Polish Annals of Medicine

Journal homepage: https://www.paom.pl

Review Paper

Pioneer of epidemiology and anesthesiology – John Snow (1813–1858)

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Article info

Article history
Received: March 27, 2024
Accepted: September 21, 2024
Available online: October 11, 2024

Keywords
History
Epidemiology
Cholera
Obstetric anaesthesia
Volatile anesthetics
John Snow

Doi
https://doi.org/10.29089/paom/193593

Abstract

Introduction: John Snow, a British physician of the 19th century, played a pivotal role in challenging prevailing medical beliefs during his time. His groundbreaking studies on the cholera epidemic led to the rejection of the miasma theory and the establishment of the link between contaminated water and the spread of the disease.

Aim: This study aims to explore the contributions of John Snow to the fields of anaesthesiology and epidemiology, focusing on his significant findings and methodologies.

Material and methods: This study utilizes a literature review approach to examine John Snow's contributions to anaesthesiology and epidemiology. Searches were conducted in databases using relevant keywords, focusing on peer-reviewed articles and authoritative sources. The data was qualitatively synthesized to extract key insights into Snow's methodologies and findings, aiming to provide a brief overview of his impact on medical science.

Results and discussion: John Snow (1813-1858) is celebrated as a pioneer in epidemiology and anaesthesiology. He identified contaminated water as the source of the 1854 cholera outbreak in London, establishing the basis for modern epidemiology. Snow's innovative mapping of cholera cases was crucial in controlling the epidemic. He also advanced anaesthetic techniques, notably using chloroform on Queen Victoria during childbirth, improving the safety of anaesthesia. His work remains influential in both fields.

Conclusions: John Snow's pioneering work significantly impacted the development of anaesthesiology and epidemiology. His insights into cholera transmission and anaesthetic agents, along with his seminal publication *On Chloroform and Other Anaesthetic*, continue to inspire advancements in medical science. Snow's legacy underscores the importance of evidence-based medicine and the pursuit of knowledge in addressing public health challenges.

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1. INTRODUCTION

John Snow, a prominent British physician of the 19th century, emerged as a transformative figure in the field of medicine through his pioneering research and innovative approaches. Amidst the backdrop of prevailing medical beliefs of his time, Snow's groundbreaking studies on the cholera epidemic sparked a paradigm shift in understanding disease transmission and paved the way for modern epidemiology.

At a time when the miasma theory, attributing diseases to 'bad air,' prevailed, Snow's meticulous investigations challenged conventional wisdom. His seminal work during the 1854 cholera outbreak in London provided compelling evidence linking contaminated water sources to the spread of the disease. Through meticulous mapping and analysis, Snow demonstrated the clustering of cholera cases around specific water pumps, notably the Broad Street pump, thus refuting the prevailing miasma theory.[1,2]

Furthermore, Snow's groundbreaking conclusions were not merely confined to the identification of the source of the epidemic but extended to revolutionary insights into disease transmission. His publication *On the Mode of Communication of Cholera* presented compelling arguments against airborne transmission and emphasized the role of contaminated water as the primary mode of cholera dissemination. This seminal work challenged the entrenched beliefs of the medical community and laid the foundation for modern epidemiological practices.[3]

In the face of skepticism and opposition, John Snow's unwavering commitment to scientific inquiry and evidence-based medicine propelled him into the forefront of medical innovation. His contributions transcended the boundaries of his time, leaving an indelible mark on the field of medicine and inspiring generations of healthcare professionals to question assumptions, challenge prevailing theories, and pursue knowledge relentlessly.

2. AIM

The primary objective of this study is to analyze John Snow's pivotal contributions to both anaesthesiology and epidemiology. By examining his groundbreaking work, including the development of innovative methodologies such as mapping and experimental approaches, the study highlights the lasting impact of his findings on modern medical practice. Through a comparative analysis of Snow's seminal contributions to both fields, this research aims to showcase the enduring relevance of his work in shaping contemporary principles and practices in medical science.

3. MATERIAL AND METHODS

We conducted a literature review to explore John Snow's contributions to anaesthesiology and epidemiology. Searches were performed using databases such as PubMed and Google Scholar, focusing on keywords like 'John Snow,' 'anaesthesiology,' 'epidemiology,' and relevant historical terms. We prioritized peer-reviewed articles and authoritative sources, analyzing them to extract key insights into Snow's methodologies and significant findings. Through a qualitative synthesis of the literature, we aimed to provide a concise overview of Snow's impact on medical science.

4. RESULTS AND DISCUSSION

4.1. Life of John Snow

John Snow was born on March 15, 1813, into a family of a coal mine worker in the English town of York, in Yorkshire County. He began his medical studies at the age of 14 by apprenticing with surgeon William Hardcastle, and later continued his studies at the University of London, graduating in 1844. In 1850, he obtained the diploma of the Royal College of Physicians of London.[4] Throughout his professional career, he conducted groundbreaking research on cholera, which earned him widespread recognition as the father of modern epidemiology.[1] Among his most famous studies are those concerning the discovery of the source of the cholera epidemic – water pumps on Broad Street in London – which took place in 1854, and The Great Experiment, research comparing cases of waterborne cholera in two regions of the city, one receiving water contaminated with sewage, and the other relatively clean.[2] John Snow's innovative reasoning and approach to cholera control remain relevant and are considered exemplary for epidemiologists worldwide. In addition to epidemiology, John Snow also made significant contributions to the history of anaesthesiology. He dedicated himself to studying the use of ether and chloroform in general anaesthesia, and his reputation on this subject was so significant that he was asked to administer chloroform to Queen Victoria when she gave birth to Prince Leopold in 1853 and Princess Beatrice in 1857.[3] For this, he was knighted by the queen, and his coat of arms bore the motto 'Victo dolore' ('Victory over pain'). John Snow's achievements are considered remarkable, especially considering his humble origins and relatively early death. In the last years of his life, he struggled with tuberculosis and chronic kidney disease. He died at the age of 45 on June 16, 1858, and was buried in Brompton Cemetery in London.[5]

4.2. Father of epidemiology

John Snow, known as the father of epidemiology, gained fame for his research on the infectious disease cholera, caused by vibrio bacteria. They produce an enterotoxin that causes very severe diarrhea in humans. In typical cases of cholera, diarrhea begins suddenly. Within a day, the patient loses several liters of water with stools, which, along with the loss of bicarbonates and electrolytes, can lead to severe dehydration and, consequently, death.[6] John Snow wrote papers on the discovery of the source of the cholera epidemic in Soho, London, in 1854. At that time, the connection

between bacteria and diseases was not yet known, and the prevailing theory, the miasma theory, pointed to bad air as the cause of infectious diseases. However, John Snow was skeptical of the miasma theory and began his own research.[7] Along with Reverend Henry Whitehead, he traced and mapped all deaths caused by cholera in the area, drawing his later famous map where each death was represented as a line at an address. It became clear then that the deaths (with one significant exception) clustered around the water pump on Broad Street. The exception was the settlement around the brewery, inhabited by brewery workers who preferred to drink beer rather than water from the pump. Subsequent investigations revealed that the pump was installed directly on the remnants of a cesspit, in which, among other things, a used diaper of a child suffering from cholera was found. Not knowing the true nature of the contamination, John Snow concluded that it must be in the water from the pump. Despite protests, John Snow convinced the city council to close the pump, which ended the cholera epidemic. In 1849, during the epidemic, John Snow reached several groundbreaking conclusions about cholera. He inferred that cholera was likely not transmitted in the air through exhalations but through food and drinks. The severe diarrhea characteristic of cholera was probably a spreading factor. Contamination of wells and other water sources caused outbreaks. John Snow also believed that cholera was likely caused by a parasite or bacterium.[8] In 1849, John Snow independently published a brochure titled *On the Mode of Communication of Cholera*. It was 39 pages long and contained thorough arguments and evidence to support them. The work was not appreciated – most doctors rejected the arguments, disagreeing with the conclusions presented. Currently, thanks to the publication by University of California, the book has been made available online.[4,9]

4.3. Pioneer of anaesthesiology

In 1846, John Snow became interested in the method of using ether to alleviate pain during surgery, which was practiced in America. He soon mastered its use and in 1847 became an anesthesiologist at St. George's Hospital in London. Still, later that year, he began working with chloroform, whose anesthetic effect was discovered on November 4, 1847, by James Young Simpson.[10] In 1847, John Snow was the first to develop a five-stage classification of the depth of anesthesia, starting from mild consciousness disturbances, through stupor, loss of consciousness with no reaction of the conjunctiva to touch, respiratory disturbances, and pupil constriction, to respiratory arrest. John Snow's research goal was to find an anesthetic with properties similar to chloroform but with a lower risk of sudden cardiac arrest. Many of the tests using the tested anesthetics were conducted on himself.[11] In 1848, he investigated the cause of death of Hannah Greener, a 15-year-old girl anesthetized with chloroform applied to a handkerchief before surgery to remove a toenail. Cardiac arrest occurred during the procedure, and the patient died.[12] Deeming the dominant method of using a handkerchief as too primitive, he developed an apparatus that improved both the safety and efficacy of chloroform, taking into account temperature during its administration. John Snow frequently used chloroform in obstetric patients, reducing the risk by administering the anesthetic only in the second stage of labor and in a reduced dose. He thus achieved the second stage of anesthesia on the scale he developed. Women in labor were in a state of 'borderline consciousness loss;' however, most of them retained the ability to cooperate during childbirth. His famous success in administering chloroform to Queen Victoria during childbirth led to an unprecedented increase in social acceptance of inhalation anesthesia. John Snow extensively discussed his work with anesthetics. In the last days of his life, he managed to complete work on the groundbreaking book *On Chloroform and Other Anesthetics*, which was published shortly after his death in 1858. Meanwhile, in Poland, a publication by Professor of Obstetrics Józef Kwaśniewski was released. It described in Polish the three-year practice of using chloroform for obstetric procedures by John Snow.

5. CONCLUSIONS

(1) John Snow's contributions to medicine, particularly in epidemiology and anaesthesiology, are profoundly significant and enduring.
(2) His groundbreaking research on cholera played a pivotal role in ending devastating epidemics in London.
(3) Snow's pioneering application of hygiene principles in medicine established him as a foundational figure in modern epidemiology.
(4) Additionally, his meticulous studies on ether and chloroform significantly advanced the technique of inhalation anesthesia.

Conflict of interest

None declared.

Funding

None declared.

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