Preoperative anaemia screening and treatment: Barrier identification and implementation strategy mapping

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Research

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Abstract

Background: Patients undergoing major surgery are at risk of significant blood loss and subsequent transfusion, which increases substantially if the patient has pre-existing anaemia. Preoperative anaemia screening and treatment pathways (PAST-P) outline recommended blood tests and treatment to ensure patient optimisation before surgery. Although documented success in using PAST-P to reduce transfusions and improve patient outcomes exists, the reporting quality of such studies is suboptimal, and it remains unclear what implementation strategies best support the implementation of PAST-P. This study uses qualitative methods to identify local barriers and maps them to recommended implementation strategies.

Method: Maximum variation, purposive sampling was used to recruit a total of 15 participants, including a range of health professionals and patients. Qualitative data was collected using semi-structured interviews. Data analysis utilised a deductive approach informed by the Consolidated Framework for Implementation Research (CFIR) for barrier identification and the Expert Recommendations for Implementing Change (ERIC) for reporting recommended implementation strategies. The Action, Actor, Context, Target and Time (AACTT) framework assisted with conceptualisation and targeted strategy selection.

Results: The analysis revealed ten barriers: external policy and incentives, patient needs and resources, structural characteristics, networks and communications, relative priority, available resources, access to knowledge and information, knowledge and beliefs about the intervention, self-efficacy and executing. ERIC strategies recommended to mitigate barriers are: conduct educational meetings, develop educational materials, distribute educational materials, access new funding, promote network weaving, organise clinician implementation team meetings, obtain and use patients/consumers/family feedback, involve patients/consumers/family members and conduct a local needs assessment.

Conclusion: Five of ten identified barriers had strong recommendations, and nine implementation strategies were identified as being suitable to address them. Mapping the barriers and strategies using the ERIC framework on the basis of individual actor categories proved to be useful in identifying a pragmatic number of implementation strategies that may help in supporting the utilisation of the PAST-P, once it is launched at the study hospital.

Contributions To The Literature

• To the authors’ knowledge, this is the first study to report qualitative interview findings from a range of perspectives, including patients, on barriers to preoperative anaemia screening and treatment pathway implementation using the CFIR.

• To the authors’ knowledge, this study is the first to demonstrate the utility of categorising PAST-P barriers using the CFIR, AACTT and ERIC framework.
This study offers a process overview of how health professionals can diagnose barriers and plan for robust implementation of a PAST-P using existing theory.

**Background**

Patients undergoing major surgery, and who lose more than 500mls of blood, are at risk of becoming anaemic postoperatively and requiring a blood transfusion[1]. Blood transfusions are not without risk and can increase the chance of infection, venous thromboembolism (VTE) and increased length of stay (in a surgical setting) [2–4]. Due to these risks, mitigation strategies are necessary to ensure patients are optimised before surgery and help them avoid a blood transfusion [1]. Patient Blood Management (PBM) guidelines outline recommended preoperative screening tests and treatment pathways for optimisation[5–8]. The tests ascertain if the patient has anaemia (iron or non-iron related) and if present, recommends treatment including iron supplementation or further investigation to determine the underlying cause of anaemia[1]. The recommendations are summarised in Figure One below:

To date, many facilities have experienced varying success in implementing Preoperative Anaemia Screening and Treatment Pathways (PAST-P), and there is no conclusive, context-specific, evidence to suggest the most effective way to mitigate reported barriers [10]. Implementation frameworks and tools exist that can help identify barriers, conceptualise the actions needed from key stakeholders, and suggest implementation strategies[11]. This paper uses the Consolidated Framework for Implementation Research (CFIR) for barrier identification, the Actor, Action, Context, Target and Time (AACTT) framework for conceptualising actors and actions, and the Expert Recommendations for Implementing Change (ERIC) framework for implementation strategy selection[12].

The CFIR consists of five domains (intervention characteristics, inner setting, outer setting, individual characteristics and process) and 39 constructs that were devised over multiple Delphi rounds by implementation experts to develop a taxonomy for common implementation barriers[12]. It can be used at multiple phases of implementation and facilitates multi-level analysis (including individual, organisational, environment and process)[12]. The AACTT is designed to assist with mapping each person involved in the delivery of an intervention, specifying the action they are required to perform, the context in which it needs to be undertaken, to whom the action is targeted at, and the time frame required to carry it out[13]. The AACTT framework is used in this study to conceptualise actor categories and defined actions they need to perform when using the PAST-P [13].

Identified CFIR barriers can then be linked to mitigation strategies using the ERIC framework [14]. The recommended strategies are categorised by strength, depending on the level of consensus provided by implementation experts as to the effectiveness of strategies in barrier mitigation[14]. Strength is divided into three categories: weak (less than 20% consensus), moderate (20–49% consensus) and strong (50% or greater consensus)[14]. In a previous review, we ascertained CFIR coded barriers related to PBM implementation as reported in the broader context and compared strategies used by health facilities with those suggested in the ERIC framework [10]. The review confirmed the common utilisation of the
implementation strategies, but there was no relationship noted between barriers identified, strategies and improvement outcomes[10].

This paper used qualitative methods to identify the most common barriers to implementing PAST-P locally, conceptualise on an individual “actor” basis, identify the most strongly recommended strategies to address the barriers and compare them with existing evidence.

Methods

Aim:

This study aimed to identify the barriers to implementing PAST-P, conceptualise the actions required of individuals, select suitable strategies to assist with implementation and compare them with existing evidence.

Design:

Using a qualitative approach we sought the perspectives of both health professionals who may influence the introduction, and operationalisation of the PAST-P, and patients who had undergone surgery, to help identify barriers to the uptake of recommended screening and treatment.

Setting:

The setting of this study is a large, metropolitan, tertiary referral hospital that provides services for both public and privately insured patients over a wide range of specialties. Approximately 1,400 major surgeries (eligible for the PAST-P) are undertaken in the public service, and 1,900 in the private service annually. Preoperative screening processes, in general, are not standardised, and the adoption of the PAST-P for both public and private patients has yet to be put in place[15].

Participants and recruitment:

We used purposive, maximum variation sampling to gain perspectives across a breadth of healthcare professionals and patients[16]. This sampling method was chosen as it was not the intention of the study to seek “data saturation”, but to conduct interviews until a clear understanding of barriers were gathered[17]. Health professional recruitment occurred by direct, personal email invitation, and postoperative patients were directly recruited by the first author (AD) on the surgical ward. AD liaised with nursing staff to determine potential patients for participation who had to meet the criteria of having undergone major surgery, be over the age of 18 years, and also be able to provide informed consent. We sought health professionals who had experience in prescribing, administering, supplying or governing the provision of blood and blood products to patients. Before each interview, participants provided informed,
written consent. Granting of full ethical approval occurred before the commencement of the study by the hospital Human Research Ethics Committee (HREC), and administrative approval was granted from the university HREC (reference: AM/MML/47826).

Data collection:

Semi-structured interviews were loosely guided by the CFIR framework. The focus of the interview questions was iteratively adapted based on emerging, preliminary findings. After each interview, AD completed a diary reflecting on the responses provided, and then discussed the results with authors JD and JM to ensure reflexivity, transparency and agreement with the direction of future interviews. All interviews were conducted in a private and quiet area in the hospital, at a time that was convenient for the participant, by one member of the research team (AD). The first author (AD) had pre-existing professional relationships with all health care professional participants. The interviews were recorded, transcribed and de-identified. Basic demographic data collected at the time of the interview included role and years of experience.

Data analysis:

The CFIR was used to code interview responses to enable barrier identification [12]. During coding, we used a pilot sampling approach, with 20% of the transcripts coded by multiple authors (AD, JD & JM). After evidence of good agreement with coded data (over 80%), one author (AD) coded the remaining interviews. Following coding, data were provided to the two other authors for perusal before analysis to ensure credibility. Consensus discussions resolved any coding disagreements. After finalisation of coding, one author (AD) organised the data by “actor” category as suggested by the AACTT framework and then identified the most common barriers mentioned by participants in each category[13]. After allocating participants to actor categories, we devised the action they contributed to the PAST-P. The data was then forwarded to participants to provide an opportunity for them to review their answers, confirm that the barriers identified were reflective of their concerns and that the actions allocated by us to their actor category were correct to ensure trustworthiness (See Figure Two). Mapping to determine appropriate ERIC strategies occurred following agreement with barrier and action confirmation from participants. [14]. During the barrier and strategy mapping, we included only the strongest suggested ERIC strategies (over 50% expert agreement for effectiveness) for each actor barrier in our recommendations to avoid losing context [14].

Results

Demographics of included participants

A total of 15 people participated in the interviews, including 13 multidisciplinary health professionals and two patients (one receiving care in the private hospital and one in the public hospital). We recruited and
interviewed one person in each of the following categories: anaesthetist, surgeon/surgical residents/preadmissions medical team, ward physicians/clinical haematologists, pathology/blood bank, laboratory haematologist, pre-admission/private practice nurses, clinical governance/quality staff. We recruited two of each of the following categories: ward nurses, executive directors and patients. There were five males and seven females across the multidisciplinary group and the years of experience in professional role ranged from 2 to 39 years. Both patients were female.

CFIR domains and barrier constructs (directed content analysis)

Four of five CFIR domains had commonly mentioned barriers, namely the outer setting, inner setting, characteristics of individuals and process. Ten (10) CFIR barrier constructs represented those most frequently mentioned across the interviews. Barriers included external policy and incentives, patient needs and resources, structural characteristics, networks and communications, relative priority (sub-construct of implementation climate), available resources, access to knowledge and information (both sub-constructs of readiness for implementation), knowledge and beliefs about the intervention, self-efficacy and executing. Below we report the interview responses by domain and construct.

Outer setting

External policy and incentives

The structure of the Australian health care system, which is split into public and private healthcare sectors, was identified as a barrier to effective blood management, in general. [18]. Participants pointed out that, in the public system, medical staff are employed by health facilities, and therefore, hospitals have greater influence over the provision of care. In the private sector, medical staff are far more autonomous and can be resistant to process-driven, standardised care [10, 18–20]. This model also impacts the way patient care is funded. One of the executive staff participants reported “a perverse incentive in the private setting around how we fund certain things. Prescribing a blood transfusion triggers a payment to the doctor” (despite evidence suggesting we should be working towards reducing the number of blood transfusions). This means that the prescriber is rewarded for giving a blood transfusion, and thus, the motivation to prevent them could be impacted. Additionally, it was acknowledged that hospital funding could be reduced depending on the quality of care, but this is not felt by private prescribers, who receive reimbursement regardless of whether care reflected good decision making.

Patient needs and resources

Multiple perspectives informed this barrier, including those of the patient, surgeon, and ward nurses. Patients explained that they were often not given information about anaemia or screening before surgery.
When asked if they received any information about preoperative preparation, they advised their source of information came from “Mrs Google”. It also emerged that patients were not actively involved in their decision making and care choices, and can make decisions without being informed of the potential risks. Patients often just trust in the recommendations of the doctor with Ward nurses sharing that often patients “…just take advice from the doctors”.

Patients also expressed some reluctance to delay procedures to optimise anaemia because of pain and other factors. One patient was asked if they would consider a delay in surgery to optimise their anaemia, they responded “If there was no other option, I would accept it, but before (surgery), I have severe pain, I have to stop exercising, and I was putting on weight, and just thinking about being home (while potentially waiting longer for surgery as a result of anaemia treatment). It wasn't really that good.” It was also noted that for the clinicians, getting patients to return to have blood tests could be difficult. The surgeon stated that “…getting patients to come back on multiple occasions to the hospital when they are anaemic can be difficult at the best of times.”

Inner setting

Structural characteristics

*Structural characteristics* were evident as a barrier across multiple actor categories, including executive, pre-admission, blood bank and haematology staff. Interview responses highlighted the different care models and how this impedes care standardisation. Executive staff pointed out that the different model of care is an issue because the “public model would see a lot more clinicians involved in maintaining a standard of care.” Other staff shared this sentiment, including the pre-admission staff member who commented “…there is a definite difference in process. Most private consultants use their own private physician who decides what that patient requires and I’m not aware of the level of workup...however, our level of workup here in the public appears to be more robust.”

Structural characteristics were also a barrier in terms of the physical environment, and how that creates “silos” in health care facilities, which can impede the level of collaboration that occurs and quality of communication. The blood bank and haematology staff felt their major barrier was that they are not visible to clinicians “…and because we are shut away, they don't see A) how hard we work or B) that we are very patient focused.”

Networks and communications

The participants from clinical governance, haematology, and preadmissions mentioned that limited interprofessional relationships, opportunities for communication and knowing who can help with improvements were a barrier to Patient Blood Management (PBM). Some participants felt the physical distance and geographic location prevented them from building quality relationships with staff in other areas. When asked about questioning PBM practice, the laboratory haematologist commented “…potentially it can be a little bit of an awkward discussion if you’re challenging someone's management.
So especially if it's, as you said, a very senior and experienced person who has been doing something somewhere for a long time. You'd have to have personality to be able to deal with those interactions.”

Having the opportunity to communicate with staff in other areas through being invited to meetings to explain audit results or safety campaigns was another identified barrier. Opportunities for networking and communicating were reported as limited by clinical governance staff who stated “...I think there's a gap there in having the opportunity to attend meetings where audit results might be getting discussed, and then having the opportunity to, I guess, have some input and try and give examples of what the results are trying to say. I don't think we're given that opportunity.”

Participants stated that it was difficult to know who to go to in order to obtain assistance. There was an identified barrier in terms of knowing where to go for help with new initiatives or troubleshooting new policy. The preadmissions staff member advised “...there's too many layers. So I have to go through about five people to get to the person I need: One person does the marketing, one does the clinical forms, one does the nonclinical forms, one does the patient information... none of them speak to each other and it's awful.”

**Implementation climate - Relative priority**

It was noted by one of the participants that PAST-P was not considered a high priority by some in the organisation as it is not perceived as being appealing or interesting by clinical and executive staff. The preadmissions staff member felt that the climate was not ideal in terms of relative priority and stated “…I think they're disengaged with making further improvements because there are further improvements that can be made...but it's (PAST-P) a pretty dry subject for people and not many people are passionate about it. So, it's very low on the list of priorities.”

**Preparedness for implementation - Available resources**

The differences between public and private models of care, and the facilities and resources available to clinicians and patients was identified as a barrier. The public model has more resources for preoperative workup, in contrast to the private sector, where this is minimal due to funding arrangements. The surgeon pointed out that in the private, “…the facility for fixing someone's anaemia preoperatively is a more difficult path to go down because in the public sphere they get sent to the pre-admission clinic, the preoperative team look after it, and they manage the preoperative anaemia. In the private sphere, there isn't a centralised service such as that. So, you'd have to book a haematologist, or go back to a GP to determine what would be appropriate blood transfusion, or blood correction of anaemia.”

Available resources were also a barrier due to time available to staff to enact and implement change through relationship building with clinicians on the floor. Clinical governance stated it was a barrier because of a “…time factor, with your expectations of what needs to be done, and what sometimes can take over your priority for the day, means that you actually don't get to do the things which is the ideal, of actually going out there and being at the coalface”.

**Preparedness for implementation - access to knowledge and information**
Multiple participants from the patient, surgical resident, executive and clinical governance categories, noted *access to knowledge and information* is an issue where either patients or staff don’t know where to access information, can’t access it flexibly, have too much to sift through or receive it in such a distilled form that it loses meaning. The patients explained that they were not given much information about their procedure or preparing for it and had to look elsewhere for guidance.

It was also said that having externally accessible resources available to clinicians would be useful, rather than requiring their presence on campus to access them through the intranet. Clinical governance stated “I think one big gap is the accessibility of our documents, particularly for medical staff. So, having them easily available on the internet, or an app by the phone, just some way that they can get access to our documents to review different things” (would be helpful).

Access was also an issue in regard to the way in which information and reports are delivered to staff. Executive staff commented that “There’s a lower level of awareness amongst the private specialists. Whilst regular communications go out to them, they’re usually in an abbreviated format and with the amount of policy updates and production, they don’t see as much detail as an employed doctor would see. So, one of the big areas that's challenging is the private sector.”

**Individual characteristics**

**Knowledge and beliefs about the intervention**

Participants across the categories of anaesthetist, surgical resident, senior medical consultant, ward nurses, clinical governance, clinical and lab haematologists, described the variation in practice amongst teams providing care, and a lack of education as being a significant barrier to PAST-P. Variation in practice is evident across the organisation as outlined in previous audits, and was acknowledged throughout the interview process[15]. The anaesthetist commented:

"...patients don't necessarily get the blood tests, and if they get blood test, it's analysing the blood tests appropriately. Which, for example, I'm picking the example of ferritin as a number. Someone's got a haemoglobin of 108 and the ferritin is 31 and they come in for a major surgery. The ferritin is just one above the reference range, which satisfies the GP and the surgeon. They could all be happy with that, but as far as I'm concerned, it significantly increases the risk of a blood transfusion in the perioperative period."

The lack of education provided to medical staff was also raised as a barrier. The surgical resident supported that education should be improved “...they have an idea, but I don't think it is enough. If there is more information, especially for the junior doctor, if you're working in the same field for a while, yes you will get it. But if you are a junior doctor, you will not know exactly what you are supposed to do and what the guideline is saying.”
Individual beliefs about care provision were also described as a barrier to standardised care delivery. Perhaps the most compelling statement came from the senior medical consultant who stated that “Peoples beliefs are probably the biggest barriers we have”. He explained that “I think it's purported to be strong science but so was the evidence behind previous iterations of the guidelines. And obviously, if they're different, they both can't be right, but they're both alleging they’re right.”

**Self-efficacy**

Health professionals noted a level of discomfort with the idea of speaking up for best practice. When asked whether or not they feel comfortable to speak up for best practice, self-efficacy was recognised as a barrier in the self-acknowledgement that “We probably don't speak up enough. We definitely don't inquire as to is this necessary, it's really not something that is done very well. We don't necessarily have the... you know, the haemoglobin's ninety-eight and completely asymptomatic and maybe they don't need that bag of blood today.”

**Process**

**Executing**

The absence of a policy that supports best practice was identified as a barrier by the anaesthetist. Currently, there is no standardised PAST-P, and existing policies prevent staff from engaging in best practice. The anaesthetist commented, “If any policy says you shouldn't have given IV Iron under anaesthesia it creates a barrier, because even if you’re doing what's in the best interest of patients, if they were one of the rare people and had adverse reactions, you would feel unsupported because you're going directly against the guideline”.

**ERIC barrier and strategy mapping analysis**

Only five of the ten identified barriers had strongly recommended implementation strategies (with ≥ 50% expert endorsement for the strategy) including *access to knowledge and information, available resources, knowledge and beliefs about the intervention, networks and communications, patient needs and resources*. For these five barriers, there were nine implementation strategies that are strongly recommended according to the ERIC tool including; *conduct educational meetings, develop educational materials, distribute educational materials, access new funding, promote network weaving, organise clinician implementation team meetings, obtain and use patients/consumers/family feedback, involve patients/consumers/family members and conduct a local needs assessment* (Table One).

**Discussion**

To the authors’ knowledge, this paper is the first to identify barriers to the implementation of PAST-P using rigorous implementation methodology. The analysis revealed ten common barriers, five of which
had nine strongly recommended implementation strategies. The utilisation of these strategies should lead to an effective change in practice. Inclusion of the AACTT framework facilitated pragmatic and context-specific conceptualisation and data analysis.

The study revealed that **external policy and incentives** have a significant impact on the ability of health care facilities to deliver standardised care. Currently, external government and private health funding policy do not support the judicious use of blood products or encourage optimisation to avoid their usage, which is the intent of the PAST-P. This sentiment has been shared in a quasi-experimental before and after study by Morgan and colleagues who acknowledge that private prescribers, in particular, have far greater autonomy than those in the public sector[19]. In the context of patient blood management, it may be implied that private prescribers can use as much blood as they like (and are reimbursed for it), but the appropriateness of that utilisation is reflected on the organisation. The latter has little power to influence the individual practitioner [18].

Despite the absence of a strongly recommended implementation strategy to mitigate **external policy and incentives**, one step towards addressing this issue would certainly be to remove the reimbursement for prescribers (**alter incentive and allowance structures**) attached to the provision of blood, which may influence the uptake of optimisation to prevent transfusions. One strategy with weak expert endorsement, but which the literature suggests is effective, is to **involve executive boards and alter incentive allowance structures**[21]. This strategy has been helpful, as demonstrated by previous studies, to champion support for blood management programs more broadly [21, 22]. Abbett et al. implemented a financial incentive attached to the reduction in utilisation of blood products overall and found a reduction of 14.3% in transfusions considered to be given outside of guidelines [21]. Others have also demonstrated, through a quasi-experimental before and after study, a reduction of 43% in units of blood per patient discharged using a PBM program that was supported and championed by the hospital executive[22].

It was identified that **patient needs related to blood management** are currently unmet in the local setting, as no specific information regarding preoperative anaemia is provided for patients. It was found that neither prescribers nor patients currently receive structured education. Obtaining patient feedback and involving them is a strongly recommended implementation strategy to address this barrier. A multidimensional framework by Carman et al. outlines different levels of patient inclusion and considers that it can range from consultation, involvement or partnership and shared leadership[23]. In the context of PBM literature, the inclusion of patients in intervention development has tended to be tokenistic, with consumer consultation and feedback usually only sought after the development of an intervention (e.g. patient information or policy)[24, 25]. Liao et al. shared this sentiment and undertook a qualitative study of health professionals and patients perceptions of informed consent [25]. They sought to understand how patients perceive the current resources available to them that aid in giving information on risks and how they would prefer to receive that information [25]. Interestingly, they found a similar trend to our study where patients tended to rely upon, and trust, doctors recommendations, as they feel too overwhelmed to make informed decisions [25]. The study also found that patients felt a verbal and
individualised conversation between the prescribing clinician and the patient is more valuable than written materials, which they would prefer to have as a source of reference, to read in their own time [25].

**Structural characteristics** provide a significant barrier due to the different care models and organisational structures. Staff admitted preoperative workup appears to be more robust in the public model, and that standardisation of care into the private that mirrors this approach might help optimise preoperative care and reduce variation. The ERIC recommends assessing the readiness for change by identifying barriers and facilitators [14]. One study in the context of PBM implementation utilised the strategy of developing a formal blueprint resulting in a 25% reduction in transfusions [26]. An additional study that has demonstrated the positive impact of using a formalised implementation planning process pioneered the first system-wide PBM project in Western Australia [27]. Their group showed a 10% decrease in the use of blood products, despite an increase in hospital activity between 2008–2012 [27]. While they were not specific in their pre-implementation assessment, this points positively towards the impact that this strategy can have on increasing the chance of intervention uptake [26].

**Relative priority** was mentioned as an issue because some participants stated that clinicians and executives found the subject of PAST-P not to be a priority. The ERIC recommends the conduct of local consensus discussions, including the formation of working parties. Albinarrate et al. established a multidisciplinary team to determine consensus on best practice before rolling out their PBM program, which included preoperative anaemia screening and treatment and demonstrated a positive effect [28]. They achieved a decrease of 21.6% in transfusion reduction within the orthopaedic service; although compliance with preoperative anaemia pathways influence on change, specifically, was not reported [28].

Networks and communications were described as a barrier by patients and health professionals. Patients mentioned the difficulty they would sometimes have in getting through to speak to their treating physician, and health professionals were unsure of whom to contact to initiate change. The ERIC suggests the promotion of network weaving and organisation of clinician implementation team meetings. One study that relied heavily on clinician meetings, including an off-site summit, managed to reduce transfusion per patient discharged by 43% in their before and after, quasi-experimental research [22].

**Available resources** were evident as an issue due to the difference in funding models, including time and resources given to health professionals to thoroughly assess patients preoperatively. The ERIC strongly suggests that accessing new funding can mitigate this issue. In this setting, an increase in available resources is required to enhance the availability of staff to review tests and increased work up in the private sector. Provision of these resources will be necessary to facilitate optimal screening and treatment. One of the first major PBM programs, globally, originated in Western Australia and had substantial support from public sector government funding [29]. They obtained funding to cover dedicated preoperative PBM assessment nurses who ensured all patients received the necessary workup [29]. While this study did not report specific compliance with preoperative anaemia screening, it formed
part of their program, and they achieved a reduction in transfused elective patients from 22.5% to just over 2% across eight years [29].

Access to knowledge and information is currently an issue because there is no standardised pathway, and any resources available that are hospital-specific and might help support good clinical decision making are only available on the hospital intranet. It was suggested during interviews that making information and support tools available remotely to health professionals and patients would help improve access and awareness of the benefits of PAST-P. The strongly recommended strategy is the conduct of educational meetings, in addition to the development and distribution of educational materials to address this barrier. An education package, alongside audit, increased the rate of pre-transfusion testing from 87–93% [30]. Again, there was no direct reporting of compliance to preoperative screening, but the broad impact of this intervention on blood utilisation was positive.

Knowledge and beliefs about the intervention were evident as a barrier where staff participants could not correctly define PBM guidelines or provide the correct parameters for haemoglobin ranges. They also stated that there is high variation in the knowledge levels amongst health professionals concerning PAST-P and PBM. The nursing staff noted a lack of coverage within their university curricula and relied on knowledge gained through their graduate nurse program from allocated mentors. Nursing staff are expected to complete mandatory online education on PBM, which includes exploration of the importance of investigating anaemia correctly before deciding on treatment. However, it is only context-specific, and a ward nurse, who is still potentially responsible for the preoperative care of a patient, may not see the patient blood management module as relevant to them. The ERIC recommends the conduct of educational meetings to address this barrier. A 43% reduction in perioperative transfusions has been demonstrated following the implementation of a PAST-P, and one aspect of achieving this reduction included ensuring continual staff education on the importance of adherence to the hospital guideline [31].

Self-efficacy is a barrier as some health professionals felt they were capable of providing best-practice care but did not feel supported by policy and procedure. This is recognised as a pervasive issue, particularly concerning guideline dissemination and prevention of autonomy through organisational barriers has been found to impact the uptake of PBM [32]. A before and after survey study that measured the beliefs of physicians before and after the implementation of a locally developed PBM programme made allowances for individualised clinical decision making and found that there was an increase in the belief that preoperative anaemia adversely affected patient morbidity and mortality from 25–37% [32]. While there are currently no strong ERIC recommendations for this barrier, perhaps ensuring that policy and procedure are written with allowances for clinicians to make truly evidence-based decisions based on their experience, patient preference and guidelines would help in addressing it [14, 33].

Strengths and Limitations

Using the CFIR framework to identify barriers was most helpful in this study, particularly since the AACTT framework was used to conceptualise what actions were required at the individual stakeholder level.
Further research that identifies which strategies are most effective at mitigating barriers will help strengthen guidance provided by these tools.

Any potential limitation due to the pilot coding process adapted was offset by utilising a rigorous checking process with all participants to ensure that the strongest barriers were summarised from their responses. In addition, employing consensus during a pilot coding phase involving three investigators, before coding of all interviews.

**Conclusion**

This study has revealed ten barriers, including five that had strong recommendations. The five barriers, *(access to knowledge and information, available resources, knowledge and beliefs about the intervention, networks and communications, patient needs and resources)* should be addressed using nine implementation strategies: *conduct educational meetings, develop educational materials, distribute educational materials, access new funding, promote network weaving, organise clinician implementation team meetings, obtain and use patients/consumers/family feedback, involve patients/consumers/family members and conduct a local needs assessment*. Mapping the barriers and strategies using the ERIC framework on the basis of individual actor categories proved to be useful in identifying a pragmatic number of implementation strategies that may help in supporting the utilisation of the PAST-P, once it is launched at the study hospital.

**Abbreviations**

AACTT (Actor, Action, Context, Time, Target framework)

CFIR (Consolidated Framework for Implementation Research)

ERIC (Expert Recommendations for Implementing Change)

PAST-P (Preoperative Anaemia Screening and Treatment Pathway/s)

PBM (Patient Blood Management)

**Declarations**

**Ethics approval and consent to participate**

Low-risk ethical approval was gained from the hospital and the University of Newcastle Human Research Ethics Committees (HREC). Written informed consent was gained from participants, prior to participation in the study. It was emphasised that participation was voluntary, and all participants were informed that they could withdraw from the study up until their data was de-identified (which was specified as five business days from completion of data collection). Data will be stored for at least fifteen years, as per the
Australian Code for the Responsible Conduct of Research[34]. No hard copy data collected for the purpose of this study will be retained in its original form. Any hard copy data was destroyed via the hospital confidential waste system after being scanned and stored on the hospital’s secure drive in a password-protected file. All other electronic data has been stored in this manner also.

Consent for publication

All participants were given an opportunity to review the preliminary results and edit their answers before the publication of the study.

Availability of data and materials

All data generated or analysed during this study are available in the published article.

Competing interests

The authors declare they have no competing interests.

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Authors' contributions

AD contributed to the conceptualisation of the study design, undertook all recruitment and data collection, analysis, synthesis and drafting of the manuscript.

JD contributed to the conceptualisation of the study design, assisted with data analysis, guidance with data synthesis and reviewed the manuscript.

JM contributed to the conceptualisation of the study design, assisted with data analysis and reviewed the manuscript.
JH assisted by providing local guidance about recruitment and the interview process. She also assisted with the review of the manuscript.

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Tables
# Table 1
Actor, action, barriers and recommended strategies

| Actor                  | Action                                                                 | Barriers CFIR                                      | Recommended implementation strategies (ERIC)         |
|------------------------|------------------------------------------------------------------------|---------------------------------------------------|-----------------------------------------------------|
| Patient                | Comply with requests to have blood tests promptly                       | - Access to knowledge and information              | - Conduct educational meetings,                     |
|                        |                                                                        |                                                   | - Develop educational materials,                     |
|                        |                                                                        |                                                   | - Distribute educational materials                   |
|                        |                                                                        | - Patient needs and resources                      | - Obtain and use patients/consumers family feedback |
|                        |                                                                        |                                                   | - Involve patients/consumers/family members          |
|                        |                                                                        |                                                   | - Conduct a local needs assessment                   |
| Anaesthetist           | - Initiate preventative treatment through referral to GP or hospital IV | - Knowledge and beliefs about the intervention     | - Conduct educational meetings                       |
|                        | Iron infusion clinic                                                   |                                                   |                                                     |
|                        | - Provide IV Iron instead of blood if appropriate                       | - Executing-                                       | - Nil strong recommendations                         |
| Surgeon/ Surgical      | Initiate test requests and follow up                                    | - Access to knowledge and information              | - Conduct educational meetings,                     |
| Residents/ POMS teams  |                                                                        |                                                   | - Develop educational materials,                     |
|                        |                                                                        |                                                   | - Distribute educational materials                   |
|                        |                                                                        | - Available resources                               | - Access new funding                                 |
|                        |                                                                        |                                                   | - Knowledge and beliefs about the intervention       |
|                        |                                                                        |                                                   | - Conduct educational meetings                       |
| Actor | Action | Barriers CFIR | Recommended implementation strategies (ERIC) |
|-------|--------|---------------|---------------------------------------------|
| Ward Physicians/ Clinical haematologists | - Use restrictive transfusion thresholds  
- Use Iron supplementation instead of blood, where appropriate | - **Knowledge and beliefs about the intervention** | - Conduct educational meetings |
| Pathology/ Blood bank | - Perform tests in a timely manner  
- Streamline processes to enable add on screening  
- Communicate with clinicians to support sound clinical decision making | - **Available resources**  
- Executing-  
- Structural characteristics | - Access new funding  
- Nil strong recommendations  
- Nil strong recommendations |
| Lab haematologist | - Encourage practise in line with PBM guidelines  
- Communicate with clinicians to support sound clinical decision making | - **Networks and communications**  
- Knowledge and beliefs about the intervention  
- Structural characteristics | - Promote network weaving,  
- Organise clinician implementation team meetings  
- Conduct educational meetings  
- Nil strong recommendations |
| Preadmission/ Private practice nurses | - Check results and help facilitate treatment or referral  
- Educate patients about anaemia and the importance of addressing  
- Champion the change and liaise with the treating team | - **Networks and communications**  
- Relative priority  
- Structural characteristics | Promote network weaving  
- Organise clinician implementation team meetings  
- Nil strong recommendations  
- Nil strong recommendations |

*Legend 1: Bolded CFIR barriers indicate a strongly recommended ERIC strategy exists*
| Actor                      | Action                                                                 | Barriers CFIR                                         | Recommended implementation strategies (ERIC)             |
|----------------------------|------------------------------------------------------------------------|--------------------------------------------------------|----------------------------------------------------------|
| Ward nurses                | - Encourage restrictive approach                                       | - **Knowledge and beliefs about the intervention**     | - Conduct educational meetings                           |
|                            | - Liaise with physicians when blood may not be needed                   | - **Patient needs and resources**                      | - Obtain and use patients/consumers family feedback      |
|                            | - Educate patients about blood management                               |                                                        | - Involve patients/consumers/family members              |
|                            |                                                                        | - **Self-efficacy**                                    | - Nil strong recommendations                            |
| Executive staff            | - Endorse policy and procedure                                          | - **Access to knowledge and information**             | - Conduct educational meetings                           |
|                            | - Allocate sufficient resources                                         |                                                        | - Develop educational materials                          |
|                            | - Encourage engagement between physicians and clinical governance       |                                                        | Distribute educational materials                         |
|                            |                                                                        | - **External policy and incentives**                   | Nil strong recommendations                               |
|                            |                                                                        | - **Structural Characteristics**                       | Nil strong recommendations                               |
| Clinical governance/quality| - Develop process, policy and procedure                                  | - **Networks and communications**                      | - Promote network weaving                                |
|                            | - Facilitate consensus discussions                                      |                                                        | - Organise clinician implementation team meetings        |
|                            | - Consult with educators to ensure accurate content delivery            | - **Access to knowledge and information**             | Conduct educational meetings                             |
|                            | - Monitor and report progress to relevant stakeholders                  |                                                        | Develop educational materials                            |
|                            | - Gain engagement from senior leadership                                 |                                                        | Distribute educational materials                         |
|                            |                                                                        | - **Available resources**                              | Access new funding                                       |
|                            |                                                                        | - **Knowledge and beliefs about the intervention**     | - Conduct educational meetings                           |

**Legend 1:** Bolded CFIR barriers indicate a strongly recommended ERIC strategy exists
Figures

**Oral Iron**
- Haemoglobin <130g/L (men); <120g/L (female)
- Ferritin level 30-100microg/L
- Non-urgent surgery

**IV Iron**
- Haemoglobin <130g/L (men); <120g/L (female)
- Ferritin level <30microg/L
- Urgent surgery

**Blood (single unit)**
- Haemoglobin less than 70g/L (80g/L in cardiac compromised)
- Signs of respiratory or haemodynamic decompensation

**Figure 1**

Simplified guidance for appropriateness of treatment (adapted from the National Blood Authority Patient Blood Management guidelines).[5, 9]

**Figure 2**

Data analysis process overview

**Supplementary Files**

This is a list of supplementary files associated with this preprint. Click to download.

- COREQImpsciQual.pdf