# Ignaz Philipp Semmelweis (1818-1865) [1]

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Ignaz Philipp Semmelweis demonstrated that the use of disinfectants could reduce the occurrence of puerperal fever in patients in nineteenth century Austria. Puerperal fever is a bacterial infection that can occur in the uterine tract of women after giving birth or undergoing an abortion [2]. Semmelweis determined that puerperal fever is contagious and argued that the unhygienic practices of physicians, like examining patients after performing autopsies, caused the spread of puerperal fever. He showed that if physicians washed their hands with a chloride solution before they attended patients, then they prevented those patients from developing puerperal fever. Despite being widely criticized during his lifetime, Semmelweis's research on the contagiousness of puerperal fever set a precedent for many scientists, and contributed to preventing the spread of puerperal fever.

Semmelweis was born on 1 July 1818 in Buda, Hungary, which in 1837 combined with Pest to form Budapest. He was the fifth child born to Teresia Müller and Josef Semmelweis, Jewish immigrants to Hungary from Germany. His parents were storekeepers that earned enough money to give their eight children an education. Growing up, Semmelweis spoke German at home instead of Hungarian. Semmelweis attended grammar school in Buda, and he finished his primary education at the Catholic Gymnasium of Buda in 1835. After his primary education, Semmelweis left Buda in 1837 to study law at the University of Vienna in Vienna, Austria. Semmelweis studied law on the advice of his father. In 1838, after attending an anatomy class with a medical student, Semmelweis transferred to the University of Pest, later called Eötvös Loránd University in Budapest, Hungary, and began studying medicine. In 1840, Semmelweis returned to the University of Vienna and obtained his doctorate of medicine in 1844. Semmelweis missed his graduation ceremony because his mother died and he returned to Buda for her funeral.

After receiving his medical degree in 1844, Semmelweis completed a master's degree in midwifery and received training in surgical procedures at the Vienna General Hospital [3] in Vienna. Afterwards, the hospital appointed Semmelweis to the maternity ward as an assistant to physician Johann Klein in 1846. Semmelweis's examined patients, assisted in obstetrical surgical procedures, taught obstetrics students, and organized clerical records. The Vienna General Hospital [3] was a lying-in hospital, meaning that after pregnant women gave birth there, they stayed at the hospital for a few days to recover, even if there were no medical complications during delivery.

The lying-in division of the hospital had two clinics: the First Obstetrical Clinic and the Second Obstetrical Clinic. Klein and his assistants, including Semmelweis, worked in the First Obstetrical Clinic. Midwives ran the Second Obstetrical Clinic. Semmelweis noted that puerperal fever, or childbed fever, was much more prevalent in the First Obstetrical Clinic. Semmelweis stated that women begged to be placed in the Second Obstetrical Clinic to avoid infection. Because of his clerical duties, Semmelweis noted that in the First Obstetrical Clinic the rate of puerperal fever was approximately thirteen percent, and in the Second Obstetrical Clinic the rate was approximately two percent.

After observing that the First Obstetrical Clinic had a much larger rate of puerperal fever compared to the other clinic, Semmelweis began to investigate the cause of puerperal fever. He observed the differences between the two clinics, studied the cadavers of women who had died from puerperal fever, and kept detailed records of the death rates in both clinics. Semmelweis found that women who underwent street births, or giving birth on the way to the hospital and not admitted to the clinic but receiving lying-in benefits, rarely showed any signs of puerperal fever. Semmelweis ordered that the two clinics switch their medical procedures to find out if puerperal fever was due to a certain procedure. Switching the medical procedures did not reduce the mortality rates. The director of the First Obstetrical Clinic did not like that Semmelweis was questioning his practices and Semmelweis was demoted. Despite his demotion, Semmelweis continued to work on puerperal fever.

Semmelweis reported that, in March 1847, he was so overwhelmed by the deaths that occurred from puerperal fever infections that he took a leave to Venice, Italy. When he returned later that month, he learned that Jakob Kolletschka, a professor of forensic medicine, had died after a student had accidentally pricked Kolletschka's finger with a knife used in an autopsy. Semmelweis studied the autopsy of Kolletschka and found that the symptoms Kolletschka had before his death were similar to those of the maternity patients who had died of puerperal fever. Because of the similarities, Semmelweis inferred that the medical students in the First Obstetric Clinic, who also dissected cadavers at the morgue, were transferring cadaverous material from the morgue to maternity patients via their hands, causing puerperal fever. The students transferred the material to the women in the maternity clinic as they examined them. The midwives that ran the Second Obstetrical Clinic did not work in the morgue and therefore were not transferring the cadaverous material to their maternity patients.

In 1847, after finding the correlation between cadaverous materials and puerperal fever, Semmelweis posted notices in the First Obstetrical Clinic that required all medical staff to examine their hands between examinations and wash them with a chloride solution, a bleaching agent, and a disinfectant. Semmelweis used a chloride solution, because at the time practitioners used it to

get rid of odors, and he hypothesized that the solution would also destroy the cadaverous materials that carried a foul odor. Disinfectants are chemical liquids that destroy bacteria. At the time, medical staff rarely used disinfectants like a chloride solution because no one had had established the existence of germs. Semmelweis hypothesized that the solution was destroying the cadaverous material, which was true, but it was also destroying the bacteria on the cadaverous material. Semmelweis's chloride solution, although harsh for human skin, reduced the rate of puerperal fever in his hospital. After Semmelweis mandated that doctors wash their hands in between procedures, the death rate from puerperal fever dropped to approximately two percent, and continued to fall. Klein attributed the drop in puerperal fever to a ventilation system that had been added to the hospital around the same time.

Ferdinand von Hebra, editor of a medical journal in Austria and a friend of Semmelweis's from medical school, reported Semmelweis's results with the chlorinated lime solution in December 1847 and again in April 1848. However, scientists in Austria did not adopt Semmelweis's conclusions, as it contrasted with established medical theories of the time. Many doctors in the early to mid 1800s argued that diseases resulted from imbalances among four humors, which they postulated to exist in all human bodies, and that each disease was unique because each person was unique. The said that a healthy person had a perfect balance of the four humors of black bile, yellow bile, phlegm, and blood. Semmelweis's findings that all puerperal cases resulted from unhygienic practices contrasted with the theory of humors. Austrian physicians dismissed his work, and historians have argued that Semmelweis's Jewish and Hungarian origins contributed to the dismissal.

Physicians elsewhere in Europe, including James Young Simpson, a doctor in Scotland who discovered the antiseptic components of chloroform, stated that Semmelweis's conclusions were similar to those of Oliver Wendell Holmes, Sr., in the US. In 1843, Holmes had published an essay about the contagious aspect of puerperal fever. Although there are similarities between some of the work of Holmes and of Semmelweis, only the latter developed a theory as to the cause of the contagiousness and a method to prevent puerperal fever.

In 1848, as Semmelweis implemented his program involving chloride solution in theVienna General Hospital [3], political revolutions erupted throughout Europe, including Semmelweis's home country of Hungary. When Semmelweis applied for an extension to continue his work at the Vienna General Hospital [3], Klein did not grant it, despite Semmelweis being the choice of most of the medical faculty. Klein said that Semmelweis was a sympathizer of the revolution in Hungary. Without a job, Semmelweis left Vienna and returned to Pest, Hungary.

In Pest, Semmelweis continued to implement his hand washing procedures. In 1851, Semmelweis became the head physician at the Szent Rókus Hospital in Pest. The hospital had a high rate of puerperal fever, but with Semmelweis heading the hospital and implementing his policies, the rate of puerperal fever plummetted. In 1855, Semmelweis became head of obstetrics at the University of Pest. There, Semmelweis implemented the chlorine washing procedure and infection rates of puerperal fever at the university hospital fell. In 1857, Semmelweis married Maria Weidenhoffer, the daughter of a wealthy merchant. Together, they had five children. Throughout the 1850s, Semmelweis wrote papers on puerperal fever and, in 1861, he published his book *Die aetiologie, der begriff und die prophylaxis des kindbettfiebers* (The Etiology, Concept, and Prophylaxis of Childbed Fever).

Semmelweis's mental health began to deteriorate after the publication of his book and he suffered from severe depression. By 1865, Semmelweis's abnormal public behavior affecting his professional life and he spent much of his time away from his family. That year, his wife and some of his colleagues committed Semmelweis to an insane asylum in Vienna, Austria.

After trying to leave the insane asylum in August 1865, Semmelweis was beaten and put in a straitjacket. After two weeks in the asylum, Semmelweis died on 13 August 1865 in Vienna, Austria. His autopsy revealed that he had died from blood poisoning in a wound that could have been sustained during the beating.

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## Subject

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