

A LIFESAVING WAKE-UP CALL FROM THE PAST: “WASH YOUR HANDS!”

A reminder to Ignacz F. Semmelweis' Thesis in the light of the current COVID-19 pandemic

¹Ernő Remsey-Semmelweis M.D., ²László Göbölös M.D., ³Zsolt A. Varga M.D., Ph.D., ⁴Gábor Szabó M.D., Ph.D., ⁵Endre V. Nagy M.D., Ph.D., D.Sc., ⁶Mario Lachat M.D., ⁷Alexander Seifalian Ph.D., ¹Christoph Nienaber M.D., Ph.D., ¹Ulrich Rosendahl M.D.

(1) Cardiology and Aortic Centre, Royal Brompton and Harefield Hospitals, NHS Foundation Trust, London, UK

(2) Heart and Vascular Surgery Institute, Cleveland Clinic, Abu Dhabi, Abu Dhabi, UAE

(3) Department of Vascular Surgery, Raigmore Hospital, NHS Highland, Inverness, UK

(4) Department of Cardiothoracic Surgery, University of Heidelberg & Halle, Germany

(5) Division of Endocrinology, Department of Medicine, Faculty of Medicine, University of Debrecen, Debrecen, Hungary

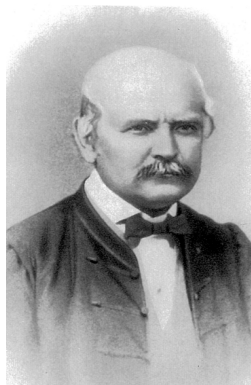
(6) Aortic and Vascular Center, Hirsladen Hospital, Zürich, Switzerland

(7) Nanotechnology & Regenerative Medicine Commercialization Centre (Ltd), London BioScience Innovation Centre, London, UK

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“Strange is our situation here upon earth. Each of us comes for a short visit, not knowing why, yet sometimes seeming to a divine purpose. From the standpoint of daily life, however, there is one thing we do know: That we are here for the sake of other men....”

(Albert Einstein)

Left: Photograph of I.F. Semmelweis, 1861 (Source: [1])

ABSTRACT

Childbed or puerperal fever has been a terrible, lethal disease that has presented a substantial unsolved problem in medicine since Hippocrates. In 1847, a Hungarian obstetrician, Dr. Ignác Fülöp Semmelweis discovered that the incidence of childbed fever, and generally, infections in hospitals and clinics could be drastically cut by hand disinfection. Unfortunately, his observations conflicted with the established scientific and medical opinions of the time, and his concept that the only condition that mattered was cleanliness was extreme at the time. Despite cutting the mortality rate by 90% both in Vienna and in his Pest clinic, it was largely ignored. He was rejected and ridiculed by the medical community simply because accepting it would have required admitting personal responsibility. The pioneer of hygiene, the “savior of mothers,” died from sepsis at the age of 47 under suspicious circumstances. Finally, we summarize the lessons of his life and repeat his 19th-century advice, which is still actual, far-reaching, and proper even today:

KEEP YOUR MIND CLEAR, YOUR HANDS, AND SOUL CLEAN!

KEYWORDS:

Childbed fever, hygiene, asepsis, gynecology, Semmelweis, Robert Koch, cause-based medicine, Louis Pasteur, pandemic, creativity, COVID-19, public healthcare

* Corresponding author: E-mail: e.r.semmelweis@gmail.com

PURPOSE AND RATIONALE

For Ignacz F Semmelweis' birth bicentenary, numerous publications [2-5] described his life. They heralded his achievements as a pioneer of asepsis, the founder of hygiene, the "savior of mothers," and a savvy researcher of causality in medicine, who probably saved millions of lives since the 19th century. The purpose of this article is to take a look at his life, achievements, and significance, and show that his message is still relevant and resonates forcefully in the middle of the current pandemic.

INTRODUCTION AND DISCUSSION

Today, we're all personally experience what it is to face a lethal viral infection, which might be detrimental to humankind. We urgently need new scientific knowledge and expertise, either from a genius individual, a professional team, or both, supported by the public and governments, who can analyze and understand the laws of Nature, see through the fog, then counteract this family of viruses by developing a widely applicable prevention or treatment to eliminate or reduce its lethal effect. This is much like what Hungarian physician, Dr. Ignacz F. Semmelweis, the "savior of mothers" did it at the beginning of the 19th century with the childbed fever.

Childbed fever

From the time of Hippocrates, the childbed or puerperal fever was a terrible, lethal disease and a substantial unsolved problem in medicine. The puerperal fever was described in "Corpus Hippocraticum, the collection of Hippocrates' writings, about 2500 years ago. There was a detailed case-report from Thausus the Greek, about a woman, wife of Philinius, who developed a high fever after an uncomplicated birth. She produced all the symptoms of sepsis, such as high fever, pelvic pain, shivers, described it as "De Muliereum Morbis." A new life was born, but the mother had to sacrifice her life in return. To find the unknown cause of this fatal disease was one of the leading academic and clinical research topics over many centuries. A lot of ridiculous hypotheses were born about the assumed reason without leading

to a treatment until, in 1847, Semmelweis, a Hungarian obstetrician working in Vienna, identified that the incidence of childbed fever – and generally infections in hospitals and clinics – could be drastically cut by hand disinfection.

Semmelweis' observation and his solution to the problem

Dr. Ignác Fülöp Semmelweis (1818-1865) was a foreign resident appointed at the First Clinic in the Department of Gynecology at the Vienna General Hospital (Wiener Allgemeine Krankenhaus) as the assistant¹ to Professor Johann Klein on July 1, 1846, in the capital of the Austrian-Hungarian Monarchy. His duties were to examine patients each morning in preparation for the professor's rounds, supervise difficult deliveries, teach obstetrics students, and be "clerk" of records. He soon realized that the mortality rate in one of the clinics was higher than the mortality rate, another run by midwives. While studying wound injuries, he observed a connection between lethal infections and childbirth deaths, when his best friend and pathologist colleague, Dr. Jakob Kolletschka, injured his finger during an autopsy, then developed sepsis and sadly died. Semmelweis recognized the similarity between these septic symptoms and the deaths of mothers in puerperal fever and set out to search for the real cause.

He collected medical histories of patients and compared the practice and high mortality at the First Clinic with those of the lower mortality at the Second Clinic, then analyzed facts accurately, honestly, and in detail. Semmelweis followed common sense and pure logic; systematically, he step-by-step eliminated the differences between the two clinics, until only one confounder was left: the medical staff. As it turned out, the leading cause of deadly infections were the physicians themselves and their medical team, who often performed autopsies. Semmelweis then introduced a simple preventive treatment, washing hands with calcium hypochlorite solution before all manual examination of all women who were pregnant, during labor, in delivery, and

¹ A comparable position today in a United States hospital would be "chief resident."

childbed and the mortality rate soon dropped dramatically.[6].

Ignacz chose an unusual method to share his lifesaving procedure—he had pamphlets printed and letters sent to his high-ranking colleagues in Europe and around the world (Fig. 1). In

these messages, he described and recommended, and argued for his method that significantly decreased mortality rate of the childbed fever from between 12% and 32% at the Klein Clinics, to 1.8% after introducing his practice there.

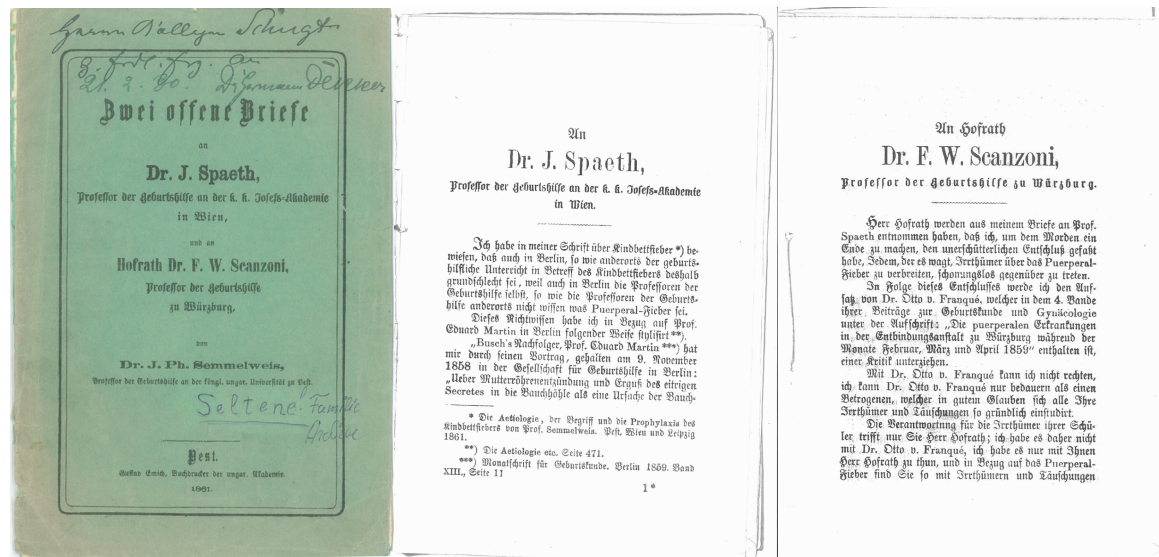


FIGURE 1: (a) cover page of one of the original brochures containing open letters sent to (b) Dr. Spaeth in Wien and (c) Hofrat (Royal Counsel) Dr. Scanzoni, in Würzburg, describing Semmelweis' method, results, and arguments. Both of these professors were rejecting his "Thesis." (From the Semmelweis Family archive). [6]

Unfortunately, both the idea and the practice presented by Semmelweis faced a severe problem: his peers' acceptance. First of all, his conclusions were way ahead of the accepted medical principles and conflicted with the established scientific and medical opinions of the time, according to which a surgeon was not required to wash his hands before seeing a patient². Second, he was Hungarian; and 1847 was not a great time to be a Hungarian in Vienna because the Emperor, Ferdinand I., was facing a simmering social crisis, which next year culminated in a revolution and the Hungarian 1948-49 War of Independence. Thirdly, he was a subordinate MD at the beginning of his career, viewed as only a "foreign assistant" to Dr. Klein, who was trying to tell all professors how to do their work. The question then was how to break through that highly narcissistic, feudal "Medical Wall," manned by favorably positioned conservative representatives of the medical society. The

bitter, unprofessional resistance of the feudal medical aristocracy against his thesis was massive, even though the clinical results spoke for themselves. A powerful 'brick' in this wall was Dr. Virchow, chairman of pathology in the famous Charité Hospital in Berlin, who was also the chairman of medical affairs at the German Parliament, and who bitterly attacked Semmelweis (and later Robert Koch as well [7]). However, the primary opponent was his own chairman at the 1st Gynecology Department at the University of Vienna [6]. Many other doctors also profoundly disagreed with his suggestion and practice [8] despite the clear communications of his results, significantly reducing mortality occasionally below 1%. Because of his aggressive, argumentative style, Semmelweis was called crazy, harassed in Vienna, and finally dismissed from the hospital for political reasons in 1849.

² Facilities for washing hands or a patient's wounds weren't even available in hospital wards at that time.

After studying botany for a year in Italy, he moved to Pest, where he took an unpaid position as head-physician at the Szent Rókus Hospital. After taking over the obstetric ward, Semmelweis demanded strict cleanliness and discipline from everybody (Fig. 2) and virtually eliminated childbed fever there. Between 1851–1855, only eight patients out of 933 births died from the disease (0.85%). In 1855 he was appointed the Professor of the theoretical and practical Gynecology at the University in Pest.

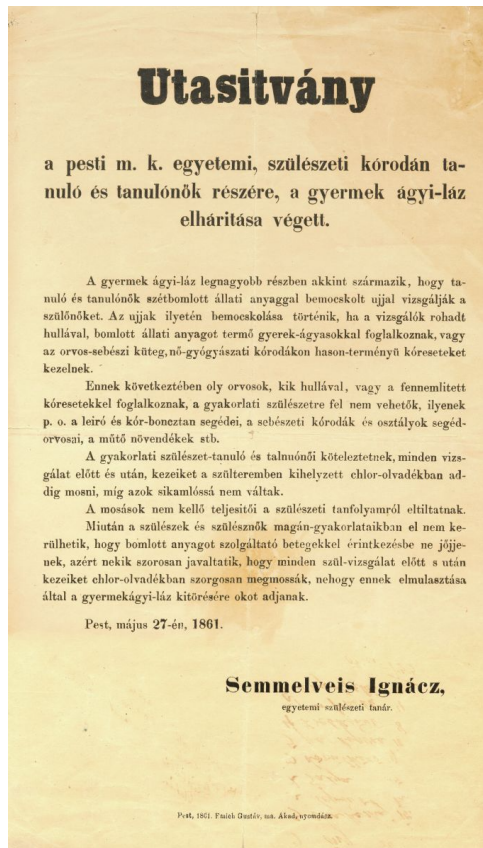


Figure 2: Semmelweis' directive to medical students studying at the obstetric ward stated that those who do not wash their hands carefully would be removed from the clinic. (in Hungarian)

Finally, in 1861, he published a book (Fig. 3.) summarizing his findings³.^[9] His thesis was that “all cases of puerperal fever were caused by the resorption of decaying animal-organic matter” and highly recommended his book to all medical professionals, including the Hungarian Academy of Sciences (Fig. 4).

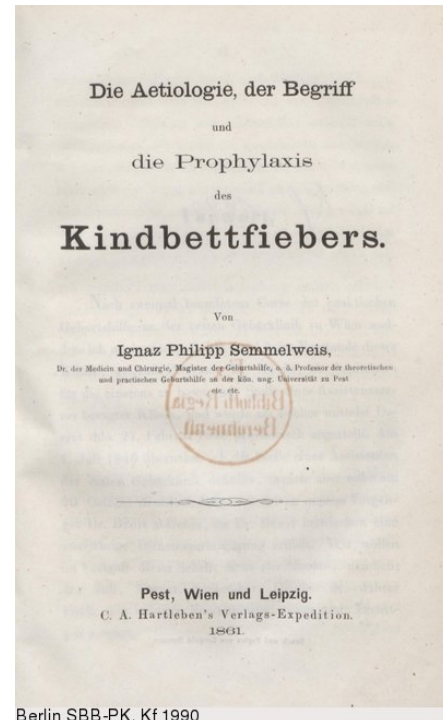


Figure 3: Original cover of Semmelweis' book. In English: Etiology, Concept, and Prophylaxis of Childbed Fever.

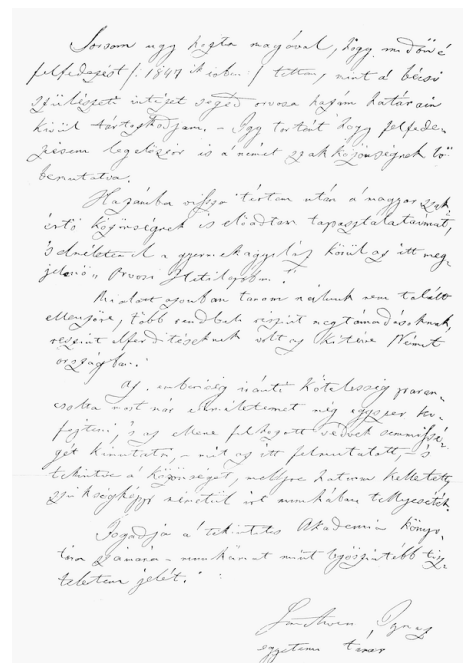


Figure 4: Semmelweis' handwritten letter, recommending his book to the Hungarian Academy of Science.

³ At that time, German medicine was in a leading position worldwide; this way his results could be read by the entire medical world.

The death of Semmelweis

Prof. Dr. med. Ignác Fülöp Semmelweis died at the age of 47 in Vienna under dubious circumstances. Dr. Silló Seidl György⁴, a well-known and highly qualified gynecologist in Germany, has successfully obtained copies of the original medical charts from Vienna more than 100 years after his death [10]. As the tragic documents and medical charts show, in 1865, Semmelweis was invited by his former university professor to come to Vienna for a medical consultation of a patient at the Psychiatry Department [1]. The invitation turned out to be a nasty trap: after he arrived, he was locked up in the closed section of the department. Documents from the Psychiatry Department of Vienna [10] show that “Professor Semmelweis was not mentally ill but the victim of a false and incorrect diagnosis.”⁵ Only 14 days after he was committed, he died of iatrogenic sepsis from his severely inflamed and suppurated wounds after having been beaten by male nurses when he tried to escape. The charts and medical reports stated that he also had several rib fractures with pneumothorax on the right side, and other fractures of his humerus and scapula as well.

Ironically, the father of antisepsis and the pioneer of hygiene, in a cruel twist of fate, died from the same disease that he helped define and successfully prevent.

Semmelweis’ thesis and practice initiated a worldwide discussion resulting in fierce resistance from some but saved many lives over time.

No success without funding and support

Let’s compare Semmelweis’ life and fate to another genius, Robert Koch, who just graduated from high school in 1866, and became one of the principal founders of modern bacteriology.

From 1885 to 1890, Robert Koch served as an administrator and professor at Berlin University. [7]. One day, Kaiser Wilhelm II.

paid him a visit incognito and was impressed by the shy gentleman. After that visit, the German Emperor took care of Robert Koch himself. The Kaiser established and had the Prussian Institute for Infectious Diseases be built in Berlin. In 1891, Koch relinquished his professorship and became a director of the institute, which later was named after him.

The support of the Kaiser made Robert Koch untouchable from the attacks of conservatives [7] and guaranteed Koch’s independence. As a result, this genius made fundamental discoveries in public health: he identified the specific causative agents of tuberculosis, cholera, and anthrax, created and improved laboratory technologies and techniques in the field of microbiology, etc. The authentic and published story of Kaiser Wilhelm II supporting the science of the future [11], is an excellent example to follow for all current powers today.

Both of these geniuses saved millions of lives, but one of them was declared to be crazy while the other one was celebrated and received the Nobel Prize in 1905.

Accomplishments

In the history of medicine, Semmelweis emerged as the discoverer of an entirely new scientific concept at that time that diseases have definite, specific causes [12]. Semmelweis’ practice earned widespread acceptance only many years after his death,⁶ His ‘Thesis’ [9], born long before antibiotics, was proven unequivocally only 20 years later by the bacteriologists of the 1870s and 80s, when Louis Pasteur confirmed the germ theory and identified that infections by *Staphylococcus* spp. and *Streptococcus pneumoniae* were the cause of those deaths, which Semmelweis observed and later prevented.

The hygiene of the surgeon is the first requisite of an aseptic procedure. The second condition, the hygiene of medical tools, was

⁴ , Silló Seidl György was born in Budapest in 1925 and was working as the Chairman for the combined Endocrinology-Gynecology Department in Feldafing, then in Frankfurt-am Maine, Germany.

⁵ Semmelweis was declared disoriented and to have the 4th grade of Syphilis –The Tabes Dorsalis.

⁶ Despite the work of Ignaz Semmelweis, a surgeon was not required to wash his hands before seeing a patient.

established later by Sir Joseph Lister, a British surgeon and the second pioneer of antiseptic surgery, who practiced hygienic methods and used phenol treated tools, and who operated with great success and low mortality. Other improvements, such as providing surgeons with rubber gloves and aseptic operating rooms, followed later [13].

Significance

Dr. Semmelweis had the rare ability to think clearly and objectively, understood the logic, structure, correlations of facts, and their connections to laws of Nature. He did not think about himself – he cared about the life of the mothers, despite every attack. His simple method effectively prevented peri-operative infections, which is an essential factor in all kinds of operative treatments, even today. Handwashing emphasized by Dr. Semmelweis is still a critical World Health Organization patient safety initiative.

His thesis and the precautionary solution he developed against childbed fever formed the basis not only for the treatment of puerperal fever, but prevented pre-, and postprocedural inflammations in all other medical procedures. Dr. Ignác Fülöp Semmelweis was the first who developed a successful, prevention-based system against sepsis and became the father of antiseptic treatments. He unintentionally established a new discipline in medicine: – Hygiene. Lister himself had stated: [12] “*Semmelweis is the Father of the antiseptic birth.*” By understanding Nature, he formulated an essential and extremely apt advice in three simple words, which the whole world had to learn again during our current viral pandemic:

“WASH YOUR HANDS!”

Since then, millions of human lives were saved by this simple and brilliant advice. He is now widely considered a pioneer of aseptic treatments because these three words constituted a highly significant step toward hygiene both on the ward and in the world. The practice resulted in an enormous success in gynecology, and it represented a paradigm shift, which influenced the developments of several other new medical disciplines (Microbiology, Immunology, etc.). It was also an essential and fundamental step toward higher living standards and a healthier human society

The heritage

Today, a collection of I. F. Semmelweis’ printed materials on his discovery and elaborating aseptic prevention was registered in the UNESCO Memory of the World Heritage in 2013. There is a world-renown medical university named after him in Budapest, Hungary, and several clinics and hospitals in Europe (included one in Vienna); his portrait is cast on memorial postal stamps in Hungary, Germany, Austria, etc., while his opponents and their arguments are largely forgotten. The handwashing emphasized by Dr. Semmelweis is still a critical World Health Organization patient safety initiative [14].

From the appreciative generations that followed, Prof. Semmelweis earned a title, which sounds as good as any Nobel Prize: “the savior of mothers.” Nevertheless, this phrase also means that he has been “the savior of newborns lives,” and consequently, “savior of many families.” The importance of a mother for a family and a healthy and prosperous human society does not need an explanation. The death of a mother is detrimental to any family.

Yes, he was a difficult person and not a great communicator. But please, tell me: what should a doctor do, who takes his Hippocratic oath seriously to save human life and cause no harm? This was a doctor who had proven that many lives could be saved by a simple procedure, and who was not only not listened to, but whose successful practice was rejected by those doing harm, who neither wanted to admit their mistake nor take responsibility for it.

First, in the history of medicine, Dr. Ignác Fülöp Semmelweis realized the “cause and effect” relation between injuries of extremities and the following symptoms of developing sepsis. Throughout his entire life, Semmelweis’ goal was to transform Symptom-Based Medicine and Symptom-Based Classifications to Cause-Based Medicine and “Cause-Based Treatment. This effort laid the foundation for today’s Evidence-Based Medicine, which is much more useful for human society than any symptom-based, long-lasting treatment.

The priority to save human lives and integrity correlates perfectly to our fundamental legal - civil, medical, and religious - laws. Almost all constitutions state in their first chapter the principle of protection of human life and its

priority. To be able to deliver on this premise, we better build and maintain a high tech-based - high standard health system before the next pandemic.

The Semmelweis syndrome

Today, there is a term in psychiatry: - “The Semmelweis Syndrome”⁷ [15-17], which has been described in different ways, such as, “Historic conflicts between science and entrenched power are often long, bitter and often tragic” [17], and:” you will be discriminated and probably be killed by the society if you can more or better understand the laws of Nature, for thinking differently, or looking through connections, correlations and its consequences forward to the future in a discipline” [18].

Those who are able to create paradigm-changing knowledge ahead of their time represent only a tiny minority of mankind. They look at the same things as everyone else but see it differently. As history shows, these individuals often suffer from discrimination and are criticized by the entire society until they

are accepted and acknowledged for their pioneering work later. These persons’ high mental ability can uncover and understand the structure and laws of Nature. Indeed, they have changed our lives and raised it to the next level; This includes people like Giordano Bruno, Galileo Galilei, Nicola Tesla, Lise Meitner, who discovered the nuclear fission, Rosalind Elsie Franklin, who found and first published the double helix of the DNA and died early of breast cancer. Let’s not forget that Einstein could not get into the academy, not even as an assistant professor, and was a third-grade patent agent when he published his theory of relativity⁸. Albert Einstein once said: “Great spirits have always encountered violent oppositions from mediocre minds.”

According to a recent scientific study [20], paradigm-changing discoveries have notoriously limited early impact precisely because the more a discovery deviates from the current paradigm, the longer it takes to be appreciated by the community. Acceptance of Semmelweis’ discovery took 20 years.

Conclusions

1. Every radically new scientific idea has its period of rejection, but to convince the established hierarchy is a challenge and requires practical communication skills, even for a genius.
2. Only knowledge and out-of-the-box thinking of creative human brains can move the human race forward and able to solve present and future problems.
3. Politics, Economics, and Science have to find a common platform to advance health and living standards. Without appropriate funding and support, no optimal solutions can be found.
4. Provide leading thinkers with the freedom of acting, and grant experts the power of driving the response to this and all epidemics. Sometimes simple actions can prevent many deaths.
5. The economy may collapse without human health. Investment in a high-quality and accessible healthcare system is way more cost-effective than suffering the consequences.

Finally, we are the creatures of Mother Nature, and we depend on Her. We must understand Her ways and respect Her laws to be able to sustain humankind. There is nothing good or bad⁹ in Nature – we assign these adjectives based on our experience, thoughts, and feelings. Today, in the era of an ongoing viral pandemic, Ignacz Semmelweis’ advice from the 19th century is as actual, as it has ever been before: KEEP YOUR MIND CLEAR, YOUR HANDS, AND SOUL CLEAN!

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Conflict of Interests

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⁷ Also known as Semmelweis effect.

⁸ The manuscript was not peer-reviewed – the editors took responsibility for the article.

⁹ “...there is nothing either good or bad but thinking makes it so.” Shakespeare, Hamlet, Act 2, Sc. 2.

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References

1. Benedek István:- Semmelweis és Kora -/Semmelweis and His Time /, Gondolat Kiadó, Budapest, Hungary, 1967; Benedek István:- Semmelweis -, Gondolat Kiadó, Budapest, Hungary, 1973; Benedek István : -Semmelweis -, Gondolat Kiadó, Budapest, Hungary, 1980
2. Miklós Kásler: Ignaz Semmelweis, the Saviour of Mothers, *Civic Review*, Vol. 14, Special Issue, 2018, 385-410, DOI: 10.24307/psz.2018.0425
3. Nicholas Kádár, MD, JD, LLM, Roberto Romero, MD, DMedSci, Zoltán Papp, MD, Ph.D., DSc, FACOG (Hon), FIAPM, Ignaz Semmelweis: “The Savior of Mothers” On the 200th Anniversary of the Birth, *Am J Obstet Gynecol.* 2018 December; 219(6): 519–522. doi:10.1016/j.ajog.2018.10.036.
4. Nicholas Kádár, MD, JD, LLM, Roberto Romero, MD, DMedSci., Zoltán Papp, MD, PhD, DSc, FACOG (Hon), FIAPM,*Ignaz Semmelweis: the “Savior of Mothers” 520 *American Journal of Obstetrics & Gynecology* DECEMBER 2018, <https://doi.org/10.1016/j.ajog.2018.10.036>]
5. 200 Years of Semmelweis, Ed: Rosivall L, Erdi Rózsa Nyomda, 2018 ISBN:979-963-331-439-5
6. Zwei offene Briefe an Dr. Spaeth, Professore der Geburtshilfe an der K.K. akademie in Wien, und an Hofrath Dr. F.W. Scanzoni, Professor der Geburtshilfe in Würzburg, von Dr. J. Ph. Semmelweis, Professor der Geburtshilfe an der königlichen Universität in Pest, Ausgeber: Gustav Smich-, Buchbruder der ungarische Akademie, 1861. /The property of the first author/.
7. Koch, Virchow and Tait, *JAMA.* 1890;XV(18):649-650. doi:10.1001/jama.1890.02410440021004, <https://jamanetwork.com/journals/jama/article-abstract/464770>
8. Friedrich Hoffman: Tödliche Welten, (Deadly Words), Verlag Herder GmbH, Freiburg, 2010)
9. I.P. Semmelweis, *Die Ätiologie, der Begriff und die Prophylaxe des Kindbettfiebers*, 1861, p.38) http://www.deutschestextarchiv.de/book/show/semmelweis_kindbettfieber_1861; <https://www.amazon.com/Die-Ätiologie-Begriff-Prophylaxe-Kindbettfiebers/dp/3226015788>; in English: Ignaz Semmelweis: The Etiology, Concept, and Prophylaxis of Childbed Fever, Madison and London, University of Wisconsin Press, 1983, (Ed: K.CODELL CARTER, translator and editor)
10. Silló Seidl György: Semmelweis Halála, (The Death of Semmelweis) - Metropolitan Verlag-Münchenstein and Frankfurt am Main, Germany, 1977; <https://www.antikvarium.hu/konyv/sillo-seidl-gyorgy-semmelweis-halala-356381>; Silló-Seidl G: Die Wahrheit über Semmelweis, Das Wirken das grossen Arzt-Forscher und sein tragischer Tod im Licht neu entdeckte Documente. Eine Biographie, Frankfurt a.M , Germany, 1984
11. Brock, Thomas. Robert Koch: A life in medicine and bacteriology. ASM Press: Washington DC, 1999.
12. Száva István: Egyedül a Halál Ellen,-Semmelweis Ignác Élete-,(Alone Against Death, The Life of Semmelweis), - Móra Ferenc Kiadó, Budapest, Hungary, 1963
13. Sara Gaines, James N. Luo, Jack Gilbert, Olga Zaborina, and John C. Alverdy, Optimum Operating Room Environment for the Prevention of Surgical Site Infections, *Surg Infect (Larchmt).* 2017 May 1; 18(4): 503–507, Published online 2017 May 1.,doi: 10.1089/sur.2017.020
14. Girish P. Joshi, Global Perioperative Patient Care Through Clinical Pathways, *ASA News*, August 2010 n Volume 74 n Number 8, p11-12
15. Sándor Kálman: The possibilities of suicide prevention in adolescents. A holistic approach to protective and risk factors (role of Semmelweis Syndrome), *Neuropsychopharmacologia Hungarica* 2013. XV. évf. 1. Szám, 27-35;
16. Paul E Wischmeyer, MD, Optimizing Care of the High-Risk Surgical Patient: Is Your Practice State of the Art or Do You Suffer From Semmelweis Syndrome? *ASA Monitor* 08 2010, Vol.74, 14-16;
17. Harry Fuller, Semmelweis Syndrome: good science, bad science and global feuding, <https://www.zdnet.com/article/semmelweis-syndrome-good-science-bad-science-and-global-feuding/0>)
18. Nasser Pouyan, Semmelweis, the Savior of Mothers and an Early Pioneer of Antiseptic, *American Journal of Medicine and Medical Sciences*, 2165-9036, 2014; 4(6): 256-261
19. Digital Einstein Papers: The Collected Papers of Albert Einstein, <https://einsteinpapers.press.princeton.edu/>
20. Dashun Wang, Chaoming Song, Albert-László Barabási, Quantifying Long-Term Scientific Impact, *Science* Vol 342 October 4, 2013, 127-132; www.sciencemag.org