The ‘H-Bug’ epidemic: lessons from antibiotic-resistant staphylococcal outbreaks in New Zealand hospitals from 1955–1963

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ABSTRACT

Deadly outbreaks of antibiotic-resistant staphylococcal infection occurred in New Zealand from the mid-1950s to early 1960s. The ‘H’ or ‘Hospital-Bug’ epidemic was part of a pandemic wave characterised by high numbers of nosocomial staphylococcal infections and the capacity of *Staphylococcus aureus* to develop resistance to commonly used antibiotics. Surgical patients and childbearing women and babies proved particularly vulnerable to the predominant pathogenic strain, identified as phage type 80/81. The post-war baby boom was at its height in New Zealand, and overcrowded maternity hospitals and outdated nursing techniques increased the risks of infection. The outbreaks challenged the medical profession, which had become reliant on antibiotics for prophylaxis and treatment. The Health Department ascribed responsibility for the indiscriminate use of antibiotics to medical practitioners but had little control over their prescribing habits. Confronted by increasing infection rates and falling public confidence in the maternity services, health officials supported a fundamental change in maternity care to ‘rooming-in’ of mother and baby, epidemiological research on staphylococcal transmission in hospitals, notification of nosocomial infections, improved barrier nursing and heightened awareness of appropriate aseptic techniques. Phage type 80/81 waned in the early 1960s concurrent with the arrival of methicillin but the emergence of methicillin-resistant *S. aureus* (MRSA) in the 1980s, vancomycin-resistant *S. aureus* (VRSA) in the 2000s, and the rapid emergence and spread of multi-drug resistant Gram-negative bacteria over the past decade, highlights the potential for further outbreaks while the use of antimicrobials remains high. Non-pharmacological interventions such as those promoted during the ‘H-Bug’ epidemic are likely to be central to controlling future waves of resistant nosocomial infection.
An epidemic of antibiotic-resistant *Staphylococcus aureus* in New Zealand hospitals

In November 1955 the deaths of eight babies from staphylococcal pneumonia born at Calvary, a popular private maternity hospital in Christchurch, alerted the medical profession and the general public to the serious nature of antibiotic-resistant nosocomial infections. From the six Calvary cases coming to autopsy, "*Staphylococcus aureus* was isolated, sensitive to chloromycetin and erythromycin, but resistant to penicillin, streptomycin and the tetracyclines". On post-mortem examination all eight cases showed similar findings: "staphylococcal pneumonia, atelectasis, lung abscess and empyema". A month later the Auckland Hospital Board, faced with the death of a baby in one of its outlying maternity units from staphylococcal pneumonia, as well as increased admissions of postpartum women suffering from mastitis, an increase in surgical infections and osteomyelitis, and breakdowns in grafts in its plastics unit, concluded that "widespread and indiscriminate use of antibiotics has given rise to conditions favourable for the emergence of new ‘mutant’ antibiotic-resistant strains of *Staphylococcus aureus*".

While other specialties were affected, the maternity services bore the brunt of the epidemic. Babies developed skin lesions and serious respiratory infections while breastfeeding women developed mastitis, breast abscesses and infections of the genital tract. As a result, the initial goal of the Auckland Hospital Board’s ‘Special [Staphylococcus] Committee’, appointed in late 1955, was to ascertain the prevalence of antibiotic-resistant staphylococcal carriage at National Women’s Hospital. A hospital-wide survey revealed 50% of doctors and 27% of nurses were carriers, as were 40% of the babies over four days old. Only 11% of younger babies were carriers, and very few positive cases were consistent with mother to baby transmission.

Recognising the delays presented by the Calvary outbreak where it had been "extremely difficult to get immediate notice that babies taken ill at home had been..."
born in a particular maternity hospital”, the Government added an amendment to the Health Act in early 1956 “requiring notification of impetigo and pemphigus of the newborn born in or discharged from maternity institutions [to] aid materially in checking another outbreak at an earlier stage”. The Health Department recommended the bacteriological investigation of serious outbreaks by the National Health Institute, and research into the eradication of antibiotic-resistant organisms from maternity units. Specific areas for attention were counts of airborne staphylococci, barrier nursing practices, handwashing, aseptic techniques, isolation procedures, soiled dressing disposal, cleaning of used equipment and records of neonatal health.

Researchers recognised that resistant staphylococcal strains were transmitted from hospital staff to babies and subsequently to their mothers during breastfeeding, and after initially concentrating on the role of airborne transmission, established that direct contact with healthcare staff who were carriers was the more important route. Staff swabbing with detailed records of antibiotic sensitivity were instigated to aid outbreak control. Carriers were issued with antibiotic nasal cream, hexachlorophene soap and Hibitane antiseptic cream, while wards and theatres stood down staff with infected lesions. Faced with chronic nursing shortages, the Health Department also emphasised ‘improved nursing disciplines’ to ensure breaches of aseptic technique did not occur despite the pressure of heavy workloads.

In his annual report for 1956 the Director-General of Health, Dr John Cairney, cited the profligate use of antibiotics as a key contributor to the development of antimicrobial resistance:

“When antibiotics were first used, the possibility of resistant organisms was seen and pleas were made to limit their use to susceptible organisms in major disorders. When their usefulness was fully established there followed an orgy of indiscriminate use. There is little doubt that such widespread use has hastened the emergence of the present staphylococcus which is resistant to most antibiotics in current use.”

Despite his strong views, Cairney was reluctant to tackle doctors’ prescribing habits head on. Departmental efforts to limit the use of oral penicillin in 1952 had met with failure, and attempts to restrict chlortetracycline, chloramphenicol and oxytetracycline to hospital boards in 1953 were unsuccessful due to persistent lobbying by doctors and wholesale distributors.

A Special Committee on Pharmaceutical Benefits appointed in 1956 offered little advice but continued reliance on the “integrity of the medical and pharmaceutical professions”. However, the urgent need to maintain effective therapy for severe infections meant that erythromycin was taken out of general use in 1956, and later, carbomycin and spiromycin were also reserved.

The Health Department overlooked the risks inherent in overcrowded wards and nurseries, aware that maternity hospitals around the country were struggling to cope with the burgeoning birth rate. It recommended instead “a careful observance of maternity nursing techniques built up over the years”. In 1955 a total of 102 public maternity hospitals provided the majority of care, with an additional 437 maternity beds available in private maternity hospitals. State-funded provision for postpartum stays of 10–14 days added pressure on the maternity services; over 55,000 babies were born in 1955, only 4,000 less than in 2017 when the New Zealand population was almost double.

Women were nursed under strictly imposed routines, including prolonged bed rest and ‘aseptic’ perineal swabbing designed to keep “the vulva and perineum in a state of surgical cleanliness”. Their babies remained in communal nurseries apart from their four-hourly feeds; often arriving in closely packed ‘baby wagons’ at their mother’s bedsides.

In 1957, 484 cases of pemphigus neonatorum were notified and 28 infants died of staphylococcal pneumonia. The following year staphylococcal pneumonia and septicaemia were added to the notifiable diseases list. Breast abscesses in nursing mothers were another manifestation of the epidemic. In 1955, 338 women with breast abscesses associated with lactation were treated in public hospitals around the country. By 1956
this number had risen to 633, peaking at 708 in 1957. As staphylococcal infections increased, women became wary of entering maternity hospitals. The popular press actively challenged official reports, research and recommendations, advising mothers-to-be to consider a home birth or at the very least to go to an exclusively maternity hospital where there was less risk of cross-infection. But in spite of the reported benefits of home confinement in preventing staphylococcal colonisation and cross-infection, neither the medical profession nor the Health Department supported a return to home confinement. The proposed ‘new’ National Women’s Hospital, in early planning stages in 1956, embodied medical aspirations for modern maternity. A novel approach to reducing the incidence of resistant staphylococcal infections was urgently needed.

The concept of ‘rooming-in’ seemed a tailor-made solution for the problems facing the maternity sector. Bedside cots replaced the communal nursery, and women were encouraged to get up and care for their babies. Perineal swabbing and bed rest gave way to early ambulation and showering before discharge home. Initially introduced in the late 1940s in the US, the idea was promoted by supporters of ‘natural motherhood’ in New Zealand to encourage closer bonds between mother and baby within the constraints of the hospital setting. This radical change to institutional baby care also appealed to medical administrators as a way of reducing contact between nurse and neonate while still providing round-the-clock supervision and care.

Plans for the new National Women’s Hospital were amended after consultation with the maternity sector in 1957. Aware of the many advantages of rooming in, the Health Department strongly recommended that it be adopted throughout the ‘old’ hospital even though it did not comply with the recently revised tenets of the H.-Mt.20, the so-called ‘Bible of New Zealand maternity nursing’, first introduced in 1926 to safeguard New Zealand women from puerperal sepsis. To back up this dramatic change in approach, the Department quoted the Medical Research Council on the control of cross-infection in hospitals which advised strongly that, “The practice of placing infants in large communal nurseries is fraught with danger and should be avoided...Infants should be nursed in the ward with their mothers”.

Most maternity units entered into the spirit of change reluctantly; a contemporary report notes the “considerable passive resistance on the part of trained nursing staff in some hospitals to the introduction of a rooming-in programme”. The physical structure and layout of many units meant that the shift to rooming-in occurred in a piecemeal way. Moreover, influential members of the medical profession expressed grave doubts about women’s capabilities: “Just how practicable or effective segregation of the nurse from the baby is, remains to be seen. Unless babies...are to be left entirely to the untrained care of the mother, there will still be much for the nurse to do”. However, the stakes were potentially high. Radical steps needed to be taken to prevent cross-infection, and to stave off a potential exodus from the maternity services. Rather than relinquish the medical model of maternity in the face of intractable infections, health officials redefined the acceptable parameters of care.

The end of the epidemic in New Zealand
Phage typing of bacterial specimens, used widely from the early 1950s, allowed epidemiological investigation of outbreaks by identification of staphylococcal strains. The NHI acquired standard bacteriophages for typing in 1955, and epidemiologist Dr HT Knights was appointed principal investigator into staphylococcal transmission in hospitals. Initially convinced that airborne transmission played a central role, Knights travelled the country, testing for staphylococci in the air of theatres, wards and nurseries, making detailed recommendations for improvements. He reassessed his approach when international research confirmed that direct contact between carrier or infected staff members and susceptible patients was largely responsible for the spread of infection. Midwives and nurses, previously portrayed as the arbiters of aseptic practice, were reframed as the primary link in the chain of infection, and handwashing gained greater significance as a result. In his collected Notes on Staph-
Staphylococcal Infection in Hospitals, published in 1960, Knights described the washbasin as “foremost in the prevention of cross infection in the hospital environment”.

Initially at least, the renewed focus on infection prevention measures did not significantly reduce infection rates. Short-staffing and overcrowded, often inadequate conditions, combined with uneven implementation of rooming-in techniques, and the difficulties of effectively isolating infectious patients, undoubtedly undermined efforts at infection prevention. Resistant staphylococcal outbreaks continued to occur, albeit less frequently. A 1959 report of significant reductions in the staphylococcal infection rates at Melbourne's Royal Women's Hospital therefore stimulated strong interest in New Zealand. The routine use of hexachlorophene emulsion, combined with an increased focus on rooming-in techniques, strict controls on the use of broad spectrum antibiotics, and treatment for staphylococcal carriers, had resulted in “an immediate and sustained effect” on neonatal infection rates. The efficacy of pHisoHex, a liquid detergent containing 3% hexachlorophene, in reducing staphylococcal colonisation of the skin was confirmed at Palmerston North Hospital in 1960. National Women's Hospital and other maternity hospitals followed suit, with protocols on preparing women for delivery and ‘dry bathing’ of babies adopted as routine infection control measures.

At the same time as pHisoHex was being trialled, significant advances were being made in chemotherapy. Vancomycin, developed in 1958, was followed by celbenin, methicillin and staphcillin in 1959. A year later, ampicillin and amoxicillin entered the market. Soframycin spray, a new treatment for the clearance of carriers of coagulase-positive staphylococci was released in 1961, with reports that 85% of cases were cleared after 24 hours. A marked change was reported in hospital isolates around this time: a 1961 survey of 427 patients with septic lesions at two Dunedin hospitals showed that in comparison with a similar survey in 1957, when almost half of staphylococcal strains were phage type 80/81, only 13% were of this type by late 1960. In late 1961 Knights was called to investigate an outbreak at the Wellington Karitane Hospital, where three babies had died of phage type 80/81 staphylococcal pneumonia, and six others were affected. One baby, who was “apparently moribund”, responded dramatically to celbenin and survived. Infections were still occurring, but the new antimicrobials enabled much improved results against a background of the decreasing prevalence of the H-Bug strain.

The deaths of three babies from phage type 80/81 staphylococcal pneumonia at the six-bedded Kaponga maternity hospital in 1963 marked the end of the eight-year long epidemic. Changes in maternity practice, heightened awareness of staphylococcal transmission in hospital environments, improved infection control procedures, routine use of hexachlorophene emulsion to ‘prep’ women for labour and bathe newborns, and the introduction of new, more potent penicillin compounds, all likely contributed to the disappearance of phage type 80/81 S. aureus from New Zealand hospitals. Amidst renewed confidence in the antibiotic paradigm, few voices were raised in favour of controls on prescribing. The immediate crisis was over, restricted antibiotics returned to general use and the H-Bug epidemic was largely forgotten except by those who had experienced the severity of its effects.

Conclusion

Antibiotics changed the face of medicine in the 1940s. Enthusiastic prescribing of antimicrobial therapies led to the rapid emergence of antibiotic-resistant strains of S. aureus. In the mid-1950s New Zealand hospitals reported patients infected with a new ‘mutant’ form of S. aureus linked to “infections occurring in hospitals all over the civilised world”. The Health Department reacted swiftly when tragedy struck; the deaths of eight babies born at Calvary Hospital shocked the nation and undermined public trust in the maternity services.

Senior health officials looked to the international experience to contain ongoing outbreaks of staphylococcal disease, motivated by laboratory research on infection transmission and control. With limited means to influence medical practice, the Health Department restricted the use of a small group of antibiotics effective for severe resistant staphylococcal infections.
and appealed to the professional integrity of doctors to control 'extravagant' prescribing. The Department's primary focus was on non-pharmacological interventions, in particular a radical rearrangement of post-partum care to reduce infection rates, and thereby maintain public trust in the medicalised model of maternity care.

While rooming-in of mother and baby has remained a fundamental aspect of postpartum care, the H-Bug epidemic appeared to have little impact on established prescribing practices. The concerns of the 1950s and 60s still challenge clinicians in the form of highly transmissible multi-drug resistant organisms, and the limitations of existing antimicrobial agents in an era of widespread use. The rapidly changing landscape of antimicrobial resistance, including the recent emergence of carbapenem-resistant Enterobacteriaceae and multi-drug resistant *Candida auris*, nosocomial pathogens causing serious infections with high associated mortality, reinforces the need for real change in prescribing patterns in New Zealand, which are excessive when compared with many western countries.\(^4\) Short-staffed, over-burdened services and poor hand hygiene are as relevant to healthcare today, if not more so, than in the past. Infection surveillance, timely reporting and multidisciplinary involvement in the implementation of effective infection prevention measures still underpin efforts to prevent the spread of resistant microbes, protect patients from infection and reduce the need for antibiotic treatment. However, a more proactive approach, including 'real time' targeted and hospital-wide surveillance and data collection would greatly enhance local and national responses to the current threats posed by multi-resistant organisms, enabling faster identification of infection rates and risks, and quicker interventions to prevent spread. New Zealand's first experience of a nosocomial resistant staphylococcal epidemic continues to provide valuable lessons for the present day.

**Competing interests:**
Nil.

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