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# Improving compliance with iron infusion therapy in the treatment of chronic anemia in haemodialysis patients with chronic kidney disease

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## Abstract

This quality improvement project was conducted at the haemodialysis unit in the paediatric nephrology department at Noah's Ark Children's Hospital, Cardiff. Stakeholders involved were the medical and nursing staff at the haemodialysis unit, responsible for the care of children with chronic kidney disease CKD.

Anaemia is prevalent among children with CKD. Iron infusion is administered to such children with chronic anaemia. Children on haemodialysis attending the Children's Kidney Center receive iron infusion if they satisfy the criteria based on haemoglobin and serum ferritin values according to departmental guidelines. This involves measurement of c-reactive protein and serum ferritin prior to iron administration. High iron exposure is detrimental to end organ function and hence warrants regular monitoring in conjunction with CRP, another inflammatory marker. We suspect that some children may be receiving iron infusions despite being iron replete. Also, we may be over-investigating these children with anaemia.

We identified all children receiving iron infusion in the haemodialysis unit over a four week period. We retrospectively enquired blood investigations done, prior to and after iron infusion. Blood investigations lagged on pre and post infusion times.

We devised a checklist for nursing staff to follow, primarily looking at set times for measuring haemoglobin, serum ferritin, and CRP during the month (at the start of the first and third week of the month) and also tabulating the ferritin values that would trigger frequency of iron infusions. These were aimed to:

1. Prevent iron overloading in patients with chronic anemia

2. Regularise the checking of bloods in those receiving iron infusions

3. Empower the nursing staff to independently take decisions on iron infusion delivery.

The strategy for change encompassed multiple PDSA cycles.

Plan: empower decision making on iron infusion by haemodialysis nursing staff

Do: formulate a checklist for iron infusion based on the recommended set values of ferritin, CRP and haemoglobin

Study: analyse adherence to checklist in three months time

Act: make appropriate changes to workplace behaviour based on findings of the PDSA cycle

We analysed 13 patient episodes prior to the intervention and a total of 19 patient episodes after the improvement cycles. The checklist was improved based on feedback obtained after the first PDSA cycle. A second cycle showed that investigations done were optimised. The third cycle showed improved adherence and compliance with prevention of over-treatment with iron infusion. There was 100% adherence to the investigations done prior to infusion and complied well with the department guidelines. This meant that the required number of blood tests were done on a more regular basis and it did not exceed from those done previously.

Nursing behaviour with regard to initiation and maintenance of iron infusion became more independent. This empowered nursing decision making skills and consequently freed doctor-time. It also resulted in improving team morale and ultimately patient safety by mitigating human errors.

For any QI project, interventions should be carefully designed. Stakeholder buy-in and easy accessibility of the intervention improves sustainability. Multiple PDSA cycles and incorporating stakeholder feedback into the cycle are key to success.

## Problem

Incidence and prevalence of end stage renal disease in children worldwide is 5 to 15 and 15 to 300 per million population respectively. Anemia is prevalent among children with CKD and its prevalence increases from 1% of stage 3 chronic kidney disease to 33% of stage 5 chronic kidney disease. Iron infusion is administered to such children with chronic anemia.

## Background

Children on hemodialysis attending the Children's Kidney Centre receive an iron infusion if they satisfy the criteria based on hemoglobin and serum ferritin values determined by department guidelines. This involves the measurement of CRP and serum ferritin prior to iron administration. High iron exposure is detrimental to end organ function and hence regular monitoring of serum ferritin. However, serum ferritin is also an acute phase reactant and hence has to be paired with CRP to avoid iron injection during inflammatory process.

We have a protocol on iron infusion for patients with chronic anemia secondary to chronic kidney disease on hemodialysis. However, we suspect that some children may be receiving iron infusions despite being iron replete. Also, we may be over-investigating these children with anemia.

See supplementary file: ds3431.pdf - “Iron infusion protocol”

## Baseline measurement

We identified all patients receiving iron infusion in the hemodialysis unit over a four week period (March 2014 - April 2014). We retrospectively enquired blood investigations done prior to and after iron infusion. Blood investigations were based as per the departmental protocol.

There were four patients (on hemodialysis) identified who received the iron infusion at different times when they attended the Children's Kidney Centre for their dialysis sessions. The blood investigations that had been done immediately prior and post infusion were logged. Blood investigations lagged on pre and post infusion times.

We devised a checklist for nursing staff to follow that primarily looked at set times for measuring hemoglobin, serum ferritin, and CRP during the month (at the start of the first and third week of the month), as well as tabulating the ferritin values that would trigger frequency of iron infusions.

See supplementary file: ds3662.doc - “Check-list for iron infusion in children with chronic kidney disease on hemodialysis”

## Design

We identified particular time periods during the month (targeting the start of first and third week of the month) to check on serum ferritin and CRP on patients who have received and completed a course of iron infusion for anemia. By adhering to the checklist prompts, we hope to:

1. Prevent iron overloading in patients with chronic anemia
2. Regularise the checking of bloods in those receiving iron infusion
3. Empower the nursing staff to independently take decisions on iron infusion for chronic anemia in patients with chronic renal failure.

## Strategy

Plan: Prevent iron overloading. Empower decision making by nursing staff in the haemodialysis unit regarding iron infusions for chronic anaemia.

Do: Setting up of iron infusion checklist to be followed for every patient who warrants iron infusion for chronic anaemia with recommendations based on set values of serum ferritin, CRP, and haemoglobin.

Study: Analyse the blood investigations done on patients after the checklist has been followed in the work place after few months. Examine patient episodes.

Act: Make appropriate changes to work place behaviour based on feedback from PDSA cycle. Iron infusions given during set times of the week, and investigations were done on fortnightly basis.

See supplementary file: ds4464.JPG - “PDSA4”

## Post-measurement

Data was collected again after three months of implementation of the checklist. Total number of iron infusions given and the blood investigations done during the period July 2014 - September 2014 were collated.

Changes were made to the checklist to incorporate the timing of blood investigations and iron infusions whilst on maintenance iron infusions.

A total of 13 patient episodes were examined in the first PDSA cycle. In the third cycle, 19 patient episodes were examined.

See supplementary file: ds4443.doc - “iron infusion compliance checklist”

## Lessons and limitations

Blood investigations done for patients receiving iron infusion were more regularised and were not excessive in comparison to the beginning of the project.

Nursing staff behaviour has become more independent as regards to initiation and maintenance of iron infusion for chronic anemia. This frees up valuable doctor time, while at the same time empowers nursing decision making. This also helps in improving team morale and ultimately patient safety by mitigating human factors.

Feedback from one of the PDSA cycles meant that one patient could have benefited from receiving less iron infusion as the iron stores were adequate.

The improvement cycle was repeated after two months which showed improved compliance and adherence to checklist. One hundred percent of patient episodes examined were correctly investigated and given infusions as per guideline after the third cycle.

The checklist was applied to limited number of patient episodes. We plan to roll it out to all patients in the department.

## Conclusion

Patients with chronic kidney disease on hemodialysis regularly need iron infusions based on their iron stores and degree of anemia. This is regulated by regular checking of hemoglobin, serum ferritin, and CRP blood values. We aimed to empower hemodialysis nursing staff to manage the iron infusions based on a checklist of ferritin and hemoglobin values thereby making them more independent. This had the added benefit of freeing doctor time.

The checklist formatting was improved after the first PDSA cycle and the second cycle showed that the number of investigations done pre and post infusions were optimised. It also revealed that one of the patient episode did not need further maintenance iron infusion at that point in time as the blood stores for iron were optimal.

We completed another PDSA cycle with the necessary interventions. The third cycle showed improved compliance and adherence with prevention of over treatment with iron infusion.

Performing multiple PDSA cycles, reflecting on feedback and making necessary changes to the service are key to any quality improvement project.

## References

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## Declaration of interests

None

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# GUIDELINES FOR THE USE OF IV IRON

# IN ANAEMIA OF CHRONIC KIDNEY DISEASE

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*DISCLAIMER: These guidelines were produced in good faith by the author(s) reviewing available evidence/opinion. They were designed for use by paediatric nephrologists at the University Hospital of Wales, Cardiff for children under their care. They are neither policies nor protocols but are intended to serve only as guidelines. They are not intended to replace clinical judgment or dictate care of individual patients. Responsibility and decision-making (including checking drug doses) for a specific patient lie with the physician and staff caring for that particular patient.*

Version 1, Dr GC Smith Apr 2010

# GUIDELINES FOR THE USE OF IV IRON IN ANAEMIA OF CHRONIC KIDNEY DISEASE

Anaemia of Chronic Renal Failure is treated with Recombinant human erythropoietin (r-HuEPO), also called erythropoetin stimulating agents (ESAs) and the treatment is ineffective in the absence of adequate iron to allow erythropoesis.

**TARGETS :**

Anaemia is defined as haemoglobin of <11g/dl.

The target haemoglobin is **>11 and <13.5g/dl.**

In severe chronic renal failure (GFR <30) the target range for serum ferritin is **200-500mg/l.**

When GFR < 30, oral iron is thought to be ineffective and hence intravenous iron is preferred.

**Before starting IV iron:**

- Stop oral iron.
- Blood transfusion in the previous month?
- If **YES**:
  - check haemoglobin and ferritin.
  - If the ferritin is <200mg/l and haemoglobin <11g/dl **start IV iron**.

- The following baseline data must be available:
  *Within the last month*
  - Haemoglobin & Reticulocyte count (2.5ml EDTA sample)
  - Ferritin (2ml clotted sample)
  - PTH (2.5ml EDTA and send ASAP to biochemistry)

**Preparations used :**

- Most effective IV iron preparation is *iron (III) hydroxide sucrose complex (**Venofer**)*.
- The incidence of anaphylaxis is low (0.1%).
- It is more rapidly released into the circulation and produces less hepatic parenchymal iron deposition compared with other IV iron agents.
- It can be given to children who are on peritoneal dialysis or haemodialysis as well as those who are not yet dialysed.

**Patients who should be reviewed before considering IV iron therapy**

- previous known allergy to iron preparations

- history of atopy, eczema, asthma
- abnormal liver function, liver cirrhosis, hepatitis
- infected
- treatment with β-blockers

If uncertain, discuss with Consultant

## Dose of IV iron (III) hydroxide sucrose complex:

The initial dose of IV iron depends on whether the child's haemoglobin is greater, or less than, 11g/dl and hence this section is divided into:

**1. Initial dose – Hb < 11g/dl**

a) *Initial IV iron for haemodialysis patients*

b) *Initial IV iron for non-dialysed children or those on peritoneal dialysis*

**2. Initial dose – Hb > 11g/dl**

**3. Maintenance IV iron schedule** (The maintenance doses are independent of the haemoglobin)

**1. Initial dose - if haemoglobin less than 11g/dl:**

Use the following formula to calculate the total initial amount of IV iron required;

**Fe required (mg) = Body wt (Kg) × (11.5 – actual Hb (g/dl)) × 2.4**

**NB**:
- One 5ml ampoule of IV iron (III) hydroxide sucrose complex =100mg of iron
- Total initial IV iron dose cannot usually be given in a single infusion
- Maximum dose *each day* is **3mg** (= 0.15ml) IV iron/Kg (**absolute maximum 200mg**)
- Maximum frequency is **three** doses in one week.

***1 a)*** *Initial IV iron for **haemodialysis** patients*

(Note – the Venofer preparation is not cleared by dialysis.)

Having calculated the total initial IV iron dose required, work out, using the maximum daily dose, how many doses will be required to give the total initial dose. Usually, the maximum daily dose is given at each

haemodialysis session until the total initial IV iron dose has been administered.

***1. b)*** *Initial IV iron for* ***non-dialysed*** *children or those on* ***peritoneal dialysis***

The above also applies to these groups. They will need to attend the Day Unit for IV iron infusion(s). If a number of doses are required to give the total iron deficit, these can be given on consecutive days up to the maximum frequency of three doses in one week.

**After completion of the total initial dose of IV iron:**

- Check the ferritin (and CRP) 2 weeks
- Then move on to the maintenance IV iron schedule. (However, if there is no improvement in the haematological parameters at this time, the original diagnosis should be reconsidered.)

**2. Initial dose - if haemoglobin greater than 11g/dl:**

The initial dose of IV iron is determined by the patient's **ferritin** alone. The following table is used:

| ***If ferritin:*** | |
|---|---|
| | ***Give 3mg(= 0.15ml)/kg IV iron (maximum 200mg per infusion):*** |
| *<200mg/l* | *Twice in 7 day period* |
| | |
| *200-500mg/l* | *Once* |

**After completion of the total initial dose of IV iron:**

- Check the ferritin (and CRP) 2 weeks after completion of the total initial dose of IV iron
- Then move on to the maintenance IV iron schedule. (However, if there is no improvement in the haematological parameters at this time, the original diagnosis should be reconsidered.)

**3. Maintenance IV iron**

Give further maintenance IV iron based on the following table:

| *If ferritin:* | *Give 3mg(= 0.15ml)/kg IV iron (maximum 200mg per infusion):* |
|---|---|
| | |
| *<100mg/l* | *Twice a week* |
| | |
| *100-200mg/l* | *Weekly* |
| | |
| *200-500mg/l* | *Monthly* |
| | |
| *>500mg/l* | *Stop but maintain monthly monitoring* |

- Give iron as required above for a period of four weeks
- Then check ferritin (and CRP) levels 2 weeks after the final dose. Alter regimen depending on result.

## Administration guidelines for IV iron (III) hydroxide sucrose complex:

- In all cases **(initial and maintenance doses)** doses are given as a **neat** solution over a **minimum of 5 minutes** followed by flush of 2ml 0.9% saline.

- **Test dose:** Before administering the first dose to a new patient a test dose should be given.

  This test dose involves administering 1ml of neat solution over 1 to 2 minutes. If no adverse events occur within 15minutes of completing the test dose, then the remaining portion of the dose can be given.

- **Regular observations** are required when administering IV iron

  Record **Heart rate, blood pressure and respiratory rate** prior to administration, after 15 minutes then after a further 15 minutes. (i.e. **at 0, 15 and 30mins)**

- The patient can go **home** if they remain well half an hour after the dose is given – i.e. after the final set of observations.

  If a test dose has been given, a further set of observations should be recorded after another 15minute interval (i.e. 45mins after initial observations recorded) and the patient can again go home following this if they remain well.

- If **extravasation** occurs during administration of IV iron then: -

  • Stop bolus
  • Aspirate any remaining iron from butterfly and tubing
  • Inject 0.5ml 0.9% saline subcutaneous using same butterfly

- Try to aspirate any fluid back from subcutaneous tissue and discard
- Remove butterfly
- If the needle is still inserted, rinse with a small amount of 0.9% NaCl solution. In order to accelerate the elimination of the iron, instruct the patient to treat the point of injection topically with a mucopolysaccharide gel or ointment (e.g. Movelat). Administer the gel or ointment gently. Do not massage in order to avoid further spreading of the iron.

- **Anaphylactic reactions and/or symptomatic hypotension are very rare but can occur.**

Observe for signs of anaphylactic/ anaphylactoid reaction and if they occur **STOP IRON INFUSION** and proceed as per guidelines of dealing with anaphylaxis.