The British Sector of the Western Front 1914-1918

What do I need to know?

- The Trench system
- Key Battles - Ypres, Somme, Arras and Cambrai
- Medical issues within the trenches (Rifle/ explosives, trench foot, trench fever, shellshock)
- Problems of transport and communication
- The Chain of Evacuation
- The Royal Army Medical Corps. (RAMC)
- The First Aid Nursing Yeomanry (FANY)
- The Development of new techniques such as the Thomas splint, x-rays, blood banks, blood transfusions, plastic surgery and brain surgery

Types of Questions

- Describe two features of ... (4 Marks)
- How would you follow up Source X to find information about...? (4 Marks)
- How useful are sources ___ and ___ for an enquiry into ....? (8 Marks)
Types of Sources

Written Sources (Private? official/ non-official)
- National Newspapers
- Poems
- Fiction
- Letters
- Diary entries
- Medical records
- Government documents
- Birth/ Death Certificates

Oral Sources
- Speeches
- Interviews

Non-Written sources
- Archaeology
- Landscape
- Buildings
- Artefacts
- Photographs/ Paintings

We shall be using and evaluating many different types of sources. As well as working out their meaning, we will be evaluating how useful they are for specific enquiries.

How do you test how useful a source is?

For what?: What is the enquiry you would be using the source for?
Content - What does it tell you? What information within the source is accurate? Is important information missing?
Context - Does the information in the source match your own knowledge?
Nature - what type of source is it?
Origin - When was it made? Where was it made? Who by?
Purpose - Why was it made? (to inform, to persuade, to encourage, to criticise)
<table>
<thead>
<tr>
<th>How could the latest knowledge and techniques in medicine benefit injured soldiers?</th>
<th>Explain why injured soldiers might not be able to benefit from all the latest medical development.</th>
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</table>
| **Aseptic Surgery**  
- By 1914 it was known that bacteria (germs) caused disease so all medical staff had to wash their hands, faces and arms before entering the operating theatre.  
- Rubber gloves and gowns were worn when carrying out operations.  
- Before entering the operating theatre the air was sterilised by being pumped over a heating system so that all germs were killed  
- A machine called an autoclave was used to sterilise surgical instruments in boiling water. | |
| **X-Rays**  
- By 1914, radiology (X-Ray) departments were opening in a number of hospitals. This had enormous potential in a war context; it would possible to see internal injuries and the remains of bullets and shrapnel using an X-ray. However this would only be possible if portable machines were developed. | |
| **Blood Transfusions**  
- Blood loss after accidents, injuries and surgery had been a major cause of death before the 20th century. Although there had been many experiments in blood transfusion had been attempted, and in 1905 the existence of different blood groups had been identified, widespread blood transfusion wasn’t yet possible because there was no way to store blood.  
- This meant transfusions had to be carried out immediately with the donor standing next to the patient connected by a tube. | |
What was the Western Front?

The **Western Front** was the main focus of fighting during the First World War. Following the outbreak of war in August 1914, the German Army opened the Western Front by invading Luxembourg and Belgium, then gaining military control of important industrial regions in France. The tide of the advance was dramatically turned with the Battle of the Marne. Following the Race to the Sea, both sides dug in along a meandering line of fortified trenches, stretching from the North Sea to the Swiss frontier with France, which changed little except during early 1917 and in 1918.

Between 1915 and 1918 there were several offensives along this front. Among the most costly of these offensives were the Battle of Verdun, in 1916, with a combined 700,000 casualties (estimated), the Battle of the Somme, also in 1916, with more than a million casualties (estimated), and the Third Battle of Ypres, in 1917, with roughly 600,000 casualties.

To break the deadlock on the Western Front both sides tried new military technology, including poison gas, aircraft and tanks. Eventually the German government surrendered in the Armistice of 11 November 1918.
The Trench System

Britain had declared war on Germany on 4th August 1914. By the end of 1914 much of Belgium and northern France had been occupied by Germans. Trenches were built as defence from the enemy.

A line of trenches was built from the English channel in the north, to Switzerland in the south. Later in 1915 a more complex system begun to develop.

Trenches were about 2.5m deep. In a trench of this depth it was impossible to see over the top, so a two or three-foot ledge known as a fire-step, was added. Trenches were not dug in straight lines. This was because if your trench was a straight line, and the enemy had a successful offensive (attack) and got into your trenches, they could shoot straight along the line.

Duck-boards were also placed at the bottom of the trenches to protect soldiers from problems such as trench foot (a medical complaint like really really bad Athlete’s Foot). Soldiers also made dugouts in the side of the trenches to give them some protection from the weather and enemy fire.

Typical battles would involved one side trying to capture the trenches of the other side, whilst trying to avoid being shot by machine gun fire.

Front line trenches were usually about seven feet deep and six feet wide. The front of the trench was known as the parapet and the back was the parados. The top two or three feet of the parapet and the parados would consist of a thick line of sandbags to absorb any bullets or shell fragments. The front-line trenches were also protected by barbed wire entanglements and machine-gun posts.

Short trenches called saps were dug from the frontline trench into No-Man’s Land. The end of the saps, called the sap-heads, usually about 30 yards forward of the front-line, would then be used as listening posts.

Behind the front-line trenches were support and reserve trenches. The three rows of trenches covered between 200 and 500 yards of ground. Communication trenches, were dug at an angle to the front line trench and were used to transport men, equipment and food supplies.

Why would trench conditions and the layout of the trench system make it difficult to treat injured or sick soldiers?

Answer this question in your exercise book.
Identify the type of weapon each picture shows and explain what kind of wounds each of the weapons would cause.
# How healthy were the trenches?

<table>
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<th>Hygiene</th>
<th>Food</th>
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<td>The trenches could be red hot in the summer and a freezing mass of mud in the winter. Not surprisingly, this led to many medical problems such as ulcers, boils, rashes, pneumonia, tuberculosis, dysentery and bronchitis. Spending days on end in knee deep water could lead to trench foot, a painful condition where the food swells up and develops open sores. Literally feet were rotting and this could lead to amputation.</td>
<td>Keeping clean was virtually impossible so almost all soldiers were infested with lice - small insects which bite and feed off the blood of their host. Their bites could cause severe itching and could lead to much more serious illnesses, such as trench fever. Rats were also a major problem. A pair of rats could produce 880 babies in a year. These rats fed on the flesh of dead soldiers and spread disease through their urine.</td>
<td>Food was very basic and consisted of tinned beef or maconochie (stew) eaten with bread or hard biscuits. Although it wasn’t exciting, for some of the poorer soldiers their army diet was more nutritious than their civilian one! Bacon, cheese and jam were treats and many soldiers received edible treats from home. The water tasted odd, as choline was added to kill germs. This wasn’t a problem so long as the water was boiled and turned into tea!</td>
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**Body louse and pubic louse**

**Trench Rats**

**The highlight of a soldier’s day!**

**Trench foot**
Ypres 1914
Early in the war the British had moved into Ypres in Belgium to prevent Germany reaching the English Channel. However Germany attacked their positions in the autumn in a battle which lasted almost a month. The British lost 50,000 men but held on to Ypres, keeping control of the ports of the English Channel. Offensive mining was used by the British to retake Hill 60 (a man-made Hill to the south east of Ypres). Tunnels were dug and the mines were placed and then exploded. The top of Hill 60 was blown off and the British gained a strategic advantage.

Ypres 1915 Second Battle
In 1915 during the Second Battle of Ypres the German army used chlorine gas for the first on the Western Front. The gas produced yellow-green clouds which drifted towards the Allied trenches. The gas had a distinctive odour, resembling pineapple and pepper. The British lost 59,000 men. By the end of the battle the Germans had advanced two miles closer to Ypres.

1917 - The Battle of Arras
The area around Arras is very chalky and so it is easy to tunnel through. In 1916 the British decided to link the existing tunnels, caves and quarries to create an underground network around Arras to act as shelters against German attacks. They were also built to enable safe underground movement.

In total, more than 2.5 miles of tunnels were built and up to 25,000 men could be stationed in the tunnels which contained electric lights, running water a light railway system and a fully functional hospital. In April 1917, 24,000 men who had been hiding in tunnels dug near the German trenches attacked. The aim of the offensive was to break through the German lines. In the first few days, it appeared that this aim was achieved, as the British advanced about eight miles. However as the advance slowed, virtually no further progress was made and by the end of the offensive in May nearly 160,000 British and Canadian soldiers were dead or wounded.
1. The man in charge of British soldiers on the Western Front was Field Marshall Sir Douglas Haig so he was the man in charge of the Battle of the Somme.

2. The Battle started on July 1st 1916 when 100,000 British troops were ordered to advance along a 15 mile front along the River Somme in an attempt to create a gap in the German front line.

3. The battle lasted 141 days, from July 1 to November 18 1916 and the official number of British dead, missing or wounded during that period is 419,654 (this is usually rounded up to 420,000)

4. The first day of the battle, July 1 1916, was also the bloodiest, and remains the worst in the British Army's history. Of Britain's first-day casualties, a staggering 19,240 died. Officers below the rank of 'Major' died at a much higher rate on the Somme than private soldiers, with 60% of British officers who were involved on the first day losing their lives.

5. The massive number of British losses was mainly because the British army had over-estimated the impact of their pre-battle artillery bombardment. Before the battle, there had been a 7 day British artillery attack on the German defences, with British guns firing 1.7m shells.

6. On the first day of the battle, soldiers from the East Surrey Regiment kicked leather footballs across the Somme's No Man's Land as they advanced towards the German lines; this was because they had been told that the week long artillery attack would have destroyed the German defences. They believed that the German trenches would be empty.

7. The German bunkers were extremely deep and very well made which had protected the soldiers from the intense artillery fire. Quite simply, Britain's shells were not good enough to have destroyed the bunkers so the German army had been largely unaffected and was therefore at full strength to defend their front line.

Was the Battle of the Somme a victory or a defeat for the British?
The original aim of the Battle of the Somme had been to break the German front line. This wasn’t achieved as only seven miles of land were gained and no gap in the front line had been created. However, despite the devastating losses, and the tiny amount of land gained, the battle was successful in two ways:

i) One of the main objectives was to relieve the pressure on the French, who were under devastating attack by the Germans at Verdun; the Battle of the Somme DID take the pressure off the French.

ii) The Battle of the Somme hurt the Germans badly in terms of casualties. It is estimated that there were 500,000 German casualties compared to Britain’s 420,000 and France’s 200,000.
Ypres 1917 Third Battle
The aim of this battle was to remove the German advantage of having the higher ground. The Allies launched their main attack in July and advanced two miles of the first day. Soon, however, the weather changed and the ground became waterlogged. The rain and mud were so bad that men actually drowned in muddy craters. Progress was impossible in such conditions. The campaign lasted until November and in total just 7 miles had been gained at a cost of 245,000 casualties.

Impact on the Injured
The Third battle of Ypres left massive craters everywhere which destroyed many roads. It became much more difficult to get the wounded away from the front line. Also, as the land had previously used for farming, the soil was full of bacteria from fertiliser. This could get inside wounds and lead to infection. Since antibiotics had not yet been developed, even a small wound could prove to be fatal or lead to the amputation of a limb. Another feature of this battle was that stretcher bearers had to move injured men day and night from No Man’s Land and they were often at risk from gunfire and shell fire.

1917: The Battle of Cambrai
The attack started on November 20th. Nearly 500 British tanks advanced across the ground supported by infantry. The bulk of the initial attack went well. The 62nd Division covered more than five miles in this attack from their starting point. Compared to the gains made at battles like the Somme and Verdun, such a distance was astonishing. However many British army units had got themselves isolated and their command structure broke down in places when the Germans counter-attacked. On December 3rd, Haig gave the order for the British units still near to Cambrai to withdraw. The failure to build on the initial success of the attack was blamed on middle-ranking commanders – some of whom were sacked. The initial phase of the battle did show that mobility was possible in the war but that to sustain it, a decent command structure was needed. While losses did not equate to the Somme or Verdun, the British lost over 44,000 men during the battle while the Germans lost about 45,000 men.
One of the most important priorities was to have an efficient system of communication to a safe area where wounded soldiers could be treated. This was known as a chain of evacuation. There were four main stages. The order of these stages was not necessarily the same for each casualty.
Problems of Transport and Communications

As there were a number of bombings and shells often the terrain near the trenches made it very difficult to cross. This caused issue in terms of transport and communication. The area around the trenches had been used as farmland so fertilizer was used which meant there was a lot of bacteria in the soil that could lead to infected wounds.

If you were injured you needed to be moved ASAP away from the trenches. Stretcher bearers would carry them away when they were stable enough. This meant they would have to avoid gunfire and shelling. It was easier to carry out more developed procedures away from the front line.

Horse-Drawn
Originally the decision was made not to send motor ambulances to the frontline. This was a mistake as horse drawn carriages could not cope with the amount of injuries and deaths. It was also not very secure and due to men being shaken about the injuries got worse. Many soldiers were either left to die or taken prisoner by the Germans.

The Use of Barges and Trains
Barges were used to transport wounded soldiers to the base hospitals on the French coast. Trains were faster but less comfortable. At the start of the war the RAMC used French goods trains rather than specially designed ones. The first ambulance train came into use in November 1914. Stretchers could fit down the side of the carriage and hundreds of soldiers were moved on these trains. However, they were criticised for damaging the war effort, as too many were moving around France and Belgium clogging up the network. This made it difficult to transport healthy soldiers to the frontline.

Motor Ambulances
When news of the problems transporting soldiers using horse-drawn ambulances reached Britain, an appeal for donations was run by 'The Times,' After three weeks enough money was raised to buy 512 ambulances. In October 1914 the first motor ambulances reached the front line. However during the winter, as the rain fell and dirt turned to thick mud, motor ambulances were even less effective than the horse drawn one. Therefore horses continued to be used, despite the horrendous conditions.
The Chain of Evacuation

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1. Regimental Aid Posts (RAP)
Aim: to give immediate first aid and return soldiers to fight as soon as possible. They were usually within 200m of the front line in a communications trench. They were staffed by a medical officer and a few stretcher bearers. They could not deal with more serious cases who had to be taken further up the chain.

2. Dressing Stations (ADS and MDS)
Ideally there would be an advanced station (ADS) within 400m of the RAP and a MAIN dressing station about half a mile away. They were often in abandoned buildings, dug outs or bunkers as this gave protection from enemy shelling. When these were not available tents were used. They were staffed by 10 medical officers and stretcher bearers of the RAMC. From 1915 there were nurses there too. Men could either walk there or be carried. The Dressing Stations were a regiment of the RAMC called the Field Ambulance unit. The Field Ambulance unit could deal with 150 men but often in battles this was much higher. They did not have the facilities to deal with men for longer than a week.

3. Casualty Clearing Stations (CCS)
These were located far enough away from the front line to provide safety but close enough for the ambulance waggons. The CCS closest to the front line specialised in the most critical injuries. They were often close to railway lines to enable the next stage of evacuation to take place. They developed a ‘triage’ system for assessing the wounded:

I. The walking wounded - patch them up and return them to the frontline.
II. Those in need of surgery - move them onto a Base Hospital.
III. No chance of recovery - make them as comfortable as possible and let nature take its course.

By 1916, Casualty Clearing Stations became more important than Base Hospitals because if wounds were not dealt with quickly they could develop. Casualty Clearing stations remained the most important place for operations until the spring of 1918 when the Germans launched their Spring Offensive. As a result of the Spring Offensive, the CCS had to move further back so most of the surgery that was required for the wounded was now undertaken again in the Base Hospitals.

What was a ‘Blighty’ Wound?
This was a wound serious enough to get soldiers away from the fighting and back to Britain (blighty) via the Chain of Evacuation, but not serious enough to lead to permanent medical problems. Some soldiers gave themselves blighty wounds but risked the death penalty if it was suspected that their wound was self-inflicted.
4. Base Hospitals
These were located on the French and Belgian coast so men could easily be transported home. After treatment men would be transported home or returned to the Front if they were thought to be fit. As the war progressed Casualty Clearing Stations became more important than Base Hospitals because if wounds were not dealt with quickly they could develop. By 1916 Base Hospitals mainly continued the treatment already begun at the CCS. The size of Base Hospitals increased when there was a major offensive. As Base Hospitals were not doing their intended role they began to find other roles. These included experimenting with new techniques which were later used in the CCS if successful. Upon arrival patients were divided into wards according to their wounds. This meant that there were separate wounds for amputees, head wounds, chest wounds etc. Doctors were then allocated to wards and able to become specialised in the treatment of particular wounds. This later benefitted treatment of civilians.
The Underground Hospital at Arras

In November 1916, tunnelling began under the town of Arras. A fully working hospital was created in 800m of tunnels. It was so close to the frontline that it was, in reality, a Dressing Station not a hospital, although life-saving operations were performed into its operating theatre. From here wounded soldiers would move through the chain of evacuation. It was sometimes called Thompson Cave after the RAMC officer who was responsible for equipping it. There were waiting rooms for the wounded and 700 spaces were stretchers could be placed as bed. Unlike normal Dressing Stations, it was supplied with water and electricity and had its own mortuary. The hospital had to be abandoned during the Battle of Arras in 1917 which it took a direct hit which destroyed its water supply but luckily didn’t kill any people.

Source B: Written by Major General Sir W.G. Macpherson in his book “Medical Services General History” published in 1924. Macpherson was stationed on the Western Front between 1916-1918 and was in charge of the RAMC at that time. His book was based on officials and his own experiences.

“Dressing stations were established in caves, cellars and basements of buildings, protected as strongly as possible with sandbags on the outskirts of the town. The chief of these was in a large subterranean cave, from which stone had been excavated for building the town in the 16th century. It was close to the 3rd Division trenches and only 800 yards from the frontline. Two entrances for stretchers were tunnelled into it from the communication trenches, and an exit tunnelled out from the back into Rue St Quentin, where an approach was constructed for ambulance cars. This cave was fitted with electric light and a piped water supply and was able to accommodate 700 wounded on stretchers in two tiers.”

Explain why Source B would be more useful than Source A for an enquiry into the underground hospitals at Arras. You must write about BOTH sources in your answer. Remember to consider content AND provenance.
Doctors and Nurses

All medical officers and men in 1914 belonged to the RAMC - Royal Army Medical Corps - which organised and provided medical care at the Western Front. It consisted of all ranks - from doctors to ambulance drivers and stretcher bearers. Amongst its responsibilities was keeping men healthy, through good sanitation but their main role was in treating the wounded and the sick at the Western Front. The RAMC rapidly expanded to deal with the increasing scale of the war and the numbers of wounded; it had 9,000 men in 1914 but this had increased to 113,000 by 1918. More doctors were recruited by raising the age at which doctors would serve abroad to 45. These doctors had to learn very quickly because the kind of wounds they were treating were unlike anything they had seen before and they were working in an environment totally different from their practices and hospitals back in Britain.

Nurses

Most of the military nurses in 1914 were well-trained Queen Alexandra nurses. There were just 300 in 1914 but this had risen to 10,000 by 1918. At the beginning of the war, the British army would only accept fully qualified Queen Alexandra nurses and turned away untrained volunteers. However as the number of casualties increased the Army was forced to change its attitude and soon thousands of volunteer nurses were at work supporting the qualified nurses. The best known group of the volunteer groups was the VAD (the Volunteer Aid Detachment). Most VADs came from middle or upper class households and therefore had no experience of any kind of work, let alone dirty or physical tasks. Immediately they found themselves scrubbing and cleaning and eventually they were trusted enough to change soldiers’ dressings and give painkillers. In general, the work of nurses varied hugely, from professional nursing in the operating theatres, to scrubbing floors, cooking food, washing clothes and even writing letters dictated to them by injured soldiers, unable to write for themselves.
Some women became members of the First Aid Nursing Yeomanry (FANY). This organisation had been founded in 1907 during the war in the Sudan, Africa, by a soldier who hoped the FANY would become a kind of nursing cavalry. He had envisioned fearless women on horseback galloping to the aid of the wounded soldiers although these vision never materialised, during the Great War, nearly 500 women did venture forward to help the wounded men. These women were not on horseback but they did help the wounded soldiers by becoming ambulance drivers and nurses. 27th October 1914 is the date which marks the official start of the FANYs' wartime services. It was on this date that Grace Ashley-Smith acquired an ambulance and set out with six FANYs to drive ambulances for the Belgians and the French. (The British Army having declined their offer of help.)

The wartime Gazettes (magazines) recount the primitive conditions in which they lived and worked; Zeppelin bombing raids; supply trips to the Front; evacuating the wounded under fire; facing death and disease along with battles with bureaucracy. One report on May 1915 describes how, in the second chlorine gas attack, they doused their sanitary towels in eau de cologne and held them over the faces of the British soldiers, because the men didn’t have gas masks in that early stage of the war.

In 1916, the British army changed their policy and members of the FANY were officially recruited into the British Army. One FANY unit ran the Calais ambulance convoy for nearly 2 years with 22 drivers and 12 ambulances. Others carried supplies to the frontline, drove motorised kitchens to supply food; they even had a mobile bath vehicle which could offer baths to up to 40 men in one hour. The Gazette mentions how one woman, Pat Waddell, lost a leg when she was hit by a train while driving an ambulance. Within the year she returned to duty with an artificial leg. In all, during the First World War FANYs were awarded 17 Military Medals; 27 Croix de Guerre; one Legion d’Honneur, and 11 Mentions in Despatches.
## Injuries and Medical Problems

### Gas Attacks
Caused great panic and fear. It was not however a major cause of death. Only 6000 soldiers died from it during the course of WWI. The troops on the Western front were given gas masks from 1915, which became more sophisticated over time. Gas attacks were greatly feared by the soldiers partly because dying from poisoning was slow and painful.

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### Shell Shock (Like PTSD)
Nowadays shell shock would be diagnosed as Traumatic Shock Disorder (PTSD). However this condition was not understood at the time and some soldiers who were experiencing shell shock were shot for cowardice. Symptoms included tiredness, headaches, nightmares, loss of speech, blindness, uncontrollable shaking and mental breakdown. Famous war poets Siegfried Sassoon and Wilfred Owen both suffered and had treatment in a hospital in England. as they were officers.

### Infection
When metal bullets or shrapnel penetrated a soldier's body, dirt and the fabric of the uniform was also taken deep into the body. As the ground often contained fertilizer it also introduced bacteria for diseases like tetanus and gas gangrene into the body. Gas gangrene is an infection that produces gas in wounds where the flesh is decaying; tetanus affects the nervous system and was sometimes called 'Lock-Jaw'. Both of these diseases caused high temperatures, great pain and death. The impact of tetanus was reduced by anti-tetanus injections from the end of 1914. However there was no cure for gas gangrene. The infection would spread through the body quickly and could kill a person within a day.

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### Trench Fever
This illness produced flu like symptoms with high temperature, headache and aching muscles. This affected an estimated half a million men on the Western front. By 1918 the cause of this condition had been linked to contact with body lice. Delousing stations were set up and after this there was a decline in the numbers experiencing trench fever.

### Trench Foot
Many soldiers fighting in the First World War suffered from trench foot. This was an infection of the feet caused by cold, wet and insanitary conditions. In the trenches men stood for hours on end in waterlogged trenches without being able to remove wet socks or boots. The feet would gradually go numb and the skin would turn red or blue. If untreated, trench foot could turn gangrenous and result in amputation. Trench foot was a particular problem in the early stages of the war. For example, during the winter of 1914-15 over 20,000 men in the British Army were treated for trench foot.

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### Head Wounds
At the start of the war the headgear worn by soldiers was soft and offered little protection but in 1915 the Brodie Helmet was introduced. This helmet was made of metal and had a strap to prevent it falling off. It was distributed to all soldiers fighting on the Western Front and it reduced fatal head wounds by up to 80%.
New Techniques

**Amputation**
The only way to deal with the spread of infection was through amputation of limbs. By 1918 over 240,000 men had lost limbs. This was because it was the only way to fully prevent disease spreading.

**Wound excision or debridement**
This involved cutting away dead, damaged or infected tissues. It needed to be done as quickly as possible to prevent infection spreading. At the beginning of the war this was the only way of preventing the need for amputation. After excision the wound needed to be closed with stitches. If any infected tissue had not been removed before stitching, the infection would spread again.

**The Carrel-Dakin method**
Antiseptics such as carbolic Antiseptics such as carbolic lotion were inefficient when treating gas gangrene. By 1917 the Carrel- Dakin method had been developed and had become the most effective solution to infected tissue. This method involved putting sterilised salt solution in a wound through a tube. The solution was only effective for 6 hours so had to be done as soon as possible. This was made difficult due to the amount of soldiers which needed treatment and of course was very painful.

**The Thomas Splint**
In 1914/1915 men with a gunshot or shrapnel wound in the leg would have a very small chance of survival (20%). It was worse when the bone had pierced the skin. If the thigh bone was fractured, it would usually cause major bleeding into the thigh. The splint that was used to secure the leg did not work. By the time the injured soldiers reached the Casualty Clearing Station, he would have lost a massive amount of blood. He would have been in shock and also possibly developed gangrene. Many who survived had to have their legs amputated. Hugh Thomas invented the Thomas Splint, which was tested on in a hospital in London. In December Hugh Thomas nephew, Robert Jones went to the frontline to instruct medical practitioners on how to use the Thomas Splint. This increased survival rates from this type of wound from 20-80%.
X- Rays

Use of mobile X-ray units

X-rays were used from the start of the war. They were mainly used to show shrapnel and bullets, if they were removed this would help stop infection. Two x-rays would be taken from different angles and this would help the surgeon identify the location and shape of the shrapnel. At the beginning of the war the British Army had only 2 mobile X-ray units but by 1916 most CCS had one. Three were some Problems with the use of X-rays:

- X-rays could not detect all objects in the body
- Length of time it took to perform an x-ray
- Tubes in the x-ray overheated quickly

Blood Transfusions

The use of blood transfusions was introduced from 1915 by Lawrence Bruce Robertson in the base at Boulogne. He used an indirect method where a syringe and tube was used to transfer the blood to the patient. The purpose of this was to ensure that the patient did not go into medical shock through blood loss before surgery. Those who did not experience a negative reaction to the transfusion usually recovered.

Geoffrey Keynes, doctor and lieutenant in the RAMC, designed a portable blood transfusion kit that was used to provide blood transfusions closer to the frontline. This kit did not use stored blood because it was difficult to keep the blood fresh with no refrigeration. Keynes added a device to the blood bottle to regulate the flow of blood which helped prevent clotting. In 1915 Keynes used this method in a CCS on the western front.

The process was made safer after Richard Lewisohn discovered that adding sodium citrate would prevent stored blood from clotting. Then scientists discovered that storing the blood in a refrigerated conditions kept the blood fresh for longer, as did adding citrate glucose solution. By 1917 blood transfusions were being carried out in the Casualty Cleaning Stations because they had been so successful at the base hospitals. The first blood depot was created before the Battle of Cambrai in 1917. Stocks of Group O were collected to be ready for use as soon as the battle began. Group O was chosen because it can be given to everyone safely, even if a person has a different blood group.
Plastic and Brain Surgery

Increase in head injuries
Approximately 20% of all injuries in the Western front were head, neck and face. This was because these were the parts of the body which were least protected. Their injuries were usually the result of bullets or shrapnel.

Plastic Surgery
A new Zealand Doctor carried out most of the research regarding plastic surgery, he was called Harold Gillies. He was an ear, nose and throat surgeon. He was sent to the front in 1914 and began working with Charles Valadier in October 1914. They became interested in facial disfigurement. He was interested in trying to discover ways of replacing and restoring parts of the face that had been destroyed. He devised different operations when new injuries appeared. These detailed operations could not be carried out in France due to the horrific conditions of life on the frontline. Queen Hospital in Kent, Britain was the main hospital for this type of treatment after 1917. Gillies helped create the design for the hospital so it matched his needs.

Brain Surgery
Injuries to the brain were almost always fatal at the start of the war. This was because:

- Very few doctors who had experience of neurosurgery before the war.
- Infection in the head was just as common as any other part of the body
- Difficulties in moving men through the chain of evacuation as they were often unconscious.

Despite not many doctors having experience in these kind of injuries, observations of different patients quickly led to improvements in treatments.

Harvey Cushing was a key person who helped new techniques in Brain surgery develop. He experimented with use of magnets to remove metal fragments from the brain. He also used local anaesthetic rather than general anaesthetic. General anaesthetic often caused the brain to swell. He operated on 45 patients in 1917 and 71% survived; the usual survival rate was 50%.

He concluded:
- It was dangerous to move men too quickly after an operation.
- Men who were operated on as soon as possible after the injury were more likely to survive.
- Brain Injuries that looked minor may be hiding more severe injuries.

All of his work led to improved brains surgery AFTER the war as well as during it.