“Medical Discovery and Progress from War”

Spring 2017

April 5 – May 3
Medical Discovery and Progress from War 2016-2017

Course Events

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<td>Scurvy, the Discovery of Vitamins, and the Development of Controlled Clinical Trials</td>
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<td>The Spanish-American War: Walter Reed and Yellow Fever; The First World War: Infectious Diseases, and the Neurology of Cerebral Trauma</td>
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<td>Wed 4/26/17</td>
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<td>From Shell Shock to PTSD: The History of Psychotraumatology</td>
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Location: Becker Medical Library, Center for History Of Medicine and Archives and Rare Books Department

Course Syllabus

Section Links:

1. Faculty Contact Information: Robert M. Feibel, feibelr@wusm.wustl.edu, 362-2725
2. Course Philosophy/Introduction to the Course
3. Course Objectives
4. Course Materials
5. Policies
6. Professional Expectations
7. Course Updates Based on Student Feedback
8. Concluding Notes

1. Faculty contact information

   **Course Master:** Robert M. Feibel, MD
   **Email:** feibelr@wusm.wustl.edu
   **Phone:** 314-362-2725
2. Course Philosophy/Introduction to the course

As long as history has been recorded, human societies have physically attached each other for various reasons. As destructive as wars have been, military history has played important roles in improving treatment of trauma, sanitation, drug development, and the understanding of many aspects of medical science. This selective will consider medicine from United States military and national history in the following areas:

- Week I - The Early Frontier, 1800-1850: William Beaumont, the first American medical researcher
- Week II - The Civil War; The beginning of a national medical library; Scurvy; and The development of clinical trials
- Week III - The Spanish-American War: Walter Reed and Yellow Fever; The First World War: Neurosurgery and Neurology of Cerebral Trauma
- Week IV - From Shell Shock to PTSD: The History of Psychotraumatology
- Week V - The Second World War: Antibiotics and Blood Transfusion

3. Course Objectives

By the end of this course students should be able to:

- Identify the beginning of medical research and the development of the first national library in America
- Understand how research showed that epidemic diseases such as yellow fever were transmitted by insect vectors and how public health dealt with this problem
- Learn how cerebral trauma from high explosive shells advanced the fields of neurology and neurosurgery
- Explore how the advent of World War II hastened the development of penicillin and blood transfusion
- Understand the development of psychiatric approach to Post Traumatic Stress Discord arising from war

Each goal is mapped to the WUSM Medical student competency-based learning objectives (indicated in parenthesis). These program level objectives can be found at:

http://bulletinoftheschoolofmedicine.wustl.edu/EducationalPrograms/mdprograms/Pages/Learning%20Objectives.aspx

4. Course Materials

5. Policies

a. Grading.

- 80% students’ discussion of their assigned chapters in the text
- 10% attendance
• 10% students’ summary of the course to be prepared at the conclusion of the course.

b. Attendance Requirements.

• Attendance required.

6. Professional Expectations

7. Course Updates Based on Student Feedback

8. Concluding notes

Course Summary:

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<td>Medical Discovery &amp; Progress from War</td>
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Session Overview - The Early Frontier, 1800-1850: William Beaumont, the first American medical researcher scientist, and The Civil War

Session Date: 4/5/17
Robert M. Feibel, MD

Session Requirements:
Everyone should read the two Learning Resources documents below.
Students will be assigned readings (see Announcements) from the Recommended Reading section at the bottom of this page.

Learning Resources:

War and Trauma: A History of Military Medicine - Part 1 (updated 11/30/16 md)
(Permission granted by the author of the article/editor of Kansas City Medicine Journal)
(Used with permission. Missouri State Medical Association copyright 2016)

War and Trauma: A History of Military Medicine - Part 2 (updated 11/30/16 md)
(Permission granted by the author of the article/editor of Kansas City Medicine Journal)
(Used with permission. Missouri State Medical Association copyright 2016)

Session Objectives:
After this session, students will be able to:

• Understand the historical development of military medicine and appreciate some of the medical progress arising from war. They will also learn about the first medical research performed in America and relate this to St. Louis.

Information About the Session:
None available at this time.

**Recommended Reading:**

These reading links will be assigned per student:

- [Brief Biography of Beaumont](https://example.com) (Links to an external site.) (read only pgs. 73-75)
- [Osler on Beaumont 1902](https://example.com)
- [Brodman on Beaumont 1967](https://example.com)
- [Green re Beaumont 2010](https://example.com)
- [Civil War Medicine](https://example.com)

**Review Materials:**

None.

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Session Overview - Scurvy, the Discovery of Vitamins, and the Development of Controlled Clinical Trials

Session Date: 4/12/17
Robert M. Feibel, MD

Session Requirements:
Everyone should read the one Learning Resources document below.
Students will be assigned readings (see Announcements) from the Recommended Reading section at the bottom of this page.

Learning Resources:

The Discovery of Vitamins (Links to an external site.) (updated 3/15/17 md)
(www.nobelprize.org)

Session Objectives:
After this session, students will be able to:

• Appreciate the importance of proper nutrition and the consequences of lack of proper vitamins in naval warfare, and how this field led to the development of controlled clinical trials in medical practice.

Information About the Session:
None available at this time.

Recommended Reading:

Scurvy - past, present, and future (Links to an external site.)
Short biography of Lind (Links to an external site.)
Lind, critical analysis of his work (Links to an external site.)

Evolution of Clinical Research:

• Lind and controlled clinical trials (Links to an external site.)
• A change in scientific approach: from alternation to randomised allocation in clinical trials in the 1940s (Links to an external site.)
• **The Fielding H. Garrison Lecture: Ceteris Paribus: The Evolution of the Clinical Trial (Links to an external site.)**

**Review Materials:**

None.

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Session Overview - The Spanish-American War: Walter Reed and Yellow Fever; The First World War: Infectious Diseases, and the Neurology of Cerebral Trauma

Session Date: 4/19/17
Robert M. Feibel, MD

Session Requirements:

Everyone should read the one Learning Resources document below.

Students will be assigned readings (see Announcements) from the Recommended Reading section at the bottom of this page.

Learning Resources:

Walter Reed and Yellow Fever (updated 3/15/17 md)
(A Biographical Sketch by William Bennett Bean, MD)

Session Objectives:

After this session, students will be able to:

- Understand the devastating consequences of infectious epidemic diseases in armies and how military medicine dealt with this problem.

Information About the Session:

None available at this time.

Recommended Reading:

Downs on Yellow Fever since Reed

World War I and Treatment of Infectious Diseases (Links to an external site.) Links to an external site.
The US Military and the Influenza Pandemic of 1918-1919 (Links to an external site.)
Neurological Advances from War Injuries (Links to an external site.)

Review Materials:
None.

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Session Overview - The Second World War: Antibiotics and Blood Transfusion

Session Date: 4/26/17
Robert M. Feibel, MD

Session Requirements:
All students are to read this brief history of the discovery of antibiotics [http://www.randomhistory.com/antibiotics-history.html](http://www.randomhistory.com/antibiotics-history.html) (Links to an external site.).

Students will be assigned readings (see Announcements) from the Recommended Reading section at the bottom of this page.

Learning Resources:
See Recommended Reading section below ([updated 3/28/16 md](http://www.randomhistory.com/antibiotics-history.html))
(Assignments will be sent via Announcement)

Session Objectives:
After this session, students will be able to:

- Understand two major advances arising from World War II; blood transfusion and antibiotics.

Information About the Session:
None available at this time.

Recommended Reading:

- [Gerhard Domagk from Smells Like Science and Chemical Heritage Foundation](http://www.randomhistory.com/antibiotics-history.html)
- [Lesch 2007 Intro](http://www.randomhistory.com/antibiotics-history.html)
- [Ligon on Penicillin - Its Discovery and Early Development](http://www.randomhistory.com/antibiotics-history.html)
- [Lesch 2007 Chapter 10 - Trial by Fire](http://www.randomhistory.com/antibiotics-history.html)
- [History of Blood Transfusion](http://www.randomhistory.com/antibiotics-history.html)
- [Cowdrey - Fighting for Life - Wounded in Action](http://www.randomhistory.com/antibiotics-history.html)
Review Materials:

None.

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Session Overview - From Shell Shock to PTSD: The History of Psychotraumatology

Session Date: 5/3/17

Robert M. Feibel, MD
Rumi Kato Price, PhD MPE

Session Requirements:

All students are to read this definition of PTSD: Post-Traumatic Stress Disorder - PTSD and this article documenting the various names for PTSD prior to its modern classification and development of the PTSD diagnosis: History of PTSD in Veterans.

Students will be assigned readings (see Announcements) from the Recommended Reading section at the bottom of this page.

Learning Resources:

See Recommended Reading section below (updated 3/28/16 md)
(Assignments will be sent via Announcement)

Session Objectives

After this session, students will be able to:

- Understand the historical development of post-traumatic stress disorder from ancient times to the present era and how this concept arising from military medicine now affects civilian populations as well.

Information About the Session:

None available at this time.

Recommended Reading:

Early Historical Literature for Post-traumatic Symptomatology

From Shell Shock and War Neurosis to PTSD - A History of Psychotraumatology

Posttraumatic Stress Disorder - A History and a Critique

Mental Health Impact of the Iraq and Afghanistan Wars:
• Veteran's Statistics of PTSD, Depression, Suicide (Links to an external site.)
• Mental health impact from the Iraq and Afghanistan wars (Links to an external site.)

Gender and PTSD:

• Health Effects of Interpersonal Violence Among Women (Links to an external site.)
• What Science Says about Gender and PTSD (Links to an external site.)
• PTSD in Women (Links to an external site.)
• Traumatic Stress in Women Veterans (Links to an external site.)

Review Materials:

None.

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Student Comments

- Thank you for the great selective!

- Thank you for an amazing selective.

- Thank you for teaching this selective, it was very interesting and enjoyable.

- Thank you so much for putting together a fantastic selective.

- Thank you for teaching this course! It is a great selective.

- Thank you again for giving us a better appreciation of the practice of modern medicine.

- Thank you for a wonderful and enlightening few weeks!
The Impact of WWII on the Production of Penicillin

In 1941, the use of penicillin in the treatment of bacterial infection was first recognized by the Office of Scientific Research and Development (OSRD) Committee on Medical Research. Despite the scientific and medical communities’ acknowledgment of its potential, the actual development and use of penicillin was limited by its production. At its point of recognition by the OSRD, there was not enough penicillin manufactured to treat a single case of infection. By 1942, there was enough penicillin synthesized to treat one patient, and by 1943, enough to treat 100 patients. However, the supply of penicillin was still severely limited.

With the ever-growing number of preventable casualties in World War II, the OSRD was convinced that the U.S. military needed to penicillin to provide a standard treatment of infection. In 1943, the OSRD met with the War Production Board’s Drugs and Cosmetics Section to create the first mass production program of penicillin.

However, despite the agreement by both the medical research community and top military officials on the validity and promise of penicillin, the synthesis of the antibiotic remained the limiting factor. In July 1943, for example, records document the limited distribution of penicillin. Military officials could only request the penicillin use only in cases of “grave life-endangering infections that have resisted other appropriate forms of therapy, especially the sulfonamides.” It goes without saying that penicillin saw very limited civilian use.

The turning point in the battle against treatable bacterial infection was in March 1944. Government representatives and penicillin producers met to negotiate a contract under which manufacturing companies agreed to share among themselves the synthesis process and patent rights for penicillin. The military hoped that the opening of information, would speed production. Indeed, the U.S. military saw dramatic surge in penicillin production. By D-day in June 1944, enough penicillin was produced and distributed to treat all Allied troops. By June 1945, monthly production of penicillin was over 150 times greater than the monthly production in 1943. The increase of penicillin supply allowed distribution and use amongst the civilian population. In 1994, a panel – made up of members of the War Production Board, the Public Health Service, OSRD, and the American Medical Association – was created to oversee the civilian penicillin distribution. By the end of 1944, penicillin was distributed and available at 2,700 designated depot hospitals.

In conclusion, the production and modern pervasive use of penicillin is deeply rooted in military history. Despite the recognition of penicillin’s potential in 1941, it was only three years later when medical community, government officials, and manufacturing companies had successfully built an alliance that allowed for the widespread synthesis, distribution, and use of penicillin amongst both the military and civilian population.
Some of the earliest childhood memories I have were images from the Bosnian War in the 90’s. Growing up in a Muslim country, the Bosnian War was fodder for propaganda material for the government. But along with images of death and suffering were those of medical personnel in white vests trying to resuscitate what was left of the country. It is staggering to think that medicine has been opportunite in reaping knowledge from wars, whether by necessity and ingenuity to save lives and improve care or simply by torture.

While our class focused on the great discoveries of penicillin, vitamin C, blood transfusion, traumatic brain injuries, etc., namely from the British, Americans, and French, it would be interesting to know what, if any, medical advancement was gained from the modern-day Turkish, Japanese, Chinese, Vietnamese, Russian, and Germans from wars in the past century.

Another interesting takeaway is the amount of lag time from initial discovery to mainstream acceptance as was seen in John Lind’s discovery of Vitamin C, Alexander Fleming’s discovery of penicillin, and injuries from post-traumatic stress disorder. Even more interesting though, is the fact that a major obstacle was the medical and scientific community itself. Whether due to lack of interest, dismissive of findings, or healthy skepticism.

I am aware that it is easy to criticize with the benefit of hindsight. This class did a great job stitching together a canvas of mini stories and struggles that went into what we now know about modern medicine, and I have come to a better understanding and appreciation of the difficult paths that many have taken to contribute to my studies.
Reflection

The subject that most interested me throughout the course was the topic of William Beaumont and his experiments on Alexis St. Martin. I enjoyed analyzing the ethics of the research and comparing them to the standards that guide clinical trials today. It was also fascinating to compare the styles of writing in the various readings, for the authors could cast Beaumont in very different roles, trending between a callous perpetrator of borderline torture to the glorified father of gastroenterology. I also enjoyed the approach of studying the minute details of Beaumont’s contract with St. Martin, and then contrasting that contract to formal agreements of labor prevalent during the antebellum period. One author argued that the Beaumont’s conflicting attitude toward St. Martin was reflective of a concurrent shift in the economy, which was transforming from a paternalistic reliance on indentured servitude to the expansion of free market capitalism and more formal conceptions of employer-employee relations.

The session on Beaumont also benefited from its obvious relevance to St. Louis and the history of medicine at our institution. I was impressed with the library’s collection of historic works and portraits associated with that era, which added depth to the topic and made the somewhat gruesome story personally real. If I could recommend anything for the course, it would be to emphasize individual characters, events, and discoveries that were intimately related to the local area. For instance, I think a whole session could have been dedicated to Base Hospital 21 during WWI. Overall, I thoroughly enjoyed the course and am very grateful to have had the opportunity to study groundbreaking medical discoveries born of war.
Medical Discovery and Progress from War

This class has been an incredibly interesting and informative selective. I thoroughly enjoyed reading the articles as well as seeing the history books and pictures presented at the end of several sessions. In terms of material, I found the history of William Beaumont to be particularly interesting—specifically the dynamic between himself and his subject. It is hard to imagine a world without HIPPA and IRBs. Before this session, it was easy for me to imagine scenarios where investigators have the opportunity to take advantage of human subjects in a different context—such as withholding treatment despite knowing there is an effective cure (like in the case of Tuskegee), and refusing to distribute drugs to populations that carried the burden of clinical trial. Although it is easily argued that Beaumont would have violated the current ethical tenant pertaining to coercion, the relationship was incredibly interesting considering Beaumont saved the patient’s life. The nuance of ownership and the overarching master/servant or employer/employee relationship seems so outlandish in current times. To make matters even more complex, great medical advancements were made based on Beaumont’s experiments. It makes me wonder what kind of advancements could be made in present day with our current knowledge and resources if there were fewer rules and regulations regarding human subject research (not saying that we should get rid of the rules by any means, I’m just curious if medical advancements we are so desperate to achieve such as “curing cancer” and HIV would be realized sooner). On the other hand, Beaumont’s story illuminates the importance of the creation of concrete rules regarding patient autonomy and beneficence. The patient’s life was essentially dictated by scientific studies and experiments—something no one should be subjected to against their will.
Medical Progress from War: Civil War Anesthesia

One of the greatest discoveries in the medicine, specifically for surgery, was the use of sulfuric ether as an anesthetic by William Morton in 1846. Sulfuric ether, and later chloroform, became widely used during the civil war for surgeries. The procedure involved placing an anesthetic-soaked sponge at the top of a cone, and putting the open end of the cone over the patient’s nose and mouth. Although our delivery methods are more advanced now, the delivery method at the time was still very effective in rapidly inducing desired anesthetic effects.

Interestingly, the phrase “bite the bullet” came from the civil war. Only low doses of anesthetic were used during the surgeries in the civil war, and the patients would writhe about even though they were unconscious and insensitive to pain. Speed was still crucial for these procedures, and spectators may have wrongly assumed that the patients were flinching due to the pain, and not because of mild anesthesia. This spectacle, coupled with bullets found with pig’s teeth marks gave birth to the myth of “biting the bullet”.

Utilization of anesthesia was unequal between the Union and Confederate armies during the war. This disparity was not due to differences in practice between surgeons on the two sides, however. The major anesthetic manufacturers were located in the North, and the Confederate states faced a naval blockade. Chloroform became a prized resource for the Confederate army, so much such that it was smuggled across the border inside of dolls and Union supply trains were frequently raided for those prized containers.

The staggering number of casualties during the war gave some surgeons experience with using anesthetics on thousands of patients in a short period, advancing the medical science of anesthesia, which would also be used extensively in the first World War.
I found this selective to be quite interesting, one of my favorite topics was learning about the history of blood transfusions. I had learned in my previous studies during my undergraduate education about the Central Doctrine of Humoral Theory and the history of blood letting dating back to the time of Hippocrates. I had not, in the past, thought much about how the transition took place from seeing blood as something that needed to be rid from the body, to the current practice of transfusing blood to patients. Learning that the first blood transfusions were between animals, and that the first human transfusions featured blood from animals was surprising to me. Learning about the progress that has been made in medicine is often difficult for me to grasp, trying to understand how concepts that were ingrained in me as a child were, for a long time, unknown to anyone.

It was interesting to learn that the modern concept of a blood bank was initially created as a result of a military conflict. Having never considered how the idea originally got started, I was surprised to think about the fact that there was a time when blood transfusions would have occurred directly from one person to another. I also found it surprising that there were, for a long time, many doctors that were skeptical of the idea of storing blood for extended periods of time, and that preferred to continue to directly transfuse blood from one person to the next on site.
Of the material presented in this selective, I found the session on vitamins and clinical trials to be the most interesting. Learning that the modern clinical trial didn’t come into existence until the second half of the twentieth century was eye-opening, especially given that James Lind carried out the first modern clinical trial in the mid eighteenth century. I found the first randomized clinical trial of streptomycin particularly interesting. It was noteworthy that the trial was only ethical because of streptomycin shortages in the UK – this was a good example of how scientific discovery can progress because of unfortunate limitations or events. I also appreciated how much work doing a truly randomized trial might have been in the late 1940s – the investigators had to generate sequences of truly random numbers by hand.

I also was surprised to learn that the isolation of most vitamins did not take place until the early 20th century. As vitamins are such a commonplace concept in our modern life, I had never conceived that discovering vitamins would be difficult. However, when you think about it, discovering vitamins would require the coincidence of careful observation in a nutritionally limited population – you would have to have a sufficient sample of people exhibiting the same symptoms, and you would have to tie that a very specific diet eaten consistently by the population.

A final session that interested me was the discussion of the Spanish influenza pandemic of 1918-1919. It was an interesting detail to learn that the pandemic was perhaps unfairly labeled as “Spanish” because the Spanish newspapers weren’t censored, unlike the newspapers from countries at war. While I had learned about the pandemic in undergraduate classes before, it was fun to look at it again with a fresh perspective after taking microbiology. Specifically, in microbiology, we discussed the mutability of the influenza antigens, hemagglutinin and neuroaminidase, and how antigenic shift can take place when different flu strains combine in a single host. It was interesting to understand more fully how the close housing of people during WWI may have contributed to the spread of the pandemic: specifically, some researchers believe that the virus’s incubation in healthy young adults may have led to the evolutionary selection of a particularly virulent and deadly strain of the virus.
**The influence of war on perceptions of PTSD**

Over the course of this selective, I learned specific historical facts and broad themes that impacted my perception of medical discovery and progress resulting from war. One broad theme that I found particularly interesting during our study of post-traumatic stress disorder (PTSD) was how external cultural climates, such as those created by war, can influence our perception of disease.

PTSD is a debilitating condition characterized by chronic emotional numbness, persistent flashbacks, and frightening thoughts and memories following a traumatic emotional or physical event. The “discovery” of this disease, as well as our subsequent perception and definition of this disease, have been heavily influenced by our direct observation of mentally scarred soldiers during post-bellum eras. The notion that war has influenced our perception of PTSD can be tracked through an analysis of the changing definition of PTSD in the Diagnostic and Statistical Manual of Mental Disorders (DSM).

While accounts of “shellshock” were documented in the wake of World War I (WWII), the first official description of PTSD was described in the DSM-I as a “gross stress reaction” in the wake of World War II (WWII) in 1952. Given the vast number of soldiers returning home from world war around this time, psychologists were forced to describe a mental disease resulting from the stresses of battle. As war faded from the American psyche, however, there was a rewriting of the DSM (DSM-II) in 1968. In this non post-bellum era, the “gross stress reaction” (or PTSD) was entirely omitted. By the time the DSM-III was written, however, the nation was reeling in the aftermath of the Vietnam War. Soldiers were returning home with the physical and mental scars of battle, and this forced an official reassessment of mental illness and the inclusion of the disease that we know today as PTSD [1]. The evolution of the DSM, therefore, offers an interesting insight into how our perception, definition, and diagnosis of disease can be affected by our cultural surroundings, especially relating to war.

A Brief History of the Early Development of Neurosurgery

Some say neurosurgery has its roots dating back as far as Hippocrates. Although very crude and ineffective, in the work *De capitis vulneribus* (written by the Hippocratic School of Medicine) ways of classifying head injuries was outlined and based on these classifications, it was determined whether trephination was to be performed.

The second big landmark in the neurosurgery field was during the Renaissance and brought about by Jacopo Berengario da Carpi (1460-1530), who was an Italian surgeon and anatomist. He produced a work called *De fractura cranii*. In this work, Carpi detailed head injuries but was the first to supplement his work with illustrations. In the years following, huge advances in neuroanatomy knowledge occurred, but few to no advances were made in the surgical realm.

Pivotal in the development of neurosurgery was overcoming the previously held beliefs that “spirits” in the ventricles were what performed cognition and sensory experience. Franz Joseph Gall (1758-1828) was the first to challenge these assumptions. He posited that cognition was performed in the folds of the cerebral cortex, and that specific functions were localized. Along with this, a physiologist named Jean Pierre Flourens (1794-1867) ablated and stimulated various parts of the nervous system (peripheral nerves, spinal cord, brainstem, cerebral cortex) on animals and determined the rough function of each part, and what occurred if these structures were damaged. These advances set the stage for understanding more localized nervous system function, and were vital towards later physicians being able to diagnose tumors or lesions purely based off a physical exam.

All of these advances helped push the field forward, and at the turn of the twentieth century, some pioneer neurosurgeons were utilizing craniotomies to remove tumors from the pituitary, remove bullets from within the brain, and performing cranial decompression.

Sources

Medical Progress and Discovery from War

Over the past several centuries, war has created powerful incentives and unique opportunities for medical discoveries and advancements. In particular, World War I is a prime example of the impacts that war has on medical progress. World War I was an incredibly bloody war, with an estimated 37 million military casualties between all countries combined. This accounts for over 55% of the men that were mobilized during the war. Since the casualty rate was so high, countries needed to keep their soldiers alive after they were injured. Two specific ways that this was approached was through improvements in blood transfusions and infection control.

Transfusions began in the 1700s, but knowledge of blood types only dates back to 1900. Thus, the large number of wounded soldiers provided physicians with a valuable experience to improve their understanding of blood transfusions and the physiological response. However, most of the front was nowhere near population centers, so blood would coagulate before it could be delivered. This was solved in 1914 when Dr. Albert Hustin discovered that adding sodium citrate to blood prevented it from coagulating, which allowed it to be transported to the front in usable condition. In 1917, the first blood bank was established on the western front using sodium citrate as a preservative. Much of our knowledge about blood transfusions arose from physicians treating and studying wounded soldiers throughout the war.

While injuries were unfortunately very common in World War I, infections of these wounds caused millions of preventable deaths over the course of the war. In 1916, a French physician and an English chemist worked together at a temporary hospital in northeast France to develop a method of wound treatment. This resulted in what became known as the Carrel-Dakin technique, where a sodium hypochlorite solution was applied directly to wounds. This decreased the incidence of gangrene and other wound-related infections dramatically. This discovery was so monumental that a similar version of this solution was used to treat wounds until the end of the 20th century.

Blood transfusion and antisepsis were only two of the many discoveries that were developed as a result of World War I. The incentives to improve medical treatment combined with the immense opportunities for application, testing, and development resulted in profound advancements in our understanding of human physiology, medications, and much more.

Sources:


Since humans have been on earth, war has been used between groups of people for a multitude of reasons, whether they be territorial, economic, or for more intangible causes such as reputation or power. There is evidence of war as far back as 14,000 years ago, with its history leading to countless casualties and brutal injuries. However, war has allowed for great amounts of medical discovery and progress due to several reasons. War has allowed for medical advancement through both testing on patients with injuries attained in battle and through understanding of the effects of the trauma of war on those who fight in it.

During World War I, there were many injuries that led to restricted deficits in the brain. Because of the design of the helmets, which left the occipital pole exposed, and the increased precision of the bullets, specific visual loss from bullet injuries allowed for visual mapping on a scale that had not been done before. Using primitive X-ray mapping and brain templates, Gordon Holmes and some of his colleagues greatly improved the understanding of the visual cortex. While these wartime injuries were devastating to the patients who had them (at times, the hospital Holmes worked at had 900+ bed patients at once), they led to great discovery for the understanding of the human brain.

War has also allowed for great understanding of how trauma can affect the human brain and what that means for its victims. War is the greatest cause of PTSD, as almost one fifth of the soldiers returning from war have PTSD, while about 1 in 25 non-veterans in a non-wartime year have PTSD from other traumatic events. This means that many of the patients who have been treated for PTSD are veterans, so much of what we know about the disease has come from wartime patients. Understanding of the causes of PTSD from veteran victims has allowed for better knowledge of the reasons for those who get PTSD, what occurs in the brain with PTSD, and how treatments can be applied to improve the symptoms of PTSD. Without wartime trauma, the medical community would have less access to the disease and would not know as much about the disease as we do now.

Other cases, such as infectious outbreaks and the desire to keep soldiers healthy or a need for improvement of blood transfusions, have also led to advancements that would have been delayed or not possible without the events of war. The effects of war on the participants are devastating and awful, as is the nature of war, but its results can create situations that provide unique circumstances for medical advancement. These advances have made medicine better for both future wars and for civilians during peaceful times and have helped both individual patients and communities in great ways.

References


Evaluation Results for: Medical Discovery & Progress from War

<table>
<thead>
<tr>
<th>Raters</th>
<th>Students</th>
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<tr>
<td>Responded</td>
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<td>Invited</td>
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<tr>
<td>Response Ratio</td>
<td>90.91%</td>
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How would you rate this selective course overall?

![Bar chart showing ratings distribution]

Statistics Value
Mean 4.20
Standard Deviation 0.63

Please provide any comments you have about this course:

Comments
The content was very interesting and I enjoyed the material.
Fascinating material, and you get to see primary material in the library archives!

How well were the course learning objectives met?

![Bar chart showing ratings distribution]

Statistics Value
Mean 4.50
Standard Deviation 0.53
How effective was the course director in organizing and administering the course?

![Bar chart showing effectiveness of course director]

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<td>Standard Deviation</td>
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How effective do you consider the assessment method to be?

![Bar chart showing assessment effectiveness]

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<td>Standard Deviation</td>
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Would you recommend this course for future students?

![Bar chart showing recommendation]

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<td>Standard Deviation</td>
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Please comment on why you would or would not recommend this course.

**Comments**

Super interesting material

Straight forward and interesting course. I thought it would focus a little more on actual battlefield related advances in medicine, but the course's topics of focus were still very interesting and enjoyable.
Please share suggestions for improvement of this course:

<table>
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<tbody>
<tr>
<td>Narrowing the scope of the course even further</td>
</tr>
<tr>
<td>This was a well organized course.</td>
</tr>
<tr>
<td>Though the visits to the archives were interesting, I thought they were at times extraneous. I think the time devoted to the archive visits could be cut down in favor of more time in the classroom or just shorter classes.</td>
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