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Review Article

Research on the Hungarian Obstetrician Ignaz Philipp Semmelweis's Life and his Momentous, Discovery of the Contagious Nature of Puerperal Fever

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ABSTRACT

Ignaz Philipp Semmelweis (1818-1865) Hungarian obstetrician while at the "Vienna Krankenhaus" observed that the mortality rates from childbirth (puerperal) fever were highest among those women attended by students who had freshly come from autopsy rooms and pathology lectures. He demonstrated that mortality due to childbirth fever could be reduced if doctors washed their hands. He insisted they wash their hands in chlorinated lime. In two years, the ward's mortality fell from 10 percent to 1.5 percent. Although this resulted in an immediate decline in the death rate, his discovery was heatedly attacked by the great obstetricians of Vienna. Semmelweis eventually was forced to resign. The brilliant and sensitive Semmelweis ultimately was broken by the indifference and callousness of his superiors and colleagues. He died in a mental hospital in 1856, when he was only 47 years old.

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Introduction

While it had been known for many centuries that certain substances could be applied to wounds to facilitate their recovery, doctors did not become fully aware of the possible role of contamination in causing disease until the early 19th centenary (figures 1 and 2). (In 1843, Oliver Wendell Holmes (1809-1894) American physician and writer studied puerperal fever and recommended hygiene precautions in hospitals for its prevention (1). Shortly afterward, Semmelweis demonstrated that mortality due to puerperal fever could be reduced if doctors washed their hands, in 1847 (2). Then, in 1867 (20 years later), Lord Joseph Lister (1827-1912) advocated the use of carbolic acid for the prevention of infection during surgery and used catgut threated with carbolic acid (phenol) to promote asepsis, in 1869 (2).

The great works of Louis Pasteur (1822-1895) French chemist and the father of bacteriology and

the germ theory of disease and Heinrich Hermann Robert Koch (1843-1910), German pioneer in bacteriology (3) and Noble laureate of 1905 (2) established the relationship between germs and disease and explained the success of the techniques of Joseph Lister and Ignaz Semmelweis. The full emergence of the germ theory of disease also inspired the search for more effective antiseptics. A great variety of antiseptics has since replaced the chlorine compounds and the carbolic acid used by the early workers in the field.

Figure 1: La Maternité (maternity hospital), the famous lying-in hospital in Paris. It was specially designed and built in the early 19th century on healthy, high open ground to avoid infection; it nevertheless had an appalling high rate of mortality from puerperal fever-higher than in any of the lying-in hospital in London (4).

The most powerful antiseptic is iodine (nonmetallic element in the seventh group of the periodic system, one of the halogens) which was first used in the treatment of wounds [1839]. In 1881, Roberth Koch suggested the use of bichloride of mercury as antiseptic. For many years this compound replaced the early chlorine solutions carbolic acid. Combinations of mercury with organic substances (Mercurochrome, Merthiolate) which are more effective and less irritating than bichloride of mercury, are now used in place of it. The essential oils, such as thymol and eucalyptole were introduced at about the same time as hydrochloride of mercury. The essential oils are among the least irritating of all antiseptics. Silver compounds were also introduced as antiseptics and are still used extensively.

Figure 2: The Dublin Lying-in Hospital or "Rotunda" - so called because of the circular building which was added some years after it was established - was by far the largest in Britain and was famous for its teaching. This hospital suffered a horrific level of mortality from puerperal fever (4).

In the 20th century two new groups of antiseptics were discovered: the bis-phenols and the quaternary ammonium compounds. The bis-phenols are used principally as bacteriostatic: They inhibit the growth of, rather than destroy, microorganisms. Hexachlorophene, a well-known member of this group, is the active ingredient in much deodorant soaps. Hexachlorophene decreases body odor by preventing skin bacteria from converting the substances contained in sweat into odorous compounds. The quaternary ammonium compounds are nitrogen-containing substances that are powerful germ killer. Zephiran is probably the best known (5).

1. Vienna General Hospital

The Vienna General Hospital (German: Allgemeines Krankenhuas der Stadt Wien=AKH) is the fifth largest hospital in Europe, both by number of personnels and beds (Figures 3 and 4). It is also the university hospital and the site of Medical University of Vienna. The origins of it go back to Dr.Johann Frackh who donated properties in 1686 for the establishment of military hospital. But since money was lacking, the disabled veterans were quartered. Then, in 1693 Emperor Leopold I arranged the establishment of a large hospital; its first ward was finished in 1897 and 1042 persons were quartered. Then, extension of the complex was made possible by the will Ferdinand Baron von Thavonat who left his estate to disabled soldiers in 1726. From 1752 to 1774 it witnessed more development.

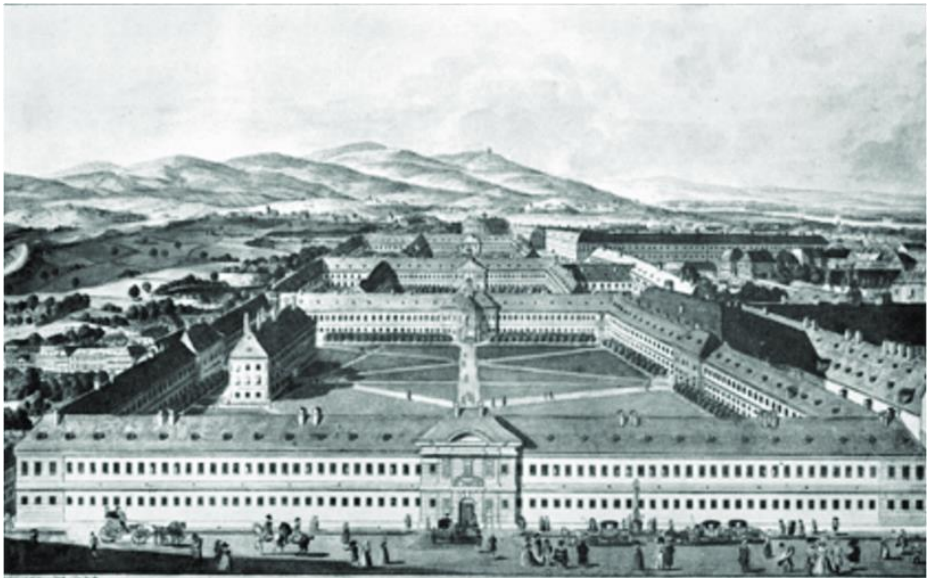


Figure 3: Vienna General Hospital in 1784.

Figure 4: Vienna General Hospital (Allgemeines Krankenhaus der Stadt Wien), main entrance, in twenty first century.

Dr. Joseph Quarin, who later became director, used a general hospital plan and in August 1784 the hospital was opened. Attached to the hospital was a maternity ward? An orphanage and a lunatic asylum. The Narrenturm (Fool's Tower) was the first special building for the accommodation of mental patients (figure 5).

Figure 5: The Narrenturm (Fool's Tower), built in 1872.

2. Main Medical Research Center

The Vienna General Hospital and its medical school, in 19th century was the main center of medical education and scientific research. Thus, Ignaz Semmelweis Hungarian obstetrician studied puerperal fever (childbed fever/childbirth fever), it causes and spread and introduced strict hygiene measures to reduce mortality, at the maternity ward of Vienna General Hospital. Karl Landsteiner (1868-1943) (figure 6) Austrian American pathologist and Nobel laureate of 1930 and founder of serology who described the major red blood types A, B, O and later AB, enabling blood to be matched for safe transfusion was from this center (6).

Figure 6: Karl Landsteiner, Austrian born American pathologist and Nobel laureate of 1930.

3. Connection between Cadaveric Contamination and Puerperal Fever

Following the death of his friend Jakob Kolletschka who had been accidentally poked with a student's scalpel while performing a postmortem examination, Semmelweis breakthrough occurred in 1847. Kolletschka's own autopsy showed a pathology similar to that of women who were dying from puerperal fever. Semmelweis directly proposed a connection between cadaveric contamination and childbirth fever. Semmelweis suggested that he as an obstetrician and the medical students carried "cadaverous particles" on their hands from the

autopsy room to the particles they examined in the first obstetrical clinic.

When on March 20, 1847, Jakob Kolletschka died from a disease similar in puerperal fever Semmelweis wrote:

"Since the identical results were found in Kolletschka's autopsy, the inference that Kolletschka died from the same disease was confirmed. The exciting cause of Professor Kolletschka's death was known; it was the wound by the autopsy knife that had been contaminated by cadaverous particles. Not the wound, but contamination of the wound by the cadaverous particles caused his death. Kolletschka was not the first to have died in this way. I was forced to admit that if his disease was identical with the disease that killed so many maternity patients, then it must have originated from the same cause that brought it on in Kolletschka. In Kolletschka, the specific causal factor was the cadaverous particles that were introduced into his vascular system. I was compelled to ask whether cadaverous particles had been introduced into the vascular systems of those patients whom I had seen die of this identical disease. I was forced to answer affirmatively… Because of the anatomical orientation of the Viennese medical school, professors, assistants and students have frequent opportunity to contact cadavers. Ordinary washing with soap is not sufficient to remove all adhering cadaverous particles. This is proven by the cadaverous smell that the hands retain for a longer or shorter time. In the examination of pregnant or delivering maternity patients, the hands, contaminated with cadaverous particles, are brought into contact with the genitals of these individuals, creating the possibility of resorption. With resumption the cadaverous particles are introduced into the vascular system of the patient… ."

"Suppose cadaverous particles adhering to hands cause the same disease among maternity patients that cadaverous particles adhering to the knife caused in Kolletschka. Then if those particles are destroyed chemically, so that in examinations patients are touched by fingers but not by cadaverous particles, the disease must be reduced… To destroy cadaverous matter adhering to hands I used chlorina liquida. This practice began in the middle of May 1847… Both the students and I were required to wash before examinations. After a time… I adopted the less expensive chlorinated lime. In May 1847, during the second half of which chlorine washings were first introduced, 36 patients died - this was 12.2% of 294 deliveries. In the remaining seven months of 1847, the mortality rate was below that of the patients in the second clinic… In 1848, chlorine washings were employed throughout the year and of 3556 patients, 45 died (1.27%). In the second clinic in the year 1848, of 3219 patients 43 died (1.33%). Chlorine washings had the same effect on the incidence of disease among the newborn… Since the chlorine washings were instituted with such dramatic success, not even the smallest additional changes in the procedures of the first clinic were adopted to which the decline in mortality could be even partially attributed. The instruction system for midwives is so instituted that pupils and instructors have less frequent occasion to contaminate their hands with cadaverous matter than is the case in the first clinic. Thus, the unknown endemic cause of the horrible devastations in the first clinic was the cadaverous particles adhering to the hands of the examiners… (But) childbed fever is caused not only by cadaverous particles adhering to hands but also by ichor from living organisms. It is necessary to clean the hands with chlorine water, not only when one has been handling cadavers but also after examinations in which the hands could become contaminated with ichor."

3-1. Semmelweis also Wrote: Once the cause of the increased mortality in the first clinic was identified as cadaverous particles adhering to the hands of the examiners, it was easy to explain why women who delivered in the street had a strikingly lower mortality rate than those who delivered in the clinic. This was so because once the infant was born and the placenta separated, there was generally no longer opportunity for instruction; thus, there were no examinations… Also, women who delivered prematurely became ill less often because they were not examined either. The first requirement in premature births is to delay birth if possible. Consequently, these persons were not used for open instruction and

decaying organic matter was not conveyed to their genitals. Early (each) morning I (had) conducted my gynecological studies in the morgue. I then went to the labor room and began to examine all the patients, as my predecessors and I were obliged to do, so that I could report on each patient during the professor's morning rounds. My hands, contaminated by cadaverous particles, were thereby brought into contact with the genitals of so many women in labor…

In consequence of my conviction, I must affirm that only God knows the number of patients who went prematurely to their graves because of me. I have examined corpses to an extent equaled by few other obstetricians. If I say this also of another physician, my intention is only to bring to consciousness a truth that, to humanity's great misfortune, has remained unknown through so many centuries. No matter how painful and oppressive such a recognition may be, the remedy does not lie in suppression. If the misfortune is not to persist forever, then this truth must be made known to everyone conceded (2).

3-2. More Research about Jakob Kolletschka: Kolletschka (figure 7) was forensic medicine professor at Vienna General Hospital. He is mostly remembered for his death which eventually led Semmelweis to his discovery of the etiology of puerperal fever. Below quote from the original reference describing the details of his death:

Figure 7: Jakob Kolletschka professor of forensic medicine at Vienna General Hospital.

Born: July 4, 1803, Bohemia.

Died: March 13, 1847, Vienna, Austria.

Field: Medical jurisprudence.

Academic employer: University of Vienna (8).

4. Semmelweis, One of the True Heroes of 19th Century Medicine

In the world of 19th century, a lot of mothers were dying from an illness known as puerperal fever (attributed or related to childbirth). Even under the medical care available, pregnant women would fall ill and die shortly after giving birth. Ignaz Philipp Semmelweis (1818-1865), Hungarian obstetrician studied puerperal fever, its causes and spread and introduced strict hygiene measures to reduce the rate of mortality. Semmelweis 30 years before Louis Pasteur (1822-1895) French chemist and father of bacteriology and the germ theory of disease, discovered that bacteria caused disease, realized that fatal fever after childbirth were caused by contamination on doctor's hands (6). He worked in the Vienna General hospital which had two separate maternity wards. One of the wards was staffed by male physicians and the other by female

midwives. Semmelweis, after research noticed that the mortality rate from the puerperal fever was much lower that the midwives delivered babies. He found out that women under the care physicians and medical students were dying at more than twice the rate of the midwives' patients.

The doctor tested a number of hypotheses for the phenomenon. Semmelweis investigated whether a woman's body position during birth had an impact. He also investigated if the literal embarrassment of being examined by a male doctor was causing the fever. He thought, perhaps it was the priests attending to patients dying of the fever that scared the new mothers to death. He assessed each factor and then ruled them out.

Semmelweis after removing these other variables found the culprit: "cadavers". At hospitals, during the mornings, the physicians observed and assisted their students with autopsies as part of their medical training.

In the afternoons, the doctors and students worked in the maternity ward examining patients and delivering babies. The midwives usually worked in their ward. Semmelweis concluded that "cadaverous particles" were being transferred from dead bodies to the new mothers by the physicians and their medical students. Unlike today, the doctors did not have to scrub their hands during the patient visit. In fact, whatever pathogens they came in contact with during an autopsy would be taken into the maternity ward.

Then, the germ theory was still in its infancy, so rather than "germs" Semmelweis called the agents "decomposing animal organic matter". Women became infected with the particles and died of the fever after coming into contact with the physicians and medical students.

5. Historic Work of Semmelweis

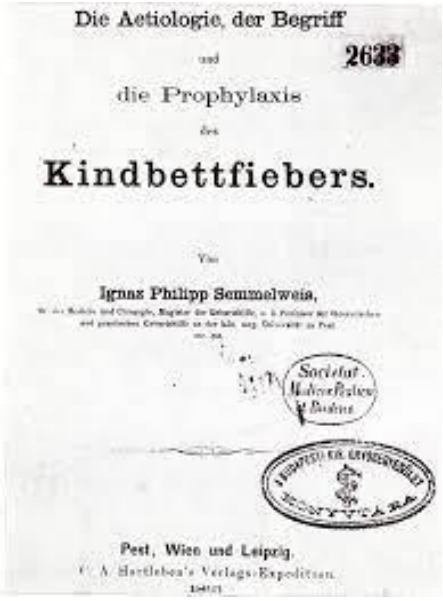
Semmelweis implemented mandatory hand washing among the doctors and medical students who worked for him at the Vienna General Hospital, in 1847. He rather than relying on plain soap used a chlorinated lime solution because it totally removed the smell of decay that lingered on the physician's hands (figure 8). Furthermore, the staff began to sanitize themselves and their instruments. The mortality rate in the physician-run maternity ward fell. Semmelweis took the stage at the Vienna Medical Society and praised the virtues of hand washing to large number of physicians. The theory flew in the face of accepted medical wisdom of the time and was rejected by the medical community who faulted both his science and logic. Historians and scientific researchers believe they also rejected Semmelweis's theory because it blamed them for their patients' mortality rates in maternity wards. The Vienna General Hospital abandoned mandatory hand washing (9).

Figure 8: This painting depicts Semmelweis (center) in Vienna General Hospital overseeing physicians washing their hands before examining obstetric patients.

Despite various publication of results including "Etiology, Concepts and Prophylaxis of Childbed fever" he could offer no acceptable scientific explanation for his findings and some doctors mocked him for his discovery. In 1865, the increasingly outspoken Semmelweis supposedly suffered a nervous breakdown and was committed to an asylum by his colleagues. In the asylum Semmelweis was beaten by the guards. He died 14 days later, from a gangrenous wound on his right hand that may have been caused by the beating. Semmelweis's practice earned widespread acceptance years after his death when Louis Pasteur (1822-1895) French chemist confirmed the germ theory of disease and Lord Joseph Lister (1827-1912) British surgeon and father of antiseptic surgery acting on the Pasteur's research, practiced and operated using hygienic methods with great success (10).

6. Adverse Reaction of Physicians and Scientists

In 1861, five years before his death, Semmelweis published his principal work, Die Ätiologie, der Begriff und die Prophylaxis ds kindbettfiebers (The Etiology, Concept and Prophylaxis of Childbed Fever) (figure 9). He sent it to all the prominent obstetricians and medical societies abroad, but the general reaction was adverse. The weight of authority stood against his teachings. He addressed several open letters to professors of medicine in other countries, but to little effect. At a conference of German physicians and natural scientists, most of the speakers-including the pathologist Rudolf Virchow-rejected his doctrine. The years of controversy gradually undermined his spirit (11).


Die Aetiologie, der Begriff

und

2633

die Prophylaxis

des

Kindbettfiebers.

Von

Ignaz Philipp Semmelweis,

Pest, Wien und Leipzig.

Figure 9: Semmelweis's main medical work "Die Ätiologie, der Begriff und die Prophylayis des Kindbettfiebers" 1861 (front page) (The Etiology, Concepts and Prophylaxis of Childbed fever).

7. More Research

This medical work was published in 1860 in Vienna but dated 1861. It collects all of Semmelweis's studies from 1847 to 1861. He himself sent a copy to the Council of the Governor-General in Hungary, who asked for the opinion of the medical faculty of the University of Pest, resulting in an official order to implement Semmelweis's proposals into hospital practice. The Council of the Governor-General, responsible for the administration of the country, sent a general order on September 1, 1862, to every local authority on implementing Semmelweis's procedures. This was followed by his first and

second open letters written to colleagues, also published in German in 1861 and 1862. Due to his new ideas and in particular his passionate tone, his views were rejected and attacked by the majority of the Hungarian and especially the international, medical community (12).

8. Washing Hands (Hands Hygiene)

Wash is act of cleaning or being cleaned with water; make clean in water or some other liquid; make oneself, clothes, one's face and hands, etc clean with water. We all know how important it is to wash our hands. In hospitals, antibiotic–resistant strains of bacteria are wiped out by the simple act of hand washing. Wards are supplied with antiseptic hand gel - which medical staff and visitors use before they see patients who are vulnerable to infection. The routine of "scrubbing up" by surgeons before an operation is, of course, a well – established practice. But this was not always the case. Until late 1800s surgeons did not scrub up before surgery or even wash their hands between patients and surgeons wore street clothes (figure 10).

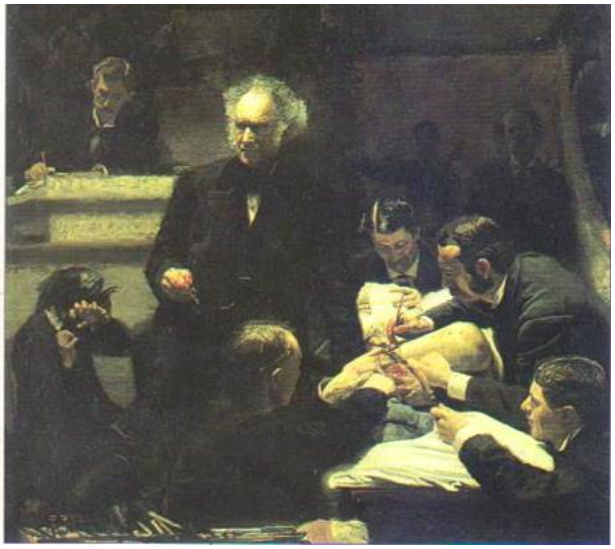


Figure 10: Samuel Gross (1805-1884) pioneer American surgeon and anatomist and professor of surgery at Jefferson University Medical College in Philadelphia demonstrates an operation for osteomyelitis (a serious bone infection). The patient is receiving an anesthetic (ether), but the surgeon wears street clothes without mask and gloves and the unsterile surgical equipment lies exposed in an instrument case. Approximately a decade after Joseph Lister developed his antiseptic procedures, (figure 11) Samuel Gross is still not using carbolic acid to prevent wound infection (13).

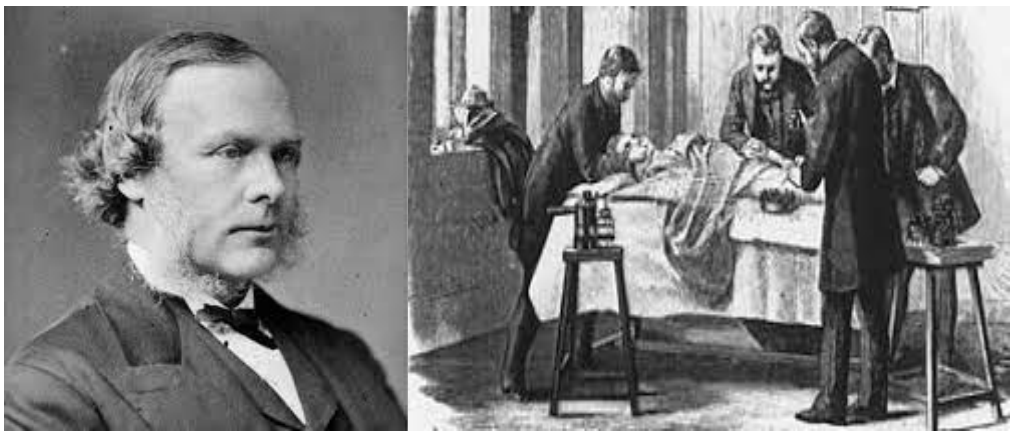


Figure 11: Joseph Lister's (left) careful trials with antiseptics were the beginning of the end of postoperative sepsis. The carbolic sprays he advocated (shown in this 1882 engraving) were at first, messy and unpleasant (13).

9. Steps and Duration

The World Health Organization recommends washing hands for at least 20 seconds before or after the following:

- Before and after caring for any sick person.

- Before, during and after preparing food.

- Before eating.

- After using th toilet (for urination, defecation, menstrual hygiene).

- After helping someone who just used the toilet.

- After blowing one's nose or coughing or sneezing.

- After touching an animal, animal feed or animal waste.

- After touching garbage.

- After coming from the hospital.

- After work.

- After any travel.

- After visiting the supermarket (14).

The Center for Disease Control recommends the public follow this guidance to stop the spread of germs:

1. Wet your hands in running water and apply soap. Neither the temperature of the water nor the type of soap you use (antibacterial or otherwise) impacts how many microbes are removed.

2. Lather the soap by rubbing your hands together. The friction will increase the number of microbes removed.

3. Scrub for at least 20 seconds, or the approximate amount of time it takes to hum the "Happy Birthday" song twice.

4. Rinse your hands completely in clean, running water. Studies have not shown that using a paper towel to turn off the faucet improves health, according to the CDC.

5. Dry your hands either on a clean towel or by air drying them. (Figure 12.)

Figure 12: Hand washing (hand hygiene) with water and soap at a sink.

10. Who Has Been the First to Show Puerperal Fever Was Contagious?

An epidemic in Aberdeen (city and seaport of northeast Scotland) which lasted 1789 to 1792 was studied by Alexander Gordon (1752-1799) an obstetrician from Aberdeen proposed the contagious nature of puerperal fever and advocated disinfection of clothes of the midwives and doctors attending the mother (2). According to his research puerperal fever was contagious in the sense that it was transmitted from one lying – in woman to another by the birth attendants. Many others confirmed Gorden's finding and one who was often quoted is Oliver Wendell Holmes (1809-1894) American physician and poet and writer who was Parkman professor of anatomy and physiology at Harvard University (figure 13) in 1843.

Figure 13: Oliver Wendell Holmes reading his famous essay "The Contagiousness of Puerpural Fever" before the Boston Society for Medical Improvement in 1843.

Gordon published a paper on the contagiousness of puerperal fever which was republished in 1855 as a pamphlet entitled "Puerperal Fever as a Private Pestilence". Holmes's work was soon followed by the work of Ignaz Phillip Semmelweis (Figures 14 and 15), who is often believed (perhaps incorrectly) to have been the first to show that puerperal fever was contagious (14).

Figure 14: Semmelweis an obstetrician who championed hand washing (hand hygiene), washing his hands in chlorinated lime water before surgical operation (15).

Figure 15: Before examining each patient, Ignaz Semmelweis scrub his hands, a precaution he required of his staff which lowered the obstetrical mortality rate dramatically.

Above: The basin and stand used by Semmelweis.

11. Simpson's Stinging Letter

Semmelweis's views in the United Kingdom were much more received than other countries in Europe but was further cited than understood. They consistently regarded Semmelweis as having supported their theory of contagion. A typical example was W.Tyler Smith who claimed that Semmelweis "made out very conclusively" that "miasmas derived from the dissecting room will excite puerperal disease". One of the first to respond to Semmelweis's 1848 communications was Sir James Young Sympson (1811-1870) British obstetrician and pioneer of anesthesia in childbirth (figure 16), used ether before he discovered the properties of chloroform and was one of the founders of gynecology (1) who wrote a stinging letter.

Figure 16: James Young Simpson who wrote a stinging letter about Semmelweis's discovery.

Simpson surmised that the British obstetrical literature must be totally unknown in Vienna, or Semmelweis would have known that the British had long regarded childbed fever as contagious and have employed chlorine washing to protect against it.

12. Semmelweis's Life

Ignaz Semmelweis was born on 1 July 1818 in Taban neighbourhood of Buda, Hungary, today part of Budapest (figure 17). Budapest is the capital and largest city of Hungary situated on both banks of the Danube, in the north-central part of the country, it was established through the unification of Buda, Pest and Óbuda in 1873. Budapest is the home of numerous educational and scientific institutions (16). Ignaz was the fifth child out of 10 of the prosperous grocer family of Jósef Semmelweis and Teréz Müller (figure 18). His father was an ethnic German born in Kismarton then part of Hungary now Eisenstadt (city of Austria and capital of the province of Burgentdand, located on the western edge the Pannonian Basin, near Neusiedler lake).

Figure 17: Ignaz Semmelweis's birthplace (Apród utca 1-3) 1906.

(Semmelweis University Archives) (12).

Figure 18: Teréz Muller, Semmelweis's mother.

Figure 19: Józef Semmelweis, Ignaz Semmelweis's father.

The great Austrian composer Joseph Haydn (1731-1809) lived there from 1766 to 1778 and his home is now the Haydn Museum, Austria. Semmelweis's father (figure 19) was granted citizenship in Bud in 1806 and in the same year he opened a wholesale business for spices and general consumer goods. His company was named "Zum weiß Elefanten (At the White Elephant) in the Meindl House. Today its name is "Semmelweis Museum of Medical History" located at 1-3 Apród Street, Budapest. He was a wealthy person by 1810 and married Teréz Müller, daughter of a coachbuilder Fülöp Müller.

Figure 20: Left, Ignaz Semmelweis in his childhood, in 1830.

Right, Ignaz Philipp Semmelweis (1818-1856) who saved a lot of lives and spared countless numbers of women and newborn feverish and agonizing mortality.

In the autumn of 1837, Semmelweis began studying law at the Vienna University, but by the following year for reasons that are not known he decided to study medicine and was graduated in 1844 when he was 26 years old. Later, after failing to obtain an appointment in a clinic for internal medicine, he began to specialize in obstetrics. Famous physicians including Rokitansky and other medical celebrities were his teachers (10):

Karl von Rokitansky (1904-1878) was an outstanding Austrian pathologist who wrote "A Manuel of Pathological Anatomy" and was the first to differentiate lobar from lobular pneumonia (1).

13. Marriage

Ignaz Semmelweis, a year after returning to Pest, he became unpaid director of obstetrics ward at St. Rachus Hospital. By applying the same methods as in Vienna General Hospital, the maternal mortality rate reduced to one per cent. In 1855, Semmelweis was appointed as professor of theoretical and practical obstetrics in the University of Pest. Ignaz 2 years later in 1857, at the age of 39 married Mária Weidenhofer (1837-1910) the daughter of a successful merchant in Pest (figure 21) 20 years his junior.

Figure 21: Ignaz Philipp Semmelweis (left) and Mária Weidenhofer (right) in their wedding portrait (1857).

They had five children, three of whom survived (10). Semmelweis (figure 20) at the same year (1875) declined to become obstetrics professor at the University of Zurich (canton of northern Switzerland and German speaking area).

14. The Death of Semmelweis according to Various Sources

- The reasons why Semmelweis's great work was almost totally ignored are complex. Until the advent of bacteriology, it was universally believed that fevers in general, puerperal fever in particular, were due to many different causes. Few were disposed to accept a unitary explanation and Semmelweis insisted that all cases of puerperal fever whatsoever were due to the single cause- the transfer of decomposing animal organic matter. Also, he made few converts because of his extreme dogmatism, egocentricity and intolerance of even the mildest criticism. These characteristics were exaggerated by the onset in the mid-1850s of mental illness, the nature of which is uncertain. At all events he died miserably in a common lunatic asylum in 1865, possibly from a head injury inflicted by brutal asylum attendants (4).

- Beginning in 1861, Semmelweis suffered from various nervous complaints. He suffered from severe depression and became absentminded. He turned every conversation to the topic of childbed fever.


Offener Brief

Professoren der Geburtshilfe

Dr. Ignaz Philipp Semmelweis.

Ofen.

Figure 22: Semmelweis's Open Letter of 1862 to all obstetrics professors.

After a number of unfavorable foreign reviews of his 1861 book, Semmelweis lashed out against his critics in a series of open letters (figure 22). They were addressed to various prominent European obstetricians, including Späth, Scanzoni, Siebold and to "all obstetricians". They were full of bitterness, desperation and fury and were "highly polemical and superlatively offensive", at times denouncing his critics as irresponsible or ignoramuses. He also called upon Siebold to arrange a meeting of German obstetricians somewhere in Germany to provide a forum for discussions on puerperal fever, where he would stay "until all have been converted to his theory".

In mid-1865, his public behavior became exasperating and embarrassing to his associates. He also began to drink immoderately; he spent progressively more time away from his family, sometimes in the company of a prostitute; and his wife noticed changes in his sexual behavior. On July 13, 1865, the Semmelweis family visited friends and during the visit Semmelweis's behavior seemed particularly inappropriate.

Semmelweis's affliction has been a subject of some debate. According to K.Codell Carter, in his biography of Semmelweis, its exact nature cannot be determined: "It is impossible to appraise the nature of Semmelweis's disorder. … It might have been Alzheimer's disease, a type of dementia, which is associated with rapid cognitive decline and mood changes. It might have been third - stage syphilis, a then-common disease of obstetricians who examined thousands of women

at gratis institutions, or it might have been emotional exhaustion from overwork and stress."

In 1865, János Balassa wrote a document referring Semmelweis to a mental institution. On July 30, Ferdinand Ritter von Hebra lured him, under the pretense of visiting one of Hebra's "new Institutes", to a Viennese insane asylum located in Lazarettgasse (Landes-Irren-Anstalt in der Lazarettgasse). Semmelweis surmised what was happening and tried to leave. He was severely beaten by several guards, secured in a straitjacket and confined to a darkened cell. Apart from the straitjacket, treatments at the mental institution included dousing with cold water and administering castor oil, a laxative. He died after two weeks, on August 13, 1865, aged 47, from a gangrenous wound, due to an infection on his right hand which might have been caused by the struggle. The autopsy gave the cause of death as pyemia-blood poisoning. Semmelweis was buried in Vienna on August 15, 1865. Only a few people attended the service. Brief announcements of his death appeared in a few medical periodicals in Vienna and Budapest. Although the rules of the Hungarian Association of Physicians and Natural Scientists specified that a commemorative address be delivered in honor of a member who had died in the preceding year, there was no address for Semmelweis; his death was never even mentioned. János Diescher was appointed Semmelweis's successor at the Pest University maternity clinic. Immediately, mortality rates increased sixfold to 6%, but the physicians of Budapest said nothing; there were no inquiries and no protests. Almost no one –either in Vienna or in Budapest– seems to have been willing to acknowledge Semmelweis's life and work.

His remains were transferred to Budapest in 1891. On 11 October 1964, they were transferred once more to the house in which he was born. The house is now a historical museum and library, honoring Ignaz Semmelweis. (figure 23).

Figure 23: Semmelweis's birthplace, now Semmelweis Orvostörténeti Múzeum.

- Sadly, Semmelweis was committed to an insane asylum when he started to exhibit what was possibly the early onset of Alzeimer's disease. While there he was beaten by the staff and died from his injuries (17).

- He observed that the first clinic (run by medical men) had a much higher (mortality) rate of puerperal fever than the second obstetrical clinic, run by midwives. He became convinced that this was caused by medical staff and students going

directly from the postmortem to delivery rooms thereby spreading infection. He instituted a strict policy of washing hands and instruments in chlorinated lime solution between autopsy work and handling patients and the mortality in the first clinic was diminished to the same level as the second. Opposition to his novel views led him to quit Vienna, in 1850. Resentful and frustrated, he died in a lunatic asylum (13).

15. More Research

- Semmelweis 30 years before Louis Pasteur discovered that bacteria caused disease, realized that fatal fevers after childbirth were caused by contamination on doctors' hands (6).

- When Semmelweis finally completed a book, "Die Äetiologie der Begriff und die Prophylaxis des Kindbettfiebers" in 1861, ten years after his original discoveries, the profession hardly took notice and prestigious scientists like Rudolf Virchow (1812-1902) German founder of cellular pathology who regarded disease as a cellular response to change, actually opposed Semmelweis's ideas. The brilliant and sensitive Semmelweis finally was broken by the indifference and callousness of his superiors and colleagues.

- Joseph Skoda (1805-1881) Austrian physician who correlated physical signs with pathological lesions and described the drum like sound heard on percussion of the chest above a pleural effusion (1).

- Semmelweis noticed that whenever someone on the ward died of puerperal fever, a priest would walk slowly through the doctors' clinic, past the women's beds with an attendant ringing a bell. This time Semmelweis theorized that the priest and the bell ringing so terrified the women after birth that they developed a fever, got sick and died.

- In spite of brilliance of Semmelweis's thesis, these ideas had not won support by the time of his death in 1865. This is perhaps all the more surprising in that of many of his observations had already been made during the previous century by men such as:

- Thomas Denman in his treatise "An Essay on Natural Labors" (1786) described the management of three stages of normal labor, especially the dangerous third stage so clearly that with a minor alteration, it could serve as a text for students today (4).

- Charles White (1728-1813) British sureon and pioneer aseptic midwifery, who was the first to exercise the head of humerus and described painful "white leg" in the puerperium.

- Alexander Gordon (1752-1799) British physician showed that puerperal fever was contagious (4).

- Joseph Clark and Robert Collins of Ireland in the 18th century sharply reduced the occurrence of postpartum sepsis (infection) by regimens of personal and environmental cleanliness, limited vaginal examinations during labour and acting cleansing of beds and linen (6).

- James Blundell (1790-1877) British physiologist and obstetrician developed pelvic surgery, differentiated between placenta previa and accidental hemorrhage and performed vaginal hysterectomy for cervical cancer.

- Oliver Wendell Holmes (1809-1894) American physician and writer who studied puerperal fever and recommended hygiene precaution in hospitals for prevention.

- Within a few years of Semmelweis's death the following discoveries threw light on the bacterial nature of disease including wound infection and in 1879 Pasteur finally identified the hemolytic streptococcus responsible for childbed fever (puerperal fever).

- Louis Pasteur (1822-1895) French chemist and father of modern microbiology and pasteurization who postulated the germ theory.

- Lord Joseph Lister (1827-1912) British surgeon and founder of antiseptic system of surgery who advocated the use of carbolic acid for the prevention infection during the surgery and use catgut treated with carbolic acid to promote asepsis (1869).

16. Legacy

Legacy of Semmelweis includes:

17. Works

1. Semmelweis is now recognized as a pioneer of antiseptic policy.

2. Semmelweis University, a university for medicine and health - related disciplines (located in Budapest, Hungary), is named after Semmelweis.

3. The Semmelweis Orvostörténeti Múzeum (Semmelweis Medical History Museum) is located in the former home of Semmelweis.

4. The Semmelweis Klinik, a hospital for women located in Vienna, Austria.

5. The Semmelweis Hospital in Miskolc, Hungary.

6. The Semmelweis Hospital in Kiskunhalas, Hungary.

7. In 2008, Semmelweis was selected as the motif for an Austrian commemorative coin.

8. Minor planet (4170) Semmelweis is named after him.

9. A postage stamp was issued by Hungary on 1 July 1932 in the Famous Hungarians series: Stamp: lgnác Semmelweis (1818-1865), physician.

10. Inclusion as a Google Doodle to promote handwashing beginning on 20 March 2020 during the covid-19 pandemic.

18. Films

1. That Mothers Might Live (1938), US, MGM, director: Fred Zinnemann, Oscar for the best short film.

2. Semmelweis (1940), Hungary, Mester Film, director: André de Toth.

3. Semmelweis – Retter der Mütter (1950), East Germany, DEFA, director: Georg C. Klaren.

4. Ignaz Semmelweis–Arzt der Frauen (1987), West Germany / Austria/ Hungary, ZDF/ORF, director: Michael Verhoeven.

5. Semmelweis (1994), the Netherlands, Humanistische Omroep Stichting, director: Floor Maas.

6. Docteur Semmelweis (1995), France / Poland, director: Roger Andrieux.

7. Semmelweis (2001 short film), US/Austria, Belvedere Film, Director: Jim Berry, producers: Robert Dassanowsky and Elfi von Dassanowsky.

19. Litrature

1. Semmelweis, ignác; von György, Tiberius (1905), Semmelweis's Gesammelte Werke Herausgegeben und zum Theil aus dem Ungarischen Übersetzt (https://books.google.com/boo ks?id= oVDSUzGAU1cC) [The complete published works of Semmelweis, in part published from Hungarian] (in German), Jena Verlag von Gustav Fischer, P.604 is the classic reference, in Latin print, not the original Gothic print.

2. Louis-Ferdinand Céline completed his M.D. thesis on Semmelweis in 1924. It was published as a fictionalized biography under the title La Vie et l'œuvre de Philippe lgnace Semmelweis in 1936 (English versions: The Life and Work of Semmelweis, tr. By Robert Allerton Parker, Boston: Little, Brown and Company, 1937; Semmelweis, tr. By John Harman, Atlas Press, 2008).

3. In William Forstchen's the Lost Regiment series of novels, one of the main characters is a doctor named Emil Weiss, the regiment's surgeon. On multiple occasions, it is mentioned that he had studied under Semmelweis and as such had developed effective sanitation techniques to avoid infection when treating injuries.

4. Morton Thompson's 1949 novel The Cry and the Covenant is a fictionalized account based on the life of Semmelweis .

5. Motherkillers, a novel by John Piper, based on the Semmelweis story.

6. Kurt Vonnegut praises Semmelweis at length in his 2005 memoir, A Man Without a Country, portraying his story as a tragic tale of a powerful force for good being ignored, mocked and derided in his own time. Vonnegut called him "my hero" and held his story up as a beneficial example for all mankind.

7. Genius Belabored: Childbed fever and the Tragic Life of Ignaz Semmelweis , Theodore G.Obenchain.

20. Drama/ plays

1. An Enemy of the People, drama by Henrik Ibsen. The protagonist, a doctor battling both microbes and societal rejection, is at least loosely

modeled on Semmelweis. (See Tomas Szasz, Liberation by Oppression: A Comparative Study of Slavery and Psychiatry, Transaction Publishers, New Brunswick & Loudon, P. 176.)

2. Semmelweis, opera-theater work by Raymond J. Lustig (music) and Matthew Doherty (libretto). Premiere production June 2018 in Miskolc, Hungary, directed by Martin Boross, featuring Szilveszter Szabó, Veronika Nádasi and the Bela Bartok Chamber Choir of Szolnok, co-produced by Budapest Operetta Theater and Bartok Plusz Opera Festival. Nine additional Hungarian-language performances in Budapest and a five-city tour throughout Hungary, 2018-19.

3. "Semmelweis" by Jens Bjrneboe. Performed in 1977 at the Studio Arena Theater in Buffalo, New York with Lewis J.Stadlen, Kathy Bates and Kim Hunter. Performed in 1978 at the Kennedy Center in Washington, D.C. with Colin Blakeley. Performed in 1981 at the Hartman Theater in Stamford, Connecticut.

4. "What are you fighting for, Dr Semmelweis" by Titus Alexander, 1968. Performed July 1969 at Churchill Theatre, Edinburgh, Scotland, by pupils of the Edinburgh Rudolf Steiner School Dramatic Society, with Simon Scott as Semmelweis with music composed by Mark Edwards. Translated into German as "Um was Kämpfen Sie, Dr. Semmelweis?" by Concillia Viegener and performed by a Steiner school in Brazil.

5. "Semmelweis" by Peter Russell. A 90-minute play broadcast 9 August 1971 on BBC Radio 4 featuring Sandor Eels in the title role [18].

21. Dictionary

21-1. Asepsis: The exclusion of putrefying bacteria from the field of operation, by the use of sterilized dressings and instruments and the wearing of sterilized gowns and gloves by the surgeon and nurses.

21-2. Lime: A substance produced by heating limestone to 825^{o}C or more as a result of which the carbonic acid and moisture are driven off.

21-3. Castor oil: Thick yellowish oil obtained from the seed of a tropical plant and used as a laxative and a lubricant.

21-4. Hexachlorophene: Widely used bactericide in soap, deodorants and other toilet products. Sometimes referred to as G-11.

21-5. Thymol: Is used as a disinfectant and in mouthwashes and in dentistry. Isomeric in carvacrol.

21-6. Contagion: Spreading of disease by being close to or touching other people; disease that can be spread by contact.

21-7. Contagious: (of a disease) Spreading by contact; spreading easily from one person to another.

21-8. Eucalyptole: Cineole.

21-9. Necropsy (Autopsy): A postmortem examination of the body.

22. Autopsy → Necropsy

22-1. Pathology: That part of medical science which deals with the causes and nature of disease and with the bodily changes wrought by disease.

22-2. Micro-organism: Organism so small that it can be seen only under a microscope.

22-3. Obstetrician: A medically qualified person who practices obstetrics.

22-4. Obstetrics: That branch of medical science which deals with the problems and management of pregnancy and labor.

22-5. Septic: Caused by or causing infection with harmful bacteria.

22-6. Wound: Injuries caused deliberately to part of the body by cutting, shooting, etc. especially as the result of an attack; cut or tear done to the outer surface of a plant or tree.

22-7. Cadaver: Dead body of a person; corpse.

22-8. Contamination: Contaminating or being contaminated.

22-9. Hygiene: Study and practice of clean lines as a way of maintaining good health and preventing disease.

22-10. Hygienic: Free from germs that causes disease.

22-11. Trichloroethane: See chloroform.

22-12. Tetra chloromethane: See carbon tetrachloride.

22-13. Carbon Tetrachloride: A colorless liquid solvent for fats and oils, widely used in fire extinguishers; it is now little used as a dry-cleaning fluid because of its toxicity.

22-14. Rudiment: The earliest recognizable stage of a member or organ.

22-15. Germ: The primitive rudiment which will develop into a complete individual, as a fertilized egg or a newly form bud; a unicellular microorganism.

22-16. Bacteriology: The scientific study of bacteria.

22-17. Disease: Illness.

22-18. Carbolic acid: Phenol; C_4H_3OH.

22-19. Chlorine: The second halogen is a greenish yellow gas with an irritating smell and a destructive effect on the respiratory tracts. It is produced from the electrolysis of conc. brine, or by oxidation of hydrochloride acid.

22-20. Chlorine: Is a powerful oxidizing agent and is widely used both pure and as javel water or bleaching powder for bleaching and disinfecting. It is used in organic chemicals industry to produce tetrachloromethane, trichloroethane (PVC) and many other solvents, plastics, disinfectants and anesthetics.

22-21. Chloroform: A colorless liquid of a peculiar ethereal odor, an anesthetic, solvent for fats and oils, resins, rubber and numerous other substances. It is prepared technically from ethanol and calcium chlorate.

22-22. Mercury: A white metallic element which is liquid at atmospheric temperature. A solvent for most metals, the products being called amalgams. Its chief uses are in the manufacture of drugs and chemicals, fulminate and vermilion. Used as metal in mercury-vapor lamps, arc rectifiers, power-control switches and in many scientific and electrical instruments.

22-23. Nitrogen: Gaseous element colorless and odorless with symbol "N". It was the determination by Rayleigh and Ramsay of its rel.at. mass that led to the discovery of inert gases in the atmosphere, argon, etc. Approximately 80% of the normal atmosphere is nitrogen, which is also widely spread in minerals, the sea and in all living matter.

22-24. Iodine: Nonmetallic element in the seventh group of the periodic system, one of the halogens. It forms blackish scales with violet luster and a characteristic smell. It is widely but sparingly distributed as iodides and is a constituent of the thyroid gland. It is a powerful disinfectant and a constituent of contrast media. The important commercial sources are crude Chile Saltpeter (caliche) and certain seaweeds; it is used in organic synthesis.

22-25. Puerperal: Related to childbirth; pertaining to or ensuing upon childbirth.

22-26. Puerperal fever: A condition caused by infection of the genital of genital tract in the course of childbirth.

22-27. Puerperium: Strictly, the period between the onset of labor and the return to normal of weeks after the completion of labor.

22-28. Postmortem: Occurring after childbirth; e.g., postpartum hemorrhage.

22-29. Homarus: The bone supporting the proximal region of the forelimb in land vertebrates; adjective: humeral.

22-30. Delivery: Process of birth.

22-31. Hysterectomy: Surgical removal of the uterus.

22-32. Servix: Neck of the uterus, situated partly above and partly in the vagina; adjective: cervical.

22-33. Deodorant: Substance that hides or removes body odors.

22-34. Substance: (particular kind of) Matter; a kind of matter, with characteristic properties and generally with a definite composition independent of its origin.

22-35. Streptococcus: A gram-positive coccus of which the individuals tend to be grouped in chains; any of a group bacterium that cause serious infections and illnesses.

22-36. Antibiotic: Chemical substances developed as metabolic products by many

microorganisms (fungi, bacteria, antimonycetes, etc) - and possibly by higher organisms – which inhibit the growth of rival microorganism. In particular, these substances, isolated and purified, or synthesized and used for therapeutic purposes: chloramphenicol, penicillin, streptomycin.

22-37. Sterile: Unable to breed; freed from bacteria and mold by treatment with heat or with antiseptics.

22-38. Lunatic: Widely foolish person; lunatic asylum: psychiatric hospital.

22-39. Orphanage: Place where orphans live.

22-40. Maternity Ward, maternity hospital: Is for women who have just given birth.

22-41. Anaesthetic, anesthetic: Insensible to touch (loosely, also to pain and temperature); a drug which produces insensibility to loach, pain and temperature, with or without loss of consciousness.

22-42. Osteomyelitis: Inflammation of bone marrow and of the bone.

22-43. Miasma: Unhealthy or unpleasant mist; bad atmosphere or influence.

22-44. Prophylaxis: The preventive treatment of disease.

22-45. Catgut: Sterilized strands of sheep's intestine used as ligatures.

22-46. Methylation: The introduction of methyl (CH_2) groups into organic compounds. Carried out by using methylating agent such as diazomethane or dimethyl sulphate.

22-47. Unicellular: Consisting of a single cell.

22-48. Ammonium: The ion NH_4, which behaves in numerous respects like an atom of a monovalent alkali metal.

Conclusion

By the late 19th century, the industrial revolution in Europe, especially in Britain had created filthy overcrowded towns and cities for its industrial workers. Encouraged by crowding and poor nutrition, germs spread in contaminated water, food and air bringing epidemics of cholera, typhoid, smallpox, tuberculosis and pneumonia. The importance of clean water was demonstrated in 1854 when John Snow (1813-1858) brilliant British anesthetist and epidemiologist discovered that London outbreak of cholera centered on a water pump. In France Louis Pasteur (1822-1895) argued that germs were the cause of decay and also of many diseases and took many experiments to show that very small living thing can cause disease.

During 19th century many medical advances were made on hospital wards. Puerperal fever was brought under control in the 1840s in a Viennese hospital by Ignaz Semmelweis. He noticed that most women who died after childbirth were on a ward attended by medical students who also dissected corpses. Semmelweis suspected students brought in infective "putrid particles" (germs) and insisted physicians and students wash their hands in chlorinated lime. In Two years, the wards mortality fell from 10 percent to 1.3 per cent. But most surgeons were hostile to Semmelweis's work and he was not proved right until 1897, when Pasteur helped formulate modern germ theory.

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The authors declares that there is no conflict of interest regarding the conduct of this research.

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