CHAPTER ONE

ORIENTATION TO THE STUDY

1.1 Introduction

Anaemia is a widespread public health problem with major consequences for human health as well as social and economic development (WHO 2004). It is defined as a condition characterised by haemoglobin concentration below established normal reference levels that differ according to age, gender, population and other aspects such as the geographical location and altitude (Silver, 2014). Iron deficiency anaemia (IDA) is the most common type of anaemia. It is characterized by reduced red blood cell production as a result of low iron stores. More than 2 billion people globally are believed to be affected by IDA, and according to Pavord et al., (2011), it is particularly prevalent in less developed countries. IDA is associated with worse clinical outcomes that include diminished quality of life, prolonged hospitalization, increased risk of maternal and child mortality as well as reduced work capacity of individuals thus leading to serious economic consequences. Effective IDA management that include the treatment and monitoring as well as other preventative measures follows the prompt and accurate diagnosis. According to Short (2013), the diagnosis of IDA requires laboratory-confirmed evidence of anaemia, as well as evidence of low iron stores.

This study focuses on the adequacy of iron deficiency anaemia management in the private health system in Namibia. Chapter one starts off by outlining the background to the research problem and clarification of the research problem as well as the purpose of the study.

1.2 Background to the research problem

According to Shander (2014), anaemia often does not receive proper clinical attention, detection, evaluation and management despite high prevalence. In a study conducted in the United Kingdom, it was noted that many patients presenting with IDA were not fully investigated resulting in some serious cases being missed (Logan, et al. 2002). Medical practitioners use Standard Treatment Guidelines (STGs) in managing diseases such as IDA. However, the desired outcomes may not be successfully achieved when the guidelines are either inadequate or obsolete or not adhered to. A review of the Namibian Standard Treatment Guidelines to assess their adequacy in addressing IDA management was the basis for this research study. The national guidelines were compared to other commonly used international guidelines, particularly the WHO guidelines.

1.3 Research problem

The researcher reviewed some Full blood count (FBC) reports from the laboratory that revealed anaemia and highly suggestive of IDA. On scrutiny of the suspected IDA cases, the researcher discovered that the majority of the cases/ patients were not followed up after the screening laboratory tests. No iron profile laboratory tests were done to either confirm the IDA diagnosis or to monitor any treatment or intervention given. The possibility of incomplete or missed diagnosis could mean that some IDA patients were not effectively managed.

The researcher also reviewed the current Namibian Standard Treatment Guidelines for their adequacy in addressing the IDA diagnosis and management. There were some notable possible deficiencies, particularly when compared to the WHO guidelines. The Namibian Standard Treatment Guidelines indicate that the patient's medical history and physical examination with the help of a variety of laboratory tests are essential to determine the cause of anaemia. There is however not enough elaboration or discussion of the laboratory tests required for the full assessment and classification of anaemia prior to commencing any treatment. It is imperative that iron deficiency should be distinguished from other causes of anaemia because of its association with underlying conditions that mandate specific investigation, and also because treatment is simple, safe and effective (Pasricha, 2010). Prompt and accurate diagnosis is important for speedy resolution of IDA to avoid the undesired worse clinical outcomes. IDA severity can be noted when considering the statistics from the World Health Organisation (WHO) showing that in 2004, IDA resulted in 273 000 deaths. According to Pasricha et al., (2013), (31%) of the deaths were in Africa, mostly the low and middle- income countries.

The possibility of non–adherence to guidelines and the inadequacy of the guidelines, coupled with the fact that there was no follow-up research on the adequacy of IDA investigation found to date, gave the researcher enthusiasm to undertake this exploration. The researcher is motivated to conduct this study using the data from the private health care system so as to come up with recommendations that will ensure that all cases of IDA are adequately investigated and effectively managed. There is a considerable high number of medical laboratories that offer medical

laboratory testing in the private health sector as compared to only one medical laboratory handling all the public health laboratory work.

1.4 Purpose of the study and research objectives

1.4.1 Research purpose

The purpose of the study is to assess the adequacy of iron deficiency anaemia (IDA) investigations and management thereof within the Namibian private health care system.

1.4.2 Research Questions

1. Which Standard Treatment Guidelines are used by private medical doctors in Namibia?
2. What is the level of adherence by private doctors to the Standard Treatment Guidelines on IDA management?
3. Which iron profile laboratory tests are offered for the diagnosis and treatment monitoring of IDA in the Namibian private pathology sector?

1.4.3 Research objectives

In order to accomplish the study purpose, the following objectives were formulated to answer the research questions:

1. To determine all the Standard Treatment Guidelines for IDA management in the Namibian private healthcare system.
2. To critically appraise the level of adherence by private doctors to the Standard Treatment Guidelines on IDA management.
3. To establish all the iron profile laboratory tests available in the private pathology health sector for IDA diagnosis and treatment monitoring.

1.4.4 The significance of the study

This research seeks to establish all the available Standard Treatment Guidelines in use for the diagnosis, treatment and prevention of IDA in the Namibian private health sector. It further aims to assess the adequacy of the Standard Treatment Guideline in the effective management of IDA. Noteworthy, IDA is simple and inexpensive to treat once diagnosed accurately. With prompt interventions, complications associated with delayed diagnosis and treatment can be avoided. Possible overtreatment complications, expensive interventions leading to resource wastage can also be averted when proper IDA management is promptly given.

The research can be used as a baseline for the review and development of new IDA investigation and treatment guidelines. New or updated Standard Treatment Guidelines will contribute towards the efficient use of health care budgets, which is particularly useful in the wake of the current increased expenditure and budget deficits. The critical appraisal of adherence to the current Standard Treatment Guidelines will give information that can be used for the training of medical practitioners to close any gaps in IDA management. This research will also serve as a basis for future research on IDA management that can be carried out on a broader scale.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter starts off by discussing the normal iron metabolism, followed by pathological conditions, iron deficiency anaemia (IDA) and iron overload. Further discussion of IDA management is also undertaken in this chapter. The purpose of this literature reviewing is to broaden the researcher's knowledge on iron deficiency anaemia (IDA) management.

2.2 Normal iron metabolism

Iron functions as a component of enzymes and proteins. It is an essential component of haemoglobin in the red blood cells where it performs a vital role of transporting oxygen from the lungs to various body cells and tissues. This is crucial for the respiratory process that produces energy for the body. A well- nourished person has 4 to 5 grams of iron in their bodies, mostly contained in haemoglobin and also in storage as ferritin in the liver, spleen and bone marrow. Smaller amounts of iron circulate through the plasma, bound to transferrin protein.

It is estimated that about 10% of the 1 g/d of dietary iron is absorbed by enterocytes, cells lining the interior of the intestines (Bishop M. L, Fody E. P, Schoeff L. E, 2013). The amount of iron absorption depends upon the amount of iron in the diet, its bioavailability and physiological requirement. Ferric reductase enzyme on the enterocyte reduces the dietary iron which is in ferric state (Fe^{3+}) to ferrous iron (Fe^{2+}) that can be absorbed. Ferroportin hormone exports the ferric iron that is bound to a protein transferrin to the liver and to other storage organs, where it will be stored as ferritin. Most of the iron is incorporated in haemoglobin, with only about one third stored as ferritin and hemosiderin. The amount of iron absorption depends upon the amount of iron in the diet. The rate of absorption also depends on the rate at which the bone marrow is producing new red blood cells as well as

oxygen concentrations levels in the blood. During inflammation, absorption is restricted so as to starve the bacteria of iron.

Iron is also recycled daily from old red blood cells in the spleen, liver and macrophages to maintain adequate levels required for erythropoiesis. An important hormone, hepcidin, helps to regulate the homeostasis process that also result in an additional iron loss. Iron deficiency will develop when the dietary intake is unable to replace the daily iron loss. The absorption and transport capacity can be increased in conditions such as iron deficiency, anaemia or hypoxia (Bishop M. L, Fody E. P, Schoeff L. E, 2013). **Figure 2.1** adapted from Escobar-Morreale (2012) presents simplified iron metabolism.

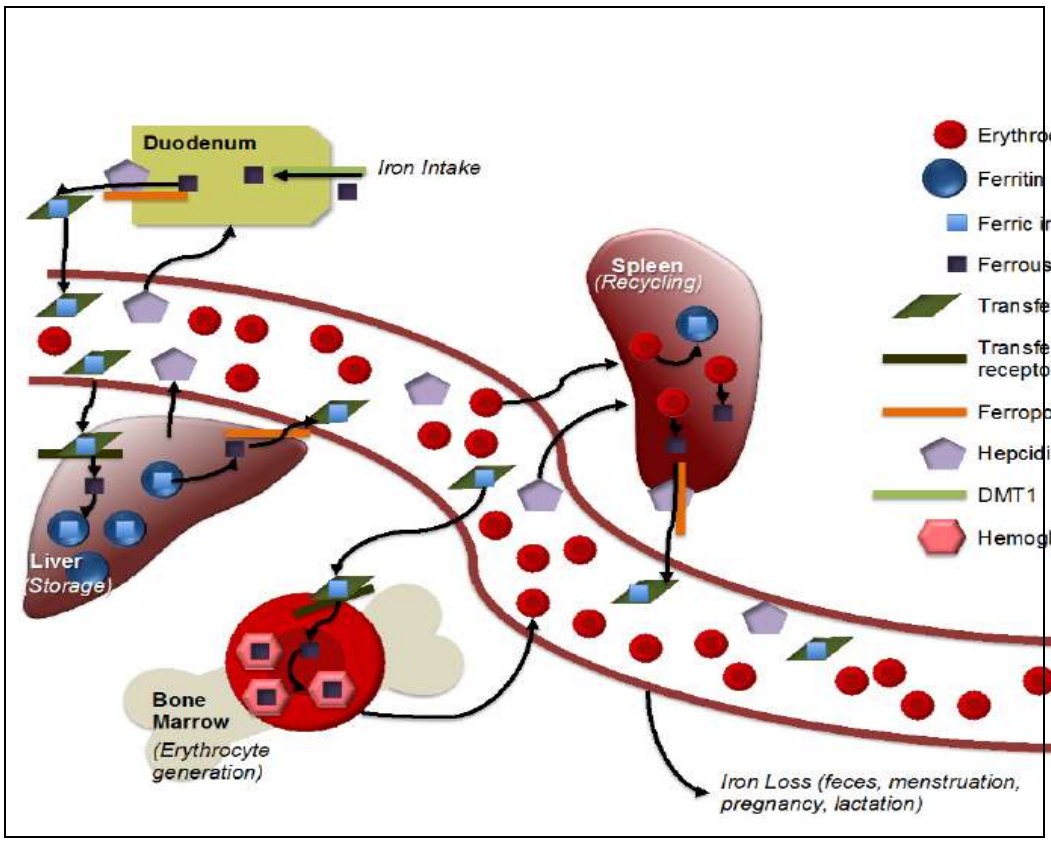

Figure 2.1 Iron metabolism

Adapted from Escobar-Morreale (2012), cited in Burke et al (2014:4095)

2.3 Pathological conditions

2.3.1 Iron deficiency anaemia

Anaemia, in general, refers to a condition characterised by the lowered ability to carry oxygen to the tissues due to decreased red blood cells or haemoglobin. According to Goddard et al (2011), World Health Organization (WHO) defines anaemia as haemoglobin (Hb) concentration below 13 g/dl in men over 15 years of age, below 12 g/dl in non-pregnant women over 15 years of age, and below 11 g/dl in pregnant women. The normal reference ranges of haemoglobin differ according to gender and age groups as well as according to the geographical locations. Goddard (2011) suggests that it is reasonable to use the laboratory's defined ranges for anaemia. However, there are no established ranges for Namibia and the reference ranges used for the Namibian population are those established by the WHO.

Iron deficiency anaemia (IDA) is the commonest form of anaemia. It is a nutritional disorder characterised by insufficient levels of iron that is required for the normal production of oxygen-carrying red blood cells. The defective haemoglobin synthesis in IDA produces abnormally small red blood cells called microcytes containing a decreased amount of haemoglobin (hypochromic). Iron deficiency anaemia is thus classified as microcytic- hypochromic anaemia. There is reduced capacity of oxygen delivery to body cells and tissues. IDA should be distinguished from other microcytic- hypochromic anaemias through iron profile tests. Once IDA has been diagnosed, the underlying cause should be investigated and treated.

2.3.1.1 Epidemiology of iron deficiency anaemia

According to Schrier, Auerbach (2018), more than a quarter of the world's population is anaemic with about one half of the burden from iron deficiency. Short (2013) concurs that IDA is estimated to constitute about 50% of all the anaemia cases. Inadequate intake of iron, decreased absorption, increased iron demand and increased iron loss in gastrointestinal bleeding are some of the major causes of IDA.

WHO (2011) reports that in resource-poor areas, IDA is worsened by infectious diseases such as malaria, human immunodeficiency virus/ acquired immunodeficiency syndrome (HIV/AIDS), hookworm infestation, schistosomiasis and tuberculosis (TB). These conditions are generally characterised by diminished haemoglobin levels.

Studies reveal that IDA is a major nutritional problem in Namibia with mostly children and pregnant women affected. According to Chotard et al., 2006 cited in UNICEF/NAMIBIA 2010, the last available data indicated that 1437 children less than five years of age had anaemia and 2419 children older than five years were anaemic. The report adds that the highest prevalence of IDA in Namibia is in children under 5 years in the Northwest parts of Namibia with a prevalence of 55%.

Searches for recent IDA epidemiology data only did not reveal any more data on IDA prevalence other than literature given by Chotard et al (2006) who exclusively studied pregnant women. Although IDA affects all people, the pregnant women formed an important group since high prevalence rates are reported for this group and also routine screening for anaemia is done during antenatal care. The pregnant women follow a scheduled visit to the health facilities and thus patients' follow-ups are done routinely and per schedule. Antenatal records of anaemia defined by haemoglobin cut off of 10g/dl showed that 21% of pregnant women in Kavango, 16% in Caprivi, 13% in the Khomas region and 11% in the Hardap region were anaemic (Chotard et al., 2006 cited in UNICEF/NAMIBIA 2010). Antenatal iron supplementation is important for both the health of the mother and her unborn child since there is an increased demand for iron for the growing foetus.

2.3.1.2 Causes of iron deficiency anaemia

For effective management of IDA, it is important to get a full understanding of the possible causes of the condition. This will help to develop and initiate appropriate preventative and treatment interventions.

Increased iron demands in pregnancy and in early childhood that is characterised by rapid growth is described as the most important cause of IDA (Munoz et al (2010). Other causes of IDA include limited external supply of iron due to poor dietary intake of iron and iron malabsorption that occurs in mucosal disorders such as coeliac disease, impaired gastric acid secretion and gastric bypass procedures. Colonisation with *H. pylori* bacteria is also known to cause IDA by impairing the iron uptake process and increasing iron loss (Pasricha, 2010). Gastric acid is required for optimal iron absorption and drugs such as gastric anti-acids and anti-secretory are known to cause interference in iron absorption. Anti-acid that reduce the acid secretion will thus result in reduced iron absorption. Increased blood loss that occurs in reproductive women who lose blood through menstruation, and gastrointestinal bleeding in adults are other important causes of IDA (Pasricha et al (2010).

2.3.1.3 Implications of iron deficiency anaemia

IDA constitutes a public health condition of epidemic proportion. Since iron influences many physiological processes, the development of IDA may lead to a diverse range of clinical manifestations. These include the impaired cognitive development in children affecting performance in school, behavioural problems in adults, shortness of breath, exercise intolerance, chronic fatigue with diminished work performance and productivity. Increased risk of low birth weight, prematurity and maternal morbidity are also important implications of IDA.

2.3.2 Iron overload

Iron overload disorder, also known as hemochromatosis, is a condition characterised by absorption of excess iron in the body. Excess iron in vital organs is harmful as organ damage can lead to diabetes, liver cirrhosis and heart failure. Hemochromatosis can be primary, a result of genetic alterations, or secondary, as a result of other conditions (Nordqvist, 2017). Primary hemochromatosis accounts for

the majority of the of the cases of iron overload and the common genetic disorders include hereditary hemochromatosis and juvenile hemochromatosis. In hereditary hemochromatosis, iron absorption is abnormally increased with up to 30% of consumed iron absorbed compared to 10% under normal circumstances. Acquired iron overload, on the other hand, can occur secondary to multiple blood transfusions, excessive iron injections or consumption of high levels of supplementary iron. It can also occur secondary to anaemia such as thalassemia. Women are less prone to hemochromatosis due to blood loss during menstruation that reduces iron levels.

According to (Nordqvist, 2017) blood tests, serum transferrin saturation and serum ferritin can detect iron overload, even before symptoms appear. High serum ferritin levels and serum transferrin saturation, above 45% are indicative of hemochromatosis. The treatment for iron overload is iron reduction therapy through phlebotomy.

2.4 Management of iron deficiency anaemia

Shander (2014) notes that, despite its high prevalence, anaemia often does not receive proper clinical attention and detection. Various diagnostic tests need to be performed to assist in the proper evaluation and management of anaemia. It will be insufficient to commence treatment interventions on iron deficiency anaemia based on the clinical picture without thorough investigations on the possible causes of the IDA.

According to Schrijvers (2009), disease management is a system of coordinated healthcare interventions and communications for populations with conditions in which patient self-care efforts are significant. In the midst of rising health care expenditure, increasing limited healthcare budgets and economic uncertainty, the efficient use of funds and other resources is of utmost importance (Freeman, 2011). The disease management involves a team of health care professionals, each playing their part from the health care practitioner physically examining the patient, taking the history and requesting for laboratory investigations. Other non- laboratory investigations such as endoscopy procedure can also be requested when

investigating gastrointestinal bleeding leading to the development of IDA. Once the root cause of IDA is established, appropriate treatment can be ordered. Dietary supplementation or counselling may also be commenced depending on the investigation findings. The coordinated activities follow standard treatment guidelines. The overall aim is to improve the clinical outcomes with an emphasis on quality and cost-effectiveness.

2.4.1 Standard Treatment Guidelines (STGs)

Standard Treatment Guidelines (STGs) are systematically developed statements designed to assist practitioners and patients in making decisions about appropriate healthcare for specific clinical circumstances (Gopalakrishnan, 2014). The STGs are country specific since each country develops STGs for its own use. WHO (2007) points out that some of the drawbacks of STGs include the challenge in regularly updating the guidelines to ensure that they do not become obsolete. Incomplete or inaccurate guidelines will provide wrong information that may result in harmful contrary outcomes. Ensuring adherence to guidelines can also be a challenge even when the STGs are available.

According to the WHO (2007) the use (STGs) provides health care providers with standardized approaches and encourages high-quality care by directing practitioners to the most appropriate medicines for a specific condition. The health care providers can concentrate on making the correct diagnosis since treatment options are provided for them through STGs. For health policymakers, the STGs help to provide a system for controlling cost by using funds more efficiently. In supply management, the demand for drug will be more predictable and thus making forecasting more reliable. The benefit of STGs to the patients is the fact that there is consistent and predictable treatment from all providers.

Some of the STGs in use by local medical doctors include; Namibia Standard Treatment Guidelines, The Essential Medicine List and Standard Treatment Guideline for Zimbabwe, The Standard Treatment Guidelines and Essential Medicine

List for South Africa. Although the STGs are country-specific, there appear to be no restrictions to clinicians on the guidelines to follow.

The current Namibia Standard Treatment Guidelines were published in 2011 and no updated guidelines were found by the researcher at the time of this study. The Namibian Standard Treatment Guidelines suggest that if there is a suspicion of anaemia then patient's history, physical examinations and haemoglobin (Hb) test should be done before iron folate treatment can be given and followed up at 4 weeks (Ministry of Health and Social Services, Namibia, 2011). The use of the various iron profile laboratory tests is not particularly highlighted. The Essential Medicine List and Standard Treatment Guideline for Zimbabwe, on the other hand, emphasize on the use of red blood cell indices and the careful examination of a peripheral blood smear to help identify the likely cause of anaemia (Ministry of Health and Child Welfare, Zimbabwe, 2011). Once the cause of anaemia is known, appropriate treatment intervention can be given and thus avoiding complications of polypharmacy or blood transfusion. Another guideline, The Standard Treatment Guidelines and Essential Medicine List for South Africa argues that prophylactic intervention with ferrous sulphate compound should be used particularly during pregnancy for managing IDA (The National Department of Health, South Africa, 2012). It further points out that if there is no positive response to iron therapy, consideration of some factors such as non-adherence, wrong diagnosis, mal-absorption, continued blood loss and mixed haematinic deficiency should be made.

A review of the various STGs reveal that the different recommendations on the laboratory iron profiles tests and treatment interventions. Some tests such as hepcidin hormone assays and reticulocyte haemoglobin content (CHr) are not indicated in IDA investigation according to the Namibia Standard Treatment Guidelines. Such tests are not yet available in the country probably due cost. Regardless of the STGs used, the classification of the anaemia and diagnosis of IDA need to be accurately established. The treatment interventions may however differ depending on the STGs being used since certain options might not be readily available due to cost.

2.5 Diagnosis and evaluation of IDA

According to Pasricha (2010), iron deficiency should be distinguished from other causes of anaemia because of its associations with underlying conditions that mandate specific investigation. According to Johnson-Wimbley and Graham (2011), evaluation for the cause of anaemia includes full blood count, peripheral smear, reticulocyte count and serum iron indices. Qunibi (2011) adds that the diagnosis of IDA is usually straightforward and that it should start with a thorough evaluation, including the previous history of anaemia, recent blood loss, and the presence of symptoms such as chronic fatigue, hair loss, pica, dyspnoea and exercise intolerance.

Treatment of IDA through iron replacement would not address a problem of iron loss. It is important that the cause of iron deficiency be identified and corrected. Iron loss through bleeding is the common cause of IDA in adults. Schrier, et al (2018) believe that abnormal uterine bleeding/ menorrhagia causes IDA in up to two- thirds of affected women and that normal menstruation does not result in iron deficiency. According to Zhu (2010), occult gastrointestinal (GI) bleeding remains the most common cause of IDA in adult male and postmenopausal female populations. There is an increased iron demand to produce new red blood cells as a replacement after acute and chronic blood loss. According to Alleyne, Horne and Miller (2008), most adults have at least 3000mg (45mg/Kg) elemental iron in their bodies. They also add that men generally have higher levels of iron compared to women who lose blood during menses and pregnancy. Waldvogel-Abramowski et al. (2013) add that males contain about 4000 mg of iron of which 2500 mg is in red blood cells, 1000 mg is stored in hepatic macrophages and the rest is distributed in various proteins such as cytochromes.

Intestinal disorders such as coeliac disease are known to cause iron malabsorption. GI investigations such as endoscopy and barium meal help to identify blood loss that leads to iron deficiency anaemia.

Patients with IDA are often asymptomatic and have limited findings on physical examination. Alleyne, Horne and Miller (2008) point out that iron stores are depleted before iron-deficient erythropoiesis occurs. Specialised testing such as

bone marrow iron stain, may be required in such cases to confirm the diagnosis of IDA when the red cell indices are still deceptively normal. Dietary history may also reveal possible iron deficiency that will require confirmation through requesting for appropriate laboratory investigations. Short (2013) argues that even in the absence of symptoms, regular monitoring or relevant laboratory tests in patients at risk is essential. Inadequate investigations or inappropriate laboratory test algorithm for IDA diagnosis may lead to delay, under treatment or over treatment that in turn can result in complications such as hemochromatosis and renal failure. The costs of managing the patients with IDA will also increase as a result of the mismanagement with possibly fatal consequences.

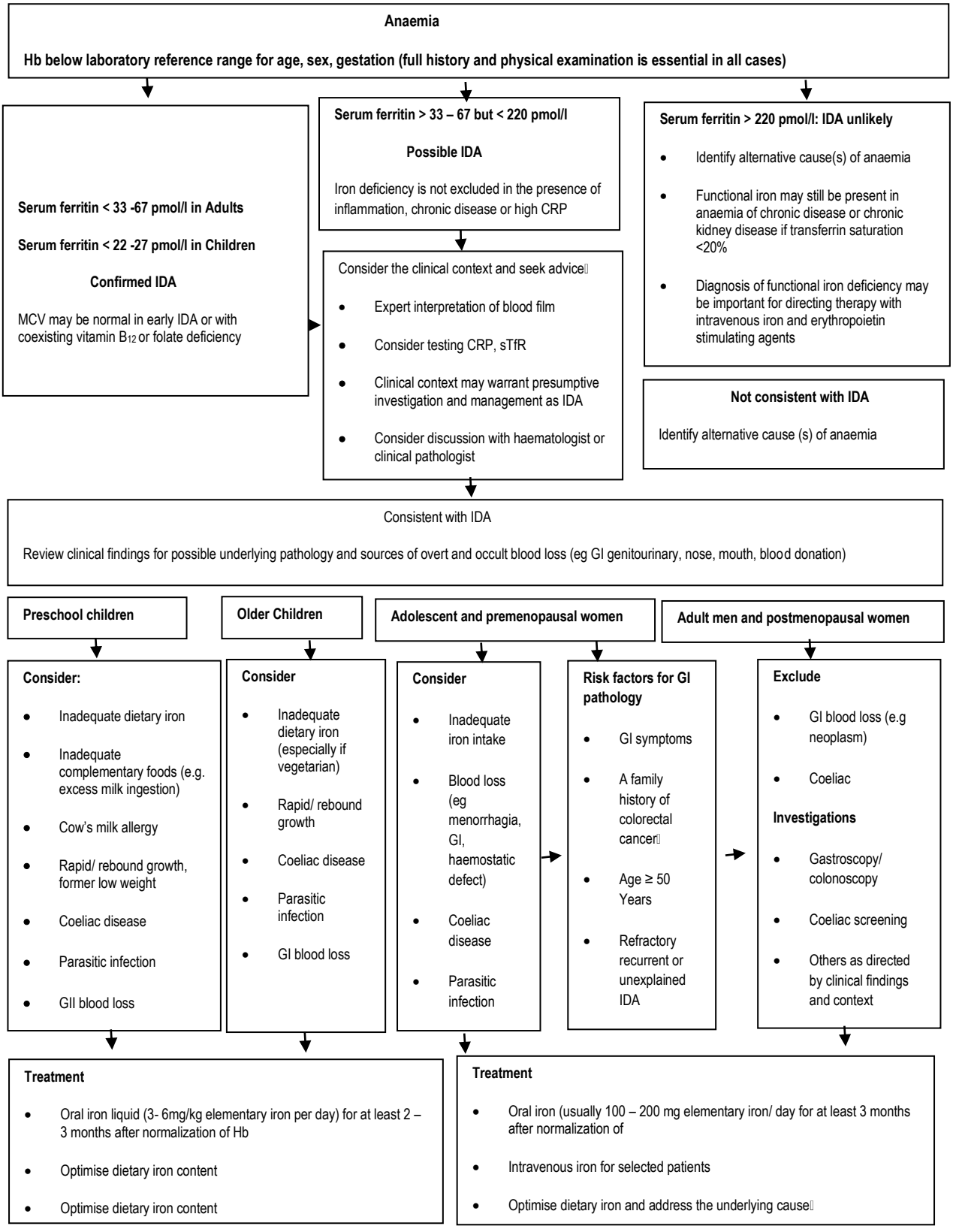

Figure 2.2 Assessment and management of Iron deficiency anaemia (IDA

Adapted from, Rayn et al (2010:527)

The diagnosis of IDA requires laboratory-confirmed evidence of anaemia and the evidence of low iron stores. The main laboratory tests for IDA diagnosis and their references ranges are presented in **Table 2.1**. According to Munoz (2010), the appropriate combination of different laboratory tests with an integrated algorithm will help to establish a correct diagnosis of iron overload, iron deficiency and anaemia. The bone marrow examination used to be the golden standard in the assessment of iron metabolism but nowadays a battery of tests has been developed and each of the biomarkers has its own advantages and disadvantages. **Table 2.2** summarises the differential diagnosis of hypochromic anaemia using various laboratory test results.

Table 2.1 Main Laboratory tests for the assessment of iron depletion

Laboratory test	Reference intervals
Iron status in the body	
➢ Serum iron	9 – 32umol/l
➢ Transferrin (Total iron binding capacity)	2 -3.6 g/l
➢ Transferrin saturation	20 – 50%
➢ Ferritin	30 – 298 ng / ml
➢ Soluble transferrin receptors (s TfR)	6.4 – 25.7 nmol/l
➢ Haemoglobin	12 – 16 g/dl (women) 13 – 17g/dl (men)
➢ Mean corpuscular volume (MCV)	80 – 100 fl
➢ Red cell distribution width (RDW)	11 – 15
➢ Mean corpuscular haemoglobin (MCH)	28 – 35pg

Adapted from Munoz (2010:288)

Table 2.2 Interpreting laboratory blood test results to assess iron status

Diagnosis	Haemoglobin	MCV & MCH	Serum Ferritin (ng/ml)	Transferrin or TIBC	Transferrin saturation	Soluble transferrin receptor	Serum iron
Tissue iron deficiency without anaemia	Normal	Normal or low	34 -67	Normal or high	Low- normal	High - normal	Low
Iron deficiency anaemia (IDA)	Low	Low (or normal) in early IDA	34-67 (Adult) 22-27 (Child)	High	Low	High	Low
Anaemia of chronic disease or inflammation	Low	Normal may be mildly low	Normal-elevated	Normal	Low	Normal	Low
IDA with coexisting chronic disease or inflammation	Low	Low	Low-normal 135-225	Normal or high	High	High	Low
Thalassaemia minor	Low (or normal)	Low or normal	Normal-elevated	Normal	Normal	Normal-elevated	Normal
Iron overload	Low	Normal	Elevated (correlates with body iron stores)	Normal to low	high	Normal	Normal-elevated

Adapted from, Rayn et al (2010:528)

2.5.1 Full blood count (FBC)

According to Goddard, James, McIntyre, and Scott (2010), modern automated cell counters provide measurements of the changes in red cells that accompany iron deficiency and these include the reduced mean cell haemoglobin (MCH) and reduced mean cell volume (MCV). Lower haemoglobin concentration compared to the normal reference values is indicative of anaemia. IDA blood picture is characterised by reduced MCH and MCV. Lower MCV occurs due to the presence of microcytes which are red cells diminished in size caused by low iron concentrations. Apart from the diagnostic value, the haemoglobin and haematocrit levels denotes the severity of the anaemia. MCH rather than MCV is an important marker for detecting iron deficiency since MCV tends to be a late indicator in patients who are not actively bleeding. He further points out that these features are "sensitive indicators of ID in the absence of chronic disease or coexistent vitamin B_{12} or folate deficiency". The red cell distribution width (RDW) is often raised when there is combined deficiency of iron and vitamin B_{12} or folate. The increased RDW represents heterogeneity in the red cell volume distribution due to anisocytosis. The examination of a peripheral blood smear for microcytes and characteristic pencil-shaped cells helps to confirm IDA. Presumptive IDA can be made on the basis of low haemoglobin and haematocrit with low serum ferritin confirming the diagnosis. However, it may be necessary to perform Haemoglobin (Hb) electrophoresis to rule out haemoglobinopathies when dealing with patients from certain ethnic groups since the blood picture will also be microcytic (Smith, 2015)

2.5.2 Serum iron, ferritin and serum transferrin

IDA is diagnosed by laboratory investigations that reveal low levels of serum iron, ferritin and serum transferrin saturation percentage. The amount of iron available in the blood for absorption is indicated by the serum iron levels. Thus lower serum iron levels mean that less than adequate amount of iron is absorbed in the intestines. Serum iron is however not a good diagnostic marker for IDA since it is affected by the diurnal iron level and its value has been superseded by serum ferritin (Smith, 2015). Zhu, Kaneshiro, and Kaunitz (2009), on the other hand, argue that serum ferritin is the single best laboratory test for IDA diagnosis. Generally, ferritin is

decreased in IDA and increased in iron overload. However, the interpretation of serum ferritin results in the diagnosis of IDA needs to be carefully done since serum ferritin is an acute-phase reactant that increases in response to inflammation or acute infection, liver disease and malignancy. In an anaemic adult, ferritin concentration <15.0 ng/ml is diagnostic of IDA (Pasricha, 2010). Another laboratory test, C- reactive protein (CRP) helps to rule out coexisting inflammation. If inflammation is present, a normal ferritin will not exclude iron deficiency and transferrin saturation (TSAT) should be measured. Patients may be considered to suffer from IDA when the TSAT is <20%, ferritin of < 67pmol/l and no signs of inflammation (Pasricha, 2010). Transferrin levels are increased in IDA and decreased in iron overload. There is less iron available to bind to the protein for transportation in IDA and consequently the percentage transferrin saturation is low.

Serum or plasma iron measures the total iron in circulation. This biomarker alone is not a helpful indicator for IDA because of the wide fluctuation in levels due to ingestion of iron at different times of the day.

2.5.3 Reticulocytes and reticulocyte haemoglobin content

Reticulocytes count is used to estimate the degree of effective erythropoiesis. The normal reference range for reticulocyte in adults is 0.5 % - 1.5 %. In anaemia, the reticulocyte percentage can be falsely elevated and thus not reflective of the true bone marrow response to anaemia. In this case, the patient's haematocrit is used to correct reticulocyte percentage. In severe anaemia, reticulocytes are prematurely released from the bone marrow into the blood circulation. A reticulocyte index calculation that takes into account the maturation time for reticulocytes is essential to counteract the premature release. Decreased reticulocyte count reveal diminished erythropoiesis which can be due to iron deficiency or other nutrients. On the other hand, increased reticulocyte count may indicate increased erythropoiesis as a result of gastrointestinal bleeding or response to iron therapy.

Other important tests included the reticulocyte haemoglobin content (CHr) and iron staining. The CHr is believed to be a sensitive and specific test to measure iron availability to cells. It measures iron that is incorporated into the haemoglobin.

Despite its high accuracy, the CHr is not widely available due to the lack of technology. Iron staining of bone marrow aspirate is considered a golden standard for the assessment of iron stores but the test is however not practical as it is too invasive (Pavord, 2011). The accurate determination of the iron stored in the bone marrow and available for erythropoiesis make this method a golden standard. The reporting of bone marrow results, however, requires competent and highly experienced personnel as compared to reporting results of other laboratory iron profile tests.

2.5.4 Other iron profile tests

Hepcidin is a hormone produced by the liver that is involved in the regulation of iron absorption in the intestinal mucosa (Angelo, 2013). An increase of plasma and storage iron levels, in turn, stimulate the production of hepcidin, which blocks iron absorption from the diet and its further storage. According to Angelo (2013), the feedback loop between iron and hepcidin ensures appropriate physiological concentration of iron in the plasma. Levels of hepcidin decrease in conditions leading to iron deficiency and an increase in conditions of iron sufficiency (Burke 2014). Hepcidin may emerge as a useful biomarker for assessment of iron status. This test is however expensive and not yet available in Namibia.

Other tests are important to rule out sickle cell trait, thalassemia, parasitic infections, anaemia related to folate and vitamin B_{12} deficiency in adolescents who have IDA which is not responsive to iron therapy (Stang and Story, 2005, 101). Drozd, Jankowska, Banasiak and Ponikowski (2017) describes bone marrow aspirations as the most accurate method to assess iron status. However, this procedure remains widely unavailable for routine practice since it is invasive leaving the other laboratory blood tests as preferred routine methods for diagnosing and monitoring IDA. A retrospective study carried out in this research study focused on the use of the routine laboratory tests namely full blood count, and iron profile tests- serum iron, ferritin and transferrin.

2.5.5 Iron deficiency anaemia follow- up laboratory investigations

Schrier (2018) believes that monitoring of patients receiving an iron replacement is crucial and that it depends on the severity of the anaemia. He further suggests that monitoring tests for haemoglobin and reticulocyte count should be carried out 2 weeks after starting iron therapy. Pavord et al (2011) also believe that the timing of further checks will depend on the degree of anaemia. The interval for monitoring treatment with intravenous (IV) iron is longer. Four to eight weeks can be allowed before iron parameters are re-checked because IV iron interferes with most assays of iron status. Iron treatment should be continued until levels of ferritin and transferrin saturation are normal. Goddard (2010) suggest that once the haemoglobin and red cell normalise, full blood count should be checked at 3 monthly intervals for a year then yearly thereafter. Other investigations can be carried out if the haemoglobin and the red cell indices cannot be maintained by oral iron therapy.

2.6 Iron deficiency anaemia treatment interventions

When iron deficiency anaemia has been diagnosed, the underlying cause needs to be investigated and treated. Historical investigations will help reveal the likely cause of iron deficiency such as excessive menstrual blood loss or GI bleeding. Short (2011) believes that patients with an underlying condition that causes iron deficiency anaemia should be treated or referred to a specialist for definitive treatment. The iron treatment should be prompt so as to avoid the risk of organ damage and progression of anaemia. According to Zhu (2010), treatment of IDA should begin with dietary replacement. He also argues that if dietary adjustment alone fails to restore the iron stores and haemoglobin levels, then treatment with exogenous iron supplements should be implemented. Dietary supplementation and Iron treatment in intestinal disorders such as coeliac disease will not resolve the anaemia since the absorption will be defective after the damage to small intestines. Bayraktar (2010) argues that the mainstay of IDA management should be the identification and correction of the underlying pathology. It will thus be wasteful to commence iron treatment without addressing the coeliac disease. There are various management strategies for IDA that are aimed at restoring haemoglobin levels and MCV to normal

and these include oral iron therapy, parenteral iron therapy, blood transfusion, dietary therapy, and other management strategies such as food fortification and deworming. **Figure 2.3** shows an algorithm that can be followed when treating IDA cases.

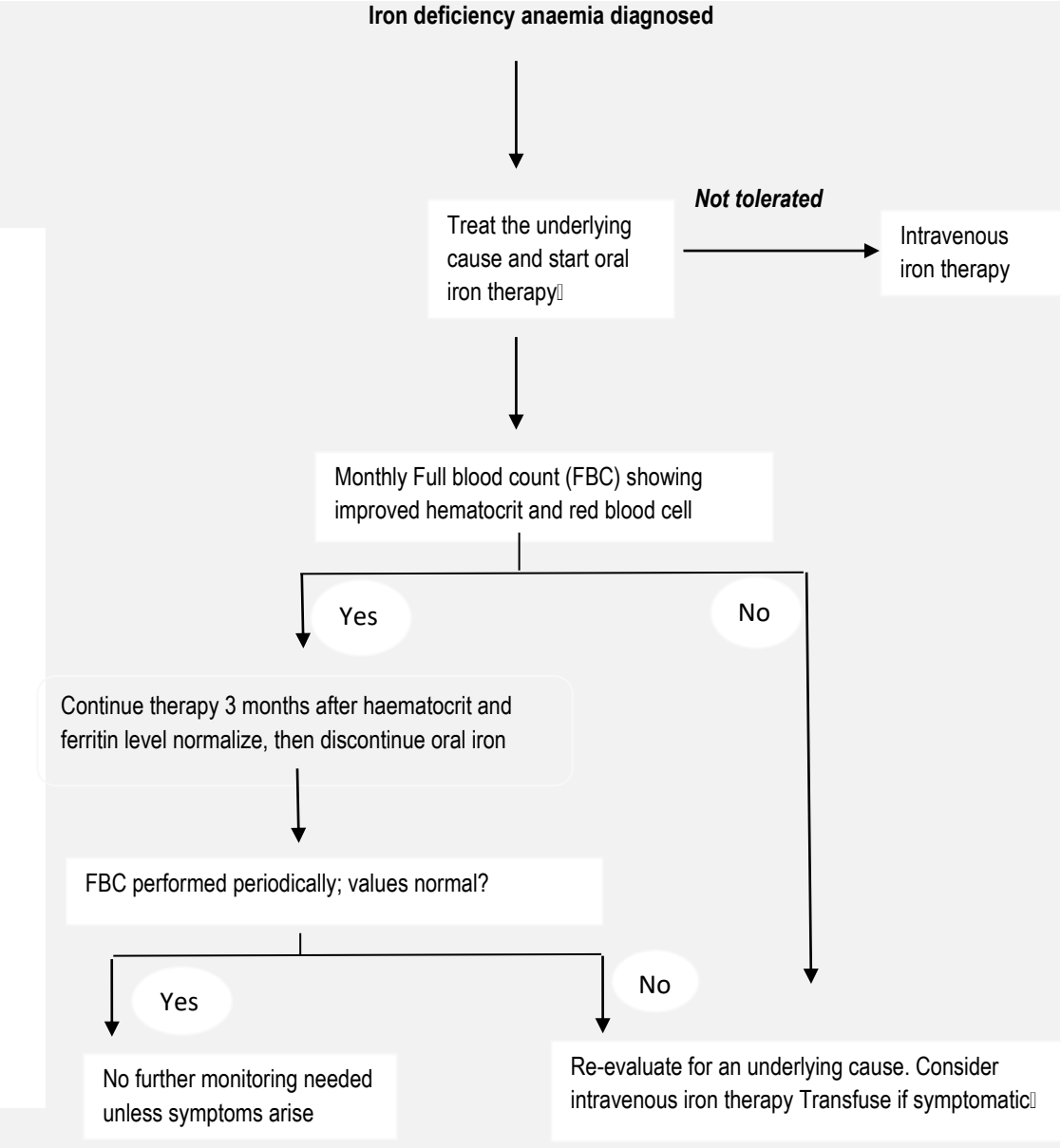

Figure 2.3 Algorithm for treatment of iron deficiency anaemia

Adapted from Short (2013: 102)

2.6.1 Oral iron therapy

Oral iron is the most convenient and least expensive therapy option aimed at correcting IDA. It has been described by Smith (2015) as the treatment of choice for IDA. The oral iron is available in different preparations- ferrous sulphate, gluconate fumarate and iron hydroxide polymaltose complex. According to Zhu (210), iron absorption is optimised when ferrous salts are taken with orange juice (Vitamin C) since iron is better absorbed in an acid environment. The recommended daily dosages 200 mg twice daily for 3 months for adults, and 3 mg per kilogram daily for children Smith (2015). The subsequent increase of haemoglobin by 1 g/dl after 1 month of treatment reveal adequate response to treatment. It is recommended to continue iron treatment for three months after haemoglobin normalisation so as to replenish the iron stores Smith (2015). Drawbacks for the oral iron include low iron absorption, gastrointestinal adverse effects that may influence treatment compliance.

2.6.2 Parenteral iron therapy

According to Qunibi (2011), Intravenous (IV) iron is a mainstay in IDA treatment for patients undergoing haemodialysis due to the chronic blood losses during the dialysis procedure. The parenteral iron therapy is also considered for patients who cannot tolerate oral preparations such as gastrectomy patients. Parental iron treatment is painful when given intramuscularly and may also cause anaphylactic reactions. Parenteral iron is indicated where there is documented malabsorption, genuine intolerance to oral preparations or continued blood loss Smith (2015).

2.6.3 Blood Transfusion

The standard treatment guidelines indicate that transfusion of packed red blood cells can be considered. In pregnant women, transfusion is recommended when the haemoglobin <6 g/dL because of the potential abnormal foetal oxygenation (Short, 2011). However, transfusion is expensive and is associated with adverse outcomes, including fluid overload, and some immunological and infections hazards. Pasricha (2011) suggest that transfusion should be served for complicated cases such as IDA

patients with acute bleeding. Transfusion should be aimed at restoring haemoglobin levels to safe as level and not necessarily normal value. However, iron therapy should always follow after transfusion so as to replenish the iron stores.

2.6.4 Dietary therapy and fortification

Zhu (2010) believes that treatment of IDA should actually begin with dietary replacement and only use the other strategies when diet alone is inadequate to restore iron stores. Pasricha (2013) believes that the increasing consumption and optimising absorption by minimizing inhibitors and maximizing enhancers may be valuable for secondary prevention of iron deficiency. Food-based approaches to increase iron intake through food fortification and dietary diversification are important strategies for preventing IDA in the general population (WHO, 2004). It is important for these strategies to be integrated with other existing programs such as roll-back malaria and deworming control measures. Targets for fortification should include the staple food such as maize, wheat and rice. Ferrous sulphate and fumarate have the highest bioavailability and similar iron content.

2.6.5 Other interventions

WHO (2010) points out that in many developing countries, iron deficiency anaemia is aggravated by worm infections, malaria and other infectious diseases such as HIV, tuberculosis. Pasricha (2013) also adds that deworming increases haemoglobin concentrations and reduces the prevalence of anaemia. Counselling on the importance and possible side effects of iron supplements are required so as to increase iron therapy compliance. Patients with severe or prolonged iron deficiency anaemia may benefit from referral to specialist doctors or dietitians.

2.7 Conclusion

In this chapter, the researcher started with a brief overview of normal iron metabolism and then described the pathological conditions, IDA and iron overload. The researcher discussed in detail the Iron deficiency anaemia, starting with the definition, causes, implications, prevalence and the management thereof. The use

and advantages of Standard Treatment Guidelines in IDA management was also discussed in this chapter followed by the various diagnostic tests for IDA diagnosis as well as the IDA interventions. The next chapter spells out the research methodology for this study.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

The research design and methods that were followed during the study are described in this chapter. The chapter starts by reviewing the theoretical framework of the study, followed by an outline of the research design, and description of the research methods including the research setting, population and sampling. The data collection and analysis is detailed at the end of the chapter.

3.2 Theoretical framework of the study

Figure 3.1 summarises the hypothetical description of a complex process used for this research study on the adequacy of iron deficiency anaemia management. The investigation starts with the establishment of available policies which are the Standard Treatment Guidelines that the medical doctors can follow in making diagnosis and therapeutic decisions. This is followed by further assessment on whether the guidelines are current or obsolete and also if training has been offered.

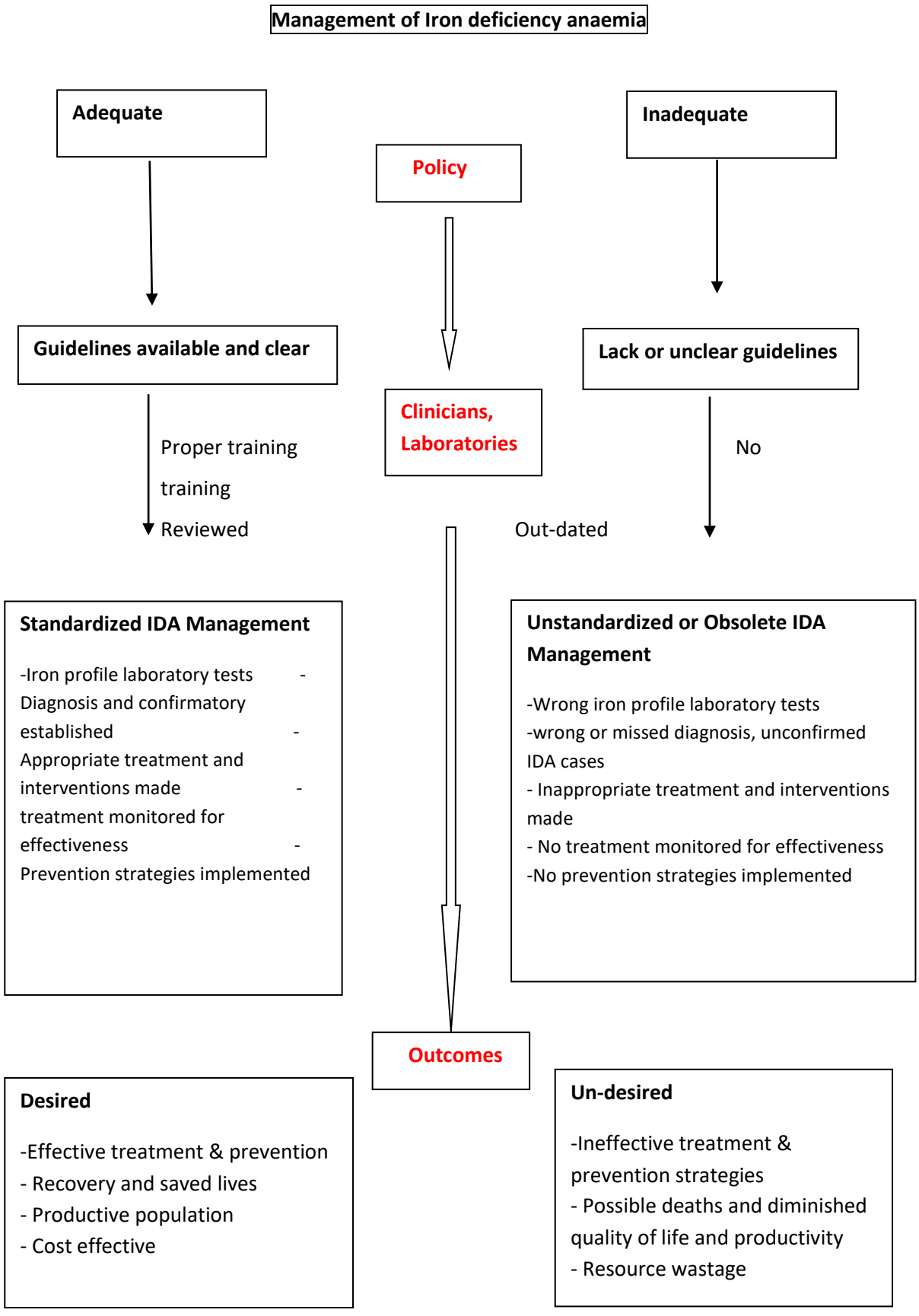

Figure 3.1 Management of Iron deficiency anaemia theoretical framework

3.3 Research Design

Grove (2013) defines research design as a blueprint of how the researcher intends to collect data in order to answer research questions in given conditions. Kothari (2004) adds that research design is advance planning of the methods to be adopted for collecting the relevant data and the techniques to be used in their analysis, keeping in view the objectives of the research and the availability of time and other resources. In this study, the researcher used quantitative, descriptive research design and data collection methods. The design was also non- experimental in nature, employing two data collection techniques namely cross-sectional survey and a retrospective study.

3.3.1 Quantitative research design

As highlighted by Grove (2013), quantitative research design uses structured tools to generate numerical data, and statistics are then used to interpret the collected data. The researcher sought to quantify data and make a generalisation of the results to the entire private health care system. The quantitative design was selected because the adequacy of iron deficient anaemia management was studied by way of precise measurement and quantification. The design was non-experimental in nature since data was collected without any manipulation to the subjects.

3.3.2 Cross- sectional descriptive design

According to Grove et at (2013), quantitative research design describes what exists and determines the importance and the frequency with which something occurs. In this study, the researcher used descriptive statistics to measure the adequacy of IDA management interventions and level of adherence to current standard treatment guidelines. In the study, the frequencies of confirmatory iron studies- laboratory test requests were investigated. The rate (in percentage) of following- up IDA cases was also determined so as to establish the treatment outcomes. The focus was on

establishing associations between variables, the standard treatment guidelines and treatment outcomes.

Survey studies can involve a one-time interaction with groups of people (cross-sectional study) or the study may follow individuals over time (longitudinal study). The purpose is to describe the state of affairs without the control of the researcher. There will be also an attempt to discover the causes of what has been noted. A cross-sectional descriptive design was used for this study.

3.3.3 Retrospective study

According to Du Plooy- Cilliers et al (2014:149), retrospective studies look back in time to assess what changes have transpired. Polit and Beck (2012:741) believe that a retrospective study is one that starts with the exhibitions of the dependent variable presently followed by an exploration for a supposed cause. The retrospective study was longitudinal research as observations were made over a duration of time. In this study, the researcher took a snapshot of IDA cases from one private medical laboratory and followed them for a period up to 12 months, looking for evidence of adequate diagnosis and treatment monitoring as well as the level of adherence to the standard treatment guidelines. The IDA cases were identified through the reviewing of screening full blood count (FBC) tests results and using the WHO normal references.

A total of 217 IDA cases that were identified through the reviewing of full blood count (FBC) reports (baseline results) between January 2016 and December 2017 were recorded on excel sheets. The individual IDA cases or patients were followed up for a period up to 12 months. The data regarding follow-up FBC including blood indices and iron profile tests were recorded on the excel sheets.

3.4 Research Method

Polit (2012) define research methods as techniques used to put together a study and to collect and analyse data relevant to the research question. Research setting, sampling, population and data collection approach and analysis are described in this section.

3.4.1 Research setting

Grove (2011) defines the research setting as a location where a study is conducted. Polit (2012) further explain that the study setting or context means the physical location and conditions in which data collection takes place. In this research, survey questionnaires were distributed to all the private medical laboratories situated in Windhoek, Namibia and to private medical doctors referring patients to High Care Laboratory. A few other doctors referring their blood samples or patients to other private laboratories that participated in this study were also included. On the other hand, the supplementary retrospective study was conducted at one of the private laboratory, High Care Laboratory which has 4 branches located in different regions of the country. Data from all the 4 branch laboratories- Khomas, Otjozonjupa, Erongo and Hardap regions were included in the retrospective study.

3.4.2 Study population

A population is defined as entities (individuals or objects) in which specified measure of interest or defining characteristics are represented (Polit, 2012). This research comprises of the following three sample populations:

The study population for the survey study included some private medical laboratories providing laboratory diagnostic tests for IDA. There is a total of 26 private medical laboratories in situated throughout all the regions in Namibia, and this is excluding branch laboratories from the same laboratory company. From this

total population, the study target population comprises of all private medical laboratories that are situated in Windhoek. Most laboratories with branch laboratories in other regions in the country have their main referral laboratory situated in the capital, Windhoek. Apart from FBC as part of the IDA screening test, the full iron profile laboratory tests are mostly offered at the main referral branch laboratory. A total of 12 were enrolled in this study and based on the above consideration, the number was considered representative of the entire population of private laboratories.

The private medical doctors who are involved in the treatment and management of IDA were included in the private medical doctors' survey questionnaire. The total number of registered private medical doctors practising as general practitioners is estimated to be above 400 in Namibia. Eighty (80) survey questionnaires were distributed to the most readily accessible private medical doctors and only 51 participated in the survey.

All IDA cases encountered at High Care Laboratories from January 2016 to Dec 2017 were included in the retrospective study. The IDA cases were identified through scrutinizing patients' FBC screening reports from chosen private health facility's laboratory information management system (LIMS) and using the WHO criteria.

3.4.3 Sample inclusion criteria

Eligibility criteria define characteristics that the subject or element must possess to be part of the target population (Grove, 2013). Out of a total of 26 registered private medical laboratories in Namibia, the questionnaire survey only included the private medical laboratories situated in Windhoek. This selection criterion was because most laboratories with branch laboratories in other regions in the country have their main referral laboratory situated in the capital, Windhoek. The full laboratory test repertoire that include iron profile tests are performed at the main referral branch.

From above 400 registered private medical doctors throughout the country, only medical doctors practising as general practitioners and involved in the routine management of IDA were engaged in the research study. For this study, all general practitioners referring blood samples or patients to High Care Laboratory were

included in this research since it was easier to make contact and follow-ups. However, since the number of these doctors was not large enough to proportionally represent the entire population, a few other readily accessible private doctors supporting other laboratories were also approached and participated in the research study.

In the retrospective study, IDA cases included both males and females of all age groups, pregnant and non- pregnant. This study population was composed of patients who were anaemic according to the WHO reference ranges who visited private medical doctors between January 2016 to December 2017.

3.4.4 Sample exclusion criteria

Private medical laboratories that do not have branches located in Windhoek were excluded. A privatised medical laboratory that handles all the medical laboratory testing for the state patients was also excluded in the study since the research scope covered the private healthcare system only.

Specialist doctors were excluded from this survey as they are not involved in the routine diagnosis of IDA but rather deal with referred confirmed IDA cases.

In the retrospective study, the researcher did not include IDA cases from other private laboratories. Obtaining retrospective research data from other private would entail accessing different and unfamiliar Laboratory information management systems (LIMS).

3.4.5 Sampling techniques

It would be impractical to study the whole population and thus sampling methods are used by the researcher to infer information about a population based on results from a subset of the population (Shlomo, 2013). Reducing the number of individuals in a study reduces the cost and workload, and may make it easier to obtain high-quality information. However, regardless of the sampling technique used, it is imperative that the individuals selected are representative of the whole population.

Non-probability sampling methods were used in this study. The survey study used convenience sampling approach. Here, the most accessible subjects comprising of the private general practitioners routinely using High Care Laboratory medical laboratory services were selected. Reaching out to other private doctors who support other medical laboratories would present some challenges this group will not be easily accessible. Judgemental sampling that is also referred to as purposive sampling strategy was used on the other hand in selecting the private medical laboratories only situated in Windhoek. The selected sample is deemed representative of the whole population since the main laboratories for most private laboratories with branches elsewhere throughout the countries have their main branch located in Windhoek. Specialised tests such as the iron profile tests are performed at the main branches thus nullifying the bias associated with the non-probability sampling methods.

In the retrospective study, the researcher used consecutive sampling which is a non-probability technique in which every subject encountered during the study period, January 2016 to December 2017 and meeting the criteria of inclusion is selected. IDA cases were identified by reviewing the screening full blood count test reports meeting the pre-defined inclusion criteria, WHO reference ranges. This was done using the most accessible population, High Care Laboratory's laboratory information management system (LIMS).

3.4.6 Sample size

According to Kothari (2004), the sample size refers to the number of items to be selected from the total population. This step of determining the sample size is critical since it should not be too small as it may not achieve the objectives or excessively large incurring huge costs and wasting resources. The number should be optimum, that is being representative and reliable. A logical process that involves determining the level of accuracy required, the total population size, type of sampling, timeline of the study and available resources needs to be followed. The researcher did not use formulas to calculate the sample sizes for the questionnaire surveys and a retrospective study. The researcher used different approaches as below.

3.4.6.1 Survey Questionnaire sample size

The researcher distributed survey questionnaires to 12 private medical laboratories in Windhoek. The total number of private medical laboratories in Namibia at the time of the study was 26 and thus the sample proportion was 46.2%. This sample size was however considered representative of the entire population since it was composed of the main medical laboratories offering wide laboratory test profiles including the iron profile tests. Other smaller laboratories located in other regions refer the specialised tests including iron profile tests to the bigger laboratories situated in Windhoek. The sample was thus judged to be purposive. All private doctors practising as general practitioners who routinely refer or has in the past referred patients or blood sample to High Care Laboratories were included in the survey. A few other private medical doctors referring patients to other medical laboratories used in this study were also included in this research giving a total of 51 doctors who participated in the survey. This convenience sample was judged as representative of the entire population since the medical doctors were easily accessed and follow-up queries were clarified.

3.4.6.2 Retrospective study sample size

Relatively fewer cases of IDA were identified for the two-year study period (January 2016 to December 2017) consequently, the researcher included the entire IDA cases observed during the study period. A total of 216 IDA patients or cases were identified and followed up for a period up to June 2018.

3.4.7 Data Collection

Grove et al, (2013) describes data as information that is gathered from counts, measurements, responses or observations. On the other hand, data collection according to Polit (2012), is the precise and systematic gathering of information to address a research question. For this research study, the perceptions collected from the respondents that included private medical doctors and private laboratories presented the data to answer the research questions on the adequacy of iron deficient anaemia. The observations made in the retrospective study

complemented the data collected through the questionnaires. It also served to validate some responses from the questionnaires.

3.4.7.1 Pilot study

According to Polit (2012), validity is the degree to which an instrument measures what it is supposed to measure. This involves the process of validating the questionnaires taken by the researcher that is the reviewing literature, consultations with supervisors and statistician expert as well as subjecting the questionnaire to a pre-test. Both questionnaires were only finalised after conducting a pre-test, pilot study that was aimed at assessing the feasibility of the questionnaires approach as well as pre-testing the research instruments. The administration process was in exactly the same way as in the main study and it helped to detect possible flaws in the measurement procedures, that includes instructions and time limits. Valuable feedback was obtained from the pilot study and it was used by the researcher to revise the questionnaires, reviewing ambiguous questions as well as shortening and even discarding some questions. The time taken by the pilot subjects to complete the questionnaire was also taken into consideration in the modifications.

The pilot questionnaire for the private laboratories was emailed to the facilities. A total of 4 medical technologists that manage the laboratories responded. It took up to 3 weeks to get all the responses back from the facilities. The completed questionnaires were analysed to determine whether the data collected answered the research objectives. The pilot study also served to check for reliability and validity of the questionnaire approach. Reliability of the questionnaire describes the consistency that the instrument measures the target attribute. Polit and Beck (2012: 336) define this as the likelihood of obtaining the same results when the research measures the same variable more than once or more than one person measures the same variable.

Two technologists reported that they had challenges printing out the questionnaires and that this had delayed their response. Other valuable feedback given included some missing job categories and tests omitted from the listed choices. They also reported that some questions were ambiguous for them to answer. All the input from this pilot study including the missing information and unclear questions was

considered in the final questionnaire revision. Emailing questionnaires did not yield good response rate and hand delivery was thus chosen as the preferred distribution method. The medical technologists who participated in the pilot study did not take part in the main research study.

The medical doctors' questionnaire was piloted with 5 private medical doctors. The input from this pilot survey included adding more choices to the treatment guidelines as well as on the treatments options. The same challenge of delayed response on the emailed questionnaire was experienced with the medical doctors. In the final medical doctors' survey study, the questionnaire administration was changed to hand delivery of printed questionnaires.

3.4.7.2 Survey questionnaire

According to Polit (2012), surveys collect information on peoples' actions, knowledge, beliefs, intentions, opinions, attitude, preference and values through direct questioning. The researcher collected data by conducting surveys through the use of questionnaires targeting the private medical laboratories and private general practitioners. Two different sets of self-designed questionnaires in English were used and contained both structured and semi-structured questions. As Polit (2012) points out, the use of structured questionnaires in research enhances the objectivity and support statistical analysis. The questionnaires were hand delivered in envelopes by the researcher to the target respondents. A few questionnaires were also sent out electronically via email particularly to the target respondents who were at far- away places. Respondents were given up to 4 days before following up. The entire data collection process took 2 months to complete. Some respondents who did not complete or return the questionnaires on time were followed up telephonically.

The self-administration method proved to be the best communication and delivery method since it gave a high return rate and in a short time. The online survey tools such as the survey monkey were deemed by the researcher as not quite suitable since most private medical practitioners lead busy schedules and may view online participation as a waste of time.

The researcher developed a questionnaire in the English language for the private doctors, ***Appendix A.*** The questions were formulated guided by the research objectives outlined in the earlier chapter. The questionnaire contained structured questions with response options listed to choose from. Some questions also included some open-ended options that gave the respondents an opportunity to mention any other information apart from the listed options. The questionnaire was designed to capture information regarding the standard treatment guidelines that the private practitioners use and the various laboratory tests that they request for the diagnosis and monitoring treatment of IDA. The questionnaire also sought to assess the private practitioners' perceptions of the adequacy of the current standard treatment guidelines.

Another questionnaire, also in English language and for the private medical laboratories, ***Appendix B*** was also formulated in line with the outlined research objectives**.** The first section of the questionnaire was aimed at capturing the biographical data of the questionnaire respondents, whilst the second section of the questionnaire sought to collect data regarding the iron profile tests available in the laboratory and the tests usage rate thereof.

A questionnaire covering letter and consent form, ***Appendix C*** accompanied all the questionnaires distributed. It explained to the participants the purpose, nature and the process of the study. Study participants signed the consent forms that formed part of the covering letter. The consent forms gave the opportunity to the research subject to voluntarily agree to participate in the research after their full understanding of the research and any related risks as explained in the covering letter.

3.4.7.3 Retrospective study data collection

A retrospective study was also carried out to provide complementary research data. The retrospective study was convenient in terms of time and costs to undertake compared to using experimental since archived data was already available.

The initial screening steps involved identifying all anaemic cases, defined as haemoglobin of 12 g/dL or below for men and 11g/dL or below for women, MCV of less than 80 fl and red cell count not exceeding 5.5 x 10^{12} /L, that were encountered

between January 2016 and December 2017. This was done by reviewing the screening full blood count test results from all High Care Laboratory's laboratory information management system (LIMS). The researcher was granted access to the LIMS after submitting a formal request to High Care Laboratory management to access and use the company's LIMS for this study following the relevant approvals from the Ministry of Health and Social Services and the Namibia University of Science and Technology's research ethics committee. The researcher used a date range in the selection criteria, and as well flag prompts on the red blood cell count (Rbc), haemoglobin (Hb), haematocrit (HCT), mean cell volume (MCV) and mean corpuscular haemoglobin (MCH) indices.

A total of 216 anaemia cases suspected to be IDA were identified using the procedure above. The second step was to identify the confirmed IDA cases through the reviewing of iron profile laboratory tests that were done in addition to screening FBC tests. The laboratory test results that include the baseline FBC results, specifically the Rbc, Hb, HCT, MCV and MCH were tabulated on excel templates that also indicated the laboratory test screening date, age and gender of the patients. The laboratory requisition numbers instead of patients' names were used to identify each of the baseline IDA cases. Although the follow-up patients' laboratory test requisitions were given new laboratory numbers, the follow-up results were automatically matched in the LIMS using the surname and names as well as the date of birth. The first and second follow- up tests, in addition to the FBC parameters and indices, also displayed the patients' iron profile tests- ferritin, serum iron, transferrin and transferrin saturation that were performed. (***Appendix H)***

3.5 Data processing and analysis

After the data was collected, processing involving editing, coding, classification and tabulation followed the data for analysis. Editing was done by examining the raw data to detect errors and omissions and to correct them when possible. Respondents were contacted to give clarifications or any elaborations to unclear responses. This careful scrutiny of the completed questionnaires ensured that the data are accurate, consistent and well arranged to facilitate coding and tabulation. Coding which involved assigning numerals to answers allowed the responses to be categorized into classes displayed in tables. The summation of raw data, in turn, facilitated comparison of data and formed a basis for statistical computation. The data was tabulated, coded and exported into the latest version 23 of the Statistical Package for the Social Sciences (SPSS).

3.6 Scope and limitation of the study

The scope of the study was to evaluate the diagnosis and treatment of iron deficiency anaemia within the private health care in Namibia. Questionnaires were however distributed to private medical laboratories in Windhoek and to doctors supporting these laboratories selected for the research study. The use of this convenience sampling can bring challenges of generalizing the findings. A few other doctors outside Windhoek were thus included in the study to as to minimise the generalisation risk. Although the the study findings can be applied to the entire private health care system, they are more reflective of the status in the regions where data was collected from. With the availability of more resources – time and funds, the broader researches can be conducted.

A retrospective study was conducted at one private medical laboratory where the researcher sought and was granted permission to access the LIMS. The IDA cases accessed on the LIMS were from 4 regions: Windheok (Khomas region), Otjiwarongo (Otjozondjupa region), Walvis Bay (Erongo region) and Rehoboth (Hardap region). No sample size was calculation was made since the researcher included all the IDA cases encountered during the study period from January 2016 to December 2017.

The IDA cases encountered were not gender and age restricted and the research findings generalised across the whole study population although it may be ideal to consider certain groups such as paediatric and pregnant women separately.

3.7 Ethical consideration

Ethical clearance was given prior to conducting this research study. The researcher submitted a research proposal to the Namibia University of Science and Technology (NUST) research ethics committee which approved the research ***(Appendix D)***. Further approval was also sought from the office of the Permanent Secretary in the Ministry of Health and Social Services (MOHSS) and the permission was granted ***(Appendix E)***. After the approvals from NUST and MOHSS, the researcher also sought for permission from High Care Laboratory management to access and use the company's LIMS. The researcher only commenced with the study after permission was granted ***(Appendix F)***.

No individual consent was sought for this research since no patient samples were handled in this research. When using the patients' laboratory reports, only the laboratory requisition number was used instead of the name and surname of the patient. Strict ethical values were followed regarding patient information confidentiality throughout the study. The information and data was used for purposes of the study only and was secured in computers with access restriction, password protection.

3.8 Validity of the data

Strategies that were used to ensure the credibility and trustworthiness of the data included voluntary participation. During the research study, participants were afforded the opportunity to refuse to participate when approached. This ensured that those willingly participating in the research gave honesty responses that would be relied on. Other strategies were undertaken to ensure trustworthiness of the research study included frequent debriefing sessions with research supervisors and

also allowing peer securitisation. Some colleagues gave fresh perspectives that challenged some assumptions made in the research. Piloting the research questionnaire helped to ensure that this research instrument measures accurately what it is supposed to measure.

3.9 Conclusion

This chapter was a comprehensive description of the research design and methods. After establishing the research aims and objectives, the research had a discussion of the theoretical framework for the study. The research study used quantitative, descriptive research design which was non- experimental in nature. It employed cross-sectional surveys data collection techniques and a retrospective study. The research method discussion focussed on the research setting, population, sampling techniques, sample size, data processing and analysis as well as the ethical considerations. The next chapter presents the data analysis and findings of the study.

CHAPTER FOUR

RESULTS

4.1 Introduction

This chapter present the research findings according to the research objectives. Descriptive statistics; standard deviation, mean, percentage were performed with tables and charts also used to present the results. The data analysis process followed the research methods laid out in the previous chapter.

4.2 Research findings

4.2.1 Objective 1: Determination of all Standard Treatment Guidelines for iron Deficiency anaemia management in the Namibian private healthcare system.

Findings from the private medical doctors' survey questionnaire were used to address this research objective. Fifty-one (51) questionnaires out of the 80 questionnaires distributed were returned. Some private medical doctors (28) did not respond even after they were reminded with 1 medical doctor declining to participate in the research study. The questionnaires were uniquely numbered from 1 up to 51 and the summarised findings are presented in **figure 4.1**.

The **figure 4.1** shows the various management guidelines (STGs) and their usage frequencies by the private medical doctors. Most private medical doctors (76.5%) use the Namibia Standard Treatment Guidelines followed by the World Health Organisation guidelines (39.2%). The usage rate for guidelines from Zimbabwe and South Africa was the same and relatively lower (19.6%). A few medical doctors indicated that the use other management guidelines namely; Centre for Disease Control and Prevention(CDC) and the National Institute for Health and Care Excellence (NICE) management guidelines. Only 3.9% of the private medical doctors indicated that they do not use any guidelines in IDA management.

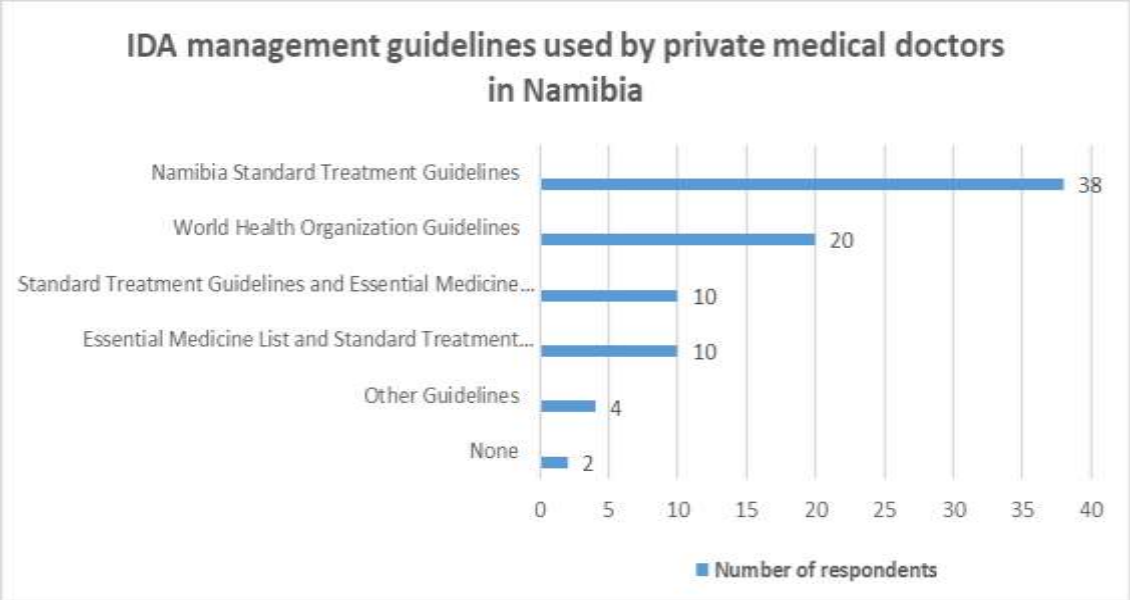

Figure 4.1 Management guidelines for IDA (N=51)

4.2.2 Objective 2: Appraisal of the Level of adherence to Standard Treatment Guidelines on iron deficiency anaemia management in the Namibian private healthcare system.

The doctors' perceptions regarding the adequacy of the IDA management guidelines and their level of adherence to the current Standard Treatment Guidelines is presented in Figure 4.2 and Figure 4.3. A retrospective study conducted also further gave evidence of the level adherence to the IDA management Standard Treatment Guidelines.

Figure 4.2 shows that the majority of the doctors 37 out of the 51, believed that the currently available guidelines are sufficient in the management of IDA. On the other hand, 8 doctors believed that the current guidelines were obsolete and required reviewing, whilst 4 responded that the current guidelines are insufficient. Two doctors did not give any response to his question.

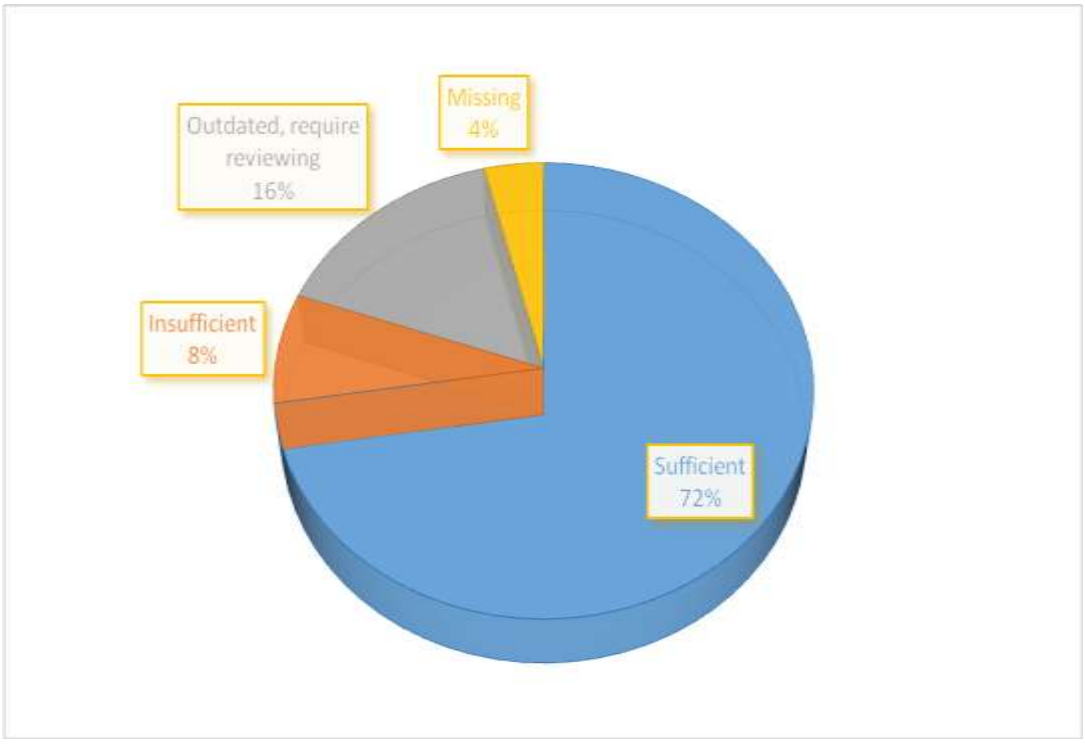

Figure 4.2 Doctors' perceptions of the adequacy of iron deficiency management Standard Treatment Guidelines (N=51)

Figure 4.3 shows that symptomatic adults form the patient group that is mostly screened for IDA. The other most screened patient groups are; antenatal care (ANC) patients, patients during a medical general check-up, and symptomatic children, in this respective order. Other patients are less frequently screened for IDA.

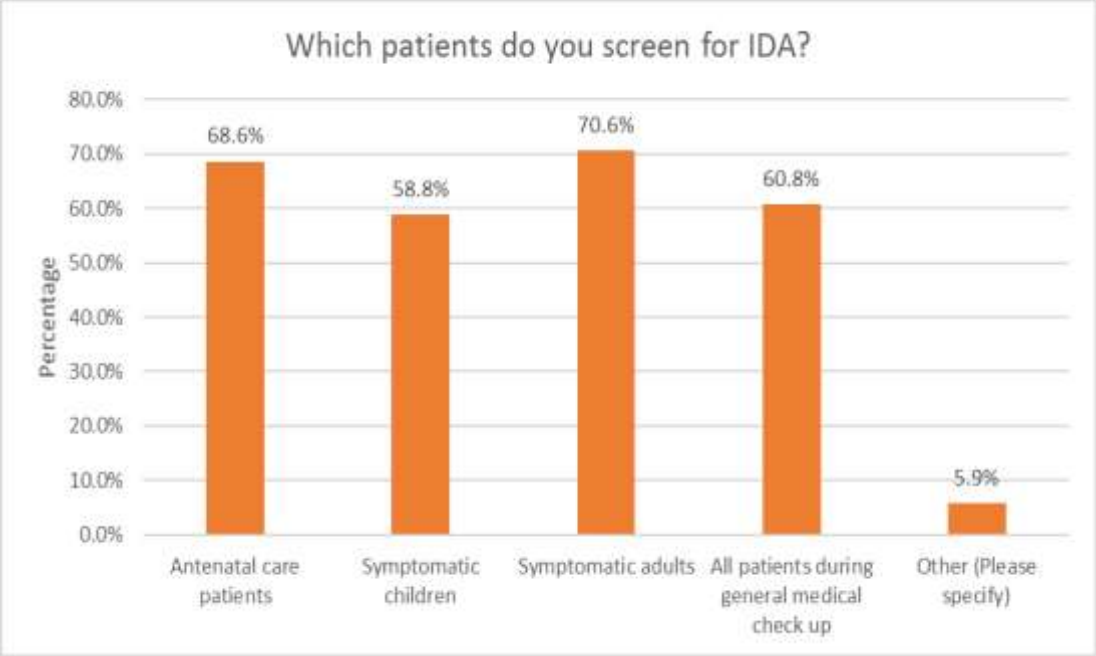

Figure 4.3 Patients screened for IDA (n= 51)

Oral iron is the most common treatment option used by the practitioners for managing IDA followed by preventative dietary measures and blood transfusion. On the other hand, the less frequently used options are parenteral iron therapy and erythropoietin therapy. Any other IDA treatment options that were specified by the medical doctors included the deworming.

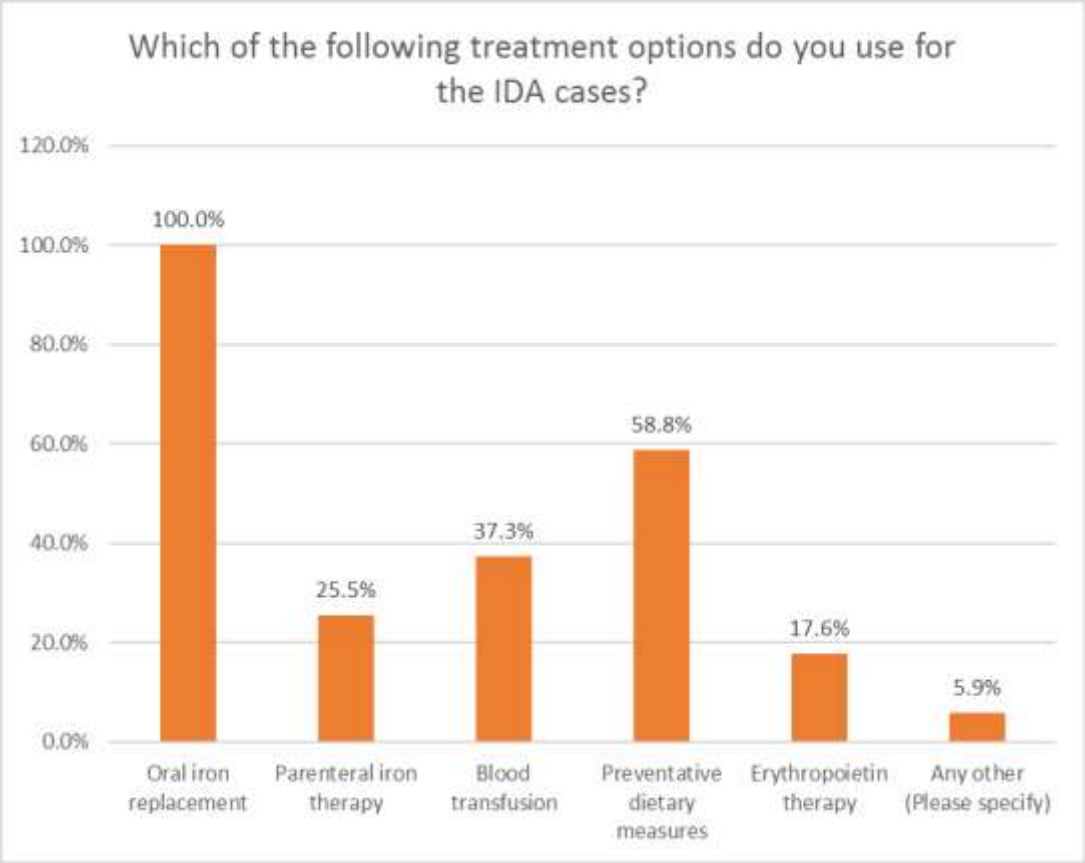

Figure 4.4 Treatment options used for iron deficiency anaemia management (n= 51)

The study showed that non-compliance to IDA therapy is mostly due to patients stopping the medication when they feel better and also due to patients stop taking medication as a result of experiencing side effects. However, some of the doctors (43.1%) believed that there is evidence that patients take their medication consistently. On the other hand,19.6% of the private doctors believed contrary and that patients do not take their pills regularly.

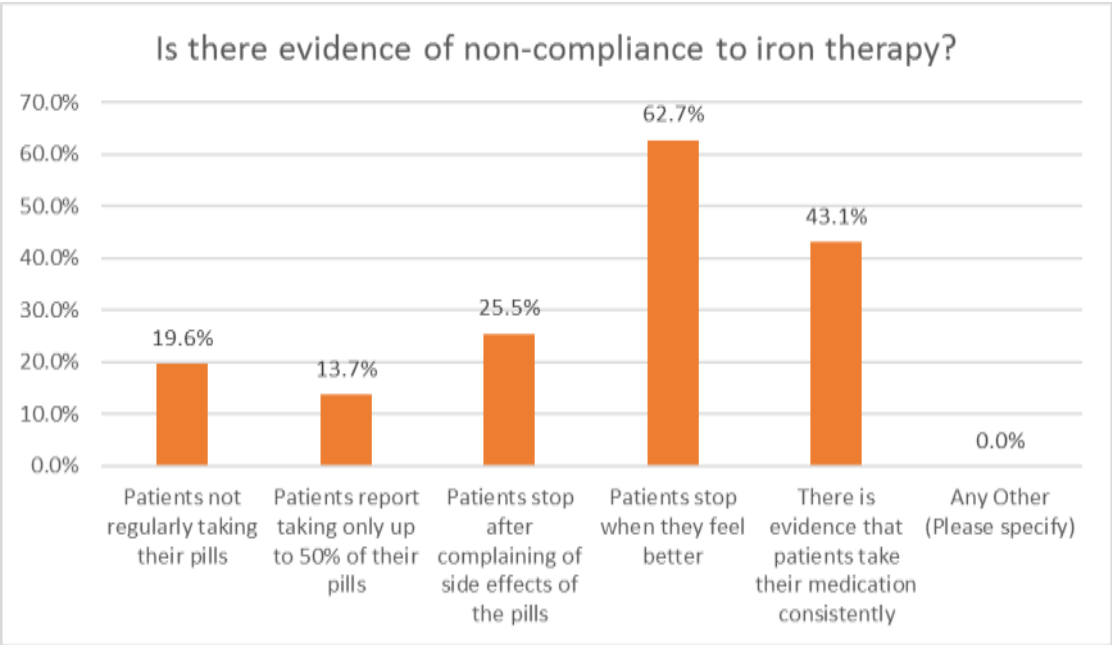

Figure 4.5: Compliance to iron therapy (n= 51)

4.2.3 Objective 3: Establishment of iron profile laboratory tests offered for the diagnosis and treatment monitoring of iron deficiency anaemia in the Namibian private healthcare system.

The most frequently requested laboratory test in the diagnosis of IDA is the full blood count (FBC) test. All the doctors indicated that they routinely request FBC and this was followed by serum ferritin, then serum iron and transferrin. The other laboratory tests that are less frequently requested include bone marrow, serum folate, FBC with blood film comments, reticulocytes, and other laboratory tests (included occult blood test).

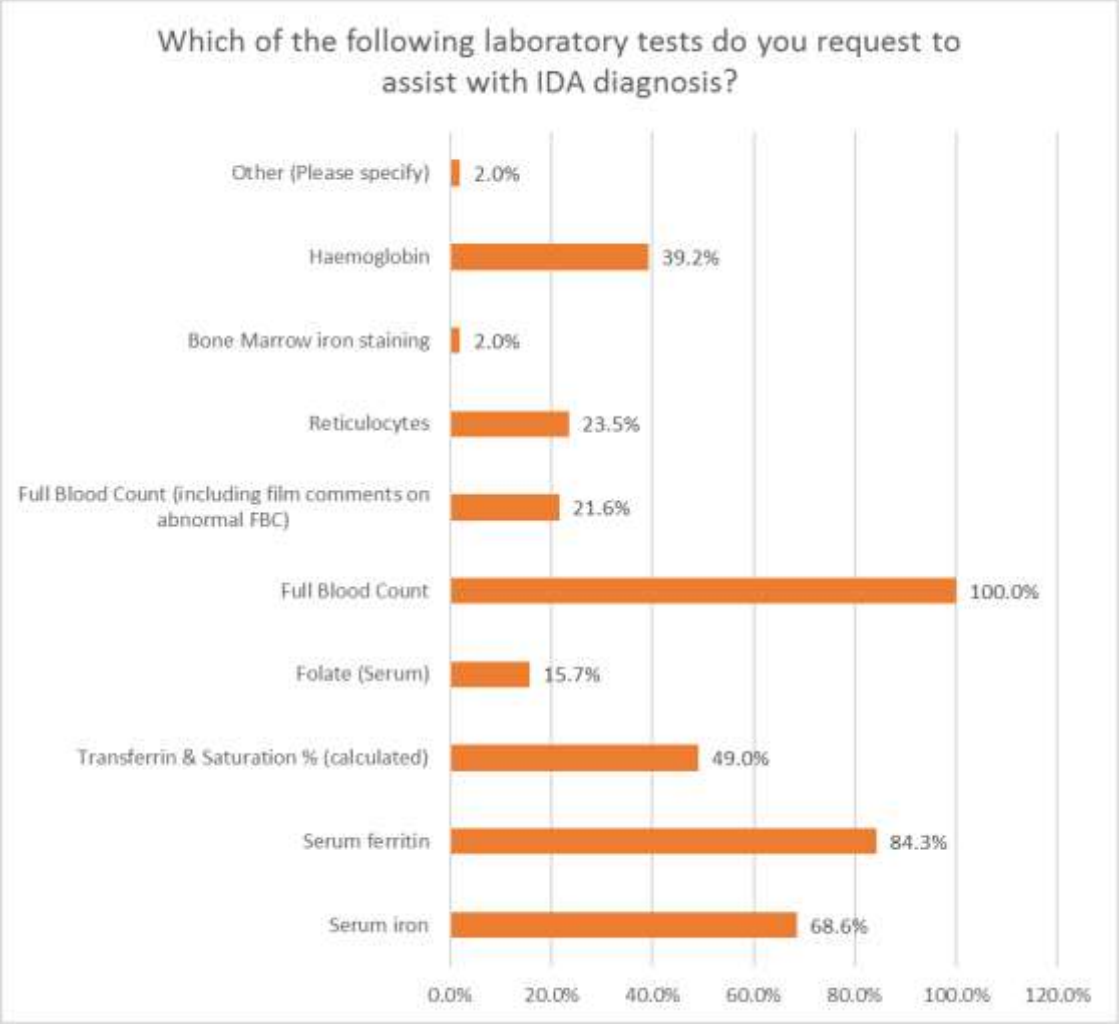

Figure 4.6 Laboratory tests for IDA diagnosis

Most of the survey doctors (96.1%) private medical doctors regarded the iron profile tests offered by the laboratories as sufficient for IDA diagnosis.

Table 4.1 Adequacy of the iron profile tests in IDA diagnosis

Do you regard Iron studies profile tests provided by the laboratory as sufficient or insufficient for the diagnosis of suspected cases of iron deficiency anaemia?	**Frequency**	**Percentage**
Sufficient	49	96.1
Insufficient	2	3.9

The research survey further revealed that the most frequently requested laboratory tests for the assessment of effective IDA treatment were; serum iron, FBC, transferrin and calculated % saturation in this respective order. Serum iron and the rest of the other laboratory tests; FBC with blood film comments, haemoglobin, reticulocytes, and folate, in this declining order of test request are not requested often in monitoring IDA treatment.

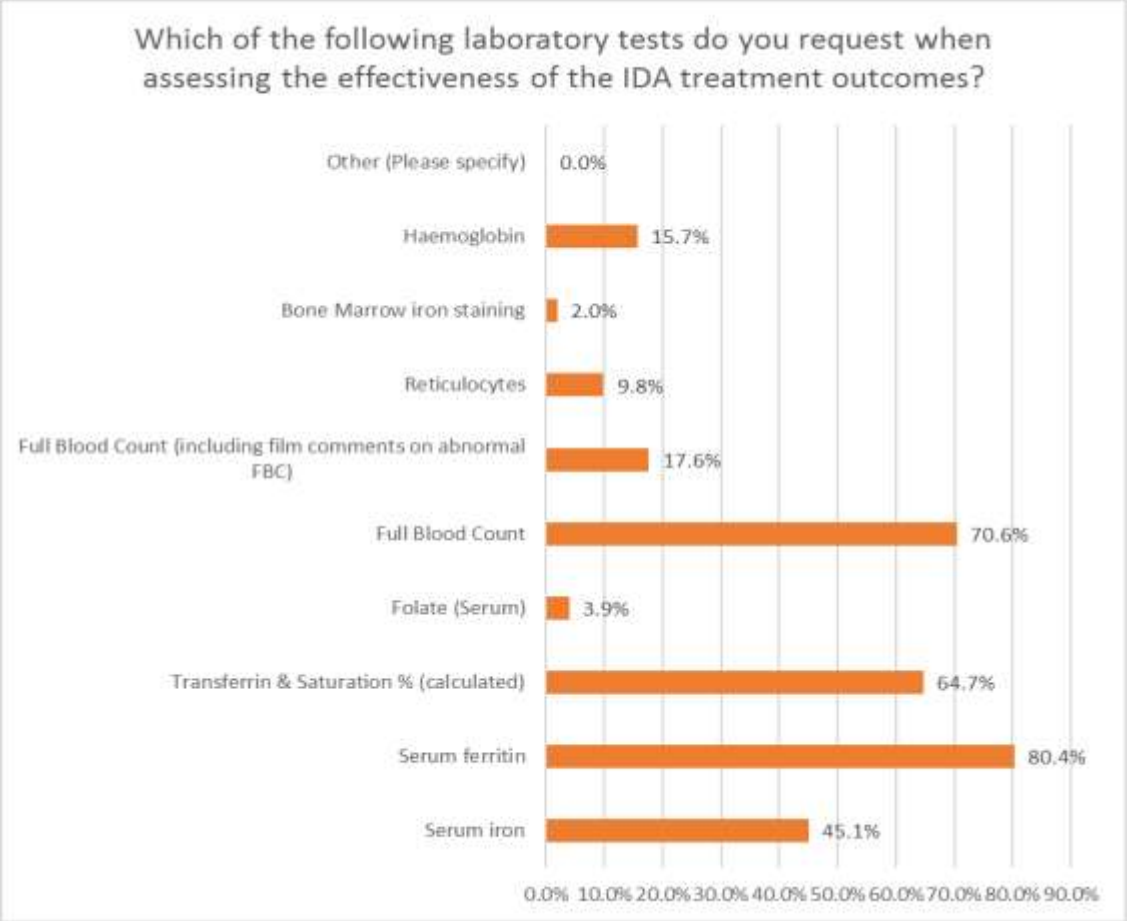

Figure 4.7 Laboratory tests for monitoring IDA treatment outcomes

The first 2 questions in the laboratory questionnaire sought to collect the demographic data of the respondents from the surveyed private medical laboratories. The majority of the research participants were laboratory managers with 11 to 15 years working experience. Fewer respondents had less than 5 years of working experience.

Table 4.2: Job category for laboratory respondents (N=12)

		Frequency	Per cent
Valid	Medical Technologist	1	8.3
	Medical Technologist in charge	2	16.7
	Specialist Medical Technologist : Haematology	2	16.7
	Specialist Medical Technologist: Microbiology	1	8.3
	Laboratory Manager	4	33.3
	Medical Scientist	2	16.7
	Total	12	100.0

Table 4.3: Years of working experience for laboratory respondents (N=12)

		Frequency	Per cent
Valid	< 2 years	1	8.3
	2 - 5 years	1	8.3
	6-10 years	2	16.7
	11-15 years	4	33.3
	16-20 years	2	16.7
	>20 years	2	16.7
	Total	12	100.0

Serum iron and ferritin formed part of the iron studies profile tests in all the 12 surveyed laboratories, followed by FBC, and FBC with film comments requests. Although haemoglobin is part of FBC practitioners also requested it separately. The serum folate and reticulocytes tests are part of the iron studies profile in one-half of the surveyed laboratories. On the other hand, only 1 laboratory indicated that bone

marrow iron staining and other tests (listed as Total Iron Binding Capacity-TIBC) are part of the iron studies profile tests.

The study findings show that 9 out of the 12 surveyed laboratories indicated that they would refer some iron studies not available in their laboratory because such tests are not requested often. Only one-half of the laboratories indicated that all the iron studies profile tests on the list were available in their laboratory. On the other hand, 4 laboratories responded that they have no analysers or testing methods in their laboratory for iron studies. Only 1 laboratory indicated that it has no appropriately trained personnel to carry out the iron studies test procedure.

Table 4.4: Laboratory tests offered by the laboratory as part of IDA investigations. (N=12)

Laboratory test		Frequency (n=12)	Percent
	Serum iron	12	100
	Serum ferritin	12	100
	Transferrin & Saturation % (calculated)	7	58.3
	Folate (Serum)	6	50.0
	Full Blood Count	11	91.7
	Full Blood Count (including film comments on abnormal FBC)	9	75.0
	Reticulocytes	6	50.0
	Bone Marrow iron staining	1	8.3
	Haemoglobin	7	58.3
	Other (Please specify) ……	1	8.3

The majority of the laboratories (83.3%) indicated that the full blood count is routinely requested as a screening test in iron deficiency anaemia laboratory diagnosis. Serum iron is not often requested by doctors when diagnosing IDA. A total of 5 out of the 12 (41.7%) laboratories indicated that serum iron test is only occasionally requested. Serum ferritin is not routinely requested by doctors when diagnosing IDA. Only very few laboratories indicated that this test is requested often for IDA. Most laboratories indicated that serum ferritin is not often requested. Transferrin and folate follow a similar trend to ferritin. Very few medical doctors

request for the tests when diagnosing IDA. The majority of the laboratories (92%) indicated that reticulocytes test is rarely requested whilst a quarter of the surveyed laboratories indicated that the test is never requested altogether.

Bone marrow iron staining is not requested according to 83%. Most laboratories (75%) indicated that no other tests are requested IDA diagnosis apart from the tests listed.

Table 4.5: Frequency for iron profile laboratory tests in IDA diagnosis

Test/ Number of Laboratories	FBC	Serum iron	Ferritin	Transferrin	Folate	Reticulocytes	Bone marrow	Other tests
Not requested	0	0	0	1	1	3	10	9
<20% (Rarely)	0	1	2	5	2	9	2	1
21-35% (Occasionally)	1	5	3	1	8	0	0	0
36 – 50 % (Sometimes)	0	4	5	4	0	0	0	0
51-75% (Often)	1	1	1	1	1	0	0	0
>75% Routinely	10	1	1	0	0	0	0	0
Total	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**10**

The majority of the laboratories receive FBC test requests as post-treatment follow-up tests as Shown in **Table 4.6.** Relatively fewer laboratories indicated that they receive follow–up serum iron test requests. Half of the surveyed laboratories also

indicated that serum ferritin levels are not routinely followed-up after treatment whilst another half indicated that the tests is sometimes requested as after IDA treatment.

The study findings indicate that transferrin test and % saturation levels are not routinely checked after treatment. Only 4 laboratories indicated that the tests are sometimes requested as post-treatment follow-up tests. Serum folate levels are not routinely followed-up after treatment. The majority of the surveyed laboratories indicated that reticulocyte test is rarely requested as a follow-up test after treatment. Bone marrow iron staining procedure is not requested according to most of the surveyed laboratories.

Table 4.6: The frequency for post-treatment iron profile laboratory test requests

Test/ Number of Laboratories	FBC	Serum iron	Ferritin	Transferrin	Folate	Reticulocytes	Bone marrow	Other tests
Not requested	0	0	0	1	1	3	10	9
<20% (Rarely)	1	2	5	6	3	8	2	1
21-35% (Occasionally)	0	4	1	1	5	1	0	0
36 – 50 % (Sometimes)	1	3	4	3	1	0	0	0
51-75% (Often)	4	1	1	0	2	0	0	0
>75% Routinely	6	2	1	1	0	0	0	0
Total	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**10**

4.2.3.1 Findings from the retrospective study

The retrospective data gave complimentary research data that helped to address research objectives 2 and 3.

Table 4.7 gives the summary statistics for the retrospective data. The demographic data, baseline as well as the first and second follow-up test (IDA screening) results statistics are summarised in this table. From the FBC screen blood picture, the total suspected IDA cases were 217 of which only one-quarter (55) of the cases were followed- up. The follow-up laboratory tests performed was composed of mostly the full blood count (FBC) test. The findings from this retrospective study also revealed that the other confirmatory iron profile tests such as serum iron, ferritin and transferrin are not often requested. These tests were only performed in 22% of the suspected cases that were followed-up.

The demographic data for the 55 IDA patients that were followed-up showed the age range of 17 to 64 with an average age of 38 years and a standard deviation of 11 years. Most of them these patients were adult females (89%). The follow-up days ranged from 28 days to 363 days with an average of 126.6 days.

Table 4.7: Descriptive statistics; Retrospective data

Parameter	Normal reference Range	N	Minimum	Maximum	Mean	Std. Deviation
AGE		55	17	64	38.29	10.944
Rbc	3.91-5.61 (6 -14 yrs) 5.21-5.81 (Adult Male) 3.91 -5.11 (Adult female)	55	3.29	6.40	4.5044	.60258
Hb	10.9-15.5 (6-14 yrs) 12-16 g/dl (Women) 13-17 g/dl (Men)	55	5.40	13.80	10.0073	1.72314
HCT	38-51 (6 -14 yrs) 38-51 (Male) 33-45 (female)	55	18.90	39.90	31.1036	4.42811
MCV	80-100 fl]	55	55.30	78.30	69.2327	6.43843
MCH	28-35 pg	55	15.80	31.20	22.6236	3.09904
FIRST FOLLOW UP						
Rbc	3.91-5.61 (6 -14 yrs) 5.21-5.81 (Adult Male) 3.91 -5.11 (Adult female	50	3.22	6.66	4.7698	.76516
HB	10.9-15.5 (6-14 yrs) 12-16 g/dl (Women) 13-17 g/dl (Men)	50	5.40	16.20	11.2260	2.34771
HCT	38-51 (6 -14 yrs) 38-51 (Male) 33-45 (female)	50	13.00	47.30	33.7260	6.89714
MCV	80-100 fl]	50	55.30	90.60	71.8780	7.31114
MCH	28-35 pg	50	15.80	34.50	24.0960	3.65318
FERRITIN	65 – 670 pmol/L	12	5.13	94.80	21.3542	27.79205
SERUM IRON	9 - 32 mmol/L	12	2.50	28.00	7.6250	7.12794
TRANSFERRIN	2 - 3.6 d/L	12	2.00	18.80	6.3250	5.47243
TRANSFERRIN SATURATION1	%	12	3.80	88.86	20.7833	23.83102
SECOND FOLLOW UP						
RBC2	3.91-5.61 (6 -14 yrs) 5.21-5.81 (Adult Male) 3.91 -5.11 (Adult female	14	3.16	5.69	4.3807	.91126
HB2	10.9-15.5 (6-14 yrs) 12-16 g/dl (Women) 13-17 g/dl (Men)	14	7.40	13.00	10.5357	2.07461
HCT2	38-51 (6 -14 yrs) 38-51 (Male) 33-45 (female)	14	23.30	39.10	31.5364	6.41128
MCV2	80-100 fl]	14	61.30	86.00	74.2429	8.02752
MCH2	28-35 pg	14	19.90	29.00	24.5500	2.69836
FERRITIN	65 -670 pmol/L	3	7.86	11.00	9.9200	1.78471
SERUM IRON	9- 32 mmo/ L	3	2.10	23.28	9.6267	11.84484
TRANSFERRIN	2- 3.6 d/ L	3	3.10	20.60	9.2000	9.88079
TRANSFERRIN SATURATION	%	3	3.60	13.90	8.7500	7.28320

4.2.3.1.1 Full blood count parameters

4.2.3.1.1.1 Red blood cells (x10^6 /uL)

At baseline Rbc(n=55) readings ranged from 3.29 to 6.40 x10^6 /uL with a mean of 4.50 and a standard deviation of 0.60. At first follow-up date (n=50), Rbc readings ranged from 3.22 to 6.66 with a mean of 4.77 and a standard deviation of 0.77. At the second follow-up date (n=14), Rbc readings ranged from 3.16 to 5.69 x10^6 /uL with a mean of 4.38 and a standard deviation of 0.91. The adult, female normal reference range of 3.91 to 5.11 x10^6 /uL can be used for comparison since this group forms the majority of the patients (89%) in this study.

4.2.3.1.1.2 Haemoglobin (g/dL)

Hb (n=55) levels ranged from 5.4 to 13.8 g/dL with a mean of 10.0 and standard deviation of 1.70 at baseline. The minimum remained at 5.4 but the maximum rose to 16.2 at the first follow-up date (n=50). The mean Hb at first follow-up also rose to 11.2. At the second follow-up (n=14), the Hb ranged from 7.4 to 13.0 g/dL and the mean was 10.5. The standard deviation declined from 2.34 at first follow to 2.07 at second follow-up date.

4.2.3.1.1.3 Haematocrit (%)

At baseline, the HCT(n=55) ranged from 18.9 to 39.9 % with a mean of 31.1 and standard deviation of 4.4. The HCT range at first follow-up (n=50) was 13.0 to 47.3, mean 33.7 and standard deviation of 6.9. At the second follow-up (n=14), the HCT values ranged from 23.3 to 39.1 % with a mean of 31.5 and a standard deviation of 6.4

4.2.3.1.1.4 Mean Cell Volume (fL)

The MCV ranged from 55.3 to 78.3 fL, with a mean of 69.2 and a standard deviation of 6.4 at baseline (n=55). The minimum remained at 55.3 and maximum was 90.6, mean rose to 71.8 and the standard deviation was 7.3 at first follow- up (n=50). At

the second follow-up (=14), the MCV ranged from 61.3 to 86.0, while the mean and standard deviation rose to 74.2 and 8.0 respectively.

4.2.3.1.1.5 Mean corpuscular haemoglobin (pg)

The MCH range, at baseline (n=55), was from 15.8 to 31.2 pg, whilst the mean was 22.6 and the standard deviation was 3.1. At the first follow-up (n=50) the MCH minimum remained at 15.8 and maximum rose to 34.5. The mean and standard deviation also increased to 24.1 and 3.6 in the first follow-up. The second follow-up MCH range was 19.9 to 29.0 pg, mean 24.6 and the standard deviation was 2.7.

4.2.3.1.2 Iron profile tests

Table 4.7 shows that from the 50 IDA cases at first follow-up only 12 cases were confirmed or monitored with iron profile tests other than the full blood count test. There was a further decline of the laboratory iron profile tests to only 3 cases at the second follow-up.

4.2.3.1.2.1 Serum ferritin (pmol/L)

At the initial follow- up (n=12), ferritin ranged from 5.13 to 94.8. The mean, at this stage, was 21.4 whilst the standard deviation was 27.8. At the second follow-up (n=3) the range for ferritin was from 7.86 to 11.0, whilst the mean was 9.9 and the standard deviation was 1.8

4.2.3.1.2.2 Serum iron (mmol/L)

During the first follow-up, (n=12), serum iron range of 2.5 to 28.0, mean iron of 7.6 and standard deviation of 7.1. At the second follow-up (n=3) minimum iron value was 2.1 and maximum 23.3, whilst the mean for the iron was 9.6 and the standard deviation was 11.8

4.2.3.1.2.3 Transferrin

At the first follow-up (n=12) the transferrin levels ranged from 2.0 to 18.8. The range rose to 3.1 to 20.6 at the second follow-up (n=3). The mean and standard deviation for transferrin also elevated to 9.2 and 9.8 at second follow-up from the first follow up values of 6.3 and 5.4 respectively.

4.2.3.1.3 Evidence of the effectiveness of iron deficiency anaemia treatment interventions

In order to test for significant mean differences data had to be tested for normality and most of the variables were not normally distributed ($p<0.05$). Therefore, non-parametric Friedman's ANOVA tests **(Table 4:8)** were conducted to evaluate the differences in the mean values for RBC, Hb, HCT, MCV, and MCH at initial baseline screening date, first, follow up and second follow-up date at 5% level of significance.

FBC parameters, RBC, Hb, HCT, MCH except MCV were normally distributed at baseline ($p>0.05$). For MCV, asymp. Sig $p< 0.05$. The non-parametric test was thus recommended.

Table 4:8: Friedman's ANOVA tests

One-Sample Kolmogorov-Smirnov Test: Baseline IDA test results

		Rbc [Normal Ranges: 6 -14 yrs 3.91-5.61, Adult Male: 5.21-5.81], Adult female: 3.91 -5.11]	Hb [6-14 yrs: 10.9-15.5, Women 12-16, Men 13-17 g/dl]	HCT [Normal range: 6-14 yrs: 38-51, Male: 38-51, Female: 33-45]	MCV [Normal range: 80-100 fl]	MCH [Normal range: 28-35pg]
N		55	55	55	55	55
Normal Parameters[a,b]	Mean	4.5044	10.0073	31.1036	69.2327	22.6236
	Std. Deviation	.60258	1.72314	4.42811	6.43843	3.09904
Most Extreme Differences	Absolute	.108	.084	.082	.184	.115
	Positive	.108	.084	.067	.086	.103
	Negative	-.061	-.081	-.082	-.184	-.115
Test Statistic		.108	.084	.082	.184	.115
Asymp. Sig. (2-tailed)		.169[c]	.200[c,d]	.200[c,d]	.000[c]	.067[c]

a. Test distribution is Normal.
b. Calculated from data.
c. Lilliefors Significance Correction.
d. This is a lower bound of the true significance.

At first follow-up, Hb, HCT and serum iron were normally distributed but MCV (p=0.003), ferritin (p, 0.001) and transferrin (p=0.006) were not normally distributed.

Table 4:9: Friedman's ANOVA tests

One-Sample Kolmogorov-Smirnov Test: First follow-up IDA test results

		Rbc [Normal Ranges: 6 -14 yrs 3.91-5.61, Adult Male: 5.21-5.81], Adult female: 3.91 - 5.11]	HB1	HCT1	MCV1	MCH1	FERRITIN1	SERUM IRON1	TRANSFERRIN 1	TRANSFERRIN SATURATION 1
N		50	50	50	50	50	12	12	12	12
Normal Parameters[a,b]	Mean	4.7698	11.2260	33.7260	71.8780	24.0960	21.3542	7.6250	6.3250	20.7833
	Std. Deviation	.76516	2.34771	6.89714	7.31114	3.65318	27.79205	7.12794	5.47243	23.83102
Most Extreme Differences	Absolute	.064	.116	.099	.159	.142	.386	.236	.338	.292
	Positive	.052	.069	.062	.105	.142	.386	.220	.338	.292
	Negative	-.064	-.116	-.099	-.159	-.101	-.280	-.236	-.215	-.238
Test Statistic		.064	.116	.099	.159	.142	.386	.236	.338	.292
Asymp. Sig. (2-tailed)		.200[c,d]	.093[c]	.200[c,d]	.003[c]	.013[c]	.000[c]	.063[c]	.000[c]	.006[c]

a. Test distribution is Normal.
b. Calculated from data.
c. Lilliefors Significance Correction.

All FBC parameters, Rbc, HCT, MCV and MCH except Rbc were normally distributed. The distribution for other IDA tests, serum ferritin, serum iron, and transferrin, however, could not be confirmed. The number of IDA followed up at this stage fell below 5 which is the minimum number required for computation with the Friedman's ANOVA test.

Friedman's ANOVA results indicated that there were no significant differences in the distributions of RBC (p=0.368); HCT (p=0.273); and MCV (p=0.080) at baseline screening date, first follow-up and second follow-up date. However, there were significant differences in the distributions of Hb (p = 0.013) and MCH (p=0.021). Average Hb was 10.007 at baseline and this rose to 11.226 at first follow up but declined to 10.36 and the second follow up. Non-parametric Wilcoxon's signed rank tests were also conducted to establish whether there were significant differences in the median for FBC parameters, ferritin, serum iron, transferrin, transferrin

saturation at the first follow-up and second follow-up dates. Results indicated no statistically significant differences in median ferritin (p=0.655), serum iron (p=0.655), transferrin (p=0.180) and transferrin saturation (p=0.317). The clinical significance is however different from the statistical significance as normal reference ranges will be used in the assessment.

Table 4:10 Friedman's ANOVA tests

One-Sample Kolmogorov-Smirnov Test: Second follow-up IDA test results

		RBC2	HB2	HCT2	MCV2	MCH2	FERRITIN2	SERUM IRON2	TRANSF ERRIN 2	TRANSFERRIN SATURATION 2
N		14	14	11	14	14	3	3	3	2
Normal Parameters[a,b]	Mean	4.3807	10.5357	31.5364	74.2429	24.5500	9.9200	9.6267	9.2000	8.7500
	Std. Deviation	.91126	2.07461	6.41128	8.02752	2.69836	1.78471	11.84484	9.88079	7.28320
Most Extreme Differences	Absolute	.170	.246	.194	.176	.146	.375	.364	.371	.260
	Positive	.170	.200	.194	.134	.146	.273	.364	.371	.260
	Negative	-.144	-.246	-.184	-.176	-.100	-.375	-.263	-.268	-.260
Test Statistic		.170	.246	.194	.176	.146	.375	.364	.371	.260
Asymp. Sig. (2-tailed)		.200[c,d]	.022[c]	.200[c,d]	.200[c,d]	.200[c,d]	.[c,d]	.[c,d]	.[c,d]	.[c,d]

a. Test distribution is Normal.
b. Calculated from data.
c. Lilliefors Significance Correction.
d. This is a lower bound of the true significance.

4.3 Conclusion

This study was conducted with its central purpose to critically investigate the adequacy of iron deficiency anaemia management. The study findings from questionnaires from private medical doctors and medical laboratories as well as from a retrospective study were presented in this chapter according to the objective/s that each of the findings addressed. Various descriptive tools were used to display the data as well as to perform statistical computations of the data. Discussion of the findings and conclusions drawn from the study as well as the recommendations and limitations of this study will be discussed in the next chapter.

CHAPTER FIVE

DISCUSSION

5.1 Introduction

The overall purpose of the research was to assess the adequacy of iron deficiency anaemia (IDA) diagnosis and management thereof within the Namibian private health care system. The findings from the study were presented in the previous chapter. Interpretation as well as discussion of the study findings is done in this chapter.

5.2 Discussion of research findings

5.2.1 Objective 1: Determination of all Standard Treatment Guidelines for iron deficiency anaemia management in the Namibian private healthcare system.

The doctors' questionnaire was designed to capture information regarding the Standard Treatment Guidelines in use and to evaluate their adequacy in IDA management by the critically appraising level of adherence thereof.

It is notable, from the survey that the majority of the private medical doctors use different STGs in managing IDA. The STGs and their usage rate are as follows; Namibia Standard Treatment Guidelines (76.5%), World Health Organization guidelines (39.2%), Standard Treatment Guidelines and Essential Medicine List for South Africa (19.6%), and Essential Medicine List and Standard Treatment Guidelines for Zimbabwe (19.6%). A smaller proportion of the doctors (3.9%) indicated that they do not use any guidelines at all whilst 7.8% used other guidelines which they listed as Centre for Disease Control and Prevention (CDC), National Institute for Health and Care Excellence (NICE) and Uptodate.Com.

The STGs are designed to provide standardised guidance to practitioners, directing them to the most appropriate medicines. Doctors can thus concentrate on making the correct diagnosis because treatment options will be provided for them. Despite the availability of several STGs, the study also revealed that some doctors do not use any guidelines at all, possibly resulting in un-standardised and thus inadequate management of IDA. Due to resource constraints, the Standard Treatment Guidelines tend to be country-specific. Some treatment interventions and diagnostic tests such as hepcidin levels may not be available.

The study showed that the widely used STGs are the Namibia Standard Treatment Guidelines. However, the use of several different STGs can also mean that there is the un-standardised management of IDA in Namibia. Although the Namibia STGs are widely used, they appear out-dated as they were last reviewed in 2011. This phenomenon is however contrary to the questionnaire- research finding that shows that only 16% of the surveyed doctors believe that the STGs in use are obsolete. The possible reason that 72% of the surveyed doctors indicated that the available guidelines are sufficient for IDA management is that they would also use other guidelines apart from the Namibian Standard Treatment Guidelines. It can be assumed here that if the practitioner identifies any particular guideline as insufficient, then he or she opts to use a different guideline. A review of the other STGs such as the online “uptodate.com” showed that they are regularly updated. Regardless of the guidelines used, training is essential as it ensures standardisation. However, there is no evidence that training has been offered before using any of STGs.

5.2.2 Objective 2: Appraisal of the Level of adherence to Standard Treatment Guidelines on iron deficiency anaemia management in the Namibian private healthcare system.

Most doctors confirmed that the iron profile tests provided by the laboratories are sufficient with a relatively smaller proportion of the doctors, 3.9% regarding the tests as insufficient. The finding is consistent with the results from the laboratories survey that also showed that most iron profile tests are available and that some specialised tests not available in the laboratory will be referred elsewhere.

Doctors indicated that they use the oral iron for IDA treatment all the time. However, without adequate monitoring, this intervention can also lead to adverse effects such as iron overload. The selection of other options, such as the dietary measures, blood transfusion and parenteral iron therapy may be evidence that some criteria are followed in the management. The doctors highlight the issue of non-compliance to iron therapy by reporting that a significant proportion of patients stop their IDA treatments when they feel better and that some also stop treatment due to side effects. This explains why only 43.1% of the doctors reported that there is evidence that patients take their IDA medication consistently.

The retrospective study was carried out to give complementary research data. The findings from the retrospective are aimed at providing answers to the investigation on whether the IDA treatment outcomes are achieved through the effective use of the available iron profile tests. The findings from the retrospective study will also help to reveal the evidence of adherence to standard treatment guidelines. From a total of 217 IDA cases identified through reviewing of full blood count test results, only 55 cases were followed up. This represented only 25% of the IDA cases and consequently, 75% of cases that should have been investigated were not attended to. This unmet medical need means a significant proportion of patients are exposed to the serious adverse effects of IDA that in turn are associated with diminished quality of life and also hindering national development.

Full blood count tests were done for 90% of the 55 IDA cases which were followed-up. However, only 12 out of the possible 55 IDA cases had other iron studies profile

tests done. The ferritin, serum iron and transferrin levels should have been requested for all the cases to confirm IDA or to monitor the effectiveness of any treatment interventions given. The same phenomenon was also noted at the second follow up. Only 14 cases were followed up with FBC tests whilst just 3 cases were followed up with the other iron profile tests. The IDA was thus inadequately followed up and consequently, treatment intervention required might have not been provided.

The statistical calculations, Friedman's ANOVA results indicated that there were no significant differences in the distributions of RBC (p=0.368); HCT (p=0.273); and MCV (p=0.080) at baseline screening date, first follow-up and second follow-up date. However, there were significant differences in the distributions of Hb (p = 0.013) and MCH (p=0.021). Average Hb was 10.007 g/dL at baseline and this increased to 11.226 g/Dl at first follow up but declined to 10.36 g/dL at the second follow up.

Results from the non- parametric Wilcoxon's signed rank tests showed that there were no statistically significant differences in median ferritin (p=0.655), serum iron (p=0.655), transferrin (p=0.180) and transferrin saturation (p=0.317). The clinical significance is, however, more important than the statistical significance. In the clinical significance, the importance of the treatment will be assessed in terms of the normalisation of the reference ranges for the parameters being corrected. The slight increases in the FBC parameters; Hb, HCT, MCV and in ferritin and transferrin, with the levels still below the desired reference ranges were thus not clinically significant.

The lack of significant improvement after treatment interventions could indicate the possibility of non- compliance to treatment. The retrospective study showed that the time frame of the follow-up tests varied from a few weeks up to 12 months. The ideal time frame for monitoring treatment with follow-up iron profile tests is 2 weeks after initial treatment (Schrier, 2018). The study thus revealed evidence that the patients failed to adhere to their treatment schedules by skipping review consultations with their doctors. It is also possible that the doctor did not follow the STGs by not requesting for post treatment follow up iron studies. The IDA monitoring tests that could have led to different treatment intervention were not done on time.

5.2.3 Objective 3: Establishment of iron profile laboratory tests offered for the diagnosis and treatment monitoring of iron deficiency anaemia in the Namibian private healthcare system.

The private doctors' questionnaire was aimed at identifying all the iron profile laboratory tests that the doctors request for the diagnosis and treatment monitoring for IDA. The study showed that the patients who are routinely screened for IDA include symptomatic adults (70.6%), pregnant patients (68.8%), all patients during general medical check-up (60.8%), and symptomatic children (58.8%). It is generally expected that pregnant women are screened for IDA as they are more vulnerable to IDA due to increased demands of iron by of the growing foetus. Screening all patients during general medical check-up is ideal since some asymptomatic IDA cases may be identified sooner. All surveyed doctors indicated that they would request FBC test all the time to assist with IDA diagnosis. The FBC blood picture will highlight if there is a need to undertake further investigations when the haemoglobin or indices are below the expected reference range for the patient. Blood film comments are done by the laboratories routinely following abnormal FBC results and the doctors do not need to submit a separate request. This would also explain why a few doctors would request for FBC with film comments. Ferritin, FBC, transferrin and transferrin saturation tests are used more frequently by doctors when assessing the effectiveness of the IDA treatment, according to the survey.

On the other hand, the laboratory questionnaire was aimed at Identifying and evaluating the laboratory test profiles that are specific for the IDA diagnosis and that are offered in the in the private health sector. More than half of the respondents were comprised of more experienced laboratory personnel (>11 years). The job positions included 4 laboratory managers (33.3%), 2 medical technologist- in charge (16.7%) and 2 specialist medical technologists: haematology (16.7%).

The majority of the respondents indicated that full blood count (FBC) tests (91.7%), serum iron (100%) and ferritin (100%) are the most common laboratory tests forming iron profile tests in their respective laboratories. These study results confirmed the findings from the doctors' questionnaire that also showed that since full blood count test is the widely used screening test for IDA. Apart from revealing the declining haemoglobin levels in anaemia, FBC gives the complete blood picture

with indices that can be used to classify the anaemia either as microcytic and macrocytic thus allowing for appropriate management thereof. Most modern haematology machines give the full blood count analysis results instead of haemoglobin parameter alone. This may explain why very few respondents indicated Hb as one of the laboratory test used in IDA diagnosis. It can also be noted that relatively fewer respondents identified full blood count including film comments (75%) as one of the most common laboratory tests for diagnosing IDA. This can be attributed to the fact that blood films comments are generally done on abnormal FBC results regardless of whether they have been requested.

Although all the laboratories reported that serum iron and ferritin tests are always requested as part of iron studies, serum iron is less frequently used in diagnosing IDA because its level fluctuates according to dietary intake. Doctors would request ferritin test more often than serum iron. Although ferritin levels are affected by inflammation, its measurement gives more diagnostic information for IDA since its levels indicate the storage levels of iron and are not immediately affected by urinal dietary intake. Respondents did not, however, list CRP as part of the other tests forming part of the iron studies. CRP rises in infection and inflammation and would be a useful indicator to help interpret ferritin results in IDA diagnosis in the presence of inflammation (high CRP). In the absence of high CRP. Other iron profile tests such as the transferrin and transferrin saturation level that are quite useful are in fact rarely requested. Doctors don't seem to get the value of these tests and that are widely available and are specific for IDA.

A considerable number of the surveyed laboratories (75%) do not perform some of the iron profile tests such as bone marrow examination in their laboratories and would refer them because they are rarely requested. Although regarded as the best method for evaluation of body iron status, the bone marrow iron staining is rarely requested by doctors according to most of the surveyed laboratories (83.3%). The procedure is considered invasive, expensive and good examination results largely dependent on the expertise of specialised pathologists or haematologists. However, only 1 out of the 12 laboratories indicated the lack of appropriately trained personnel to carry out the test procedure. The limited scope of practice by most of

the surveyed laboratories that do not have a pathologist in their establishments meant that they cannot perform bone marrow iron staining.

According to the survey results, doctors do not often request follow-up iron profile tests in the monitoring for the effectiveness of IDA treatment. FBC is the only test that is requested routinely requested after IDA treatment. Doctors are normally interested in checking the increase of the haemoglobin levels after treatment. However, the FBC gives a better picture of IDA resolution. The effective IDA treatment would result in the normalisation of the FBC parameters and indices such as the HCT, MCH and MCV. Laboratory tests such as the reticulocytes and bone marrow iron staining, that are rarely requested after treatment, may be useful in following-up complicated cases. The baseline test results are always critical for monitoring the effectiveness of IDA treatment and including other interventions such as dietary adjustment.

5.3 Conclusion

The study findings have been discussed according to the study objectives. The final chapter presents the research study conclusions as well as recommendations.

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

The various STGs suggest that the management of IDA involves physical examination, evaluation of the patient's history of anaemia and blood loss as well as requesting for appropriate laboratory investigations. This study focused primarily on the later. The study highlighted the several laboratory tests that are available in the private laboratories for the diagnosis and treatment monitoring of IDA. The retrospective study showed that only 55 cases (25%) were followed up out of the 217 anaemia cases suspected to be IDA. The target of investigating the IDA cases is 100% since no IDA patients should be left untreated. This observation may indicate failure to strictly adhere to STGs regarding the establishment of iron status and treatment.

In the laboratory, the IDA screening is routinely carried out either during a medical check-up or during antenatal care. The review of full blood count results would indicate the presence of anaemia and this can then be followed by specific iron profile tests that are widely available in the private medical laboratories. They are a few tests that are not often provided by the majority of the laboratories such as bone marrow iron staining. The iron profile tests that are not done in some laboratories is mostly because the tests are rarely requested by the private medical doctors thus making it less cost-effective to perform. Another reason for non-availability is because the laboratories lack the necessary expertise to perform or interpret the iron profile test results. The surveyed laboratories indicated that they refer the iron profile tests that they do not perform to other laboratories with the capacity to carry out the laboratory tests.

Despite the availability of various iron studies tests, this study showed that there is no full utilization of the iron profile tests for the diagnosis and treatment monitoring for IDA. This is evidenced by the failure of following-up 75% of the IDA cases

identified. The screening for IDA through the review of full blood count blood picture only serves as preliminary finding. However, the response from the laboratory questionnaires also indicated that iron profile tests such as serum iron, ferritin, and transferrin that are important in the confirmation of IDA and monitoring iron treatment effectiveness, are not often requested by doctors. In the first follow-up of the 55 IDA cases, only 12 cases (21.8%) had other iron profile tests performed. Coincidentally the same proportion of (21.4%) was followed up in the second follow-up of 3 iron profile tests for 14 IDA cases. There was also no indication that the IDA cases not followed–up were referred elsewhere to specialist medical practitioners. This finding is consistent with what Shander (2014) noted, that despite IDA's high prevalence, proper clinical attention, and detection, evaluation and management is not always given. When more IDA cases are promptly and adequately investigated, then IDA treatment can be given to those deserving. The study revealed that follow-ups of treatment with appropriate laboratory investigations for iron status were inconsistent and not at recommended regular monthly to 3 monthly intervals.

The lack of full utilization of the available diagnostic tests by the medical doctors who are responsible for requesting for the tests after consulting the IDA- suspected patients can be explained in terms of obsolete standard treatment guidelines that the clinicians follow. Apart from the use of obsolete STGs, some practitioners do not use any guidelines in the management of IDA patients. It can thus be concluded that although several guidelines are available, most medical doctors do not adhere to the protocols when investing and treating IDA patients. This is also compounded by the fact that there appears to be no training offered on the standard treatment guidelines. A few medical doctors even indicated that they do not follow any standard treatment guidelines for the diagnosis and management of IDA.

6.2 Recommendations

In view of the lack of strict adherence to recommended STGs, the researcher proposed the following recommendations.

6.2.1 Recommendation on iron deficiency anaemia diagnosis

With new diagnostic technologies and advancement in the pharmaceutical industry, provision of new laboratory tests should be considered. Although the pathology industry is regarded as highly competitive, there is a need that the commercial interests be set aside and have more interaction between medical laboratories. Laboratories who due to their limited scope cannot offer clinical advice may choose to refer certain cases or tests such as bone marrow examination for pathologists' review. Tests such as transferrin receptor (TfR) and hepcidin can be introduced by bigger laboratories who can act as referral laboratories for other laboratories. TfR is important in that it is less sensitive to inflammation than serum ferritin, whilst hepcidin reflects the iron homeostasis and can be measured in blood or urine (Burke, 2014). Clinicians will then have wider choices of laboratory tests to request in different circumstances.

It is important to provide clinical advice on certain abnormal FBC results suggestive of IDA to the consulting medical doctor so that he or she is prompted to do the necessary follow-up tests or start a treatment regimen. Whenever it is cost-effective, the laboratories can consider recruiting specialised technologists or scientists to ensure the provision of complete diagnostic tests. Some laboratories had reported that they lack adequately qualified personnel.

6.2.2 Recommendation on treatment and monitoring

Since the study revealed that there is a lack of standardisation in IDA management. There is a need to ensure that the national guidelines that are specific to Namibia, the Namibia Standard Treatment guidelines, updated regularly and available to all.

Gopalakrishnam (2014) highlighted that a compressive standard treatment guideline should be based on local disease factors. For Namibia, the STG on IDA needs to consider the management of other diseases and conditions such as malaria, intestinal parasitic infections, TB and HIV as well since these are all linked to low haemoglobin (anaemia).

An important observation was made by Bruycker (2013) that in developing countries, the proportion of patients treated according to clinical standard treatment guidelines in the private sector is about 30%. Availability of the STGs alone will however not guarantee better management of IDA. Thus the emphasis of pre-service training on the guidelines to be given to the clinicians either in workshops or mandatory continuing education programs (CPD). The up-to-date STGs may help to ensure appropriate treatment is given without delay and thereby saving unnecessary expenses. Bruycker (2013), believes that the rational use of medicines requires that patients take medication appropriate to their clinical needs. He further adds that the medicine should be in doses that meet their own individual requirements, for an adequate period of time and at the lowest cost to themselves and their community. STGs will help to ensure that medication is administered safely, effectively and in a cost-effective- manner. Health care providers can also concentrate on correct diagnosis as suggested in the guidelines. Since the Namibia Standard Treatment guidelines did not seem to adequately cover all the aspect of IDA investigation, clinical protocols that are more specific than STGs can be developed for IDA.

Schrier et al (2018) point out that the effective treatment of IDA is the resolution of symptoms and normalisation of haemoglobin. He further suggests that lack of response include non-adherence to oral iron, on-going blood loss and incorrect initial diagnosis. With the research finding that some patients do not adhere to their IDA treatment schedule when they feel better or when they suffer side effects, it is important to provide health education and counselling to the patients. Educating the patients on the dangers of non-adherence to IDA treatment and on good nutrition will help to ensure resolution of IDA. Since IDA is associated with poor cognitive and physical performance, tiredness and reduced work capacity, increased risk of

maternal and child mortality, the resolution of IDA will result in a healthy and productive population that is ideal for national development.

6.2.3 Recommendation on future research

This study could serve as a basis for future research on IDA management to be carried out on a broader scale. This study only focused on the private health system and data was collected from relatively few private medical practitioners and medical laboratories. A broader scale study could use the entire country regions and can also focus on different patient age groups since the management differ considerably in paediatric, adults and also in pregnant women.

6.3 Contributions of the study

Findings from this study serve to inform policymakers on the need to review national standard treatment guidelines and to support pre-service training and health education. STGs will bring among other benefits better value of the country's health care budget through efficiency and utilisation of cost-effective treatment options.

Study findings can also be utilised by the health policy developers on the need to ensure standardisation through promoting the use of national standard treatment guideline so as deliver quality health care. Successful resolution of IDA will help to improve the lives of the people and become productive thus adding value to national development.

6.4 Scope and limitations of the study

The study was aimed at collecting data regarding the adequacy of iron deficiency anaemia management in the Namibian private health system. However, the primary focus was broadened to include mostly the IDA investigations. The researcher believed that prompt and accurate diagnosis will eventually lead to adequate treatment of IDA.

The generalisation of the study findings to the entire Namibian private health care system may not be quite accurate. They may be some bias since data were collected from fewer laboratories and medical doctors situated in the capital, Windhoek. If funds and time were not constraining, the research would have been expanded to include the public health sector.

6.5 Concluding remarks

Literature has shown that iron deficiency anaemia (IDA) continues to be a major health burden. IDA is high in developing countries due to a high prevalence of other diseases/conditions such as malaria, tuberculosis (TB), human immunodeficiency virus/ acquired immunodeficiency syndrome (HIV/AIDS, intestinal parasitic infections and malnutrition. Namibia is not an exception to the challenge posed by IDA although no prevalence data for IDA is readily available. Limited health care budget makes it crucial to follow STGs in managing IDA so as to befit from non-wastage of medicines and promote efficient use of resources. Up-to-date disease management programs will not only result in cost-effectiveness but also in the delivery of improved quality of care. Overall, the use of STGs supports the decision-making process in patient care with the benefits of using appropriate care based on the best available scientific evidence. The prompt and accurate investigation of IDA using an appropriate test algorithm will ensure better management thereof and resolution of IDA. Most importantly strengthening the inter-laboratory referral system will ensure the provision of best diagnostic service to support clinicians' decisions.

Findings from this study supported the findings from the literature that despite IDA's high prevalence, proper clinical attention, and detection, evaluation and management is not always given. The study concluded that there is inadequate investigations and management of iron deficiency anaemia in the Namibian private healthcare system. Based on the study findings, the researcher proposed some recommendations that could ensure adequate IDA management and prompt resolution of iron deficiency anaemia. The recommendation included the need to

review the Namibia Standard Treatment guidelines and also to ensure that training on the guidelines is offered. There is need to strengthen the health education to the patients so as to increase medication adherence thus resulting in greater therapeutic success and reduced hospitalisation. The research showed that some patients do not adhere to their IDA treatment schedule when they feel better or when they suffer side effects, it is thus important that health education and counselling to the patients be offered to patients.

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Appendix A: Research questionnaire: Medical doctors

NAMIBIA UNIVERSITY OF SCIENCE AND TECHNOLOGY

Faculty of Health and Applied Sciences,

Department of Health Sciences **Student No. 217112862**

Research Topic: Adequacy of iron deficiency anaemia management within the Namibian private health care system.

Research Questionnaire (CLINICIAN) **15 JANUARY 2018**

Dear Participant

Thank you for taking your time to answer the following research questions by ticking the box or boxes if there is more than one answer regarding iron deficiency anaemia (IDA) management.

SECTION A: STANDARD GUIDELINES IDENTIFICATION

Question1. Which of the following management guidelines do you use for the IDA management in your practice?

1) ▢ Namibia Standard treatment guidelines

2) ▢ World Health Organization guidelines

3) ▢ Standard Treatment guidelines and essential Medicine list for South Africa

4) ▢ Essential Medicines List and Standard Treatment Guidelines for Zimbabwe

5) ▢ Any other guidelines (*Please indicate*) .....

6) ▢ None

SECTION B: STANDARD GUIDELINES ADEQUACY IN DIAGNOSIS, TREATMENT AND PROGNOSIS

Question 2. Are the available guidelines considered sufficient for IDA management?

1) ▢ Sufficient

2) ▢ Insufficient

3) ▢ Outdated, require reviewing

4) ▢ If insufficient, please state briefly the shortfalls .....

Question 3. Which patients do you screen for IDA?

1) ▢ Antenatal care patients

2) ▢ Symptomatic children

3) ▢ Symptomatic adults

4) ▢ All patients during general medical check up

5) ▢ Other *(Please specify)* .....

Question 4. Which of the following laboratory tests do you request to assist with IDA diagnosis?

1) ▢ Serum iron

2) ▢ Serum ferritin

3) ▢ Transferrin & Saturation % (calculated)

4) ▢ Folate (Serum)

5) ▢ Full Blood Count

6) ▢ Full Blood Count (including film comments on abnormal FBC)

7) ▢ Reticulocytes

8) ▢ Bone Marrow iron staining

9) ▢ Haemoglobin

10) ▢ Other (*Please specify*) …….

Question 5. **Do you regard Iron studies profile tests provided by the laboratory as sufficient or insufficient for the diagnosisof suspected cases of iron deficiency anaemia?**

1) ▢ Sufficient

2) ▢ Insufficient

3) ▢ If insufficient, please indicate the additional iron studies tests required .....

Question 6. **Which of the following laboratory tests do you request when assessing the effectiveness of the IDA treatment outcomes?**

1) ▢ Serum iron

2) ▢ Serum ferritin

3) ▢ Transferrin & Saturation % (calculated)

4) ▢ Folate (Serum)

5) ▢ Full Blood Count

6) ▢ Full Blood Count (including film comments on abnormal FBC)

7) ▢ Reticulocytes

8) ▢ Bone Marrow iron staining

9) ▢ Haemoglobin

10) ▢ Other (Please specify)…….

Question 7. **Which of the following treatment options do you use for the IDA cases?**

1) ▢ Oral iron replacement

2) ▢ Parenteral iron therapy

3) ▢ Blood transfusion

4) ▢ Preventative dietary measures

5) ☐ Erythropoietin therapy

6) ☐ Any other (*Please specific*) ……

Question 8. Is there evidence of non-compliance to iron therapy?

1) ☐ Patients not regularly taking their pills

2) ☐ Patients report taking only up to 50% of their pills

3) ☐ Patients stop after complaining of side effects of the pills

4) ☐ Patients stop when they feel better

5) ☐ There is evidence that patients take their medication consistently

6) ☐ Any Other*(Please specify)* .....

***** THANK YOU *****

Appendix B:	Research questionnaire: Private medical laboratories

NAMIBIA UNIVERSITY OF SCIENCE AND TECHNOLOGY

Faculty of Health and Applied Sciences, Department of Health Sciences Student No. 217112862

Research Topic: Adequacy of iron deficiency anaemia management within the Namibian private

health care system.

Research Questionnaire (LABORATORY) January 2018

Dear Participant

Thank you for taking your time to answer the following research questions by ticking the box or boxes if there is more than one answer regarding iron deficiency anaemia (IDA) management.

SECTION A: BIOGRAPHY

Question 1. Which of the following describes your position in your laboratory?

1) ☐ Medical Technologist
2) ☐ Medical Technologist in charge
3) ☐ Specialist Medical Technologist: Haematology
4) ☐ Specialist Medical Technologist: Clinical Chemistry
5) ☐ Specialist Medical Technologist: Microbiology
6) ☐ Laboratory Manager
7) ☐ Medical Scientist
8) ☐ Other *(please specify)*.....

Question 2. Please indicate your level of work experience in the laboratory.

1) ☐ < 2years
2) ☐ 5 years
3) ☐ 6- 10 years
4) ☐ 11-15 years
5) ☐ 16- 20 years
6) ☐ >20 years

SECTION B: IRON PROFILE TESTS FOR IRON DEFICIENCY ANAEMIA MANAGEMENT

Question 3. Which of the following laboratory tests form part of iron studies profile in your laboratory?

1) ☐ Serum iron
2) ☐ Serum ferritin
3) ☐ Transferrin & Saturation % (calculated)
4) ☐ Folate (Serum)
5) ☐ Full Blood Count
6) ☐ Full Blood Count (including film comments on abnormal FBC)
7) ☐ Reticulocytes
8) ☐ Bone Marrow iron staining
9) ☐ Haemoglobin
10) ☐ Other (Please specify) ……

Question 4. If any of the tests listed above (4) are not available at your laboratory (including at your main laboratory branch), please indicate the possible reasons.

1) ☐ All tests listed above are available at our laboratory.
2) ☐ Tests are referred to other referral laboratories because they are not requested often.
3) ☐ No analysers or method is available for testing.
4) ☐ Lack of appropriately trained personnel to carry out the test procedure.
5) ☐ Any other (Please specify) …….

Question 5. How often do clinicians request for the following iron profile tests?

5.1 Full blood count

1) ☐ Not requested
2) ☐ <20% (Rarely)
3) ☐ 21- 35% (Occasionally)
4) ☐ 36- 50% (Sometimes)
5) ☐ 51-75% (Often)
6) ☐ >75% (Routinely)

5.2 Serum iron

1) ☐ Not requested
2) ☐ <20% (Rarely)
3) ☐ 21- 35% (Occasionally)
4) ☐ 36- 50% (Sometimes)
5) ☐ 51-75% (Often)
6) ☐ >75% (Routinely)

5.3 Serum ferritin

1) ☐ Not requested
2) ☐ <20% (Rarely)
3) ☐ 21- 35% (Occasionally)
4) ☐ 36- 50% (Sometimes)
5) ☐ 51-75% (Often)
6) ☐ >75% (Routinely)

5.4 Transferrin and % saturation (calculation)

1) ☐ Not requested
2) ☐ <20% (Rarely)
3) ☐ 21- 35% (Occasionally)
4) ☐ 36- 50% (Sometimes)
5) ☐ 51-75% (Often)
6) ☐ >75% (Routinely)

5.5 Folate (Serum)

1) ☐ Not requested
2) ☐ <20% (Rarely)
3) ☐ 21- 35% (Occasionally)
4) ☐ 36- 50% (Sometimes)
5) ☐ 51-75% (Often)
6) ☐ >75% (Routinely)

5.6 Reticulocytes

1) ☐ Not requested
2) ☐ <20% (Rarely)
3) ☐ 21- 35% (Occasionally)
4) ☐ 36- 50% (Sometimes)
5) ☐ 51-75% (Often)
6) ☐ >75% (Routinely)

5.7 Bone Marrow iron staining

1) ▢ Not requested
2) ▢ <20% (Rarely)
3) ▢ 21- 35% (Occasionally)
4) ▢ 36- 50% (Sometimes)
5) ▢ 51-75% (Often)
6) ▢ >75% (Routinely)

5.8 Other tests (please specify) ….

1) ▢ Not requested
2) ▢ <20% (Rarely)
3) ▢ 21- 35% (Occasionally)
4) ▢ 36- 50% (Sometimes)
5) ▢ 51-75% (Often)
6) ▢ >75% (Routinely)

Question 6. Does your laboratory receive the following post- treatment 'follow- up' tests?

6.1 Full blood count

1) ▢ Not requested
2) ▢ <20% (Rarely)
3) ▢ 21- 35% (Occasionally)
4) ▢ 36- 50% (Sometimes)
5) ▢ 51-75% (Often)
6) ▢ >75% (Routinely)

6.2 Serum iron

1) ☐ Not requested
2) ☐ <20% (Rarely)
3) ☐ 21- 35% (Occasionally)
4) ☐ 36- 50% (Sometimes)
5) ☐ 51-75% (Often)
6) ☐ >75% (Routinely)

6.3 Serum ferritin

1) ☐ Not requested
2) ☐ <20% (Rarely)
3) ☐ 21- 35% (Occasionally)
4) ☐ 36- 50% (Sometimes)
5) ☐ 51-75% (Often)
6) ☐ >75% (Routinely)

6.4 Transferrin and % saturation (calculation)

1) ☐ Not requested
2) ☐ <20% (Rarely)
3) ☐ 21- 35% (Occasionally)
4) ☐ 36- 50% (Sometimes)
5) ☐ 51-75% (Often)
6) ☐ >75% (Routinely)

6.5 Folate (Serum)

1) ☐ Not requested
2) ☐ <20% (Rarely)
3) ☐ 21- 35% (Occasionally)
4) ☐ 36- 50% (Sometimes)
5) ☐ 51-75% (Often)
6) ☐ >75% (Routinely)

6.6 Reticulocytes

1) ☐ Not requested
2) ☐ <20% (Rarely)
3) ☐ 21- 35% (Occasionally)
4) ☐ 36- 50% (Sometimes)
5) ☐ 51-75% (Often)
6) ☐ >75% (Routinely)

6.7 Bone Marrow iron staining

1) ☐ Not requested
2) ☐ <20% (Rarely)
3) ☐ 21- 35% (Occasionally)
4) ☐ 36- 50% (Sometimes)
5) ☐ 51-75% (Often)
6) ☐ >75% (Routinely)

6.8 Other tests (please specify) ….

1) ☐ Not requested
2) ☐ <20% (Rarely)
3) ☐ 21- 35% (Occasionally)
4) ☐ 36- 50% (Sometimes)
5) ☐ 51-75% (Often)
6) ☐ >75% (Routinely)

******THE END, THANK YOU ******

Appendix C:	Research study informed consent letter: Respondents

NAMIBIA UNIVERSITY OF SCIENCE AND TECHNOLOGY

Faculty of Health and Applied Sciences, **Department of Health Sciences**

Student No. 217112862

RESEARCH INFOMED CONSENT

15 September 2017

Dear Respondent

I am Kudzanai Ephraim Mugweni working for High Care Laboratory and a post graduate student at Namibia University of Science and Technology (NUST). I am carrying out a study as part of the requirement for Master of Health Sciences qualification. My study focuses on the ***adequacy of iron deficiency anaemia (IDA) management in the Namibia private health care system.***

The aim of this research is to evaluate the current available guidelines on the management of iron deficiency anaemia as well as to assess the level of adherence thereof. The research will come up with some recommendations to close any gaps identified in the current IDA management guidelines. I shall be grateful if you could kindly spare a few minutes and complete the attached questionnaire on the management of iron deficiency anaemia.

I would like to bring to your attention the following ethical considerations which will guide your participation in this research:

1. Your participation is entirely voluntary and that there are no direct personal benefits for participating in this study. Furthermore, you reserve a right to withdraw at any point in time.
2. All information provided will be treated as confidential and kept securely by the researcher. Participants will not be identified by names as code numbers will be assigned.
3. A research proposal for this study was approved by the NUST as well as the Ministry of Health and Social Services ethics committee. The proof can be provided when required.
4. I can be contacted on my mobile, 081 247 1031, if you need clarity on any questions regarding this study. My supervisor is Mr Martin Gonzo, contact number 081 775 9475.

I thank you for your anticipated cooperation

Yours sincerely,

Kudzanai Ephraim Mugweni

CONSENT

I confirm by signing this consent that I have read and understood the given information. I understand that my participation in this research study is voluntary and I am free to withdraw at any time.

I voluntarily agree to take part in this study.

Signature _____ Date _____

Appendix D:	**Research ethical Clearance**

NAMIBIA UNIVERSITY OF SCIENCE AND TECHNOLOGY

13 Storch Street
Private Bag 13388
Windhoek
NAMIBIA

T: +264 61 207 9111
F: +264 61 207 2444
W: www.nust.na

FACULTY OF HEALTH AND APPLIED SCIENCES

DECISION/FEEDBACK ON RESEARCH PROPOSAL ETHICAL CLEARANCE

Dear ~~Prof/Dr~~/Mr/~~Mrs/Other(s)~~: Kudzanai Ephraim Mugweni

Student No (if applicable): 217112862

Research Topic:	Adequacy of iron deficiency anaemia management within the Namibian private healthcare system
Supervisor (if applicable):	Mr Martin Gonzo
Co-supervisor(s): if applicable	Mr Jomin George
Qualification registered for (if applicable):	Master of Health Sciences

Re: Ethical screening application No: REC -0005/2017

The Research Ethics Screening Committee has reviewed your application for the above-mentioned research project. Based on the recommendation of the expert reviewer, the research as set out in the application is hereby:

(Indicate with an X)

Approved: i.e. may proceed with the project		
Approved provisionally: i.e. may proceed but subject to compliance with recommendation(s) listed below	**X**	
Not approved: Not to proceed with the project until compliance with recommendation(s) listed below and resubmit ethics application for consideration		
IS MINISTRY OF HEALTH & SOCIAL SERVICES (MoHSS) APPROVAL REQUIRED?	YES: **X**	NO:

It is important to note that as a researcher, you are expected to maintain ethical integrity of your research, strictly adhere to the ethical policy of NUST, and remain within the scope of your research proposal and supporting evidence as submitted to the REC. Should any aspect of your research change from the information as presented, which could have an impact or effect on any research participants/subjects/environment, you are to report this immediately to your supervisor or REC as applicable in writing. Failure to do so may result in withdrawal of approval. Kindly consult your supervisor or HoD if you need further clarification.

We wish you success in your research endeavour and are of the belief that it will have positive impact on your career as well as the development of NUST and the society in general.

Ethical issues that require compliance/ must be addressed		
No.	**Ethical issues**	**Comment/recommendation**
1.	None	Student should attend to minor corrections in the questionnaire.
2.	Use of data from an organisation	To obtain consent from High Care Laboratory for data usage.
3.	Use of hospital records of patients	To obtain MoHSS approval and submit copy to FHAS-REC secretariat*.

NB: May attach additional page as required; * Failure to do so will invalidate research outcome

Full Name (reviewer): ...PROF SYLVESTER R. MOYO **Signature:** ..... **Date:** 07/09/2017

Full Name: .... PROF OMOTAYO AWOFOLU... **Signature:** ..... **Date:** 7/09/2017
Chair: Ethics Screening Committee

Appendix E: Ministry of Health and Social Services research approval letter

REPUBLIC OF NAMIBIA

Ministry of Health and Social Services

Private Bag 13198 Ministerial Building Tel: 061 – 2032150
Windhoek Harvey Street Fax: 061 – 222558
Namibia Windhoek Email: shimenghipangelwa71@gmail.com

OFFICE OF THE PERMANENT SECRETARY

Ref: 17/3/3 **KM**
Enquiries: Mr. J. Nghipangelwa

Date: 19 October 2017

Mr. Kudzanai E Mugweni
Namibia University of Science and Technology
Windhoek
Namibia

Dear Mr. Mugweni

Re: Adequacy of Iron Deficiency Anaemia management within the Namibian Private Health Care System.

1. Reference is made to your application to conduct the above-mentioned study.
2. The proposal has been evaluated and found to have merit.
3. **Kindly be informed that permission to conduct the study has been granted under the following conditions:**

3.1 The data to be collected must only be used for academic purposes;
3.2 No other data should be collected other than the data stated in the proposal;
3.3 Stipulated ethical considerations in the protocol related to the protection of Human Subjects' should be observed and adhered to, any violation thereof will lead to termination of the study at any stage;
3.4 A quarterly report to be submitted to the Ministry's Research Unit;
3.5 Preliminary findings to be submitted upon completion of the study;

3.6 Final report to be submitted upon completion of the study;

3.7 Separate permission should be sought from the Ministry of Health and Social Services for the publication of the findings.

Yours sincerely,

Andreas Mwoombola (Dr.)
Permanent Secretary

"Your Health Our Concern"

Appendix F: High Care Laboratory approval letter for accessing and collecting data

High Care Laboratory cc (HCL)

P.O Box 912 Windhoek Tel: +264 61 250 462, +264 81 146 9097

Email: highcare@iway.na Reg cc 2011/9046

23 October 2017

Mr K.E Mugweni
Department of Health Sciences
Faculty of Health and Applied Sciences
Namibia University of Science and Technology

Dear Sir

REF: Request for permission to access and use High Care Laboratory Information Management System and Data to carry out a study entitled "Adequacy of iron deficiency anaemia management within the Namibian private health care system."

The above subject has reference:

High Care Laboratory management has reviewed your proposal and is pleased to grant you access and permission to use data from our Laboratory Information Management System (LIMS) to carry out the above mentioned study.

The following conditions must strictly be adhered to:
1. Data extracted from High Care Laboratory LIMS to be used for academic purpose only,
2. All ethical/ confidentiality issues to be observed through the study,
3. Permission to be sought from High Care Laboratory for any publication using data from the HCL LIMS.
4. A copy of the final report to be submitted to HCL upon completion of the study.

I wish you all the best in your research study.

Yours sincerely

Rebecca Mugweni
Manager: Administration, Human Resource and Finance

High Care Laboratory 23 OCT 2017 PO Box 912, Windhoek 061 250 462 / 081 146 9097

1

APPENDIX G: MEDICAL LABORATORIES, DATA COLLECTION LABELS

MEDICAL LABORATORIES DATA COLLECTION LABEL

LAB	A1.1	A1.2	A1.3	A1.4	A1.5	A1.6	A1.7	A1.8	A2.1	A2.2	A2.3	A2.4	A2.5	A2.6	B3.1	B3.2	B3.3	B3.4	B3.5	B3.6	B3.7	B3.8	B3.9	B3.10
1						6								6	1	2	3		5	6	7		9	
2					5	6							5		1	2		4	5	6				
3			3											6	1	2	3	4	5	6	7		9	
4						6						4			1	2	3			6				10
5							7					4			1	2		4	5	6	7			
6						6							5		1	2		4	5		7		9	
7		2										4			1	2	3		5					
8	1											4			1	2	3						9	
9		2								2					1	2	3	4	5	6			9	
10							7		1						1	2			5	6				
11	1										3				1	2			5	6	7		9	
12			3								3				1	2	3	4	5	6	7	8	9	
13																								
14																								
15																								

APPENDIX G: MEDICAL LABORATORIES, DATA COLLECTION LABELS

MEDICAL LABORATORIES DATA COLLECTION LABEL

LAB	B4.1	B4.2	B4.3	B4.4	B4.5	B5.1.1	B5.1.2	B5.1.3	B5.1.4	B5.1.5	B5.1.6	B5.2.1	B5.2.2	B5.2.3	B5.2.4	B5.2.5	B5.2.6	B5.3.1	B5.3.2	B5.3.3	B5.3.4	B5.3.5	B5.3.6	
1		2									6				4						4			
2		2	3								6			3						3				
3	1	2								5						5				3				
4	1	2									6				4						4			
5		2									6		2								4			
6		2	3								6			3						3				
7		2									6						6						6	
8		2	3	4				3					2							3				
9	1										6				4						4			
10		2	3								6			3					2					
11		2									6			3					2					
12	1									5					4						4			
13																								
14																								
15																								

APPENDIX G: MEDICAL LABORATORIES, DATA COLLECTION LABELS

MEDICAL LABORATORIES DATA COLLECTION LABEL

LAB	B5.4.1	B5.4.2	B5.4.3	B5.4.4	B5.4.5	B5.4.6	B5.5.1	B5.5.2	B5.5.3	B5.5.4	B5.5.5	B5.5.6	B5.6.1	B5.6.2	B5.6.3	B5.6.4	B5.6.5	B5.6.6	B5.7.1	B5.7.2	B5.7.3	B5.7.4	B5.7.5	B5.7.6
1				4					3					2					1					
2		2							3					2					1					
3		2					1						1						1					
4				4					3					2						2				
5		2							3					2					1					
6		2							3					2					1					
7				4								6	1						1					
8			3					2					1						1					
9				4					3					2					1					
10		2						2					1						1					
11	1						1							2					1					
12		2							3					2						2				
13																								
14																								
15																								

APPENDIX G: MEDICAL LABORATORIES, DATA COLLECTION LABELS

MEDICAL LABORATORIES DATA COLLECTION LABEL

LAB	B5.8.1	B5.8.2	B5.8.3	B5.8.4	B5.8.5	B5.8.6	B6.1.1	B6.1.2	B6.1.3	B6.1.4	B6.1.5	B6.1.6	B6.2.1	B6.2.2	B6.2.3	B6.2.4	B6.2.5	B6.2.6
1	1									4						4		
2	1											6			3			
3	1										5					4		
4	1											6				4		
5	1											6			3			
6		2										6			3			
7	1										5						5	
8	1										5			2				
9	1											6						6
10	1											6						6
11	1										5				3			
12	1							2						2				
13																		
14																		
15																		

APPENDIX G: MEDICAL LABORATORIES, DATA COLLECTION LABELS

LAB	B6.3.1	B6.3.2	B6.3.3	B6.3.4	B6.3.5	B6.3.6	B6.4.1	B6.4.2	B6.4.3	B6.4.4	B6.4.5	B6.4.6	B6.5.1	B6.5.2	B6.5.3	B6.5.4	B6.5.5	B6.5.6
1				4						4				2				
2		2						2							3			
3				4						4					3			
4				4						4				2				
5				4				2							3			
6				3				2							3			
7		2						2									5	
8		2						2						2				
9						6						6				4		
10					5				3								5	
11		2					1						1					
12		2						2						2				
13																		
14																		
15																		

APPENDIX G: MEDICAL LABORATORIES, DATA COLLECTION LABELS

B6.6.1	B6.6.2	B6.6.3	B6.6.4	B6.6.5	B6.6.6	B6.7.1	B6.7.2	B6.7.3	B6.7.4	B6.7.5	B6.7.6	B6.8.1	B6.8.2	B6.8.3	B6.8.4	B6.8.5	B6.8.6
	2					1						1					
	2					1						1					
		3				1						1					
	2						2					1					
	2					1						1					
	2					1							2				
1						1						1					
1						1						1					
	2					1						1					
1						1						1					
	2					1						1					
	2						2					1					

APPENDIX H Retrospective Data: Adequacy of Iron Deficiency Anaemia Management_ High Care Laboratories

AGE	GENDER	INITIAL/ BASELINE FBC (SCREENING) DATE	LAB NUMBER	Rbc [Normal Ranges: 6 -14 yrs 3.91-5.61, Adult Male: 5.21-5.81], Adult female: 3.91 -5.11]	Hb [6-14 yrs: 10.9-15.5, Women 12-16, Men 13-17 g/dl]	HCT [Normal range: 6-14 yrs: 38-51, Male: 38-51, Female: 33-45]	MCV [Normal range: 80-100 fl]	MCH [Normal range: 28-35pg]	RESULT COMMENT COMMENT	REASON FOR REQUEST	1st FOLLOWUP DATE	LAB NUMBER	Rbc [Normal Ranges: 6 -14 yrs 3.91-5.61, Adult Male: 5.21-5.81], Adult female: 3.91 -5.11]	Hb [6-14 yrs: 10.9-15.5, Women 12-16, Men 13-17 g/dl]	HCT [Normal range: 6-14 yrs: 38-51, Male: 38-51, Female: 33-45]	MCV [Normal range: 80-100 fl]	MCH [Normal range: 28-35pg]	FERRITIN [Normal range: 30-300ng/ml]	Serum IRON [Normal range: 50-180 ug/dl]	Transferrin [Normal range: 2.0-3.6g/l]	Transferrin Saturation [Normal range: 20-50%]	2nd FOLLOW UP DATE	LAB NUMBER	Rbc [Normal Ranges: 6 -14 yrs 3.91-5.61, Adult Male: 5.21-5.81], Adult female: 3.91 -5.11]	Hb [6-14 yrs: 10.9-15.5, Women 12-16, Men 13-17 g/dl]	HCT [Normal range: 6-14 yrs: 38-51, Male: 38-51, Female: 33-45]	MCV [Normal range: 80-100 fl]	MCH [Normal range: 28-35pg]	FERRITIN [Normal range: 30-300ng/ml]	Serum IRON [Normal range: 50-180 ug/dl]	Transferrin [Normal range: 2.0-3.6g/l]	Transferrin Saturation [Normal range: 20-50%]
34	F	06/01/2017	24026	4.58	10.4	32.4	70.7	22.7	7		1	1	1	1	1	1	1	1	1	1	1	1	1									
44	F	07/01/2016	24065	4.07	8.4	27.6	67.8	20.6			12/04/2017	35483	5.22	16.2	47.3	90.6	34.2														
51	M	09/01/2016	24102	6.36	13.6	40.8	64.2	21.4			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
34	M	11/01/2016	24124	6.40	13.8	39.4	62.2	21.6			22/03/2016	26113	6.66	14.1	41.9	62.9	21.2	1	1	1	1			1	1	1	1	1	1	1	1	1
44	F	12/01/2016	24160	4.40	8.5	26.9	61.1	19.3			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
49	F	13/01/2016	24193	5.28	11.3	34.4	65.2	21.4			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
50	M	14/01/2016	24225	4.59	12.1	34.7	75.5	26.4			18/01/2016	24285	4.39	11.4	32.8	74.7	26.0							1	1	1	1	1	1	1	1	1
47	F	14/01/2016	24227	4.80	10.5	33.7	70.2	31.2	3	8	11/02/2016	25029	5.00	11.5	35.9	71.8	23.6	6.76	5.9	3.9	5.9			1	1	1	1	1	1	1	1	1
57	M	14/01/2016	24243	4.56	11.7	35.2	77.2	25.7			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
36	F	14/01/2016	24246	4.94	11.0	33.9	68.6	22.3			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
59	M	15/01/2016	24260	5.55	13.6	39.7	71.5	24.5			18/04/2016	26869	5.46	13.4	39	71.4	34.5	1	1	1	1			1	1	1	1	1	1	1	1	1
51	F	18/01/2016	24293	3.32	6.8	21.7	65.4	20.5		10	15/07/2016	29259	4.16	7.5	24.6	59.1	18	1	1	1	1	29/03/2016	35181	3.29	7.5	23.7	72	22.8	1	1	1	1
64	M	18/01/2016	24302	5.86	13.5	39.9	68.1	23.0			11/10/2016	31473	5.7	13.2	39.9	70	23.2							1	1	1	1	1	1	1	1	1
30	F	19/01/2016	24321	4.24	11.3	32.9	77.6	26.7		8			1	1	1	1	1	1	1	1	1			1	1	1	1	1	1	1	1	1	1
42	F	20/01/2016	24345	3.84	8.9	28.7	74.7	23.2		7	04/04/2016	26412	4.14	9.7	31	74.9	23.9	1	1	1	1	29/09/2017	38480	3.16	7.7	25.4	80.4	25.3	1	1	1	1

42	M	20/01/2016	24356	5.09	13.4	39.9	78.4	26.3			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
56	F	20/01/2016	24362	5.90	11.1	33.1	56.1	18.8			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
49	F	22/01/2016	24421	3.95	7.8	26.2	66.3	19.7			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
53	M	22/01/2016	24442	4.61	11.1	33.2	72.0	24.1			12/01/2017	33430	5.9	15	45.7	77.5	25.4	1	1	1	1			1	1	1	1	1	1	1	1	1
42	F	23/01/2016	24461	5.19	9.3	29.7	57.2	17.9			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
27	F	27/01/2016	24590	5.12	11.4	34.2	66.8	22.3		7	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
34	F	27/01/2016	24592	3.99	9.7	30.6	76.7	24.3		7	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
51	F	27/01/2016	24605	4.06	10.4	30.9	76.1	25.6			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
27	F	29/01/2016	24663	5.44	11.5	35.1	64.5	21.3			16/01/2017	39737	5.13	11.2	33.7	65.7	21.8	1	1	1	1			1	1	1	1	1	1	1	1	1
78	M	01/02/2016	24673	4.30	11.4	33.6	78.1	26.5			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
48	F	01/02/2016	24712	4.78	11.6	33.5	70.1	24.7			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
20	F	01/02/2016	24722	4.09	8.5	26.8	65.5	20.8			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
29	F	02/02/2016	24728	4.84	10.8	34.1	70.5	22.3			03/05/2016	27255	5.4	13.3	40	74.1	24.6	1	1	1	1			1	1	1	1	1	1	1	1	1
21	F	02/02/2016	24758	3.95	10.6	30.4	77.0	26.8			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
38	F	02/02/2016	24969	4.11	11.1	31.6	77.4	27.5		7	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
71	M	10/02/2016	24977	5.07	13.1	39.0	77.7	25.8			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
21	F	10/02/2016	24979	4.75	8.8	27.7	58.3	18.5		7	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
21	F	10/02/2016	24996	4.42	10.6	32.9	74.4	24.0			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
50	F	11/02/2016	25036	4.09	7.3	24.2	59.2	17.8				37925	4.95	13.1	39.1	79	26.5	1	1	1	1			1	1	1	1	1	1	1	1	1
35	F	11/02/2016	25045	4.42	10.8	30.7	69.5	24.4			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
22	F	12/02/2016	25095	4.93	11.5	36.0	73.0	23.7			23/03/2018	35040	5.52	13.5	41.2	74.5	24.5	1	1	1	1			1	1	1	1	1	1	1	1	1
19	M	12/02/2016	25098	5.56	12.6	38.0	68.3	22.7			30/07/2016	29656	6.21	14.2	43.5	70	22.9	1	1	1	1			1	1	1	1	1	1	1	1	1
45	F	16/02/2016	25166	3.93	8.9	29.1	74.0	22.6		10	14/06/2017	37560	3.82	8.2	27.1	70.9	21.5	1	1	1	1			1	1	1	1	1	1	1	1	1
61	M	16/02/2016	25185	4.72	12.5	36.9	78.2	26.5					1	1	1	1	1	1	1	1	1			1	1	1	1	1	1	1	1	1
34	F	17/02/2016	25204	4.13	10.2	32.0	77.5	24.4			23/03/2016	26152	1	1	1	1	1	7.2	3.5	8.1	17.3			1	1	1	1	1	1	1	1	1
32	F	17/02/2016	25225	4.34	10.3	32.2	74.2	23.7			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
43	F	18/02/2016	25235	4.57	10.7	33.0	72.2	23.4			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
25	F	19/02/2016	25265	5.18	11.6	34.6	66.8	22.4			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
48	F	25/02/2016	25411	3.69	9.3	28.9	78.3	25.2			27/02/2016	25486	3.75	9.4	29.5	78.7	25.1	1	1	1	1			1	1	1	1	1	1	1	1	1
54	F	25/02/2016	25429	4.90	8.4	28.8	58.8	17.1			22/08/2016	30219	4.63	8.8	29.9	62.5	19	1	1	1	1			1	1	1	1	1	1	1	1	1
75	M	26/02/2016	25447	2.86	6.3	21.4	74.8	22.0			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
48	F	27/03/2016	25539	3.97	8.9	71.3	71.3	22.4			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
34	F	01/03/2016	25581	4.94	10.5	32.7	66.2	22.1			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

49	F	02/03/2016	25594	4.80	10.7	33.1	69.0	22.3			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
64	M	07/03/2018	25713	4.42	11.4	33.7	76.2	25.8			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
21	F	07/03/2016	25716	4.40	10.8	32.9	74.0	24.4			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
15	F	10/03/2016	25853	4.22	10.9	32.3	76.5	25.8			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
45	F	14/07/2016	29203	4.62	11.7	35.5	63.2	20.8			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
51	F	16/07/2016	29259	4.16	7.5	24.6	59.1	18.0	10		14/02/2017	35181	3.42	5.4	18.9	55.3	15.8	1	1	1	1	29/03/2017	37953	3.29	7.5	23.7	72	22.8	1	1	1	1
51	F	04/01/2016	29291	4.58	11.5	34.8	76.0	25.1			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
38	F	09/08/2016	29928	4.29	7.3	25.3	59.0	17.0	ANC		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
35	F	19/09/2016	30939	4.83	9.1	29.5	61.1	30.8	2	8	06/02/2016	34064	4.80	9.8	30.2	62.9	20.4	5.13	3.2	3.3	3.8	23/05/2017	37173	5.38	10.7	33	61.3	19.9	7.86	3.5	3.9	3.6
25	F	24/10/2016	31806	4.49	11.6	33.5	74.6	25.8	5	8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
21	F	25/10/2016	31852	4.56	7.7	26.6	58.3	16.9	2	8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
40	F	25/10/2016	31858	4.80	8.6	28.6	59.6	17.9	2	8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
53	F	28/10/2016	31937	4.34	7.5	24.9	57.4	17.3	2	8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
28	F	29/10/2016	31943	3.63	8.2	26.1	71.9	22.6	3	7	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
74	F	01/11/2016	32012	4.82	11.0	34.2	71.0	22.8	1	8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
53	F	04/01/1900	32047	4.38	10.1	32.6	74.4	23.1	1	8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
48	F	03/11/2016	32101	4.56	10.1	30.5	66.9	22.1	4	8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
30	F	08/11/2016	32268	4.14	10.4	31.9	77.1	25.1	1	8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
69	F	09/11/2016	32281	4.96	8.7	32.4	65.3	17.5	2	8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
34	F	15/11/2016	32395	4.47	11.2	34.0	76.1	25.1	1	8	24/02/2017	34515	4.5	11.6	34.4	76.3	25.7	1	1	1	1	09/03/2017	34777	4.39	11.3	33.4	76.1	25.7				
62	M	18/11/2016	32479	4.90	11.9	35.6	72.7	24.3	5	8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
36	F	21/11/2016	32529	4.84	11.1	34.5	71.3	22.9	5	10	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
51	F	24/11/2016	32620	4.33	9.5	30.9	71.4	30.7	2	9	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
32	F	30/11/2016	32788	4.66	10.9	32.8	70.4	23.4	1	9	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
57	F	01/12/2016	32799	4.58	8.6	32.9	71.8	18.8	2	8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
24	F	02/12/2016	32839	4.84	11.9	34.4	71.1	24.6	5	8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
31	F	05/12/2016	32864	4.13	9.5	30.0	72.6	23.0	3	8	07/03/2017	34740	5.0	13.2	39.7	78.9	26.2	1	1	1	1												
44	F	05/12/2016	32866	4.78	10.2	30.3	63.4	21.3	4	8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
22	F	23/12/2016	33198	4.44	11.5	33.9	76.4	25.9	1	8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
41	F	07/01/2017	33313	2.69	6.5	20.9	77.7	24.2	3	8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
61	F	12/01/2017	33422	4.52	10.7	32.7	72.3	23.7	1	10	12/07/2017	36107	5.09	12.1	36.5	71.7	23.8	1	1	1	1												
39	F	20/01/2017	33641	4.36	8.9	28.9	66.3	20.4	2	8	27/02/2017	34534	4.86	11.2	35.5	73.0	23.0	1	1	1	1	30/03/2017	35203	5.04	12.7	39.0	77.4	25.2				
33	F	20/01/2017	33666	4.37	10.7	33.9	77.6	24.5	2	8	28/09/2017	38455	4.33	11	33.5	77.4	25.4	1	1	1	1												

54	F	26/01/2017	33789	4.29	6.7	24.5	57.1	15.6	2	8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
45	F	01/02/2017	33956	4.06	10.1	30.8	75.9	24.9	1	8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
27	F	02/02/2017	33974	4.38	4.4	33.0	75.3	25.8	1	7	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
26	F	08/02/2017	34138	2.91	6.8	22.5	77.3	23.4	3	8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
42	F	08/02/2017	34141	3.87	8.4	26.9	69.5	21.7	3	7	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
48	F	10/02/2017	34192	5.26	11.3	33.2	63.1	21.5		11	03/08/2017	36555	5.58	12.0	35.0	62.7	21.5	11.8	2.5	18.8	88.9	18/05/2017	37098	5.69	12.1	35.6	62.6	21.3	10.9	2.1	20.6	
21	F	13/02/2016	34225	4.38	7.1	23.5	53.7	16.2	2	8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
51	F	14/02/2017	34260	3.42	5.4	18.9	55.3	15.8	2	10	29/03/2017	35181	3.29	7.5	23.7	72	22.8	1	1	1	1	29/08/2017	37953	3.22	7.4	23.3	72	23	1	1	1	
59	F	20/02/2017	34385	4.04	10.9	31.9	79.0	27.0	1	8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
39	F	27/02/2017	34534	4.86	11.2	35.5	73.0	23.0	1	8	30/03/2017	35203	5.04	12.7	39	77.4	25.4	1	1	1	1											
23	F	27/02/2017	34544	4.06	9.4	29.6	72.9	23.2	3	8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
42	F	01/03/2017	34595	4.16	10.5	29.6	71.2	25.2	1	8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
40	F	04/03/2017	34668	3.81	9.2	27.1	72.7	24.1	3	8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
39	F	06/03/2017	34715	4.34	8.4	27.5	63.4	19.4	2	8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
64	M	08/03/2017	34771	4.72	10.4	31.4	66.5	22.0	3	10	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
33	F	09/03/2017	34777	4.39	11.3	33.4	76.1	25.7	1	8	07/08/2017	36608	4.7	12.1	35.7	76	25.7	1	1	1	1	29/11/2017	4.27	4.27	11	32.3	75.6	25.8	1	1	1	
33	F	09/03/2017	34786	4.43	8.9	29.5	66.6	20.1	2	7	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
51	F	29/03/2017	35181	3.29	7.5	23.7	72.0	22.8	3	10		37953	3.22	7.4	23.2	72	23	1	1	1	1											
53	F	04/04/2017	35305	4.46	10.9	31.3	70.2	24.4	1	8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
22	F	12/04/2017	35490	4.36	8.0	27.1	62.2	18.3	2	8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
20	F	21/04/2017	35641	4.55	11.0	34.7	76.3	24.2	1	8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
41	F	04/08/2017	36566	4.58	10.8	33.1	72.3	23.6	1	8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
37	F	08/08/2017	36645	3.81	6.9	25.1	65.9	18.1	2	10	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
35	F	28/04/2017	36762	4.78	11.7	34.8	72.8	24.5	1	8	05/05/2017	37503	5.09	12.9	37.3	73	25.3	1	1	1	1											
47	F	02/05/2017	36811	4.26	9.3	28.7	67.4	21.8	3	8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
46	F	14/08/2017	37745	4.14	9.4	30.0	72.5	22.7	3	8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
32	F	16/08/2017	37802	4.62	10.6	31.4	68.0	22.9	3	8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
44	M	25/08/2017	37906	5.09	11.7	36.6	71.9	23.0	1	8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
36	F	12/09/2017	38159	5.31	11.9	36.7	69.1	22.4	1	8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
25	F	15/09/2017	38226	5.23	11.9	35.4	67.7	22.8	1	7	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
59	F	18/09/2017	38230	4.66	11.6	35.6	76.4	24.9	1	8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
5	M	19/09/2017	38279	2.85	6.4	19.2	67.4	22.5	3	8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
43	F	21/09/2017	38325	4.21	11.0	32.4	77.0	26.1	1	8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

23	F	21/09/2017	38331	4.43	10.5	33.5	75.6	23.7	1	8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
34	F	03/10/2017	38513	4.72	8.2	27.6	58.5	17.4	3	8	24/11/2017	392612	4.78	7.9	27.4	57.3	16.5	1	1	1	1	23/01/2018	39831	5.36	12.1	39.1	72.9	22.6	1	1	1	1
39	F	10/10/2017	38648	4.80	9.4	30.9	64.4	19.6	2	8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
45	F	10/10/2017	38649	4.10	9.6	29.0	70.7	23.4	3	8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
30	F	11/10/2017	38662	5.09	11.5	34.2	67.2	22.6	5	8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
24	F	11/10/2017	38672	4.22	10.5	31.4	74.4	24.9	1	7	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
41	F	12/10/2017	38694	4.46	11.4	33.9	76.0	25.6	1	8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
40	F	16/10/2017	38728	4.92	11.8	35.2	71.5	24.0	1	8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
32	F	17/10/2017	38766	4.04	10.9	31.7	78.5	27.0	1	7	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
25	F	24/10/2017	38849	4.82	11.8	36.5	75.7	24.5	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
23	F	24/10/2017	38856	4.77	10.0	31.0	65.2	21.0	4	8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
46	F	25/10/2017	38861	4.54	11.6	34.9	76.9	25.6	1	8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
35	F	25/10/2017	38875	3.71	9.0	28.4	76.5	24.3	3	8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
40	F	28/10/2017	38924	4.65	10.1	31.6	68.0	21.7	4	8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
46	F	09/11/2017	39070	3.93	9.7	27.9	71.0	24.7	3	8		40312	4.72	13	13	82.6	27.5	1	1	1	1											
61	F	09/11/2017	39072	4.69	11.1	33.7	71.9	23.7	1	8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		27/12/2016	OH0475	4.10	10.5	32.2	78.5	25.6	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		28/01/2017	OH534	4.20	10.9	32.2	76.7	26.0	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		07/02/2017	OH555	4.58	8.4	27.8	60.7	18.3	2		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
44	11	03/02/2017	RH0119	4.81	10.6	33.0	68.6	22.0	4	7	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
34	11	20/12/2016	5252	4.63	12.1	36.2	78.2	26.1	1	1	1		1	1	1	1	1	1	1	1	1	1		1	1		1	1	1	1	1	1
20	11	23/12/2016	5267	4.75	11.4	34.0	71.6	24.0	1	1	1		1	1	1	1	1	1	1	1	1	1		1	1		1	1	1	1	1	1
40	F	23/12/2016	5268	4.04	10.6	31.0	76.7	26.2	1	10	12/01/2017		3.93	10.2	29.8	75.8	26	1	1	1	1	1		1	1		1	1	1	1	1	1
34	F	04/01/2017	5291	4.07	9.9	31.8	78.1	24.3	3	1	1		1	1	1	1	1	1	1	1	1	1		1	1		1	1	1	1	1	1
47	F	04/01/2017	5296	5.01	10.0	29.7	59.3	20.0	4	1	1		1	1	1	1	1	1	1	1	1	1		1	1		1	1	1	1	1	1
33	F	06/01/2017	5309	4.16	11.3	32.7	78.6	27.2	1	7	1		1	1	1	1	1	1	1	1	1	1		1	1		1	1	1	1	1	1
25	F	06/01/2017	5316	3.98	10.0	30.1	75.6	25.1	1	1	1		1	1	1	1	1	1	1	1	1	1		1	1		1	1	1	1	1	1
40	F	09/01/2017	5321	5.12	11.9	36.7	71.7	23.2	1	1	1		1	1	1	1	1	1	1	1	1	1		1	1		1	1	1	1	1	1
5	F	11/01/2017	5350	4.03	10.4	29.6	73.4	25.8	1	1	1		1	1	1	1	1	1	1	1	1	1		1	1		1	1	1	1	1	1
40	F	12/01/2017	5366	3.93	10.2	29.8	75.8	26.0	1	1	1		1	1	1	1	1	1	1	1	1	1		1	1		1	1	1	1	1	1
32	F	13/01/2017	5375	4.42	10.0	32.1	72.6	22.6	1	1	03/08/2017		4.57	12.3	36.8	78.5	26.9	1	1	1	1	22/01/2018		3.97	11.3		86	28.5	1	1	1	1
48	F	13/01/2017	5382	3.95	9.6	29.6	74.9	24.3	3	1	1		1	1	1	1	1	1	1	1	1	1		1	1		1	1	1	1	1	1
34	F	17/01/2017	5416	3.99	10.1	30.6	76.7	25.3	1	7	02/05/2017		3.83	10.1	29.9	78.1	26	1	1	1		1		1	1		1	1	1	1	1	1

8	F	17/01/2017	5423	4.12	10.1	29.8	72.3	24.5	5	1	1		1	1	1	1	1	1	1	1	1	1		1	1		1	1	1	1	1	1
47	F	19/01/2017	5435	5.05	9.5	30.7	60.8	18.8	2	1	1		1	1	1	1	1	1	1	1	1	1		1	1		1	1	1	1	1	1
17	F	20/01/2017	5453	4.63	11.5	35.6	76.9	24.8	1	1	18/01/2018		4.56	11.5	34.6	75.9	24.9	62	9.9	3	13.1	1		1	1		1	1	1	1	1	1
24	F	21/01/2017	5456	3.65	9.5	27.6	75.6	26.0	3	1	1		1	1	1	1	1	1	1	1	1	1		1	1		1	1	1	1	1	1
38	F	23/01/2017	5469	3.42	8.0	25.5	74.6	23.4	3	1	1		1	1	1	1	1	1	1	1	1	1		1	1		1	1	1	1	1	1
32	F	26/01/2017	5507	3.77	9.0	28.4	75.3	23.9	3	10	1		1	1	1	1	1	1	1	1	1	1		1	1		1	1	1	1	1	1
41	F	03/02/2017	5603	3.56	7.7	25.2	70.8	21.6	2	10	1503/2017		3.68	8.8	27.1	73.6	23.9	8.19	28	2.7	40.6	05/04/2017		4.14	12		86	29	1	1	1	1
44	F	14/02/2017	5700	4.71	10.2	32.1	68.2	21.7	4	1	08/04/2018		4.75	10	32.4	68.2	21.1	1	1	1	1	1		1	1		1	1	1	1	1	1
29	F	15/02/2017	5713	4.65	11.3	32.3	69.5	24.3	5	1	1		1	1	1	1	1	1	1	1	1	1		1	1		1	1	1	1	1	1
34	F	16/02/2017	5727	4.39	7.5	24.4	55.6	17.1	2	1	05/06/2017		4.46	7.8	24.8	55.6	31.5	1	1	1	1	17/07/2017		5.45	11.2		63	24	11	23.28	3.1	13.9
3	F	24/02/2017	5799	4.59	11.0	32.1	69.9	24.0	5	1	1		1	1	1	1	1	1	1	1	1	1		1	1		1	1	1	1	1	1
3	F	24/02/2017	5806	4.44	11.1	33.3	75.0	25.0	1	1	1		1	1	1	1	1	1	1	1	1	1		1	1		1	1	1	1	1	1
25	F	03/03/2017	5876	4.48	9.6	28.2	62.9	21.4	3	1	1		1	1	1	1	1	1	1	1	1	1		1	1		1	1	1	1	1	1
23	F	13/03/2017	5972	3.83	8.4	25.4	66.3	21.9	3	7	1		1	1	1	1	1	1	1	1	1	1		1	1		1	1	1	1	1	1
39	F	14/03/2017	5984	4.32	8.3	26.9	62.3	19.2	2	7	18/01/2018		1	1	1	1	1	5.56	2.8	2.9	3.8	1		1	1		1	1	1	1	1	1
30	F	20/03/2017	6026	3.97	9.8	28.3	71.3	24.7	3	7	12/08/2017		3.97	10.3	30.1	75.8	25.9	1	1	1	1	14/08/2017		1	1		1	1	1	1	1	1
30	F	20/03/2017	6030	4.34	10.4	30.7	70.7	24.0	1	1	14/08/2017		5.8	13	37.9	71.8	24.6	1	1	1	1	1		1	1		1	1	1	1	1	1
28	F	31/03/2017	6101	3.98	10.4	29.9	75.1	26.1	1	1	1		1	1	1	1	1	1	1	1	1	1		1	1		1	1	1	1	1	1
26	F	21/04/2017	6115	4.52	10.8	32.3	71.5	23.9	5	1	1		1	1	1	1	1	1	1	1	1	1		1	1		1	1	1	1	1	1
44	F	05/04/2017	6153	4.76	11.4	34.4	72.3	23.9	1	1	1		1	1	1	1	1	1	1	1	1	1		1	1		1	1	1	1	1	1
9	F	07/04/2017	6171	4.79	11.2	31.6	66.0	23.4	4	1	1		1	1	1	1	1	1	1	1	1	1		1	1		1	1	1	1	1	1
27	F	19/04/2017	6238	4.14	10.9	30.4	73.4	26.3	5	1	1		1	1	1	1	1	1	1	1	1	1		1	1		1	1	1	1	1	1
28	F	28/04/2017	6321	4.07	10.6	29.8	73.2	26.0	1	1	1		1	1	1	1	1	1	1	1	1	1		1	1		1	1	1	1	1	1
48	F	03/05/2017	6354	4.88	11.8	33.8	69.3	24.2	4	1	1		1	1	1	1	1	1	1	1	1	1		1	1		1	1	1	1	1	1
24	F	22/05/2017	6500	4.33	11.5	31.9	73.7	26.6	5	1	1		1	1	1	1	1	1	1	1	1	1		1	1		1	1	1	1	1	1
34	F	06/06/2017	6594	4.46	7.8	24.8	55.6	17.5	3		17/07/2017		5.46	11.2	34.4	63.1	20.6	11	3.1	13.9	23.3	1		1	1		1	1	1	1	1	1
53	F	07/06/2017	6612	2.33	4.4	14.7	63.1	18.7	2	1	1		1	1	1	1	1	1	1	1	1	1		1	1		1	1	1	1	1	1
56	F	06/07/2017	6772	4.97	12.5	34.7	69.8	25.2	4	1	1		1	1	1	1	1	1	1	1	1	1		1	1		1	1	1	1	1	1
36	F	09/08/2017	6974	4.64	9.5	29.7	64.0	20.5	3	1	1		1	1	1	1	1	1	1	1	1	1		1	1		1	1	1	1	1	1
22	F	16/08/2017	7009	4.03	10.5	30.8	76.4	26.1	1	1	1		1	1	1	1	1	1	1	1	1	1		1	1		1	1	1	1	1	1
3	F	08/09/2017	8067	4.24	10.8	29.7	70.0	25.5	1	1	1		1	1	1	1	1	1	1	1	1	1		1	1		1	1	1	1	1	1
28	F	23/09/2017	8174	4.22	10.4	31.7	75.1	24.6	1	1	27/01/2018		5.33	12	37.3	70	22.5	12.8	4.5	11.1	9.47	1		1	1		1	1	1	1	1	1
32	F	06/10/2017	8290	4.18	8.8	26.6	63.6	21.1	3	1	1		1	1	1	1	1	1	1	1	1	1		1	1		1	1	1	1	1	1

30	F	16/10/2017	8345	4.75	11.5	33.6	70.7	24.2	5	1	1		1	1	1	1	1	1	1	1	1	1		1	1		1	1	1	1	1	1
22	F	05/09/2017	8047	4.94	9.6	31.3	63.4	19.4	2	1	04/10/2017		5.57	12.7	39.2	70.4	22.8	1	1	1	1	1		1	1		1	1	1	1	1	1
3	F	08/09/2017	8067	4.24	10.8	29.7	70.0	25.5	1	1	1		1	1	1	1	1	1	1	1	1	1		1	1		1	1	1	1	1	1
31	F	01/04/2016	1714	4.79	11.5	35.5	74.1	24.0	5	1	1		1	1	1	1	1	1	1	1	1	1			1	1	1	1	1	1	1	1
20	F	05/04/2016	1740	3.69	8.4	27.5	74.5	22.8	2	7	1		1	1	1	1	1	1	1	1	1	1			1	1	1	1	1	1	1	1
23	F	09/06/2016	2059	4.67	11.3	35.9	76.9	24.2	1	1	1		1	1	1	1	1	1	1	1	1	1			1	1	1	1	1	1	1	1
45	F	15/06/2016	2099	4.14	9.8	29.6	71.5	23.7	3	1	21/09/2016		3.45	8.6	26.5	76.8	24.9	13.3	6.9	3.1	8.7	1			1	1	1	1	1	1	1	1
44	F	24/06/2016	2157	4.30	10.9	33.5	77.9	25.3	1		1		1	1	1	1	1	1	1	1	1	1			1	1	1	1	1	1	1	1
17	F	06/07/2016	2232	4.19	10.6	32.2	76.8	25.3	1		1		1	1	1	1	1	1	1	1	1	1			1	1	1	1	1	1	1	1
33	F	19/07/2016	2291	4.57	10.8	33.9	74.2	23.6	1		18/01/2017	3175	4.73	11.4	35.4	74.8	24.1	1	1	1	1	1			1	1	1	1	1	1	1	1
19	F	19/07/2016	2292	4.50	10.6	33.5	74.4	23.6	1		16/09/2016	2643	4.9	12	37.7	76.9	24.5	1	1	1	1	1			1	1	1	1	1	1	1	1
66	F	30/08/2016	2520	3.49	6.9	24.7	70.8	19.8	2		1		1	1	1	1	1	1	1	1	1	1			1	1	1	1	1	1	1	1
37	F	31/08/2016	2535	4.50	11.1	33.6	74.7	24.7	1		21/02/2017		1	1	1	1	1	17.7	9.9	3.1	12.5	1	3357	4.68	13	38.4	82.1	27.8	1	1	1	1
20	F	09/09/2016	2599	4.59	11.2	33.7	73.4	24.7	1		1		1	1	1	1	1	1	1	1	1	1			1	1	1	1	1	1	1	1
36	F	27/09/2016	2690	4.28	10.5	32.6	76.2	24.5	1		1		1	1	1	1	1	1	1	1	1	1			1	1	1	1	1	1	1	1
34	F	29/09/2016	2701	3.22	8.0	25.1	78.0	24.8	3		1		1	1	1	1	1	1	1	1	1	1			1	1	1	1	1	1	1	1
51	F	29/09/2016	2706	4.63	9.5	31.6	68.3	20.5	2		1		1	1	1	1	1	1	1	1	1	1			1	1	1	1	1	1	1	1
47	F	18/10/2016	2791	4.73	10.9	32.9	69.6	23.0	4		1		1	1	1	1	1	1	1	1	1	1			1	1	1	1	1	1	1	1
39	F	28/11/2016	2939	3.77	8.1	26.3	69.8	21.5	2		1		1	1	1	1	1	1	1	1	1	1			1	1	1	1	1	1	1	1
10	F	06/12/2016	2981	4.76	10.7	31.9	67.0	22.5	4		1		1	1	1	1	1	1	1	1	1	1			1	1	1	1	1	1	1	1
45	F	07/12/2016	2985	4.43	11.0	33.6	75.8	24.8	1		1		1	1	1	1	1	1	1	1	1	1			1	1	1	1	1	1	1	1
6	F	26/01/2017	3228	4.63	10.4	31.8	68.7	22.5	4		1		1	1	1	1	1	1	1	1	1	1			1	1	1	1	1	1	1	1
21	F	27/01/2017	3234	4.67	10.4	32.3	69.2	22.3	4		1		1	1	1	1	1	1	1	1	1	1			1	1	1	1	1	1	1	1
32	F	09/02/2017	3311	4.50	9.5	31.7	70.4	21.1	2		15/05/2018	4993	5.28	15.3	43	81.4	29	1	1	1	1	1			1	1	1	1	1	1	1	1
35	F	14/02/2017	3332	4.81	11.3	33.9	70.5	23.5	5		1		1	1	1	1	1	94.8	11.3	2	22.1	1			1	1	1	1	1	1	1	1
37	F	13/03/2017	3460	4.73	11.2	34.6	73.2	23.7	1		1		1	1	1	1	1	1	1	1	1	1			1	1	1	1	1	1	1	1
51	F	15/03/2017	3472	3.90	7.4	26.3	67.4	19.0	2		1		1	1	1	1	1	1	1	1	1	1			1	1	1	1	1	1	1	1
31	F	17/05/2017	3745	4.03	9.3	29.5	73.2	23.1	3		1		1	1	1	1	1	1	1	1	1	1			1	1	1	1	1	1	1	1
4	F	21/06/2017	3905	3.51	5.8	21.2	60.4	16.5	2		1		1	1	1	1	1	1	1	1	1	1			1	1	1	1	1	1	1	1
37	F	22/06/2017	3913	4.36	9.0	28.1	64.4	20.6	3		1		1	1	1	1	1	1	1	1	1	1			1	1	1	1	1	1	1	1
40	F	29/06/2017	3940	4.58	8.0	27.7	60.5	17.5	2		1		1	1	1	1	1	1	1	1	1	1			1	1	1	1	1	1	1	1
35	F	14/07/2017	4022	5.06	10.4	34.8	68.8	20.6	2	haart	1		1	1	1	1	1	1	1	1	1	1			1	1	1	1	1	1	1	1
34	F	21/07/2017	4057	4.78	10.5	31.6	66.1	22.0	5	anc	1		1	1	1	1	1	1	1	1	1	1			1	1	1	1	1	1	1	1

6	F	26/07/2017	4073	4.18	10.1	30.9	73.9	24.2	1		1		1	1	1	1	1	1	1	1	1	1			1	1	1	1	1	1	1	1
36	F	14/08/2017	4149	4.83	10.0	30.1	62.3	20.7	4		1		1	1	1	1	1	1	1	1	1	1			1	1	1	1	1	1	1	1
19	F	02/11/2017	4412	4.87	10.7	34.1	70.0	22.0	1		19/01/2018	4587	5.3	12.8	38.1	71.7	24.2	1	1	1	1	1			1	1	1	1	1	1	1	1
34	F	09/11/2017	4441	5.24	9.2	29.9	57.1	17.6	2		13/11/2017	4447	4.46	7.8	26.2	58.7	17.5	1	1	1	1	1			1	1	1	1	1	1	1	1

KEY

1 NOT AVAILABLE 2 ID = IRON DEFICIENCY 2 ID = IRON DEFICIENCY 3 A = ANAEMIA 4 MI = MICROCYTOSIS 5 HB = HAEMOGLOBIN DEFECT

6 OTHER NON IDA TESTS DONE 7 ANC 9 FOLLOW UP 10 HAART 11 FEMALE 12 MALE