

The Story of the Discovery of Contact Infection by Semmelweis

Texts from scientific journals or historical documents are often difficult to read. If these texts are of value for students, teachers can support students in their reading. Reading aloud around a class, gives opportunity to stop and discuss any difficult points or vocabulary. Providing a glossary, or pointing out difficult passages beforehand can help. You could ask students to highlight tricky passages as they read to ask about later. It may be worth pointing out that it is not necessary to understand every word in order to extract useful meaning from a text.

Answers to questions on the text:

- 1 He showed real emotional concern for the suffering which motivated him.
He had a questioning mind which refused to accept existing explanations.
He was willing to work really hard.
He was constantly thinking about the problem and trying different hypotheses.
He made extensive observations and was aware of all the symptoms.
He was able to use his knowledge to make imaginative leaps.
- 2 (a) The women in the two wards were similar socially and they were in the same physical environment so these could be eliminated as an explanation for the difference in death rate.

(b) He got women to give birth on their side.
He touched them gently like midwives do.
He tried to reduce fear by stopping the priest ringing his bell.

(c) Semmelweis's theory was based on data from large numbers of deliveries over a long period of time. He also noted a replication of the effect at other institutions where he introduced hygiene and contamination in the different circumstances of surgery and accidents during dissection.
- 3 By seeing the correlation between dead bodies and infection he was able to imagine the existence of an invisible 'cadaverous substance' which could be transmitted from one person to another. He thought through the implications of this and how to prevent transmission.
- 4 (a) If richer, more influential families were affected, there may have been more political pressure for wider research into the causes of puerperal fever. It may be useful to discuss the parallel with diseases mainly affecting developing countries today.

(b) Semmelweis was young and relatively inexperienced.
Klein was well connected.
Virchow had made very important contributions to science and was well respected therefore his view was more highly regarded despite Semmelweis's strong evidence.

(c) It is always difficult to overthrow accepted theories, scientists are reluctant to reject the ideas they have worked with all their lives.
The 'cadaverous substance' could not be seen.

References

Textbook
Chapter 1

Specification
9.1 Infectious diseases

12.1 d-i
12.2 a-c

Directed activities related to text

Passive reading techniques such as copying text from the board rarely involve deciphering and comprehension of the text. There are many ways that reading text can be made into a more active process.

Making notes from a chapter can be made more active by providing particular headings to structure the notes. Even better, students can be asked to summarise ideas in the text, or present ideas in an alternative form such as a flow chart, table or mind map.

Students could be asked to devise questions they have on the text. This will help identify problem areas. As a group activity, students could swap questions, and discuss the answers. They could also attempt to answer each other's questions and hand them back for 'marking'.

Active engagement with texts is needed when students are asked to seek information for a task such as researching for a presentation, or making an information leaflet or poster.

Questions relating to a text can be provided to create a comprehension exercise. Questions can be carefully worded to discourage copying of passages from the text, and encourage re-writing or interpretation of the text. It can be useful to highlight passages which answer questions or provide information for an explanation.

The Story of the Discovery of Contact Infection by Semmelweis

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Today, more than half a century later, no one would deny Semmelweis the credit for being the first to recognize the nature of 'contact infection' and to find, pragmatically, a way to overcome it. Yet the story of his discovery is full of both poignancy and tragedy.

The twenty-eight year old Hungarian Ignaz Philipp Semmelweis, who became assistant at the First Obstetrical Clinic in Vienna in February 1846, had not previously practised obstetrics. He did not suspect that he was about to enter upon the great task, and the great tragedy, of his life. He had been merely looking for a position, and had taken this assistantship because chance offered it. At bottom it was owing to chance that he had become a doctor at all.

Semmelweis had been a law student. Chance led him to drop into the squat, ground-level building called 'the Blockhouse' which in those days served as the morgue for the Vienna General Hospital. There Semmelweis watched a dissection by Professor Karl Rokitansky, who had made it his aim to create a new branch of medicine, 'pathological anatomy', the anatomy of the sick body and its diseased organs. Reports on autopsies performed now and again by doctors with intent to discover the causes of death in patients existed by the thousands – but no one hitherto had attempted to build up a systematic picture of the sick organism, based upon tens of thousands of autopsies.

Semmelweis's chance visit to Rokitansky's modest 'laboratory' made so deep an impression upon him that he transferred from law to medicine, with emphasis on anatomy. His first job was as assistant in Vienna's First Obstetrical clinic.

When Semmelweis began his work, puerperal fever was, in his mind, no more than medical concept, an unfortunate but not always avoidable consequence of childbirth. The obstetrical science of the day knew no more about the cause of childbed fever than it did about the origin of surgical wound fevers. This acceptance of childbed fever as a thing inexorably fated was an attitude that Semmelweis had naturally absorbed from his teachers – until he himself came face to face with it.

The lying-in section of Vienna General Hospital was a breeding place of puerperal fever during the eighteen-forties. In the month in which Semmelweis assumed his duties, no less than 36 of 208 mothers died in his wards. The majority of the maternity patients were 'poor cases', many of whom had become mothers without the 'blessing of the church'. In those days self-respecting women had their confinements at home. The director of the clinic, Professor Klein, was inured and indifferent to childbed fever. In the considered opinion of Professor Johann Boer, the foremost obstetrician of the day, Klein was 'the most incompetent of incompetents', a man without imagination who owed his high post to favouritism at Court.

A few months after Semmelweis began work at the clinic, Professor Klein noticed that the fate of the mothers dying of puerperal fever, the sight of mourning husbands and lovers, and the cries of motherless children were beginning to work on the feelings of his new assistant, who was evidently over-sensitive. Semmelweis was manifesting a foolish concern with the causes of childbed fever. He was poring over all available books, and even troubling Klein himself with his questions. A spirit of restiveness which Klein found greatly perturbing emanated from this assistant. Semmelweis refused to be content with existing scientific explanations. He refused to believe in the inevitability of the disease, and expressed doubts about its epidemic character. He dared to challenge the existing theories, which for a man like Klein were beyond question.

The obstetrical section of the Vienna General Hospital was organized in two subdivisions. The first division, where Semmelweis worked, was used for training medical students in obstetrics. The second division was not visited by students. Here midwives were trained. Semmelweis found that the first division lost more than 10 per cent of its patients from childbed fever, whereas the second division regularly had less than 1 per cent of victims of the dreaded disease. The two divisions were side by side in the same building. If childbed fever were a genuine

epidemic disease, Semmelweis argued, the number of cases should be equal in both divisions. The divergence seemed inexplicable. But when he came to Klein with such arguments, the chief merely shrugged.

Semmelweis drove himself to find the explanation. Again and again he and his students went to the morgue and dissected the bodies of the women who had died. The clinical picture was always the same: suppuration and inflammation in almost all parts of the body, not only in the uterus but also in the liver, the spleen, the lymph glands, the peritoneum, the kidneys, the meninges. There was a striking resemblance to the clinical picture of the various diseases lumped together under the title of 'surgical fever' or wound fever'. But Semmelweis did not yet observe the relationship. For the present he was following in Rokitansky's footsteps, trying to determine the pathological anatomy of the disease. After completing their dissections, he and his students went into the wards. They carefully examined the women who were about to be delivered, or who were in labour, or who had already been delivered. He taught his students, to whose hands the sweetish odour of the morgue still clung, the usual examination methods of the time. Driven by his tormenting urge to understand, he conducted these examinations more intensively than was customary.

The result of his zeal, however, was not better understanding of the disease. Instead, the number of sick and dying women suddenly increased – and did so only in his first division, where Death already seemed to have taken up a preferred station. The death toll in his division became an object of terror for all those women who had no homes where they could undergo their confinements and spend the week after birth. They desperately sought to escape being sent into this notorious first division.

The two maternity divisions accepted their patients on a rigid schedule – the first division on Sunday, the second on Monday, the first again on Tuesday, and so on. Frightened women would give birth in some doorway because they had waited too long and could not make the Mondays, Wednesdays, or Fridays when the doors of the second division were opened. On the other hand, those who were brought against their will, in the midst of labour, into Semmelweis's division, fought, kicked, and begged to be released for one more day, until the second division was open to them. How could a person of any intelligence go on thinking that the 'atmospheric, cosmic, tellurian influences', which science cited as the causes of puerperal fever, could operate only on Sundays, Tuesdays, Thursdays, and Saturdays?

Under the impress of these experiences, Semmelweis's whole personality changed. He became a demon for work. Night after night, with mounting agony of mind, he threshed over the problem with his colleagues.

By the end of 1846 the mortality in his division had reached 11.4 per cent; in the second division it amounted to only 0.9 per cent. Semmelweis drew up countless comparisons. The women in both divisions came from the same segment of the population. In both parts of the hospital, the physical conditions were the same; in fact, conditions were worse in the second division, since it was always overcrowded. The obstetrical techniques were identical. Semmelweis had his patients adopt a sideways position during the birth process, since this was customary in the second division. The number of deaths did not diminish. In his examinations Semmelweis practised the greatest possible gentleness, because someone suggested that the women's hands of the midwives in the second division were gentler than the hands of the male students in the first division. Since all the textbooks also mentioned fear as one of the causes of childbed fever, and since the priest was always passing through five wards of women with his bell, in order to reach the room where the moribund were isolated, Semmelweis requested the priest not to ring his bell as he came through. Still not one woman the less died. Semmelweis determined that those women whose confinements took an unusually long time were attacked by the fever almost without exception. He racked his brains to find an explanation. But in vain.

By the spring of 1847, Semmelweis' colleague Kolletschka feared Semmelweis would suffer a nervous breakdown as a result of his obsession. Semmelweis was sent off on a three week holiday. On his return to the morgue, he asked an attendant why Kolletschka was not at his normal position in the dissecting room.

The attendant looked at him aghast for a moment. Then he exclaimed: "Why, Doctor, don't you know?"

"Know what?" Semmelweis asked impatiently, stirred by a vague sense of anxiety.

"Professor Kolletschka is dead," the attendant replied.

Semmelweis could not believe it at first. Then he hurried to Rokitansky. There he learned the full story. In the course

of an autopsy a clumsy student had nicked Kolletschka's arm with his scalpel. It was only a tiny cut, and Kolletschka paid no attention to it. But the following night he was attacked by chills and fever. A few days later, after delirious ravings, he died.

Semmelweis asked for the report on the autopsy which had been performed on Kolletschka's body. As he read this report, he felt altogether stunned. The symptoms listed were: suppuration and inflammation of the lymph glands, the veins, the pleura, the peritoneum, the pericardium, the meninges! He felt as if he were reading, not the autopsy on his deceased friend, but one among hundreds of reports which he himself had written on mothers who had died of puerperal fever while under his care. The symptoms were much the same.

If the autopsies revealed the same symptoms, he asked himself, then were not the causes of the death of Kolletschka and for the deaths of his puerperal fever victims exactly the same? Kolletschka had died because the knife had introduced poisonous traces of cadaverous substance into a wound. Had he, Semmelweis, and his students, with their own hands introduced similar material into the genital canals of his patients when they proceeded from their work in the dissecting room to examination of the maternity cases? That question pursued Semmelweis day and night thereafter. His mind shaken, but with the logic of genius, he built up a whole structure of terrifying assumptions. If his idea were right, the differences between the death-rate in the first and second maternity divisions would be explained. For no doctors or students worked in the second division, only midwives who did not dissect cadavers before they examined the patients.

Agonized, Semmelweis arrived at the conclusion that the number of deaths from childbed fever in his division had increased so frightfully precisely because he had spent so many hours, day after day, in the dissecting room, in the made hope that he could track down the anatomical causes of the fever. He suddenly saw why the women whose labour was slow were most prone to the disease. They were more frequently examined than those who were delivered quickly.

On May 15th, on his own responsibility and without consulting Klein, Semmelweis posted a notice on the door of his clinic. It read: "As of today, May 15th, 1847, every doctor or student who comes from the dissecting room is required, before entering the maternity wards, to wash his hands thoroughly in a basin of chlorine water which is being placed at the entrance. This order applies to all, without exception. I.P. Semmelweis."

Semmelweis had no idea that micro-organisms were the agents of childbed fever and all other surgical fevers. That discovery was still thirty years in the future; But he had penetrated the secret of disease transmission via the hands and instruments of doctors; he had hit upon the concept that, thirty years later, would form the basis of aseptic procedures. On May 15th he began the crusade of his life.

In May, 1847, 12-34 per cent of some 300 patients had died. During the next several months there were only 56 fatalities in 1841 deliveries – a precipitous drop to 3.04 per cent. This percentage still exceeded the approximately 1 per cent of deaths in the second division. But never before had so low a mortality been achieved in the first division.

Semmelweis was already beginning to believe himself on the verge of success. Then, on October 2nd, 1847, came the worst blow of all. That morning, when he entered a ward with twelve maternity cases, he found all twelve down with puerperal fever – in spite of all the washings, in spite of the checks, in spite of the absolute certainty that no one had left the dissection room and entered this ward with unwashed hands.

When Semmelweis straightened up from the bed of the twelfth patient, he had recovered sufficiently from the smashing disappointment to meet the eyes of the students who were waiting behind him with ill-concealed triumph on their faces triumph because here at last was 'proof of the senselessness of his fanatical cleanliness'. Within a few days no less than nine of these women died.

But Semmelweis did not give up. He pondered all the possibilities, became stricter and more tyrannical about washing than before – and he found the solution. In the first bed of this particular ward lay a woman with an infected uterine carcinoma. Semmelweis and his students had cleansed their hands before entering the room, but one after another they had examined the cancerous patient and then the other patients, without washing afresh between each examination.

Semmelweis had made his second great discovery. Infectious materials could be carried not only from the dead to the living, but also from the diseased or purulent process of living patients to healthy persons.

He promptly instituted a new phase of his programme. He ordered the most stringent washing of hands before every examination. He supervised the cleaning of all instruments – which he, like every doctor in the world, had previously wiped off on his coat-tails. He had sick maternity cases with inflamed or discharging processes placed in isolation rooms.

In the course of the next six wearisome years Semmelweis struggled to put forward his theory on transmission of infection to the scientific community with little success. In this time he had so far reduced the mortality in his new position at a Hospital in Budapest, that in the last year only 8 out of 933 women died of childbed fever. This was less than 1 per cent.

Several times setbacks led him to new discoveries. A sudden incidence of the disease taught him that unclean bed linen could also transmit infectious materials. His eye happening to fall upon a bed made up for a new arrival, he saw that the sheets were stained with the purulent discharges from a woman who had died. He fought a furious battle with the hospital administration for proper laundering of the line. And finally he won when, ranging with indignation, he stormed into the office of the administrative director and tossed the repulsive sheets on his desk.

By 1860, Semmelweis's desire to communicate had grown so compelling that for the first time in his life he voluntarily took up the pen. Aided by his old friend Markusowsky, who had been with him when he first made his discovery in Vienna, he wrote a book: *The Etiology, The Concept, and the Prophylaxis of Puerperal Fever*.

It was a small essay, really, badly written and full of repetitions. Nevertheless, it remains one of the most moving books ever written by a doctor. It stated the simple truth against a world that persisted in error. It was a book of prophecy, and it was published at a time when Semmelweis himself was beginning to suspect that the importance for his discovery went beyond the struggle against childbed fever, that it could be applied also to combat the closely related surgical fever in the infection-ridden operating rooms and surgical wards of the world. Semmelweis had just succeeded in persuading the chief surgeon in Budapest to prevent sepsis by rigorously cleaning hands and instruments.

But was there anyone prepared to read Semmelweis's book with an open mind, and adopt his doctrines? Once again he was to be terribly disillusioned.

At the Thirty-sixth Congress of German Scientists and Physicians in 1861 only one doctor, Professor Lange of Heidelberg, defended Semmelweis's idea. This medical man stated that he had followed Semmelweis's method and had had only one case of puerperal fever out of three hundred deliveries. But this was a voice crying in the wilderness. Never again was the arrogance, narrow-mindedness, and rigidity of the acknowledged 'gods of medicine' to prove so fatal to the progress of medicine as it was during that conference. Virchow, who had discovered the importance of the cell, and who now thought only in terms of cells, condemned Semmelweis because his doctrine did not fit in with Virchow's own, according to which every disease developed independently in the cells of the human body. But to Virchow's worshippers his word was the word of a god. No one took heed of Semmelweis.

His outcry took the form of open letters addressed to Drs Scanzoni, Siebold, and Spathe – men who were among the foremost obstetricians in Europe. He outlined his theory, stating that "to differ from me on this is equivalent of being a murderer...." Even these outcries from Budapest died away without reverberation. Instead, they led to the professors dismissing Semmelweis as a person who by his own 'lack of moderation' was cutting himself off from the medical profession. As a man, in fact, who must be considered insane.

Nevertheless, Fate which had so abused him at least granted him a fitting death. He lost his life even as his friend Kolletshka had, as had innumerable women in childbed, and as countless victims of surgical operations were doing at the moment and would in the years to come. During one of his last deliveries or dissections at Budapest, Semmelweis had cut his finger slightly. Through this wound entered the very disease which he had devoted the major part of his career to fighting: general sepsis. He died on August 14th, 1865, barely forty seven, after prolonged delirium. The autopsy revealed the same clinical picture that he himself had seen so often: inflammation and suppuration throughout the body.

The man who was the first to grasp the nature of sepsis and asepsis, who laid the foundations on which the future of surgery would have to built, had died of septicaemia.

Questions on the text:

- 1 What do you think it was about Semmelweis and the way he worked that enabled him to develop the theory of contact infection whilst others working in the same wards and seeing the same disease did not learn anything about the causes of puerperal fever?
- 2 (a) Why was the existence of a control group, the second division, important in helping Semmelweis develop his theory and in disproving other possible explanations such as ‘atmospheric influences’?

(b) Semmelweis studied several variables which he thought might account for the difference in the two group’s mortality. What variables did he change so that they were the same in both groups?

(c) How were Semmelweis’s findings replicated?
- 3 What role did ‘conjecture and creative imagination’ play in his discovery, particularly after Kolletscha’s death?
- 4 Semmelweis had great difficulty in getting his theory accepted.
(a) Explain how this could be partly explained by the fact that only poor women gave birth in hospital in the 19th century?

(b) How important were the social standing and reputation of the different scientists involved in preventing acceptance.

(c) What other factors might have also played a part?
- 5 Explain Semmelweis’s observations in terms of the now accepted ‘germ theory of disease’