C-315

Analysis of Healthcare-Associated Methicillin-Resistant *Staphylococcus aureus* Infections and the Effectiveness of a Community Hospital's Medical Isolation District

Rebecca Creech Tart[1] and Emily Mabry[2]
[1]Catawba Valley Medical Center, Hickory NC, [2]Lenoir-Rhyne College, Hickory NC

INTRODUCTION

The CDC reports healthcare-associated infections (HAI) are among the top ten leading causes of death in the US (1). Fifty percent of staphylococcal infections acquired by persons hospitalized in 2004 were due to methicillin-resistant *Staphylococcus aureus* (MRSA). In the past, MRSA were primarily nosocomial pathogens (2). Today, community-associated MRSA (CA-MRSA) is an emerging infection in the US and around the world. CA-MRSA skin infections often occur in persons devoid of risk factors, e.g. in athletes (3).

MRSA spreads easily from person to person via direct contact. Confined quarters augment the infection rate in high density facilities such as hospitals and institutions. According to a study by Kopp et al (4), the average hospital stay for a patient with MRSA bacteremia exceeds that of patients with methicillin-sensitive *S. aureus* infections by 4.5 days.

The Centers for Medicare & Medicaid Services (CMS) new policies halting payment for patient care resulting from preventable injuries takes effect October 2008. HAI are under consideration for inclusion in the 2009 CMS list of preventable injuries providing further impetus for hospitals to reduce HAI (5).

This retrospective study explored the relatedness between MRSA strains colonizing patients entering Catawba Valley Medical Center (CVMC) and MRSA strains infecting patients during their hospital stay.

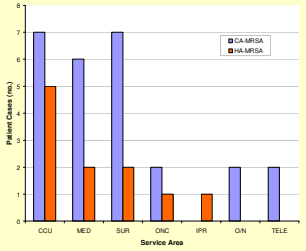
METHODS

- **Epidemiology**
  - The hospital course for each MRSA-infected patient was tracked from admission to discharge from CVMC
  - Chronological comparisons between CA-MRSA and HA-MRSA patient courses included
    - hospital location(s)
    - fixed and floating hospital staff
    - medical staff
    - respiratory and radiology equipment

- **Pulse-Field Gel Electrophoresis (PFGE)**
  - MRSA chromosomal DNA recovered from clinical isolates was digested with *Sma*I using The Rapid *Staphylococcus aureus* Protocol adapted from The Marco Method (6)
  - Restricted DNA samples were electrophoresed at 6 V and 15ºC for 23 hours in a Contour Clamped Electrophoresis Fields (CHEF) apparatus
  - After ethidium bromide staining and destaining, digital images were taken via trans-UV light

- **MRSA Prevalence**
  - Data from two archiving databases were used to determine
    - number of patients colonized with CA-MRSA on admission
    - number of patients diagnosed with HA-MRSA during stay
    - medical and nonmedical census
  - Colonization or infection rate = (# cases/patient days) x 1000

EPIDEMIOLOGY FINDINGS



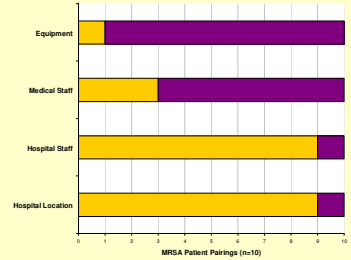
Incidence of MRSA among patients hospitalized at CVMC from 01/01/04 to 03/31/04. Service areas- CCU: critical care unit; MED: medical; SUR: surgical; ONC: oncology; IPR: inpatient rehabilitation; O/N: orthopaedics/neurology; and TELE: telemetry.

- 37 MRSA cases were identified among patients hospitalized from January 01 to March 31, 2004 at CVMC

- Nasal cultures positive for MRSA ≤48 hours of admission were classified CA-MRSA (26 cases); patients culturing MRSA positive ≥49 hours post-admission were designated HA-MRSA (11 cases)

- Critical care unit, medical and surgical service areas represented 77% of MRSA-colonized patient admissions, while more HA-MRSA infections (5 of 11) occurred in the critical care unit than elsewhere housewide

- A single inpatient rehabilitation (IPR) patient developed HA-MRSA infection though no MRSA-colonized patients were admitted to IPR



- Of the 11 HA-MRSA patients, 10 were linked epidemiologically to a CA-MRSA patient or another HA-MRSA patient by one or more potential transmission routes, i.e. human contact or common fomites

- Proximity of hospital location and hospital staff interaction were the most common transmission factors in the 10 patient pairs

- Common respiratory staff were identified in 6 of 9 pairings that involved hospital staff

MOLECULAR ANALYSIS

- MRSA clinical isolates were not available for either or both patients in all CCU HA-MRSA pairs prohibiting molecular investigation

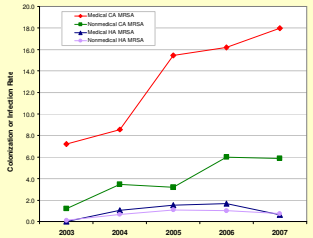
- DNA typing was limited to 3 of the 10 patient pairs-
  - Hospital staff, room location in common: M14273 & M245
  - Medical staff, hospital staff, OR location factors: M2865 & M1290
  - Medical staff in common, but separated in time: M2865 & M3140

PFGE of MRSA DNA from clinical isolates. Lane 1: Lambda ladder PGE marker; Lanes 2, 3, 5: M14273 in varying concentrations; Lane 4: M245; Lanes 6, 7: M2865; Lane 8: M1290; and Lane 9: M3140.

- CA-MRSA isolate M14273 and HA-MRSA isolate M245 DNA fingerprints reveal the MRSA strains recovered from these patients were different, but highly related

- M2865 (CA-MRSA) was the same strain infecting the linked HA-MRSA patient (M1290 DNA), but not the same as M3140 (HA-MRSA)

MRSA PREVALENCE OVER TIME



- CA-MRSA has increased hospital-wide and significantly on the medical service during the 5-yr period shown, yet the medical HA-MRSA rate fell by 63% in 2007 compared to a 26% decrease for all other service areas

- The medical unit established an isolation district in late 2005, and it moved to another area on the floor early in 2006. By establishing a group of patient rooms in a central district, MRSA-colonized patients were cohorted together. The isolation district was closed due to construction at the end of 2006.

CONCLUSIONS & IMPLICATIONS

- Given the rate at which MRSA-positive individuals has been reported to be on the rise in US communities, the increase in hospital admissions of patients colonized with MRSA as observed in this study was expected.

- Relatively few of the CA-MRSA/HA-MRSA patient pairs were candidates for DNA investigation of strain relatedness since storage of MRSA clinical isolates was inconsistent and the study was conducted retrospectively.

- Though epidemiologic evaluation of patient data may suggest a connection(s) for possible transmission of MRSA bacteria between patients, these findings reveal the means is not definitive.

- Molecular analysis of DNA from MRSA isolates can provide evidence to support or deny a suspected route of transmission between hospitalized patients.

- Many challenges were encountered in the implementation of an isolation district on the medical service at CVMC. Though closed at present, opportunity may exist in the future to reestablish an isolation district in a separate area for medical and surgical patients.

- Raising awareness of the importance of hand hygiene and the use of personal protective equipment (PPE) in reducing bacterial transmission in the acute care setting paid dividends in that HA-MRSA infection rates fell even though CA-MRSA colonization rates continued to rise in 2007.

- Controlling HA-MRSA is critical as patients move between hospitals more frequently today than in the past. Thus, one facility's MRSA problem can contribute to the microbial population in another fairly rapidly.

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CONTACT INFORMATION

Rebecca Creech Tart, PhD rtart@catawbavalleymc.org