

# An Observational Study in the UK Comparing the Safety and Cost-Effectiveness of Intravenous Iron Preparations Monofer to Venofer for the Treatment of Iron Deficiency Anaemia in Pregnancy

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**Abstract:** This observational study compares the cost and safety of monofer to venofer in pregnancy for iron deficiency anaemia.

Over a year period, of the 5000 deliveries in our hospital, 24 women received intravenous iron; 9 venofer, 15 monofer.

Prescription cost was calculated using net ingredient cost per item from the NHS prescription cost analysis database. Our hospital finance department provided cost of day attendance to the maternity unit for infusion.

On average a single infusion was required of monofer compared to four for venofer. Estimated treatment cost per patient was £847 for monofer and £2175.55 for venofer. Following monofer infusion, a small number of patients experienced flushing, headaches, vomiting, however these were self-limiting.

No severe drug reactions were seen in either group.

The use of monofer in place of venofer, resulted in fewer infusions and therefore hospital visits, resulting in substantially lower healthcare costs, without increased safety risks in pregnancy.

**Keywords:** Intravenous iron, monofer, venofer, iron deficiency anaemia, cost analysis, safety, pregnancy

## 1. INTRODUCTION

Iron deficiency anaemia (IDA) is common in pregnancy, the World Health Organisation (WHO) estimates a global prevalence of 40% [1]. Maternal implications are grave, IDA increases risk of pre-eclampsia, placental abruption, preterm birth, and postpartum haemorrhage [2, 3]. Moreover, poor foetal outcomes are associated with anaemia; low birth weight, long-term cognitive and behavioural problems [4, 5].

IDA can be prevented by timely detection and correction of iron deficit. In most cases, oral iron is an appropriate treatment. However, malabsorption, problems with adherence or ongoing blood loss may make oral treatment ineffective [6,7]. Across various socio-economic settings, parenteral iron is becoming

increasingly popular for IDA in pregnancy [8-10]; it rapidly increases haemoglobin (Hb) levels and replenishes iron stores faster than oral iron, with no severe adverse reactions. Additionally, comparatively lower rates of gastrointestinal problems are reported with intravenous iron preparations. At present its use is for failure to respond to oral treatment, or cases where rapid replacement is required [11], often for late diagnosis IDA.

Concerns regarding risk of hypersensitivity reactions, dominate discourse on parenteral iron use, despite the European Medicines Agency (EMA) report rates of severe anaphylactic reactions as uncommon ( $\geq 1/1,000$  to  $< 1/100$ ) [12]. A popular theory for mechanism for hypersensitivity to intravenous iron is complement activation-related pseudo allergy

(CARPA), provoked by nanoparticles present in parenteral iron preparations [13]. Subsequent activation of mast cells and basophils triggers release of histamine, thromboxanes, leukotrienes precipitating smooth muscle contraction and increased capillary permeability [13]. According to the Ring and Messmer classification [14], this results in symptoms of itching, flushing, joint pain in mild cases, chest tightness, shortness of breath, hypotension in moderate cases and in severe cases progresses to stridor, cyanosis and cardiac arrest.

In the UK at present three forms of injectable iron are being used for the pregnant population; iron carboxymaltose, iron sucrose (venofer) and iron isomaltoside (monofer) [11], the latter two are available in our hospital's formulary. In our Trust at present monofer is reserved for late diagnosis of IDA due to the potential for single dose total iron replacement.

In other populations, monofer has replaced venofer due to single dose replacement [15-17]. Firstly, it is a safe treatment, EMA report rates of hypersensitivity at <0.02% [12]. Secondly it is similar in effectiveness to iron sucrose in sustaining Hb levels post infusion. In a study of anaemia in dialysis patients, both monofer and venofer had comparative efficacy in maintaining Hb concentrations [15].

Mild adverse drug reactions (ADR) are mostly seen post iron infusion. Systematic review comparing iron preparations showed rates of ADR varied 0 to 20% [18]; common were mild symptoms such as nausea, headaches and pruritus which self-resolved within minutes of infusion. In the peripartum population, studies have shown iron carboxymaltose is not as well tolerated, with frequent reports of skin related reactions (erythema, pruritus, pain at injection site) [19, 20].

Cochrane review [21] highlighted there are limited studies of the safety intravenous iron preparations in pregnancy. Therefore in clinical practice the risks and benefits of their use must be outweighed.

Current available evidence for neonatal outcome following infusion is limited. Pre-clinical marketing studies report use of monofer in animals was not found to increase teratogenicity at therapeutic doses [22].

A rare case of intrauterine death secondary to generalised oedema in the mother, following venofer infusion has been reported [23]. Although no similar cases have been reported, it is nonetheless a cautionary warning the potentially fatal outcomes associated with their use in pregnancy.

Additionally, long term risks associated with intravenous iron and toxicity are unknown, with concerns regarding the risk of developing atherosclerosis, Alzheimer's and increased susceptibility to bacterial infections [24-26].

Overall, current available evidence shows the safety profile of monofer appears to be favourable and well tolerated by patients, with single dosing providing a more cost-effective form of treatment.

This study aims to add further evidence to support safety of parenteral iron preparations in pregnancy, with particular focus on monofer and venofer comparing safety, cost and patient outcomes.

## 2. MATERIALS & METHODS

### 2.1. Patient Population

We retrospectively identified all women receiving intravenous iron during pregnancy, over a year period from November 2018-November 2019. Cases were identified using electronic pharmacy dispensary records for maternity services. Our Trust guidelines state pharmacy dispensary must record patient details for all patients dispensed iron infusions. Data requiring patient demographic and antenatal care were obtained directly from paper maternity notes.

Over our study period, 24 patients were identified during our study period; 15 patients received monofer and 9 venofer. Both cohorts were similarly matched in terms of demographics as shown in Table 1.

**Table 1.** Characteristics of patient population receiving intravenous iron

	<b>Iron isomaltoside 1000 (n=15)</b>	<b>Iron sucrose (n=9)</b>
Age (range)	28 (19-39)	27 (21-31)
Body mass index (range)	26 (18-36)	23 (16-32)
History of anaemia	13% (2/15)	22% (2/9)
Multiparous	87% (13/15)	77% (7/9)

## **2.2. Timing of IDA Diagnosis**

We reviewed paper antenatal booking notes and electronic blood reporting systems to collate timing (in weeks) a diagnosis of IDA was made.

## **2.3. Oral Iron Therapy- Compliance and Monitoring**

Routine assessment of Hb and iron studies is mandatory at both 12 and 28 week antenatal midwifery appointments [6]. According to national guidelines for anaemia in pregnancy, Hb and ferritin levels should be checked 2 weeks post initiation of iron replacement therapy, with an increase in Hb 20g/L signifying effective response. Once Hb and ferritin have reached normal levels, iron replacement should be continued for 3 months [6].

All antenatal notes contain any medication (dose and route) patients have been commenced on. Therefore, for all patients prescribed parenteral iron replacement, we were able to review their 12-week antenatal appointment notes, medication charts, combined with the electronic blood reporting systems to collect the following data:

- Number of patients given iron tablets as first line for IDA treatment
- How many patients were given pre-treatment education (recommendation to take in morning, empty stomach, diet rich in Vitamin C, without other medications or antacids)
- How many patients were given alternative oral preparations or regimes before consideration of intravenous iron for IDA
- How many patients had repeat Hb and ferritin levels 2 weeks following initiation of oral treatment

## **2.4. Intravenous Iron**

### *2.4.1. Indication, Timing of Intravenous Iron Infusion*

In our hospital, parenteral iron can only be dispensed to the maternity unit following Haematology approval. Our Trust introduced monofer in 2018, however in line with current evidence, its use was reserved for cases of IDA requiring rapid iron replacement.

Using antenatal notes, birth notes, pharmacy dispensary records and electronic blood reporting systems, we collected the following information:

- Indication for intravenous preparation
- Timing of infusion (gestational age in weeks)

### *2.4.2. Patient Outcome Following Infusion*

All patients require post-infusion monitoring for at least 30minutes. Using data from antenatal, delivery notes, drug charts and electronic blood reporting systems we collected data on:

- Hypersensitivity reactions- mild, moderate, severe as classified by Rampton et al [13]
- Delivery Hb
- Post-partum haemorrhage
- Blood transfusion required at delivery due to anaemia

We performed statistical analysis with Fisher's t test to identify whether the type of iron preparation was associated with risk of adverse reaction.

We used the following hypotheses:

- $H_0$ : intravenous iron preparation and adverse reaction are independent
- $H_1$ : intravenous iron preparation and adverse reaction are not independent

### *2.4.3. Dose Calculation*

Infusion dose was calculated using the simplified table on the summary of product characteristic (smPC) data for both monofer [22] and venofer [27] on the electronic medicine compendium (emc), approved by the UK Medicines and Healthcare products Regulatory Agency.

Monofer 100mg/ml, is available in 1ml, 2ml, 5ml and 10ml ampoules. The following applies to monofer use; a single infusion should not exceed 20mg/kg body weight, a bolus injection should not exceed 500mg iron. Where the dose exceeds 20mg/kg body weight, then the dose must split into two administrations, at least one week apart. It may be administered undiluted or diluted in maximum 20 ml sterile 0.9% sodium chloride. The usual adult dose is 1000-2000mg [23].

Venofer 20 mg iron / ml, solution for injection is available in 2.5ml, 5ml and 10ml ampoules. Maximum administration as in infusion of 200mg in 100ml 0.9% saline [27].

Thus a course of Venofer is 1000 mg, would be given over five separate occasions.

**2.4.4. Cost Comparison**

The Prescription Cost Analysis 2018 database was used to obtain net ingredient cost per item

[28]. A comparison of prescription cost per per 1000mg for monofer and venofer is provided in Table 2.

**Table2.** Cost comparison per 1000mg for monofer and venofer

Drug/ pack size	Cost per pack	Cost of 1000mg dose
Venofer (100mg/5ml x 5)	£52.22	£104.44
Monofer (1000mg/10ml x 2)	£324	£162

**Source:** NHS Digital Prescription Cost analysis 2018

Owing to the route of administration and monitoring requirements, all patients receiving iron infusions require attendance to the day admissions ward in the maternity unit. Our hospital finance department were able to provide an average bill for patients admitted to this area at £523 per visit. This cost is inclusive of staffing, medical equipment and ward supplies such cannulas, phlebotomy equipment and emergency drugs. Staffing in this area includes a band 6 midwife, band 6 nurse, healthcare assistant, with clinical support provided by the on-call obstetrics physicians.

Total cost of treatment for each patient was calculated by the following:

**Cost of total calculated iron dose + (number of hospital visits x £523)**

**2.5. Ethics Approval**

We did not seek ethical committee approval for this study, and provide the following justification for this. Firstly, all data analysed were collected as part of routine antenatal care. Screening Hb levels and collection of demographic information forms routine part of antenatal care and was in no-way added on for the benefit of this study.

Secondly this study does not report on the use of experimental or new treatment. Patients were diagnosed and treated according to Trust guidelines which were built in accordance with national guidance from the British Society of Haematology clinical standards for the management of iron deficiency anaemia in pregnancy.

Lastly, our analysis looked retrospectively at patient outcomes between the two groups and therefore did not influence decisions of the healthcare professions involved in the patients' care.

**3. RESULTS**

**3.1. Timing of IDA Diagnosis**

25% (n=24) of patients who received intravenous iron replacement during pregnancy,

were identified as anaemic at booking appointment, with Hb(g/L) ranges 76 to 102.

5 out of the 6 patients identified as anaemic at booking were commenced on oral iron therapy.

At 28-week antenatal appointments, 24 patients (including those identified and initiated at treatment at booking) were diagnosed with IDA with Hb(g/L) ranges 78-105.

**3.2. Oral Iron Therapy- Initiation, Monitoring and Compliance**

20 patients (80%, n=24) received oral ferrous sulphate tablets as first line for IDA.

Of these patients, only 3(15%, n=20) had an increase in Hb following 2 weeks of oral replacement.

Evidence of pre-treatment education was seen in only 5 cases (25%, n=20).

All patients prescribed oral iron therapy had repeat Hb levels at least 2 weeks following initiation of treatment. Only 54% had compliance to oral iron regime was documented in 15 cases (63%, n=20).

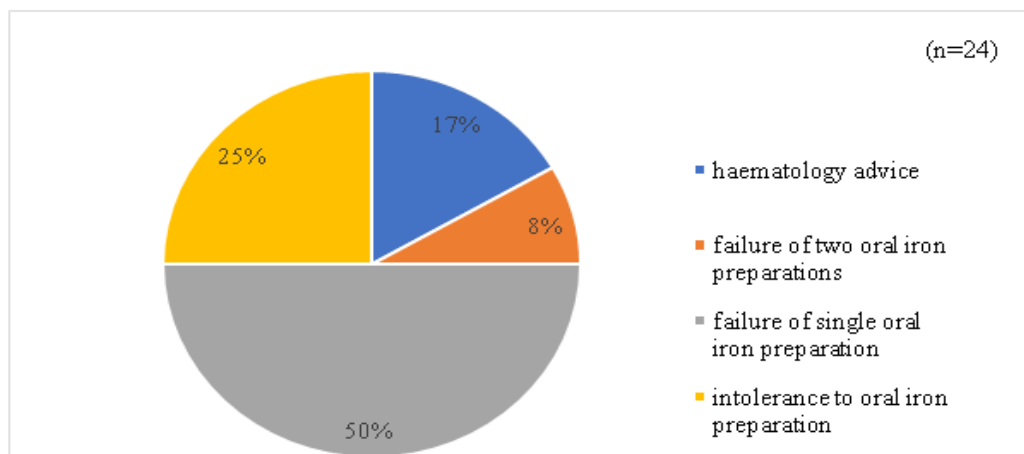
2 patients (10%, n=20) were trialled on alternative preparations of oral iron; one patient was prescribed liquid iron supplement and the other on a reduced oral iron dosing regimen.

**3.3. Parenteral Iron**

**3.3.1. Indication**

Therapeutic doses of iron should increase Hb levels by 10g/L per week, therefore we defined treatment failure where repeat 2-week Hb level had either fallen, remained the same or failed to rise >10g/L.

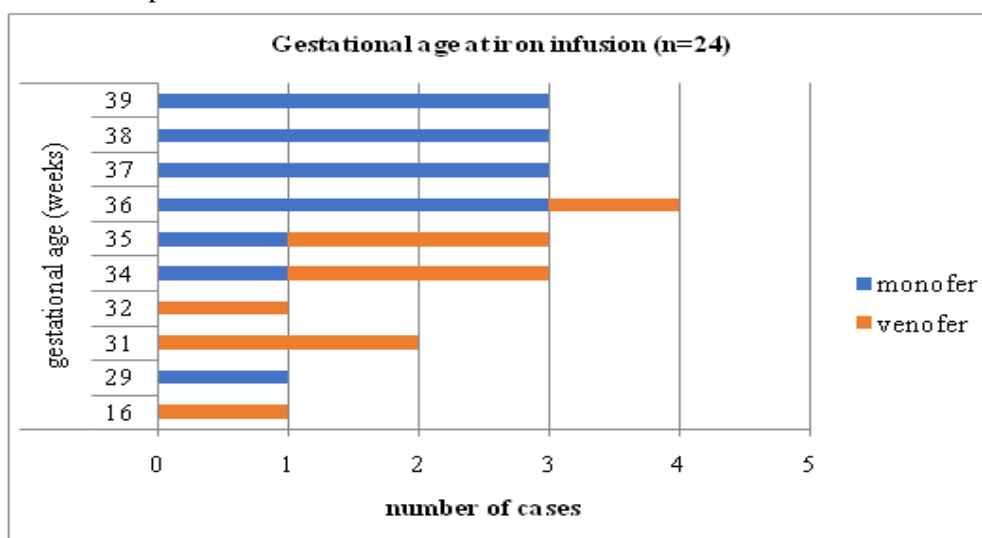
In most cases, intravenous iron were given after failure of an oral preparation. Under Haematology advice, intravenous iron as first line for the following cases; vaginal bleeding secondary to uterine fibroids, occult bleeding secondary to haemorrhoids, rapid replacement required in patients >34weeks pregnant.



**Figure1.** Pie chart illustrating the indication for intravenous iron

### 3.3.2. Timing of Infusion

Intravenous infusions were given between 16-39 weeks. 34 weeks was the median gestational age intravenous iron was used in our services. On average women were given monofer later in pregnancy than venofer; 36 compared to 31 weeks.



**Figure2.** Bar chart comparing gestational age at time of iron infusion

We compared Hb levels prior to infusion, the average for monofer, Hb 84g/L and venofer, Hb 93g/L.

### 3.3.3. Patient Outcomes

#### ➤ Hypersensitivity Reaction

We recorded incidence of hypersensitivity reaction (HSR) for the two cohorts into mild, moderate and severe, according to the following clinical signs as described by Ring and Messmer [14]

- Mild :urticaria, pruritus, flushing, myalgia, hypertension
- Moderate :chest tightness, shortness of breath, tachycardia, hypotension

- Severe : stridor, wheeze, cyanosis, loss of consciousness, cardiac/respiratory arrest

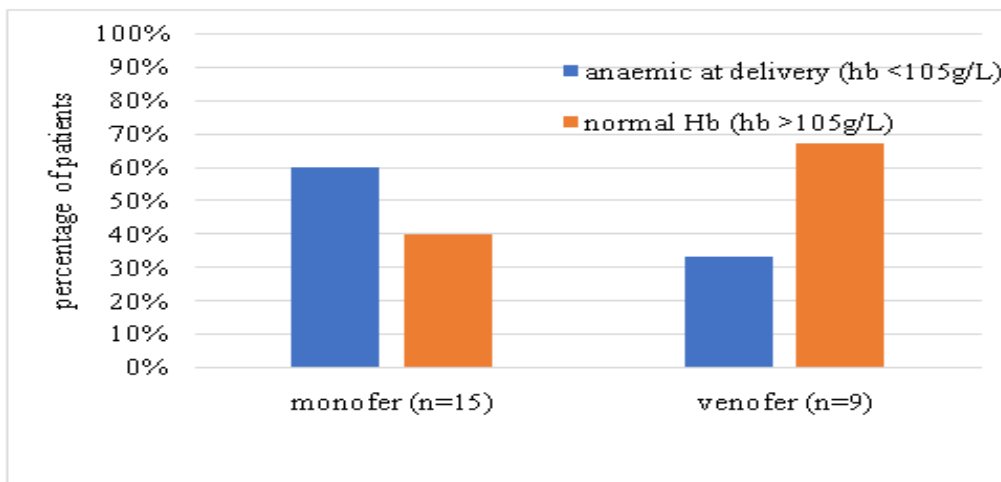
Among the venofer cohort, all patients completed the infusion without any adverse effects noted. However, in the monofer cohort, 4 patients (27%, n=15) experienced adverse effects: 3 mild HSR, 1 moderate HSR. Flushing was seen in one patient, which subsided with antihistamines. Headache, diarrhoea and flushing were experienced by two other patients within 2 hours following infusion, which self-terminated. Lastly one patient required treatment for moderate HSR in the form of flushing, chest tightness and dyspnoea, which resolved following chlorphenamine and hydrocortisone and the infusion was successfully completed at slower rate with no further adverse effects.



The two-tailed P value equals 0.2589, therefore we do not have sufficient evidence to state there is a statistically significant association between iron preparation and adverse effect of infusion.

➤ *Delivery Hb*

As part of our Trust’s intrapartum care plan, all women Hb and crossmatch taken on admission in labour, using this information, we compared number of anaemic patients on admission in labour following iron infusion, this is displayed in figure 3.



**Figure3.** Bar chart comparing Hb levels at delivery between monofer and venofer cohort

- *Post- Partum Haemorrhage*

Blood loss  $\geq 500$ mls was seen in 6 patients (25%, n=24); 2 in monofer cohort, 4 in the venofer cohort.

- *Blood Transfusion at Delivery*

At delivery, blood transfusion were given to two women (13%, n=15) in monofer cohort due to symptomatic anaemia. None of these women had postpartum haemorrhage; estimated delivery blood loss was  $< 500$ mls, however blood transfusion was given due to  $< 90$ g/L in the presence of symptoms such as dizziness, breathlessness, fatigue.

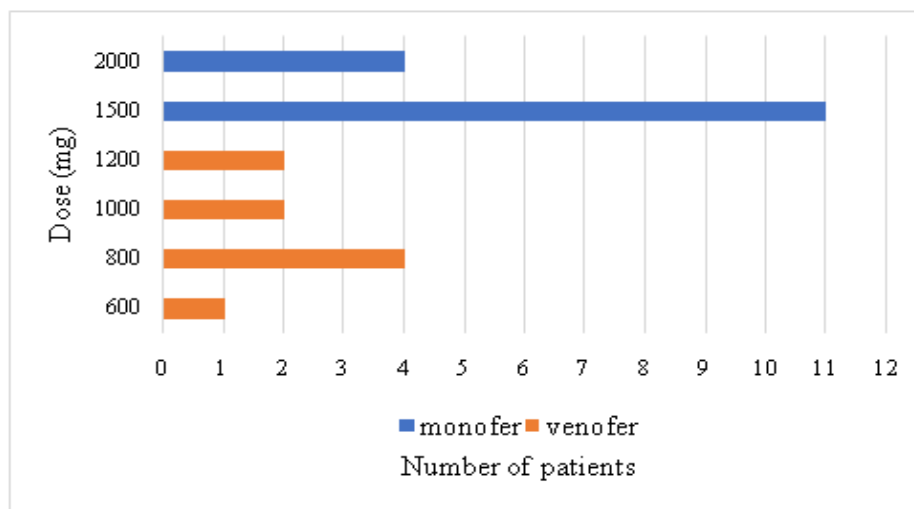
In the venofer cohort one women (11%, n=9), with a Hb 85 was given blood transfusion at delivery based on clinical symptoms of anaemia.

*3.3.4. Dose calculation*

Patients had similar booking weights across both cohorts as noted in Table 1.

Average Hb prior to infusion was 84g/L for those who received monofer and 93 g/L in the venofer cohort.

Therefore, the doses for total iron replacement (mg) required for total iron replacement was greater in the patients receiving monofer. The average dose of monofer was 1500mg and venofer, 800mg.

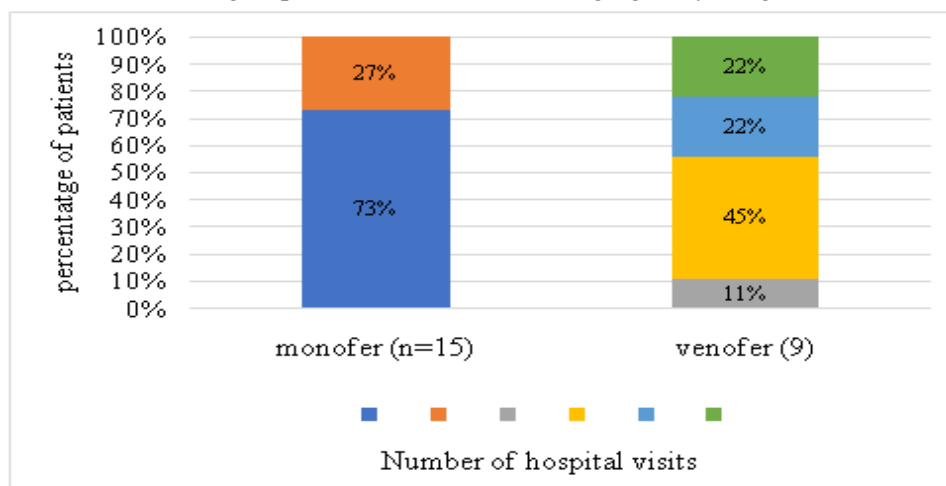


**Figure4.** Bar chart comparing doses required for total iron replacement between monofer and venofer cohort

*3.3.5. Cost comparison monofer versus venofer*

Each visit to the maternity day unit for infusion was documented in the patient's antenatal note, we recorded the number of hospital visits for infusion between the two groups. Maximum

dose per visit was dependant on drug and body weight. Venofer maximum is 200mg per single infusion or injection and for monofer maximum is 20mg/kg body weight.



**Figure 5.** Comparison of the number of hospital attendance for infusion monofer vs venofer

Total treatment was calculated using cost of hospital visits and using the prescription cost analysis 2019 database (cost without discount and dispensing feeds per single item prescribed). The pharmacy can only dispense by drug by vial size, therefore doses provided could be dispensed in 100mg/5ml vials for venofer whereas dispensary for monofer is as 1000mg/10ml vials, with additional medication discarded as the infusion are single use only.

On average patients receiving monofer for IDA required 1500mg doses for total iron replacement and were able to have these doses in a single hospital visit, costing £847 (medication expenditure £324, hospital attendance £523). Those on venofer required 800mg over 4 hospital visits, costing £2175.55 (drug = £83.55, hospital attendances =£2092).

In light of the different doses and hospital visits required, an estimate of £11,659 was spent for all patients prescribed monofer for IDA, compared to £22,590.52 for all patients prescribed venofer.

#### 4. DISCUSSION

In this study, we evaluated the indication, safety and cost implication of monofer compared to venofer iron use in pregnancy for IDA.

The main reason for intravenous iron use in our study was a failure to achieve optimal response with oral iron, however we noted inconsistent patient counselling prior to oral iron supplements or trial of alternative oral preparations/ regimes. This is a common issue,

both FIGO [29] and UK [11] reports, stress timely review following initiation of treatment and strategies to improve compliance or issues of malabsorption are standards for clinical practice in this area.

Irrespective of the above, only a small group of patients during pregnancy will require intravenous iron. Results of this study estimate 1 in 200 pregnancies require parenteral iron replacement.

Although slight Hb rise is seen within 7 days of iron infusion, it takes up to 4 weeks for rise of 20-30g/L [11,21]. Due to late diagnosis in pregnancy and lower Hb levels, most patients were more commonly given monofer over venofer in pregnancy. Unsurprisingly, a greater number of patients following monofer infusion remained anaemic at delivery, Hb<105, suggesting there was inadequate time for infusion to optimise iron stores prior to delivery.

Hb <85g/L in labour increases risk of postpartum haemorrhage, preterm labour and low-birth weight babies and therefore requires delivery on a consultant led unit.

Limitations of our study is a small sample size, however, no severe HSR seen in either group, consistent with literature that severe anaphylaxis is rare with intravenous iron [9,10,12,30] and is therefore a safe option in pregnancy. Furthermore, separate systemic reviews by Rognoni et al. [18] and Qassim et al. [31], have shown equal effectiveness and safety profile for iron sucrose, iron caboxymaltose and iron

isomaltose in pregnancy. We observed mild adverse effects following monofer infusion, but this was not statistically significant, and they were more suggestive of side effects of medication rather than serious effects. Rampton et al [13] approaches such issues and describes clinical strategies to ensure safe administration of iron infusion.

Patients prescribed venofer required multiple infusions compared to monofer. In our study, we focused on the economic impact of repeated infusions. Administrative costs, staffing time and added burden to patients are additional factors, although not explored here, add weight to the argument for pursuing single dosing intravenous iron preparation for IDA in pregnancy. Risk of HSR can be mitigated through identifying high risk patients, staff training on administration of infusion and in a facility equipped to manage cardiopulmonary resuscitation.

## 5. CONCLUSIONS

Monofer is a safe and cost-effective treatment for IDA in pregnancy. Current clinical practice for use of iron sucrose (venofer) as first line amongst intravenous iron preparation is less cost effective owing to repeated outpatient hospital visits, utilises greater labour and material resources. We should consider clinical use of the iron isomaltoside (monofer) preparation being the most expedient and cost-effective method. Therefore, we propose expansion of iron isomaltoside for use not only in late pregnancy where rapid replacement is required, but also for consideration as the first line intravenous iron preparation in pregnancy.

## REFERENCES

- [1] World Health Organisation. *Worldwide Prevalence of Anaemia 1993-2005*. Geneva: WHO; 2008. <https://www.who.int/vmnis/anaemia/en>. Accessed December 31, 2020.
- [2] Hercberg S, Preziosi P, Galan P. Iron deficiency in Europe. *Public Health Nutr*. 2001;4(2b):537-545. doi:10.1079/phn2001139
- [3] Brabin B, Hakimi M, Pelletier D. An Analysis of Anemia and Pregnancy-Related Maternal Mortality. *J Nutr*. 2001; 131(2):604S-615S. doi:10.1093/jn/131.2.604s
- [4] Lozoff B, Beard J, Connor J, Felt B, Georgieff M, Schallert T. Long-Lasting Neural and Behavioral Effects of Iron Deficiency in Infancy. *Nutr Rev*. 2008; 64:S34-S43. doi:10.1111/j.1753-4887.2006.tb00243.x
- [5] Radlowski E, Johnson R. Perinatal iron deficiency and neurocognitive development. *Front Hum Neurosci*. 2013; 7. doi:10.3389/fnhum.2013.00585
- [6] Beard J. Effectiveness and strategies of iron supplementation during pregnancy. *Am J Clin Nutr*. 2000; 71(5):1288S-1294S. doi:10.1093/ajcn/71.5.1288s
- [7] Youssef A, Shata A, Kamal H, El-Saied Y, Ali O. A Comparative Study of Efficacy, Tolerability, and Compliance of Oral Iron Preparations for Iron Deficiency Anemia in Pregnant Women. *American Journal of Medicine and Medical Sciences*. 2014;4(6):244-249. doi:10.5923/j.ajmms.20140406.09
- [8] Smith-Wade S, Kidson-Gerber G, Shand A, Grzeskowiak L, Henry A. The use of intravenous iron in pregnancy: for whom and when? A survey of Australian and New Zealand obstetricians. *BMC Pregnancy Childbirth*. 2020; 20(1). doi:10.1186/s12884-020-03363-3
- [9] Shafi D, Purandare S, Sathe A. Iron Deficiency Anemia in Pregnancy: Intravenous Versus Oral Route. *The Journal of Obstetrics and Gynecology of India*. 2012; 62(3):317-321. doi:10.1007/s13224-012-0222-0
- [10] Al R, Unlubilgin E, Kandemir O, Yalvac S, Cakir L, Haberal A. Intravenous Versus Oral Iron for Treatment of Anemia in Pregnancy. *Obstetrics & Gynecology*. 2005; 106(6):1335-1340. doi:10.1097/01.aog.0000185260.82466.b4
- [11] Pavord S, Daru J, Prasanna N, Robinson S, Stanworth S, Girling J. UK guidelines on the management of iron deficiency in pregnancy. *Br J Haematol*. 2019; 188(6):819-830. doi:10.1111/bjh.16221
- [12] European Medicines Agency. *Assessment Report For: Iron Containing Intravenous (IV) Medicinal Products*. London: European Medicines Agency; 2013. [https://www.ema.europa.eu/en/documents/referral/intravenous-iron-containing-medicinal-products-article-31-referral-assessment-report\\_en.pdf](https://www.ema.europa.eu/en/documents/referral/intravenous-iron-containing-medicinal-products-article-31-referral-assessment-report_en.pdf). Accessed December 31, 2020.
- [13] Rampton D, Folkersen J, Fishbane S et al. Hypersensitivity reactions to intravenous iron: guidance for risk minimization and management. *Haematologica*. 2014; 99(11): 1671-1676. doi:10.3324/haematol.2014.111492
- [14] Ring J, Messmer K. Incidence and severity of anaphylactoid reactions to colloid volume substitutes. *The Lancet*. 1977;309(8009):466-469. doi:10.1016/s0140-6736(77)91953-5
- [15] Bhandari S, Kalra P, Berkowitz M, Belo D, Thomsen L, Wolf M. Safety and efficacy of iron isomaltoside 1000/ferric derisomaltose versus iron sucrose in patients with chronic



- kidney disease: the FERWON-NEPHRO randomized, open-label, comparative trial. *Nephrology Dialysis Transplantation*. 2020; 36(1):111-120. doi:10.1093/ndt/gfaa011
- [16] Derman R, Roman E, Modiano M, Achebe M, Thomsen L, Auerbach M. A randomized trial of iron isomaltoside versus iron sucrose in patients with iron deficiency anemia. *Am J Hematol*. 2017;92(3):286-291. doi:10.1002/ajh.24633
- [17] Pollock R, Muduma G. Intravenous iron treatments for iron deficiency anemia in inflammatory bowel disease: a budget impact analysis of iron isomaltoside 1000 (Monofer) in the UK. *Expert Opin Drug Deliv*. 2017;14(12):1439-1446. doi:10.1080/17425247.2017.1393412
- [18] Rognoni C, Venturini S, Mereaglia M, Marmifero M, Tarricone R. Efficacy and Safety of Ferric Carboxymaltose and Other Formulations in Iron-Deficient Patients: A Systematic Review and Network Meta-analysis of Randomised Controlled Trials. *Clin Drug Investig*. 2015; 36(3):177-194. doi:10.1007/s40261-015-0361-z
- [19] Breymann C, Gliga F, Bejenariu C, Strizhova N. Comparative efficacy and safety of intravenous ferric carboxymaltose in the treatment of postpartum iron deficiency anemia. *International Journal of Gynecology & Obstetrics*. 2008; 101(1):67-73. doi:10.1016/j.ijgo.2007.10.009
- [20] Van Wyck D, Mangione A, Morrison J, Hadley P, Jehle J, Goodnough L. BLOOD MANAGEMENT: Large-dose intravenous ferric carboxymaltose injection for iron deficiency anemia in heavy uterine bleeding: a randomized, controlled trial. *Transfusion*. 2009; 49(12):2719-2728. doi:10.1111/j.1537-2995.2009.02327.x
- [21] Reveiz L, Gyte G, Cuervo L, Casasbuenas A. Treatments for iron-deficiency anaemia in pregnancy. *Cochrane Database of Systematic Reviews*. 2011. doi:10.1002/14651858.cd003094.pub3
- [22] EMC. Monofer 100mg/ml solution for injection/infusion - Summary of Product Characteristics (SmPC) - (emc). Medicines.org.uk. <https://www.medicines.org.uk/emc/>
- medicine/23669. Published 2014. Accessed December 31, 2020.
- [23] Basavareddy A. A rare occurrence of intrauterine death following an allergic reaction to iron sucrose. *Indian J Pharmacol*. 2020; 52(1):53. doi:10.4103/ijp.ijp\_169\_18
- [24] Auerbach M, Deloughery T. Single-dose intravenous iron for iron deficiency: a new paradigm. *Hematology*. 2016; 2016(1):57-66. doi:10.1182/asheducation-2016.1.57
- [25] Rund D. Intravenous iron: do we adequately understand the short- and long-term risks in clinical practice? *Br J Haematol*. 2020. doi:10.1111/bjh.17202
- [26] Goetsch A, Moore C, Minnich V. Observations on the effect of massive doses of iron given intravenously to patients with hypochromic anemia. *Blood*. 1946;1(2):129-142. doi:10.1182/blood.v1.2.129.129
- [27] EMC. Venofer (iron sucrose) 20 mg iron / ml, solution for injection or concentrate for solution for infusion - Summary of Product Characteristics (SmPC) - (emc). Medicines.org.uk. <https://www.medicines.org.uk/emc/product/5911/smpc>. Published 2009. Accessed December 31, 2020.
- [28] NHS. Prescription Cost Analysis - NHS Digital. NHS Digital. <https://digital.nhs.uk/data-and-information/publications/statistical/prescription-cost-analysis>. Published 2019. Accessed December 31, 2020.
- [29] FIGO. *Good Clinical Practice Advice: Iron Deficiency Anemia In Pregnancy*. London: FIGO; 2018.
- [30] Wesström J. Safety of intravenous iron isomaltoside for iron deficiency and iron deficiency anemia in pregnancy. *Arch Gynecol Obstet*. 2020; 301(5):1127-1131. doi:10.1007/s00404-020-05509-2
- [31] Qassim A, Mol B, Grivell R, Grzeskowiak L. Safety and efficacy of intravenous iron polymaltose, iron sucrose and ferric carboxymaltose in pregnancy: A systematic review. *Australian and New Zealand Journal of Obstetrics and Gynaecology*. 2017; 58(1):22-39. doi:10.1111/ajo.12695.

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