.5)		**3,2** (IC95%: 0.5-21.9)	
Bilateral significance (Fisher´s exact test)	0,026		1		0,316	

P32

Iron status in preoperative patients with a hemoglobin level >13 g/dl

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Introduction: The starting point of Patient Blood Management (PBM) programs is the optimization of preoperative Hb within the first pillar. The need to raise the pre-surgery Hb threshold to at least 13g/dl in both men and women is widely extended and accepted. Even so, it is clear that there are patients who have exceeded this threshold and have insufficient iron for an adequate post-surgical recovery.

Material and methods: All the preoperative tests in the hospital within the specialties included in the PBM program during the second half of 2021 have been analyzed. Hemograms were performed with Becman Coulter DxH series analyzers and biochemical parameters of iron metabolism in Abbott Alinity.

Results: 5970 preoperative tests were carried out at the Hospital within the PBM program, 3171 in men and 2799 in women; 500 were urology patients, 271 gynecology, 680 general surgery, 4245 traumatology, 182 vascular surgery and 92 patients from other services (Table 1). Around half of the patients awaiting gynecological intervention or general surgery presented Hb levels below 13 g/dl in our series and only traumatology interventions presented levels below 13 g/dl in less than 20% of patients (22% of gynecological patients had Hb levels less than 12 g/dl) (Table 2). Almost half (49%) of women awaiting surgery with Hb between 13-13.5 g/dl have iron deficiency and almost two thirds (74%) require presurgical iron administration to optimize deposits.

Conclusions:
- The prevalence of preoperative anemia in our center is higher in general surgery and gynecology compared to other surgeries.
- We consider that the percentage of patients in the Hb range between 13 and 13.5 g/dl is small (9% of all tests and 12% of those greater than 13 g/dl), however, in women, 75% would benefit of the ferrokinetic study, since it will allow optimization of pre-surgical iron deposits.
- It is important to complete this study to assess up to what level of Hb the ferrokinetic study should be considered necessary, as well as whether there are other different parameters that guide an underlying iron deficiency, together with differentiated studies according to the type of intervention.

Table 1

Preoperative Hb		Surgical services	% of patients
Hb<13g/dl: 18% (N=1098)		Urology (n:137)	27
		Gynaecology (n:119)	44
		General Surgery (n:158)	58
		Traumatology (n:577)	16
		Vascular (n:45)	25
Hb>=13g/dl: 82% (N=4887)	Other preoperative Hb ranges		
	Hb 13-13,5g/dl: (N: 567) **12 %**	Urology	2
		Gynaecology	**16**
		General Surgery	5,5
		Traumatology	8
		Vascular Surgery	2
	Hb>13,5g/dl: (N:4.320) 88%		

Table 2

Sex	304 males				949 females			
Preoperative **Hb** ranges (g/dl)	**12 - 12,9**		**13-13,5**		**12-12,9**		**13-13,5**	
N° patients	157	%	147	%	529	%	420	%
Iron Status								
Absolute iron deficiency without inflammation (ferritin<30ng/dl)	39	25	28	**19**	221	**42**	117	**28**
Absolute iron deficiency with inflammation (ferritin<100ng/dl, IST<20%, PCR>5mg/L)	29	18,5	23	**16**	90	**17**	87	**21**
Iron sequestrum (ferritin>100ng/dl, IST<20%, PCR>5mg/L)	29	18,5	21	14	53	10	40	9
Insufficient deposits (ferritin 30-100ng/dl, IST>20%)	14	9	23	16	98	18	106	25
Iron repletion* (ferritin>100ng/dl, IST>20%)	46	29	52	35	67	13	70	17

Objective to be achieved with the first PBM pillar before surgery

P33

Correlation of preoperative hemoglobin levels in tumor staging of colorectal carcinoma

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Introduction: Anemia is the most common blood abnormality in patients with colorectal cancer (CRC). Anemia has been associated with decreased survival in neoplastic patients. It is generally a moderate anemia, although 15-23% of patients require at least one transfusion.

Material and methods: We performed a retrospective study of all patients who underwent surgery for primary CRC in a regional hospital during one year and a half (from November 2019 to March 2021).

Results: Data have been analyzed with the statistical program IBM SPPS Statistics version 22.0. Comparisons of quantitative values have been made with Student T-tests for independent samples. A total of 128 patients were recruited during the study period, of which 27 were excluded due to non-tumoral pathology. Therefore, 101 patients were finally included: 64 patients were men (63.4%) and 37 women (36.6%) and had a mean   age at diagnosis of 69.9 years Standard deviation (SD): 1.09 years.

The mean preoperative haemoglobin (Hb) level was 12.79 (SD:0.22). The mean preoperative Hb levels of each tumor stage group are shown in Table 1. Means of proeperativeHb level between TNM stages were compared. There were no significant differences in mean HB between TNM stages except between stages I and III (p=0.043). However, we observed that patients with a higher TNM-stage have lower mean Hb levels, with a difference of up to 1.4 g/dL points between the lower and higher stages, which is clinically relevant.

Table 1. Preoperative Hb levels of each tumor stage group.

TNM STAGE	PATIENTS (N)	Mean Hb mg/dL (SD)	HB MIN LEVEL	HB MAX LEVEL
0- I	39	13.43 (0.29)	9.9	16.8
II	35	12.46 (0.39)	7.6	16.9
III	23	12 .3 (0.51)	7.6	16.8
IV	4	12.23 (0.51)	10.8	13

Conclusions: Although our study did not demonstrate a relationship between preoperative Hb levels and TNM-stage, perioperative Hb levels may be related to tumor staging in CCR, which is clinically relevant. It is important to take this into account during the perioperative period for better oncologic outcomes.

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P34

Non-anaemic iron deficiency – a marker for poor outcome in women having elective cardiac surgery

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Introduction: The WHO defines anaemia as a haemoglobin (Hb) of less than 130g/l in men and 120g/l in non-pregnant women. This discrepancy disadvantages women undergoing cardiac surgery with borderline anaemia (Hb 120-129g/l) as they share the same peri-operative risks as anaemic patients with increased Packed Red Cell (PRC) transfusion and poor outcomes1. This has led to many centres using the same definition of anaemia for men and women.

Recent studies have shown that patients presenting for cardiac surgery with Non-Anaemic Iron Deficiency (NAID) have increased risk of PRC transfusion, complications, and hospital Length of Stay (LoS)2. As part of a retrospective study comparing outcomes between NAID and Non-Anaemic Iron Replete (NAIR) patients undergoing cardiac surgery, we performed a sub-group analysis to investigate whether women were more at risk than men.

Methods: All adult patients undergoing cardiac surgery in 2019 were identified and baseline data collected. Patients were grouped for analysis according to their haemoglobin, ferritin, and sex (Table 1). PRC transfusion, complications, alive at one year and LoS in ICU and hospital were compared between the groups.

Results: 537 patients were included in the study, 388 non-anaemic patients were included for sub-analysis. Women with NAID had the highest PRC transfusion with a median of 1 unit, the other groups had a median of 0 units (p<0.001). This group also had the highest transfusion need, with 55.6% requiring at least one unit PRC (p<0.001). Hospital LoS was highest in the NAID women (median 10 days, p=0.002) when compared to other groups. Median ICU LoS was 4 days for NAID women and 3 days for the NAID men and NAIR groups (p=0.127). NAID women had the highest incidence of major complications (15.6%, p=0.04) and lowest survival at one year (93.3%, p=0.07), but only the former was significant between the groups.

Conclusions: This sub-group analysis demonstrates that iron deficiency alone is a peri-operative risk factor for women undergoing cardiac surgery. Although there is limited evidence on the treatment of NAID prior to cardiac surgery, NAID women should be considered a high-risk group and offered iron replacement pre-operatively.

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Table 1: Summary of results

	NAID (hb ≥130g/l, Ferritin <100mcg/l)		NAIR (Hb ≥130g/l, Ferritin ≥100mcg/l)		p-value
	Female (n=45)	Male (n=134)	Female (n=28)	Male (n=181)	
Transfused ≥1 PRC unit (n)	25 (55.6%)	34 (35.4%)	12 (42.9%)	36 (19.9%)	<0.001
Median PRC transfusion per patient (unit)**	1 (3 [0-10])	0 (0.75 [0-8])	0 (1 [0-5])	0 (0 [0-14])	<0.001
Median LoS CICU (days)**	4 (2 [2-116])	3 (2 [1-26])	3 (2 [2-10])	3 (2 [1-47])	0.127
Median LoS Hospital (days)**	10 (9.25 [6-116])	7 (5 [4-36])	7.5 (7 [5-19])	8 (6 [4-199])	0.002
Major complication* (n)	7 (15.6%)	14 (10.5%)	3 (10.7%)	12 (6.6%)	0.04
Alive at 1 year (n)	42 (93.3%)	132 (98.5%)	28 (100%)	178 (98.3%)	0.07

*major complication defined as Clavien-Dindo grade greater than III
**median (IQR [range])

P35

Non-anaemic iron deficiency – a risk for surgical patients

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Introduction: Association between Iron Deficiency Anaemia (IDA) and poor outcome is well described. Recent evidence suggests cardiac surgical patients with Non-Anaemic Iron Deficiency (NAID) are at risk of increased Packed Red Cell (PRC) transfusion, complications, mortality, and length of stay (LoS) in hospital 1,2.
To further optimise our local Perioperative Blood Management (PBM) measures, we conducted a retrospective observational study to investigate the incidence and outcome of patients with NAID undergoing cardiac surgery.

Methods: 537 adult patients, who underwent cardiac surgery in 2019 were identified. Baseline demographic data was collected, and patients grouped for analysis according to Haemoglobin (Hb) and ferritin (table 1).
The primary outcome was to identify the number of patients presenting for elective cardiac surgery with NAID. Secondary outcomes included number of patients who became anaemic waiting for surgery, incidence of PRC transfusion, LoS in ICU and hospital, complications 90 days post-operatively, and death at one year.

Results: 179/537 (33.3 %) had NAID at presentation. While waiting for surgery, 17 (9.5%) patients became anaemic in the NAID group compared to 7 (3.3%) in the Non-Anaemic Iron Replete (NAIR) group (p=0.02). The NAID group had a higher incidence of PRC transfusion (33% vs 23%, p<0.04). The NAID group trended towards increased major complications (13.4%) and death at one year (2.4%) compared to the NAIR group (8.1% and 1.0%), this was not statistically significant. NAID and NAIR groups had the same median LoS in CICU and hospital (3 and 8 days respectively).

Conclusions: One-third of patients presenting for cardiac surgery had NAID; higher than previously reported1,2. In addition to increased transfusion, and a trend towards higher complications and mortality, the study demonstrated NAID patients are more likely to become anaemic whilst waiting for surgery over NAIR. International consensus recommends treatment of iron deficiency in surgery with expected blood loss of >500ml, but further research is needed to investigate if this reduces peri-operative risk confronted by NAID patients3.

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Table 1 Summary of results

	NAID (hb ≥130g/l, Ferritin <100mcg/l)	NAIR (Hb ≥130g/l, Ferritin ≥100mcg/l)	IDA (hb <130g/l, Ferritin <100mcg/l)	NIDA (hb <130g/l, Ferritin ≥100mcg/l)	p-value
Number (n)	179 (33.3%)	209 (38.9%)	111 (20.7%)	38 (7.1%)	
Transfused ≥1 PRC unit (n)	59 (33.0%)	48 (23.0%)	84 (75.7%)	27 (71.1%)	<0.001 (0.02)****
PRC transfusion per patient (unit)**	0.89 (1.76)	0.56 (1.47)	2.6 (3.2)	2.1(2.1)	<0.001 (0.04)****
LoS CICU (days)***	3 (3[1-116])	3 (2 [1-47])	4 (3 [1-72])	4 (2.8 [1-14])	<0.001
LoS Hospital (days)***	8 (6.8 [4-116])	8 (6 [4-199])	11 (9.5 [1-106])	13 (7.8 [5-42])	<0.001
Major complication (n)*	24 (13.4%)	17 (8.1%)	23 (20.7%)	7 (18.4%)	0.012 (0.095)****
Death at 1 year (n)	5 (2.8%)	2 (1.0%)	5 (4.5%)	2 (5.3%)	0.182

*major complication defined as Clavien-Dindo grade greater than III. **mean (SD). ***median (IQR[Range]). ****compared between NAID and NAIR group

P36

Effects of iron deficiency and iron repletion on changes in cerebral tissue oxygenation and metabolism: an in vivo near infra-red spectroscopy study

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Introduction: Iron deficiency (ID) is the most common cause of anaemia. Iron is essential for energy production via mitochondrial respiration, yet non-haematological manifestations of ID, 'brain fog' and fatigue, are underappreciated. To understand the role of iron in cortical energy metabolism, we used a novel, non-invasive near infra-red spectroscopy (NIRS) device. We examined changes in oxyhaemoglobin ([HbO2]), deoxyhaemoglobin ([HHb]) and cortical cytochrome c-oxidase ([oxCCO]), a marker for mitochondrial respiration, in mice fed control diet, iron-deficient diet, or iron-deficient diet mice treated with intravenous (i.v.) iron (ferric-carboxymaltose).

Methods: Mice were fed either iron-depleted (2-6ppm iron, n=20) or control diet (50-58ppm iron, n=10). Blood haemoglobin concentration ([Hb]) was measured weekly from a tail puncture. After seven weeks, a subset of mice fed iron-deficient diet received an i.v. FCM, thus becoming iron-repleted (IR) group (n=10). 72h post-injection, mice were anaesthetised, two optical fibres, a light source and a detector, were placed colinearly on the shaved mouse head, and changes in [HbO2], [HHb] and [oxCCO] were recorded in response to tactile stimulation (toe-pinching) hyperoxia and hypoxia.

Results: When exposed to hyperoxia, ID and IR mice had a significantly greater increase in tissue oxygenation, assessed as the difference between deoxygenated and oxygenated haemoglobin ([HbO2]-[HHb]) compared with control mice ($p < 0.0001$). Overall, [Hb] correlated positively with [HHb] during hypoxia ($p < 0.042$, $R2 = 0.16$), and negatively with [oxCCO] ($p < 0.002$, $R2 = 0.35$). Importantly, only in mice fed iron-deficient diet a significant correlation was found between [Hb] and [HbO2] ($p = 0.048$, $R2 = 0.67$), [HHb] ($p = 0.034$, $R2 = 0.71$) and [oxCCO] ($p = 0.018$, $R2 = 0.79$) in response to hypoxia, as well as during the recovery period from hypoxia ($p = 0.012$, $R2 = 0.83$ for [HbO2]; $p = 0.005$, $R2 = 0.89$ for [HHb]), and between [Hb] and [HHb] during toe-pinching ($p = 0.043$, $R2 = 0.59$). Remarkably, there was no correlation between any of these parameters in IR mice or control mice.

Conclusion: NIRS measurements taken during hypoxia, hyperoxia and toe-pinching revealed that iron-deficient diet induces significant changes in brain tissue oxygenation and metabolism, in comparison with control mice. Tissue oxygenation in mice fed iron-deficient diet is compromised even under normoxic conditions. Importantly, a single i.v. iron injection appears to rapidly improve changes precipitated by iron-deficient diet. Based on our findings, NIRS measurements of [HbO2], [HHb] and [oxCCO] offers a non-invasive in vivo examination of cerebral oxygenation and metabolism.

P37

Association between iron deficiency and risk of infections in patients undergoing cardiac surgery: a retrospective study

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Introduction: Anemia is a frequent disease that affects about 25% of the world's population (1), and for which the main etiology is iron deficiency (ID) (2). ID concerns a third of cardiac surgery patients (3), and since iron has an important role in the immune system (4) we hypothesized that ID increases infections in cardiac surgery post-operative period.

Methods: This single-centered study was based on a prospective cohort conducted in Angers University Hospital, France from 2017 to 2019, including patients in cardiac surgery peri-operative period. Clinical variables were prospectively collected, whereas biological data were retrospectively included. We searched for risk factors among several variables: anemia, ID, transfusion, thoracic artery graft, diabetes, hypertension, dyslipidemia, obesity, Euroscore II.

Results: Among 1647 patients included in this analysis, 584 (35%) were iron deficient. Iron deficient patients were at higher risk of infections, in the post-operative period of cardiac surgery than the others (9% versus 6%, $p=0.02$). Multivariate analysis found that ID (OR=1.50, $p=0.04$), history of transfusion (OR=2.39, $p=0.01$) and Euroscore II>3 (OR=2.31, $p=0.01$) were associated with a greater risk of infection. Thoracic artery graft (OR=7.89, $p<0.01$), history of transfusion (OR=3.72, $p<0.01$), Euroscore II>3 (OR=3.12, $p<0.01$), obesity (OR=2.19, $p=0.03$) and diabetes (OR=2,13, $p=0.04$) were associated with a greater risk of mediastinitis. Iron deficiency seems to increase mediastinitis without significant difference (OR=1.93, $p=0.07$). Furthermore, patients with ID were more transfused (20%) that the others (13%).

Conclusion: ID is an independent risk factor of infections in post-operative period of cardiac surgery and, although this outcome remained non-significant, seems to increase mediastinitis. Further studies are needed to investigate the impact of iron reload on this risk.

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Table 1: patients' baseline characteristics according to Iron Deficiency

Characteristics	Total cohort n=1647	Iron Deficiency		P-value*
		No n=1063 (65%)	Yes n=584 (35%)	
Age, years, mean±SD	67±11	67±11	68±12	0.89
Female gender	355 (21.5)	172 (16.1)	183 (31.3)	**<0.01**
Weight, kg, mean±SD	78±15	79±14	77±17	**0.04**
Height, cm, mean±SD	169±9	170±8	167±9	**<0.01**
BMI, kg/m², mean±SD	27±5	27±4	27±5	0.66
Redux surgery	79 (4.8)	40 (3.8)	39 (6.7)	**0.02**
EUROSCORE II, med [IQ]	1.21 [0.78-2.09]	1.15 [0.75-1.99]	1.31 [0.85-2.22]	**<0.01**
Hypertension	1077 (65.3)	678 (63.8)	399 (68.3)	0.06
Diabetes	408 (24.8)	218 (20.5)	190 (32.5)	**<0.01**
Dyslipidemia	956 (58)	628 (59)	338 (57.8)	0.64
Smoking status	187 (11.3)	116 (10.9)	71 (12.1)	0.45
Obesity ‡	449 (27.3)	285 (26.8)	164 (28.1)	0.58
Thoracic artery graft	909 (55.2)	620 (58.3)	289 (49.5)	**0.01**
Duration of Extracorporeal Circulation, minutes, mean±SD	105±57	104±60	106±52	0.63
Transfusion	252 (15.3)	135 (12.7)	117 (20)	**0.01**
Anemia ¥	289 (17.5)	146 (13.7)	143 (24.5)	**<0.01**
Hemoglobin, g/dL, mean±SD	13.8±1.6	14±1.6	12±1.2	**<0.01**
Ferritin, µg/L, med [IQ]	205 [108-345]	298 [187-427]	83 [45-168]	**<0.01**
Transferrin saturation, %, mean±SD	26±11	28±10	17±8	**<0.01**

Data presented as n (%) where applicable; *: between-group comparisons based on Chi-square test or Student t test, as appropriate.
BMI: Body mass index
Iron Deficiency: ferritin < 300 µg/mL or ferritin < 100 µg/mL and transferrin saturation ≤ 20%
‡: BMI >30 kg/m²; ¥: hemoglobin < 12g/dL for women, hemoglobin < 13g/dL for men.

Table 2: Post-operative infections according to Iron Deficiency.

	Total cohort n=1647	Iron Deficiency		P-value*
		No n=1063 (65%)	Yes n=584 (35%)	
Infection during hospitalization	114 (6.9)	62 (5.8)	52 (8.9)	**0.02**
Mediastinitis	36 (2.2)	17 (1.6)	19 (3.2)	**0.03**
Pneumopathy	34 (2.1)	21 (1.9)	13 (2.2)	0.73
Urinary tract infection	56 (3.4)	29 (2.7)	27 (4.6)	**0.04**
Catheter infection	8 (0.5)	5 (0.5)	3 (0.5)	0.9
Other infections	18 (1.1)	11 (1)	7 (1.2)	0.76

Data presented as n (%) where applicable; *: between-group comparisons based on Chi-square test or Student t test, as appropriate.
Iron Deficiency: ferritin < 300 µg/mL or ferritin < 100 µg/mL and transferrin saturation ≤ 20%

Table 3: Multivariate analysis showing the Odds Ratio for all post-operative infections according to the patients'characteristics at baseline.

	Fully adjusted model		
	OR	**[95% CI]**	**p-value**
Thoracic artery graft	**1.48**	**[0.98-2.23]**	**0.06**
Transfusion	**2.39**	**[1.46-3.90]**	**0.01**
EUROSCORE II >3	**2.31**	**[1.42-3.78]**	**0.01**
Obesity ‡	**1.51**	**[0.98-2.32]**	**0.06**
Diabetes	**1.19**	**[0.76-1.87]**	**0.43**
Anemia ¥	**1.38**	**[0.82-2.35]**	**0.23**
Iron Deficiency ⌐	**1.50**	**[1.01-2.24]**	**0.04**
Duration of Extracorporeal Circulation <90 minutes	**0.68**	**[0.41-1.06]**	**0.09**
Hypertension	**1.09**	**[0.58-1.41]**	**0.68**

‡: BMI >30 kg/m²
¥: hemoglobin < 12g/dL for women, hemoglobin < 13g/dL for men.
⌐: ferritin < 300 µg/mL or ferritin < 100 µg/mL and transferrin saturation ≤ 20%

Table 4: Multivariate analysis showing the Odds Ratio for post-operative mediastinitis according to the patients' characteristics at baseline.

	Fully adjusted model		
	OR	**[95% CI]**	**p-value**
Thoracic artery graft	7.89	[2.43-21.92]	**<0.01**
Transfusion	3.72	[1.64-8.46]	**<0.01**
EUROSCORE II >3	3.12	[1.38-7.05]	**<0.01**
Obesity ‡	2.19	[1.06-4.55]	**0.03**
Diabetes	2.13	[1.03-4.42]	**0.04**
Anemia ¥	1.37	[0.62-3.08]	0.43
Iron Deficiency ⌐	1.93	[0.95-3.93]	0.07
Duration of Extracorporeal Circulation <90 minutes	0.61	[0.28-1.36]	0.23
Hypertension	1.65	[0.65-4.19]	0.29

‡: BMI >30 kg/m²
¥: hemoglobin < 12g/dL for women, hemoglobin < 13g/dL for men.
⌐: ferritin < 300 µg/mL or ferritin < 100 µg/mL and transferrin saturation ≤ 20%

P38

POSTVenTT (POST operative Variations in anaemia treatmenT and Transfusions) study: A student- and trainee-led collaborative audit of 2730 patients undergoing major abdominal surgery in Australia & New Zealand

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Introduction: Anaemia among is common in patients undergoing surgery and negatively impacts perioperative morbidity. We aimed to assess compliance with Patient Blood Management guidelines and the impact on patient outcomes after major abdominal surgery.

Methods: The POSTVenTT Collaborative study was a student- and trainee-led, prospective, multicentre, cohort studyrun over two fortnight periods in 2021. Data included patient demographics, operation and Hb levels, any blood transfusion and follow up to 30 days. Patient Blood Management (PBM) audit standards were: 1. Preoperative anaemia management. 2. Operative Tranexamic acid. 3. Restrictive blood transfusion 4. Post-operative anaemia management.

Results: Complete datasets (>95%) were returned for 2730 patients, mean age 56.7 ± 17.3 years; 57.1% were female.
1. Preoperative anaemia was present in 28% (689/2461), 244 (35.4%) had iron studies (128 ferritin <100 µg/L) and 41 (32.0% of 128) received IV iron. Audit standard compliance was associated with a lower risk of blood transfusion (4.1% vs. 10.9%, p<0.001), complications (5.9% vs. 9.0%, p=0.01), and hospital stay (3 vs. 4 days, p=0.005).
2. Tranexamic acid was used in only 128 patients (4.7% of 2728) predominantly by gynaecology.
3. Pretransfusion Hb averaged 73.9 (SD 11.6) g/L with audit compliance in 57.5% (96/167).
4. Postoperative anaemia was common 59.3% (1227/2069). 9.9% (121/1227) received oral, and 11.1% (136/1227) intravenous iron. Severe anaemia (Hb < 100 g/L) was associated with higher 30-day readmission (20.2% vs. 9.4%, p<0.001).

Conclusion: PBM remains variable and attention to anaemia management remains a target for patient care.

P39

Preoperative anaemia in major gynaecological surgery – room for improvement?

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Introduction: Within the preoperative period patients often have multiple healthcare encounters in both primary and secondary care. As such there are numerous opportunities for anaemia investigation and low risk intervention (e.g. oral iron supplements) early in the preoperative period. Early identification, investigation and treatment has multiple benefits to the patient, organisation and society as a whole. The aim of the study was to report rates of preoperative anaemia, investigation and treatment in patients undergoing major gynaecological surgery with a view to identifying pre-existing opportunities for timely intervention.

Methods: We conducted a retrospective observational cohort study in patients undergoing major (estimated surgical blood loss >500 ml) gynaecological surgery over six months (April –September 2021) in a single tertiary referral centre. Consecutive patients were identified from the Opera theatre management system (GE Healthcare). Clinical data was collected from the patients' electronic health record. Criteria for anaemia in women was as per local and World Health Organisation guidance; haemoglobin (Hb) <120g/l. Investigations constituted one or all of iron studies, CRP, B12 and folate.

Results: Three hundred and seven patients were identified, of which 102 (33%) had documented anaemia in the preoperative period. Forty-six (45.1%) anaemic patients presented with vaginal bleeding as their primary complaint. Most common underlying diagnoses in the anaemic patients were fibroids 24.5% (n=25), ovarian cancer 36.3% (n=37) and endometrial cancer 9.8% (n=10). Median age and BMI of the anaemic patients was 57 y and 27 kg/m^2 respectively. Only 75 (73.5%) of these patients had investigations for anaemia and just 50% (n=51) of all anaemic patients had their anaemia treated preoperatively. Sixty-nine (67.6%) of these patients were still anaemic on the preoperative sample nearest to surgery (median Hb 116 g/l) and 13 (12.7%) patients required a blood transfusion preoperatively. The median length of hospital stay for surgery for anaemic patients was four days, versus two days for non-anaemic patients.

Conclusion: Anaemia in patients presenting for major gynaecological surgery is common but often not investigated or treated despite vaginal blood loss being a common presenting complaint. The reasons for this are likely to be multifactorial, however the preoperative period provides a window of opportunity for assessment of anaemia and timely low risk intervention in order to improve perioperative outcomes and reduce length of hospital stay for surgery.

P41

Targeting preoptimisation of iron deficiency anaemia in an orthopaedic cohort

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Introduction: Preoptimisation of anaemia is an established part of patient blood management, recommended by international consensus. In lower limb arthroplasty, this may reduce transfusion rate, morbidity and hospital stay[1,2]; likewise, allogeneic transfusion is associated with increased surgical site infection. In patients undergoing major abdominal surgery, iron did not reduce blood transfusion[3].
Our aim was to ensure optimal utilization of IV iron and improve targeted indication.

Methods: All elective hip and knee arthroplasty over a 2-year period (2018-2020) were included.
Databases were searched to identify patients with WHO criteria for iron deficiency anaemia (IDA) or receiving blood transfusion. The impact of preoperative Hb, MCV, and ferritin on response to IV iron was evaluated and a comparison of blood transfusion rate (BTR) between anaemic patients, who received IV iron or not, was made.

Results: 2269 patients received primary or revision arthroplasty. Incidence of IDA, with ferritin < 100mcg/l was 11%; 58% received iv iron. Average Hb rise after iron was 10.2g/l, with greater response at lower Hb and ferritin: with starting Hb 100-120g/l, Hb rise was 16.3 vs 6.4g/l when ferritin <=30 and >30 mcg/l respectively (Table 1), maximal at 5-6 weeks post iron. In patients with IDA, BTR was 8.3% in patients receiving IV iron (average preoperative Hb 11g/l) vs. 17.3% in those who did not (average preoperative Hb 118g/l). In patients with IDA and ferritin <=30mcg/l, BTR was 2% in those receiving iron versus 27% who did not.

Discussion: Demonstrated benefit of preoperative IV iron in orthopaedics patients remains inconclusive; heterogenicity in studies (emergency and elective) and time interval between IV iron and surgery play a role. In our large cohort of elective arthroplasty, patients with preoperative ferritin <30mcg/l, and time interval to surgery of >4 weeks demonstrated most benefit; transfusion rate was also reduced by preoperative administration of iron. Limitations include retrospective analysis. High quality RCTs in elective orthopaedic arthroplasty are required for definitive answers.

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2. Elhenawy AM et al. Syst Rev. 2021;10:36.
3. Richards T et al. Lancet 2020;396:1353-61 .

P42

Improved preoperative iron status assessment by biochemical and new hematimetric parameters

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Introduction: Iron deficiency anemia (IDA) is common in the preoperative period, being associated with poor outcomes. Guidelines recommend investigating patients with hemoglobin (Hb) values < 130 g/L requiring high bleeding risk surgery or a strong likelihood of blood transfusion. The WHO recommends serum ferritin (SF) as the primary measure of iron status. However, in patients with inflammation, elevated serum F and IDA may coexist. The aim of this study is to improve IDA diagnosis in surgical patients by combining new hematimetric parameters and biochemical test.

Methods: Six hundred and fifty-three subjects scheduled for knee or hip replacement surgery were included retrospectively. Demographic and clinical data were obtained from our hospital information system. The variables included were: age, gender, SF, transferrin, transferrin saturation (TSAT), C-reactive protein (CRP), Hb, reticulocyte Hb content (CHr), reticulocyte mean corpuscular Hb content (MCHr), proportion of hypochromic red cells (HYPO), and proportion of hypochromic reticulocytes (HYPOr). Only patients who met the criteria exposed in the International consensus statement on the peri-operative management of anaemia and iron deficiency for IDA with or without chronic inflammation (Figure 1), and those without anemia (Hb >130 g/dL) were included for multivariate analysis (Table 1).

Given the imbalanced number of IDA cases (N=100) and non-anemic cases (N=476) synthetic data was generated by randomly oversampling. The data set was split into training and test set before performing multivariate statistical analysis through logistic regression (LR), and classification tree (CT) through the CART algorithm considering the occurrence of IDA as the response variable. Statistical analyses were performed using R version 4.0.2.

Results: A total of 100 patients presented IDA. CT model showed accuracy, sensitivity and specificity values of 75.5%, 67.6% and 77.2%, respectively (AUC of 72.5%) to distinguish patients with IDA or without anemia (Figure 2). Among all the explanatory variables considered initially, only gender, HYPO, HYPOr, MCHr and transferrin were early independent predictors of IDA by LR, showing accuracy, sensitivity, and specificity values of 75.5%, 82.3% and 74.0%, respectively (AUC of 83.5%) (Table 2).

Conclusions: The proposed models overcome the limited ability of SF to detect iron deficiency when inflammation is present, showing a good performance to early predict IDA in surgical patients.

Table 1

	IDA patients (N=100)	Non-anemic patients (N=476)
Female, n(%)	84 (84%)	307 (64.4%)
Age (years), (median± IQR)	75.5 ± 12.0	72.0 ±9.00
Hb (g/L), (median± IQR)	12.3 ± 1.00	14.1 ± 1.43
Ferritin (ng/mL), (median± IQR)	27.0 ± 41.2	79.5 ± 117
CRP (mg/dL), (median± IQR)	0.36 ± 0.81	0.25 ± 0.45
HYPO (%), (median± IQR)	4.90 ± 7.95	1.10 ± 2.10
HYPOr (%), (median± IQR)	65.9 ± 28.6	41.6 ± 27.9
CHr (pg), (median± IQR)	28.6 ± 2.72	30.5 ±2.42
MCHr (g/L), (median± IQR)	271 ± 20.2	286 ± 17.2
Transferrin (g/L), (median± IQR)	3.00 ± 0.80	2.70 ± 0.60
TSAT (%), (median± IQR)	12.7 ± 8.00	21.5 ± 9.70

Figure 1
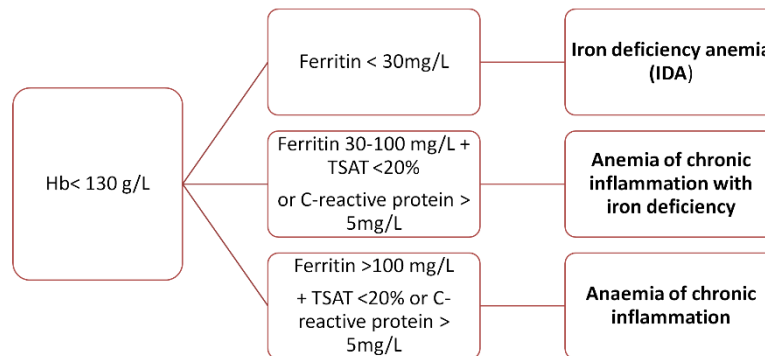
Table 2

	Odd ratio	Std.error	Z-statistic	p.value
Gender (Women)	2.64	0.23467	4.139	3.48e-05
HYPO	1.1	0.03096	2.943	0.003250
HYPOr	0.95	0.03236	-1.681	0.092790
MCHr	0.87	0.04975	-2.831	0.004641
Transferrin	2.29	0.21655	3.828	0.000129

Figure 2
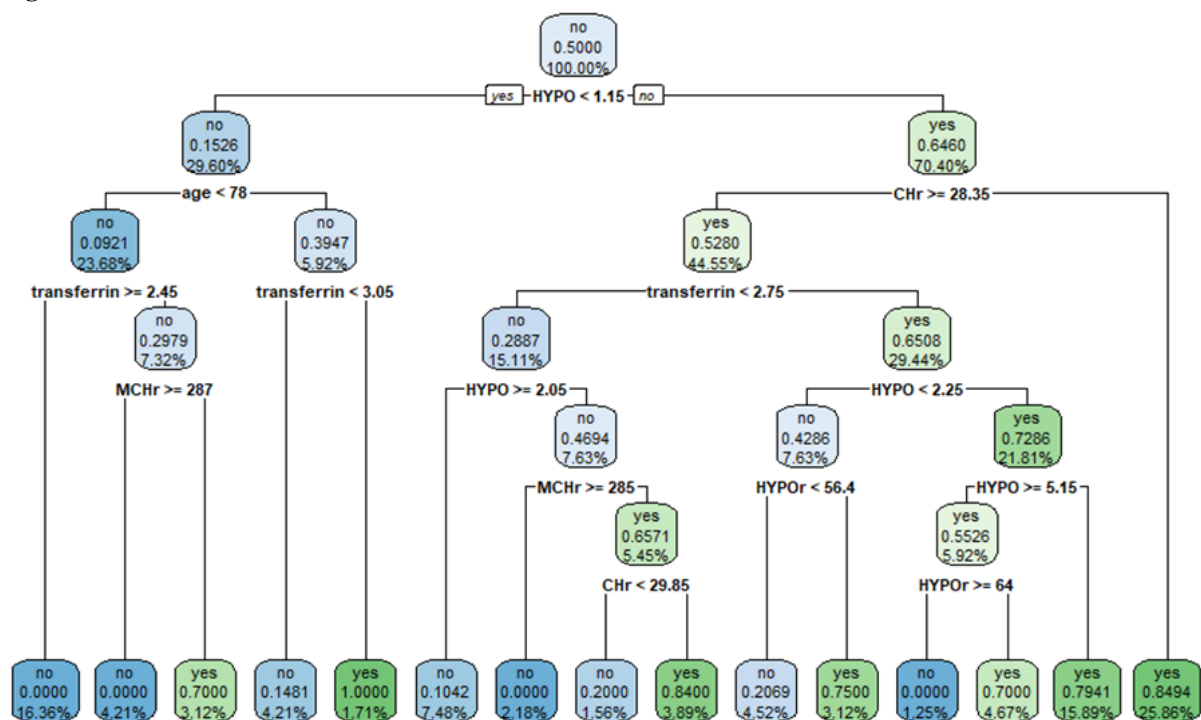
P43

Iron substitution for iron deficiency anemia in primary lung cancer patients

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The role of iron in the blood cell production cycle and the associated provision of adequate oxygen supply to the tissue is absolutely central. The basic requirement for the production of hemoglobin is sufficient iron storage, which continuously supplies the iron II complex of the haem with iron. The daily iron requirement that must be covered is between 10 mg iron per day and can increase up to 30 mg iron per day.

Especially in patients with a chronic inflammatory process, e.g. pulmonary malignancies, the iron storage is regularly depleted: Up to 30-45% of the patients who are scheduled for a anatomic pulmonary resection present with anemia and the vast majority of these patients have iron deficiency anemia.

The preoperative iron substitution and the associated improvement in perioperative iron stores are supposed to influence the perioperative morbidity in a positive way. This assumption is based on a series of meta-analyses that examined the influence of perioperative iron administration. Essentially, preoperative substitution seems to have an advantageous effect on the hemoglobin concentration. Whereby a reduction in allogeneic blood transfusion is assumed directly. As analyses from 2014-2017 have shown, this effect seems to have an impact on the rate of intraoperative allogeneic blood transfusion in particular which in turn influences the postoperative morbidity rate as well as mortality rate.

The primary question of the study presented here is the influence of preoperative intravenous iron substitution (20mg/kg/BW of ferric derisomaltose) on the perioperative (preoperative, intra- and postoperative) allogeneic blood transfusion rate in patients with a confirmed iron deficiency anemia. Secondary endpoints are the preoperative hemoglobin value, the postoperative mortality and morbidity rate, the length of hospital stay and the overall- and tumor-recurrence free survival. In summary an improvement of treatment quality.

P44

Quality of life and physical activity after intravenous iron for anaemia in advanced cancer: results from the ICaRAS randomised controlled trial

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Introduction: Anaemia and fatigue are highly prevalent in advanced cancer. Intravenous (IV) iron has shown promise as an effective treatment for anaemia across a number of conditions. We explore the impact of IVI on physical activity and quality of life in advanced cancer.

Methods: The ICaRAS trial randomised anaemic, fatigued, advanced cancer patients to receive either IV iron isomaltoside (Monofer®) or placebo (0.9% NaCl) in a double-blind design. Haemoglobin and haematinics were recorded at baseline and 4 and 8 weeks after infusion. Change in quality of life via the EQ5D5L, QLQC30 and FACTI-F questionnaires was recorded at the same timepoints. Patient activity was assessed using a pedometer (Fitbit Flex2) for 8 days prior to infusion and at 4- and 8-weeks post-infusion.

Results: We recruited 34 patients over 18 months (17 IV iron, 17 placebo) at 2 UK centres. The IV iron group had a higher haemoglobin at both 4 weeks (Mean difference (MD) 7.3g/L, P=0.047) and 8 weeks (MD 4.3g/L, P=0.13) follow up. There was no difference in daily step count between groups at baseline (IV iron mean (SD) 3209 (2338), placebo 3256 (2688), P=0.962). At 4 weeks the IVI group recorded a mean daily step count of +770 (SD 2235) steps from baseline compared to -1006 (2125) in the placebo group. By 8 weeks the mean difference between groups was 1707 (1142) steps (IVI +318 [1195] from baseline; placebo -1658 [2846]).

QLQC30 Global health (MD 15.8, P=0.027) and social functioning (MD 14.9, P=0.019) improved for the IV iron group at 4 weeks. FACIT-F fatigue scores exceeded the intergroup minimum clinically important difference (3 points) for IV iron at both follow up timepoints (week 4 MD 3.38 [-14.94-8.18], P=0.548], week 8 MD 3.49 [-17.52-10.53], P=0.609). The EQ5D5L MCID for the UK value set was exceeded by both groups at week 4 (placebo MD 0.079 [95% CI -0.268-0.11] P=0.379; IVI 0.132 [0.235-0.031] P=0.017) and by the IV iron group only at week 8 (MD from baseline 0.066 [0.179-0.047] P=0.223).

Conclusion: IV iron was efficacious at improving haemoglobin in advanced cancer. Patients receiving placebo saw a significant decline in activity and physical performance whereas the IV iron group maintained activity and improved quality of life on select measures.

P46

Curative efficacy of ferric derisomaltose (FDI) for iron deficiency anemia at Institute of Hematology & Blood Diseases Hospital, Chinese Academy of Medical Sciences & Peking Union Medical College – a first experience of high-dose IV iron in the Chinese population

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Introduction: The prevalence of iron deficiency anemia (IDA) is estimated as 20.1% in China. As the largest national-level specialized hematology hospital, we held an anemia clinic in our out-patient department. The usual IV iron treatment option in our hospital is iron sucrose (IS), which only allows 100-200 mg per infusion, 3 times per week. A new generation of IV iron named Monofer (ferric derisomaltose, FDI) was available in China since 2021. It can be administered as a single high dose of up to 20 mg of iron per kg of patient body weight, providing a more effective and convenient option for IDA treatment. This study evaluated our first experience of Monofer in the Chinese population.

Methods: Data was retrospectively collected from 100 IDA patients who attended our clinic and used FDI between August 2021 and January 2022. The pre- and 4 weeks post-infusion hemoglobin (Hb), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), serum ferritin (SF) and transferrin saturation (TSAT) levels were collected and compared. 16 out of 100 patients had their completed data collected, while the rest of data collection is still ongoing. We are presenting these preliminary analysis results in this abstract.

Results: All patients had a diagnosis of IDA. Baseline mean age was 39 years, 18.7% male and 81.3% female (n=16). The mean dose of FDI was 1031 mg, with all the patients completed their infusion within one visit. Baseline mean Hb was 72 g/L and increased to 115 g/L (p < 0.001, SD=15.486), resulting an increase of 43 g/L in Hb within 4 weeks-time. Moreover, SF increased from 6.8 to 150.7ng/ml (p < 0.001) and TAST increased from 3% to 24% (p < 0.001). The same trend was observed in other parameters, with mean MCV raised from 68.0 to 85.2 fl, mean MCH raised from 19.1 to 26.1 pg, and mean MCHC raised from 280 to 306 g/L.

Conclusion: This is the first presented FDI experience in Chinese population. A single high dose of IV iron increased the Hb level and relevant haematinics parameters dramatically within 4 weeks. The greater increase in Hb level than previously reported in other RCTs [1,2], indicating a more pronounced effect of high dose IV iron in moderate to severe anemic patients. Meanwhile, the reduction in the number of IV iron infusion visits brought more convenience to both patients and hospital, which is especially important during the COVID-19 pandemic.

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2. Auerbach M et al. Am J Hematol 2019;94:1007-14.

P47

Association between intravenous iron therapy and short-term mortality risk in older patients undergoing hip fracture surgery: an observational study

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Introduction: Anaemia is frequent among older hip fracture patients and leads to impaired mobility, prolonged recovery, and increased mortality. An alternative to treating postoperative anaemia with allogenous blood transfusions is intravenous iron which has been associated with enhanced haemoglobin recovery and reduced postoperative mortality, although evidence is not entirely clear. This study aimed to investigate the effect of intravenous iron on short-term mortality risk and haemoglobin recovery among older, anaemic patients after hip fracture surgery.

Methods: This retrospective cohort study involved 210 patients with a hip fracture surgery between July 2018 and May 2020 at the Department of Orthopaedic Surgery, Aalborg University Hospital, Hjørring, Denmark. The patients were enrolled if they were alive and had a haemoglobin level ≤ 6.5 mmol/L on the 3rd postoperative day. In May 2019, a new treatment strategy for postoperative anaemia after hip fracture surgery was implemented. Hereafter, intravenous iron (Monofer®) was administered if the patients' haemoglobin on the 3rd postoperative day was ≤ 6.5 mmol/L. The primary outcome was 30-day mortality. The secondary outcome was the effect on haemoglobin level within 14 to 30 days postoperatively. Multivariable Cox regression was used to estimate the 30-day mortality standardized to age, sex, Charlson Comorbidity Index, polypharmacy, admission source, and infection in hospital of all included subjects to account for confounding.

Results: Based on the treatment of postoperative anaemia between the 1st and 3rd day postoperatively, the patients were divided into four groups: no treatment (n=52), blood transfusion (n=38), Monofer (n=80), and blood transfusion & Monofer (n=40). Seventeen patients (8%) died within 30-days after surgery. The patients who only received Monofer had significantly lower mortality than those who received no treatment (HR: 0.17, 95% CI: [0.03-0.93], P = 0.04). Eighty-six patients had their haemoglobin levels measured within 14 to 30 days postoperatively (6.6 ± 0.7 mmol/L). There was no significant difference between the treatment groups (P = 0.12).

Conclusion: Intravenous Monofer on the 3rd postoperative day is associated with reduced 30-day mortality compared to no treatment among older, anaemic hip fracture patients. No significant differences were found in haemoglobin levels within 14 to 30 days postoperatively across treatment groups. However, this was assessed in a minor subset of patients with available haemoglobin levels.

Figure 1
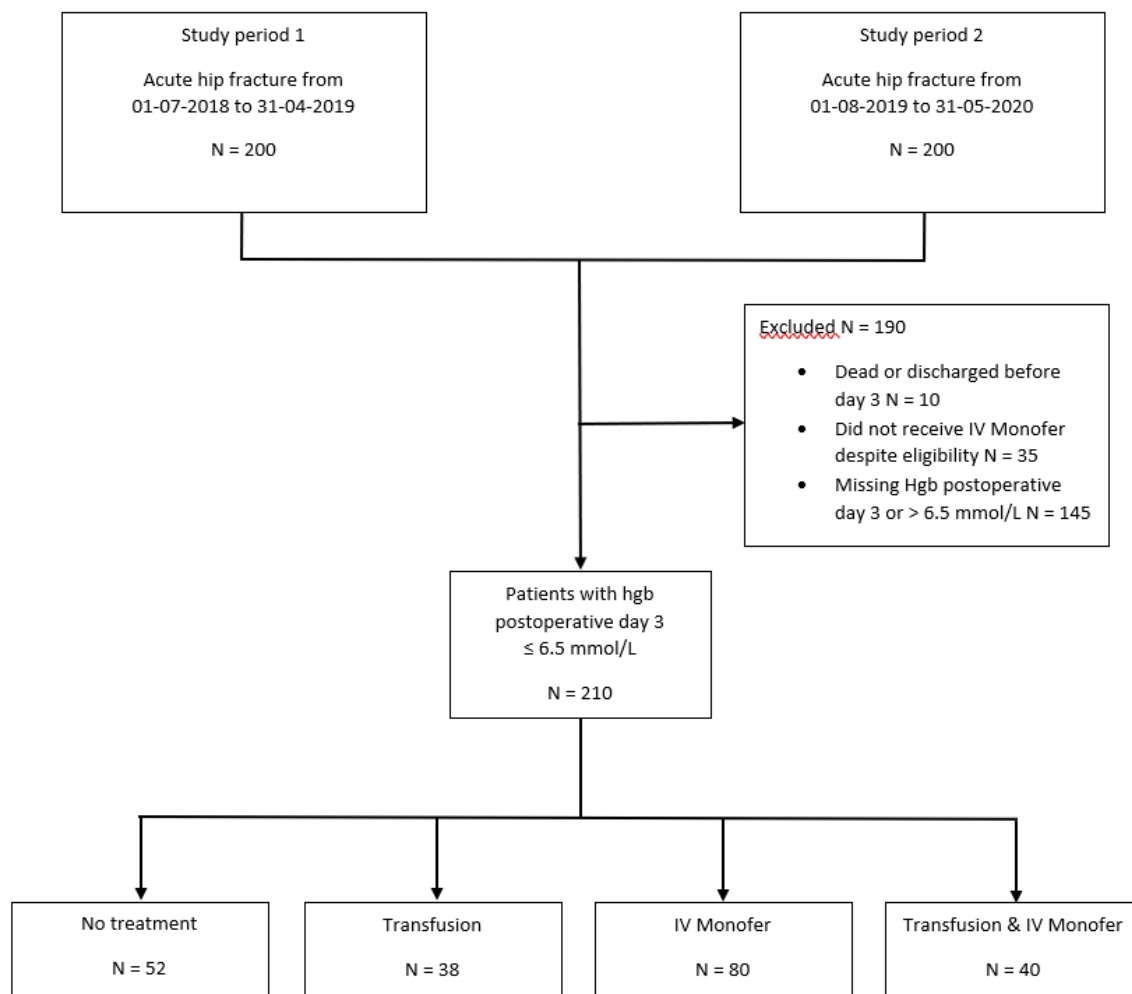
Table 1. Demographics among patients with haemoglobin ≤ 6.5 mmol/L on the 3rd postoperative day

	No treatment (n=52)	ABT (n=38)	IV Monofer (n=80)	IV Monofer & ABT (n=40)	Total (n=210)	p-value
Gender						
Female	28 (53.8)	20 (52.6)	41 (51.2)	18 (45.0)	107 (51.0)	
Male	24 (46.2)	18 (47.4)	39 (48.8)	22 (55.0)	103 (49.0)	0.853
Age	82.6 (9.1)	83.2 (7.1)	83.6 (8.9)	84.7 (9.2)	83.5 (8.7)	0.709
BMI (kg/m²)	24.1 (4.2)	24 (5.1)	24.2 (3.9)	23.2 (3.8)	23.9 (4.2)	0.655
Charlson Comorbidity Index	1.9 (2)	2.7 (2.1)	1.9 (2.2)	2.1 (1.7)	2.1 (2.1)	0.219
Polypharmacy (≥5 medications)	34 (65.4)	33 (86.8)	55 (68.8)	34 (85.0)	156 (74.3)	0.023*
Admission source						
Home-independent	38 (73.1)	27 (71.1)	55 (68.8)	29 (72.5)	149 (71.0)	
Nursing home	14 (26.9)	11 (28.9)	25 (31.2)	11 (27.5)	61 (29.0)	0.951
Study period						
1)	51 (98.1)	37 (97.4)	12 (15.0)	7 (17.5)	107 (51.0)	
2)	1 (1.9)	1 (2.6)	68 (85.0)	33 (82.5)	103 (49.0)	< 0.001*
Fracture						
Intracapsular	29 (55.8)	14 (36.8)	31 (38.8)	13 (32.5)	87 (41.4)	
Extracapsular	23 (44.2)	24 (63.2)	49 (61.2)	27 (67.5)	123 (58.6)	0.098
Operation						
Arthroplasty	19 (36.5)	16 (42.1)	23 (28.8)	7 (17.5)	65 (31.0)	
Intramedullary nails	19 (36.5)	21 (55.3)	48 (60.0)	30 (75.0)	118 (56.2)	
AO screws	2 (3.8)	0 (0.0)	3 (3.8)	1 (2.5)	6 (2.9)	
Dynamic hip screws	7 (13.5)	1 (2.6)	4 (5.0)	1 (2.5)	13 (6.2)	
other	5 (9.6)	0 (0.0)	2 (2.5)	1 (2.5)	8 (3.8)	0.014*
Time to theatre (days)	0.6 (0.5)	0.8 (0.8)	0.8 (0.5)	0.7 (0.6)	0.7 (0.6)	0.425
Preoperative Hgb (mmol/L)	7.7 (0.8)	7.4 (1)	7.9 (0.7)	6.8 (1)	7.5 (0.9)	< 0.001*
Missing	9	5	19	10	43	
Perioperative blood loss (mL)	185.7 (108.9)	387.1 (414.1)	205.1 (159.9)	254.7 (196.1)	246.8 (241.1)	0.001*
Missing	17	7	21	8	53	
Hgb postoperative day 1 (mmol/L)	6.3 (0.6)	5.4 (0.8)	6.1 (0.6)	5.1 (0.6)	5.8 (0.8)	< 0.001*
Missing	2	0	0	0	2	
Hgb postoperative day 3 (mmol/L)	5.8 (0.5)	5.4 (0.7)	5.6 (0.5)	5.2 (0.7)	5.6 (0.6)	< 0.001*
Hgb postoperative between day 14 – 30 (mmol/L)	6.3 (0.7)	6.4 (0.5)	6.8 (0.6)	6.6 (0.8)	6.6 (0.7)	0.116
Missing because deceased	5	4	2	4	15	
Missing because no hgb control	28	21	48	12	109	
Length of stay (days)	6.5 (3.9)	7.1 (4)	5.9 (2.1)	6.9 (2.6)	6.5 (3.1)	0.177
Discharged to						
Home-independent	18 (34.6)	14 (36.8)	37 (46.2)	14 (35.0)	83 (39.5)	
Nursing home	34 (65.4)	20 (52.6)	43 (53.8)	24 (60.0)	121 (57.6)	
Dead in hospital	0 (0.0)	4 (10.5)	0 (0.0)	2 (5.0)	6 (2.9)	0.023*
Readmission/transmission to ICU						
Readmitted	13 (25.0)	5 (13.2)	14 (17.5)	10 (25.0)	42 (20.0)	
Transmitted to ICU	0 (0.0)	0 (0.0)	1 (1.2)	1 (2.5)	2 (1.0)	0.558

Data are presented as mean ± SD (age, BMI, Charlson Comorbidity Index, perioperative blood loss, time to theatre, haemoglobin levels, length of stay) or number of patients and percentage (all others). ABT = allogenous blood transfusion. Hgb = haemoglobin. ICU = Intensive Care Unit.
* = p < 0.05.

Table 2. Estimation of 30-day mortality risk among patients with haemoglobin ≤ 6.5 mmol/L on the 3rd postoperative day stratified by no treatment and Monofer.

	ATE analysis		Multivariable Cox Regression model		
	Average risk	CI (95%)	Hazard ratio	CI (95%)	p-value
No treatment	0.196	[0.027 – 0.364]	1	Reference	
IV Monofer	0.024	[0.000 – 0.051]	0.17	[0.03 – 0.93]	0.041*

Estimation of the average treatment effect and multivariable Cox regression model among patients with haemoglobin ≤ 6.5 mmol/L on the 3rd postoperative day stratified by no treatment and Monofer (30-day follow-up) n = 132. The multivariable analysis is adjusted for age, sex, Charlson Comorbidity Index, polypharmacy, admission source, and infection in hospital

Table 3. Estimation of 30-day mortality risk among patients with haemoglobin ≤ 6.5 mmol/L on the 3rd postoperative day stratified by allogenous blood transfusions and Monofer & allogenous blood transfusions.

	ATE analysis		Multivariable Cox regression model		
	Average risk	CI (95%)	Hazard ratio	CI (95%)	p-value
ABT	0.220	[0.039 – 0.400]	1	Reference	
IV Monofer & ABT	0.072	[0.009 – 0.135]	1.34	[0.269 – 6.653]	0.7215

Estimation of the average treatment effect and multivariable Cox regression model among patients with haemoglobin ≤ 6.5 mmol/L on the 3rd postoperative day stratified by ABT and IV Monofer & ABT (30-day follow-up) n = 78. The multivariable analysis is adjusted for age, sex, Charlson Comorbidity Index, polypharmacy, admission source, and infection in hospital. ABT = allogenous blood transfusions.

P48

Perioperative anaemia management in major upper gastrointestinal cancer surgery – an innovative multidisciplinary care approach

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Introduction: Anaemia is common in cancer and incidence can be more than 60% of patients requiring major cancer surgery. Perioperative anaemia is associated with poor outcomes after major cancer surgery. As a specialist cancer centre, The Royal Marsden Hospital introduced several multi-disciplinary pathways to manage perioperative care. In Oct 2019, a multi-disciplinary team (MDT) called SUMMIT (systematic multidisciplinary management of investigation and intervention) was commenced to help optimise patients undergoing major upper gastrointestinal(UGI) surgery early in their perioperative journey. This MDT consists of surgeons, anaesthetists, physiotherapists, dieticians, and advanced nurse practitioners. In Feb 2020, an anaemia service was expanded to both preoperative and postoperative anaemia management through everyday ward rounds with the anaemia team, The anaemia team consists of consultant anaesthetists, clinical fellows and an anaemia nurse.

Aim: To assess the effectiveness of anaemia care after the introduction of a unique collaborative approach to anaemia care in major UGI cancer surgery.

Methods: We looked at all the patients who have undergone major UGI surgery between Feb 2019-Feb 2021. The first year was before the expansion of the anaemia service. The second year started with the introduction of an anaemia service that works with the SUMMIT MDT.
We reviewed the patients' data from their first preoperative encounter until their postoperative discharge. Anaemia was defined as haemoglobin <130 g/L and iron deficiency was defined as transferrin saturation <20% +/- ferritin <100 mcg/L as per trust guidelines.

Results: Within the two years, 101 patients were identified. Though iron studies were consistently performed in both years, only 23% of patients with iron-deficient anaemia received intravenous iron therapy in the first year compared to 78% in the second year. The average preoperative haemoglobin (Hb) rose from 121g/L in the first year to 122.9 g/L in the second year. The incidence of blood transfusion remained unchanged.

Conclusion: Our multidisciplinary approach to perioperative anaemia management has shown improvement in care as per NICE guidance. The combination of the SUMMIT MDT and anaemia service has allowed early identification and optimisation of patients undergoing UGI cancer surgery with an increased proportion of anaemic patients receiving iron therapy, with improvement in their preoperative haemoglobin. Further research is required looking at anaemia care in cancer surgery including outcome benefits, the timing of IV iron therapy and functional outcome after iron therapy.

Table 1

	PRESUMMIT PREANAEMIA SERVICE Feb 2019-Oct 2019	START SUMMIT, PREANAEMIA SERVICE Oct 2019-Feb 2020	FIRST YEAR ANAEMIA SERVICE Feb 2020-Feb2021
Number of patients	36	18	47
Average starting HB (g/L)	122.7	124.7	116.5
Number of patients who are anaemic (initial Hb<130 g/L)	26 (72%)	11 (61%)	34 (72.3%)
Anaemic patients who got iron studies	23 (88.4%)	10 (90.9%)	33 (97.1%)
Anaemic patients who are iron deficient	17 (65.4%)	10 (90.9%)	28 (82.4%)
Percentage of anaemic patients with iron deficiency received iron infusion	23.5%	40%	78.6%

Table 2

	PRESUMMIT PREANAEMIA SERVICE **Feb 2019-Oct 2019**	**START SUMMIT, PREANAEMIA SERVICE** **Oct 2019-Feb 2020**	**FIRST YEAR ANAEMIA SERVICE** **Feb 2020-Feb2021**
Average preop Hb(g/L)	121.0	125.2	122.9
Average preop HB (g/L) for patients receiving iron	103.25	121.5	121.1
Proportion of all patients with preop Hb < 130 (g/L)	26 (72.2%)	10 (55.6%)	32 (68.1%)
Patients who had blood transfusion	7 (19.4%)	3 (16.7%)	9 (19.1%)

P49

Randomised controlled trial comparing intravenous iron and an erythropoiesis-stimulating agent versus oral iron to treat preoperative anaemia in cardiac surgery

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Introduction: The optimal treatment to correct preoperative anaemia has not been determined. We compared the effectiveness of using a combination of ferric derisomaltose and darbepoetin versus oral ferrous sulphate to reduce blood transfusion in elective cardiac surgery.

Methods: This was an open-label, parallel groups, pragmatic randomised controlled trial at a single-centre (ISRCTN Number: 41421863. EUDRACT number: 2011-003695-36). We randomised 156 adults undergoing elective cardiac surgery with a low haemoglobin (100-130g/L) and iron deficiency (serum ferritin <100 µg/L or transferrin saturation <30%) to the intervention or control treatment more than 2 weeks before surgery. The intervention group received a single dose of intravenous ferric derisomaltose 1000mg and darbepoetin 200µg (subcutaneous) and the control group was commenced on oral ferrous sulphate 600mg daily. Primary outcome was transfusion of at least one unit of allogeneic red cells during surgery and within the following 5 days. Secondary outcomes were the change in haemoglobin level between randomisation and surgery, red cell transfusion volume, postoperative blood loss, pre-specified postoperative complications, length of hospital stay, and in-hospital death.

Results: The odds of red cell transfusion were lower in the intervention group compared to the control group (adjusted OR 0.33. 95% CI: 0.15 to 0.75, p=0.008). Fewer patients in the intervention group received a blood transfusion, with an absolute difference in transfusion rate of 14.7% Based on this difference, the number needed to treat with the intervention to have one less participant require transfusion is 6.8 (95% CI: 3.5 to 80). The intervention group also received a lower volume of packed red cells (-212.2 ml, 95% CI: -422.1 to -2.3ml, p=0.047). There was no difference in the other secondary outcomes.

Conclusion: Preoperative treatment with a single dose of ferric derisomaltose and darbepoetin, given more than 2 weeks before cardiac surgery, decreased the proportion of patients who received a blood transfusion after surgery, as a consequence of a greater increase in haemoglobin compared to oral ferrous sulphate.

P50

Management of preoperative anaemia in patients scheduled for elective major surgery

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Introduction: Preoperative anaemia is an independent risk factor for allogeneic blood transfusion in patients undergoing major elective surgery, and it has also been associated with in-hospital complications and poor recovery. Hematinic deficiencies such as low levels of iron, folate and B12 vitamin are the commonest etiologic factors of anaemia. This study aims at evaluating the effects of the therapeutic approaches adopted in our hospital to optimize preoperative haemoglobin (Hb) and minimize intra-operative blood transfusion for patients scheduled for elective major surgery.

Methods: In our Transfusion Medicine Unit we implemented a Patient Blood Management medical office for pre-operative consultancy. Patients' general state of health and invasiveness of the planned surgical procedure were assessed together with pre-operative Hb and iron status levels. 210 patients scheduled for major surgery were visited between January and October 2021; all the medical examinations were carried out about 45 days before the scheduled surgery. Administered therapies included: intravenous iron, oral iron, B12 and folic acid. The main outcome was the need for RBCs transfusion during surgery.

Results: Of the 210 patients visited in our pre-operative medical office, 94 received pre-operative therapy for the correction of anaemia. Among them, 28 patients with mean Hb value of 9.5g/dL received intavenous iron, whereas 58 (mean Hb = 11 g/dL) received oral iron. Eight patients received vitamin B12/foline. Of the 94 treated patients, 17% were transfused with RBCs during surgery, the mean Hb value at transfusion was 8.7g/dL. Intravenous iron was able to prevent blood transfusion in 89% of examined cases.

Conclusion: The preoperative therapies were able to correct anaemia. In particular, parenteral iron supplementation was an effective and safe therapy to optimize the pre-operative Hb values, mitigating the risk of allogeneic blood transfusion. The effectiveness of this preparation can be attributed to a greater bioavailability, absorption and faster response of this drug with respect to oral iron administration.

P51

Perioperative anaemia – achieving a national pathway in Wales

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Introduction: The Covid-19 pandemic has led to fragility in donor blood supply. In response the Welsh Blood Service (WBS) and the Blood Health National Oversight Group (BHNOG) have raised awareness of the need for patient blood management (PBM).
UK guidance on anaemia management.[1-3] The first pillar is well established, however pathways and implementation across Wales is inconsistent leading to avoidable transfusions.
Development of an All-Wales Perioperative Anaemia Pathway could ensure equitable, prudent healthcare for pre-operative patients throughout Wales, reduce anaemia incidence and avoid transfusion.

Methods: In July 2020, the BHNOG set up an anaemia workstream and engaged with multidisciplinary key stakeholders, primarily the Welsh Perioperative Medicine Society (WPOMS), having representation from all Welsh hospitals. Virtual meetings outlining the current and proposed positions were held with agreement to form and implement an All-Wales Perioperative Anaemia Pathway. All hospitals shared local guidance to establish baseline practice followed by a survey to allow prioritisation of standards (Attachment 1) A draft pathway was developed. Benchmarking against the agreed pathway was performed to determine current compliance and barriers.
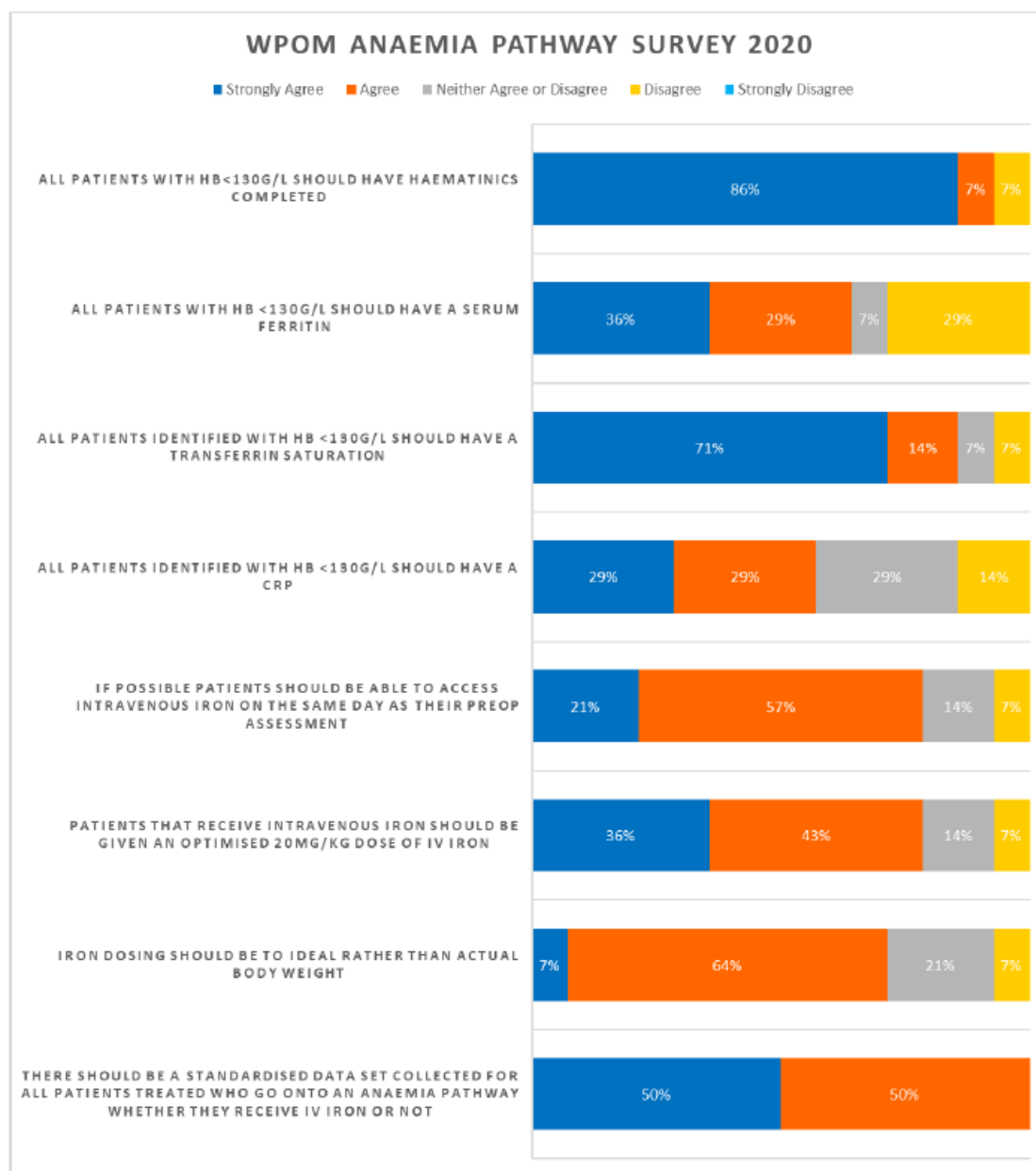
Results: At baseline, 50% (9/18) hospitals in Wales had a perioperative anaemia pathway. In June 2021, all 18 hospitals (100%) from the 6 Health Boards in Wales agreed to use the All-Wales Perioperative Anaemia Pathway[4]. Benchmarking data against the pathway demonstrated significant compliance across Wales. 15/16 (94%) hospitals responded using Haemoglobin >130g/L for all patients and serum Ferritin and/or TSATs for anaemia identification in line with the new pathway (Attachment 2). With regards to anaemia management, 14/16 (88%) used IV iron for first line treatment of iron deficiency anaemia for urgent surgical patients in line with the All-Wales pathway (Attachment 3).

Conclusion: Prior to this work, pockets of perioperative anaemia management existed across Wales leading to variation in preoptimization of anaemia. Engagement with stakeholders has allowed agreement of a deliverable All Wales Perioperative Anaemia Pathway, the standard to which all preoperative services within Wales should be working. Further work to seek support from pathology services to reflex test and give same- day results for all departments and develop an automated anaemia audit tool and funding of a national anaemia coordinator are in our next steps.

References
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2. https://www.nice.org.uk/guidance/ng180/resources/perioperative-care-in-adults-pdf-66142014963397
3. GPP Preoperative patient blood management during the SARS-CoV-2 pandemic
4. https://wbs-intranet.cymru.nhs.uk/bht/wp-content/bht-uploads/sites/4/2022/01/All-Wales-Pathway-Final-Version-2.pdf

Attachment 1. Results from the WPOMS anaemia pathway survey 2020

WPOM ANAEMIA PATHWAY SURVEY 2020

■ Strongly Agree   ■ Agree   ■ Neither Agree or Disagree   ■ Disagree   ■ Strongly Disagree

Attachment 2. Benchmarking survey – Perioperative Anaemia identification

ALL WALES PERIOPERATIVE ANAEMIA PATHWAY BENCHMARKING SURVEY 2021
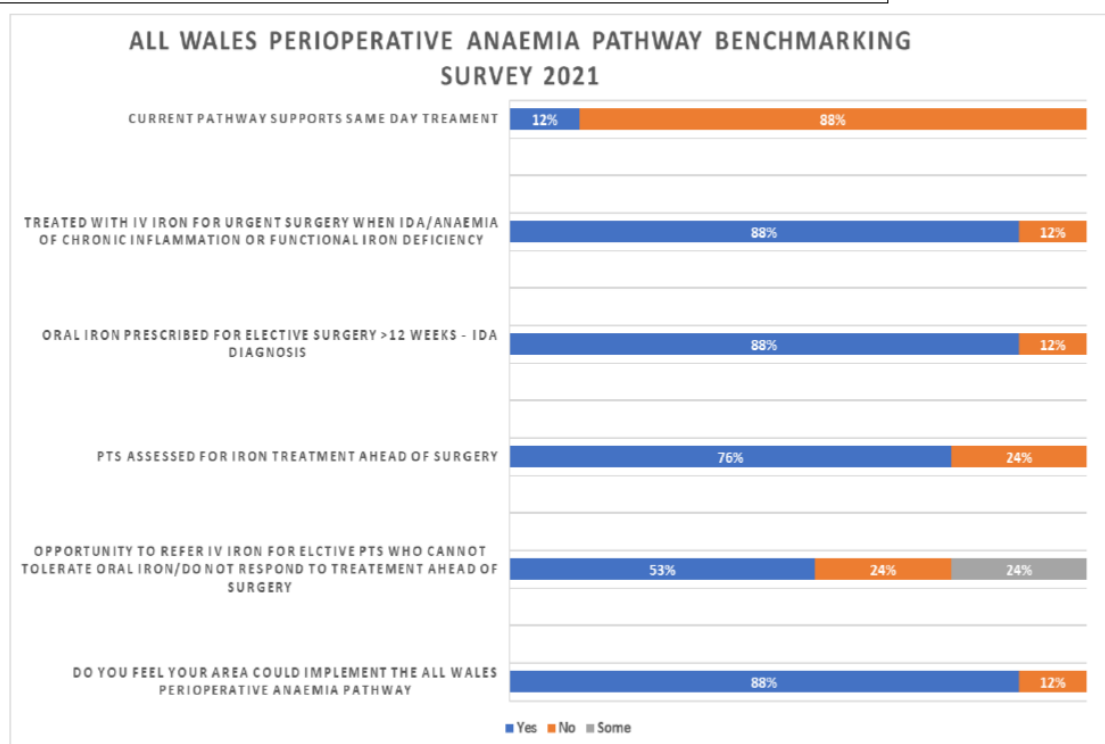
	Yes	Some	No
ALL PTS OVER 18 MEETING THE PATHWAY ACCEPTANCE ARE ASSESSED FOR ANAEMIA	12%	82%	6%

	FBC	Ferritin	TSATs	Ferritin +/or TSATs	CRP	U&E	B12/ Folate
BLOOD TESTS INCLUDED IN PERIOPERATIVE ANAEMIA SCREEN	100%	88%	94%	100%	65%	53%	35%

	<130g/L ALL	<120g/L F <130g/L M
HAEMOGLOBIN (HB) TO ENTER LOCAL PERIOPERATIVE ANAEMIA PATHWAY	94%	6%

	FBC	TSATs	Ferritin	None
SAME DAY TURNAROUND FOR 'CORE' ANAEMIA SCREENING TESTS	76%	47%	18%	24%

	Yes	No
REVIEW OF BLOOD TESTS WITHIN PRE ASSESSEMENT/SAME DAY REVIEW	53%	47%

	Not back in a timely manner	No suitable staff to review	No same day turnaround	No daily pre op assessments
PRE-OP CLINIC ALLOW FOR SAME DAY REVIEW OF RESULTS	41%	29%	18%	6%

	Yes	No
UTILISATION OF HISTORIC BLOOD RESULTS TO SUPPORT PATIENT MANAGEMENT/REDUCE EXCESSIVE TESTING	71%	29%

Attachment 3 – Benchmarking Survey – Perioperative Anaemia management

ALL WALES PERIOPERATIVE ANAEMIA PATHWAY BENCHMARKING SURVEY 2021

	Yes	No	Some
CURRENT PATHWAY SUPPORTS SAME DAY TREAMENT	12%	88%	
TREATED WITH IV IRON FOR URGENT SURGERY WHEN IDA/ANAEMIA OF CHRONIC INFLAMMATION OR FUNCTIONAL IRON DEFICIENCY	88%	12%	
ORAL IRON PRESCRIBED FOR ELECTIVE SURGERY >12 WEEKS - IDA DIAGNOSIS	88%	12%	
PTS ASSESSED FOR IRON TREATMENT AHEAD OF SURGERY	76%	24%	
OPPORTUNITY TO REFER IV IRON FOR ELCTIVE PTS WHO CANNOT TOLERATE ORAL IRON/DO NOT RESPOND TO TREATEMENT AHEAD OF SURGERY	53%	24%	24%
DO YOU FEEL YOUR AREA COULD IMPLEMENT THE ALL WALES PERIOPERATIVE ANAEMIA PATHWAY	88%	12%	

■ Yes ■ No ■ Some

P52

Iron in practice

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Introduction: Anaemia is common surgery and cancer, associated with poor outcomes. Iron deficiency is the commonest underlying cause.
Here at our tertiary cancer centre, we have the unique set up of a perioperative Anaemia Management Service (AMS), allowing for routine screening in both pre- and postoperatively. This set up has allowed continued increase in intravenous iron therapy for over 1000 patients, and year on year reduction of the number of units of blood utilized overall.
We present a breakdown of our routine practice and how the pattern of treatment has changed over the course of the pandemic.

Methods: All patients undergoing major cancer surgery are screened in accordance with NICE guidelines, in the preoperative setting, and those patients with iron deficiency anaemia are treated with intravenous iron where required.
Then all patients are screened routinely in the postoperative setting, while recovering on the wards, with any patients identified with pre-operative iron deficiency receiving parenteral iron therapy prior to discharge.
All routine data was collected as part of service evaluation for 2020 and 2021, and analysed.
We present our findings here, comparing specialties, and pre- and postoperative iron.

Results: A total of 735 iron infusions were given in 2020, of which 511 were given to surgical patients.
In comparison, 1556 iron infusions were given in 2021, with over 1000 surgical patients.
There was a reduction of approximately 3% of total units of blood transfused in 2020 and a further 2% reduction in 2021.
Further analyses were performed to compare haemoglobin between patients who received iron in the pre-op and post-op periods.

Conclusion: Through the set-up of a routine integrated multidisciplinary service, iron therapy to treat iron deficiency anaemia has become a standardized practice.

P53

Effect of a Patient Blood Management preoperative consultation on allogeneic transfusion of cancer patients

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Introduction: Anaemia in cancer patients is a common condition, mainly due to an absolute or functional iron deficiency as a result of their disease or its treatment. However, it is well known that perioperative blood transfusions may negatively influence disease recurrence and overall survival, possibly because of the immunosuppressive effect of transfusions Therefore, the application of Patient Blood Management (PBM) principles to cancer patients, should be strictly recommended. This study aims at evaluating the effects of the therapeutic approaches adopted to correct pre-operative anaemia on intraoperative blood transfusion on a cohort of oncologic patients identified at risk of allogenic transfusion.

Methods: Within our OECI Comprehensive Clinical Cancer Centre, we set up a PBM medical office specifically dedicated to the treatment of pre-operative anaemia of cancer patients undergoing major surgery. A total of 103 cancer patients were visited between January and October 2021. According to diagnosis, haemoglobin (Hb) levels and invasiveness of the surgical intervention, patients could receive intravenous iron preparation, oral iron, B12 vitamin or folate, or no therapy. Intraoperative transfusions were collected for all the patients recruited.

Results: The timing of the PBM visit was usually high, with a mean of 36 days before scheduled surgery. This allowed physicians to prescribe oral iron for correcting anaemia in the majority of cases (42/103 patients). Intravenous iron preparation was usually administered to patients with lower Hb levels and/or with upcoming surgery (22/103 patients). For 38 patients it was not necessary (or sometimes not possible) to prescribe a therapy for anaemia. One patient having Hb < 9 g/dL at visit was immediately transfused. Intra-operative blood transfusion was registered for 12% of the patients treated with oral iron, while only 4.5% of those treated with intravenous iron needed a transfusion.

Conclusion: Despite patients that received intravenous iron accessed the PBM medical office with a lower mean Hb level, only 4.5% of them was transfused, compared to 12% of those that received oral iron. These results may be, at least in part, attributed to the poor absorption of oral iron in the gastrointestinal tract of cancer patients. Our data confirm that intravenous iron preparations are usually more efficient in avoiding the risk of transfusion in anaemic cancer patients.

P54

Impact of Patient Blood Management in a developing country

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Background: Implementing Patient Blood Management (PBM) in a developing country is a painfully demanding process. Although in long term, PBM has proven to be beneficial in terms of patients' clinical outcomes, healthcare human resources, and overall cost-effectiveness. Despite the hurdles, our center has successfully managed to follow restrictive transfusion strategies stringently. In this study, the impact of PBM strategy, particularly pre-operative and peri-operative anemia correction was seen in a multi-specialty tertiary care hospital in a resource-limited country.

Objectives: 1) To study the effect of patient blood management on overall prognosis, recovery, and duration of hospital stay in surgical patients. 2)To study the impact of close monitoring of patient blood management strategies on perioperative morbidity in patients undergoing elective surgery.

Methods: This is a quality improvement study over two years involving a multidisciplinary team at a tertiary care center in India. The study involved the implementation of PBM strategies to improve clinical outcomes in patients. Before starting the PBM program, the ongoing practice was observed and relevant data was collected. Based on the problem areas, execution of PBM policies through a multidisciplinary approach was undertaken. The primary focus of this study was the optimization of the red cell reserve of the patient by correction of anemia using iron. Other PBM measures were also promoted. The strategies employed are included in the attachment. After advocating the PBM initiatives, a comparison was made with the previous data to assess the efficacy of the PBM program in a developing country.

Results: A total of 938 patients were included in the study, out of which 518 were in the pre-PBM implementation group and 420 were in the post-PBM group. There was a statistically significant improvement in pre-operative hemoglobin and hemoglobin at the time of discharge after PBM strategies ($p<0.05$). The percentage of transfusion decreased from 24.9% to 14.5% after PBM. The average length of stay before PBM was 13.2 ±22.38 days which decreased by approximately 48% to 7.09±6.4 days after PBM ($p=0.0005$). ICU admission was required in 112 (21.6%) patients before PBM whereas it was required only in 12.6% patients after PBM ($p=0.0005$). Also, ICU stay and length of hospital stay were directly proportional to the degree of pre-operative anemia.

Conclusion: The highly prevalent pre-operative anemia, the practice of using a transfusion to correct anemia, and the unmet need for bleeding control all point to the significant problem area in healthcare of a developing country. Our study showed positive outcomes after the implementation of PBM strategies. Reproducing similar results on a national level will take massive effort but the benefits would also be magnified.

Generate a sense of requirement for PBM

- The result from baseline data used to motivate surgeons and physicians to act on anemia correction
- Problem areas which are preventable should be addressed

Formation of PBM Team

- Led by transfusion medicine specialist, the team comprises of treating clinician, anesthetist, nurse and concerned paramedical staff.

Setting up PBM goals

- Depending on the prevailing problems in the system and availability of the resources, achievable goals should be formed. Our goal was to correct pre-operative anemia in elective surgery patients using IV or oral iron
- The goals should be achievable and flexible enough so that every team member can promote and perpetuate.
- Setting up of impossible goals will demotivate the participants and lead to failure of the program.

Identify potential obstacles

- Difficulties faced by anyone involved in the PBM program should be addressed appropriately.
- Necessary modifications should be made in the strategies to accomodate larger group of people.
- In our study, initial plan was to correct anemia using IV ferric caraboxymaltose. But some clinicians preferred oral iron and some preferred other formulations of IV iron. In such cases emphasis should be on the goal i.e., anemia correction rather than means to approach the goal.

Inculcate PBM in culture

- Through repeated trial and error, and over a substantial amount of time, PBM can be successfully implemented.
- Necessary changes in institutional protocols and transfusion guidelines are required.

Groups		N	Mean	SD	p-value
Preop Hb	Pre-PBM	518	11.94	2.18	0.011
	Post-PBM	420	12.30	2.14	
Postop Hb	Pre-PBM	481	10.54	2.12	0.067
	Post-PBM	295	10.82	2.01	
Hb At Discharge	Pre-PBM	482	10.14	1.80	0.001
	Post-PBM	294	10.62	1.98	

P-value = 0.0005			Groups		Total
			Pre-PBM	Post-PBM	
ICU Stay	**Yes**	**Count**	112	53	165
		%	21.6%	12.6%	17.6%
	No	**Count**	406	367	773
		%	78.4%	87.4%	82.4%
Total		**Count**	518	420	938
		%	100.0%	100.0%	100.0%

P-value=0.0005		N	Mean	SD
Length of stay after surgery	Pre-PBM	518	7.14	5.733
	Post-PBM	420	3.49	4.388

p-value=0.0005			Groups		Total
			Pre	Post	
Transfusion	Yes	Count	129	61	190
		%	24.9%	14.5%	20.3%
	No	Count	389	359	748
		%	75.1%	85.5%	79.7%
Total		Count	518	420	938
		%	100.0%	100.0%	100.0%

P55

Systematic review and meta-analysis of intravenous iron therapy for non-anaemic, iron deficient adults: An abridged reanalysis of a previous Cochrane review

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Background: Iron deficiency is the commonest nutritional deficiency globally, affecting approximately 2 billion individuals. If untreated, iron deficiency can progress to iron deficiency anaemia, which is also highly prevalent, affecting 1.2 billion individuals in 2016. Both iron deficiency and anaemia are accompanied by an array of symptoms, all of which have been demonstrated to significantly decrease both work capacity and quality of life. Therefore, empirical knowledge concerning the efficacy of iron supplementation on quality of life and work capacity is essential so as to inform both current and future guidelines. In states of iron deficiency anaemia, the benefits of iron supplementation, such as IV iron therapy, on physical function and quality of life has been well demonstrated. However, empirical knowledge concerning the effect of IV iron therapy on non-anaemic iron deficient individuals is equivocal. As a result, this systematic review and meta-analysis aimed to explore the efficacy of IV iron therapy on physical function in the treatment of adults with non-anaemic iron deficiency.

Aims: Update and reanalyse a published Cochrane systematic review, assessing the effects of intravenous iron therapy on physical function in the treatment of non-anaemic iron deficient adults.

Methods: Electronic databases were searched as per Cochrane methodology. Randomised controlled trials that compared intravenous iron to placebo in adults were eligible for inclusion. The primary outcome measure was physical function as defined by the trial authors. Secondary outcome measures were haemoglobin concentration, ferritin concentration, fatigue and quality-of-life scores at end of follow-up.

Results: 21 randomised controlled trials, comprising of 3514 participants were included. Intravenous iron significantly increased physical function (SMD 1.76 mL/kg/min, 95% CI 0.03-3.50) on multiple scales. However, the quality of evidence of this conclusion was rated 'very low', mainly due to most studies presenting with a high risk of bias. Furthermore, intravenous iron therapy increased haemoglobin concentration (MD 4.65 g/L, 95% CI 2.53-6.78), increased ferritin concentration (MD 245.52 µg/L, 95% CI 152.11-338.94), decreased fatigue scores (SMD 0.30, 95% CI -0.52-(-0.09)) and showed no difference in quality-of-life (MD 0.15, 95% CI -0.01-0.31).

Conclusion: We demonstrated that intravenous iron therapy is associated with reduced fatigue scores, however, the effects on physical function remain latent due to low quality evidence. Overall, there is a need for more randomised control trials at a low risk of bias, which are powered to measure clinically important differences in physical function.

Haemostasis & Thrombosis

P56

A rare case of compound FII, FVII and FX acquired deficiency in a cancer patient infected with SARS-Cov-2: diagnostic challenges

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Introduction: The authors present a clinical case report of a patient with multiple compound acquired clotting factors deficit associated to advanced sarcoma and concomitant SARS-CoV2 infection.

Case report: A 57-year-old female, diagnosed with stage IV pleomorphic rhabdomyosarcoma of the right thigh, with pulmonary and pleural metastasis was hospitalized to initiate chemotherapy. Her clinical condition was complicated by febrile neutropenia, respiratory failure and a de novo prothrombin time (PT) increase (post-cancer diagnostic but already present before starting chemotherapy) with previous bleeding history. She tested positive for COVID19, maintaining fever, decreased breath sounds, and difficult-to-control hemostasis after punctures. CT reevaluation showed signs of disease progression with multiple pulmonary metastasis, large left pleural effusion, significant atelectasis, pulmonary nodules, but no inflammatory/infectious-type alveolar or interstitial lung infiltration. Laboratorial reevaluation showed: microcytic anemia, worsening of PT values (max INR ~3), high TTPa, elevated fibrinogen and persistent elevated inflammatory parameters. Progressive worsening of respiratory failure due to increase of the left pleural effusion was observed, with indication for drainage. However, given the patient's bleeding risk, a complementary coagulation study was requested, revealing: decreased FII (36%), FVII (12%) and FX (29%), with normal FIX and elevated FV, FVIII and vWF. Elevated indices of hemolysis and lipemia in the blood samples were excluded. Coagulation inhibitors testing was negative. Viscoelastic tests (Rotem®) showed prolonged EXTEM/INTEM-CT (higher in EXTEM) but elevated FIBTEM-A5 and A10 plus other signs of high clot stiffness suggesting a hypercoagulability pattern concomitant to prolonged bleeding time (consistent with paraneoplastic and COVID-19 alterations). No evidence of sepsis, autoimmune active process, liver failure or DIC was found. There was also no deficit correction after vitamin K administration given at admission. SARS-Cov2 infection was stable at the time of the coagulopathy abnormalities worsening making it less likely to be its cause. Unfortunately, the had an unfavorable clinical evolution due to refractory hypoxemia.

Discussion: As the coagulation alterations were first observed at the time of the cancer diagnosis and their subsequent worsening were coincident with rapid disease progression, having excluded alternative etiologies, a paraneoplastic multiple clotting factor deficiency was assumed. SARS-CoV2 infection as a modulating or contributing factor cannot be excluded.
Acquired coagulation disorders are important conditions to be aware of as they can represent paraneoplastic syndromes or be secondary to infections and autoimmune diseases. Coagulopathies secondary to malignancies and/or COVID19 are particularly challenging due to their paradoxal presentation with both bleeding and thrombosis risk.
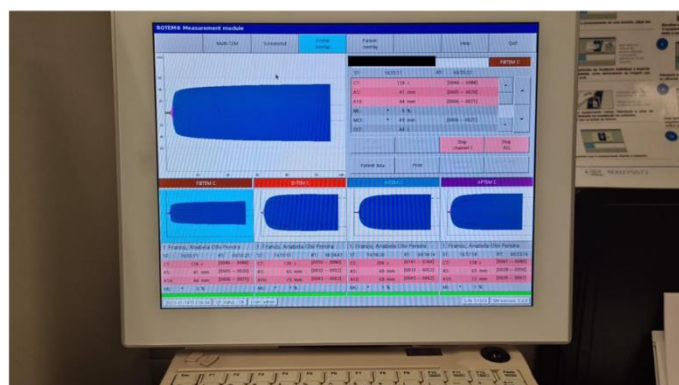
P57

Follow-up of patients with severe hemophilia A before and during the SARS-Cov-2 pandemic – the reality of a Reference Center for Congenital Coagulopathies

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Background: When a pandemic situation is declared, health services can become ineffective, exhausted, and subjected to the risk of collapse thus making it necessary to implement procedures that help us to minimize these constraints.
In our case, these procedures were the implementation of the telephone consultation and the adoption of the drug delivery program in the proximity pharmacy (PEMProxi) previously developed by the pharmacy service of the Centro Hospitalar Universitário de Coimbra (CHUC).

Objectives: To demonstrate that the implementation of teleconsultation and the "PEMProxi" program was effective in monitoring our patients during the pandemic period.

Methods: In this retrospective observational study, we analyzed the follow-up of 55 patients with Severe Hemophilia A (21 pediatric and 34 adults) at our Center from 01/01/2019 to 01/01/2022. We recorded the number and type of consultation performed, annual bleeding rates (BAEP), comparing the data with previous records, to verify the existence or not of lapses in the quality of care for our patients.
In addition, a questionnaire was carried out to assess the degree of satisfaction of our users in relation to the methods applied.

Results: We observed that there were no statistically significant differences in relation to the number of consultations performed and BAEP, in the evaluated period ($P > 0.05$ by the Wilcoxon Test). Regarding the degree of satisfaction, most patients were satisfied or very satisfied with the strategy applied.

Conclusion: In short, with the implementation of the telephone consultation and the "PEMProxi" program, there was no increase in disease-related complications and patients' satisfaction was high or very high.

P58

Can we count on 4T's low probability of HIT when the platelet count is low: correlation of 4T clinical score and positive HIT in COVID-19 and non-COVID-19 patients

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Background and goal of study: To prevent acute venous thromboembolism, a leading cause of preventable hospital mortality, a large proportion of at-risk hospitalized patients are put on thromboprophylaxis with heparin. Since patients with severe COVID-19 have an increased risk of thrombotic complications following systemic inflammatory response associated and endothelial activation, most protocols for COVID-19 treatment include thromboprophylaxis with heparin. However, heparin therapy is associated with a rare, but severe complication - heparin-induced thrombocytopenia (HIT). It is caused by antibodies against PF4/heparin complexes, which in turn activate platelets. It leads to consumptive thrombocytopenia and a high risk of arterial and venous thrombosis, and is a reason for immediate discontinuation of heparin therapy and active search for thrombosis. Thrombocytopenia in severe COVID-19 patients, as well as other hospitalized patients, can have multiple causes (sepsis, HIT, drug-induced...). Laboratory testing for HIT is time-consuming and often not available outside regular working hours. Thus, clinicians often rely on clinical scoring systems. 4Ts is a validated pretest scoring system for HIT diagnosis. Patients are scored in 4 categories (platelets count, timing of thrombocytopenia onset, presence of thrombosis or other complications of HIT, and concurrent other possible causes of low platelets count). A total of ≤3 points suggests a low, 4-5 moderate and 6-8 high probability of HIT. This study evaluates the accuracy of 4Ts for exclusion of HIT in our patient population and the difference between the COVID-19 and non-COVID-19 patients.

Materials and methods: This research was conducted by retroactive analysis of the electronic medical database of our hospital centre, for the period of 25 months (January 2020. – February 2022.). As a standard clinical practice, laboratory HIT testing is ordered for patients treated with heparin (unfractionated or LMWH) who develop sudden moderate or severe thrombocytopenia or are evaluated for persistent thrombocytopaenia, in the absence of other obvious immediate cause (eg. massive bleeding, haematological condition). Blood samples are tested using ELISA assay for the detection of antiheparin antibodies. Optical density (OD) higher than 0,400 is considered positive. At the same time, the probability of HIT is clinically evaluated using the 4Ts test.

Results: In the examined period, 895 ELISA assays were conducted for 731 patients. When we eliminated paediatric and cardiosurgical cases, a total of 600 patients was analysed, of which 81 (13,5%) HIT assays came back positive (OD>0,400). Complete medical history was available for 53 of those patients, and those were used for further analysis. 4Ts was calculable for 51 patients. 3,9% had high, 68,6% intermediate and 27% low 4Ts score. When stratified by COVID-19+ status, 40% of HIT+ patients had low (1-3) 4T scores, as opposed to 24% of non-COVID-19, HIT+ patients, but this difference is not statistically significant, as assessed with the chi-square test ($\chi2$ (1) = 0,98, p = 0,432).

Discussion and conclusion: Our results suggest that in patients with clinical suspicion of HIT, the presence of antiheparin antibodies was not reliably excluded by a low 4Ts score. This effect is present irrespective of COVID-19 infection status.

P59

Management of massive hemorrhage during gynecologic surgery: case report and literature review

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Introduction: Surgical blood loss that requires a transfusion of 4 red blood cell concentrates (RBC) in one hour defines massive haemorrhage. Massive intraoperative bleeding is a potentially life-threatening complication during surgical procedures. We present a case of a massive haemorrhage during gynecologic surgery and its management.

Case report: A 50-year-old woman developed haemorrhagic shock during a laparoscopic myomectomy. Intraoperatively, right iliac vein was injured due to the morcellation, which caused massive bleeding. This forced to convert to a laparotomy and activate the massive transfusion protocol (MTP). 4 0- RBC, 3 0+ RBC, 1 pool of platelets and about 2500 ml. of fresh frozen plasma were transfused during surgery. Vasopressors and crystalloids and colloids were required. Intensive monitoring was done, as well as a frequent control of urine output and serial blood tests. Surgeons successfully controlled the haemorrhage with pressure and a standard suture closure. Subsequently, the patient remained hemodynamically stable and was moved to the intensive care unit. Blood test results of the hours after the accident are collected in Table 1.

Results: Massive haemorrhage is one of the most important causes of mortality and morbidity in any patient following major surgery. Morcellator technical problems are a rare complication (0.12–0.3%), but in many cases they can be serious, like the massive haemorrhage that our patient suffered.
Coagulopathy is the most feared complication in massive bleeding. When such coagulopathy is accompanied by hypothermia and acidosis (lethal triad), the patient prognosis is seriously worsened. In these cases, MTP must be activated to treat the patient early and aggressively with blood products, in order to avoid exsanguination and coagulopathy.

Conclusions: Preparation, planning, and practicing for a massive haemorrhage is essential for all surgeons.
- Conventional treatment consists of a damage surgery control approach and volume replacement, including the transfusion of blood products
- Local adherence to a multidisciplinary, evidence-based treatment protocol is important to improve the survival of these patients.

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Table 1

Tabla 1

	Hb	Plaquetas	AP / INR	Fibrinógeno	PH / EB	Leucocitos / PCR	Ca++
Preoperatorio	14,5	312.000	88 / 1,09	497			
13:45 h	3,8	143.000	25 / 2,53	88	7,13 / -14,9		5,3
14:48 h	8,6	205.000	53 / 1,55	196	7,2 / -11,6		10
18:41 h	10,6	177.000	78 / 1,18	326	7,44 / 3,9		

P60

Effectiveness of oral versus intravenous tranexamic acid on perioperative blood loss in primary total hip arthroplasty: preliminary results of a non-inferiority prospective randomized clinical trial

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Introduction: The antifibrinolytic tranexamic acid (TXA) is strongly recommended for reducing intra- and postoperative blood loss in total hip arthroplasty (THA). The three possible administration routes (oral, intravenous, and topical) are effective, but no consensus exists on which one is preferable. Oral TXA is an attractive option in terms of cost and safety, but its efficacy needs to be clearly confirmed, considering the major role of TXA in patient blood management strategies. The aim of this trial was to demonstrate the non-inferiority of oral TXA to intravenous TXA in reducing intra- and postoperative total blood loss (TBL) in elective THA.

Methods: This monocentric, prospective, double-blind, randomized, controlled trial was previously approved by our local Institutional Review Board (IRB number: 707, study number 2020/316) and registered to EU Clinical Trial with EudraCT number 2020-004167-29. Following written informed consent and between May and December, 2021, 78 patients scheduled for posterolateral-approached THA were enrolled. They were randomly allocated to two groups of 39 patients each. Patients, anesthesiologist and orthopedic surgeon were blind to group allocation. According to the pharmacokinetic properties and oral bioavailability of TXA, patients of group PO received 2 g TXA orally two hours before surgery and 6 hours after the first dose. Patients of group IV received 1 g TXA intravenously immediately before skin incision and 4 hours later. The primary outcome measure was TBL defined as the total amount of blood loss observed during surgery and during the first postoperative 48 hours. Data were analyzed using Chi-square, Fisher's exact, Student t-test, and Wilcoxon-Mann-Whitney tests as appropriate. The non-inferiority limit for rejecting the null hypothesis was set at 164.4 mL, corresponding to 20% of previously reported TBL1. A one-tailed P-value <0.025 or a two-tailed P-value <0.05 as appropriate was considered statistically significant.

Results: Demographic characteristics and postoperative biomarkers were comparable between groups (Table 1). Median [IQR] of estimated TBL was 450 mL [300, 550] in group PO and 500 mL [350, 615] in group IV. The between-group difference in TBL confirms the non-inferiority hypothesis (Figure 1). Postoperative hemoglobin levels were comparable between groups.

Conclusions: Preliminary analysis suggests that oral TXA is non-inferior to intravenous TXA. Nonetheless, these results should be confirmed once the total trial sample-size (218) will have been achieved.

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P61

Is low dose (0.5 gram) tranexamic acid less effective than a standard dose (1 gram) at inhibiting hyperfibrinolysis in hemorrhagic caesarean section? Multicenter double-blind placebo-controlled dose-ranging (TRACES) ancillary study

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Objective: To study the effect of a low (0.5 g) or a standard (1 g) tranexamic acid (TA) dose compared to placebo on biological endpoints in women experiencing postpartum hemorrhage (PPH).

Design: TRACES ancillary-study is a double-blind, randomized, placebo-controlled, dose-ranging study.

Setting: 8 women hospitals in France.

Population: Women experiencing PPH > 800 mL during caesarean section.

Method: After informed consent, patients were randomized to receive either TA 0.5g (n=57), TA 1g (n=58), or a placebo (n=60). Data were collected at 8 time-points.

Main outcome measures: D-dimers, plasmin-antiplasmin complexes (PAP), simultaneous-generation-thrombin-plasmin-potential.

Results: Compared to placebo, 1 g TA dose-regimen, but not 0.5 g, inhibited hyperfibrinolysis as diagnosed by the % increase in D-dimers from injection to 120 minutes (93% [95%CI 68 to 118] vs 58% [95%CI 32 to 84] (p=0.06) vs 38% [95%CI 13 to 63] (p=0.003) and % increase in PAP from injection to 30 minutes (56% [95%CI 25 to 87] vs 13% [95%CI 18 to 43] (p=0,051) vs -2% [95%CI -32 to 28] (p=0.009)) (fig 1).

Conclusions: In this study, fibrinolysis inhibition was more sustained after the administration of 1g TA compared to 0.5g TA or a placebo. Further pharmacokinetic-pharmacodynamic modelling will be needed to determine the optimal TA dose to be administered in PPH regarding fibrinolytic profile.

Figure 1: Dose-ranging impact of TA 0,5g and TA 1 g compared to placebo on percentage of D-dimers (1A) and plasmin-antiplasmin complexes (1B) increase from baseline before injection to 30, 60, 120 and 360 minutes after injection.
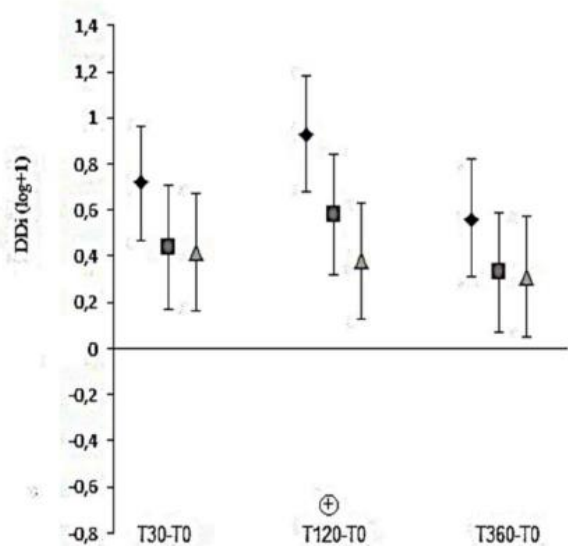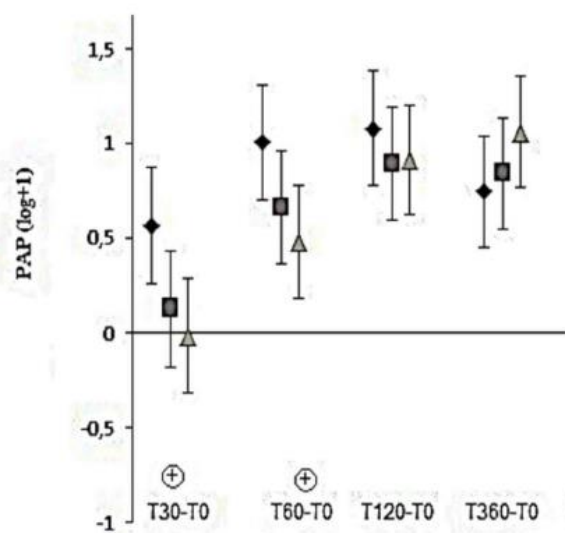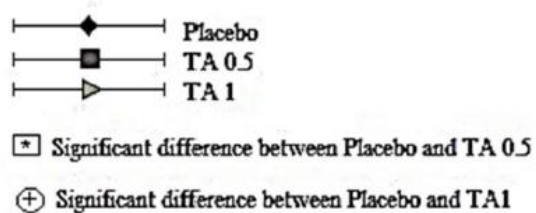
P62

Freeze-dried plasma development and assessment of biochemical quality

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Introduction: OctaplasLG® is a frozen solvent/detergent-treated, coagulation active plasma product for treating complex coagulation factor deficiencies and can be used as substitution therapy in situations where specific factor concentrates are not available, or in emergency situations where precise laboratory diagnosis is not possible. The recently developed freeze-dried pharmaceutical form, OctaplasLG® Lyo, a more convenient lyophilized form, offers faster reconstitution and more flexibility in storage conditions (refrigerated/room temperature), thus increasing ease of logistics and utilisation. This study aimed to compare the biochemical quality of OctaplasLG® Lyo with OctaplasLG® and single-donor fresh frozen plasma (FFP) units.

Methods: Three OctaplasLG® Lyo batches for process performance qualification were manufactured at Octapharma AB (Stockholm, Sweden), freeze-dried, and reconstituted with sterilized water. Twelve batches of OctaplasLG® and FFP units were used for comparison. All plasma samples were assessed for global coagulation parameters, coagulation factors and protease inhibitors, activation markers of coagulation and fibrinolysis, as well as important plasma proteins.

Results: Frozen OctaplasLG® and freeze-dried OctaplasLG® Lyo demonstrate identical quality profiles upon thawing and reconstitution, respectively. All coagulation factor (Figure 1) and protease inhibitor activity parameters (Figure 2) were in line with levels mandated by the European Pharmacopoeia. FFP units show comparable coagulation factor activities, with higher protein S and plasmin inhibitor levels compared with the OctaplasLG® products. OctaplasLG® and OctaplasLG® Lyo parameters show lower bag-to-bag variation compared with FFP.

Conclusions: OctaplasLG® frozen and freeze-dried products have equally high biochemical quality. The key features of the new freeze-dried OctaplasLG® Lyo are the fast reconstitution time and flexibility of storage conditions (refrigerated/room temperature), which has advantages in emergency situations and in prehospital settings. In addition, the standardised content of plasma proteins in both OctaplasLG® products facilitates appropriate planning of high efficacy treatment.
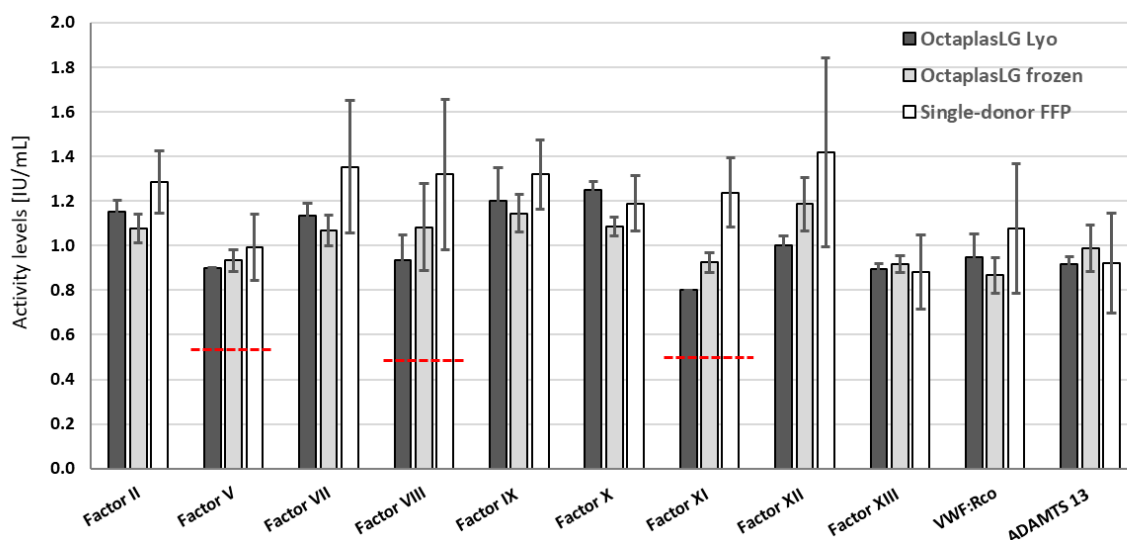
Figure 1: Coagulation factor activities in different plasma groups
Dashed red line indicates levels mandated by the European Pharmacopoeia (factor V, VIII, XI: 0.5 IU/mL)
ADAMTS-13, a disintegrin and metalloproteinase with a thrombospondin type 1 motif member 13, also known as von Willebrand factor-cleaving protease (VWFCP); FFP, fresh-frozen plasma; VWF:Rco, von Willebrand ristocetin cofactor
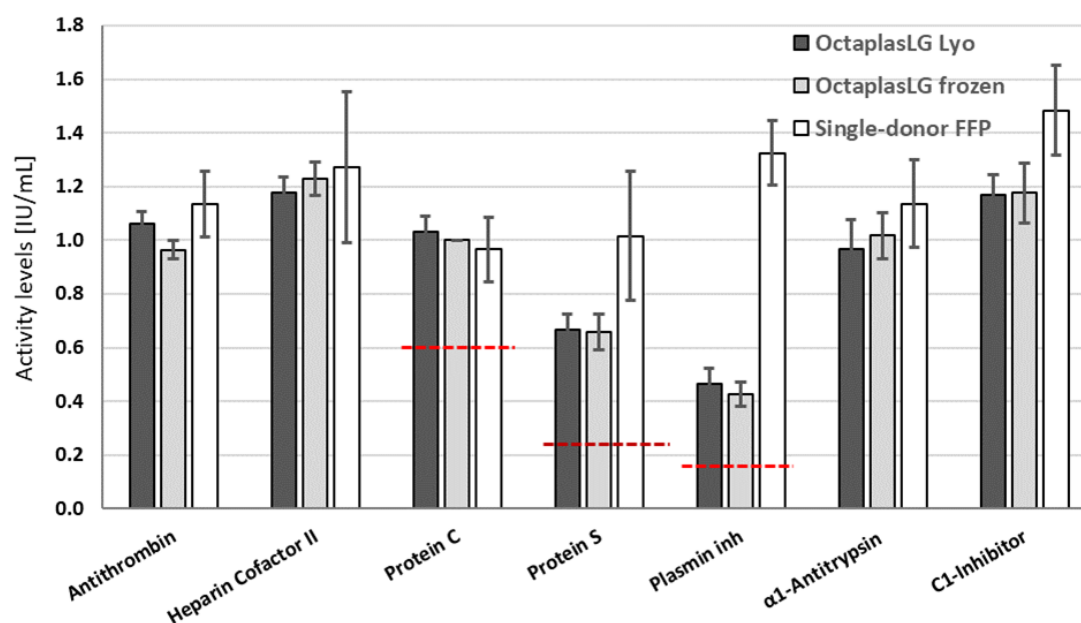
Figure 2: Protease inhibitor activities in different plasma groups
Dashed red line indicates levels mandated by the European Pharmacopoeia (Protein C: 0.7 IU/mL; Protein S: 0.3 IU/mL; Plasmin inhibitor: 0.2 IU/mL)
FFP, fresh-frozen plasma

P63

In vivo effect of cryoprecipitate versus fibrinogen concentrate on the neonatal fibrin network after cardiopulmonary bypass

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Introduction: Bleeding is a serious complication of cardiopulmonary bypass (CPB) in neonates and is associated with substantial morbidity and mortality (1). To adequately restore hemostasis, transfusion is often a necessity. However, given the risks associated with blood product transfusion, neonates would benefit from other effective, and safe, therapies to augment hemostasis after CPB. Our prior studies suggest that adult fibrinogen does not seamlessly integrate with neonatal fibrinogen and may result in prolonged clot degradation, thus increasing the risk of thrombotic events in neonates post-operatively. However, it is unclear if this is a direct result of the adult fibrinogen molecule or the other clot stabilizing factors (von Willebrand Factor (vWF) and Factor XIII (FXIII)) in cryoprecipitate (2). An alternative to cryoprecipitate, fibrinogen concentrate (FC; RiaSTAP®, CSL Behring, Marburg, Germany) contains purified fibrinogen with a low volume of administration. The use of FC has been growing in popularity, but it has not been adequately studied in pediatric cardiac patients and the limited experience in adults may not be relevant to pediatric practice. Our study in infants undergoing cardiac surgery suggests that FC may be most beneficial in reducing post-CPB bleeding and transfusions in neonates when compared to cryoprecipitate when used as part of a post-CPB transfusion algorithm.3 In this randomized control trial, we sought to compare clot structure, clot degradation rates, and post-CPB blood transfusions in neonates who are randomized to receive either FC or cryoprecipitate as part of a post-CPB transfusion algorithm.

Methods: After IRB approval, 36 neonates were block randomized 1:1 to receive either FC (FC group) or cryoprecipitate (control group) as part of a post-CPB transfusion algorithm. Inclusion criteria for neonates included: 36-42 weeks gestational age, age < 30 days, APGAR score >6 at 5 minutes, non-emergent surgery, parental consent. Blood samples were collected from neonates undergoing cardiac surgery at four time points: 1) baseline; 2) after either FC or cryoprecipitate; 3) arrival to ICU; 4) 24h after ICU arrival. All samples were centrifuged to yield platelet poor plasma Clots were formed ex vivo from each time point. We then analyzed clots for fiber density (FD), clot degradation rates, and levels of thrombin, fibrinogen, FXIII, and vWF. Demographic information, post-CPB blood transfusions, and adverse events (AE) were collected. Based on our previous data, to detect a difference in degradation times between clots formed with neonatal fibrinogen and clots formed with adult fibrinogen with 80% power, we will enroll at total of 36 patients, with 18 in patients in each arm. All quantitative data will be analyzed using a paired t-test or Wilcoxon rank-sum test to determine differences between the two groups. Significance will be defined by a p-value less than or equal to 0.05.

Results: Eighteen neonates were enrolled in each group. Demographics, intraoperative data, and post-CPB transfusion of packed red blood cells (pRBCs), fresh frozen plasma (FFP), and platelets were not different between groups (Table 1). Preoperative and post-operative coagulation values on ICU arrival were similar between groups. Three patients received prothrombin complex concentrate (PCC) as part of rescue hemostatic therapy: 2 in control group and 1 in FC group. Patients in the FC group received less cryoprecipitate (p=<0.001). There were two deaths within 30 days (controls) and 4 thrombotic events, 2 in each study group. Representative images of clots are shown in Figure 1. Clots from both groups had similar FD (Figure 2) and 24-h degradation rates (Figure 3). Procoagulant levels were lower in the FC group, but not statistically significant (Figure 4A-D).

Conclusion: This study suggests that while cryoprecipitate contains additional factors required for clot strength and stabilization, there is no significant difference in clots formed in vivo in neonates who receive either cryoprecipitate or FC. Clinically, patients receiving FC appear to have adequate hemostasis with similar post-operative ICU labs and outcomes. FC may result in less post-CPB allogenic transfusions. Our data shows no significant differences in adverse events between groups. FC may provide an alternative strategy to achieve hemostasis and reduce overall allogenic transfusions in neonates undergoing cardiac surgery without increased risk of adverse events.

Reference
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Table 1

Table 1. Demographics and clinical data for neonates enrolled in the study.					
	All Patients	Cryoprecipitate	Fibrinogen	P-value[a]	SMD[b]
	(n=36)	(n=18)	Concentrate (n=18)		
Male (%)	23 (63.9%)	14 (77.8%)	9 (50.0%)	0.164	0.604
Age (days)	6.00 [4.00, 11.25]	6.00 [5.00, 12.75]	5.00 [4.00, 7.00]	0.232	0.545
Weight (kg)	3.40 [2.68, 3.69]	3.50 [2.92, 3.69]	3.10 [2.66, 3.58]	0.311	0.286
Prematurity	10 (28.6%)	3 (17.6%)	7 (38.9%)	0.264	0.485
Baseline Saturation (%)	93.50 [90.75, 98.00]	94.50 [89.25, 98.00]	93.00 [91.00, 95.75]	0.886	0.038
Lowest Temperature	26.15 [18.00, 28.00]	28.00 [19.00, 28.00]	21.00 [18.00, 28.00]	0.416	0.256
Anesthesia Time (hours)	6.75 [6.21, 7.78]	7.38 [6.32, 9.22]	6.50 [5.94, 6.81]	0.065	0.628
Surgery Time (hours)	4.27 [3.40, 4.87]	4.42 [3.67, 6.07]	4.04 [3.18, 4.46]	0.109	0.721
CPB time (min)	146.50 [112.75, 162.50]	143.50 [112.25, 174.25]	146.50 [115.00, 157.50]	0.629	0.289
Aortic CxClamp (min)	81.00 [58.00, 97.00]	92.50 [79.25, 128.00]	74.00 [57.00, 82.00]	0.025	0.768
Pre-Op labs					
Hemoglobin	13.80 [12.88, 14.90]	14.00 [12.93, 16.05]	13.60 [12.53, 14.43]	0.367	0.312
Hematocrit	41.05 [38.53, 45.17]	41.35 [38.78, 48.85]	40.25 [38.38, 42.95]	0.438	0.262
Platelets	271.50 [232.00, 383.75]	261.50 [230.00, 318.50]	281.00 [236.00, 391.25]	0.343	0.262
Fibrinogen	236.50 [199.25, 286.00]	236.50 [190.25, 278.25]	239.00 [200.50, 292.75]	0.569	0.241
ICU Arrival labs					
Hemoglobin	14.10 [12.40, 14.88]	12.50 [12.00, 14.30]	14.40 [13.50, 15.20]	0.048	0.574
Hematocrit	40.50 [36.10, 42.98]	36.90 [35.10, 42.40]	41.50 [39.20, 44.50]	0.109	0.469
Platelets	206.50 [165.00, 266.75]	187.00 [149.00, 268.00]	213.00 [176.00, 263.00]	0.469	0.087
Fibrinogen	311.00 [270.00, 363.00]	355.00 [325.00, 397.00]	276.00 [264.50, 305.00]	0.001	1.026
Post-CPB Blood Products (ml/kg)					
RBCs	0.00 [0.00, 13.92]	0.00 [0.00, 14.16]	0.00 [0.00, 11.88]	0.565	0.192
FFP	0.00 [0.00, 0.00]	0.00 [0.00, 0.00]	0.00 [0.00, 0.00]	0.713	0.033
Platelets	19.58 [13.95, 28.56]	16.08 [13.57, 26.93]	23.13 [14.53, 28.84]	0.486	0.239
Cryoprecipitate	9.93 [0.00, 12.82]	12.56 [10.80, 16.62]	0.00 [0.00, 0.00]	<0.001	2.043
Cell Saver	0.00 [0.00, 13.25]	0.00 [0.00, 7.93]	0.00 [0.00, 15.97]	0.805	0.345
Fibrinogen Dose (total)	---	---	299.10 [230.75, 350.25]	---	---
Fibrinogen Dose	---	---	96.14 [86.86, 104.15]	---	---

[a] two-groups comparisons were conducted using Fisher exact/Chi-square test for categorical variables, and Wilcoxon rank-sum test for continuous variables.

[b] Effect sizes were additionally calculated, as standardized mean differences (SMDs), and interpreted using Cohen's d thresholds, 0.2 (small), 0.5 (moderate), and 0.8 (large).
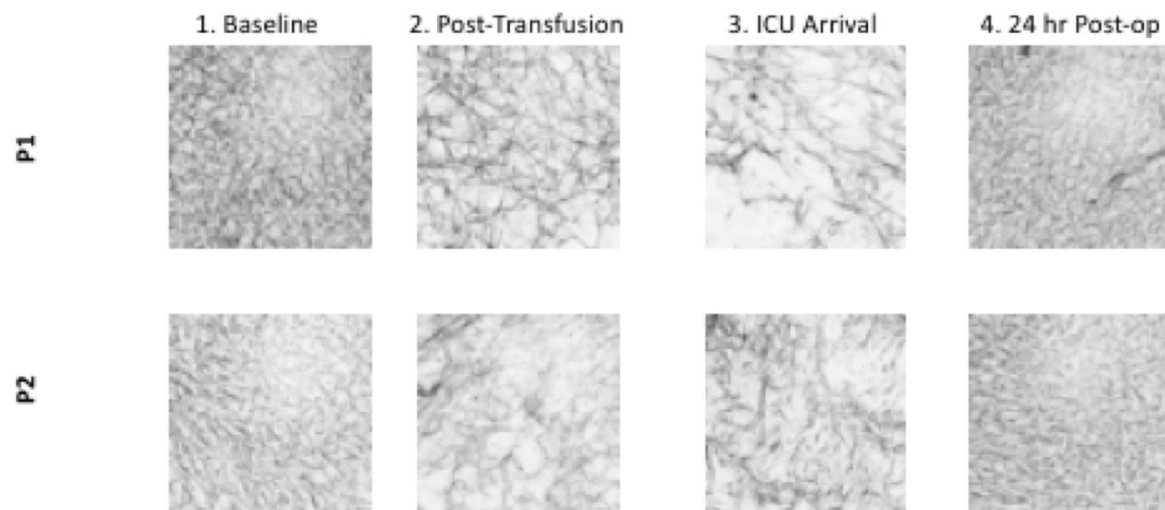
Figure 1

Figure 1. Electron microscopy of clot at each time point. Patient 1 received Cryo and Patient 2 received FC.
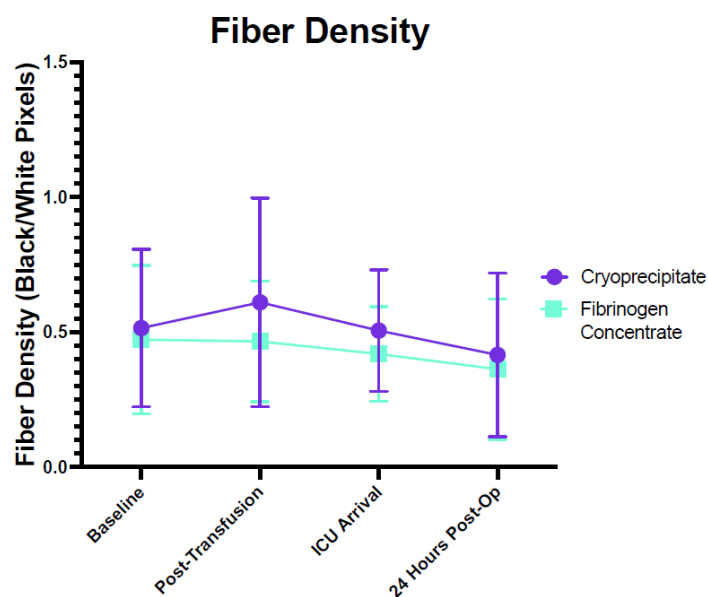
Figure 2

Figure 2. Fiber density of clots formed by neonatal samples at each time point. Baseline samples are prior to transfusion of either FC or cryo. There is no significant difference between fiber density, but fiber density tends to be higher in the cryoprecipitate group when compared to FC immediately after transfusion, but is similar at 24h after surgery.
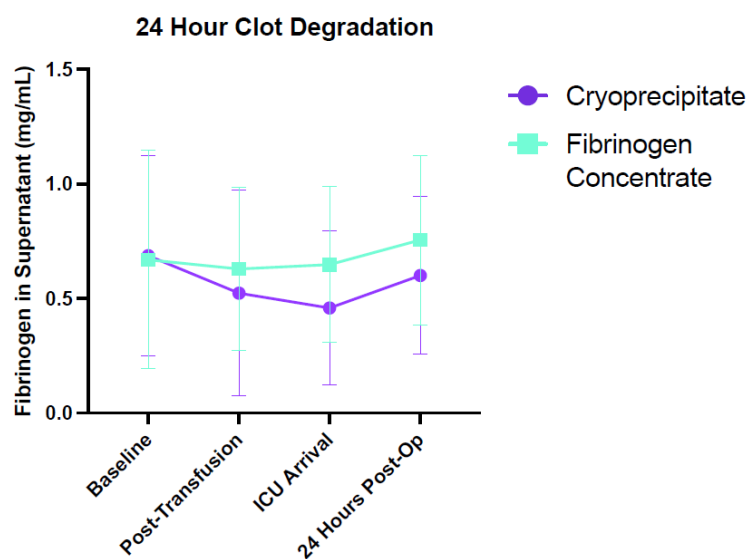
Figure 3

Figure 3. Clot degradation rates of patient samples at each time point. The assay allows the clot to form and then measures the amount of fibrinogen in the supernatant as the clot degrades over 24h. There is no significant difference between clot degradation rates between the two groups, but FC tends to have more similar degradation rates to the neonatal baseline clot, while clots formed with cryo may degrade slower over the first 24h.
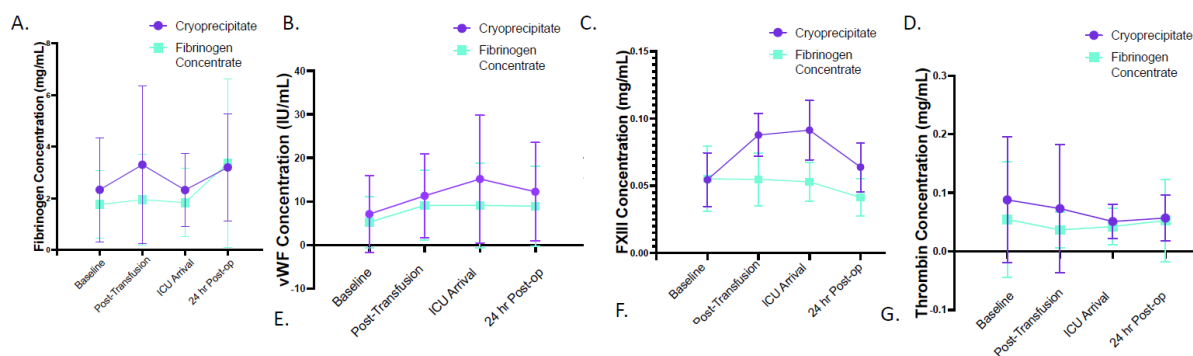
Figure 4

Figure 4. ELISA was used to determine A)Fibrinogen levels, B)von Willebrand levels,C) FXIII levels, and D)Thrombin Levels from neonatal samples at each time point. Baseline samples are prior to transfusion of either FC or cryo. There is no significant difference between the levels of procoagulant factors, but patients who received cryo tend to have higher levels of vWF and FXIII as expectred. Thrombin levels and Fibrinogen tend to be higher in the cryoprecipitate group when compared to FC immediately after transfusion, but are similar at 24h after surgery.

P64

Comparing weight-adjusted and empiric dosing of fibrinogen concentrate and cryoprecipitate for hypofibrinogenemic bleeding adult cardiac surgical patients: A post-hoc analysis for the FIBRES randomized controlled trial

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Introduction: Clinically significant bleeding requiring blood transfusion is a common complication during and after cardiac surgery, increasing the risk of morbidity and mortality. Acquired hypofibrinogenemia is associated with excessive bleeding, for which guidelines recommend fibrinogen replacement with either fibrinogen concentrate (FC) or cryoprecipitate. While empiric dosing of fibrinogen replacement products is widely utilized and well-tolerated, it may be sub-optimal in some cardiac surgery patients, leading to inadequate bleeding control. This dosing strategy may lead to additional transfusion requirements, impacting clinical outcomes. Our aim was to compare the efficacy and safety of weight-adjusted vs. empiric dosing of fibrinogen replacement for the treatment of excessive bleeding in cardiac surgery patients with hypofibrinogenemia.

Methods: Post-hoc analysis of the FIBRES trial included adult cardiac surgery patients with clinically significant bleeding and hypofibrinogenemia across 11 Canadian centers. Empiric dosing of FC (Fibryga®, Octapharma; 4 g) or cryoprecipitate (10 IU) was utilized, and patients were grouped into quartiles based on increasing weight-adjusted dosing. Generalized estimating equation models accounting for clustering by hospital were used to adjust for age, sex, surgical complexity, urgency, and critical preoperative status. Primary outcome was the number of red blood cell (RBC) units transfused within 24 h of cardiopulmonary bypass (CPB). Secondary outcomes included the total number of individual allogeneic blood components transfused within 24 h post-CPB, re-exploration, and the incidence of thromboembolic and/or ischemic complications within 28 days of CPB.

Results: The median weight-adjusted FC dose was 52 mg/kg (IQR 45–61; n=372) and 1.30 U/10 kg (IQR 1.11–1.54; n=363) for cryoprecipitate. In patients given a single dose of either product with plasma fibrinogen levels measured before and after, the increase in plasma fibrinogen was significantly higher with FC (0.96 g/L, IQR 0.74–1.28; n=252) vs. cryoprecipitate (0.78 g/L, IQR 0.52–1.00; n=225), with a mean difference of −0.23 g/L (95% CI: −0.31 to −0.15; p<0.0001). For both FC and cryoprecipitate there was no consistently observed difference for the lower and higher quartiles for the outcomes of number of RBC units transfused within 24 h of CPB (Table 1), or the number of allogeneic transfusions received within 24 h, re-exploration for bleeding or tamponade, or thromboembolic/ischemic complications within 28 days of CPB (secondary outcomes) (Table 2).

Conclusions: Transfusion and safety outcomes for lower and higher weight-adjusted doses of FC and cryoprecipitate were comparable. Weight-adjusted dosing was non-inferior to fixed dosing in hypofibrinogenemic adult cardiac surgical patients experiencing excessive bleeding.

Table 1. Adjusted hierarchical generalized estimating equation models for primary outcome.

| Quartile | FC | | Cryoprecipitate | |
	Mean (SD) dosing (mg/kg)	Relative risk (95% CI); p-value	Mean (SD) dosing (IU/10 kg)	Relative risk (95% CI); p-value
No. of RBCs transfused within 24 h of CPB*				
1	40 (5)	Reference	1.01 (0.09)	Reference
2	49 (2)	1.04 (0.77, 1.40); p=0.81	1.21 (0.06)	0.82 (0.52, 1.27); p=0.37
3	57 (2)	0.89 (0.70, 1.15); p=0.38	1.39 (0.06)	1.17 (0.85, 1.60); p=0.33
4	71 (10)	0.90 (0.71, 1.13); p=0.36	1.78 (0.22)	1.04 (0.76, 1.43); p=0.80

*Poisson regression accounting for clustering by study site, adjusted for sex, age, surgical complexity, urgency, and critical pre-operative status.

CI, confidence interval; CPB, cardiopulmonary bypass; FC, fibrinogen concentrate;

IU, international units; RBC, red blood cells; SD, standard deviation.

Table 2. Adjusted hierarchical generalized estimating equation models for secondary outcomes.

Quartile	FC Mean (SD) dosing (mg/kg)	Relative risk (95% CI); p-value	Cryoprecipitate Mean (SD) dosing (IU/10 kg)	Relative risk (95% CI); p-value
No. of all ABP transfusions within 24 h of CPB*				
1	40 (5)	Reference	1.01 (0.09)	Reference
2	49 (2)	1.02 (0.87, 1.20); p=0.81	1.21 (0.06)	0.78 (0.55, 1.11); p=0.17
3	57 (2)	0.83 (0.69, 1.00); p=0.05	1.39 (0.06)	0.99 (0.73, 1.34); p=0.95
4	71 (10)	0.90 (0.78, 1.04); p=0.16	1.78 (0.22)	0.92 (0.70, 1.21); p=0.56
Re-exploration due to bleeding or tamponade[†]				
Quartile	**Mean (SD) dosing (mg/kg)**	**Odds Ratio (95% CI); p-value**	**Mean (SD) dosing (IU/10 kg)**	**Odds Ratio (95% CI); p-value**
1	40 (5)	Reference	1.01 (0.09)	Reference
2	49 (2)	0.89 (0.46, 1.70); p=0.72	1.21 (0.06)	1.29 (0.45, 3.72); p=0.63
3	57 (2)	1.40 (0.80, 2.44); p=0.24	1.39 (0.06)	1.20 (0.41, 3.48); p=0.74
4	71 (10)	0.49 (0.23, 1.04); p=0.06	1.78 (0.22)	1.80 (0.49, 6.58); p=0.37
Thromboembolic and Ischemic Complications[†]				
Quartile	**Mean (SD) dosing (mg/kg)**	**Odds Ratio (95% CI); p-value**	**Mean (SD) dosing (IU/10 kg)**	**Odds Ratio (95% CI); p-value**
1	40 (5)	Reference	1.01 (0.09)	Reference
2	49 (2)	0.94 (0.38, 2.34); p=0.90	1.21 (0.06)	1.37 (0.42, 4.46); p=0.60
3	57 (2)	1.67 (0.64, 4.40); p=0.30	1.39 (0.06)	1.79 (0.70, 4.59); p=0.22
4	71 (10)	0.92 (0.40, 2.11); p=0.85	1.78 (0.22)	1.98 (0.73, 5.36); p=0.18

*Poisson regression accounting for clustering by study site, adjusted for sex, age, surgical complexity, urgency, and critical pre-operative status.

[†]Logistic regression accounting for clustering by study site, adjusted for sex, age, surgical complexity, urgency, and critical pre-operative status.

ABP, allogeneic blood product; CI, confidence interval; CPB, cardiopulmonary bypass;

FC, fibrinogen concentrate; IU, international units; RBC, red blood cells;

SD, standard deviation.

P65

FiiRST-2 – a prospective, randomized study of clotting factor concentrates versus standard massive haemorrhage protocol in severely bleeding trauma patients

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Background: Acquired fibrinogen deficiency and impaired thrombin generation are major drivers of acute traumatic coagulopathy (ATC), which coupled with bleeding is a leading cause of early in-hospital mortality in trauma patients. Early administration of clotting factor concentrates (fibrinogen concentrate [FC] and prothrombin complex concentrate [PCC]) may be superior to the current standard of care (SOC), a ratio-based red blood cell and plasma transfusion via a massive haemorrhage protocol (MHP).

Aims: To examine the impact of the early use of clotting factor concentrates (FC+PCC) on the number of allogenic blood products (ABPs) required by bleeding trauma patients compared to frozen plasma administered in a ratio-based plasma resuscitation.

Methods: FiiRST-2 is a randomised, parallel-control, superiority trial with an adaptive two-stage design, performed in 11 Canadian level one trauma centres. Due to the emergency setting, a deferred consent approach is employed, in accordance with the Tri-council policy statement for the ethical conduct. Bleeding trauma patients >16 years old (N=350) for which the MHP is triggered within 1 hour of arrival at the trauma bay will be randomised to receive either FC+PCC or a minimum 2:1 red blood cells (RBCs):plasma transfusion plus platelets. The intervention period will be considered until the second MHP pack has been given, MHP is terminated, or 24 hours has elapsed from admission (Figure 1). Exclusion criteria include receipt of RBCs before randomisation, >3 hours elapsed from injury, catastrophic brain injury, or known bleeding disorder. Assessments will be performed throughout the study to address primary and secondary endpoints, as well as additional efficacy and safety endpoints (Table 1).

Results: FiiRST-2 has enrolled 80 patients at 4 sites to date and the other 7 sites will be launching the study within the next few months. An interim analysis will be performed once 120 patients are enrolled. Completion is expected in Q4 2023.

Conclusion: The FiiRST-2 study will determine if early use of factor concentrates (FC+PCC) is superior to the current standard of care (a ratio-based plasma resuscitation) in bleeding trauma patients. This could have a major impact on clinical practice, improving management and outcomes for this high-risk patient population

Figure 1
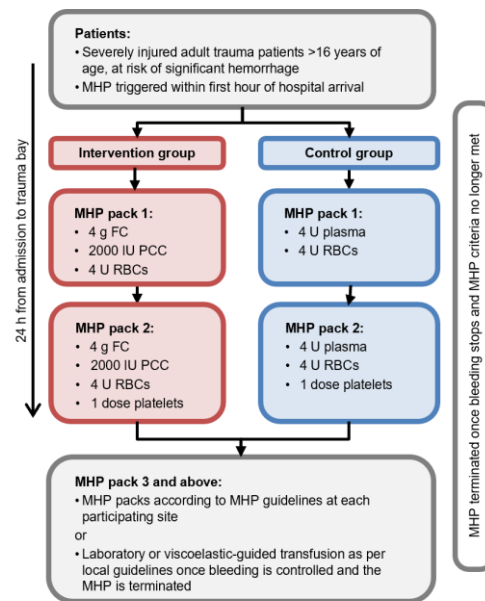
FC = fibrinogen concentrate; IU = international units;
MHP = massive hemorrhage protocol; PCC = prothrombin complex concentrate;
RBC = red blood cells

Table 1

Endpoints	Arrival at trauma bay (Day 0)	First 24 h after arrival (Day 1)	Day 2–27 after arrival at trauma bay	Final study visit (Day 28)
Primary endpoint				
Total composite units of RBC + FP + platelets		x (24 h)		
Secondary endpoints				
Total number of units of RBCs		x (24 h)		
Thromboembolic events[*]		x	x	x
Ventilator-free days				x
Additional efficacy endpoints				
Total and individual numbers of units and volumes of ABPs (RBCs, FP, platelets) transfused		x (6 and 24 h)	x (Day 7)	
Total volume of crystalloids and other colloid use		x (6 and 24 h)		
Rescue use of r-FVIIa		x		
Total FC use		x		
Laboratory tests, including ROTEM, where available		x	x (Day 7)	
Days out of hospital within 28 days				x
Time to death				x
Safety endpoints				
AEs and SAEs		x	x	x
MOF (SOFA score)		x	x (Daily)	x
ACS and LCS		x	x	x
Transfusion reactions from products transfused following arrival at trauma bay		x	x	x
Treatment-emergent events		x	x	x
Duration of ICU stay				x
All-cause mortality				x

*Including leg Doppler ultrasound or other imaging as per clinical indications
ABPs, allogenic blood products; ACS, abdominal compartment syndrome; AEs, adverse events; FC, fibrinogen concentrate; FP, frozen plasma; rFVIIa, recombinant activated factor VIIa; ICU, intensive care unit; LCS, limb compartment syndrome; MOF, multiple organ failure; PCC, prothrombin complex concentrate; RBC, red blood cells; ROTEM, thromboelastometry; SAEs, serious adverse events; SOFA, sequential organ failure assessment.

P66

Rotational thromboelastometry (ROTEM®) and platelet function as measured by Multiplate® in pre-eclamptic obstetric patients: A prospective observational study

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Introduction: Pre-eclampsia is a pregnancy-specific syndrome associated with thrombocytopenia and other platelet abnormalities [1]. Assessment of platelet function is important for the clinical management of pre-eclampsia. Multiplate® measures platelet aggregation in whole blood samples using impedance aggregometry. We aimed to describe and compare coagulation and platelet function as assessed by rotational thromboelastometry (ROTEM®) and Multiplate®, between pregnant women with and without pre-eclampsia.

Methods: This prospective observational study was conducted at a tertiary referral hospital and focused on collecting quantitative data in the form of Multiplate® (ADP, ASPI, TRAP), ROTEM® NATEM, standard coagulation profile values (prothrombin time, international normalised ratio, activated partial thromboplastin time, fibrinogen) and full blood counts. Women with uncomplicated pregnancies were included in the comparator group via sampling from elective lower segment Caesarean section patients upon presentation for their elective procedure. Ethics approval was granted for an opt-out recruitment approach for women with confirmed pre-eclampsia and written informed consent was obtained from women with uncomplicated pregnancies presenting for an elective Caesarean delivery. Pregnant women at >30 weeks' gestation were included in the pre-eclampsia group, if they had a confirmed diagnosis or were treated for suspected pre-eclampsia. ROTEM® and Multiplate® testing was performed in women with clinically diagnosed pre-eclampsia and in women with uncomplicated pregnancies. These results were compared in women with pre-eclampsia and those with uncomplicated pregnancies via Pearson's correlation.

Results: One hundred and nineteen women met inclusion criteria with a diagnosis of pre-eclampsia and were compared to 22 women with uncomplicated pregnancies. The mean age was 31.8 (SD 6.5) years with 73 (61.3%) nulliparous women and 36 (30.3%) with a pre-pregnancy BMI >30 kg/m². Only weak correlations were seen between the standard coagulation parameters and the ROTEM® NATEM and Multiplate® methods. There was a moderate positive correlation between each of the Multiplate® parameters and the ROTEM® NATEM amplitude (firmness), maximum clot firmness and AUC.

Discussion: There was a difference in coagulation parameters between women with pre-eclampsia and those with uncomplicated pregnancies. Our results may not show any differences between pre-eclampsia and uncomplicated pregnancies for the distribution outside of the reference ranges, but it is likely to be of significant interest to the field of obstetrics. There is some evidence that amplitude (firmness) and area under the curve (AUC) were lower in uncomplicated pregnancies. There is also some correlation between some of the Multiplate® and ROTEM® NATEM parameters, both of which have low correlation with the standard coagulation parameters.

Reference:
Tranquilli AL et al. Preg Hypertens 2014;(4):97-104.

P67

Rotational thromboelastometry (ROTEM®) and platelet function in pre-eclamptic obstetric women and those with features of severity: A prospective observational study

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Introduction: Pre-eclampsia affects between two and five percent of all pregnant women and is the leading cause of maternal and foetal morbidity and mortality [1]. It is a pregnancy-specific syndrome associated with thrombocytopenia, hypercoagulability, platelet activation, increased platelet consumption, and decreased platelet lifespan are common features [1]. Multiplate® is a test for platelet function and aggregation [2] but has not yet been investigated in the pre-eclamptic population. Rotational thromboelastometry (ROTEM®) is increasingly being used in the management of obstetric haemorrhage but has not yet been used to define the coagulopathy seen in pre-eclampsia. The aim of this study was to describe and compare coagulation and platelet function as assessed by ROTEM® and Multiplate® respectively in pre-eclampsia and pre-eclampsia with features of severity.

Methods: This was a single-centre prospective observational study. Ethics approval was granted for an opt-out recruitment approach. ROTEM® (FIBTEM, EXTEM and INTEM) and Multiplate® testing was performed in women with clinically diagnosed pre-eclampsia. Results from routine standard coagulation profiles and full blood counts were collected for correlation. These results were compared in women with pre-eclampsia and those with pre-eclampsia with features of severity. Features of severity included severe blood pressure elevation, symptoms of central nervous system dysfunction, hepatic abnormality, thrombocytopaenia, renal insufficiency and pulmonary oedema.

Results: One hundred and nineteen women met inclusion criteria and 93 (78.2%) of these had pre-eclampsia with features of severity. The average age was 31.8 (SD 6.5) with 61.3% of women nulliparous and 30.3% with a pre-pregnancy BMI >30 kg/m2. Women with severe PET features had an earlier gestation of 35.9 weeks (IQR 30.9, 37.7) compared to 37.6 weeks (36.4, 38.7) in less severe PET (p=0.001). Only weak correlations were seen between the standard coagulation parameters and the ROTEM® NATEM and Multiplate® methods. There was a moderate positive correlation between each of the Multiplate® parameters and the ROTEM® NATEM amplitude (firmness), maximum clot firmness and AUC.

Conclusion: There was some evidence that clot formation time was greater and clot formation rate, amplitude (firmness) and AUC was lower in women with thrombocytopaenia (platelets <100x109/L). Overall, there was little difference in coagulation parameters between women with pre-eclampsia and those with pre-eclampsia with features of severity.

References
Tranquilli AL et al. Preg Hypertens 2014;(4):97-104.
Davies JR et al. Anesth Analg 2007;104:416-20.