



Binary typing individual probe results

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

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

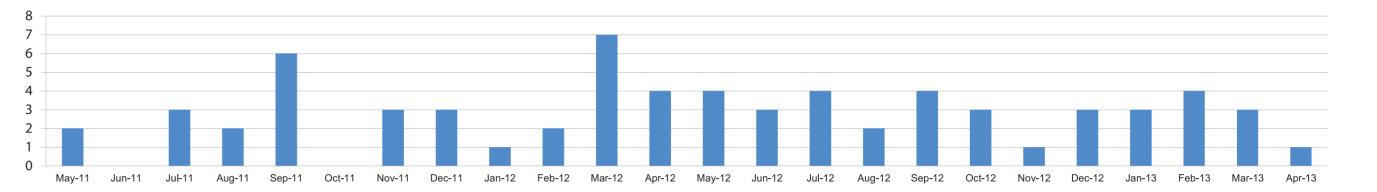
¹Infection Prevention and Control Unit, Westmead Hospital, Sydney, Australia, 2Centre for Infectious Diseases and Microbiology.

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.

Fig 1: MRSA strains in NICU, May 2011 – April 2013. Graphs demonstrating MRSA outbreak and identified strains

Total MRSA Cases in NICU



2 Problem

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

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

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 and causal links
- Implementation of an enhanced environmental decontamination system using vaporised Hydrogen Peroxide (H2O2) (ProXcide[™])
- 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 ProXcide and ongoing processes

MRSA Strain Types in NICU

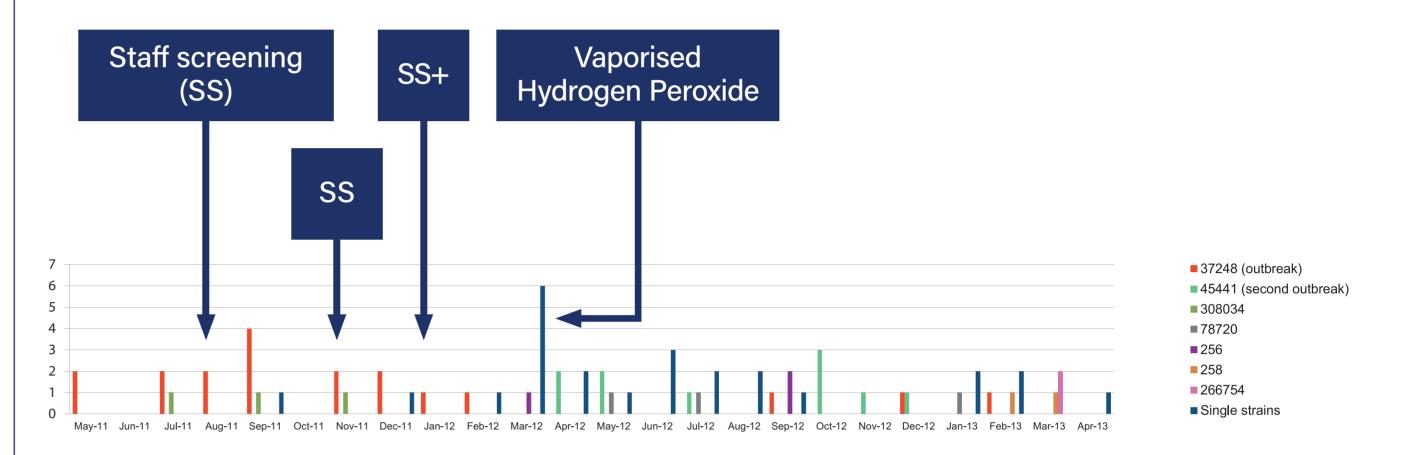


Fig 2: Staphylococcus aureus typing report. Sequencing pattern²

| | | | | | | | | | | | | _ | Binary typing individual probe results^ | | | | | | | _ | |
|-------|---------|---------|-------|----------|----------|----------------|-------------------------------|--------------|----------------------------|-----|------------|-------------------|---|-------------------------|--|--|--|---|--|--|---|
| No | MRN | Name Ho | osp | Ward | Date col | Note | Age Resistance | nuc mecA pvl | Binary Typing Result | | edicte | d)* <i>spa</i> | secAp secSp seaAp seaSp | pvIAp sedAp sedSp | PV83ORF2Ap PV83ORF2Sp SAV0881Ap SAV0881Sp N046Ap | phi11-4568Sp SAV0858Ap SAV0858Sp | SA1801Ap SA1801Sp sltORF257Ap sltORD257Sp | sltORF182Ap sltORF182Ap sltORF182Sp SAV1974Ap SAV1974Sp | mecR1Ap mecR1Sp ccrCAp ccrCSp ccrAB1Ap | cadBAp cadBSp CQ002Ap CQ002Sp E007Ap E007Sp | _ |
| 81511 | 2647534 | W | MD | Birth Un | 13/12/12 | Mother 53 | 39 Not Done | | 37248 | 22 | IV.3.1.2 | ? t005 | | | | | | | | | |
| 93542 | 1283231 | WN | MD | BT Dialy | 6/10/11 | | 60 CIP CLI ERY GEN COT | | 280847 | 239 | <i>III</i> | t037 | | | | | | | | | - |
| 41660 | 2772611 | W | MD | W.Neon | 3/02/13 | | 6d Not Done | | 258 | 73 | IV | t002 | | | | | | | | | - |
| 60297 | 2747650 | WN | MD | W.Neon | 11/12/12 | Baby 53 | 4d Not Done | | 45441 | 22 | | t852 | | | | | | | | | - |
| 11131 | 2738081 | W | MD | W.Neon | 16/12/12 | Baby 54 | 4w Not Done | | 37248 | 22 | IV.3.1.2 | ? t005 | | | | | | | | | - |
| 42066 | 2752173 | WI | MD | W.Neon | 19/12/12 | Baby | 6w Not Done | | 160002 | 78 | IV | t1951 | | | | | | | | | - |
| 32204 | 2755913 | WN | MD | W.Mater | 28/12/12 | Baby 55 | 5d Not Done | | 144257 | 22 | IV | t032 | | | | | | | | | - |
| 41374 | 2755456 | WN | MD | W.Mater | 29/12/12 | Baby | 5d Not Done | | 144257 | 22 | IV | t032 | | | | | | | | | - |
| 43510 | 2762921 | WN | MD | W.Neon | 14/01/13 | Baby 56 | 7d CIP CLI ERY GEN COT | | 46465 | | | | | | | | | | | | - |
| 82600 | 2665606 | WN | MD | C.Unive | 18/01/13 | Mother 56 | 32 Not Done | | 46465 | | | | | | | | | | | | - |
| 71874 | 2768016 | WN | MD | W.Neon | 27/01/13 | Baby (Guthrie) | 8d Not Done | | 78720 | 22 | IV | t032 | | | | | | | | | - |
| 41789 | 2770128 | WM | MD | W.Neon | 3/02/13 | | 11d Not Done | | 37248 | 22 | IV.3.1.2 | ? t005 | | | | | | | | | - |
| 20140 | 2440780 | WM | MD | | 22/05/11 | Baby 1 | GEN COT | | 37248 | 22 | IV.3.1.2 | t005 | | | | | | | | | - |
| 81202 | 2443079 | WM | MD | | 18/05/11 | Baby 2 | GEN COT | | 37248 | 22 | IV.3.1.2 | t005 | | | | | | | | | - |
| 43698 | 2474441 | WM | MD | | 28/07/11 | Baby 3 | GEN COT | | 37248 | 22 | IV.3.1.2 | t005 | | | | | | | | | - |
| 81109 | 2474442 | WN | MD | | 17/07/11 | Baby 4 | GEN COT | | 37248 | 22 | IV.3.1.2 | ? t005 | | | | | | | | | _ |
| 51198 | 2478006 | WN | MD | | 28/07/11 | Baby 5 | Nil | | 308034 | 1 | IV | t127 | | | | | | | | | _ |
| 11319 | 2488374 | WI | MD | | 9/08/11 | Baby 6 | 7 days GEN COT | | 37248 | 22 | IV.3.1.2 | t005 | | | | | | | | | _ |
| 54499 | 2492275 | WI | MD | | 23/08/11 | Baby 7 | 2 weeksGEN COT | | 37248 | 22 | IV.3.1.2 | t005 | | | | | | | | | _ |
| 60451 | 2507673 | WN | MD | | 13/09/11 | Baby 8 | 7 days CIP CLI ERY GEN COT | | 427152 | 772 | V | t657 | | | | | | | | | _ |
| 91867 | 2508934 | WI | MD | | 16/09/11 | Baby 9 | 6 days ^{Nil} | | 308034 | 1 | IV | t127 | | | | | | | | | _ |
| 20338 | 2509819 | W | MD | | 19/09/11 | Baby 10 | 7 days GEN COT | | 37248 | 22 | IV.3.1.2 | t005 | | | | | | | | | _ |
| 40113 | 0001568 | Chi | ildre | | 21/09/11 | Baby 11 | GEN COT | | 37248 | 22 | IV.3.1.2 | t005 | | | | | | | | | _ |
| 13771 | 2517070 | WI | MD | W.Ctr N | 28/09/11 | Baby 12 | 4 days GEN COT | | 37248 | 22 | IV.3.1.2 | t005 | | | | | | | | | _ |
| 13774 | 2517076 | W | MD | W.Ctr N | 28/09/11 | Baby 13 | 5 days GEN COT | | 37248 | 22 | IV.3.1.2 | t005 | | | | | | | | | _ |
| 34182 | 2532415 | WI | MD | W.Ctr N | 9/11/11 | Baby 14 | 2 weeks ^{Nil} | | 308034 | 1 | IV | t127 | | | | | | | | | _ |

Routine implementation of MRSA control bundle to other high risk units

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
- Colonised 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) (ProXcide[™]) (Pic 2)

6 Effects of Change / Measured Improvement

- The successful implementation of MRSA control bundle of a previously unscreened patient population
- Hand hygiene compliance improved over the course of investigation from 50% 95%
- Utilising the ProXcide[™] process(Fig3) hroughout 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)

7 Lessons Learnt

 Surveillance and molecular typing of outbreaks typically focuses on patient isolates but should also involve environmental assessment , SCCmec and spa results in italics are predicted values based upon known isolates typed with the RLB binary typing system (MRSA only); Those in blue bold have been typed. SCCmec nomenclature as per Kondo et al [AAC 51(1):264-74] ^ Toxin genes are in blue, phage-derived open reading frames in black and SCCmec elements in red. Sp=Sense Probe, Ap=Antisense Probe

Fig 3: Outbreak MRSA strain in NICU. Implementation of vaporised Hydrogen Peroxide (H₂O₂) and a reduction eradication of virulent outbreak MRSA strain

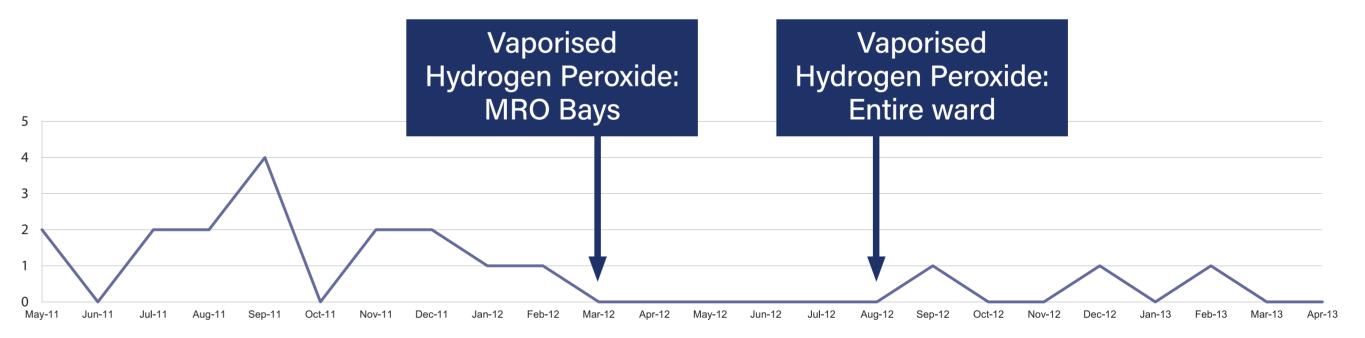
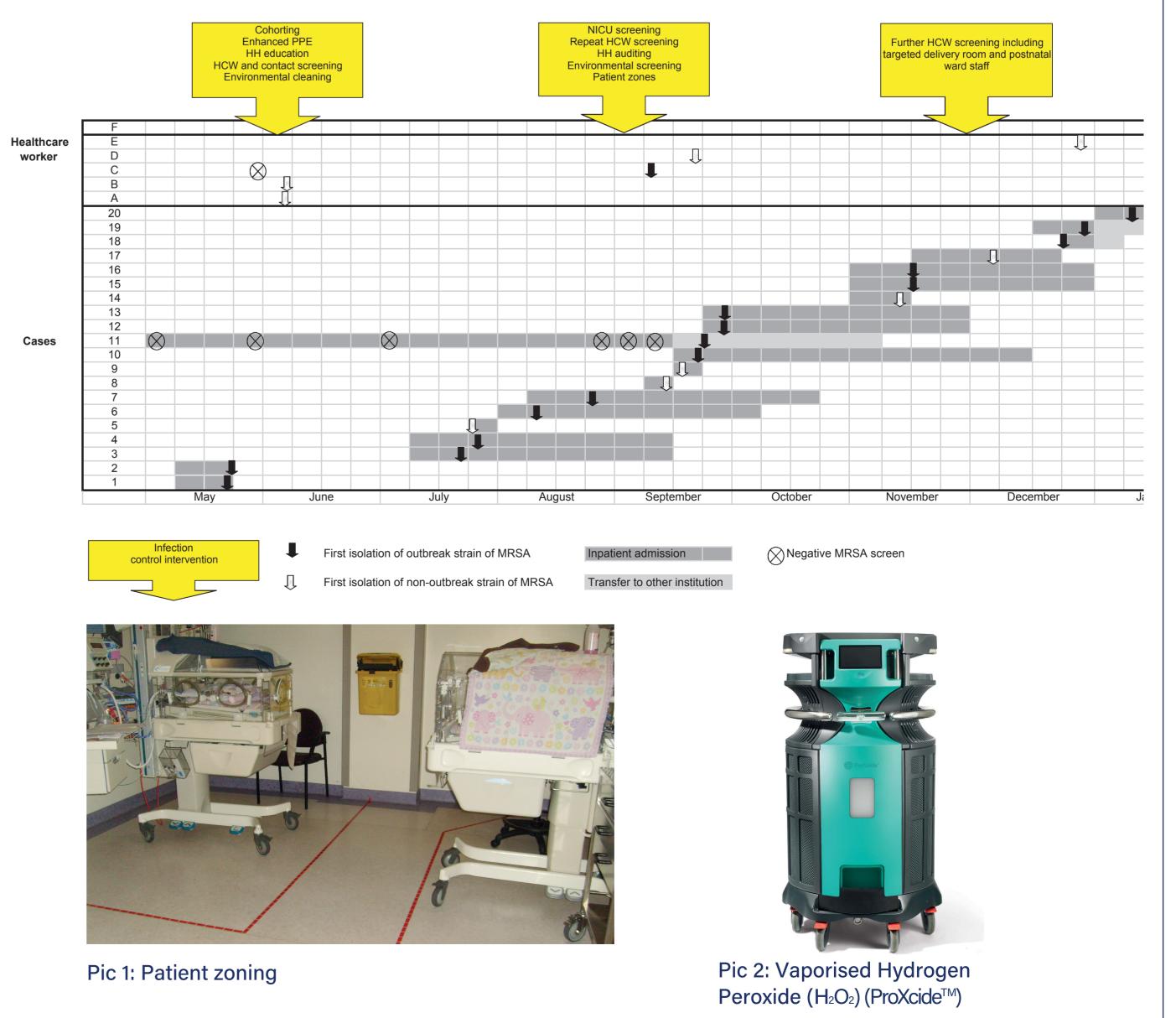


Fig 4: Outbreak timeline between 18 May 2011 until 23 January 2012. PPE (Personal Protective Equipment); HH (Hand Hygiene); HCW (Healthcare Worker)



- 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

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 (ProXcide[™]).

The use of vaporised Hydrogen Peroxide H2O2 (ProXcide[™]) 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 ProXcide[™] 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.