



Hospital infections in Birmingham, England, in the nineteenth and twentieth centuries[☆]

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ARTICLE INFO

Article history:

Received 28 June 2018

Accepted 28 June 2018

Keywords:

Infection

Hygiene

Hospital

History

Birmingham



The eighteenth-century Midlands Enlightenment saw the sudden emergence of the English city of Birmingham at the forefront of worldwide developments in science, technology, medicine, philosophy, and natural history. This was the

[☆] This paper is published simultaneously in the *Journal of Hospital Infection* and the *Journal of Infection Prevention*. The Editors of the Journals have agreed that joint publication of the article is justified to facilitate dissemination of the content to all relevant healthcare professionals.

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[†] Deceased. This article was begun by Professor Ayliffe and the week before he died he asked me if I would help him finish it. I think it is a fitting tribute to him that this, his last article, has now been published.

beginning of a massive growth in population that continued through to the twentieth century. The population of 24,000 in 1750 grew to 73,000 by the end of the eighteenth century, to 140,000 by 1841 and to more than 500,000 by the end of the nineteenth century [1]. This population growth led to overcrowding, poor sanitation and an increased need for hospitals, particularly in the industrial areas. However, hospitals built during this period often proved inadequate for the requirements.

The General Hospital in Birmingham was opened for patients in 1779; by 1790, 700 patients were being admitted with a remarkably low mortality rate of 3%. However, the annual reports in this hospital during the nineteenth century showed that many community-acquired infections were treated, including typhoid, smallpox, dysentery, and pulmonary tuberculosis. Overcrowding became an increasing problem, and by 1857 it was reported that all wards were overcrowded. In 1860, no less than 10 children with burns were reported in a ward containing only four beds. In 1862–3, the medical Board called the special attention of the hospital management to the bad sanitary state of the hospital as manifested by the unhealthy appearance of wounds and slow recovery of patients. Infections reported that year included smallpox (six cases), typhoid fever (24 cases), pulmonary tuberculosis (43 cases), phagedaena (hospital gangrene) (20 cases), and erysipelas (21 cases). Already, hospital-acquired infections were becoming important. In 1865–6 a new hospital wing was built which included a fever ward. Thereafter phagedaena was no longer reported in the hospital, although erysipelas, cellulitis, and pyaemia (septicaemia resulting in metastatic abscess formation) (11 cases) were still common. At this time, miasmas (unpleasant or unhealthy smell/vapour) were still considered to be mainly responsible for infection although contagion was being increasingly recognized as possibly more important. Good hygiene and avoidance of overcrowding were still the main preventive measures and were to some extent effective but the discovery of bacteria as a cause of infections was being reported by Pasteur, Koch, and others. Lister was already

working on his antiseptic methods, and surgeons in many hospitals across Europe began to take an interest in the prevention of hospital infection. By now, many new, often specialist, hospitals were being established by medical practitioners in Birmingham and some of these doctors were pioneers in the field of infection prevention and control.

The Queen's Hospital, or Royal School of Medicine and Surgery, whose first president was Prince Albert (the Consort of Queen Victoria), opened in 1841. After opening, the hospital expanded rapidly, and by 1845, separate wards were added containing 28 beds for infectious and contagious disease cases. Dr Joseph Sampson Gamgee was appointed to the Queen's Hospital in Birmingham in 1857. He studied wound care and believed that dry absorbent dressings were optimal for wound healing where he introduced the well-known Gamgee dressing. Although he had a great respect for Lister, he did not believe that a germ theory should be used as a foundation for surgical procedures. He opposed the use of strong phenolic solution, but he did believe in absolute cleanliness and was probably the first surgeon in Birmingham to wash his hands before operating.

In 1871 Lawson Tait, a nationally recognized surgeon who had a special interest in gynaecology, was appointed surgeon to the newly incorporated Birmingham and Midlands Hospital for women. He wrote an essay on mortality in British hospitals [2]. Although he identified that large hospitals were more unhealthy than small ones, he found that accurate statistics were difficult to obtain and that multiple factors influenced differences in mortality, making comparisons between hospitals difficult. A similar problem still exists today with hospital league tables. Although Lawson Tait was a supporter of the germ theory he also disagreed with Lister, and considered soap, water and general cleanliness (including boiling his instruments) to be as effective as phenolic solutions. In a short study on ovariectomies in 1877 he reported deaths in three out of 50 operations. Two of the deaths occurred in the 29 operations that used the antiseptic technique of Lister, whereas one death occurred in the 21 operations that used no antiseptics. Lawson Tait was a meticulous surgeon and believed his improved results were due to increased skill and experience. However, his operations were mainly clean and quite different from the traumatic surgery carried out by Lister. Lawson Tait was in effect one of the earliest surgeons to use the aseptic, rather than antiseptic, technique.

Research into hospital infection as we know it today really began in Birmingham during World War II. The old Queen's Hospital reopened as the Birmingham Accident Hospital in 1941 with William Gissane as Clinical Director, and it is generally recognized as the world's first trauma centre. Wound infection was a major problem at the time, both in war wounds and in industrial injuries sustained locally in Birmingham. Gissane persuaded the UK Medical Research Council (MRC) to set up a wound research unit with Professor Ashley Miles, a distinguished bacteriologist, as the Director. He was joined by a young bacteriologist Robert Williams, who later became a leading national expert in hospital infection. After leaving Birmingham he became Director of the Public Health Laboratory Service in London and President of the Royal College of Pathologists. The research laboratory was housed in a converted pre-Listerian operating theatre on the top floor of the Accident Hospital. The team found that in open war wounds, staphylococcal and streptococcal cross-infection was common; haemolytic streptococci increased in wounds from about 8% to

30% over two to four weeks. The group was also involved in the development of the 'no touch' dressing technique for reducing cross-infection of wounds.

In 1943 an MRC Burns Research Unit was set up in Birmingham by another distinguished bacteriologist, Leonard Colebrook [3,4]. In addition to studies on sepsis and use of topical penicillin, he introduced a ventilated dressing room and demonstrated a considerable reduction in airborne bacteria. He designed the unit with an engineer, Robert Bourdillon, who devised an air sampler, a modification of which is still in use [5]. Edward Lowbury was appointed bacteriologist to the burns unit on Colebrook's retirement in 1949. He continued with clinical trials and confirmed the effectiveness of the ventilated dressing room in terms of a reduction in clinical infection as well as a reduction in airborne bacteria. He also studied the use of plastic isolators in the prevention of burns infections, and collaborated with burns surgeons in a series of controlled trials of topical antimicrobial agents. He was particularly interested in the emergence of antibiotic resistance and its prevention, and kept a unique record of resistance changes in the burns unit until his retirement in 1979. The burns research team, together with the Hospital Infection Research Laboratory (see below), identified a plasmid encoding for resistance to carbenicillin, the first penicillin with activity against *Pseudomonas aeruginosa* [6]. Other important work during Lowbury's tenure included studies on surgical handwashing, wound healing, and even a vaccine against *P. aeruginosa* which was successfully tested in India but never developed commercially. Edward Lowbury received many awards and honorary degrees for his work in medicine, and as a poet, and was appointed to the Order of the British Empire on his retirement [7].

Concern about the general problem of infection in hospitals in the Birmingham Region led to the establishment of the Regional Hospital Infection Research Laboratory (HIRL) at the Dudley Road Hospital (later the City Hospital) in Birmingham in 1964. This laboratory was administered by the MRC Burns Unit, and Edward Lowbury became the Honorary Director while retaining his post at the Burns Unit. Graham Ayliffe was first appointed there as an MRC Senior Scientific Officer, and became Director of the Laboratory on Lowbury's retirement in 1979 and Professor of Medical Microbiology at the University of Birmingham in 1980 [8].

The initial functions of the HIRL were to assess the extent of infection in local hospitals, and to determine the causes of infection and recommend preventive measures. Later, this evolved into a special interest in disinfection and sterilization. In the early days the laboratory investigated outbreaks of infection in the region. These were mainly caused by *Staphylococcus aureus* and *P. aeruginosa*, but other problems encountered included outbreaks arising from operating theatres, and klebsiella and salmonella in maternity units.

During the first years of the HIRL more than 38 hospitals in the region were visited or revisited by a bacteriologist or Senior Technical Officer, together with Kathy Brightwell, a research nurse who became a founder member and treasurer of the Infection Control Nurses Association in 1970. The team accumulated data showing that the prevalence of hospital-acquired infection was around 10%, similar to that in a much later national UK prevalence study in 1980, and similar to prevalence surveys performed in hospitals across the developed world [9]. Subsequent surveys focusing on Dudley Road Hospital in Birmingham showed a reduction in the prevalence of infection to

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