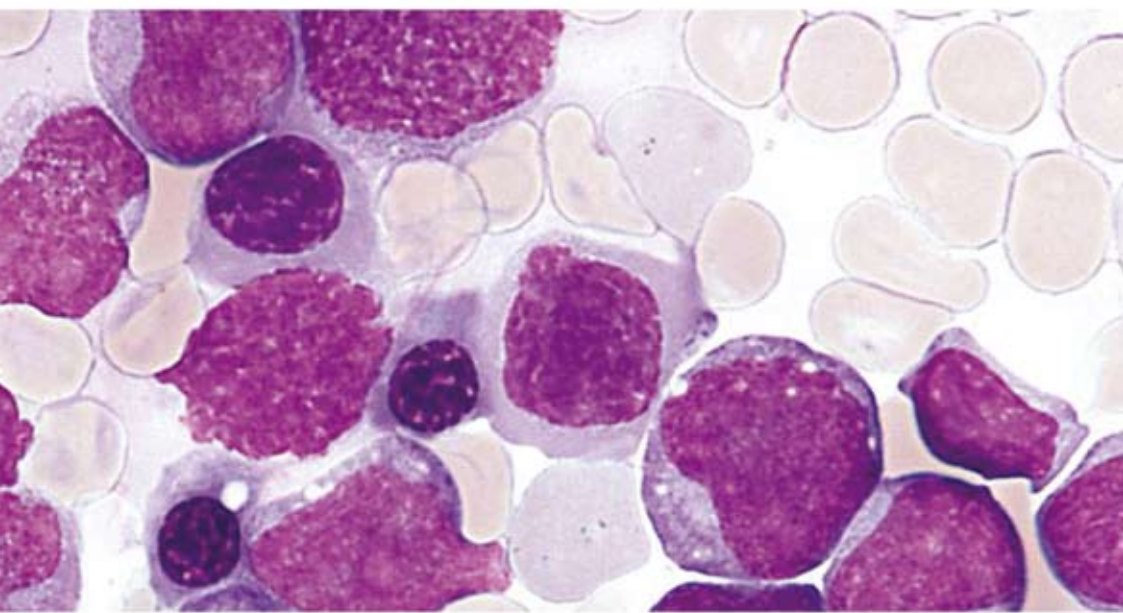


Blood & bone marrow transplantation



The seven steps

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‘The Seven Steps’ was written to help pave your recovery. Use the stages as stepping-stones to help you keep moving and looking forward.

It is important to understand that details of procedures may vary from hospital to hospital and between patients. This book was written to provide information about the typical experience of a patient receiving a stem cell transplant.

Patients should always rely on the advice of their specialist doctors and nurses who are the only people with full information about their diagnosis and medical history.

For further advice contact the clinical information team on 020 7269 9060.

Contents

- 3.** Introduction
- 14.** Step one: Planning ahead
- 22.** Step two: Preparing for your transplant
- 35.** Step three: Conditioning therapy
- 41.** Step four: The transplant
- 44.** Step five: Waiting for engraftment
- 60.** Step six: Recovery after engraftment
- 74.** Step seven: Long-term recovery
- 78.** Final comment
- 79.** Appendix A: Bone marrow donation and harvesting
- 87.** Appendix B: Early menopause following bone marrow transplant and high-dose chemotherapy
- 92.** Appendix C: TBI or total body irradiation
- 96.** Appendix D: Clinical trials
- 97.** Appendix E: Reduced intensity conditioned (mini) transplant
- 99.** Appendix F: Glossary of terms

Introduction

The team at your hospital and transplant centre

You will have an experienced team of professionals dedicated to fulfilling your special needs as a haematology patient, from the point of referral, right through to discharge.

Routine

If you have not been admitted to the hospital before, it may help to read the following paragraphs, which describe some of the events and tests that are routinely carried out.

Blood tests

Blood tests are sometimes performed as often as every day, depending on your treatment and general condition. These are important, but you may find them tiresome.

Blood can either be taken from a vein (peripheral sampling) or your nurse can take it from your central venous catheter if you have one. Blood samples are usually taken in the morning, but sometimes, additional samples maybe required at other times of the day.

Your team carefully watches the results of all of your investigations, but if you would like to keep your own record, please feel free to ask about the results.

X rays

Chest X rays are performed as often as weekly for patients who are having, or have had, chemotherapy. This is because there are some types of lung infection that do not show any symptoms until they are severe and so by performing regular X rays, some of these infections can be found early.

Medicines, intravenous antibiotics and chemotherapy

Routine medicines are brought to you several times a day. Medicines, such as painkillers or anti-sickness drugs, are often prescribed on an 'as required' basis, so please ask your nurse when you feel you need them. Sometimes patients can receive their painkillers via a locked pump so that they can, to a certain extent, control their pain themselves.

Most intravenous antibiotics are made-up and given by the nursing staff. Every effort is made to ensure that these are given during the hours that you are awake, but on some occasions, when many infusions need to be given, the nurses may need to start them early in the morning and complete them during the night.

Many nursing staff are specially trained to give chemotherapy. Each patient is prescribed chemotherapy as part of a treatment 'protocol'. This is a kind of plan for the treatment you are going to receive. Chemotherapy can be given in many different forms, but tablets and intravenous injections are the most common.

One of the doctors will explain your treatment protocol to you before you start, so that you know how often you are having chemotherapy, how long the course of treatment takes to complete and in what form it is given to you.

Observations

While you are in hospital, there are various ways of monitoring your condition. The most common are described below.

••• Temperature

This may be checked frequently over the course of the day. A thermometer may be placed in your mouth (under your tongue), or if you have a sore mouth, or feel nauseous, you can place it under your arm. The reading

obtained from using the second method is usually lower. There is a newer type of thermometer, which is placed in the outer ear, and can read the temperature electronically using an infra-red sensor.

✧ Pulse

This may be checked frequently over the course of the day. You may find that your pulse rate is faster if you are anaemic or if you have a raised temperature when you have an infection.

✧ Blood pressure

This may be checked frequently over the course of the day. You may find that your blood pressure runs a little lower than normal when you have a raised temperature, or a little higher if you are anxious or in pain.

✧ Respiration rate

This may be checked frequently over the course of the day. Your respiration rate tells us how quickly or slowly you are breathing. The rate may be quick if you are anxious or in pain, or have an infection, and slow if you are asleep or drowsy.

✧ Fluid monitoring

Because of the types of treatment you are given, it is necessary to ensure that you are getting plenty of fluid, either by mouth or by drip. It is also necessary to ensure that you are passing sufficient amounts of urine. Too much fluid in your body can be a problem, while too little can lead to dehydration. High fluid intake can help to flush harmful toxins and waste products away.

To monitor your input and output, a fluid balance chart is used. This is a record of your input (drinks, intravenous infusions) and output (urine and other body fluids). The nurse may suggest that you keep your own record.

Pulse oximeter

This is a machine that can be used to measure the level of oxygen in the blood. Oxygen in the blood is important as it helps to provide nutrients to the cells of your body. The machine has a soft clip that is placed onto one of your fingers for a few moments, and then it takes a reading. This technique causes no discomfort. In some circumstances, the doctor may need to take a blood sample from one of the arteries in the wrist or the groin, to get an accurate measure of the different gases that are in your blood.

Ward rounds

Ward rounds are the time when your doctor(s) visit to check your progress and review or change your treatment. You will also have the opportunity to ask questions about your treatment and take part in any decisions that need to be made.

Occasionally, there may be other doctors or medical students accompanying your usual doctor(s) when they come to see you, as the round is an important forum for learning. If you would prefer the number of doctors that you see kept to a minimum, please let your nurse know in advance.

Counselling

Your hospital may have a counsellor who is able to help to support you through your treatment. Experience has shown that the psychological aspects of disease can play a significant part in the outcome of treatment. It is important to address the emotional and psychological impact of the diagnosis and any subsequent treatments.

It is also important that you and your family and friends have the opportunity to discuss and express feelings in confidence and in a manner in which feels comfortable. This can be done at your own pace and with a professional who is trained and experienced in listening and offering emotional and psychological support.

A counsellor can fulfil this role by:

- Offering counselling to patients, family members and friends, either individually or together
- Providing general advice and help with welfare benefits, housing issues, charity applications, referrals to other agencies and other more practical problems

If your hospital does not provide a counselling service for you, please ask your nurse or GP for contact details of a counsellor who can help.

Introduction to bone marrow and stem cell transplantation

For the purpose of this book, the transplant process is described as a series of steps. If you prefer, you can think of these as steps towards your recovery. Each step has its own important place, and prepares you for the next one.

When you get this book, you may already be well on the way to completing your first step (**see Planning ahead**), which is detailed in the next chapter.

You may have been considering or discussing a transplant with your doctor, and so you may already have some ideas about what is involved. If you have just begun to think about a transplant as an option, but have not yet had the opportunity to ask questions about what is involved, you will find these next few chapters very helpful.

If you do have any questions at all, please ask.

In order to understand the **Seven Steps** of your transplant, it might be helpful to have some background information about:

- Bone marrow, blood and blood cells
- Bone marrow and stem cell transplantation

About bone marrow, blood and blood cells

Blood cells are produced in the bone marrow. The bone marrow is a tissue that is found in the centre of bones, such as the back of the hips (the iliac crests), and the breastbone (the sternum). These areas are very rich in bone marrow and so are used for obtaining bone marrow for tests or for harvesting. The bone marrow needs to continually produce blood cells to maintain normal health. This is because, like all cells, blood cells have a limited life span.

There are three different types of blood cell, each performing its own special function.

⚡ White blood cells

- Lymphocytes
 - ⚡ T cells — control immunity, kill viruses and cancer cells
 - ⚡ B cells — make antibodies
- Neutrophils
 - ⚡ Fight infection, kill bacteria, remove damaged tissue
- Monocyte/Macrophage
 - ⚡ Work with lymphocytes to fight infection

⚡ Red blood cells

Red blood cells contain haemoglobin, which is the red pigment used to carry oxygen to all parts of the body.

⚡ Platelets

Platelets help to prevent or stop bleeding or bruising.

Without normal blood cell production, you can become susceptible to infections, tiredness and bruising. Specific terms are used to describe low numbers of the three groups of cells that are listed above. You will hear these terms mentioned frequently.

- Neutropenia – low neutrophil (granulocyte) count
- Anaemia – low haemoglobin level
- Thrombocytopenia – low platelet count

The type of disease or the treatment that you have for it may affect normal blood cell production.

Blood transfusions are given for anaemia, and platelet transfusions for thrombocytopenia, but as yet white blood cell transfusions are not available, since white blood cells have a very short life span once they leave the bone marrow. As you may now know, a low white blood count increases your susceptibility to infections. Therefore, if you do have a low white cell count or are neutropenic, you may be given medication in the form of antibiotics, firstly to prevent (prophylaxis), and secondly to treat these infections. You may also be given growth factors which can help the white blood count to recover, so that the severity and duration of infections may be reduced.

These types of support will be discussed in further detail in **Step five: Waiting for engraftment.**

The normal blood values in healthy adult males and females are:

	White blood count	Haemoglobin	Platelets
Adult male	3.7 to 9.5x10 ⁹ /l	13.3 to 16.7g/dl	150 to 400x10 ⁹ /l
Adult female	3.9 to 11.1x10 ⁹ /l	11.8 to 14.8g/dl	150 to 400x10 ⁹ /l

These normal values can vary slightly from hospital to hospital.

Patients who require blood and platelet transfusions, are generally topped-up to a haemoglobin level of 10 to 11g/dl, and a platelet count of 10 to 50x10⁹/l.

About bone marrow and stem cell transplantation

In the 1970s, bone marrow transplantation (BMT) was still very much an experimental procedure. Major developments have occurred since those early days. This previously experimental procedure has now become the treatment of choice for a wide range of haematological, non-haematological disorders and cancers, which respond well to very high doses of chemotherapy and/or radiotherapy.

High doses of chemotherapy and radiotherapy damage the bone marrow's ability to produce cells, and indeed without the transplanted cells, marrow function might never recover. The transplanted cells will engraft — i.e. start to produce new cells, in about two to three weeks. A transplant, in essence, breathes in new life by either reviving or replacing the old marrow to go on to produce new and healthy blood cells.

Recent developments have led to reduced intensity or so called 'mini' transplants. The doses of chemotherapy used for these donor transplants are much lower, and so many of the side-effects associated with a 'mini' transplant are less severe. For more details about reduced intensity conditioned transplants please refer to the **Appendix**.

∴ Where do cells come from?

There are two categories of transplant:

- **Autograft** — the patient's own bone marrow or stem cells are used
- **Allograft** — the bone marrow or stem cells from a donor are used

There are different types of donor:

- **Sibling** — a brother or sister
- **MUD (VUD)** — a matched unrelated donor or a volunteer unrelated donor
- **Alternative family donor** — a parent, cousin or child
- **Syngeneic** — an identical twin

∴ Donors and tissue-typing

The type of bone marrow transplant depends upon the type of disease that is being treated and the quality of the patient's own bone marrow or stem cells. If a patient's own stem cells cannot be used, or it is known that the patient would benefit from a transplant using donor cells, then the donor option is explored in more detail.

Just as there are several different red blood cell groups (ABO), there are also a variety of white blood cells that can determine a person's tissue type, known as HLA type (human leukocyte antigen). Unlike red cell groups, there is an enormous number of possible tissue types.

Tissue typing is not related to blood group, so a donor can be a very good tissue type match but a different blood group.

It is important when selecting a donor that one with the closest tissue type match is used. This will help to minimise immune system reactions such as graft versus host disease or rejection of the graft (graft versus host disease and graft rejection are discussed in more detail in Step Five).

For the test itself, just a small (approx. 20 ml) sample of blood is taken from one of the veins in your arm. This blood is then sent to the tissue-typing laboratory to be processed. The results are usually available about two weeks later.

When a donor search is started, a patient's brothers and sisters are tested first to see if they might be a suitable match.

An identical twin is considered to be the most perfect match but this is not always ideal. A transplant from an identical twin is called a **syngeneic transplant**. There are no problems with immune system reactions in this type of procedure, although the transplant can fail for other reasons, such as relapse, i.e. the return of the haematological condition.

The next type of donor is a matched sibling (brother or sister). Because of the way that we inherit tissue types from our parents, in most cases, a sibling can be a good match, half-matched (haploidentical) or not matched at all. Statistically, there is a 1 in 4 chance of a brother or sister being a full match.

For anyone who does not have any siblings, or none that match, a search of the bone marrow donor registries can be carried out to see if there is a volunteer unrelated donor with the same tissue type. There are now several million volunteers around the world who are registered as potential bone marrow donors. The Anthony Nolan, the Bristol and the Welsh panels in Great Britain have many donors on their lists but, sometimes, a search of the registries in Europe and America needs to be made in order to find a suitable donor.

Unfortunately, there are particular difficulties in finding donors for patients from non-Caucasian ethnic groups. Ethnic minorities tend to be under represented on the donor registries but, through appeals and increasing public awareness, this is slowly improving.

All donors require a physical check-up to make sure that they are fit and healthy. This consists of a physical examination by a doctor and some blood tests (a blood count, blood chemistry and virology – including Hepatitis and HIV screening), a heart trace (ECG) and a chest X ray.

∴ How are the cells collected

The cells for a transplant are obtained from the bone marrow or the blood and are known as **stem cells**. The process used to collect stem cells is called **harvesting**.

There are two different ways that the cells can be harvested:

- **Bone marrow harvest**
- **Peripheral blood stem cell harvest**

These two procedures are quite different and are explained in detail in the **Appendix A**.

More recently stem cells obtained from the blood on the umbilical cord have been used for transplants in children. Research and clinical trials looking at the use of cord stem cells for adult patients are ongoing.

The type of procedure that is selected for you will be based upon certain criteria, such as your disease, previous chemotherapy and treatment. For donor harvests, the type of procedure that is used depends on what is most suitable for the patient and donor.

Step one: Planning ahead

The time has now come for you to start preparing for your transplant. There are several points to consider before you begin treatment and these are covered in this first step.

Issues discussed in this step

- Timing
- Fertility
- Early menopause
- Clean diet
- Losing your hair
- And growing it back again!

Timing

You may not have been given any dates yet, but you may have a general idea of when your transplant is due.

If you are planning any special events, such as weddings, etc., it may be possible to move the date of your transplant to accommodate these. It is worth bearing in mind that you can expect to be in hospital for about six weeks. After this, you will need to attend the outpatient department up to three times a week, sometimes more, during the immediate period following discharge. This period can last anything from one to three months after the transplant and varies from patient to patient. It can be roughly six months, depending on the type of transplant that you have, before your level of activity will return to normal. If you are concerned about the timing of your admission, please discuss it with your transplant team.

Other areas to consider are:

- The **type of transplant** you are going to have and the kind of preparation you feel you need
- **Child care** while you are in hospital
- Restricting your social activity during the weeks leading up to your transplant
- **Help** at home when you are **discharged**
- Learning about looking after your **venous catheter** (Hickman™ line), in hospital and at home
- The probability of not returning to full time **employment** for six months after the transplant and arrangements that may need to be made during this time
- **Goals** and **targets** you might wish to set

All of these considerations are an important part of your psychological preparation for the transplant and are particular to you. There is little available in the way of written advice on these issues since there is no single, correct way of dealing with them, but planning these kinds of things in advance will help when you come into hospital. If you do anticipate having problems sorting things out, or would like to discuss any issues, please ask your nurse or doctor if there is someone who can help to advise you.

Fertility

While patients are forewarned of the extremely high probability of infertility associated with high-dose chemotherapy, it is not 100% inevitable that all patients will be infertile. While it remains highly unlikely, there are a few reported cases of conceptions and births following bone marrow transplants. It is for this reason that the use of contraception is recommended following treatment.

The techniques for preserving fertility are changing and your doctor can discuss current treatments with you prior to any fertility damaging therapy.

It is technically easier and quicker to obtain semen from male patients, than it is to obtain eggs from female patients. By discussing these important issues at this stage in the book, you will have plenty of time before your transplant to consider the options that are offered, and complete any subsequent fertility treatments.

Fertility treatments are described in more detail over the next few pages.

∴ **Male patients**

Prior to starting your treatment, you may wish to consider storing some semen for use later on. Donating semen is a simple procedure, and your doctor can give you further advice and information on semen storage, and can answer any questions you may have regarding fertility and infertility.

Prior to donating semen, you will be asked to give your consent for a blood sample to be taken to test for viruses. The viruses that will be tested for include HIV and Hepatitis B and C. The testing is performed because your samples will be stored with others. It is done to ensure that all of the samples are stored safely.

There are some general points that you may wish to consider before donating.

- There is a possibility that your sperm may already have been damaged by your illness. The quality and sperm count is checked when you donate. Samples are always stored if there is any possibility at all that they are fertile, but there is no guarantee of their quality afterwards.
- Although every effort is made to ensure that your samples are stored to a high standard, there is no guarantee that the samples will be viable after thawing. Nor is there a guarantee that you will achieve a pregnancy with your samples even if they appear satisfactory after thawing.

- Infective agents, such as viruses, are potentially carried in the semen. There is a very small risk that samples in the bank may carry infections. It is theoretically possible, but extremely unlikely, that cross-infection could occur should one of the ampoules containing semen break open.
- To make the best use of your stored semen, your partner may need treatment with in vitro fertilisation. If you are eligible for NHS treatment, there may be a long waiting list. Private treatment can be very expensive.
- Your semen samples belong to you and are your responsibility. For legal reasons, you need to let the unit know how you would like them to be dealt with if you die. If you have a partner, you may want the responsibility to pass onto her, and if so, your partner should be named. One further aspect of this complex issue is how you might feel about having a child born should you die.
- All clients are asked to read and sign a contract for semen storage. It is usually expected that you contact the unit every twelve months to confirm that you wish your semen samples to remain in storage. If you neglect to do this you may find that your samples have been discarded as, stocks are audited at regular intervals.

🔗 Female patients

The following pages advise you of the fertility treatments available at present. These options obviously require careful consideration and it is recommended that you seek advice before making a decision.

It is worthwhile bearing in mind that the options that are available can be time consuming and the results can be disappointing. However, every effort should be made to discuss any concerns so that you can be supported through your chosen method of treatment.

There are currently four options to consider:

- **Using your own eggs following embryo storage** — this option currently requires that you are in a stable relationship with someone you have already planned to have children with. Prior to starting your chemotherapy, you can be given treatment to stimulate your ovaries to produce a number of eggs. These eggs are collected and then fertilised with your partner's sperm. Eggs that are successfully fertilised (embryos) are then frozen and can be used at a later date when you have fully recovered from your chemotherapy.
- **Using donor eggs** — you can wait until your treatment is over and then use donated eggs rather than your own. These eggs are fertilised with your partner's sperm and then placed in your womb where the embryo can grow naturally. Egg donors, although available, are difficult to recruit but you may well have a relative who is willing to offer to be your donor. If you do not have a male partner at the present time, you can still consider egg donation as a future option.
- **Using your own eggs following egg storage** — this is suitable for women who are not in a steady relationship. After the ovaries have been stimulated, the eggs can be collected and frozen without fertilisation. This is relatively new and there is very little information about the results of this technique but you may wish to discuss it further with your doctor.
- **Ovarian tissue storage** — some units are able to offer a fairly new treatment which involves freezing ovarian tissue. The eggs in this tissue are matured at a later date and then fertilised to form embryos. This is still experimental and you may wish to explore this option further. Since this treatment is still developing, it is not yet clear how successful it is going to be.

Early menopause following bone marrow transplant and high-dose chemotherapy

Early menopause may not be your main concern at this stage of your preparation but the high-dose chemotherapy and/or radiotherapy that you will receive before your transplant is likely to damage your ovaries. This damage frequently leads to premature menopause.

This area is covered in depth in the **Appendix B**.

Clean diet

Nutrition and diet are extremely important following chemotherapy and especially following a bone marrow transplant. A clean diet reduces the risk of picking up infections that can be contracted from the food that you eat.

During the time when your blood count is low or you are immune suppressed, you will be advised to follow guidelines for a 'clean diet'. Guidelines and restrictions vary slightly from unit to unit, so you should ask your doctor or nurse to provide you with a copy of the diet you will be following.

A 'clean diet' is generally recommended for those patients who have undergone a bone marrow transplant and the diet should be followed until the white blood cell count recovers.

A 'clean diet' is usually also recommended for those patients who are on intensive chemotherapy regimes or for those whose white blood count falls below $1 \times 10^9/l$ on less intensive regimes.

For those patients who have a chronically low white blood count, or are immune compromised or immune suppressed (on ciclosporin or long-term steroids), then the guidelines on food safety and hygiene that are regularly updated by the government can be followed. The dietician at your transplant centre will have a copy. These guidelines are less restrictive than those of the 'clean diet'.

Losing your hair

As a side effect of your treatment, you will probably lose your hair. This loss is not immediate, and it can take up to two weeks after you finish the chemotherapy before your hair starts to fall out. This can be a very sensitive time for male as well as female patients and your team will do all they can to support you.

When you lose your hair, it is a gradual process that occurs over a number of days. Some patients prefer their hair to fall out naturally, while others prefer their heads to be shaved.

During this time your scalp may feel sore. Avoiding the shower or your hairbrush will not make your hair stay in any longer and can sometimes make this problem worse.

There is a method of reducing hair loss by cooling the scalp. Unfortunately this has no effect on reducing hair loss following very high-dose chemotherapy. In addition scalp cooling is not recommended for patients with haematological diseases. This is because cancer cells can sometimes develop in the meninges. The meninges are the membranes surrounding and covering the brain and spinal cord. Scalp cooling works by reducing blood flow to the scalp and so will also reduce the amount of chemotherapy delivered to this area.

Some patients see losing their hair as a way of getting rid of the old cells and making way for the new.

When you have lost your hair, you should be advised to cover your head whenever you go outside, especially in extremes of temperature. In winter, your scalp is a great source of heat loss and you will probably find it uncomfortably cold. In summer, your scalp is at great risk of sunburn. Make sure you wear sunblock and cover up. While you are in hospital, just do what feels comfortable. There are various ways of covering your head:

- Hats
- Baseball caps
- Scarves
- Turbans
- Wigs

If you are receiving your treatment on the NHS, you will be entitled to a free wig, or vouchers towards a wig. The best time to have a consultation and choose your wig is before you come into hospital, or before you lose your hair. This way, your hair colour, texture and style can be matched as closely as possible.

If you don't get the chance to choose your wig before you lose your hair, don't worry. There are catalogues of styles for you to choose from and you can still take time to make sure you get the style that you feel is right for you. Once you have chosen your style, it will be ordered for you. You may wish to be shown how to shape and style it. You will also get some tips on how to look after it so it continues to look good. If you do not like the wig when you try it on, you can often order an alternative in exchange.

And growing it back again!

The good news is that your hair does, of course, grow again. About six to ten weeks after the transplant you may be able to see and feel the new growth of hair coming through. You might find it a slightly different colour and texture at first. The initial growth can tend to be slightly wavy, thicker and darker. This often changes as your hair grows longer.

Step two: Preparing for your transplant

Usually, from the time you are referred for your transplant, you will begin the physical and psychological preparation for your transplant. There is a lot of important work to be done and this will involve frequent visits to the hospital during the weeks leading up to your admission.

Issues discussed in this step

- Consent
- Fertility appointment
- Dental appointment
- Pre-transplant appointment
- Pre-transplant investigations and procedures
 - ✦ Bone marrow aspirate and trephine
 - ✦ Blood tests
- 24-hour urine collection and EDTA clearance
- Lung function tests
- Chest X ray
- MUGA scan or ECHO scan
- Electro-cardiogram (ECG)
- Virology screening (including HIV)
- CT scan (not applicable for all patients)
- PET scan (not applicable for all patients)
- MRI scan (not applicable for all patients)
- Central venous catheter insertion
- Care of your line

Consent

By law, your written consent must be obtained prior to any operation and also before some procedures and treatments can be carried out. Staff will explain the risks, benefits and alternatives before they ask you to sign a consent form. If you are unsure about any aspect of the treatment proposed, please do not hesitate to speak with the doctor again.

Fertility appointment

If you have not yet had the opportunity to discuss your fertility, or would still like to discuss the options available to you, please ask your doctor to organise this for you.

Fertility and infertility are covered in more detail in **Step one**.

Dental appointment

As a matter of precaution, all patients must make an appointment to see their dentist for a check-up. If you have any teeth that require attention (fillings, extractions), you should have the work done before you are admitted for your transplant. If this work is not done, it is likely that these teeth could be a very problematic source of infection and this could be detrimental to the outcome of your transplant.

Teeth that, under normal circumstances are simply troublesome, can easily become infected leading to nasty abscesses and can cause a great deal of pain when the white cell count is low. This problem is difficult, though not impossible, to treat in immune compromised patients and extractions can be high-risk procedures, due to a low platelet count.

If you have difficulty making an appointment with your dentist, please let your doctor know.

Pre-transplant appointment

Some patients will have several appointments at the hospital where their transplant will take place whilst others will have only one or two.

Feel free to take your partner or a relative with you, especially if they are going to play a significant part in your care. If your brother or sister is going to be your donor, they will usually be sent their own clinic appointment.

During your appointment(s), the type of transplant that you will have and the treatment and tests that you will need before you have the transplant are discussed. You may be given some provisional dates for your transplant but these may not be confirmed until nearer the time.

You will also be told about the effects and side effects of a bone marrow transplant, and you will have the opportunity to ask plenty of questions.

Pre-transplant investigations and procedures

There are a number of investigations and tests that are carried out before the transplant. These tests are to ensure that you are generally fit and well. The doses of therapy that you will be given are very high and it is necessary to ensure that your body will be able to tolerate the treatment. You will also have a number of blood tests. The details of these are explained later in this section.

Sometimes you may be able to get most or all of the tests done in one day. They may be planned at your local hospital or at the transplant centre. However, the departments are in great demand and you may need to make more than one visit to the hospital to get them completed.

∴ Bone marrow aspirate and trephine

A bone marrow aspirate involves inserting a fine needle into the bone marrow space under local anaesthetic. A syringe is connected to the needle to aspirate

or suck out a few bone marrow cells to stain and view under a microscope. Other tests can also be carried out on this sample, such as typing of the cells and chromosomal analysis.

A bone marrow biopsy or trephine is often carried out at the same time. This is where a small core of the bone marrow is removed, using the same technique as an aspirate.

The complete results can take up to ten days, but some will be available in two to three days. The test takes about ten minutes to complete.

✧ Blood tests

- Blood count
- Blood group
- Kidney function
- Liver function
- Bone function
- Thyroid function
- Clotting
- Ferritin (iron level)
- Glucose

and for some patients:

- Immunoglobulins
- T cell numbers
 - ✧ CD4, CD8, CD16, CD56 and CD57
- Hormone screen
- Beta 2 microglobulin
- Lactate dehydrogenase (LDH)

Blood tests are a regular part of diagnosis and for detecting the way your body has responded to treatment. Some of the above tests can take several days to process whilst others are available within an hour. There may be additional blood tests that are not listed above.

24-hour urine collection

This procedure tests the function of your kidneys. For the 24-hour urine collection, you are given a large bottle in which you are required to collect all the urine you pass for 24 hours. The bottle should contain a small amount of powder preservative called boric acid. Do not tip this away.

It is best to start the collection in the morning.

To start the collection, you pass your first stream of urine straight into the toilet but write the time of this on the bottle. From this point, for the next 24 hours, you need to collect all of your urine into the container. You finish collecting the next day at exactly the same time as you started. After this time, you do not collect any more urine in the bottle. If you forget to collect any urine at any point during the collection, you will need to start again. You should take the bottle back to the hospital on the day that you finish. In order that the results can be calculated, you will need to have a blood sample taken when you return the collection.

⚡ EDTA clearance

This is simply another way of testing the function of your kidneys.

This test is often used to check the reliability of the 24-hour urine collection, if the results are low or borderline.

Before the test, unless otherwise instructed, you should eat and drink normally.

For this test, you need to go to the Department of Nuclear Medicine at the hospital. For the test you are given a small injection of radioactive dye into one of the veins in your arm. After this, a series of four blood samples are taken between two and four hours after the injection. A calculation can then be made from these blood tests.

The injections do not have any side effects and are not harmful.

It is important that you tell the technician if you have had any blood or platelet transfusions within the 24 hours before this test.

Lung function tests

This procedure tests the function of your lungs. Most of the tests involve you breathing into different machines, which work out how big your lungs are and how well they are working. Sometimes a small sample of blood is taken to work out how much oxygen is in your blood. Some tests may involve walking on a treadmill, so please wear comfortable shoes.

If you normally take inhalers for your breathing, please try not to take them for four hours before the test. This is because the technicians can test how much the inhaler is helping your breathing. Of course, if you are feeling very breathless, then take your inhalers as usual.

Please take a list of any medication that you are prescribed.

Chest X ray

This is a simple X ray of your chest, which acts as a baseline before you start your treatment.

MUGA scan or ECHO scan

These are scans to test the function of your heart. You usually only need to have one, not both of these scans.

Before the test, unless otherwise instructed, you should eat and drink normally.

A MUGA scan is performed in the Department of Nuclear Medicine. The test involves two small injections in your arm. Following the first injection of a small amount of radioactive dye there is a wait of about half an hour before the second injection is given. This dye attaches itself to your blood, so that a series of pictures can be recorded. A heart trace (ECG) may also be recorded. The whole test takes about an hour to complete, after which you are able to go home.

The injections do not have any side effects and are not harmful.

It is important that you tell the technician if you have had any blood or platelet transfusions within the 24 hours before this test.

Another way of checking your heart is by having an ECHO scan or cardiac ultrasound.

When the test starts, you are asked to undress to the waist, and then lie on a couch on your back. The doctor who is doing your scan puts some gel on the area of skin around your heart. He then moves a probe around the area and this produces an image of your heart on a monitor. The doctor then needs to repeat this process while you are lying on your side.

This test is not painful but you may be asked to lie quite still at times.

Electro-cardiogram (ECG)

An electro-cardiogram (ECG) is a trace of your heart rhythm. This is done by placing a series of electrodes, like sticky plasters, on your chest around your heart and on your wrists and ankles. A graph of your heart rhythm is produced on a piece of paper. The test takes about five to ten minutes to complete.

Virology screening

All patients have a blood sample sent for virology screening, prior to the transplant. There are a number of viruses that may play an important part in your transplant and in some cases may affect your recovery. All patients are screened for viruses prior to a harvest, if they have one. However, if there is a long time gap in between the harvest and your transplant, the screen may be repeated.

The viruses that are routinely screened for are:

- HIV (type 1+2)
- Hepatitis B+C
- CMV
- HTLV 1+2
- EBV

There may be some additional tests that your transplant centre performs.

The results are usually available in a few days. These tests include:

- Syphilis
- Toxoplasma

You need to be notified of the nature of these tests before they are performed, so that you can give your permission (usually verbal consent) for the tests to be done. If you would like to discuss the test with your haematology doctor, any questions or concerns that you may have can be answered. You may wish to speak to a health adviser prior to the test.

If you would like any further information, please do not hesitate to ask.

CT scan

Before your transplant you may need to have a CT scan. CT means computed tomography. The scanner is a complex X ray unit that is able to produce cross-sectional images, a bit like slices of the head and body, which are analysed on a computer. Your doctor may wish to scan a part of your body, such as your chest, or abdomen. In some patients he may wish to scan the sinuses.

You may be asked not to have anything to eat or drink for two to four hours before your scan.

For the scan itself, you are asked to lie on your back on the hard scanning table and you are then positioned in the scanner. The table passes through the scanner, and for a short time, you may feel slightly enclosed. You are able to hear the noise that the scanner makes while it is in action.

For neck and chest scans, you may be asked to hold your breath intermittently during the scan and you may need to have a small injection into a vein in your arm. This is a special X ray contrast fluid. The injection may make you feel warm and occasionally gives a feeling of nausea but this soon wears off.

Before abdominal and pelvic scans, you are given a drink of special contrast fluid. This can taste a little like aniseed and it is diluted in about a pint of water. You can mix fruit drinks with the contrast fluid if you dislike the taste. The fluid is essential to produce good pictures. You will be given more cups of fluid during the hour before the scan.

For a scan of the pelvis only, you may need to have a small amount of the same fluid put into the rectum via a small tube and, in women, a tampon may be inserted vaginally. The scanning time for this examination is quite short but the total time involved, with the preparation, is longer.

PET scan

A PET scan is another form of scan, where an injection of a very weak and harmless radioactive dye is used to highlight the area of the body being scanned. Pictures are then obtained using a special camera and the scan takes about half an hour.

MRI scan

This scan can be used as an alternative to a CT scan and uses radio waves rather than X rays to produce pictures which are then analysed on a computer.

You are asked to remove all metallic objects, such as jewellery, money and keys. If you have a cardiac pacemaker this type of scan may well be unsuitable because of the powerful magnetic field.

Each scan takes about one hour to complete and you may eat and drink normally before and after the procedure. It may be necessary for you to have a small injection of contrast fluid into a vein in your arm to help get better pictures.

You are positioned on a table that goes through the scanner, and for a short time, you may feel enclosed. It is a painless procedure with no known side effects.

Central venous catheter insertion

During your transplant you need a large number of infusions. It is impossible to rely on your veins for this kind of intensive treatment. Before your transplant you have a special line inserted, if you don't already have one. This is a surgical procedure and can be carried out in the operating theatre under general anaesthetic or in a special X ray department under local anaesthetic. Each hospital usually has its own preferred method.

Each hospital and transplant centre also have their own preferred type of central venous catheter. The most commonly used type of catheter is a 'Hickman™', but you may hear other names such as 'Groshong™'.

There are some risks associated with the procedure. The chance of any of these things happening is small but you should be aware of these before you sign the consent form.

- Pneumothorax – lung collapse
- Bleeding
- Infection

Your doctor will discuss these risks with you in more detail before you sign your consent form. If there is any part of the procedure that you do not understand, please ask your doctor.

The catheter is tunnelled so that it runs underneath the skin and the tip sits in one of the large veins that lead into your heart. It exits on the skin, usually about five to 10 centimetres below the collarbone. The catheter has a cuff underneath the skin to stop it from falling out, but initially it is held in place with a couple of stitches. The width of the catheter is a little larger than a biro refill. The catheter is made from very flexible material which can bend without breaking.

Because the catheter is in such a big vein, the infusions that you are given are easily carried into your blood. Large volumes of fluid or even small infusions can be given effectively. The catheter can also be used for taking blood tests. This means that when you have a central venous catheter you no longer need to have blood taken from your veins, except on rare occasions and if you have a temperature.

Care of your central venous catheter

Your catheter needs to be looked after, to help prevent it from becoming infected or blocked. It is best, if you are able to choose one person, that either you or your carer look after it. This is shown to vastly reduce the number of infections that are associated with these catheters. The care of your catheter is not difficult and it does not take long to teach you. All you need is a little practice.

Hints and tips for a healthy catheter:

- Always keep your catheter secured with tape so that it won't easily get pulled
- Only use the technique that you have been shown for flushing and redressing

Should any of the following occur, you must contact the hospital for advice.

This applies 24 hours a day.

- If you get shivers at any point after flushing your catheter
- If the area around your catheter begins to look red, discharge pus, or blood
- If you notice that the 'cuff' is more exposed than usual
- If you notice that your catheter has become split or damaged in any way
- If you are having difficulty in withdrawing blood from your catheter using the usual technique, but you are still able to flush it, the catheter may be blocked.
- If you are having difficulty flushing your catheter, it may be blocked
- If you notice any swelling in you arm, neck or face

The dos and don'ts of catheter care

There are certain dos and don'ts that are worth noting:

- Do redress your catheter after showering
- Do redress your catheter at least twice a week if not showering daily
- Do inspect the area of skin around the catheter daily, looking for any redness, pus or bleeding
- Do flush your catheter three times a week using either saline or heparinised saline
- Do change the bungs after each flushing (there is no need to do this if you are using a 'closed' system, such as the green Bionectors™)

And

- Don't clean your catheter with anything other than the recommended solutions
- Don't leave your catheter without a dressing unless advised to do so by your haematology doctor
- Don't persist with a dressing that irritates your skin. Seek advice from your doctor
- Don't leave a wet dressing on your catheter
- Don't flush or dress the catheter without first washing your hands. Always wash hands after any catheter care.
- Don't swim or bathe whilst you have the catheter

Any questions?

If you are ever unsure about your catheter or the way it is being looked after, either by you, the district nurses or the hospital, please ask

Step three: Conditioning therapy

The following pages discuss the inpatient part of your transplant and how the treatment may affect you.

Issues discussed in this step

- Things to take into hospital
- Conditioning therapy
- Mouth care
- Expected side effects
 - ✧ Nausea and vomiting
 - ✧ Altered bowel habit
 - ✧ Altered taste and smell
 - ✧ Tiredness and lethargy
 - ✧ Fluid gain
 - ✧ Weight loss
 - ✧ Other considerations

Things to take into hospital

When you go into hospital for your transplant, you can take some personal belongings with you, such as pictures of your family, books, needlework, a personal stereo or CD player. You can often take your own pillow and single duvet, as long as someone can take the covers home and wash them regularly for you.

Other items you need to think about are:

- Something to sleep in
- Day clothes (optional)
- Wash-bag with toiletries (soft or baby toothbrush)

You may wish to contact the transplant unit before you are admitted to see if there is a television or video player in the room.

Please bear in mind that the rooms in transplant units are usually small and the staff need to be able to see you among all your belongings!

Conditioning therapy

Before you can receive your transplant your existing bone marrow and immune system needs to be treated and prepared, to make way for the new cells.

Chemotherapy or radiotherapy, or a combination of the two does this. This treatment is called conditioning therapy.

Not all patients have radiotherapy. Total body irradiation (TBI) is covered in **Appendix C**.

Almost all patients have chemotherapy. This can either be given in tablet form or intravenously, depending on the regime that you are having. The intravenous chemotherapy is given through your line, either in a bag to be infused over an hour or a number of hours, or in a syringe to be given over several minutes by your nurse.

The day after you go into hospital, you usually begin your conditioning therapy. The treatment takes anything from five to 10 days to complete, depending on the type of regime and the type of transplant you are having.

Your transplant is usually scheduled for the day after the conditioning therapy has finished, although this may vary depending on the treatment and the type of transplant. The way the transplant is done is discussed in **Step four: The transplant**.

After the transplant, it is necessary to wait for the cells to engraft or grow again. When engraftment occurs it is usually the recovery of the white blood cells that happens first, and when they are at a safe level, from two to four weeks following the transplant, you will be able to go home. Things to expect during this recovery period are described in more detail in **Step five: Waiting for engraftment.**

Mouth care

When you begin your conditioning therapy, you are given some products to use that help to prevent infections in your mouth. Most types of infections can either be bacterial or fungal.

The mouthcare products are as follows:

- **Antibacterial mouthwash** – to rinse around and then spit out
- **Antifungal suspension** – to rinse around and then swallow
- **Antifungal lozenges** – to be dissolved in your mouth

A combination of these products is to be used regularly throughout the day, at least four times. If you have any difficulty with your mouthcare, please let your nurse know.

Expected side effects

☹️ Nausea and vomiting

Nausea and vomiting have long been associated with chemotherapy. Thanks to continuing research in this area, sickness is now much less of a problem than it used to be.

When you begin your treatment, you are prescribed an anti-sickness drug or anti-emetic. This is to prevent the onset of nausea. This can be given as an injection through your line or as a tablet. If you find that your sickness is not very well controlled, the anti-emetic drug can be changed to another type. There are many different anti-emetics to choose from and one that is most suitable for you will be found.

The use of mild sedatives can also help to achieve control of nausea. Once again, these can be given intravenously.

∴ Altered bowel habit

Another very common side effect of chemotherapy is a change to your normal bowel habit. Diarrhoea is a common complaint, both during and following treatment.

If you have diarrhoea, you are usually asked to provide a specimen which is sent to the laboratory to make sure that there is no infective cause. You need to drink extra fluids or may need an intravenous infusion of fluid and you might need to take a tablet to reduce the number of times you need to go to the toilet.

If you become constipated, please tell your nurse or doctor. They will be able to give you a laxative or a softener to help you go to the toilet. Constipation can become very uncomfortable, so please let them know should the given medication not work.

∴ Altered taste and smell

Chemotherapy and radiotherapy can alter your taste and smell. You may find that you cannot tolerate some foods or aromas at all during your treatment. Adding extra sugar to sweet foods and salt to savoury foods may help. You may even find that cold foods are more palatable than hot. Your sense of taste and smell will return to normal but this can sometimes take time.

∴ Tiredness and lethargy

Conditioning therapy frequently causes tiredness and lethargy. Don't be too worried if after a few days of treatment you find that you are sleeping more, especially during the day. Intensive treatment together with the emotional stresses of going into hospital can be a strain on your reserves. You may also experience a lack of concentration and you may well find that your sleep and rest patterns change altogether.

⚡ Fluid gain

During the conditioning therapy, you may find that you actually put weight on. This can often be caused by the accumulation of the fluid that is given with your chemotherapy. This kind of fluid gain is simple to resolve by the use of diuretics. These are drugs that are used to make you pass increased amounts of urine. They can be given intravenously through your line or as a tablet and take about 30 minutes to an hour to start working. The effects usually wear off after about four to six hours.

⚡ Weight loss

It is common to lose weight when you are not eating your normal diet. Although weight loss is not normally significant during the days of your conditioning therapy, you may well find that your appetite decreases. It may help to adjust your usual eating habits by eating small amounts frequently and to supplement your diet with one of the nutrient drinks at each mealtime.

You can see a dietician for further advice.

There is a possibility, if you are losing a lot of weight, that you may need to begin supplementary feeding. This is often done when you have lost roughly 10% of your starting weight and there is no immediate sign of your appetite improving. There are a number of different ways that food can be given. Nasogastric feeding and total parenteral nutrition (TPN) are the most common.

Nasogastric feeding is done via a very fine tube which is passed through the nostril into the stomach. The feed can be given continuously or intermittently. The latter method provides breaks during which food can be eaten if desired.

TPN is given to you via your central venous catheter. Each bag of TPN (up to 2.5 litres) is usually infused over 24-hours and contains all the nutrients and calories that you need. TPN will usually help to slow down the rate of

weight loss or help to maintain your weight. If you do feel like eating while you are on TPN, then go ahead. TPN, like everything else, is not without its own drawbacks. The nutrient rich liquid can be a magnet for bacteria, and 2.5 litres is a large volume of fluid to be infused each day, alongside antibiotics and transfusions.

Obviously the requirement for each patient is assessed, just like any other drug.

∴ **Other considerations**

There are some other feelings that you may experience when you come into hospital for your transplant. Whilst you may wish to maintain your independence while in hospital, it is often difficult to be totally independent when you are feeling unwell. It is common to have moments, or even days, when you don't want to do anything and would rather depend on your nurse or your carer to help you.

You should be advised not to plan too far ahead with your visitors. Whilst close family and partners are often more than happy to spend the afternoon watching you sleep, some friends can be a little more demanding. If you don't feel like having visitors, please ask your nurse to let them know.

Step four: The transplant

At last the transplant preparation is complete, and you are now ready for the cells to be transplanted.

Issues discussed in this step

- Your transplant
- Before the infusion
- The infusion
- After the infusion

Your transplant

The day of the transplant is often a very exciting one as it signifies a new beginning. This day is referred to as day zero with the days following referred to as plus days, i.e. the day after your transplant is day plus one, two days after is plus two, and so on.

The cells are infused through your line in the same way as a blood transfusion is given through the line.

You have already come a long way in your treatment and this day is an important landmark. However, the transplant itself brings you only part of the way on your journey to recovery. There is still quite a long way to go and you will continue to need help and guidance as you make your way through the remaining steps.

Before the infusion

Just before the infusion of the cells, your nurse gives you some medication through your line, and also starts a saline drip. The medication, an anti-histamine, and sometimes a small dose of steroid, is given to prevent any

allergic reaction during the infusion. Your nurse also checks your temperature, pulse and blood pressure.

The infusion

The actual infusion of the cells can seem a little bit of an anti-climax, since it often doesn't take much longer than half an hour to complete.

The length of time for the infusion depends on the number of bags that are infused. Different types of harvest yield different volumes of fluid. If more than one harvest is required, then there are more bags. Sometimes there are so many bags that the cells need to be infused over two sessions, i.e. two days.

A bone marrow harvest yields approximately 1 to 1.5 litres. The harvest from the marrow contains lots of red blood cells. If the donor and recipient blood groups are different the red blood cells are removed to give a resulting volume of between 80 and 100 mls. This is infused in one bag. If the bone marrow harvest is frozen and stored, then again the red cells are removed but it may be infused in more than one bag. If the bone marrow cells are given fresh, and nothing is removed, then it can take four to six hours to infuse.

A peripheral stem cell harvest (harvesting cells from the blood) performed over one session yields approximately two to three bags. Each bag contains between 90 and 100 mls if it is collected from yourself. The yield is only one bag if the harvest is collected from a donor, unless the cells have been frozen.

A peripheral stem cell harvest performed over two sessions, yields approximately four to six bags, with 90 to 100 mls of fluid per bag. If the harvest is from a donor, then two sessions will produce two bags.

Bone marrow and stem cells that have been harvested and then stored have a preservative added to them, so that the freezing process does not damage the cells. This preservative carries a smell, often described as being 'like boiled

sweetcorn'. You may not be able to pick this smell out at all, but your relatives and visitors may well pass a comment. You excrete the preservative through your skin and in your bodily fluids (in a similar way to excreting garlic) for about 24 hours after the transplant.

After the infusion

After the infusion, your nurse flushes the drip with saline and then takes it down. You have your observations re-checked and then the transplant infusion is finished.

Step five: Waiting for engraftment

This is the time after the transplant that the stem cells make their way to the bone marrow. There they will start to grow and mature into normal blood cells. This is called ‘engraftment’.

Engraftment occurs during the next two to three weeks, although it can sometimes take longer. Often the first sign is a rise in your white blood cell count. This rise can sometimes be unsteady, so don't worry if your count fluctuates up and down a little during the initial stages.

While waiting for your white blood cell count to improve, you continue to be monitored carefully.

The support continues with blood and platelet transfusions, as you require them until you begin to produce your own. You may find that you require blood transfusions a couple of times a week and platelet transfusions around three times a week. Transfusion demand can increase at times, for example when infection occurs.

You may find the uncertainty of this waiting period quite unsettling and it is common to feel vulnerable at this time. You may also feel that the constant monitoring, medical procedures, infusions and treatments are invasive to your personal space. Working out a daily routine may help you to maintain some control.

Issues discussed in this step

- Protective isolation or reverse barrier nursing
- Medication
- Infections
- CMV

- Growth factors
- Mucositis
 - ✦ Mouthcare
 - ✦ Pain
- Venous-occlusive disease (VOD)
- Kidney problems
- Graft rejection
- Graft versus host disease (GvHD)
- Graft versus leukaemia (GvL)
- Fatigue and lethargy
- Immobility
- Coping with your transplant

Protective isolation or reverse barrier nursing

During this time, your immunity against all infections is severely compromised and so you need to be looked after in protective isolation. Protective isolation, or reverse barrier nursing as it is sometimes referred to, is the way of reducing your risks of picking up infections.

Protective isolation methods do vary between transplant centres, but at most centres you are looked after in a single room with the door closed. You are allowed visitors and more details about these are written on the next page. It is usually the centres that perform donor transplants that tend to have special air conditioning systems. These make the air in your room cleaner and so reduce the risk of airborne infections.

When your white cell count falls, your protective isolation period begins. This is usually around the day of the transplant. Activities outside the room

are restricted to absolute essentials such as X rays or scans, which cannot effectively be done in the unit. Restricting activity outside the room does not mean that you cannot move around inside your room. It is important that you do try to get some exercise and walking to the toilet, rather than using urinals or the commode is a good way of keeping active.

There are several elements of protective isolation:

👤 Visitors

Isolation does not mean solitary confinement. You should check visiting times with the nurse in charge of the unit, but on many units you are free to have visitors whenever you wish. Although some units do have a very relaxed policy, please remember that it is a hospital and the nurses and doctors may still need to attend to you while your visitors are there. The number of visitors that you have at one time should be kept to two or three. The rooms are usually quite small and crowds of people can breed infections.

Each unit has its own guidelines about children and babies visiting. If they are permitted you should only have your own children to visit.

There are a number of other considerations with regard to children. If your children are due to be vaccinated, you should speak to the medical staff first. Prior to going in for your transplant, it is worth letting your children's teachers know about your forthcoming treatment so that you may be forewarned of any infections or viral outbreaks (chickenpox, measles) that your children may have been exposed to. Obviously, visits from anyone in contact with any infection are strictly out of the question until they are clear of any incubation period or they are 'infection free'.

If in doubt, please ask the nursing or medical staff.

Your visitors should not mix with other patients. This practice increases your risk of catching infections.

To summarise, any visitors who have been in contact with any infectious disease should not visit until they have gained advice from the medical or nursing staff. If they have been in contact with, or have been suffering from chickenpox, measles, flu, coughs or colds, or are in any doubt at all, they should contact the nursing staff before visiting.

✿ Hand washing

The most important part of protective isolation is hand hygiene. The nurses and doctors always wash their hands with antibacterial soap (in the dispensers that are usually outside the rooms) and then rinse them with an alcoholic rub before they come into your room. Your visitors should do the same.

✿ Clothing

Your visitors should remove their outdoor coats and put on a plastic apron before they visit you.

✿ Fresh flowers and plants

These are not allowed inside your room. They are good breeders of infection. If your friends and family want to send flowers, suggest that they send flowers made of silk, paper or plastic.

✿ Fresh fruit

Fruit is usually not allowed to be kept in your room as the skin can often harbour bacteria and fungi that are dangerous when your white count and immunity are low. However you may eat fruit that can be peeled.

Medication

There are numerous drugs that are used to support you through your transplant. Most of these are given to you in tablet or capsule form initially and then converted into drips and injections if you are unable to tolerate the tablets.

Some of these are medicines to control the symptoms that you may experience, such as nausea and diarrhoea.

When your white blood count is low, you may need to be protected (by antibiotics) from infections caused by bacteria that occur naturally in your body. This is called prophylactic antibiotic therapy. Under normal circumstances, these bacteria are harmless, but with a poorly functioning immune system they can cause infections. You may also need anti-viral treatment to help prevent viral infections. These antibiotics and anti-virals are an important part of your treatment.

Despite prophylactic or preventative medication, it is likely that at some point during your transplant you will develop an infection. This area is discussed in the next section.

Infections

Infections are a common complication of bone marrow transplantation. Your low white cell count and poorly functioning immune system contribute to a high risk of infection.

Fever is the most common sign of infection. Your temperature is checked regularly along with your pulse and blood pressure, particularly at the time when your white cell count remains low.

Some patients can experience a rigor (shivering & feeling cold), before the onset of a fever. If you experience a rigor, you should let your nurse know straight away. Sometimes an infection can cause your blood pressure to fall. If this happens, you will be given extra fluid and sometimes you may even need drugs to help bring the blood pressure back up.

The medicines that are used to treat infections include antibiotics, antifungals and antivirals.

Some of these drugs can cause problems with your liver or kidneys. Therefore these organs will be monitored very closely and adjustments made if necessary.

When you have a fever, the doctor will examine you and will most probably prescribe intravenous antibiotics. These are antibiotics that are given to you through the line. The doctor may also order a chest X ray and take a blood sample from one of the veins in your arm. In addition, the nurse will take blood from each lumen of your line. These blood samples, called 'cultures' are then sent to the laboratory to see if the cause of your temperature can be identified. You may also be given a dose of paracetamol, which brings your temperature down and helps you to feel a little better while waiting for the antibiotics to work.

Some other samples may be taken to investigate the source of infection such as urine, stool or swabs.

It is not unusual for the laboratory to get a negative result from the cultures while you still look and feel as though you have an infection. This is why a broad range of antibiotics is used to treat you for an infection. These antibiotics are effective against many organisms and bacteria and are used until the cause is identified or your temperature returns to normal.

If your temperature persists after 24-48 hours, the test may be repeated and the antibiotics may be changed.

Once the fever and symptoms of infection have resolved, the antibiotic treatment is stopped. It is common for patients to have several fevers and 'rounds' of antibiotics during their transplant.

Once a week a different blood screen may be performed on the patients that have had donor transplants, either from a sibling or an unrelated donor. This is to check for a virus (CMV — discussed below) that can sometimes be present without causing any symptoms.

Another source of infection is the bacteria that other people carry. Good hand washing plays a vital part in stopping the spread of infection from one person to another.

CMV

CMV (cytomegalovirus) is a virus that can cause infection almost anywhere in the body, but most commonly causes pneumonia. It is estimated that about 50 percent of people have been exposed to it and are therefore carriers. With a normal immune system, exposure to CMV causes mild flu-like symptoms. If your immune system is poor, exposure to or reactivation of CMV can be serious. Significant progress has been made in preventing CMV infections, especially in patients who carry the virus or are at risk of reactivating the virus.

Regular blood samples are taken, from those patients that have had donor transplants, particularly during the first few months, to check for any CMV activity in the blood. The test that is used is extremely sensitive and can detect viral activity at very low levels. Patients often require treatment even though they feel well. You will be notified immediately if any viral activity is found.

Growth factors

These are drugs that can be used to speed up the rate of engraftment.

Growth factors are naturally occurring hormones that control the production and function of white blood cells. The side effects are minimal and they do not affect your risk of relapse.

It is normal for the white blood count to fall slightly when the growth factor support is discontinued. This is expected and your white count will recover again after a short while.

Mucositis

∴ Mouth care

Almost all patients experience changes in their mouths and/or gut. The reason that this happens is because the chemotherapy agents that are used attack and damage cells that divide quickly. This includes cancer cells but it also includes bone marrow cells, hair cells and those cells that line the mouth and the gut. This damage usually begins a couple of days after the transplant but can start earlier. These changes are called mucositis and are caused by your conditioning therapy. They can also be caused by treatment you may receive to suppress your immune system.

The type of conditioning therapy and the type of transplant dictates the degree of mucositis you should expect. The stronger and more intense the therapy, the more the likelihood of mucositis.

As a rough guide, mucositis tends to be mild to moderate in those patients that have autologous or reduced intensity conditioned transplants, and moderate to severe in those patients having standard donor transplants or those receiving total body irradiation.

At the onset of mucositis, you may notice that your mouth begins to look white and feels rougher than usual. Your saliva may become thicker and less manageable. You may find it quite difficult to swallow this kind of saliva. You can either spit it out into a receiver or ask one of the nurses to show you how to use the suction. As your mouth continues to change, the surface may become red and inflamed and sometimes painful ulcers can develop.

The areas of your mouth that are usually affected include the insides of your cheeks, the sides and underneath of the tongue and the back of the throat.

Your throat may become very sore and you might find it very difficult to swallow. It is often difficult to do your mouth care at this time, but it is even more important than ever that you do it now as this is when mouth infections are most likely to occur.

In addition to your regular mouthcare routine consisting of a combination of:

- Anti-bacterial mouthwash
- Anti-fungal suspension
- Anti-fungal lozenge

which you are asked to perform throughout the day, there are a number of things you can do to keep your mouth clean and minimise infections.

- Use a soft bristled or baby's toothbrush for keeping your teeth clean. A brush is better, but if this is too sore, there are mouth sponges that may be more gentle
- Use a mouthwash with local anaesthetic, such as Difflam™
- Suck ice cubes or ice-lollies
- Look after your lips. They can often become sore and cracked. Try petroleum jelly or a lip balm
- Your mouth may also feel dry. Boiled sweets and tinned pineapple can often help. Saliva substitutes are available and some patients find them very useful in the short-term

Mucositis in the oesophagus, digestive tract and bowel can manifest itself as discomfort, indigestion, pain and sometimes diarrhoea. Should this occur, please discuss your symptoms with your doctor so that appropriate medication can be prescribed.

Pain

Some patients can get quite severe and painful mucositis. Sometimes painkillers are required to help relieve it. It is important to note that this is not the kind of pain that will go away completely with painkillers but the

painkillers will make you feel more comfortable. There are a number of drugs that can be used to ease the pain, from paracetamol, to special mouthwashes, to morphine. There are also a number of ways that these drugs can be given.

- **Orally** – tablets or suspensions
- **Topically** – mouthwashes, lozenges
- **Intravenously (usually morphine)** – injections into the line, or PCA

PCA is short for patient-controlled analgesia. This is a pump that is connected to your line or under the skin. The pump has a hand set with a button which, when pressed, delivers a small dose of morphine through the line. The pump has a lockout timer which means that no matter how many times the button is pressed, the pump only delivers a certain amount of drug in a certain period of time. This is often a very useful method of pain control, as patients tend only to press the button when they have pain. This way patients often use less of the painkiller than if they were having it all the time.

Please ask your doctor or nurse to give you more advice about these medicines.

It is important to remember that your mouth pain is temporary and it will heal once the effects of the conditioning therapy have gone and your graft begins to function. However, it can be some time before your mouth really feels ‘normal’ again.

Mouthcare is essential and helps to make you feel more comfortable, helps to reduce the risk of infection and may help your mouth to heal more quickly.

Veno-occlusive disease (VOD)

Veno-occlusive disease is a problem with the liver. You may hear it referred to as VOD. It is a specific disease where the blood flow through the small veins of the liver is partially blocked. VOD can be life threatening if severe.

This can cause symptoms such as yellowing of the eyes and skin (known as jaundice), swelling or distension of the abdomen and fluid accumulation.

VOD can be caused by the high doses of conditioning therapy that you have before the transplant. The stronger the chemotherapy, the higher the risk of VOD. The chemotherapy, as well as preparing the way for your transplant, can have a damaging effect on otherwise healthy tissues. When the liver is damaged, this can result in VOD. It can occur at any time from after the start of the conditioning therapy, to the third week after transplantation and in a very few cases it can occur even later.

VOD is more prevalent in those patients having standard donor transplants than in those receiving reduced intensity conditioned transplants. It is usually very mild, disappears very quickly and you are often not even aware of it.

VOD can however, be a very serious problem and treatment is aimed at minimising its effects. Recovery is aided by the liver's great ability to recover and regenerate from the effects of diseases such as this.

Kidney problems

Your kidneys perform several very important function, such as:

- Urine production
- Fluid balance
- Removal of waste products from the body
- Processing of drugs

Your kidneys depend on the efficiency of your other organs in order to function normally.

Mild kidney problems are common following a bone marrow transplant.

Your nurse and doctor will keep a close eye on your kidney function through:

- Blood tests
- Urine quality
- Urine quantity
- Daily weighing

These factors are taken into account when your kidney function is assessed and help it to return to normal. It is important to note that although mild kidney problems are common, they are usually treated aggressively and will usually resolve completely.

Graft rejection

Graft rejection can occur in donor transplants. It is when the donor cells do not engraft properly, and are unable to produce new and healthy blood cells. Graft rejection can happen for a number of reasons but it is not very common.

One factor that can affect the risk of graft rejection is the degree of tissue type compatibility between the donor and recipient. Generally speaking, the closer the tissue type match the lower the risk of graft rejection.

Graft versus host disease (GvHD)

GvHD is an effect that can occur following donor transplants. The new stem cells (new immune system) recognise the host (your body) as 'foreign' and fight against it. This can create a certain response in some organs. GvHD can be mild, moderate or severe and it can also be life-threatening.

There are drugs that are used to prevent GvHD and drugs used to treat it.

The drugs given as prophylaxis against GvHD are given as part of your conditioning therapy and can be in the form of antibody therapy (such as MabCampath™) and chemotherapy (such as methotrexate).

The drugs used to treat GvHD are varied and include ciclosporin, steroids and other immune suppressive agents. Treatment is individualised and these drugs can have some side effects as well as beneficial effects on your body.

Ciclosporin in particular is very commonly used and can cause hirsutism (extra hair growth), fluid retention and high blood pressure. These side effects disappear once the ciclosporin has been stopped. **While you are on ciclosporin you should avoid grapefruit and grapefruit products.**

GvHD can be divided into two different types, acute and chronic graft versus host disease.

∴ Acute graft versus host disease

This occurs within the first 100 days of the transplant. It primarily affects the cells of the skin producing a rash but it may also attack the cells of the liver and gut. Around the time that the cells are expected to engraft the doctors will seem particularly interested in the palms of your hands and the soles of your feet, inspecting them daily for any signs of GvHD, such as redness or itching. They will also be monitoring your gut and bowel. You are frequently asked if you have had any diarrhoea and specimens may be requested.

Occasionally, the doctors may also ask for a rectal biopsy. This is a small sample of tissue taken from just inside the bowel. It can be analysed to see if any of the cells present GvHD.

The doctors will also be monitoring your liver, mostly by routine blood tests. If you have GvHD of the liver, you may notice a yellowing of the skin and eyes (jaundice). The doctors may wish to perform an ultrasound or CT scan of the liver.

The treatment for acute graft versus host disease is with immune suppressive drugs and ciclosporin.

∴ Chronic graft versus host disease

Chronic GvHD occurs after the first 100 days and can present in many ways in addition to skin, liver and gut manifestations. While chronic GvHD mainly affects the skin, and can cause it to become scarred over time, it can also affect the gut and cause weight loss and problems associated with malabsorption. Chronic graft versus host disease can also affect the cells of the eyes, mouth, liver and lungs.

Chronic GvHD is mainly treated with immunosuppressive drugs. Sometimes it can linger and be very difficult to treat. In these cases, different treatments can be tried and after a time the condition can improve.

Graft versus leukaemia

In donor transplants the same cells which cause GvHD may also attack any remaining leukaemia cells. This is a positive and powerful effect and is considered a great advantage, especially in patients where a good remission has been difficult to maintain. This effect can also work in other diseases such as lymphoma and myeloma, but does not tend to be quite as powerful as it is in some leukaemias.

There is a treatment available to some patients who relapse soon after their transplant. This treatment induces the graft versus leukaemia effect and is performed by giving the patient lymphocytes from the original stem cell donor. This is called donor lymphocyte infusion (DLI). With this treatment, there is no need to prepare you, unlike the transplant. The lymphocytes can simply be given to you, like a blood transfusion, usually as an outpatient. Donor lymphocytes can be given for reasons other than relapse. Your doctor will discuss this with you in more detail.

This procedure can be carried out several times until the graft versus leukaemia effect is achieved, although there are a number of patients in whom this treatment is unsuccessful.

A known side effect of DLI is graft versus host disease. If this occurs, it may need to be treated with drugs as described above.

Fatigue and lethargy

Fatigue is a common problem during this stage. Patients often find it difficult to concentrate on reading a book, watching television or even holding a conversation. This is normal and it is important that you set yourself realistic goals and reasonable expectations of your abilities at this time. Rest and light exercise are often helpful.

There are a number of reasons why you can feel tired. You are still having a lot of treatment, you may have a lower number of red blood cells than usual, your usual sleep pattern may well be disturbed and there is often still a lot of anxiety about the treatment.

You may well find that activities such as showering or bathing are exhausting. Try to conserve your energy by doing things for a shorter period of time, and then rest.

A good night's sleep is important to prepare you for the day ahead. Getting to sleep at night can often be difficult. Maybe you are resting too much during the day. Remember the things that you do at home that help you to go to sleep, e.g. reading, listening to the radio, hot milky drinks. Try to recreate the same atmosphere while you are in hospital.

Please talk to your nurse or doctor if you are having problems with sleeping.

Immobility

Problems associated with the effects of bed rest, illness and reduced mobility are common. Daily light exercise helps to:

- Maintain muscle strength
- Minimise muscle loss associated with prolonged bed rest

- Maintain balance and co-ordination
- Promote feelings of wellbeing
- Enhance physical comfort
- Prevent chest infections associated with prolonged bed rest

You are certainly going to have some days that are better than others. Try to take advantage of these by getting up more and moving around.

Coping with your transplant

During this period, it is common to feel anxious and emotional. Some days you may feel very strong and ready to take on the world, while on other days you may feel weaker and unable to face the day ahead. The way of coping with these feelings is a very individual thing and you will find your own way of dealing with them.

Remember your goals and your own personal reasons for having your transplant. Focus on your future, and try to remain positive. Laughter is very therapeutic and gives you a sense of wellbeing from the inside as well as the outside.

You may find relaxation techniques are a useful way of helping to redirect your anxieties.

The following suggestions may help:

- Relaxation tapes
- Listening to music or books on tape
- Deep breathing techniques
- Gentle massage
- Reading
- Time alone or with your partner

Step six: Recovery after engraftment

This step is about your continuing recovery. Even though you have engrafted, and your white cell count is recovering, you are still susceptible to complications. In particular, those patients that have had a donor transplant have very immature immune systems for many months after the transplant.

Issues discussed in this step

- Getting ready to go home
- Things to look out for
- Re-admission to hospital
- Outpatient appointments
- Drugs to take at home
- Risk of infection
- Bleeding
- Central line
- Fatigue
- Exercise
- Emotional changes
- Avoiding crowds
- Going back to work
- Appetite and diet
- Mouth care
- Skin care
- Hair regrowth
- Sexual activity
- Foreign travel

Getting ready to go home

Going home after your transplant can be a very difficult period of re-adjustment for you and your family. You have undergone an intensive and often stressful procedure. Although you may feel excited, as you leave the hospital on the day you go home, you may also feel a little anxious about leaving the security of the hospital.

This is perfectly normal and if you have any questions when you get home, please phone the transplant unit. A familiar voice is often reassuring and the nurse or doctor can probably sort out any queries that you have over the phone.

During the days prior to your discharge, your nurses will help you with your plans for going home.

Outlined below is some information that will hopefully make this transition a little easier for you. Do not hesitate to discuss any of your worries with your doctor or nurse.

Things to look out for

You need to contact the hospital immediately if you develop any of the following symptoms:

⚡ **Central line**

- Shivering episode after flushing your line
- Swelling, tenderness or pus around your line

⚡ **Bowels**

- Persistent diarrhoea or constipation
- Change in the colour or consistency of your stools
- Gut cramps

⚡ Urine

- Change in colour
- Pain or burning sensation
- Red urine, clots or difficulty in passing urine

⚡ Skin

- Appearance of a rash
- Worsening rash
- Itching

⚡ Temperature/shivering

- Temperature over 38°C, with or without shivering
- Shivering with or without temperature

⚡ Pain

- A persistent headache which does not respond to paracetamol
- Stomach ache
- Gut cramps
- Joint pain
- Mouth lesions or sore throat

⚡ Nausea or vomiting

- Let the hospital know if this is new or is preventing you from drinking or taking your medication.

⚡ Medications

- Let the hospital know if, for whatever reason, you are unable to take your medication.

⌚ **Bleeding**

- Any signs of bleeding or bruising; for example bleeding gums, or blood in the urine or stools
- Persistent nosebleed

⌚ **Cough or breathlessness**

- A new or persistent or worsening cough
- Shortness of breath or increasing shortness of breath

⌚ **Others**

- Suspected contact with anyone who has chickenpox, measles, shingles etc.

This list of problems is intended to provide you with a rough guide. It is impossible to include everything that may happen. If you do have a problem, or you feel unwell, please call the hospital straight away. It is important and could be vital!

Re-admission to hospital

It is very common for patients who have had a transplant to be re-admitted in the immediate weeks or months following discharge. There are a number of reasons for this. If there is a problem, please do not delay in letting the hospital know. Do not be too worried or disappointed if this happens to you.

Common reasons for re-admission are:

- **Infections** – bacterial, viral or fungal
- **Nausea/vomiting** – particularly if you are unable to drink or take your medication
- **Diarrhoea** – particularly if you are at risk of becoming dehydrated
- **Graft versus host disease for patients that have donor transplants** – this may require more intense monitoring and treatment

Outpatient appointments

You need to be seen in the hospital as an outpatient quite regularly (often three times a week) when you first go home.

Each time you go to the hospital you will have blood tests and, when the results are ready, the doctor will see you. Sometimes your doctor may arrange for you to have a chest X ray or other tests when he sees you. This is normal and just part of the way of keeping an eye on your progress.

You may continue to need regular platelet or blood transfusions. These can usually be given to you at your outpatient unit.

You may also have formal clinic appointments in the outpatient clinic at the transplant centre. Here you have your progress reviewed and have plenty of opportunity to ask questions.

The frequency of your outpatient appointments lessens as your recovery continues.

Depending on your disease, you may need to have further investigations following your transplant, such as scans and bone marrow tests. Through these your continuing progress is checked and the overall response of your disease to the transplant is assessed. These tests are fully explained to you as they are planned.

Don't forget you don't need to wait until your next outpatient appointment to ask questions that might be bothering you.

Drugs to take at home

You probably need to continue to take some of your drugs when you go home. The number and type of drugs depends on the type of transplant that you have had. The nurses on the unit will go through the drugs that you need

to take with you and for how long. You are usually given a list of the drugs for your own record. It will be useful to take this list with you to your clinic appointments. You initially get a supply of drugs for one to two weeks, and then you are able to get a further prescription when you go to the clinic.

If you are taking ciclosporin when you go home, you need to have your levels checked when you go to the clinic. This is done by taking a blood sample. It is very important that you DO NOT take your ciclosporin on the morning of your appointment.

Risk of infection

Even though you are now well enough to go home, you are still at risk of infection as your white count is not yet normal. If you have had a donor transplant your immune system remains immature for many months.

You need to continue to take the same precautions that you began in hospital:

- Daily shower
- Regular hand washing
- Regular mouth care
- Avoiding contact with people who have colds, flu or other viral infections
- Avoiding contact with people who have been in contact with others, particularly children, who may have measles, chickenpox or shingles
- Make sure that any pets that you have, if they can't be looked after elsewhere, are kept clean and free of fleas, and try not to have close facial contact with them
- Always wash your hands thoroughly after contact with pets

You may begin some tablet antibiotics as you go home. These are to help prevent infections that can occur after your bone marrow transplant. It is important that you continue to take these antibiotics until your haematology doctor stops them.

You also need treatment to prevent you from catching a particular chest infection called PCP (*Pneumocystis carinii* pneumonia). When your white cell count is low, this is done by giving you a solution (pentamidine) that you inhale through a nebuliser. You can be given the treatment in the outpatient department, usually once a fortnight or once a month and it takes about 30 minutes to complete each time. When your white count has improved, this drug can be given to you in a tablet form called Septrin™, which continues for at least six months.

You need to take your own temperature when you are at home, as this can provide a sign of infection even if you feel well. Take your temperature at least once a day or more often if you feel unwell. Infections at home can progress just as rapidly as they can while you are in hospital, and if you do develop a temperature (38°C or above) you need to contact the hospital as soon as possible.

Temperatures are a common cause of re-admission to the hospital in the days and weeks after you go home. These temperatures often require prompt treatment and you should never sit at home and wait for it to go away. These temperatures if left untreated can develop into life-threatening infections.

Bleeding

You may still need to have platelet transfusions after you go home. You should contact the hospital immediately if you develop any new bruising, bleeding (for example, blood in your urine or stools) or a persistent nosebleed.

Central line

If you are still requiring regular transfusions (blood and platelets) you still need your line. As you will have discovered, as well as giving you infusions down the catheter, it can also be used for your blood tests. These also continue at each visit to the clinic.

The catheter needs to be looked after at home, flushing and cleaning it and redressing the site. The district nurse can do this for you, but you may find it much more convenient to learn to look after it yourself or have your partner do it for you.

If you would like to learn how to look after the catheter, the staff on the transplant unit can teach you before you go home.

As soon as your blood counts are stable, and your catheter is no longer required, it is removed. This is a minor procedure and is nothing to worry about.

Fatigue

When you first go home after your transplant, no matter how keen you are to go, or how bored you may have been in hospital, it is common to feel tired at this stage in your recovery. This can continue for some time.

Your body has been through intensive treatment and you need time to heal and recover. If you have had total body irradiation as part of your treatment, you may feel these effects more than other patients. Take it easy at home, take gentle exercise and get plenty of rest. Have a sleep during the day if it helps.

The important thing is not to worry. The tiredness could go on for several weeks, possibly even months in some cases, but it will pass.

You may need to have occasional blood transfusions in your outpatient department. This is not uncommon and may help with the feeling of tiredness.

Exercise

Despite the fatigue it is important to keep active, as this can actually help to prevent some of the complications of the transplant.

At first, you probably won't feel up to much in the way of exercise! You need to start gently. Make sure you get up, shower and dress each day. Initially, this may feel like an incredible achievement. Soon you will be able to go for a short walk, even if it's just around the garden. The fresh air will feel wonderful and do you good after weeks in the hospital.

Gradually, you will be able to build it up, and within a couple of months you will be well on the way to being back to your old active self!

The journey to good health and normality often seems like a long one, but you have come a long way and you are almost there. It just takes time and patience.

Try to take it one day at a time. Achieving simple, but realistic goals, is a huge boost to your confidence, which help you to measure your improvement.

Sometimes, keeping a diary can help you to measure your progress over a period of time, as you may quickly forget the improvement as the weeks pass.

Emotional changes

It is also common to feel depressed at times. There are a lot of changes going on in your life at this time and you may feel that you don't need to depend on your carers as much, and you may even experience changes in your relationships with your partner and family.

You may feel the need to re-assert your role in the family and to take back some of the responsibilities that go with that role. This is rarely achieved overnight and you really need to set yourself attainable goals.

Avoiding crowds

Use your common sense to guide you in making decisions. You will need to avoid crowds, but this does not mean that you can't go out. If you want to go to public places, such as restaurants and shops, make sure that you avoid them during peak hours.

Touching people and physical contact are not discouraged but you should limit this to family and others that are close to you.

Going back to work

There are no hard and fast rules about when you should return to work. This applies if you go out to work, or if you are a full time housewife or mother/father. As a rough guide, if you have had an autologous transplant, then you would normally need about three months off work. For donor transplants, this extends to four to six months.

You should not consider committing yourself to the pressures of work until you feel fully able to cope. If you are able to go back part time initially, that is best. Generally, whenever you feel ready, it is okay, but you should discuss it with your doctor first.

Appetite and diet

Your appetite has probably reduced while you have been in hospital. This is likely to dramatically improve as soon as you get home and away from the hospital food!

It is usually a good idea to eat small meals — little and often.

If you are having problems managing meals, then have your food served on a small plate. Large meals often look too difficult to manage and you can be put off as soon as you see it.

It is common for partners and carers to devote a great deal of time to preparing your favourite meals for you. You may be quite faddy and fussy about your food. You might dream of a Sunday roast and then when it is cooked and served, you may have gone off the idea altogether. Choose food that can be prepared quickly and is tasty and easy to eat.

Go for things that you really fancy – maybe you've been craving something while you've been in hospital – now's your chance.

Even if you are not eating as much as usual, make sure that you drink a lot – aim for six to eight glasses a day.

You won't need to stick to the dietary advice quite as rigidly once you go home, but please be sensible.

You may continue to experience taste changes for some time after your transplant. Sweet tastes often return to normal first – a good excuse to treat yourself and add extra sugar.

You may also continue to experience some changes in your sense of smell. Cold foods tend to smell less than hot foods, so if smells make you feel nauseous, try it cold.

It is important to remember that if you are taking ciclosporin, you should avoid grapefruit and any products containing grapefruit.

Mouth care

You may need to continue with some mouthcare when you go home. Your white cell count may still be lower than normal, so you need to protect your mouth from infections. Make sure you keep it clean, especially after eating.

If you notice any bleeding, ulcers or coldsores, let your doctor know. If you are having any problems with your teeth, please let your doctor know. Do not visit your dentist unless you have discussed it with your doctor first.

Your mouth may also continue to be dry for some time, especially if you have had total body irradiation. Everyone finds their own particular way of managing this, but some suggestions include:

- Increasing the amount you drink each day, especially with meals
- Iced lollies
- Boiled sweets
- Chewing gum
- Citrus fruits and tinned pineapple chunks (except grapefruit – while on ciclosporin)
- Synthetic saliva sprays

Skin care

Following your transplant, your skin may be drier or more sensitive than usual. If so, you may find it helpful to use baby oil, another non-irritating oil or an aqueous cream such as E45.

If you develop a rash or your skin looks red, please contact the hospital straight away.

If you have had total body irradiation, you should be particularly careful in the sun. Avoid strong sunlight for at least six months after your transplant and then always use a sunblock.

Hair regrowth

Your hair will start to grow back, and you will probably see a difference in a few weeks. When your hair does grow, don't be surprised if it's a different texture. People with previously straight hair often develop curls during the first few months of growth. Sometimes it's a slightly different shade from before. These differences often disappear as your hair continues to grow.

Until your hair grows back, it's important to look after your scalp. Make sure it's covered when you go out in either hot or cold weather.

Sexual activity

It is likely that your transplant will affect your sex life. Initially, you may feel too tired or simply experience a reduced desire for sexual activity. This is common and it is likely that everything will return to normal in time. If you have any questions, or are experiencing any persistent problems in this area, don't hesitate to talk to your doctor.

It is often a good idea for women to use a lubricating jelly as the vagina may be drier than usual. Men should also use lubrication to prevent friction.

It is recommended that you always use a reliable method of contraception, since although you are likely to be infertile after your transplant there are no guarantees. A barrier method of contraception, such as condoms (with a spermicide) is generally suggested as this also helps to reduce the risk of infection.

Some women may need to be referred for hormone replacement therapy (HRT). This again, depends on the type of conditioning therapy and the type of transplant that you have had. Please refer to the **Appendix – Early menopause** for further details.

If you have any questions about the menopause or your symptoms, please ask your nurse or doctor.

Foreign travel

It is not usually a good idea to plan a holiday abroad immediately after you go home. You should discuss any travel plans with your doctor. You will almost certainly need to get special travel insurance cover. Please ask for details.

Step seven: Long-term recovery

The length of time it takes for you to fully recover from the transplant is a very individual thing and is dependent on the type of transplant that you have had.

Getting back to your previous routine may not be exactly what you want at this stage. You may need to make some adjustments, in your personal as well as professional life, in order to realise your potential.

It is common to feel that your life has been put on hold by your ill health. Preparing to re-enter work and your family life can be difficult.

In getting your control back, you may be surprised that your views and attitude to many things may have changed. A few patients have experienced a change of direction in their lives, a greater compassion to others and appreciation of the simple things, improved family relationships etc.

Many patients feel that their quality of life is better than before their illness, and are often surprised that they notice and value things in life with renewed enthusiasm.

Although the transplant is a serious time, most patients are happy with the results of their treatment and are very positive about their future.

Issues discussed in this step

- Recovery of the immune system and vaccinations
- Possible late complications
- Chronic graft versus host disease

Recovery of the immune system and vaccinations

Following an autologous transplant, the immune system will recover within a few months. There is no need in this setting to worry about re-vaccinations.

Following donor transplants, it can take up to a year or even longer for the donor immune system to recover its function. As part of this type of transplant, you lose your immunity to all of the diseases that you were vaccinated against as a child. After the first year you will see your doctor and he will assess whether you are ready to have your vaccinations. These include measles, mumps, rubella and the non-live polio vaccine.

If you have an infant at home, who has recently had the oral polio vaccine, you must avoid contact with them for a period of six weeks. This is because the virus from this particular form of the polio vaccine is shed in the urine and faeces during this time. An alternative is to give the infant the non-live (inactivated) polio vaccine. Your GP will be able to give you advice on the vaccines available.

There is no need for isolation from family members having any of the other vaccines.

Possible late complications

⚠️ Infection

In the first year after your transplant, you may experience reactivation of viral infections. These include cytomegalovirus (CMV) as well as the chickenpox (*Herpes zoster*) virus.

As previously mentioned, CMV can cause severe infections and there will be regular checks for signs of CMV in the blood. If CMV activity is found then it may be necessary to admit you to the hospital for a number of weeks of treatment.

The infection which results from the chickenpox virus is called shingles. This can be painful and can cause scarring. You often need to be admitted to hospital for intravenous treatment with anti-viral drugs.

You may also be vulnerable to chest infections and you should report any symptoms such as fever, cough, difficulty in breathing etc, to your doctor straight away.

Cataracts

If you had TBI as part of your conditioning therapy, then you may recall that patients who have had this type of irradiation are at increased risk of developing cataracts during the first five years following transplantation. You will have annual eye examinations for this reason.

Chronic graft versus host disease

If you have had a donor transplant, around day 100 is the time that you can develop chronic graft versus host disease (GvHD).

Chronic GvHD mainly affects the skin and can cause it to become dry, scaly and discoloured with patches of thicker and harder underlying tissue.

The surface of the eyes and mouth can become quite dry and mouth sores can occur.

With chronic GvHD of the gut, malabsorption of food and nutrients may be a problem and maintaining weight can be difficult.

Chronic GvHD is mainly treated with immune suppressive drugs. Because of this treatment, chronic GvHD sufferers are more prone to infections and so should take extra care.

Sometimes chronic GvHD can linger and be very difficult to treat. In these cases different treatments can be tried and, after a time, the condition can improve.

However, chronic GvHD, although a recognised side effect of donor transplantation, only affects a small number of patients.

It is also well documented that patients who develop GvHD have a lower risk of their disease returning than those who do not.

Final comment

Now that you have reached the end of this book, I hope that you found it useful.

During its development I learned a lot about the needs of patients and individuals approaching a bone marrow transplant. I hope this helps to make your journey to recovery a little easier.

Use the book as you wish. You might want to read it in steps, or read it right the way through. You may want your family to read it, so they can learn a little more about your transplant.

Michelle Kenyon

Appendix A: Bone marrow donation and harvesting

The techniques that are used to obtain bone marrow or peripheral blood stem cells from patients and donors are essentially the same, although there are some subtle differences.

How do we get the cells?

The cells for a transplant are obtained from the bone marrow or the blood. These are called stem cells.

The process used to collect stem cells is called harvesting.

There are two different ways that we can harvest the cells:

- Bone marrow harvest
- Peripheral blood stem cell harvest

These two procedures are quite different and are explained in detail over the next few pages.

For patients, the type of harvesting procedure that is selected is based upon certain criteria such as your disease, previous chemotherapy and treatment.

For patients receiving a matched unrelated donor transplant, some of your cells will usually need to be harvested and stored before the transplant.

For donors, the two options are usually discussed at the time of the medical assessment or the clinic appointment.

Routine virology screening

All patients and donors need to have a routine virology screening performed prior to the harvest. This is done to prevent cross-infection when the cells are put into storage. The viruses routinely screened for are:

- **HIV (type 1 + 2)**
- **Hepatitis B + C**
- **CMV**
- **HTLV 1 + 2**
- **EBV**

The results are usually available in a few days. There may be some additional tests including:

- Syphilis
- Toxoplasma

It is a requirement that you are notified of the nature of these tests before they are performed. If you need to discuss the test further with your haematology doctor, please do so. You may wish to be offered counselling from a specialist health adviser prior to the test. If you would like any further information, please do not hesitate to ask.

Bone marrow harvesting

This type of harvesting is carried out in theatre under a general anaesthetic. It is considered a very safe procedure and is routinely carried out in very large numbers of volunteer donors without any significant problem.

The sites that are used for collecting the bone marrow in this way are the back of the hips (iliac crests) and infrequently the breastbone (sternum). A special needle is inserted through the skin into the site and the liquid marrow is drawn off.

The harvest takes about an hour to complete and about 1-1.5 litres in volume are removed. This amount of bone marrow is replaced very quickly (within approximately three weeks) and the procedure does not affect normal blood cell production. The bone marrow that we take contains a number of red blood cells and they may need to be replaced with a blood transfusion of one or two units. This may be given in theatre or when you return to the ward. When you come back from the operating theatre, you will usually have an intravenous drip of fluid to help replace the fluid that is drawn off with the bone marrow stem cells.

In some cases, immediately following the harvest, the bone marrow may be 'processed' to filter out and remove the excess of red blood cells, fat and other unwanted particles. This also reduces the volume of the end product to less than 100 mls. The stem cells can be used immediately or can be frozen and stored for months or even years.

For a bone marrow donor whose normal blood level is on the low side of normal, it may be necessary to donate one or two units of blood a couple of weeks or a month prior to the harvest. This eliminates any slight risks of transfusion related transmission of blood-borne viruses.

∴ Admission procedure

You are usually admitted to the hospital the day before the harvest. When you arrive at the hospital, you may need to have some routine blood tests. You may also be seen by the doctor to discuss the procedure and to sign your consent form.

As well as taking your nightwear, you may wish to take in some books, magazines or tapes.

You are not allowed anything to eat or drink from midnight the night before theatre but you are allowed to drink when you return.

In the morning, you are asked to shower and put on a hospital gown. No powder, creams or make-up should be used after showering and any nail polish should be removed. Contact lenses and any jewellery, except a wedding ring, should also be removed.

You usually need to stay in hospital for two nights, the night before and the night after the procedure.

∴ Side effects

There is a very small risk associated with the general anaesthetic, but if you have any concerns about this please do not hesitate to discuss them with your doctor.

You usually feel a little sore following the procedure but the use of simple painkillers, such as paracetamol, should be sufficient.

You may be slightly anaemic when you go home and for donors a prescription of iron tablets will correct this over the following weeks.

The majority of people are able to go back to normal activity after a few days and will feel perfectly normal after a week or two.

Peripheral blood stem cell harvesting

In normal health there are small numbers of stem cells circulating in the bloodstream but not enough to collect for a harvest. It is now possible to move or 'mobilise' stem cells from the bone marrow into the blood to provide adequate numbers for harvesting to be performed.

The cells can be mobilised in two different ways:

○ With the use of growth factors alone

This type of mobilisation is used for donors and patients.

Growth factors are natural hormones, which stimulate cell production and are given as an injection under the skin.

The growth factor used is called G-CSF, which stands for granulocyte colony stimulating factor. A number of patients and donors have reported minor flu-like symptoms and moderate bone pain, often in the breastbone, hips and back. A simple painkiller, such as paracetamol should ease the discomfort. These effects disappear once the injections have stopped.

○ **With chemotherapy and growth factors**

This type of mobilisation is only used for patients.

Chemotherapy is given and then, during cell recovery, growth factor injections are given to mobilise the stem cells and stimulate recovery.

The cells are harvested by passing the whole blood through a machine (cell separator). The cell separator contains a centrifuge that spins the blood at a very high speed without damaging the cells. This spinning separates the different cells in the blood into layers. The layer containing the stem cells is selected and the cells are collected in a bag. This is a continuous process, and while blood is being spun in the centrifuge, the rest of the blood is returned to the patient via a return line. All components which come into contact with the blood are single-use only.

You may need to be seen at the hospital before the harvest, so that your veins can be assessed to see if they are suitable for the needles. If your veins are too small you may need to have a temporary line or catheter inserted into one of the large veins in your groin by a doctor.

For patients who have a central venous catheter you may well find that this is unsuitable for the harvest, so once again you may need a temporary groin line.

If your veins are suitable, you will have a needle in one arm and one in the back of your hand (one for the blood going out and one for the blood being returned) and because of this your movements are fairly restricted during the procedure.

You can eat and drink normally while you are on the machine so take a light snack or sandwich with you.

Each session takes about three to four hours but you should expect to spend the whole day at the hospital or harvesting centre. You may need to arrive early for the first session to allow plenty of time for blood tests before the procedure starts. The harvest is normally completed in one or two sessions. A third session is sometimes required but usually only applies to patients who have already had many courses of chemotherapy.

You can come with an escort and be driven home or accompanied on public transport. You are advised not to drive following the procedure.

∴ Side effects

It is not unusual to experience some of the side effects that are listed below. If you report them immediately they can be treated promptly and effectively, without the need to interrupt the procedure.

Although the cell separator removes and replaces only a small portion of blood at any one time (about a teacupful), changes in blood volume can sometimes make you feel dizzy, light headed, cold or nauseated. You should inform the nurse or doctor who is with you if you begin to feel uncomfortable.

The anticoagulant that is used to prevent the blood in the machine from clotting, may cause a sour taste in the mouth, tingling around the lips, cheeks or fingertips or in other areas where you may have sensitive nerve endings. This can very easily be treated by giving a tablet called Calcichew™ which

tastes like an orange lozenge, or you could have a glass of milk. It is a good idea to have breakfast the morning of the harvest as this seems to reduce this side effect. In addition, an extra glass of milk or some cheese the night before the harvest will help to give you a little extra calcium.

Once again, you should inform the nurse or doctor who is with you if you feel any of these symptoms.

You will probably feel quite tired following the procedure and require rest.

Donor lymphocyte collection

In some instances, a further collection is taken from the blood of the donor. The timing of this collection might be around the same time as the stem cell harvest or performed at a later date if required.

The cells that are collected are called lymphocytes and these can be used to help prevent or treat relapse of the disease.

The cells are obtained in the same way as in a peripheral stem cell harvest (described in the previous section); the big difference being that there is no need to 'mobilise' the cells or give any growth factors. The lymphocytes are readily available in the blood stream.

The process of collecting the lymphocytes is usually completed in one session of approximately three hours.

Storage of cells

When the cells are harvested they can be used straight away or they can be frozen and stored until they are required. The latest technology and equipment is used to ensure that the cells are stored safely. Cells can be stored for many years this way, although many centres are adopting a policy of storing cells for a set number of years.

When the cells are frozen, a preservative is added to them to protect them from damage during the freezing process.

Research and developments in this area are ongoing and over the years the methods of storage and equipment may change.

Time off and return to work

⌚ Following a peripheral stem cell harvest

You should be able to work as normal during the injections but you need to take time off work for the day(s) of the harvest.

You will be fit to return to work the day after the procedure(s). However, you may wish to take a further day off as the harvest can be tiring.

⌚ Following a bone marrow harvest

Bone marrow donors may need to take time off from work prior to the harvest so that unit(s) of blood can be pre-donated if required.

You will need to take time off for the two days in hospital and additional week to stay at home and recover.

Appendix B: Early menopause following bone marrow transplant and high-dose chemotherapy

Early menopause may not be your main concern at this stage of your preparation, but the high-dose chemotherapy and/or radiotherapy that you receive before your transplant is likely to damage your ovaries. This damage frequently leads to premature menopause.

The term menopause simply means stopping menstruation (periods). It is often referred to as 'the change of life' or simply 'the change'.

The menopause usually occurs in your late forties or early fifties, but the early menopause that occurs as a result of treatments such as chemotherapy and radiotherapy can occur at any age. The onset of the menopause, in this setting, is often relatively sudden. Since your ovaries cannot be protected during your treatment this cannot be prevented from happening. When the menopause occurs, the levels of the hormones oestrogen and progesterone in the bloodstream are altered. Your body has to adapt to these changes. Often this happens with few or no problems but sometimes the lack of progesterone and oestrogen and the other changes can lead to further conditions, especially if the menopause has occurred at a relatively young age.

The hormonal changes can affect you in different ways:

- Changes in periods
 - Missing periods
 - Shorter times between periods
 - Less frequent periods
 - Irregular cycle length
 - Scanty flow
 - Heavier flow
- Physical symptoms
 - Hot flushes
 - Sweats
 - Dry skin
 - Dry hair
- Genital changes
 - Vaginal dryness
 - Itchiness
 - Tenderness
- Other symptoms
 - Headaches
 - Joint pain
 - Anxiety
 - Tension
 - Depression
 - Irritability

In about five percent of women with premature menopause, the ovaries have become active again after a period of time and a very small number of women have become pregnant.

It is for this reason that you should use some form of contraception after your transplant.

Long-term effects of premature menopause

Although many of the early symptoms of menopause do lessen with time, there are other symptoms that can be more persistent or even permanent.

∴ Infertility

Because you are no longer able to produce eggs once you go through the menopause, you will no longer be fertile. The effects of high-dose chemotherapy and bone marrow transplant on fertility are discussed in

Step one: Planning ahead.

∴ Osteoporosis

Your ovaries produce the hormone oestrogen. This hormone helps to prevent osteoporosis which is a condition where the bones become brittle and more likely to break.

Osteoporosis is preventable and if it occurs it can be treated effectively.

∴ Cardio-vascular disease

The risk of coronary heart disease is increased in women who are 'post menopause'. It is thought that oestrogen helps to protect the heart. However, there are treatments available that can reduce the risk of heart disease.

The start of the menopause is not the end of your sex life! However, many women do experience a reduced sex drive, during and after the menopause. Remember the menopause is not the only reason that you may feel less interested in sex. You have been through intensive treatment. Recovery from this treatment is at best tiring and at worst exhausting. You may have feelings about the way you look and the way you feel. You may have lost weight, gained some bruises, lost your hair, gained a line. There are many reasons

why you may not feel 'sexy' after your treatment. Don't keep your concerns to yourself as this can easily put an added strain on your relationship. Try to discuss your feelings with your partner and if you feel you need further support, please ask.

Treatment

The first step you should take if you begin to experience any of the symptoms associated with the menopause is to tell your haematology doctor.

There is no reason that you should 'grin and bear' the menopause. There is treatment available in the form of hormone replacement therapy (HRT). HRT consists of low doses of oestrogen that help to replace your body's own oestrogens which are lost during the menopause. The most common form of HRT is a tablet but it is available as a patch that can be worn like a sticky plaster on your skin, as a cream and even as an implant.

HRT in tablet form is usually taken as a continuous monthly course of 28 days of oestrogen tablets combined with a ten to fourteen day course of progestogen which produces a regular withdrawal bleed, or 'period' and helps to protect the lining of the womb.

You may be prescribed HRT for up to two years. Some women may be prescribed HRT on a long-term basis (for five to ten years or more), particularly if you are at risk of developing osteoporosis. You are advised not to stop any of these therapies without first consulting your doctor.

The facts about, and the benefits of HRT:

- HRT replaces the natural hormones that are lacking during the menopause
- HRT relieves hot flushes, vaginal dryness, frequent urination and other unpleasant symptoms that can be caused by the lack of oestrogen
- HRT helps to prevent thinning of the bones
- HRT can help to improve your emotional state
- HRT can be taken as tablets, creams, patches or implants
- HRT is not a contraceptive pill. If there is any chance that you might still be ovulating and you do not want to have a baby, you should use contraception
- HRT using combined oestrogen and progestogen is not thought to increase the risk of cancer of the lining of the womb
- HRT occasionally causes breast tenderness or nausea but this can often be cured by changing to a different tablet
- HRT can help many women but it is not suitable for everyone. Your doctor or clinic will be able to give you advice on what is best for you

Appendix C: TBI or total body irradiation

Radiotherapy is sometimes used in bone marrow transplantation. This form of radiotherapy is known as total body irradiation or TBI. The radiotherapy is given as high energy X rays which affect the whole of your body however your normal cells are able to recover from the effects.

TBI treatment

For the actual TBI treatment, you sit in a chair or lie on a couch to one side of the radiotherapy machine for about eight minutes. You may have some gel packs placed around you to provide a uniform shape for the treatment. The chair is then turned around so that the other side of your body can be treated. The treatment is not painful, in fact you cannot see or feel it at all. You are alone in the treatment room during the treatment; the staff are at an operating console just outside the door and can see you on a TV monitor.

There is often a cassette player in the treatment room and a variety of cassettes, but if you have strong preferences you can take your own music with you.

You are usually treated twice a day, in the morning at around 8.30am and in the afternoon/evening usually around 4pm. There must be a minimum of six hours between treatments.

You will usually have six to eight treatments over three or four days depending on the type of transplant you are receiving.

Side effects

Your doctor explains the effects of the treatment to you. If you have any questions regarding the treatment or the side effects, please ask.

Whilst you are having the treatment and after it finishes you are given several drugs to reduce, as far as possible, the side effects which include:

⌘ Nausea and vomiting

Vomiting is rarely a problem. You are given drugs to control this which are extremely effective. Nausea can be a problem for a minority of patients but usually settles down after a couple of treatments. If you continue to feel sick, tell the radiographers or nurses who are caring for you, and they can try to make you feel more comfortable.

⌘ Alopecia or hair loss

You may have already lost your hair as a result of chemotherapy. The effects are very similar following this sort of radiotherapy. The hair on your head falls out about ten to fourteen days after the treatment. Other body hair may or may not fall out — everybody is different. Your hair regrows after several months.

⌘ Mucositis

Mucositis means inflammation of the inside of the mouth, tongue and throat. Good mouth care during and after treatment will help to reduce this. Once your treatment begins, changing to a softer diet, a soft (or baby) toothbrush and using a good mouthwash will help to reduce problems associated with mucositis.

⚡ Parotitis

This is inflammation of the parotid salivary glands, which are in the cheeks just in front of the ears. The inflammation may cause some stiffness in the jaw but this usually settles down after a few hours. These glands produce most of your saliva and may stop functioning for a period of days or weeks following the treatment. This can make eating uncomfortable. You may find that drinking more, especially with meals, or eating meals with gravy etc, is helpful.

⚡ Erythema

Some patients, especially those with fair skin, may experience some reddening of the skin. This disappears within a couple of days after finishing the treatment.

⚡ Diarrhoea

A few patients experience a little diarrhoea, during or at the end of their TBI. If your symptoms persist and become a problem, medication can be given to you. Please let your doctor know if you have a problem.

⚡ Cataracts

This is a clouding of the lens of the eye which causes blurring of your vision and can eventually lead to blindness. There is a high risk of developing cataracts after you have had this type of radiotherapy. They tend to develop after approximately two years, although it may be considerably longer. If they should develop, they are easily treated.

⚡ Pneumonitis

This is inflammation of the lungs which may cause breathlessness or a dry cough.

∴ Infertility

You may already be infertile as a result of the chemotherapy you have already received. If you are not, the combination of the chemotherapy and the TBI will almost definitely make you infertile.

Please refer to the section on fertility in **Step one: Planning ahead**.

∴ Second malignancies

In the future, partly because of the TBI, there is a very slight increase in the risk of you developing a second malignant condition. The chance is very small, but because it is there, you should be informed of it.

Appendix D: Clinical trials

Before starting the treatment for your transplant you may be given information about a clinical trial or study or you may have seen information about trials on the internet.

There are several types of trials. Some are run at international level (by international organisations or pharmaceutical companies), others are funded by the government (Medical Research Council trials), some by charities, such as Leukaemia Research or Cancer Research UK, and others are performed 'in-house', i. e. only at the hospital where you are having treatment.

Clinical trials sometimes test new treatments, for example chemotherapy, but more frequently explore new combinations of existing treatments or changes in the way they are given. This is either to make them more effective or to reduce side effects. Trials are the only reliable way to find out if a different type of chemotherapy or a bone marrow transplant is better than that already available or has been used before.

Clinical trials are carefully designed to minimise the risks and maximise the benefits to all people who take part, regardless of which treatment they get. The trials are designed by groups of medical and other specialists.

All trials that are carried out within a hospital will have received ethical approval from the hospital's ethics committee.

You do not have to participate in clinical trials and this will not affect the care that you receive. If you do participate in a clinical trial, and then wish to withdraw from that trial, the care that you receive will not be affected.

Appendix E: Reduced intensity conditioned (mini) transplant

Research into bone marrow transplantation has led to the introduction of reduced intensity conditioned (RIC) or ‘mini’ transplants.

This method uses much less intensive chemotherapy regimens without the need for radiotherapy. Particularly in those patients for whom a standard transplant carries unacceptably high risks, reduced intensity conditioned transplants are felt to be far safer. Like standard treatment, your stay in hospital is four to six weeks and although the risks of this type of procedure are considerably lower, there is still the possibility of serious and potentially fatal complications during and following the procedure.

At present it is not known if patients who are treated with a less intensive regime will have a higher or lower long-term survival rate compared to a standard transplant. Reports from transplant centers for reduced intensity transplants are extremely encouraging, but the numbers of patients that have long-term follow-up are still quite small.

The RIC treatment concentrates on attacking the recipient’s immune system by using immune suppressive drugs. A much lower dose of chemotherapy is also given to ‘make room’ in the bone marrow for the donor cells so that engraftment can take place.

The same risk of graft versus host disease exist, together with other problems associated with immune suppression in the allogeneic group.

There are also risks associated with bone marrow suppression such as anaemia, bleeding and bruising, and severe infections. However, the problems incurred during the transplant such as severe mucositis and organ failure seem to be less.

The RIC transplant is becoming more widely used in many centers and research and developments in this area are ongoing.

If you have questions about this treatment, please discuss them with your doctor.

Appendix F: Glossary of terms

Some drugs used in treatment

⌘ Allopurinol

This is a drug which prevents build-up of uric acid (produced by breakdown of proteins when cells are killed). Large quantities of uric acid in the blood lead to crystal deposits in the joints, which causes gout or can lead to kidney damage.

⌘ Antibiotics

Drugs which kill or stop the growth of bacteria, for example penicillin.

⌘ Anti-emetic

A drug to prevent or alleviate the nausea and vomiting which sometimes occur as side effects of chemotherapy. Drugs of this type include metoclopramide (Maxalon™), ondansetron, (Zofran™).

⌘ Anti-fungals

Drugs used to fight fungal infections.

⌘ Anti-viral

Drugs used to fight viral infections.

⌘ Chemotherapy/cytotoxic drugs

Treatment using anti-cancer drugs. These may be used singly or in combination to kill or prevent the growth and division of cells. Although aimed at the cancer cells, chemotherapy will also unavoidably affect rapidly dividing normal cells such as in the hair and gut causing hair loss and nausea, which are usually temporary and reversible.

⌘ Corticosteroids (steroids)

A group of synthetic hormones including prednisone, prednisolone, methylprednisolone and dexamethasone used in the treatment of some leukaemias and myeloma. Also used to suppress graft rejection and graft versus host disease following a stem cell transplant. Side effects include an increased risk of infection, rise in blood pressure, peptic ulcers, diabetes mellitus and osteoporosis.

⌘ Ciclosporin A

A drug used to prevent and treat rejection and graft versus host disease in transplant patients by suppressing their normal immune system.

⌘ Diuretic

A drug to stimulate the excretion of urine by the kidneys. May be used during chemotherapy to ensure the excretion of anti-cancer drugs.

⌘ Growth factors

A complex family of proteins produced by the body to control growth, division and maturation of blood cells by the bone marrow. Some are available as products of genetic engineering, and are used clinically to stimulate normal white cell production following chemotherapy or bone marrow transplantation, for example G-CSF, GM-CSF.

⌘ Sedative

Drug that has a calming effect.

General terminology

⌘ Allogeneic stem cell transplant

Also called an allograft. A transplant using stem cells collected from a 'matched' healthy donor, usually a brother or sister. The risks associated with the transplant increase with age.

⌘ Alopecia

The loss of hair. A side effect of some forms of chemotherapy or radiotherapy used to treat leukaemia and other cancers, which is usually temporary.

⌘ Anaemia

Deficiency in the oxygen-carrying pigment haemoglobin in the blood. Causes pallor, tiredness and breathlessness.

⌘ Anorexia

Loss of appetite.

⌘ Antibodies

Naturally produced substances in the blood which destroy or neutralise specific toxins or 'foreign bodies', for example viruses. They are produced by the white blood cells known as lymphocytes in response to exposure to antigens.

⌘ Antigen

A substance which stimulates cells of the body's defence system to react by producing antibodies.

⌘ Aplasia

Failure of production of blood cells in the bone marrow because of a lack of stem cells. Usually this condition affects all types of blood cells and is called aplastic anaemia.

⌘ Auto-immune disease

Diseases caused by an individual's immune system producing antibodies against tissues of its own body.

⌘ Autologous stem cell transplant (ASCT)

A blood stem cell transplant using the patient's own marrow or peripheral blood stem cells which have been collected and stored at an early-stage of the disease, also called autograft. The marrow may be manipulated in the laboratory, a procedure called purging, to try to ensure there is no contamination with leukaemia cells. This type of procedure may be carried out even in older patients in contrast to donor transplants.

⌘ Bacteria

Microscopic organisms which cause many types of infectious disease, for example pneumonia. Patients have a reduced ability to fight infections following chemotherapy or bone marrow transplantation. This may mean that even harmless bacteria, for example those which are normally found on the skin, may cause serious illness.

⌘ Benign

Non-cancerous growths that may or may not need to be surgically removed.

⌘ Biopsy

A small sample of fresh tissue, for example lymph node or bone marrow, removed for laboratory analysis to establish or confirm an exact diagnosis of disease.

⌘ Blood cells

There are three main types of cells in the blood stream: the red cell, which carries oxygen; the white cell, which fights infections; and the platelets, which help prevent bleeding. The correct balance between each cell type must be maintained. Production of blood cells is controlled by natural chemicals called growth factors, which may be used in treatment.

⌘ Blood count

A routine test requiring a small blood sample to estimate the number and types of cells circulating in the blood.

⌘ Bone marrow

The tissue which produces the blood cells. It is found within the hollow cavities of many of the bones of the body. Bone marrow contains the stem cells from which all blood cells are derived. Examination of the bone marrow is an important part of the diagnosis of leukaemia and the monitoring of treatment.

⌘ Bone marrow aspirate

A small volume of liquid bone marrow removed under local or general anaesthetic from either the hip (pelvis) or breastbone (sternum). The cells in the sample can then be examined under the microscope to identify any abnormality in the developing blood cells. A trephine biopsy, where a small 'core' of bone marrow tissue is removed under local anaesthetic, may be taken at the same time.

⌘ Bone marrow transplant (BMT)

A procedure used in the treatment of a variety of blood disorders including leukaemia, lymphoma and sometimes myeloma. The patient receives very high doses of chemotherapy and/or radiotherapy to treat the disease and produce immune suppression. This damages the bone marrow and makes the blood count fall. Replacement marrow is taken from a matched donor (allogeneic bone marrow transplant), or from the patient themselves (autologous bone marrow transplant) under a general anaesthetic and returned to the patient through a vein (or central venous line) in a similar way to a blood transfusion. Peripheral blood stem cells may be used instead, especially for autografts.

❖ **Candida**

A type of fungus. *Candida* infection in the mouth (oral thrush) is a common problem for immune suppressed patients.

❖ **Cannula**

A tube for insertion into the body, usually into a vein, via a sharp needle-type fitting which is then withdrawn from the cannula to allow fluids to pass through the tube.

❖ **Carcinogen**

A substance which has the ability to cause cells to become cancerous.

❖ **CAT scan (CT scan)**

Computer assisted tomography (CAT) is a sophisticated X ray technique used to produce detailed internal images of the body, particularly the chest and abdomen. The patient lies on a couch, which gradually moves through the X ray machine and the image is built up by a computer as a cross-section through the body.

❖ **Catheter**

A hollow tube inserted into organs of the body for admitting or removing gases or liquids. For example, for the removal of urine from the bladder.

❖ **Cells**

The individual units from which tissues of the body are formed.

❖ **Central nervous system (CNS)**

The brain and spinal cord.

⌘ Central venous catheter

A line passed through a blood vessel into a large central vein, used for patients undergoing intensive therapy and to provide a route for taking blood samples and administering drugs without repeated needle puncture of a vein. See Hickman Line and Portacath.

⌘ Cerebrospinal fluid (CSF)

This fluid surrounds and protects the brain and spinal cord. Samples can be obtained by lumbar puncture.

⌘ Chromosomes

Chromosomes carry the 30,000 or so genes which provide the inherited blueprint of each individual. In humans there are normally 23 pairs contained in the nucleus of each cell. Alterations in the number or organisation of the chromosomes may play a key role in the development of cancer.

⌘ Clotting factors

A group of chemical constituents of the blood (factors I to XIII) which interact to make the blood clot.

⌘ CNS-leukaemia

Invasion of the brain or spinal cord by leukaemic cells. This may be diagnosed by examination of the surrounding cerebrospinal fluid.

⌘ Coagulation

Clotting of the blood. A complex reaction depending on a series of biochemical components (clotting factors) and platelets in the blood.

⌘ Consolidation treatment

A course of treatment with anti-cancer drugs, given to the patient whilst in remission with the aim of killing any remaining cancerous cells.

⌘ Contrast

A medium or fluid that is used in certain tests to show up or highlight organs or parts of the body.

⌘ Cord blood

Blood obtained from the umbilical cord at the time of birth, which derives from the baby.

⌘ Cord blood stem cells

Stem cells recovered from cord blood which have been shown to have the capability to re-populate bone marrow and produce blood cells.

⌘ Cytogenetics

The study of the structure of chromosomes. Cytogenetic tests are carried out on samples of blood and bone marrow taken from leukaemia patients to detect any chromosomal abnormalities associated with the disease. These help in the diagnosis and selection of optimal treatment.

⌘ Cytomegalovirus (CMV)

A virus which is harmless in healthy people but may cause serious disease in severely immune suppressed patients. This is particularly dangerous following a bone marrow transplant.

⌘ Cytopenia

A reduction in the number of cells circulating in the blood.

⌘ DNA

Deoxyribonucleic acid (DNA) provides the essential building block for storing genetic material. There are four different chemical components of DNA (bases) arranged in a coded sequence as genes, which determine an individual's inherited characteristics.

⌘ Donor lymphocyte infusion (DLI)

If a patient who has had an allogeneic bone marrow transplant has a relapse (return of the disease), he may be given lymphocytes from the same donor. This may eliminate the leukaemia cells.

⌘ Engraftment

The establishment and growth of donor cells.

⌘ Fungus

An infective agent such as a mould or yeast, causing particular problems in immune suppressed patients, for example candida.

⌘ Graft rejection

Rarely, when a patient has an allogeneic bone marrow transplant, the new bone marrow will fail to start producing blood cells. This is called graft rejection. It may be possible to do a second transplant.

⌘ Graft versus host disease (GvHD)

A common and serious complication of bone marrow transplantation. Some of the donor's immune cells recognise the patient's own cells as foreign and attack them. The skin, liver and gut may be affected. It can occur in either a chronic or acute form and is treatable with immune suppressive drugs.

⌘ Graft versus leukaemia (GvL)

Describes the effect of allografted stem cells in attacking leukaemia cells in the recipient. If graft versus host disease is present but not severe, it may be beneficial in helping to kill off leukaemia cells. If all the T-lymphocytes are removed from an allogeneic bone marrow transplant it minimises the risk of graft versus host disease but increases the risk of relapse.

⌘ Granulocyte

A type of white blood cell. They protect the body against infection by seeking out and killing microorganisms. Neutrophils, a type of granulocyte.

⌘ Haploidentical

'Half-matched'. Term used in tissue-typing.

⌘ Haematologist

A doctor specialising in the diagnosis and treatment of blood diseases.

⌘ Haematology

The study of blood diseases including leukaemia.

⌘ Haematopoiesis or haemopoiesis

Term to describe the production and maturation of blood cells from very primitive stem cells. This takes place in the bone marrow, which is a spongy tissue in the middle of bones.

⌘ Haemoglobin

The iron containing pigment in red blood cells which carries oxygen around the body. Lack of haemoglobin is called anaemia. Normal values are 13.5 to 17.5 g/100ml of blood in males, 11.5 to 15.5 g/100ml in females.

⌘ Haemorrhage

Bleeding either to the outside through the skin or internally.

⌘ Hepatitis

Inflammation of the liver.

⌘ Hepatomegaly

Enlargement of the liver.

⌘: **Hickman™ line**

A narrow plastic tube or catheter, which is inserted, into a major blood vessel in the chest under anaesthetic. It is used for patients undergoing intensive therapy and provides a route for taking blood samples and administering drugs without repeated needle puncture of a vein.

⌘: **Histology**

The investigation of tissue samples by chemical and microscopical analysis.

⌘: **Immune compromised/Immunocompromised**

Impaired ability of the body's defence system.

⌘: **Immunoglobulins**

Proteins in the blood plasma which function as antibodies and play an important part in controlling infections.

⌘: **Immune suppression/Immunosuppression**

A treatment-induced reduction in the body's defence mechanisms. Deliberate immune suppression is a necessary part of the bone marrow transplant procedure to prevent graft versus host disease and graft rejection.

⌘: **Intensification**

Increasing the amount, number or combination of anti-cancer drugs given to a patient in an attempt to kill drug-resistant or residual leukaemic cells.

⌘: **Intramuscular injection**

Injection into the muscle.

⌘: **Intrathecal injection**

Injection of drugs into the spinal fluid to prevent or treat CNS leukaemia or lymphoma.

⌘ Intravenous infusion

Administration of antibiotics, blood products, anti-cancer drugs or nutrients into a patient's vein over a prolonged period of time.

⌘ Intravenous injection

The application of drugs into a vein through a syringe.

⌘ Late-effects

Results of chemotherapy and/or radiotherapy which only become apparent with long-term monitoring of the patient over a period of years. These are of particular concern in patients below the age of puberty.

⌘ Leukocytes

Collective term for white blood cells.

⌘ Lumbar puncture

A procedure for removing spinal fluid from around the spinal cord using a fine needle in the lower part of the back. Samples are analysed for evidence of any CNS-leukaemia. Also used to administer anti-cancer drugs to either prevent or cure CNS-disease.

⌘ Lymph nodes or glands

Small structures found throughout the body, e. g. neck, groin, armpits, abdomen, which contain both mature and immature lymphocytes.

⌘ Lymphatic system

This consists of the spleen, lymph nodes and areas of lymphoid tissue such as the tonsils. It plays a major part of the body's immune response.

⌘ Lymphoid

Referring to the lymphatic system including lymphocytes and lymph nodes.

⌘ Magnetic resonance imaging (MRI)

A body scanning technique which uses an intense magnetic field to generate images of the internal organs. Properties of normal and cancerous tissue differ, allowing malignant tumours to be visualised by computer processing of the signals detected.

⌘ Maintenance treatment

Treatment given for a period of months or years to maintain remission and eliminate any residual leukaemic cells in the body, usually for acute lymphoblastic leukaemia.

⌘ MRC (Medical Research Council)

Government funded body 'to promote the balanced development of medical and related biological research' in the UK. It organises national clinical trials for the assessment of new treatment protocols for leukaemia and some of the related diseases.

⌘ Mucositis

Inflammation of the mouth and throat which may be caused by anti-leukaemia drugs.

⌘ Multi-drug resistance (MDR)

Multi-drug resistance occurs when leukaemia cells eliminate anti-cancer drugs before a high enough concentration to kill the cells is achieved. Resistance against most drugs will make the leukaemia very difficult to treat.

⌘ Myeloid

Collective term for the non-lymphocyte groups of white blood cells. It includes cells from the granulocyte, monocyte, red cell and platelet lineages.

⌘ Neuropathy

Damage to the nerves which may occur as a complication of anti-leukaemia treatment. It usually affects the peripheral nerves (nerves to the arms and legs) and may be reversible when treatment is stopped or reduced.

⌘ Neutropenia

A condition in which the neutrophil count is reduced. It may be caused by high-dose chemotherapy and carries an increased risk of infection.

⌘ Neutrophil

The most common type of cell within the granulocyte group of white blood cells.

⌘ Oesophagus

The part of the digestive tract between the throat and the stomach.

⌘ Oncologist

A specialist in the diagnosis and treatment of cancer.

⌘ Palliative care

Treatment aimed at relieving symptoms and pain rather than curing the disease.

⌘ Pancytopenia

Condition in which there are reduced numbers of all types of blood cells.

⌘ Paraprotein

Paraprotein is a form of antibody characteristic of, and produced by, a clone of cells of the B cell type, for example in multiple myeloma. Its presence in the blood acts as an important marker of disease.

⌘ Pathologist

A doctor who specialises in the cause and diagnosis of disease and how disease affects the organs of a body.

⌘ Peripheral blood stem cell (PBSC)

There are small numbers of stem cells in the circulation. These are known as peripheral blood stem cells.

⌘ Peripheral blood stem cell transplant

The use of peripheral blood stem cells as an alternative to bone marrow transplantation. The stem cells are obtained by using growth factors given to the donor to increase numbers in the circulation to a level where they can be harvested.

⌘ Petechiae/purpura

Small red or purple pin-head spots on the skin. They are small haemorrhages and usually the result of a shortage of platelets.

⌘ Plasma cells

Large cells derived from the lymphocytes that form antibodies. These are not normally found in circulating blood but restricted to bone marrow and lymph nodes.

⌘ Plateau phase

Stable stage of disease in multiple myeloma following good response to anti-cancer treatment.

⌘ Platelets or thrombocytes

They are tiny cell-like bodies derived from megakaryocytes in the bone marrow. Platelets circulate in the blood and play an important role in the prevention and control of bleeding. Normal values are $150\text{--}400 \times 10^9$ per litre.

⌘ Portacath™

A form of central venous line in which the whole of the line is surgically implanted within the body, unlike a Hickman™ line. A membrane just below the skin gives access by a simple skin puncture to a line running straight into one of the main blood vessels. This simplifies the administration of chemotherapy.

⌘ Prognosis

An assessment of the likely course of disease for a patient, particularly concerning the chances of cure and complete recovery or length of survival.

⌘ Prophylaxis

Precautionary treatment given with the aim of preventing a disease occurring.

⌘ Protocol

A schedule of treatment. For example, the number, frequency and timing of administration of a course of anti-cancer drugs.

⌘ Pruritis

Itching, sometimes severe, which may be a significant problem in lymphoma.

⌘ Radiology

The use of X rays in the diagnosis of a disease.

⌘ Radiotherapy

The use of X rays and other forms of radiation in treatment. Radiotherapy kills cancer cells in the area of the body being treated and is therefore an effective treatment for localised disease, particularly in lymphoma and multiple myeloma. Side effects vary according to the type of treatment and will be discussed with the patient by the hospital staff.

⌘ Red blood cells or erythrocytes

The cells of the blood which contain the red pigment haemoglobin and carry oxygen to all the tissues of the body. Normal red cell count in the blood is $4.5-5.0 \times 10^{12}$ per litre.

⌘ Relapse

The recurrence of disease. In leukaemia this may be indicated by changes in the blood, bone marrow, CNS or testes even before the patient experiences any symptoms.

⌘ Remission

Restoration of the blood, bone marrow and general health of the patient to normal, induced by chemotherapy and/or radiotherapy.

⌘ Remission induction or induction treatment

The initial course of treatment given to patients on admission to hospital to remove all clinically detectable cancer.

⌘ Septicaemia

This is a general term to describe serious bacterial infection of the blood stream often associated with high fever.

⌘ Serum

The part of the blood which remains after cells, platelets and fibrinogen have been removed.

⌘ Sibling

Brother or sister.

⌘ Specimen

A sample of tissue, blood, urine etc., taken for examination.

⌘ Sinuses

A large channel between the brain and skull.

⌘ Spleen

The spleen acts as a 'discriminating filter' of the blood. It can selectively remove old red blood cells and bacteria and other foreign bodies. The spleen also acts as a store for platelets. It is often enlarged in leukaemia.

⌘ Splenectomy

Surgical removal of the spleen. This is sometimes done in leukaemia or lymphoma as part of a patient's treatment.

⌘ Splenomegaly

Enlargement of the spleen.

⌘ Staging

An assessment of the spread of disease through the body, for example in lymphoma. It is of importance for the selection of optimal treatment.

⌘ Stem cells

The most primitive cells in the bone marrow from which all the various types of blood cell are derived.

⌘ Subcutaneous injection

An injection into tissue immediately under the skin.

⌘ Syngeneic

Literally 'sharing the same genes'. It refers to bone marrow or peripheral blood stem cell transplants between identical twins.

⌘ T lymphocyte (T cell)

A type of white blood cell derived from the thymus (hence T cells) involved in controlling immune reactions and in fighting viral infections. Uncontrolled proliferation of this type of cell gives rise to T cell leukaemia/lymphoma.

⌘ Thrombocytopenia

Shortage of platelets, leading to problems with bleeding.

⌘ Thrombosis

The development of a clot in a blood vessel, usually in a vein but sometimes in an artery. It is potentially life-threatening if left untreated.

⌘ Total body irradiation (TBI)

Radiotherapy often given in several doses prior to bone marrow transplantation with the aim of killing any residual leukaemia in the patient. It is used in conjunction with high-dose anti-cancer drugs. The procedure and its side effects will be discussed individually with the patient.

⌘ Trephine biopsy

Removal of a small 'core' of bone marrow under local anaesthetic. It is used to assess bone marrow structure, the number and distribution of all the blood cell types. The trephine biopsy is normally done at the same time as a bone marrow aspirate.

⌘ Ultrasonography (ultrasound)

Pictures of the body's internal organs built up from the interpretation of reflected sound waves.

⌘ Virology

The study of viruses and viral diseases.

⌘ Virus

A minute infective agent, which depends on the cell it infects for its replication and survival.

⌘ White blood cells (leukocytes)

They comprise several different types of cells within three main types: granulocytes (mainly consisting of neutrophils), lymphocytes and monocytes. They are formed in the bone marrow and it is their uncontrolled proliferation, which leads to leukaemia. Normal values are within the range $4.5 - 11.0 \times 10^9$ per litre.

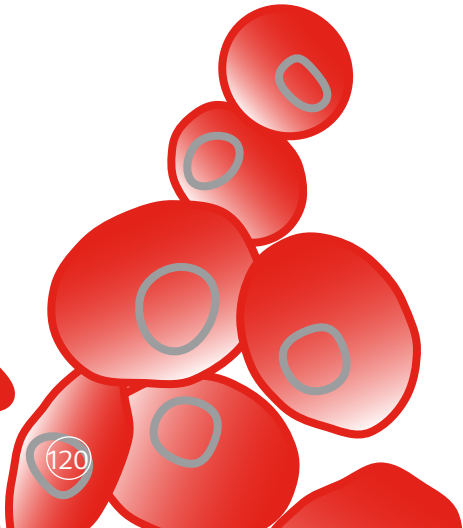
⌘ X rays

Used in diagnosis and staging of lymphoma and multiple myeloma. Also used to diagnose, for example, a chest infection.

Notes



Notes





The following patient information booklets are available free of charge from Leukaemia Research. You can download them from our website or request copies by phone or post (see form inside):

Leukaemia and Related Diseases

Acute Promyelocytic
Leukaemia (APL)

Adult Acute
Lymphoblastic Leukaemia (ALL)

Adult Acute
Myeloid Leukaemia (AML)

Childhood Acute
Lymphoblastic Leukaemia (ALL)

Childhood Acute
Myeloid Leukaemia (AML)

Chronic Lymphocytic
Leukaemia (CLL)

Chronic Myeloid Leukaemia (CML)

Aplastic Anaemia (AA)

The Myelodysplastic
Syndromes (MDS)

The Myeloproliferative
Disorders (MPD)

Multiple Myeloma (MM)

Hodgkin's Lymphoma (HL)

Non-Hodgkin's Lymphoma (NHL)

**Leaflets on a range of associated
blood disorders are also available
from Leukaemia Research**

Bone Marrow and Stem Cell
Transplantation (BMT)
– for children and adults

Donating stem cells
– what's involved?

Donor Lymphocyte Infusion (DLI) –
what's involved?

The Seven Steps – Blood & bone
marrow transplantation

Undergoing high dose therapy and
autologous stem cell transplant

Chemotherapy
– what do I need to know?

Clinical Trials

Complementary and
Alternative Medicine (CAM)

Dietary advice for patients
with neutropenia

Supportive care

Treatment decisions

Watch and wait

Young adults with a blood cancer –
what do I need to know?

Jack's Diary: an illustrated children's
book to help young patients
understand and deal with blood
cancers, treatment and life changes

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