Joseph Lister's Antiseptic Surgery: Revolutionizing the Boundaries of Medicine

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"Lister saw the vast importance of the discoveries of Pasteur.

He saw it because he was watching on the heights, and he was watching there alone."

— Sir Thomas Clifford Allbutt, 1911[1]

When one envisions a hospital nowadays, a massive building filled to the brim with lifesaving technology, clean white rooms, and shiny sterile instruments comes to mind. This was not always how it was. During the peak of the Industrial Revolution in England, patients were lucky if they left with all their limbs if they left at all. Hospitals were packed full with the victims of progress, surgeons operated in the same clothes they left their house in and typically used the same instruments on multiple patients.[2] More than half of patients who were operated on lost their life, not to their injuries but to the infection that followed. That is until a man named Joseph Lister came forward with a potential solution he called antiseptic surgery.[3] This supposedly revolutionary procedure involved a special chemical that could decrease the risk of infection. Instead of drawing applause from the medical community, Joseph Lister was faced with heaps of harsh criticism and accusations of falsifying his research even though he proved his new technique time and time again.[4] Although Joseph Lister's revolutionary procedure was initially faced with overwhelming negativity, his innovative method would permanently change the way certain injuries were treated and would reinvent the system of surgery.

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[1] Greenbaum, Perry J. "Joseph Lister: Father of Antiseptic Surgery." *Perry J Greenbaum*. 28 Apr. 2011. Web. 09 Jan. 2012. <http://perryjgreenbaum.blogspot.com>.

[2] Lister, Joseph. *The Collected Papers of Joseph Lister*. Oxford: Clarendon, 1909. *Internet Archive*. Web. 1 Jan. 2012. <http://www.archive.org>.

[3] Lister, Joseph. "Illustrations Of The Antiseptic System Of Treatment In Surgery." *The Lancet* 90.2309 (1867): 668-69. *The Lancet*. Web. 8 Jan. 2012. <http://www.thelancet.com>.

[4] Lister, Joseph. "Key Passages: On The Effects Of The Antiseptic System Of Treatment Upon The Salubrity Of A Surgical Hospital." *The Lancet* 95.2419 (1870): 40-42. *James Lind Library*. Web. 15 Dec. 2011. <http://www.jameslindlibrary.org>.

Right from the beginning, Joseph Lister had all the tools to make a mark on the scientific world. He was the fourth of seven children born to a wealthy Quaker family in Essex on April 5th 1827. Lister's father, Joseph Jackson Lister, was a fellow of the Royal Society of London and invented the achromatic lens for microscopes.[5] As a young man, Lister attended two private Quaker schools, the first was named Hitchin in Hertfordshire then he graduated to Tottenham near London, where he excelled in nearly every single subject. While at Tottenham around 1840, he discovered his passion for medicine and decided to become a surgeon. At fourteen, all his free time was spent dissecting small animals and then piecing the bones back together. In a letter to his father while on vacation from school at home he describes his experiments, showing his avid affection for his newfound passion, saying:

> "When Mamma was out I was by myself and had nothing to do but draw skeletons, so I finished the cranium and named the bones of it, and also drew and painted the bones of the front and back of the hand, and named them. Mamma came home on the seventh day, at about 2 o'clock, and in the evening, with John's help, I managed to put up a whole skeleton, that of a frog, and it looks just as if it was going to take a leap, and I stole one of Mary's pieces of wood out of the drawers of the cabinet in the museum, to stick it down upon, and put it on the top of the cabinet with a small bell glass over it, and it looks rather nice. Do not tell Mary about the piece of wood."[6]

In the spring of 1844 when he was just seventeen, Lister decided to attend college to fulfill his goal of becoming the first surgeon in the family.

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[5] "Sir Joseph Lister | 1827-1912." *NAHSTE: Navigational Aids for the History of Science Technology & the Environment*. Web. 9 Jan. 2012. <http://www.nahste.ac.uk>.

[6] Godlee, Rickman John. *Lord Lister*. London: Macmillan, 1917. Electronic.

However on this new path, Lister met what would be the first of many challenges. Since Quakers were seen as mystical non-conformists, many prestigious colleges of the time denied Quakers entrance. As a result, Lister was rejected by many esteemed universities such as Oxford University, Cambridge University, and even King's College due to his religious beliefs. Luckily, the University College in London, the first English University to admit Quakers and other non-conformists, accepted Lister where he continued his studies.[7] College presented Lister with many new opportunities to gain more experience. For example, he was present when the first amputation using an anesthetic was performed in 1864 in the University College Hospital across the road from the school (Appendix I).[8] Lister eventually earned both his Bachelor of Arts in 1847 as well as his Bachelor in Medicine in 1852 from University College. He also became a member of the Fellowship of the Royal College of Surgeons in 1852, allowing him to begin practicing medicine.[9]

After completing college, he was invited to visit James Syme's famous clinic in Edinburgh, Scotland in 1853. During his three years stay at the clinic, Lister served as house-surgeon as well as Syme's personal assistant. He married Syme's eldest daughter, Agnes who would prove invaluable and imperative to his later works, in 1856 and became an assistant surgeon at the Royal Infirmary in Edinburgh.[10] While still in Scotland, good fortune fell to the medically-minded couple when Lister was elected a Fellow of the Royal Society and gained the

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[7] "Joseph Lister (1827-1912)." *Quakers in Britain*. Web. 9 Jan. 2012. <http://www.quaker.org.uk>.

[8] Banerjee, Jacqueline PhD. "Joseph Lord Lister (1827-1912), F.R.S., O.M." *The Victorian Web*. Web. 09 Jan. 2012. <http://www.victorianweb.org>.

[9] "Joseph Lister." *NNDB: Tracking the Entire World*. Web. 13 Nov. 2011. <http://www.nndb.com>.

[10] Griffith, Robert K. "Joseph Lister." *Chemistry: Foundations and Applications*. Web. 27 Nov. 2011. <http://www.chemistryexplained.com>.

much coveted position of Regius Professor of Surgery at Glasgow University in 1860. This position enabled Lister to experiment and eventually develop and test a new method of surgery.[11]

After a successful year at the University of Glasgow, he was given charge of the surgical wards of the adjacent hospital where he was shocked by the number of septic cases present. Blood poisoning and gangrene overwhelmed amputation patients, claiming most of their lives (Appendix II). This troubled Lister and tortured him as he fruitlessly sought for a solution until a fateful day in 1864 when Lister first heard of Pasteur's new theory about these things called "germs".[12] Pasteur proposed that microscopic organisms that caused inflammation and infection actually traveled through the air when he discovered that putrefaction only occurred when exposed to open air.[13] It all made sense! When Lister first accepted the surgery chair in 1860, he was told that the city's new hospital had been built over an old cemetery that had been filled with cholera victims.[14] His patients were in grave danger if what Pasteur said was true. This was the answer that Lister had been looking for. If he could find something that could act as a barrier from these tiny killers, maybe he could stop infection.

Shortly after discovering Pasteur's new theory, Lister read about the use of carbolic acid in the town of Carlisle. Farmers there were fertilizing their fields with the town's sewage and

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[11] Paterson, Clare. "Joseph Lister Baron Lister." *University of Glasgow*. Web. 9 Jan. 2012. <http://www.universitystory.gla.ac.uk>.

[12] "Joseph Lister." *Zephyrus Interactive Education Website*. Web. 08 Jan. 2012. <http://www.zephyrus.co.uk>.

[13] Cope, Zachary. "Joseph Lister, 1827-1912." *The British Medical Journal* (1967): 7-10. *BMJ*. Web. 25 Nov. 2011. <http://www.bmj.com>.

[14] Anderson, Eric G. "Here's to the Giants of Medicine." *Medical Economics* 20 Dec. 1999: 64. *Health and Wellness Resource Center*. Web. 15 Dec. 2011. <http://galenet.galegroup.com>.

used the carbolic acid not only to rid their fields of an awful stench, but also to kill off deadly parasites that threatened their livestock.[15] His curiosity riled, Lister began to formulate a method to test this chemical as a potential antiseptic.

On August 12th 1865, Lister performed the first primitive surgery on a compound fracture victim. Although his patient eventually succumbed and had to have an amputation, Lister was able to see some progress.[16] Determined to get a positive response, Lister performed many more experimental procedures on patients with compound fractures and other injuries that doctors would not have even bothered attempting to treat, having his wife take extensively detailed notes of every action performed.[17] Lister began to soak his instruments and wash his hands in a diluted solution of carbolic acid before performing on each patient. He even went as far as to devise a device that could continuously spray the carbolic acid onto his patient, providing a thick layer of protection from airborne bacteria (Appendix III).[18]

The results were astounding. Before he implemented his concept, his patients suffered a death rate of about 46%. Three years after he first began experimenting, it fell to below 15%.[19] These formidable injuries that usually ended with an infected amputation site were completely healing without issue. Two years after his first experiment, Joseph Lister published his findings

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[15] Lister, Joseph. "On A New Method Of Treating Compound Fracture, Abscess, Etc. With Observations On The Conditions Of Suppuration." *The Lancet* 89.2278 (1867): 507-09. *The Lancet*. Web. 8 Jan. 2012. <http://www.thelancet.com>.

[16] Lister, Joseph. "Remarks On Some Points in the History of Antiseptic Surgery." *The Lancet* 171.4426 (1908): 1815-816. *The Lancet*. Web. 9 Jan. 2012. <http://www.thelancet.com>.

[17] Lister, Joseph. "On a Case Illustrating the Present Aspect of the Antiseptic System of Treatment in Surgery." *British Medical Joseph* 1.524 (1871): 30-32. *BMJ*. Web. 9 Jan. 2012. <http://www.bmj.com>.

[18] "Carbolic Steam Spray Used by Joseph Lister, England, 1866-1870." *Science Museum*. Web. 9 Jan. 2012. <http://www.sciencemuseum.org.uk>.

[19] "Joseph Lister and Antiseptic Surgery." *ABPI - Resources for Schools*. Web. 27 Nov. 2011. <http://www.abpischools.org.uk>.

in an article called “On the Antiseptic Principle in the Practice of Surgery” in the British Medical Journal. In it, he explained the revolutionary procedure’s miraculous results and the detailed steps of its discovery.[20] The medical world would never be the same (Appendix IV).

The reaction to this revolutionary procedure was highly unexpected. Lister’s breakthrough was not met with praise, instead with doubt and uncertainty. No one believed him. He tried to help his cause by clarifying himself in numerous follow-up articles in the Lancet and the British Medical Journal, explaining different steps and highlighting different cases.[21] It didn’t work. No matter what he reported to the Royal Society, he was only faced with heightened criticism. His two main resources, the Lancet and the British Medical Journal, stopped publishing supportive material and doctors across Europe took Lister’s incredible results with his method as an insult to the rest of the hospitals of the world, insinuating their lack of cleanliness resulted in the deaths of their patients.[22] Some even sent letters accusing him of falsifying his results, a crime punishable by the loss of one’s license to practice medicine.

Of course not all the reactions by the medical community were negative. Lister’s colleagues and students stood by his side, supporting his claims. Many of his students saw for themselves the phenomenal results of antiseptic surgery. Lister, with their support and a cool head, began to counter the negativity with overwhelming evidence to the contrary. He wrote two articles about the results his procedure had on a particular hospital, in which the hospital

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[20] Lister, Joseph. "On the Antiseptic Principle in the Practice of Surgery." *The British Medical Journal* 2.351 (1867): 246-48. *BMJ*. Web. 25 Nov. 2011. <http://www.bmj.com>.

[21] Lister, Joseph. "An Address on the Antiseptic System of Treatment in Surgery." *British Medical Journal* 2.409 (1868): 461-63. *BMJ*. Web. 8 Jan. 2012. <http://www.bmj.com>.

[22] Noble, Iris. *The Courage of Dr. Lister.* New York: Messner, 1960. Print.

did not have a single patient die from a septic disease within a three year period.[23] He wrote directions for applications of antiseptic surgery on the battlefields of the Franco-Prussian War, resulting in thousands of lives saved.[24] He traveled the world lecturing on the processes and the results of his groundbreaking procedure (Appendix V).There was even the miraculous story of a thirty-three year man who suffered a compound fracture and severe dislocation of his ankle after being struck by a train at work who completely recovered.[25] Finally the medical community, swamped with irrefutable evidence, began to accept and implement the lifesaving technique Joseph Lister called antiseptic surgery.

Lister eventually received overwhelming recognition for his efforts. He won worldwide praise and countless awards and honors. He was even named Baron of Lyme Regis by the Queen in 1897.[26] Lister spent the rest of his life perfecting the system he helped to create and even discovered other important surgical tools, such as catgut sutures that can be absorbed by the body allowing doctors to minimize the patient's innards being exposed to potential contaminants in the air.[27] Finally after eighty five full years of life, Joseph Lister passed away on February 10th 1912 of natural causes (Appendix VI).[28]

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[23] Lister, Joseph. "Further Evidence Regarding The Effects Of The Antiseptic System Of Treatment Upon The Salubrity Of A Surgical Hospital." *The Lancet* 96.2452 (1870): 287-89. *The Lancet*. Web. 8 Jan. 2012. <http://www.thelancet.com>.

[24] Lister, Joseph. "A Method of Antiseptic Treatment Applicable to Wounded Soldiers in the Present War." *British Medical Journal* (1870): 243. *BMJ*. Web. 9 Jan. 2012. <http://www.bmj.com>.

[25] Lister, Joseph. Remarks on a Case of Compound Dislocation of the Ankle with Other Injuries; Illustrating the Antiseptic System of Treatment. Edinburgh, 1870. Electronic.

[26] "Joseph Lister Biography." *Encyclopedia of World Biography*. Web. 13 Nov. 2011. <http://www.notablebiographies.com>.

[27] Lister, Joseph. "On Recent Improvements In The Details Of Antiseptic Surgery." *The Lancet* 105.2701 (1875): 787-89. *The Lancet*. Web. 9 Jan. 2012. <http://www.thelancet.com>.

[28] "Baron Lister Dies In London." *The New York Times* 12 Feb. 1912. *The New York Times*. Web. 8 Jan. 2012. <http://query.nytimes.com>.

Lister's revolutionary spirit lived on though. His idea of antiseptic surgery provided a platform for a myriad of reformations in the medical field. His procedure inspired an even more effective version called asepsis, again based on Pasteur's work.[29] His students captured his bravery and broadened the horizons by attempting incredibly risky surgeries, such as procedures that involved opening the abdominal or cranial cavity, once deemed a death sentence for the patient before the idea of antiseptic surgery. For example, one of Lister's students named John Stuart Nairne went down in history beside his teacher for his experimentation with Caesarean sections.[30]

Such an idea could not have come at a better time. Industrial Age England was a terrible place to be. Factories crushed and mangled thousands of working class people, leaving most laborers deformed or missing limbs. Rats were more common than flowers. Filth and disease spread like wildfire through the slums of downtown London. Raw sewage flowed down the Thames so thickly it stained the river dark brown. Along with the assistance from previous discoveries, Lister's revolutionary procedure helped pull England out from the grime of the Industrial Age and into an era of medical advancement.

Today, the standards of antisepsis have continued to improve. The risk of infection today for the exact same injuries is now less than two percent. It is now the surgical standard to administer pre-operative antibiotics along with the disinfection of the surgical site. U.S.

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[29] "Lister, Joseph (1827-1912)." *Encyclopedia of World Biography*. 1st ed. Thomson Gale, 1998. *Health and Wellness Resource Center*. Web. 9 Jan. 2012. <http://galenet.galegroup.com>.

[30] Robinson, Solveig C. "Medical Lives in the Age of Surgical Revolution." Rev. of *Medical Lives in the Age of Surgical Revolution. Perspectives in Biology and Medicine* 51.1 (2008): 154. *Health and Wellness Resource Center*. Web. 15 Dec. 2011. <http://http://galenet.galegroup.com>.

guidelines now require a dose of antibiotics within one hour of skin incision. Mark Schnitzer, the Head of Neurosurgery at Kaiser Permanente in Hawaii, explained how antiseptic surgery has affected his field today, saying:

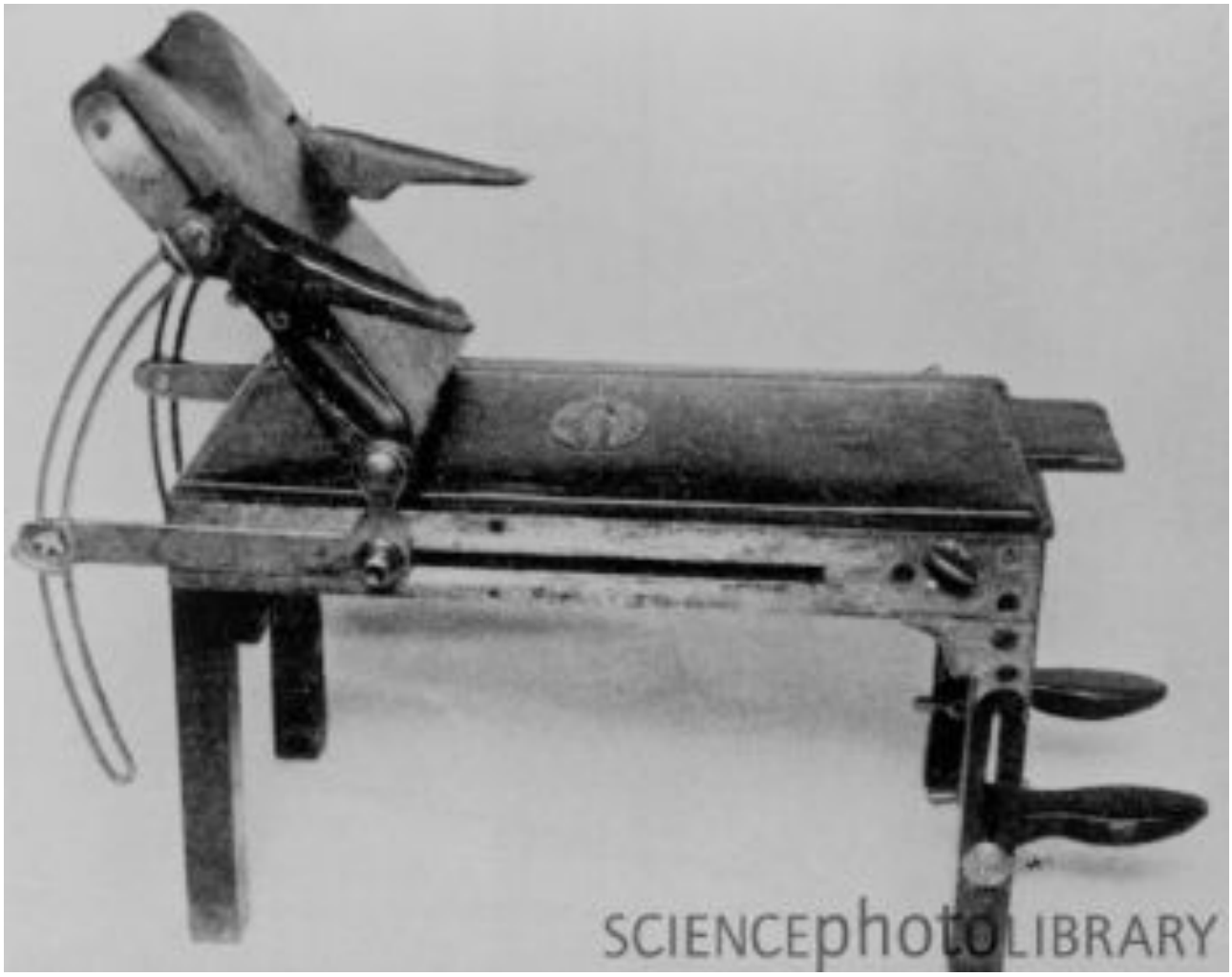
> "For example, a patient with a 'pinched nerve from a slipped disk' in their back has a 90% chance of improving with no surgery over about two years and a 90% chance of improving with surgery over about six weeks. If the infection rate were greater than one-two %, the risks of surgery would outweigh the benefits costing patients almost two years of pain and disability while they (90%) healed."[31]

Antiseptic surgery continues to save time, pain and lives even today thanks to the determination and innovation of Joseph Lister.

Joseph Lister revolutionized surgery with his concept of an antiseptic procedure. By ensuring the prevention of infection, the boundaries of the possible were expanded tenfold. The number of deaths from sepsis plummeted after his revelation. Although the initial reaction was mixed, Lister was able to prove the effectiveness of his groundbreaking technique through many amazing testimonies and carefully documented records. His trailblazing method acted as a spring board for future reformations to the medical field and continues to inspire today (Appendix VII). In the end, Lister's revolutionary concept of antiseptic surgery broadened the definition of a treatable injury as well as transforming the system of surgery forever.

[31] Schnitzer, Mark, M.D., F.A.A.N.S., F.A.C.S . "Effects of Antiseptic Surgery on Neurology." E- mail interview. 19 Feb. 2012.

Appendix I



***19th Century Operating Table Used by Joseph Lister*. Photograph. *Science Photo Library*. Web. 15 Dec. 2011. <http://www.sciencephoto.com>.**

This image depicts a typical operating table during Joseph Lister's time as a surgeon. Not only is it very uncomfortable, these tables were rarely wiped down in-between the steady flow of patients before Lister's concept of antiseptic surgery.

Appendix II

***Antiseptic Surgery*. Photograph. *The Victorian Times*. Web. 16 Jan. 2012. <http://thevictoriantimes.blogspot.com>.**

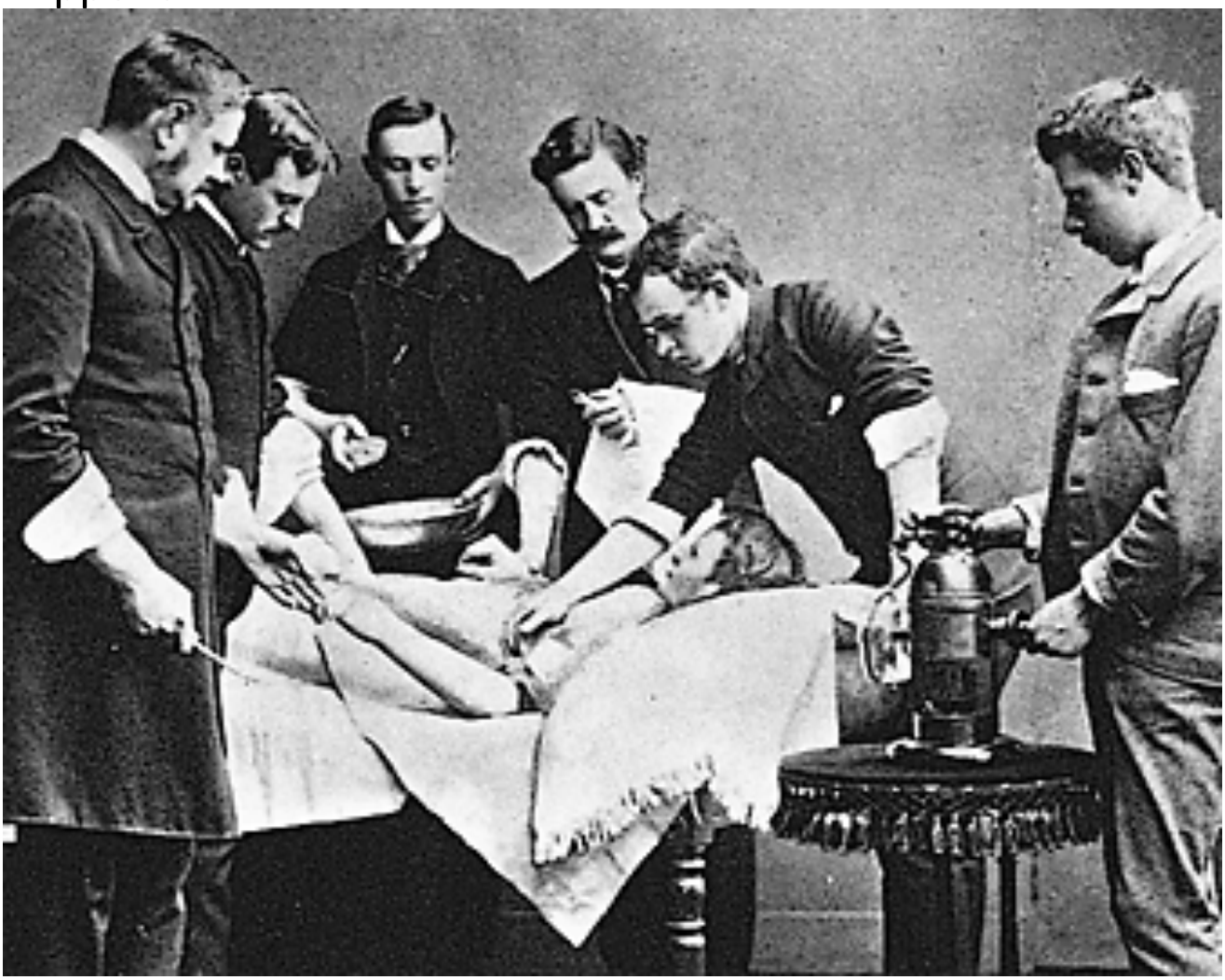
This overhead photograph displays a typical emergency room in the late 1800's. The boy is suffering from a head injury as well as a potential closed fracture (which will probably result in an amputation) after falling from his horse. Notice that all the men in the room are wearing street clothes and have more than likely not washed their hands.

Appendix III

***Joseph Lister's Carbolic Spray*. 2008. Photograph. The Hunterian Museum at the University of Glasgow, Glasglow. *The Sterile Eye*. Web. 15 Dec. 2011. <http://sterileeye.com>.**

An original carbolic sprayer actually used by Joseph Lister in one of his countless operations is on permanent display today in Glasgow Scotland. This device along with thousands of replicas helped save the life and limb of patients across Europe.

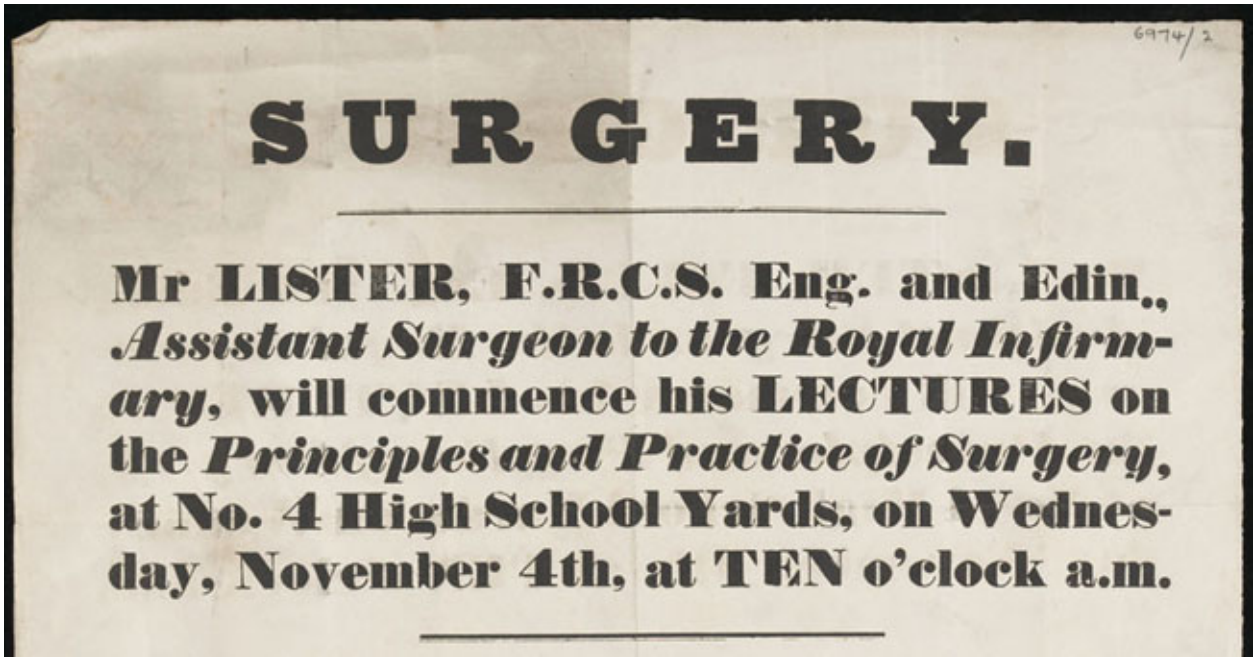
Appendix IV



***First Antiseptic Surgery*. 1870. Photograph. Edinburgh, Scotland. *First Antiseptic Surgery*. *World Book Online Reference Center*. Web. 15 Dec. 2011. <http://worldbookonline.com>.**

Five doctors huddle around a patient during an antiseptic procedure, while one doctor stands to the side working the carbolic sprayer that protected the patient from hidden contaminants in the impure air.

Appendix V



***Advertisement for a Lecture in Edinburgh by Joseph Lister*. 1857. Photograph. WellcomeImages. *Wellcome Collection*. Web. 16 Jan. 2012. <http://www.wellcomecollection.org>.**

An advertisement from the late 1800's is promoting a lecture by Dr. Lister. Lister was forced to travel the globe and share his results in order to defend the effectiveness of his method.

Appendix VI

Lister Seated in Male Casualty Ward of Kings College Hospital, 1891. **1891. Photograph. Kings College Hospital, London, United Kingdom. *Wellsome Collection Blog*. Web. 15 Dec. 2011. <http://wellcomecollection.wordpress.com>.**

This image of Lister, center seated in a chair, was one of the last ever taken of him. He dedicated his life to helping others through his discoveries and helped save hundreds of thousands of lives.

Appendix VI

***Listerine Bottle 1924*. Photograph. *Kilmer House: The Story of Johnson & Johnson and Its People*. 27 Feb. 2008. Web. 16 Jan. 2012. <http://www.kilmerhouse.com>.**

Listerine, along with Listeria and many others, was named after Joseph Lister after its creation in the 1920s. It is one among many results from the inspiration Joseph Lister's legacy has left behind.

Annotated Bibliography

Primary Resources

Book

Godlee, Rickman John. *Lord Lister*. London: Macmillan, 1917. Electronic.

This insightful biography was written by Joseph Lister's nephew, Sir Rickman Godlee, who also was a successful and influential surgeon during the time Lister began to publish his finding and ideas. Sir Godlee was primarily responsible for the collection and publication of Lister's works after his death. In this book, Sir Godlee emphasizes Lister's development of antiseptic surgery and highlights numerous works during his life.

Lister, Joseph. *The Collected Papers of Joseph Lister*. Oxford: Clarendon, 1909. *Internet Archive*. Web. 1 Jan. 2012. <http://www.archive.org>.

This extensive collection of Lister's works was imperative to my research as it contained every single piece of Lister's written works, both published and unpublished. It was easy to see the progression of Lister's developments as well as the impact they were having on the medical world through his written results as well as the increase of public speaking engagements he participated in later on.

Journal Article

Lister, Joseph. "A Method of Antiseptic Treatment Applicable to Wounded Soldiers in the Present War." *British Medical Journal* (1870): 243. *BMJ*. Web. 9 Jan. 2012. <http://www.bmj.com>.

Joesph Lister, in an effort to help those fighting on the frontlines, created this set of guidelines for simple antiseptic surgery that was easy enough to be performed within the combat zone of the Franco-Prussian War. His instructions saved numerous lives on both sides and practically halted infection on the battlefield. This proved not only was antiseptic surgery effective but that it was simple enough to be used anywhere, even on the chaotic battlefields of war.

Lister, Joseph. "An Address on the Antiseptic System of Treatment in Surgery." *British Medical Journal* 2.409 (1868): 461-63. *BMJ*. Web. 8 Jan. 2012. <http://www.bmj.com>.

This address given before the Medico- Chirugical Society of Glasgow explains the foundations of antiseptic surgery. Lister explains how he decided to use carbolic acid, how much and where to put it on the patient's wounds. He also details the many steps to maintaining a sterile environment and keeping the air "pure" to prevent disease.

Lister, Joseph. "Further Evidence Regarding The Effects Of The Antiseptic System Of Treatment Upon The Salubrity Of A Surgical Hospital." *The Lancet* 96.2452 (1870): 287-89. *The Lancet*. Web. 8 Jan. 2012. <http://www.thelancet.com>.

This is a follow-up article written by Joseph Lister about the effects his procedure had on the health and wellness of patients in a specific hospital. He was known to have the most successful wards in any hospital in the British Isles yet people still didn't believe in his methods even after having three years without one patient dying from a hospital disease.

Lister, Joseph. "Illustrations Of The Antiseptic System Of Treatment In Surgery." *The Lancet* 90.2309 (1867): 668-69. *The Lancet*. Web. 8 Jan. 2012. <http://www.thelancet.com>.

Although no drawings are present in this article, Lister does an excellent job of describing the purpose and actions of the carbolic sprayer. He details what it does for the surgical environment as well as how the procedure should occur to maximize sterility of the surgery site.

Lister, Joseph. "Key Passages: On The Effects Of The Antiseptic System Of Treatment Upon The Salubrity Of A Surgical Hospital." *The Lancet* 95.2419 (1870): 40-42. *James Lind Library*. Web. 15 Dec. 2011. <http://www.jameslindlibrary.org>.

This article contains key passages from an article that Joseph Lister wrote for the Lancet, a popular British magazine, about his advancements in antiseptic surgery. He wanted to report his findings and the results to prove the effectiveness and practicality of his procedure. However he only drew more criticism from doctors and societies across Europe

Lister, Joseph. "On a Case Illustrating the Present Aspect of the Antiseptic System of Treatment in Surgery." *British Medical Joseph* 1.524 (1871): 30-32. *BMJ*. Web. 9 Jan. 2012. <http://www.bmj.com>.

This article depicts one particular case in which one of Lister's patients had a rather complex injury to the lower bones of his arm and the joint of his elbow. Lister describes every detailed fact and step of the surgery from the concentration of the carbolic acid solution he was using to every single incision he made on this man's arm.

Lister, Joseph. "On A New Method Of Treating Compound Fracture, Abscess, Etc. With Observations On The Conditions Of Suppuration." *The Lancet* 89.2278 (1867): 507-09. *The Lancet*. Web. 8 Jan. 2012. <http://www.thelancet.com>.

In this journal article, Lister details the basics of his procedure and then goes on to list several different cases that he has taken and applied his method of treatment to. In each case he applies the treatment in a different way, displaying antiseptic surgery effectiveness and flexibility. These cases vary from small abscesses to large, formidable open fractures.

Lister, Joseph. "On Recent Improvements In The Details Of Antiseptic Surgery." *The Lancet* 105.2701 (1875): 787-89. *The Lancet*. Web. 9 Jan. 2012. <http://www.thelancet.com>.

This article is just explaining all the little tweaks Lister made to his procedure to increase the already overwhelming good results. He talks about different thicknesses of gauze to use in certain situations and how to wrap bandages soaked with carbolic acid onto a patient to maximize healing power. Finally after years of dispute and criticisms, other doctors began to recognize the remarkable results of antiseptic surgery.

Lister, Joseph. "On the Antiseptic Principle in the Practice of Surgery." *The British Medical Journal* 2.351 (1867): 246-48. *BMJ*. Web. 25 Nov. 2011. <http://www.bmj.com>.

This is a first article that Lister published in the British Medical Journal, the official premiere of his groundbreaking research. By publishing his revolutionary findings, hospitals began to implement this lifesaving technique, leading to a significant and steady decline of deaths from infection. However he still faced harsh ridicule and opposition for some time. This article was the springboard for revolution and reform regarding this new procedure as well as the creation of Lister's legacy.

Lister, Joseph. "Remarks On Some Points in the History of Antiseptic Surgery." *The Lancet* 171.4426 (1908): 1815-816. *The Lancet*. Web. 9 Jan. 2012. <http://www.thelancet.com>.

This was actually an unfinished letter that was published as an article in the Lancet. In it, Lister describes to a colleague the importance of antiseptic surgery of the world as well as providing him with a detailed timeline of all the many discoveries, advancements, and challenges he faced and overcame starting back with his very first experiment in 1865.

Newspaper Article

"Baron Lister Dies In London." *The New York Times* 12 Feb. 1912. *The New York Times*. Web. 8 Jan. 2012. <http://query.nytimes.com>.

The New York Times notified the American public on February 12th 1912 that the medical giant, Joseph Lister had passed away two days before. His discoveries helped save the lives of millions of people around the world. He lived a very full life and passed away at the ripe old age of 85. Although he was no longer physically present in medical world, his findings and legacy will live forever.

Pamphlet

Lister, Joseph. *Remarks on a Case of Compound Dislocation of the Ankle with Other Injuries; Illustrating the Antiseptic System of Treatment*. Edinburgh, 1870. Electronic.

This pamphlet, presumably passed out at some convention that Lister spoke at, details a specific case in how the antiseptic treatment was applied to a thirty three year old man's extreme open fracture of his ankle after we was sideswiped by a train at work. He explains how they treated it and the miraculous progress of the man who would have otherwise lost his foot.

Photograph

***19th Century Operating Table Used by Joseph Lister*. Photograph. *Science Photo Library*. Web. 15 Dec. 2011. <http://www.sciencephoto.com>.**

This image portrays an operating table once used by Joseph Lister to perform one of the first antiseptic surgeries. It looks primitive and very uncomfortable. Not only does it make one grateful for modern medicine, it allows you to see how things really happened during that time.

***Advertisement for a Lecture in Edinburgh by Joseph Lister*. 1857. Photograph. Wellcome Images. *Wellcome Collection*. Web. 16 Jan. 2012. <http://www.wellcomecollection.org>.**

This flyer announces the time and date of one of Lister's many lectures about the implementation of antiseptic surgery. After his procedure had so many stunning results, people wanted to know more and Lister began to travel and give lectures about this revolutionary procedure.

***Antiseptic Surgery*. Photograph. *The Victorian Times*. Web. 16 Jan. 2012. <http://thevictoriantimes.blogspot.com>.**

This photo is a overhead view of a rudimentary emergency room during the 1800s in which this patient, a young boy, is being treated after he falling from his horse. He is probably suffering from some sort of head injury and a closed fracture depending on how he landed. Before Lister's revolutionary procedure, his limb with the facture would be amputated and then more than likely become infected and potentially claim his life.

***First Antiseptic Surgery*. 1870. Photograph. Edinburgh, Scotland. *First Antiseptic Surgery*. *World Book Online Reference Center*. Web. 15 Dec. 2011. <http://worldbookonline.com>.**

This photograph shows numerous doctors gathered round a patient, performing one of the first antiseptic surgeries. Beside the patient, the carbolic sprayer can be seen spraying the antiseptic onto the open wound while the doctors fervently work on the exposed area. The carbolic acid was the key part of this and any antiseptic surgeries performed according to the directions of Joseph Lister.

***Joseph Lister's Carbolic Spray*. 2008. Photograph. The Hunterian Museum at the University of Glasgow, Glasglow. *The Sterile Eye*. Web. 15 Dec. 2011. <http://sterileeye.com>.**

This is an actual carbolic acid sprayer developed and used by Joseph Lister in numerous antiseptic surgeries. This item is part of a permanent display at a museum in Scotland, where Lister developed his idea of antiseptic surgery. This device was used to continuously spray the solution that killed germs and prevented infection.

***Lister Seated in Male Casualty Ward of Kings College Hospital, 1891.* 1891. Photograph. Kings College Hospital, London, United Kingdom. *Wellsome Collection Blog*. Web. 15 Dec. 2011. <http://wellcomecollection.wordpress.com>.**

This is a photograph of Joseph Lister relaxing in a wing of a hospital that he frequently operated in. Lister made a point of checking in with all of his patients and recording their progress, always looking for room to improve his methods for future generations. He seems so at home here and it is obvious he is very dedicated to his field.

***Listerine Bottle 1924*. Photograph. *Kilmer House: The Story of Johnson & Johnson and Its People*. 27 Feb. 2008. Web. 16 Jan. 2012. <http://www.kilmerhouse.com>.**

Listerine is just one example of Joseph Lister's legacy. This substance was developed by scientists at Johnson & Johnson in the 1920's and was used as an antiseptic for minor cuts and scratches as well as a mouthwash. Having been inspired by the creator of antiseptic surgery, they decided to name their mild antiseptic after Joseph Lister.

Secondary Resources

Book

Brock, Thomas D. *Milestones in Microbiology 1546 to 1940*. Washington, DC: ASM, 1999.

This book describes many different advances in microbiology reaching back more than five hundred years ago. Included in this timeline, the author has a chapter dedicated to Joseph Lister. It describes his work and many discoveries and the author comments on how the medical community reacted and eventually implemented these new life and limb saving techniques.

Noble, Iris. *The Courage of Dr. Lister.* New York: Messner, 1960. Print.

This insightful novel describes the darker side of medicine that Lister faced. It makes it very clear that Lister faced innumerable amounts of obstacles and criticism in the process of proving his method of antiseptic surgery. Even after having years of spotless hospital records, countless doctors and societies degraded his research and results as a falsified attempt to get famous.

Interview

Schnitzer, Mark, M.D., F.A.A.N.S., F.A.C.S . "Effects of Antiseptic Surgery on Neurology." E-mail interview. 19 Feb. 2012.

This personal interview that I conducted with a close friend of the family who is head of neurosurgery at Kaiser Permanente in Hawaii was extremely insightful. He explained the many changes that antiseptic surgery has undergone as well as the current standards for surgery. In one example he explains how the revolutionary procedure has continued to save patients from excruciating pain and how without the guarantee of an infection-less recovery, many surgeries would not even be worth performing.

Online Database

"Lister, Joseph (1827-1912)." *Encyclopedia of World Biography*. 1st ed. Thomson Gale, 1998. *Health and Wellness Resource Center*. Web. 9 Jan. 2012. <http://galenet.galegroup.com>.

This biographical entry contained a complete chronology of Lister's life and discoveries. It depicts all of Lister's achievements and all the steps he made towards his revolutionary procedure, emphasizing the great impact this discovery had on the medical community.

Rodowskas, Christopher, Jr A. "Antiseptic." *World Book Online Reference Center*. World Book. Web. 15 Dec. 2011. <http://worldbookonline.com>.

This brief article provided a detailed background on antiseptic surgery and its developments. It describes advancements and reformations made to the procedure since the time of its creation and the affects that Lister's contributions have had on the medical world since.

Journal Article

Cope, Zachary. "Joseph Lister, 1827-1912." *The British Medical Journal* (1967): 7-10. *BMJ*. Web. 25 Nov. 2011. <http://www.bmj.com>.

This is an article that was published in the same journal that Lister first posted his research about antiseptic surgery in. It provides some biographical information as well as detailed descriptions about his many experiments and accomplishments, highlighting on the results on his revolutionary procedure and his legacy.

Jones, Peter F. "Two Nineteenth Century Surgeons." *British Medical Journal* 305.6868 (1992): 1546-548. *Health and Wellness Resource Center*. Web. 15 Dec. 2011. <http://galenet.galegroup.com>.

This journal article shows the effect that Lister's work had on two famous doctors. It describes the connection that their work had to Lister's and the effect his research had on their advancements.

Magazine Article

Adams, Sharon. "Then And Now – Medical." *Legion* 1 July 2010. *Legion Magazine*. 1 July 2010. Web. 15 Dec. 2011. <http://www.legionmagazine.com>.

This magazine article is a list of the greatest medical advancements made in the past couple of centuries and one entry is about Joseph Lister's antiseptic surgery. It gives a short biography and description of his accomplishments and the procedure he developed.

Anderson, Eric G. "Here's to the Giants of Medicine." *Medical Economics* 20 Dec. 1999: 64. *Health and Wellness Resource Center*. Web. 15 Dec. 2011. <http://galenet.galegroup.com>.

This article provided me with a timeline of great advancements made in the medical field along with a short biography of Lister's life and education. This was extremely helpful and made it very clear that bacteria had not yet been defined when Lister created the foundations of antiseptic surgery.

Brooks, Anne Marie. "The Antiseptic Agenda." *Weekly Reader* Apr. 1992: 4+. *Gale Opposing Viewpoints In Context*. Web. 25 Nov. 2011. <http://ic.galegroup.com>.

This source gave me insight into what Joseph Lister's accomplishments really were and the affect that they had on the world of medicine. It gives a short synopsis of his life and provides details of the processes that he developed for antiseptic surgery. It also includes valuable statistics about the results of procedures.

Schneider, Philip. "Sterility - You Couldn't See It Then; You Can't See It Now." *Healthcare Purchasing News* Oct. 2011: 34. *Health and Wellness Resource Center*. Web. 15 Dec. 2011. <http://galenet.galegroup.com>.

For a long time people were mystified by germs and the idea of tiny living things that could make them sick. Since their discovery, the number of deaths from infection has plummeted. This article discusses just how important Lister's discovery of antiseptic surgery was in the battle against these invisible killers.

Newspaper Article

Hird, Ed. "Dr. Joseph Lister: Medical Revolutionary." *Deep Cove Crier* [North Vancouver] Jan. 1998. *Deep Cove Crier*. Web. 8 Jan. 2012. <http://www3.telus.net>.

This Canadian newspaper summarizes Lister's achievements and the impact his procedure had on the medical world. It describes in great detail the actual procedure and how the carbolic acid was applied to the patient as well as the innovation of the actual carbolic sprayer.

Review

Brosco, Jeffery P., and Sheldon Watts. "Two Views: Bad Medicine: Doctors Doing Harm Since Hippocrates." Rev. of *Two Views: Bad Medicine: Doctors Doing Harm Since Hippocrates*. *Journal of Social History* (2007). *Gale Opposing Viewpoints In Context*. Web. 25 Nov. 2011. <http://ic.galegroup.com>.

This is a review of a book that discusses the harmful things that doctors have been doing, in the author's opinion, since ancient times. He criticizes doctors that have revolutionized the field including Lister. The reviewers provide both a supporting and opposing viewpoint, arguing about the ethics of Lister's as well as others actions.

Robinson, Solveig C. "Medical Lives in the Age of Surgical Revolution." Rev. of *Medical Lives in the Age of Surgical Revolution. Perspectives in Biology and Medicine* 51.1 (2008): 154. *Health and Wellness Resource Center*. Web. 15 Dec. 2011. <http://http://galenet.galegroup.com>.

This is a review on a collection of biographies from Lister's many students. It provided inside information on what it was like to work with the man who reinvented surgery. It also gave me some background on Lister's research and many of his students who became famous as well.

Website

Banerjee, Jacqueline, PhD. "Joseph Lord Lister (1827-1912), F.R.S., O.M." *The Victorian Web*. Web. 09 Jan. 2012. <http://www.victorianweb.org>.

This detailed biography was packed with information about Lister's education. It discussed every school he went to and all the achievements he made at each school. It detailed every position he held and how he became interested in the medical field. It was interesting to see how dedicated Lister was to bettering himself through education.

"Carbolic Steam Spray Used by Joseph Lister, England, 1866-1870." *Science Museum*. Web. 9 Jan. 2012. <http://www.sciencemuseum.org.uk>.

This short article describes the carbolic sprayer that Lister used in his antiseptic procedures. It explains how it works and how to operate it, down to the fact that the carbolic acid had a pungent smell.

Greenbaum, Perry J. "Joseph Lister: Father of Antiseptic Surgery." *Perry J Greenbaum*. 28 Apr. 2011. Web. 09 Jan. 2012. <http://perryjgreenbaum.blogspot.com>.

This article provided a ton of biographical information but made a point of emphasizing the effect that this revolutionary discovery had on the patients. This was a solution that could save limbs that suffered compound fracture when traditionally, these injuries resulted in an amputation.

Griffith, Robert K. "Joseph Lister." *Chemistry: Foundations and Applications*. Web. 27 Nov. 2011. <http://www.chemistryexplained.com>.

Although simply worded, this website provided me with crucial information regarding Lister's groundbreaking procedure and the reactions to it. It also gave some material about his background and his many famous teachers and friends.

"Internet History Sourcebooks." *Fordham.edu*. Web. 13 Nov. 2011. <http://www.fordham.edu>.

This website provided me with a complete digital copy of Lister's publication about his findings about how to ward off infection and prevent the need for amputation. It was nice to have an easy access to Lister's works.

"Joseph Lister (1827-1912)." ***Quakers in Britain*****. Web. 9 Jan. 2012. <http://www.quaker.org.uk>.**

This website gave me insight to Lister's personal life and some of the obstacles his religion created. For example, he was denied entrance into Oxford University, Cambridge University, and even King's College due to his religious beliefs. This article allowed me to get a perspective on the many things he had to overcome to achieve his goal.

"Joseph Lister and Antiseptic Surgery." ***ABPI - Resources for Schools*****. Web. 27 Nov. 2011. <http://www.abpischools.org.uk>.**

This website provided me with images as well pertinent information about his discovery of carbolic acids applications as well as the results from its use in his own personal office. This website is an educational site that is meant to provide lesson material to teachers and was very helpful.

"Joseph Lister Biography." ***Encyclopedia of World Biography*****. Web. 13 Nov. 2011. <http://www.notablebiographies.com>.**

This brief yet crucial resource provided a biography and an overview of Lister's many accomplishments and results. The author provides important information about the topic while still getting right to the point.

"Joseph Lister." ***History Learning Site*****. Web. 13 Nov. 2011. <http://www.historylearningsite.co.uk>.**

This website provided me with a lot of biographical information regarding Lister's life and education. His teachers and research partners also made important medical advances that probably helped fuel his discovery.

"Joseph Lister." ***NNDB: Tracking the Entire World*****. Web. 13 Nov. 2011. <http://www.nndb.com>.**

This article was packed with important information that really gave me a lot of insight into the trials Lister faced in making this huge advance in medical care and surgery. It also discussed all the benefits this procedure provided patients with as opposed traditional procedures.

"Joseph Lister." ***Zephyrus Interactive Education Website*****. Web. 08 Jan. 2012. <http://www.zephyrus.co.uk>.**

This detailed website gave me insight to the conditions of the hospitals before Lister's reformations as well as a look into what the beliefs were of the day. Doctors believed that sepsis, or hospital gangrene, was caused by exposing moist tissue to contaminated or dirty air. This would lead to the putrefaction of the tissue exposed.

"Lister, Joseph." *Medical Discoveries*. Web. 9 Jan. 2012. <http://www.discoveriesinmedicine.com>.

This article contained a biography of Lister as well as a list of his accomplishments. It describes all the positions he held as a professor at different prestigious colleges as well as his appointment to a Lord after receiving recognition for his achievements.

Paterson, Clare. "Joseph Lister Baron Lister." *University of Glasgow*. Web. 9 Jan. 2012. <http://www.universitystory.gla.ac.uk>.

On the University of Glasgow website, they have a special page dedicated to famous alumni and towards the top is Joseph Lister. He was a professor at the University and many of his students went on to also become famous doctors. The impact that he had on his students and patients was massive.

Reinhardt, Donald. "Joseph Lister, Antiseptic Surgery and Antisepsis: Microbial Control With Phenol in Surgical Medicine." *Suite101.com*. Web. 13 Nov. 2011. <http://donald-reinhardt.suite101.com>.

This website article was really insightful. It provided my research with in depth descriptions of the procedures that Lister worked so hard to develop. It also provided detailed information about the chemical Lister used to achieve these miraculous results, carbolic acid AKA phenol.

"Sir Joseph Lister | 1827-1912." *NAHSTE: Navigational Aids for the History of ScienceTechnology & the Environment*. Web. 9 Jan. 2012. <http://www.nahste.ac.uk>.

The biographical information available on this website was astounding. I discovered his father was a famous inventor who created the achromatic lens for microscopes. It describes in great detail all of his many achievements and titles as well as his childhood and the difficulties he had to overcome.