

Basic Microbiology and Infection Control for Midwives

Elisabeth Presterl
Magda Diab-El Schahawi
Jacqui S. Reilly
Editors



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Preface

According to the 2017 Revision of the World Population Prospects published by the UN Department of Economic and Social Affairs, every year there are about 139 million births worldwide, and the WHO estimates that about 830 women die from pregnancy- or childbirth-related complications every day. Of these, 99% occur in developing countries. Infections are one of the major complications that account for these maternal deaths. The access to quality healthcare before, during, and after childbirth is a key to save the lives of women and their newborn babies. Midwives are frontline providers of care for pregnant women. They are in a powerful position to significantly contribute and increase the health of future mothers and their babies among other things by reducing the burden of infectious diseases. The principles of infection prevention and control are essential for all healthcare settings. Understanding the fundamental processes behind infection transmission is the basis for setting appropriate actions which are intended to protect the health of patients as well as healthcare workers. This book focuses on “hygiene and microbiology for midwives” in high- and middle-income countries and is meant to enhance the knowledge and role of midwives regarding infections and infectious diseases, their transmission routes, and finally their prevention and control. A chapter dedicated to midwifery in low-income countries will briefly summarize relevant international literature and WHO documents.

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Foreword I

Infections play a major role in the morbidity and even mortality in obstetrics. Knowledge about existing guidelines is an important prerequisite for quality assurance; therefore, publications about these topics are of utmost importance. I congratulate the authors for this extensive overview to address the midwives. Midwife-led care for physiologic deliveries will become more important in the future based on excellent data demonstrating good quality care and high patient satisfaction. The present textbook should be of integral part of midwives' education in the future.

Peter Husslein
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Foreword II

Ignaz Philipp Semmelweis was the first doctor to identify the mode of transmission of puerperal fever (sepsis) in the General Hospital in Vienna 170 years ago. He recognized the difference in maternal mortality in two clinical departments. One department only employed midwives and students in midwifery; the other was also staffed by obstetricians and medical students who conducted autopsies. His introduction of washing hands with chlorinated lime solution was a highly effective and preventive measure which reduced maternal mortality substantially. Knowing about this history is important for midwives and doctors alike. The knowledge of hygiene and microbiology as is presented in this textbook is therefore vital in the contemporary as well as future education of midwives. I wish to thank the authors for their excellent task in compiling this essential work!

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History

The word hygiene originates from the Greek, ὑγιεινή [τέχνη] (hygieine téchne), meaning “healthy art.” Hygeia is the name of the Greek goddess of health. Hygiea is the daughter of the god and physician Asclepius, who is a son of the god of medicine Apollo. In the Roman Empire, the knowledge of hygiene was well developed. Already at that time, the Roman physician Marcus Terentius Varro knew that diseases are caused by microorganisms. It was known that quarantine (isolation) could prevent the spread of infectious diseases. In Christian Europe in 1670, Antoni van Leeuwenhoek discovered the first “micro-creatures” seen using his self-built microscope. He saw in human secretions (saliva, dental plaque) “little animals” (microorganisms).

One of the pioneers of hygiene in Central Europe/Austria was Gerard van Swieten (1700–1772), who was the personal physician of Maria Theresia and founded the older Vienna School of Medicine. His successor Johann Peter Frank (1745–1821) was a professor at the Vienna General Hospital, Vienna, and founded the so-called public hygiene, today called public health (Public Health). He introduced strict guidelines for the protection of the population against infectious diseases. Further extensions of this institution are public health departments and regulatory reporting for infections that have the protection of the public against epidemics goal.

Ignaz Semmelweis (1818–1865) was an assistant doctor at the University Hospital in Vienna. As such, he made the observation that substances are transmitted to other people through contact with corpses, which can cause serious diseases (sepsis). He witnessed the death of his friend Jacob Kolletschka following an injury during autopsy of a septic corpse. Due to the similar clinical picture of the sepsis seen in women with puerperal fever and the sepsis of his friend, he concluded that there may be same cause and that there may be a transfer of infection via the hands of doctors and students working on postmortems of corpses and then going to the ward and treating pregnant women. He therefore called for hand hygiene prior to any examination of patients.

He performed the first epidemiological study comparing the mortality rates of two obstetric wards. At the Vienna University Hospital, there were two obstetric wards for the care of pregnant women. In one the care was in the hands of midwives and student midwives; the other was run by medical doctors, medical students, and midwives. In a meticulous investigation, he showed that the mortality rate at the

medical ward was much higher than the mortality rate at the ward with the midwives. Then he performed the first intervention study. The medical students and medical doctors had to disinfect their hands with chlorinated lime solution before contact with the postnatal women. It really came to a sharp drop in the death rate, which was finally identical on both wards. Nevertheless, there was considerable controversy, so Semmelweis finally had to leave Vienna. He received a professorship in Budapest. The mortality rate increased again.

Quite late in his life, he summed up his scientific findings in the scientific essay “The Etiology, the Concept and the Prophylaxis of Puerperal Fever.” Semmelweis died eventually after a serious illness in Oberdöbling near Vienna.

The great period of medical microbiology came in the nineteenth century. Louis Pasteur (1822–1895) and Robert Koch (1843–1910) are considered to be the founders of clinical microbiology. Microbiology is the science of microorganisms including bacteria, fungi, and viruses. Louis Pasteur was the first to detect bacteria using the microscope and culturing them. He developed methods of clinical microbiology for the diagnosis of infectious diseases. Robert Koch discovered the pathogen of tuberculosis, *Mycobacterium tuberculosis*. He also established the so-called Koch’s postulates for the general definition of a pathogen. Paul Ehrlich (1854–1915) was the founder of anti-infective therapy. He discovered and developed the drug Salvarsan. Salvarsan was used for the treatment of syphilis. Ilya Metchnikoff (1845–1916) developed basic microbiology and immunology. Immunology is the science of the immune system and its reaction to infection but increasingly to many other triggers. Metchnikoff also set milestones for the diagnosis and therapy of infectious diseases.

Infection Prevention in Hospital: Tasks of Hospital Hygiene

Infection prevention and control (IPC) in hospitals aims to streamline processes and care actions with respect to avoid the transmission and/or spread of infections and/or microorganisms. Measures include the advice of medical personnel and the involvement of the management of hospitals to implement the advice given, the choice of adequate technology and medical devices for use in patients, and the establishment of standards and guidelines. Additionally, the infection prevention and control team is consulted when building or rebuilding hospitals or parts of it.

In hospitals, specialist IPC advice is given by the IPC team. The IPC team consists of IPC nurses, IPC doctors, sometimes other IPC professionals, supporting assistants, epidemiologists, scientists, etc. IPC nurses, IPC doctors, and IPC professionals have special training in infection prevention and control. The IPC team creates the so-called IPC plan of the hospital. This plan includes IPC guidelines, disinfection and sterilization rules, surveillance (epidemiology) of healthcare-associated infection, etc. In some European countries, including Austria, IPC is legally endorsed.

Other tasks of the IPC team are surveillance and epidemiology of healthcare-associated infections (HAI) and detection of infectious outbreaks and transmission of pathogens.

Frequency and descriptive statistics on the antibiotic susceptibility of the most common pathogens in the hospital are usually supplied by the microbiological laboratory. These together with national and international guidance are the basis for the antibiotic policy within a healthcare institution. Additionally, these data give insight for the spectrum of pathogens, the change of susceptibility pattern, and also the mechanisms of antibiotic resistance.

In Austria hygiene and infection control are endorsed in three laws: the Act on Healthcare Institution, the Act on Physicians, the Act on Nursing, and indirectly the Act on Midwifery – “Midwives have to practice their profession conscientiously without distinction of person. The welfare and health of pregnant women, women giving birth, new mothers, newborns, mothers and infants have to be treated on the basis of statutory provisions and in accordance with the technical and scientific knowledge and experience....”

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General Definitions

1

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Luigi Segagni Lusignani, Helga Paula, and Jacqui S. Reilly

In the German-speaking parts of the world, hygiene is the science of the preservation of health and prevention of disease. According to the more up-to-date definition, hygiene comprises all measures for prevention and control of infections.

The World Health Organization (WHO) definition of health (1946) is: “Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity”.

In other parts of the world, hygiene mainly focuses on cleaning, disinfection and sterilization. All other parts are summarized under “infection prevention and control”.

Infection Prevention and Control or Hygiene Comprises the Following:

- Any measures to combat and destruct pathogenic microorganisms, e.g. disinfection, sterilization, antimicrobial therapy, etc.
- Protection against and prevention of infections by laws and regulations in hospitals, the public health system, enforcing quality in the medical environment and vaccinations.
- Communication and networking to disseminate knowledge and information to protect against infection.

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- Teaching, educating and training of all people working in the health-care systems and beyond.
 - *Epidemiology*: Description of the incidence, distribution and control of a disease in a population including the detection of the source and cause of epidemics of infectious diseases. Epidemiology is the study of the occurrence of diseases, their course and their distribution in a population. Epidemiological descriptive numbers to measure the burden of (infectious) causes of disease are mortality, morbidity, incidence and prevalence of a disease (see Chap. 24 on epidemiology).