

The Broad Street Pump



Hospitals in the Community - a matter of public health.

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A hospital is complex institution – a melting pot, where sick, vulnerable patients come into close physical and social contact with busy, active, healthy staff in circumstances that are often stressful, emotional and physically challenging. Hospitals have always been risky places, despite their intended role as places of respite, healing and recovery. Among the risks, of course, is infection, not only for vulnerable patients, but also, potentially, for healthy staff and their families and friends in the community. Hospitals are efficient incubators of communicable diseases that can amplify and spread into, as well as from, the community. This is why hospital infection prevention and control is both a patient safety, and a public health issue and a major area of research for CIDM-Public Health.

For the past 3 years we have been working on two NHMRC-funded research projects with a common goal but very different approaches. The common goal is to protect new patients from becoming colonized with methicillin resistant *Staphylococcus aureus* (MRSA) and other pathogens - with all of the risks, costs and personal inconvenience that entails. To do this we need to develop novel strategies to improve infection control behaviours - particularly, but not only, hand hygiene - among hospital staff.

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The first approach involved developing a highly sensitive MRSA strain typing system that is rapid and inexpensive enough to be used routinely for all MRSA isolates. This was done as part of a PhD project by Dr Matthew O'Sullivan¹ and is in routine use. Our CIDM-Public Health post doctoral fellow Dr Rosie Sadsad is also well on the way to implementing an electronic alert system that draws on patient and laboratory information systems and strain typing results to rapidly identify and automatically report MRSA transmission events to clinicians. This will allow timely intervention to prevent further spread. Already these systems have had a major impact on transmission and colonization rates in several wards where MRSA is endemic or outbreaks have occurred, including the neonatal (NICU)(Pinto) and adult (ICU) intensive care units and general surgical wards.

Among other things, this project has demonstrated the important role of environmental contamination in transmission of MRSA from patient to patient, which has been underestimated until now. This first became apparent – with confirmatory evidence from MRSA strain typing – during an outbreak of infection and colonization, with a particularly virulent strain of MRSA, in the NICU. This incident led to the purchase of a system to deliver vapourised hydrogen peroxide (VHP), which is now recognized as safer and more effective agent than bleach for terminal cleaning. Its use in the NICU and subsequently in surgical wards significantly reduced environmental contamination and contributed to reductions in MRSA transmission. Reports by the Infection Control Unit – led by Kathy Dempsey and Jo Tallon - on the incorporation of VHP environmental disinfection and MRSA strain typing, into a bundle of enhanced infection control measures, won the 2013 NSW Health Innovations Harry Collins award, was presented by Kathy and Jo at the recent International Forum on Quality and Safety in Healthcare in Paris and has reached the finals of the National Lead Clinicians Group *2014 Awards for Excellence* (posters attached)

The second approach involved a collaboration with Professor Rick Iedema, formerly Professor of Health Communications at the University of Technology, Sydney, now at the Agency for Clinical Innovation. This project involves video feedback research, pioneered and used by Rick for many years in health services research to allow healthcare workers to visualize their day-to-day practices and “innovate from within”. This project is one of the first, in which infection prevention and control has been the focus. At Westmead, it was conducted in two surgical wards, where the project officer, Dr Suyin Hor, spent many hours, during 2013, getting know staff, filming them (with appropriate consent) undertaking routine tasks. Together with Infection Control Professional, Marija Perisa, the staff watched and discussed the video clips, which provided a new insight into the complexity of their daily tasks, to analyse and devise innovative ways to streamline or improve their interactions with

patients, colleagues and the environment. In parallel with this project a PhD student, Mary Wyer, is using video feedback with patients to explore their perceptions of hospital infection control and how being colonized or infected with MRSA and isolated in a single room affects them and their families.

These studies have demonstrated that improving infection prevention behavior among healthcare professionals is more complex than developing rules and policies. We believe that the combination of providing staff with both timely and highly specific surveillance data and new opportunities to reflect on how they work and to hear from patients about how a hospital-acquired infection affects them, can potentially change clinician behavior.

Our work has been noted overseas – we were recently invited (for the second time) to contribute to International Innovation – “the leading global dissemination resource for the wider scientific, technology and research communities” (<http://www.research-europe.com/index.php/category/health/>) a glossy science magazine with publications based on several different thematic areas, including health. In this issue of the Broad St Pump we have reproduced that contribution (with permission) as well as the posters presented by the Infection Control team at the International Forum and as their entry to the National Lead Clinicians Group *2014 Awards for Excellence*, as well as abstracts from selected papers describing or MRSA strain typing project.

References

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2. Pinto AN, Seth R, Zhou F, Tallon J, Dempsey K, Tracy M, Gilbert GL, O'Sullivan MV. Emergence and control of an outbreak of infections due to Pantone-Valentine leukocidin positive, ST22 methicillin-resistant *Staphylococcus aureus* in a neonatal intensive care unit. *Clin Microbiol Infect.* 2013;19(7):620-7.
3. Gilbert L. Breaking the cycle. *International Innovation.* 2012; November: 82-84. <http://www.research-europe.com/magazine/HEALTHCARE2/EX4/index.html>
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Preventing infections

Hospital-acquired infections can cause patient suffering, longer hospital stays and even fatalities. With this in mind, **Professor Lyn Gilbert** and her colleagues are exploring new strategies to empower both patients and staff to prevent transmission



To begin, how have your investigations developed since you last spoke with *International Innovation* in November 2012?

Our highly discriminatory methicillin-resistant *Staphylococcus aureus* (MRSA) strain typing system, which was reported on previously, is now in routine use at Westmead Hospital in Sydney, Australia, and has been used to successfully identify and investigate transmission events and outbreaks of MRSA infection and colonisation within the hospital.

For example, in two surgical wards where there was a high prevalence of MRSA colonisation, we used strain typing to identify transmission both between patients and from environmental sources. This facilitated the implementation of enhanced hand hygiene education and environmental cleaning. We also simultaneously conducted a video-reflexive ethnography project (using video recording to capture and allow participants to reflect upon their hygiene practices) in the same wards. Overall, these initiatives resulted in a significant and sustained fall in the prevalence of MRSA colonisation over a 12-month period.

Could you briefly outline how the automated informatics system you

are developing helps to identify MRSA transmission sources and routes?

At present, a web-based Infection Control Management System captures relevant microbiology laboratory results for patients with infections or who carry antibiotic-resistant bacteria and require infection control action. Once fully developed, our new automated monitoring system will integrate this information with MRSA strain typing results, patient admission/discharge records and bed movement data. This will help identify new MRSA acquisitions, rank possible sources according to likelihood, and issue an alert to ward staff so they can rapidly identify and correct any breaches of infection control.

This might mean we identify that Patient A has become colonised with an unusual MRSA strain following hospitalisation. We may then discover Patient B also carries that same rare strain. The system might flag that Patient B occupied the bed adjacent to Patient A one day prior to Patient A's admission. From this, we could infer the cleaning of the room in question has not been adequate, and could take appropriate actions to prevent future transmissions.

How did the potential of video-reflexive ethnography as a clinical tool come to be recognised?

My colleague Professor Rick Iedema has been using video technology for more than a decade as a way to help clinicians better understand – and find ways to rationalise – the complex work that they do (although this is not always easily reconciled with hospital policies and guidelines). We would like to see video used as a 'routine' tool to allow for continued improvements in practice, or for troubleshooting when infection outbreaks occur or persist despite the usual control measures.

To what extent is it realistic to expect patients to actively contribute to their own safety within the context of hospital-

acquired infections (HAIs)?

We can't expect patients to take responsibility for their own safety or for healthcare worker behaviour – but we should give them permission to contribute if they feel comfortable doing so. At the very least we should provide easy-to-understand information about what the risks and potential consequences of acquiring an infection are. We should also encourage patients to ask questions; this is not always easy for them as, regrettably, they are often rebuffed by busy staff. Those who are willing to be involved therefore need support – indeed, some hospitals already have active patient education programmes designed to encourage this involvement.

Do you have any future research plans that you would like to highlight?

Many studies have demonstrated that compliance with hand hygiene is consistently 15-20 per cent lower for doctors than for nurses. Although, when asked, most doctors acknowledge hand hygiene as important, independent auditing has revealed they often believe they comply better than they do. The challenge is therefore to better understand these inconsistencies and devise ways of making hand hygiene and infection prevention a more important and integral part of day-to-day medical practice.

In light of this I, along with Iedema and others, have applied for a new grant to investigate the reasons why doctors in particular often fail to fully participate in infection prevention and control programmes. Using in-depth interviews and deliberative discussion groups, we will investigate hospital doctors' perceptions of the importance of HAIs as well as of their roles and responsibilities for prevention. We shall then explore new strategies to increase doctors' participation, including more timely and sensitive surveillance methods such as pathogen strain typing and patient involvement.

Bacteraemia battle

Researchers at the **University of Sydney**, Australia, are working to make hospitals safer places by using novel strain-typing techniques, video-reflexive ethnography and automated informatics to curb the transmission of dangerous pathogens

HOSPITAL-ACQUIRED INFECTIONS (HAIs) affect millions of patients worldwide annually. At present, methicillin-resistant *Staphylococcus aureus* (MRSA) is one of the world's most common causes of HAI, and is responsible for a high proportion of all bacteraemia (bacterial infections of the blood) in hospital settings. Surgical wards often show high levels of MRSA colonisation, which puts surgical patients at risk of MRSA bacteraemia, while newborn infants also suffer particularly high mortality rates in the event of MRSA infection outbreaks. In addition to human cost, such outbreaks place a significant economic burden on healthcare systems.

Recent developments of MRSA strain typing have helped hospitals to quickly identify outbreaks of microbial infections. Attention is now turning towards methicillin-sensitive *S. aureus* (MSSA), which, although neither new nor antibiotic resistant, is a more common cause of hospital-acquired bacteraemia than MRSA. At present, its epidemiology in the hospital setting is poorly understood. Both MRSA and MSSA bacteraemia can be difficult to treat and have high mortality rates. However, a significant number of infection outbreaks can be prevented by something as simple as ensuring that hospital staff and patients follow good hygiene practices.

JUST THE TYPE

Rising to this task is Professor Lyn Gilbert, a clinical microbiologist in the Marie Bashir Institute for Infectious Diseases and Biosecurity at the University of Sydney. Over the past few years Gilbert, together with her colleagues Dr Matthew O'Sullivan and Associate Professor Vitali Sintchenko, has been working on the development of a novel, highly discriminatory MRSA strain typing system, which was implemented at Westmead Hospital – a University of Sydney teaching hospital – in 2011. That same year, two extremely premature babies within the hospital's neonatal intensive care unit sadly died due to MRSA infections, signalling the start of an outbreak. Using the strain typing system, additional infants went on to be identified as being colonised or infected with the same highly virulent and transmissible strain of Pantone-Valentine leukocidin-positive, ST22 MRSA. Since many of these infants had been born by Caesarean section, it seemed likely that transmission was occurring nosocomially (originating in the hospital environment) rather than vertically (passed from mother to child).

In light of this, the Sydney scientists' novel strain typing system successfully defined the strain responsible for the outbreak, distinguished it from other strains present in the ward at the same time and enabled the implementation of appropriately targeted infection control interventions, ultimately leading to the outbreak's successful termination. For example, enhanced cleaning of MRSA-colonised patient rooms was employed using vapourised hydrogen peroxide, and a review of hand hygiene practices was undertaken. Staff were educated about the World Health Organization (WHO)'s 'Five Moments of Hand Hygiene' – a programme developed to help healthcare providers understand the critical points at which to wash their hands: before touching a patient, before procedures, after procedures or exposure to body fluids, after touching a patient and after touching a patient's surroundings.

Now, a group of colleagues led by O'Sullivan aims to develop a similar system that is capable of rapidly identifying MSSA strains. "Little is actually known about the molecular epidemiology of MSSA and the extent to which it is transmitted in hospitals," Gilbert elucidates.

SCREEN TIME

The team is not only using cutting-edge microbial genetic epidemiology to tackle HAIs; it is also applying video-reflexive ethnography to the hospital work environment. Since WHO recommends involving patients themselves in infection control, the researchers are combining their strain typing system with video to better observe the infection control behaviour of patients and staff. At present, Gilbert's colleague Dr Suyin Hor and PhD student Mary Wyer (under the supervision of Professor Rick Iledema) are exploring ways in which video-reflexive ethnography can better capture how patients and hospital staff play a part in the transmission of MRSA and MSSA. The researchers video record hospital staff during patient care and ward rounds. Participants subsequently review the video footage, which allows them to observe their interactions with other individuals and the hospital environment, and consider new strategies that might reduce the risk of microbial transmissions. "This approach has been shown as highly effective in providing new insights and raising awareness in many areas of healthcare, including infection control," enthuses Gilbert.

Of course, the use of video recording in a clinical context gives rise to some tricky ethical issues. "Like any research, this work requires the approval of the institutional research ethics committee. The team must explain the process and background to the project and gain the consent of unit directors and ward managers well in advance," elaborates Gilbert. Participating staff are allowed to opt out of being filmed, while patients are assured that their faces will not be included in the video footage without their consent.

CLEVER INFORMATICS

Finally, the team is also working to develop an automated informatics system that combines patient information (such as admission dates and ward and bed movement) with relevant laboratory results (including MRSA strain types) to identify potential sources and routes of MRSA transmission. "The automated system will allow us to match MRSA-colonised



INTELLIGENCE

THE ROLE OF SURVEILLANCE IN HOSPITAL INFECTION CONTROL: LINKING BASIC SCIENCE WITH CLINICAL EPIDEMIOLOGY AND ETHICS

OBJECTIVES

To protect hospital patients, including the especially vulnerable, from preventable healthcare-associated infections (HAIs) by increasing healthcare professionals' awareness of HAIs and, hence, their motivation to contribute optimally to HAI prevention and control.

KEY COLLABORATORS

Dr Matthew O'Sullivan and **Associate Professor Vitali Sintchenko**, Centre for Infectious Diseases and Microbiology – Public Health & University of Sydney • **Dr Rosemarie Sadsad** and **Dr Fei Zhou**, Centre for Infectious Diseases and Microbiology – Public Health • **Dr Suyin Hor** and **Mary Wyer**, University of Technology, Sydney • **Professor Rick Iedema**, Agency for Clinical Innovation, New South Wales

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LYN GILBERT is an infectious diseases physician and clinical microbiologist, with research interests in the diagnosis, surveillance, prevention and ethics of communicable diseases of public health importance. Her research involves the use of a broad range of approaches such as molecular epidemiology and strain typing, including whole genome sequencing; integration, analysis and modelling of data from diverse sources using health informatics; and novel interventions to understand and improve infection prevention and control behaviours of healthcare professionals.

patients with others carrying the same strain and identify the most likely sources or routes of transmission based on proximity and duration of exposure," clarifies Gilbert. The automated informatics system is still under development, but Gilbert hopes to have it fully operational by the end of 2014.

A THREE-PRONGED APPROACH

The researchers believe that the combined use of these three diverse approaches will leave clinicians more aware of microbial transmission in hospitals and help them to prevent the spread of infection wherever possible. The application of the techniques being developed by Gilbert and her group have already led to a considerable reduction in the risk of potentially life-threatening MRSA and MSSA bacteraemia at Westmead Hospital.

Looking ahead, new drug-resistant organisms are likely to appear in hospitals, bringing with them a new set of HAIs. This necessitates constant vigilance against bacterial infections. "My goal is to create an environment in which hospital staff performing routine service tasks are encouraged to collaborate so that this work is constantly improved through innovation," reveals Gilbert. In the meantime, the team's progress tracking MRSA and MSSA will ensure clinicians and other hospital staff are fully aware of the latest hygiene protocols and have the information they need to prevent the spread of *S. aureus* in the clinical setting. This will ultimately improve patient outcomes both in Sydney and further afield.



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Implementation of MRSA Control Bundle – Strain Identification, Environmental Management, Reducing health care associated acquisition and improving patient outcomes”

Kathy Dempsey^{1,2}, Jo Tallon^{1,2}, Matthew V. N. O’Sullivan^{1,3}, Marija Parisa^{1,2}, Nicole Tolhurst^{1,2}, Rachel Paton^{1,2}, Fei Zhou^{1,3}, Vitali Sintchenko^{1,3} and Lyn Gilbert^{1,2,3}.
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BACKGROUND

Westmead Hospital is a 980-bed teaching hospital in Sydney; Following two severe MRSA infections in NICU the project of developing the MRSA control bundle was formed:

1. Enhanced surveillance with screening of patients & environment
2. High resolution strain typing using a novel high-resolution and inexpensive rapid method, designed in-house, to observe transmission events and to link environmental isolates of MRSA with patient isolates.
3. Key Infection Control Strategies (Hand Hygiene, Patient zoning, cohorting & isolation)
4. Environmental Decontamination using vaporized hydrogen peroxide (H₂O₂) - Deprox™

SURGERY

Over a 12month period, 22 hospital healthcare-associated MRSA bacteraemias. (0.74 per 10,000 OBDs) were identified. MRSA colonisation rates have been shown to be even higher.

OBJECTIVES

Decrease patient and environmental acquisition of MRSA. Through the successful implementation of the MRSA Control Bundle. A clinical practice bundle that can be transferred and replicated across all patient groups and resistant organisms reducing MRSA colonisation and the risk to patients of potentially serious infection.

METHODS

A study was performed in three adjacent surgical wards in a large tertiary hospital. Routine screening for MRSA is not performed in these wards but infection rates are high. Isolation and contact precautions are instituted for known MRSA carriers (identified through clinical samples or on previous screening). A point prevalence survey of MRSA carriage was conducted in these wards in response to a high rate of clinical infections. All patients were screened (nose and perineal sites), as a result of a high MRSA colonisation rates environmental swabbing was conducted. Subsequently, 144 selected environmental locations were sampled which included individual patient handsets, other surfaces in the vicinity of patient beds and surfaces outside of patient rooms and in administrative areas. This process was repeated following each MRSA control bundle intervention.

Environmental decontamination with the Deprox™ system, an integral component of the MRSA control bundle, was initiated. This system is self monitoring and self calibrating and delivers a vapor that will penetrate the most hard to reach places and is effective against a wide spectrum of multi resistant micro-organisms. It uses high frequency ultrasonic vibrations to vaporise the solution. It is an oxidising agent that attacks cell components and is designed to deliver a log 6 reduction to surfaces.

Environmental sampling when combined with highly discriminatory typing using a novel 19-target binary typing system in a setting of high MRSA endemicity helps to target infection control measures to achieve the best possible outcomes for our patients. Analysis of the spatial distribution of MRSA strains from patient and the environment indicates an association between the strain carried by an individual and the strains isolated from their immediate environment. The relatively high rate of positive environmental samples with links to patient colonisation suggested environmental contamination and inadequate cleaning as a major factor for the high MRSA acquisition rates in these wards. (fig 2)

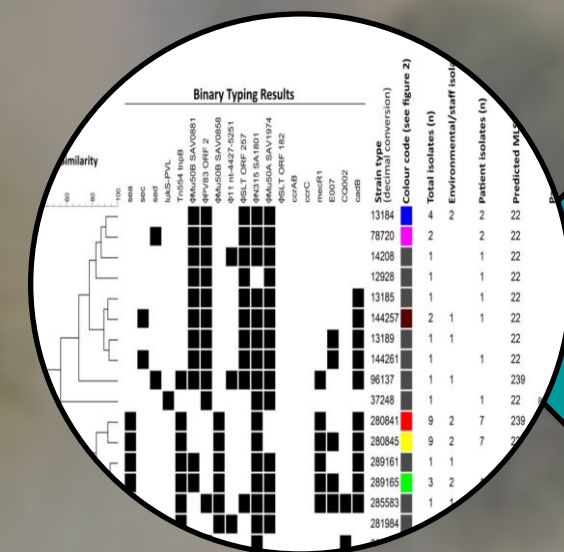
The binary strain typing system developed for this project is rapid, (<24 hour turnaround time) highly discriminatory (similar to Pulse Field Gel Electrophoresis), inexpensive (approximately US\$2 per isolate) and high throughput (40 isolates per membrane and two membranes can be processed simultaneously). These characteristics make it suitable for routine typing of MRSA isolates as part of infection control surveillance. It can be used prospectively to detect outbreaks and emergence of novel clones of MRSA and the results correlate well with traditional strain typing methods (which are more expensive, slower and/or less discriminatory).

This project has proven that this binary typing method can be used to link environmental strains of MRSA with those causing human colonisation or infection in a highly endemic hospital setting.

MRSA CONTROL BUNDLE



Surveillance / Screening
– Patients & Environment



High Resolution Strain Typing



Key Infection Control Strategies



VAPORISED HYDROGEN PEROXIDE
(H₂O₂) (Deprox)

RESULTS

The implementation of MRSA control bundle has shown to improve patient outcomes initially eliminating the virulent MRSA outbreak strain from a previously unscreened patient population. Transference of the bundle to other settings with equal success such as a busy surgical unit that showed gross environmental contamination with strains linked to patient colonisation, reducing those colonisation rates from 38% to 6% and reducing environmental contamination from 20% to 6%. (Fig 1)

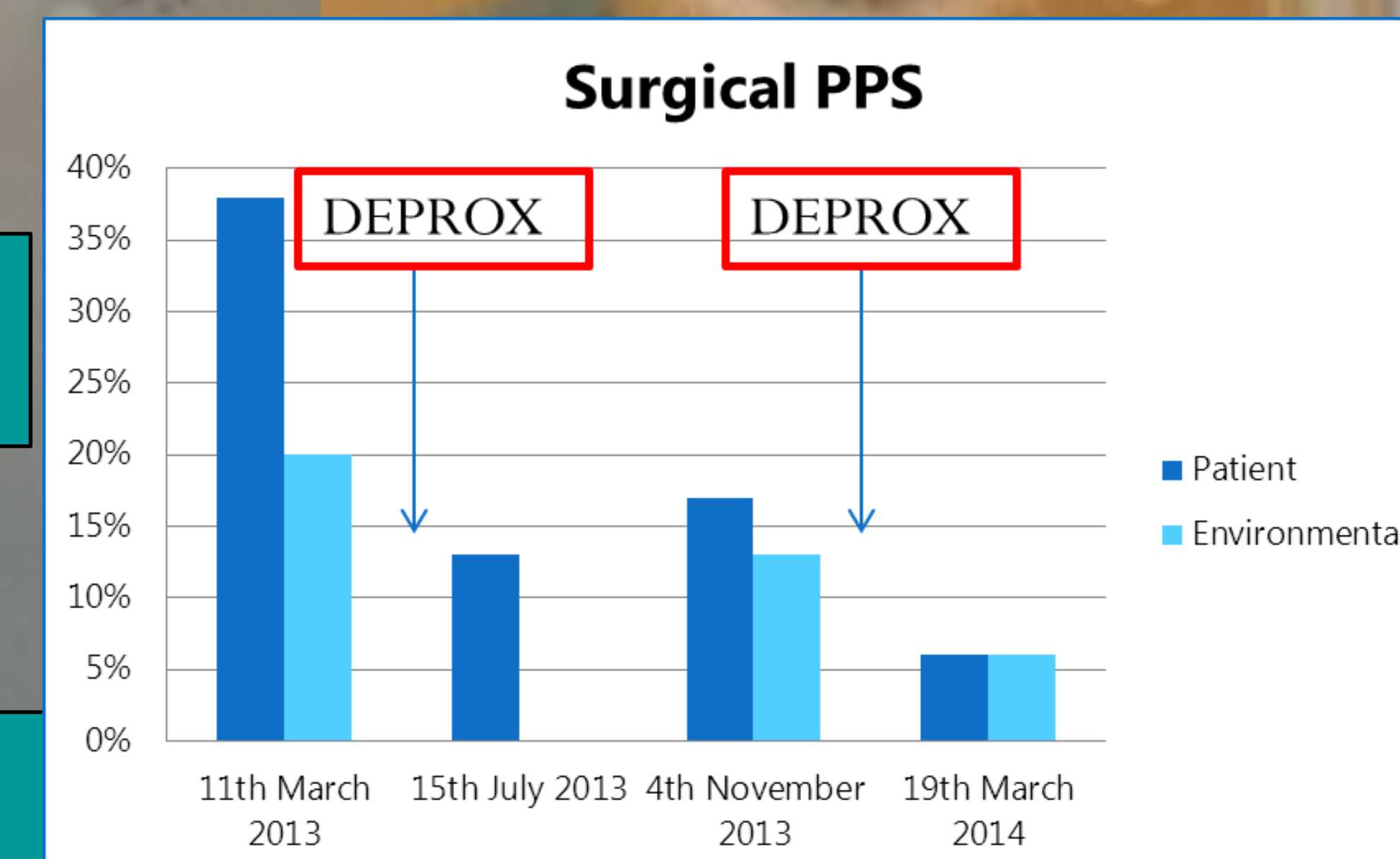


Fig 1 point prevalence study showing Patient and environmental colonisation /contamination pre & post MRSA Control Bundle

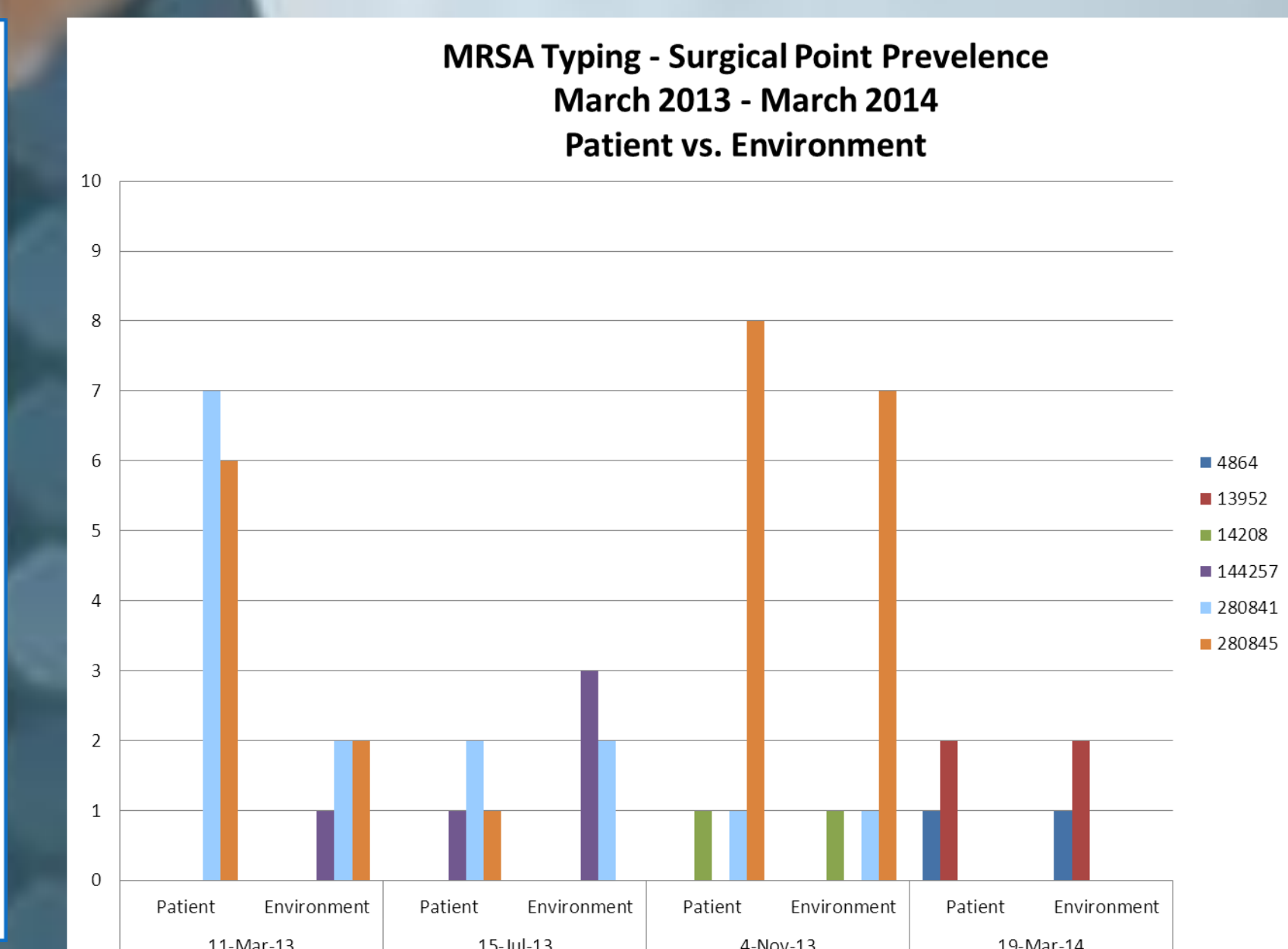


Fig 2. Patient & environmental strain typing

CONCLUSIONS

- The role of environmental sampling in investigations of nosocomial outbreaks of MRSA remains controversial and is often underestimated. As demonstrated it is important to intervene using a bundled approach for Infection Prevention & Control using revolutionary technology: such as highly rapid discriminatory MRSA typing system and vaporised Hydrogen peroxide H₂O₂ Deprox.
- The use of vaporised, Hydrogen peroxide H₂O₂ Deprox greatly increases the reduction in microbial load in the environment. As the premier hospital in Australia for this technology we are leading the way in incorporating the Deprox system into normal cleaning processes to avoid any future outbreak situations. Routine procedures now incorporate linking strain types of MRSA among patients, identifying possible transmission events and any causal links with environmental contamination.
- The principles of this project are extending hospital wide, and to other institutions. We now perform routine MRSA strain typing for 6 other large public hospitals in NSW who are using this data to enhance their own MRSA surveillance programs. This approach to MRSA control provides an innovative strategy for clinical practice in the fight against Health care acquired colonisation and infection with multiple resistant organisms, a strategy improving patient outcomes.

'Innovations for MRSA control in a Neonatal Intensive care Unit (NICU)- MRSA control bundle'

Kathy Dempsey^{1,2}, Jo Tallon^{1,2},

¹Infection Prevention and Control Unit Westmead Hospital, Sydney, Australia, ²Centre for Infectious Diseases and Microbiology.

1. Context

Westmead Hospital is a 980-bed teaching hospital in Sydney, Australia, serving a population of 1.5 million; there are 5500 deliveries annually. The 42-46 bed NICU comprises 20-22 high acuity ventilator cots and 22-24 lower acuity special care cots and no single cot isolation rooms; in 2011 there were 1635 admissions, including over 100 infants <1500 grams birth weight. From May 2011 to April 2012 31 babies were identified as being colonised with MRSA. 1066 patients were admitted during the outbreak period (18 May 2011 to 23 January 2012). The standard nurse/bed ratio is 1:1-1.4, depending upon staffing levels and patient acuity.

5. Intervention / Implementation

- The MRSA control bundle consisting of genotyping MRSA isolates, implementing key Infection control strategies – monitoring/improving Hand Hygiene compliance, outlining patient zoning and the introduction of vaporised H₂O₂ for environmental decontamination.
- Colonized babies were placed on **contact precautions** and cohorted until discharge; **zoning** of patient areas was implemented (pic 1); a unit-wide review of hand hygiene practices, education on '5 Moments of Hand Hygiene' and enhanced **environmental decontamination**.
- An integral part of the MRSA control bundle was decontamination of the environment using **vaporised Hydrogen peroxide (H₂O₂) (Deprox)** (pic 2)



Pic 1. Patient Zoning

2. Problem

- MRSA outbreak in our NICU resulting in severe adverse outcomes for babies,
- Staff colonisation with MRSA identified
- Environmental contamination with MRSA

6. Effects of Change / Measured Improvement

- The successful implementation of MRSA control bundle of a previously un-screened patient population.
- Hand Hygiene compliance improved over the course of investigation from 50% - 95%.
- Utilising the Deprox process (Fig 3) throughout the entire NICU has effectively eliminated transmission of the virulent MRSA outbreak strain. Transference of the bundle to other settings with promising success.
- Recording the number of colonised babies over time and placing interventions on a time line showing reductions in colonisation rates and non-circulation of virulent MRSA outbreak strains. (Fig 4)

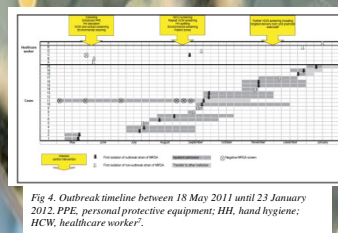


Fig 4. Outbreak timeline between 18 May 2011 until 23 January 2012. PPE, personal protective equipment; HH, hand hygiene; HCW, healthcare worker.

7. Lessons Learnt

- Surveillance and molecular typing of outbreaks typically focuses on patient isolates but should also involve environmental assessment.
- The need for precise strain typing data, to define an outbreak and to identify and map patient acquisition
- The role of the environment as a potential transmission risk; and the need for targeted environmental decontamination in addition to cleaning.

3. Assessment/Analysis

- Between May 2011 and April 2012 31 MRSA-colonised babies were identified
- Genotyping information on all MRSA results of patients, staff and environment identified a number of circulating strains (Fig 1) and enabled a sequencing pattern (Fig 2) around transmission and associated causal links.

MRSA Strains in NICU

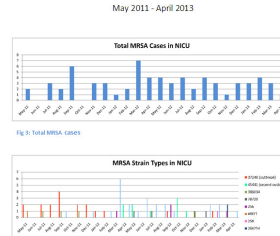


Fig 1. Total MRSA cases

Fig 4. MRSA Strains in NICU

Fig 1 Graphs demonstrating MRSA outbreak and identified strains

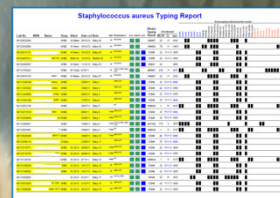


Fig 2 sequencing pattern

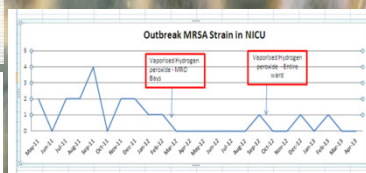


Fig 3 Implementation of Vaporised Hydrogen Peroxide and a reduction eradication of virulent outbreak MRSA strain



Pic 2 vaporised Hydrogen peroxide (H₂O₂) (Deprox)

4. Strategy for change

Need For:

- Routine screening of all babies and mothers,
- Routine Strain typing of MRSA both patient and environment to map acquisition & causal links.
- Implementation of an enhanced environmental decontamination system using vaporised Hydrogen peroxide (H₂O₂) (Deprox).
- Staff consultation and involvement around education with focused efforts on the entire MRSA control bundle – **Environmental decontamination, MRSA strain typing and targeted Infection Prevention & Control**
- 3 months initial assessment and 6 months to complete entire unit decontamination with Deprox & ongoing processes.

- Routine implementation MRSA control Bundle to other high risk units**

8. Message for others

- The role of environmental sampling in investigations of nosocomial outbreaks of MRSA remains controversial and is often underestimated. As demonstrated it is important to intervene using a bundled approach for Infection Prevention & Control using revolutionary technology: such as highly rapid discriminatory MRSA typing system and vaporised Hydrogen peroxide H₂O₂ (Deprox).
- The use of vaporised, Hydrogen peroxide H₂O₂ (Deprox) greatly increases the reduction in microbial load in the environment. As the premier hospital in Australia for this technology we are leading the way in incorporating the Deprox system into normal cleaning processes to avoid any future outbreak situations. Routine procedures now incorporate linking strain types of MRSA among patients, identifying possible transmission events and any causal links with environmental contamination.

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MRSA strain typing project related abstracts by CIDM-PH & MBI

Prospective genotyping of hospital-acquired methicillin-resistant *Staphylococcus aureus* isolates by use of a novel, highly discriminatory binary typing system. O'Sullivan MVN *et al*, *J Clin Microbiol*. 2012;50(11):3513-9.

In settings of high methicillin-resistant *Staphylococcus aureus* (MRSA) prevalence, detection of nosocomial transmission events can be difficult without strain typing. Prospective typing of all MRSA isolates could potentially identify transmission in a timely fashion, making infection control responses to outbreaks more effective. We describe the development and evaluation of a novel 19-target binary typing system for MRSA using the multiplex-PCR/reverse line blot hybridization platform. Pulse-field gel electrophoresis (PFGE), *spa* typing, and phage-derived open reading frame (PDORF) typing were performed for comparison. The system was utilized to identify transmission events in three general surgical wards over a 12-month period. Initial MRSA isolates from 273 patients were differentiated into 55 unique binary types. One or more

potential contacts colonized with the same MRSA strain were identified in 69 of 87 cases (79%) in which definite or possible nosocomial MRSA acquisition had occurred. The discriminatory power of the typing system was similar to that of PFGE (Simpson's index of diversity [D] = 0.994, versus 0.987) and higher than that of *spa* typing (D = 0.926). Strain typing reduced the total number of potential MRSA-colonized source contacts from 859 to 212 and revealed temporal clustering of transmission events. Prospective MRSA typing using this novel binary typing method can rapidly identify nosocomial transmission events, even in high-prevalence settings, which allows timely infection control interventions. The system is rapid, inexpensive, discriminatory, and suitable for routine, high-throughput use in the hospital microbiology laboratory.

Emergence and control of an outbreak of infections due to Panton-Valentine leukocidin positive, ST22 methicillin-resistant *Staphylococcus aureus* in a neonatal intensive care unit Pinto AN *et al*. *Clin Microbiol Infect*. 2013;19(7):620-7.

Methicillin resistant *Staphylococcus aureus* (MRSA) infection can cause significant morbidity and mortality in neonates. We investigated a nosocomial MRSA outbreak in a neonatal intensive care unit (NICU), using a novel typing method. Following two fatal cases, in May 2011, a prospective outbreak investigation was conducted, involving neonates, mothers and healthcare workers in a large tertiary NICU in Sydney. MRSA isolates were characterized by antimicrobial susceptibility testing, a multiplex PCR-based reverse line blot (mPCR/RLB) binary typing system and other molecular typing methods. Over 7 months, 14 neonates were colonized with MRSA and six infected: three with superficial lesions and three with life-threatening disease, including the two index cases, who died despite empirical treatment with vancomycin. Isolates from 15 neonates were indistinguishable by RLB typing and identified as

a PVL-producing ST22 SCCmec IV MRSA strain, which was resistant to gentamicin and trimethoprim-sulphamethoxazole. The outbreak strain was also isolated from one healthcare worker, one environmental swab and one father, but the source remained obscure. During the same period several different non-multiresistant and multiresistant MRSA strains were isolated from five neonates, five mothers (including two whose infants were colonized with the outbreak strain), one father, three healthcare workers and two environmental swabs. Rapid turnaround time of typing results allowed us to recognize and define the outbreak and implement targeted infection control interventions. PVL-producing ST22 SCCmec IV MRSA appears to be a virulent and highly transmissible pathogen in the NICU, which was difficult to control.

Effectiveness of hospital-wide methicillin-resistant *Staphylococcus aureus* (MRSA) infection control policies differs by ward specialty. Sadsad R *et al*. *PLoS One*. 2013;10;8(12)

Methicillin-resistant *Staphylococcus aureus* (MRSA) is a major cause of preventable nosocomial infections and is endemic in hospitals worldwide. The effectiveness of infection control policies varies significantly across hospital settings. The impact of the hospital context towards the rate of nosocomial MRSA infections and the success of infection control is understudied. We conducted a modelling study to evaluate several infection control policies in surgical, intensive care, and medical ward specialties, each with distinct ward conditions and policies, of a tertiary public hospital in Sydney, Australia. We reconfirm hand hygiene as the most successful policy and find it to be necessary for the success of other policies. Active screening for MRSA, patient isolation in single-bed

rooms, and additional staffing were found to be less effective. Across these ward specialties, MRSA transmission risk varied by 13% and reductions in the prevalence and nosocomial incidence rate of MRSA due to infection control policies varied by up to 45%. Different levels of infection control were required to reduce and control nosocomial MRSA infections for each ward specialty. Infection control policies and policy targets should be specific for the ward and context of the hospital. The model we developed is generic and can be calibrated to represent different ward settings and pathogens transmitted between patients indirectly through health care workers. This can aid the timely and cost effective design of synergistic and context specific infection control policies.

Staff Profile

Mary Wyer

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Mary Wyer is a PhD candidate at the University of Technology, Sydney. Her research is being conducted at Westmead hospital as part of a wider National Health and Medical Research Council-funded project aimed at reducing MRSA transmission. Mary uses a multi-method approach, including interviews, ethnographic observations and video-reflexive ethnography, to explore how patients and carers experience, understand and enact infection control. Her specific focus is on roles patients play in preventing infection transmission. This research also offers patient and carer feedback to frontline clinicians and policy makers that can inform patient-centred re-design of infection control services.

Mary is a registered nurse and has specialised as a nurse educator. She recently spent five years in Abu Dhabi as a new graduate nurse program coordinator, working with local nurses in a large teaching hospital. Since her return from the Middle East she has worked casually as a clinical nurse at St Vincent's Hospital in Sydney.

In 2013 Mary took on a research assistant position with the Sydney Medical School. She is part of a team, headed by Professor Lyn Gilbert and Dr Matthew O'Sullivan, that uses strain typing to identify MRSA transmission sources. Part of Mary's role is to assist CIDM-Public Health post doctoral fellow Dr Rosie Sadsad, who is implementing an electronic alert system that can report transmission events to clinicians. Mary does 'on the ground investigation', such as reviewing hospital records, patient bed/ward movements and talking to patients and staff, to uncover as many transmission sources as possible so that these can be incorporated into the alert system.



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