Institution: University of Birmingham

Unit of Assessment: A1

Title of case study: Saving lives through universal MRSA Screening

1. Summary of the impact (indicative maximum 100 words)

Methicillin-resistant Staphylococcus aureus (MRSA) are strains of bacteria which are resistant to a range of commonly used antibiotics and as a result are difficult to treat and cause significant morbidity and mortality amongst hospitalised patients and individuals with compromised immunity. Research conducted by Professor Peter Hawkey at the University of Birmingham has demonstrated that by rapidly screening patients for MRSA on hospital admission and then using an effective decolonisation treatment, the rate of MRSA acquisition can be significantly reduced. The Department of Health (DoH), who commissioned the research, used the results of the work to formulate guidance, which was published in 2008, for universal MRSA screening in England. This has contributed to the sustained reduction in MRSA infection in England, which is indicated by the fall in MRSA bacteraemia rates from 7,274 in 2002 to 1,185 in 2011 (-83.7%).

2. Underpinning research (indicative maximum 500 words)

Staphylococcus aureus is an opportunistic pathogen, with about a third of the population being colonised. It can cause disease if there is an opportunity for it to enter the body through broken skin, or a procedure requiring the use of an invasive medical device. If the bacteria enter the body, mild to life-threatening illnesses may then develop. MRSA strains have emerged which are not only resistant to beta lactam antibiotics, (e.g. flucloxacillin, amoxicillin and cephalosporins), but many other unrelated antibiotics. MRSA is an important health care associated infection as it is difficult to treat and causes a significant degree of morbidity and mortality, with between 1000 and 2000 deaths per year in the UK being attributed to MRSA between 2001 and 2009 (Office of National Statistics Data). Since April 2001 there has been mandatory reporting of all MRSA bacteraemias, which are used as a surrogate marker for the prevalence of MRSA in England. In 2003/4 the government introduced targets for each NHS Trust and, as a result, multiple infection control measures were introduced. Prior to introducing universal screening for MRSA in England, a controlled trial investigating the impact on MRSA rates of two different screening methodologies was funded by the DoH and undertaken by Professor Hawkey (Professor of Clinical and Public Health Bacteriology, at UoB from 2012) and Dr Hardy (Clinical Scientist) at the University of Birmingham from January 2005 to April 2007 [1].

A prospective, cluster, two period cross-over design was used. Seven surgical wards at a large hospital were allocated to two groups, and for the first eight months four wards used rapid MRSA screening by polymerase chain reaction (PCR) and three wards used a standard culture method. The groups were reversed for the second eight months. Regardless of the method of detection, all patients were screened for nasal carriage of MRSA on admission and every four days thereafter. MRSA control measures were the same in both arms and included barrier nursing or isolation of patient, prescribing of decolonisation treatment and alteration of prophylaxis if having surgery [2]. Results were analysed using a log linear Poisson regression model. A total of 12,682/13,952 patient ward episodes were included in the study.

Admission screening identified 453 (3.6%) MRSA positive patient ward episodes, with a further 268 (2.2%) acquiring MRSA post-admission. After adjusting for other variables, rapid PCR screening was shown to statistically reduce MRSA acquisition with patients being 1.49 times (p=0.007) more likely to acquire MRSA in wards where they were screened using the culture method [3]. Screening of surgical patients using rapid PCR testing resulted in a statistically significant reduction in MRSA acquisition [3].

3. References to the research (indicative maximum of six references)

1. Department of Health Grant: A study of the efficacy and cost-effectiveness of MRSA screening and monitoring on surgical wards using a new, rapid molecular test (EMMS), award to: Professor Peter Hawkey. Period of the grant: October 2005 to June 2007. Value of the grant: £575,046
2. **Hardy KJ**, Szczepura A, Davies R, Bradbury A, Stallard N, Gossain S, Walley P, **Hawkey PM**. A study of the efficacy and cost-effectiveness of MRSA screening and monitoring on surgical wards using a new, rapid molecular test (EMMS). BMC Health Serv Res. 2007 Oct 3;7:160. *DOI 10.1186/1472-6963-7-160*
3. **Hardy K**, Price C, Szczepura A, Gossain S, Davies R, Stallard N, Shabir S, McMurray C, Bradbury A, **Hawkey PM**. Reduction in the rate of methicillin-resistant *Staphylococcus aureus* acquisition in surgical wards by rapid screening for colonization: a prospective, cross-over study. Clin Microbiol Infect. 2010 Apr;16(4):333-9. *DOI 10.1111/j.1469-069.2009.02899x*

4. Details of the impact (indicative maximum 750 words)

Impact on policy and guidance

Since the publication of the research outcomes in 2010, the work has attracted considerable attention across the UK and internationally. The findings from the research described above were used by the DoH in formulating their national policy for MRSA screening in patients (published in 2008), which required all NHS trusts to screen all elective patients on admission and all emergency admissions as soon as practicable possible for MRSA [1, 2]. The letter supplied by the Inspector of Microbiology and Infection Control at the DoH details that "the work in Birmingham was an important contribution to our [DoH] understanding of the epidemiology of MRSA in hospital patients" and "the study on the use of rapid screening methods to identify patients colonised with MRSA on admission was a seminal study that informed and influenced the national guidance on screening from the DoH" [3]. The importance of the work in influencing NHS policy and practice is further exemplified in the letter supplied by the Director of Infection Prevention and Control at the Hammersmith Hospital, London, who detailed that 'the work provided valuable information to the NHS and all NHS trusts about the effectiveness and application of such screening in the NHS environment to tackle the challenge of MRSA" [4]. The results of this work have been widely used internationally in formulating guidance on the use of screening in USA [5] and Europe [6].

Impact on Infection rates and patient outcomes

The combination of control measures (including PCR screening) instituted in England has resulted in a 38% decrease in MRSA bacteraemias from April–June 2009 compared to April–June 2011 with substantial improvements in patient outcome, as reported on the Department of Health/Public Health England website for mandatory reporting [7]. These measures include screening of the patient, followed by prompt decolonisation and isolation, with the advantage of PCR testing being that patients are identified rapidly enabling control measures to be implemented in real time. This has the effect of limiting the transmission of MRSA to other patients on the ward and thereby preventing colonisation and infection.

Impact on clinical practice

Following the completion of the research, a business plan was written by Professor Peter Hawkey and presented to the Heart of England NHS Foundation Trust recommending the use of PCR based MRSA screening for emergency patients. This strategy was adopted in June 2008 and since the introduction the number of MRSA bacteraemias has continued to decline and the Trust has met the targets that the DoH has set. Annually the Trust screens 71,000 patients for MRSA using the molecular method. Heart of England NHS Foundation Trust published in 2010 that "by using the latest DNA technology to find patients carrying MRSA within hours of admission and giving them treatment, the chance of those patients passing on MSRA was reduced by 50%" [8]. Furthermore the Health Protection Agency published in 2009 that "the use of rapid surveillance testing can

further accelerate the reduction in MRSA transmission", with Professor Hawkey's research being cited directly [9].

The proposal for the use of rapid screening form MRSA coupled with decolonisation in a selected setting (high incidence surgical patients) has been modelled for cost effectiveness by a collaboration of international centres and found to be one of the best options [10].

At the 2011 General Meeting of the American Society of Microbiology (largest US infection society) Professor Peter Hawkey's work was cited by the Director of Microbiology and Infectious Disease Research at NorthShore University Healthcare System, as one of the most significant studies (as it captured ≥ 80% of missed isolation days) supporting rapid PCR screening of surgical patients [11].

5. Sources to corroborate the impact (indicative maximum of 10 references)

1. Operational guidance document from DoH detailing screening requirements (31st July 2008), sent to all NHS Chief Executives and other senior NHS officials.
2. Operational document from DoH detailing screening requirements (31st March 2010)
3. Letter of support from the Inspector of Microbiology and Infection Control at the Department of Health
4. Letter of support from the Director of Infection Prevention and Control at the Hammersmith Hospital, London.
5. Marlowe et al, 2011, Conventional and Molecular Methods for the Detection of Methicillin-Resistant *Staphylococcus aureus*, JCM, 49 : S53-6
6. Harbarth et al, 2010, Update on screening and clinical diagnosis of methicillin-resistant *Staphylococcus aureus* (MRSA), IJAA, 37(2) : 110-7
7. http://www.hpa.org.uk/web/HPAweb&HPAwebStandard/HPAweb_C/1233906819629 (table 2a)
8. Heart of England NHS Foundation Trust, 2010, Warding off MRSA through rapid screening study drives down super bugs
9. HPA, 2011, Health Protection Report, Study concludes active surveillance testing with molecular methods reduces transmission of MRSA among surgical patients
10. Hubben et al, 2011, Modelling the costs and effects of selective and universal hospital admission screening for methicillin-resistant *Staphylococcus aureus*, PloSOne, 6(3): e14783
11. Petersen, 2011, Molecular vs non-Molecular Testing for MRSA/MSSA: The Case for Molecular Screening