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The emerging infection of superbug (MRSA) in hospital as well as in community

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ABSTRACT:

The term superbug is a nonspecific word that is used to describe any microorganism that is resistant to at least one or more commonly used antibiotics. MRSA is "Methicillin Resistant *Staphylococcus aureus*" is a bacterium that is resistant to a synthetic penicillin- methicillin. MRSA causes a variety of disseminated, lethal infections in humans. MRSA has the ability to easily transfer resistant genes to other species directly and indirectly. Overuse of antibiotics imposes selective pressures which mediates the acquisition of resistance. MRSA has been a major concern in hospital-based institutions for many years. Now "Community acquired MRSA" has become a health concern for everyone. 100,000 people are hospitalized each year with MRSA infections. *Staph aureus* bacteria are commonly carried on the skin or in the noses of healthy people. The one cannot get rid of MRSA; can only control it. MRSA frequently lives harmlessly on skin surfaces of the mouth, genitalia and rectum. The study showed a 17% drop in invasive MRSA infections that were diagnosed before hospital admissions (community onset) in people with recent exposures to healthcare settings.

Keywords: super bug, MRSA, community, hospital, emerging infection.

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INTRODUCTION:

The term *Staphylococcus* is derived from the Greek expression *staphyle* (bunch of grapes). The term *aureus* was named due to the organisms golden appearance when viewed under the microscope. The term superbug is a nonspecific word that is used to describe any microorganism that is resistant to at least one or more commonly used antibiotics. Some authors restrict its use to microorganisms resistant to two or more antibiotics. The most common bacteria described as superbug are the following:

- * MRSA (*Staphylococcus aureus* strains resistant to multiple antibiotics)
- * VRE (*Enterococcus* species resistant to vancomycin)
- * PRSP (*Streptococcus pneumoniae* strains resistant to penicillin)
- * ESBLs (*Escherichia coli* and other Gram-negative bacteria resistant to antibiotics such as cephalosporin and monobactams)

MRSA:

Methicillin-resistant *Staphylococcus aureus* (MRSA) is a type of staph bacteria that is resistant to certain antibiotics called beta lactams. Methicillin-Resistant *Staphylococcus aureus* (MRSA) is a bacterium responsible for several difficult to treat infections in humans. It may also be called multidrug resistant *Staphylococcus aureus* (ORSA).

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SCIENTIFIC CLASSIFICATION:

Taxonomy	Name	Reason
Domain	Bacteria	Bacteria are very small, single-celled organisms that can reproduce qu
Kingdom	Eubacteria	Eubacteria are commonly occurring prokaryotes that live in a variety o
Phylum	Firmicutes	Firmicutes are gram-positive
Class	Bacilli	Bacilli are rod-shaped
Order	Bacillales	
Family	Staphylococcaceae	A lot of medically significant pathogens are in this family
Genus	Staphylococcus	Divide into two planes
Species	Staphylococcus aureus	Yellow coloring
subspecies	Methicillin-resistant Staphylococcus aureus	Resistant to methicillin an antibiotic

In the community, most MRSA infections are skin infections. More severe or potentially life-threatening MRSA infections occur most frequently among patients in healthcare settings. While 25% to 30% of people are colonized* in the nose with staph, less than 2% are colonized with MRSA (Gorwitz RJ et al. Journal of Infectious Diseases. 2008:197:1226-34.). (*Colonized: When a person carries the organism/bacteria but shows no clinical signs or symptoms of infection. For *Staph aureus* the most common body site colonized is the nose.)

MRSA is spread by mainly contact. MRSA is carried by about 1% of the population although most of them are not affected by them or they had no type of injury or infection.

MRSA is mostly seen in hospitals acquired patients, nursing staff and other primary health centre and community health centre. MRSA cause mainly more than 62% of staphylococcus infection.

MRSA strains are currently resistant to several different antibiotics such as penicillin, oxacillin, and amoxicillin (Amoxil, Dispermox, Trimox). HA-MRSA is often also resistant to tetracycline (Sumycin), erythromycin and clindamycin (Cleocin). Now vancomycin resistance *Staphylococcus aureus* also emerged in some area.

BINOMIAL NAME: *Staphylococcus aureus*

MRSA CATEGORISATION BY SOURCE OF INFECTION:

1) CA-MRSA - community-acquired MRSA: This occurs in individual that are normally healthy and not receiving healthcare on an ongoing basis for chronic conditions.

CA-MRSA is mainly infecting younger people of the PHC or CHC. Minnesotan published in the Journal of American Medical Association, the average age of people of MRSA in hospital or other PHC or CHC was 68. But average of a patient having CA-MRSA was only 23. So it is easily understood that MRSA is infection which is mainly seen in young age.

2) HA-MRSA – Hospital (or Healthcare) acquired Methicillin Resistant *Staphylococcus aureus* which occurs in a hospital.

3) E-MRSA - Epidemic type of MRSA.

BASIC FEATURES AND DESCRIPTIONS:

Methicillin resistant *Staphylococcus aureus* progresses substantially inside 24-48 hours of first topical symptoms. Later on 72 hrs, MRSA can take hold in human tissues and eventually become resistant to handling. Usually first symptom of these bacteria is small red bumps that resemble pimples, spider bites or boils that may be followed by fever and from time to time rashes. Within a couple of days the bumps get larger, more painful and finally open into deep, pus-filled boils. MRSA is now resistant to methicillin, amoxicillin, penicillin, oxacillin, and other antibiotics.

MRSA INFECTION FACTS:

- The majority of CA-MRSA starts as skin infections; HA-MRSA can begin an infection of the skin, a wound (often a surgical site), or a location where medical devices are placed (catheters, IV lines, or other devices).

- Most MRSA infections are diagnosed by culture and antibiotic sensitivity testing of *Staphylococcus aureus* bacteria isolated from an infected site; a polymerase chain reaction test is also available.
- Currently, MRSA bacteria are almost always found to be resistant to multiple antibiotics. All isolated MRSA strains need to have antibiotic susceptibility determined to choose the correct or appropriate antibiotic therapy.
- Treatment of HA-MRSA frequently involves the use of vancomycin, often in combination with other antibiotics given by IV; CA-MRSA can often be treated on an outpatient basis with specific oral or topical antibiotics, but some serious CA-MRSA infections (for example, pneumonia) often require appropriate antibiotics by IV.

CAUSES

- Rational use of antibiotics
- Overuse of antimicrobial drugs
- Inadequate treatment with antimicrobial agent
- Poor drug quality
- Rarely , erratic absorption of drug
- Treatment with wrong kind of infection, in the wrong dosage and for the wrong period of time.
- Non standardize treatment regimen
- Genetic mutation among the micro-organism

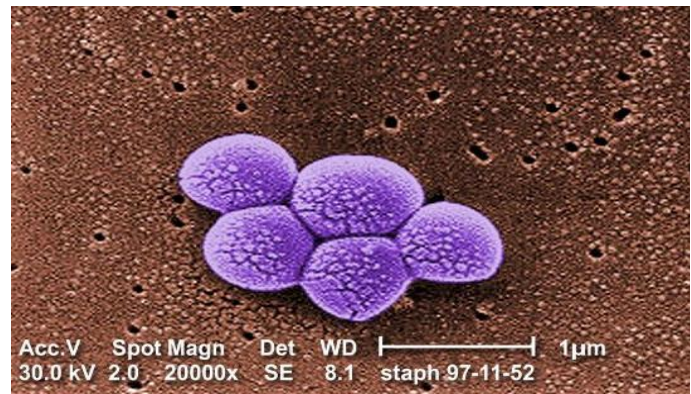
SYMPTOMS

It is normal for healthy people to have staph on their skin. Most of the time, it does not cause an infection or any symptoms. This is called "colonization" or "being colonized." Someone who is colonized with MRSA can spread MRSA to other people.

MRSA in healthcare settings usually causes more severe and potentially life-threatening infections, such as bloodstream infections, surgical site infections, or pneumonia. The signs and symptoms will vary by the type and stage of the infection.

A sign of a staph skin infection is a red, swollen, and painful area on the skin. MRSA infections in patients in health care facilities tend to be severe. These staph infections may be in the bloodstream, heart, lungs, or other organs, urine, or in the area of a recent surgery. Some symptoms of these severe infections are: Chest pain, Cough or shortness of breath, Fatigue, General ill feeling, Headache, Rash which are mainly seen in the MRSA infection.

Photo credit: Janice Carr (public health image library)



TRANSMISASION OF MRSA INFECTION:

MRSA infection is mainly transmitted by the physical skin contact by patients. The other thing is the things (door, utensils, books, etc) which are used by the MRSA patients. MRSA infection is occurring at any geographical area. Times ago, MRSA infection was mainly seen in hospital acquired patients but now MRSA infection are seen in community also. The mainly factor which affect the transmission of MRSA is the broken or injured skin. When the Patients is hospitalized and visitors are come in contact with patients by kissing, hugging and touching, the visitor gets increases the risk of MRSA infections.

WHO IS AT RISK?

- a weakened immune system, for example in elderly people, newborn babies and people with a long-term health condition, such as [type 2 diabetes](#)
- an open wound
- a catheter or an intravenous drip
- a [burn](#) or [cut](#) on the skin
- a severe skin condition, such as a [leg ulcer](#) or psoriasis
- surgery
- taking frequent courses of antibiotics

DIAGNOSIS AND TESTING OF MRSA INFECTION:

MRSA is mainly diagnosed by mainly skin and soft tissue infection (SSTI) comparable with *S. aureus* infection. A skin sample, sample of pus from a wound, blood, urine, or biopsy material is sent to a microbiology lab and cultured for *S.aureus*. There are mainly 4 types of culturing is mainly done for the diagnosis of MRSA.

- 1) Skin infection culturing
- 2) Pneumonia culturing
- 3) Bloodstream infection culturing
- 4) Urinary infection culturing

Laboratory detection of MRSA: The National Committee for Clinical Laboratory Standards (NCCLS), now called the Clinical and Laboratory Standards Institute (CLSI), recommends the ceftoxitin disk screen test, the latex agglutination test for PBP2a, or a plate containing 6 µg/ml of oxacillin in Mueller-Hinton agar supplemented with NaCl (4% w/v; 0.68 mol/L) as alternative methods of testing for MRSA.

TREATMENT FOR MRSA INFECTION:

Most MRSA infection can be treated by specific antibiotics vancomycin, linezolid, and other often in combination with vancomycin. Some CA-MRSA strains are susceptible to trimethoprim-sulfamethoxazole (Bactrim), doxycycline and Clindamycin (Cleocin).

MEDICATION FOR MRSA:

Types of antibiotic medications that may work include:

Clindamycin	Tetracyclin	Doxycycline
Damptomycin	Bactrim	Vancomycin
Linezolid	Bactrim DS	
Minocycling		

Mild infections usually respond to Mupirocin medication (Bactrocin).

NDM 1:

New Delhi Metallo-beta-lactamase (NDM-1) is an enzyme that makes bacteria resistant to a broad range of beta lactam antibiotics. The gene for NDM-1 is one member of a large gene family that encodes beta lactamase enzymes called carbapenemases. Bacteria that produce carbapenemases are often referred to in the news media as “superbug” because infections caused by them are difficult to treat. Such bacteria are usually only susceptible to polymyxins and tigecycline.

NDM-1 was first identified in December 2009 in a patient hospitalized in New Delhi with infection caused by *Klebsiella pneumoniae*. The most common bacteria that make this enzyme are Gram negative such as *Escherichia coli* and *Klebsiella pneumoniae*.

ENVIRONMENTAL CONTROL

Inmate housing areas and bathroom facilities should be regularly cleaned with an EPA registered detergent disinfectant according to the manufacturer’s instructions. Recreational equipment, such as weight benches, should routinely be wiped clean after use with a clean dry towel. Inmates should use barriers to bare skin, such as a towel or clean shirt, while using exercise equipment.

ENZYME FUNCTION:

Carbapenems are a class of beta-lactam antibiotics which are capable of killing most bacteria by inhibiting the synthesis of

one of their cell wall layer. The carbapenemes were developed to overcome antibiotic resistant mediated by bacterial beta-lactamase enzymes. However, the blaNDM-1 gene produces NDM-1, which is a carbapenemase beta-lactamase- an enzyme that hydrolyzes and inactivates these carbapenem antibiotics. The NDM-1 enzyme is one of the class B metallo-beta-lactamase; other types of carbapenemases are class A or class D beta-lactamase class A *Klebsiella pneumoniae* carbapenemase (KPC).

NEW DRUG:

- UK researchers recently revealed that they have developed a new anti-bacterial drug named **XF-73**, which has the potential to eliminate deadly superbug such as *C.diff* and MRSA, within five minutes.
- A new antibiotic, **tedizolid phosphate**, appears to be a reasonable alternative to linezolid for the treatment of MRSA infection. A short (6-day) course of tedizolid phosphate was as effective as a 10-day course of linezolid

PREVENTION

The best way to prevent the spread of *S. aureus* is for everyone to keep their hands clean. It is important to wash your hands properly.

Health care workers and other hospital staff can prevent staph. Visitors also need to take steps to prevent spreading germs. If you have surgery planned, tell your health care providers if: You have frequent infections. You have had a MRSA infection before.

In recent years, rates of MRSA have fallen because of increased awareness of the infection by both medical staff and the public. However, MRSA still places a considerable strain on healthcare services.

To reduce your risk of MRSA infection:

- Wash your hands before and after visiting someone in a care home (many hospitals provide antibacterial gel in wards).
- If you are going into hospital for an operation, ask to be screened for MRSA.
- Speak to your nurse or doctor if you have any concerns about hygiene in your hospital.
- Put all disposable items, such as dressings, into the appropriate bins promptly.

PREVENTION FOR HOSPITAL STAFF:

Hospital staff that comes into contact with patients should maintain very high standards of hygiene and take extra care when treating patients with MRSA:

- Staff should thoroughly wash and dry their hands before and after caring for a patient, before and after touching any potentially contaminated equipment or dressings, after bed making and before handling food.
- Disposable gloves should be worn when staffs have physical contact with open wounds, for example when changing dressings, handling needles or inserting an intravenous drip. Hands should be washed after gloves are removed.
- Patients with a known or suspected MRSA infection should be isolated.
- Hands can be washed with soap and water or, if they are not visibly dirty, a fast-acting antiseptic solution like a hand wipes or hand gel.
- The hospital environment, including floors, toilets and beds, should be kept as clean and dry as possible.

PREVENTION FOR VISITOR:

Visitors can reduce the chance of spreading MRSA to other people by not sitting on the patient's bed and by cleaning their hands before and after entering the ward. They should use hand wipes or hand gel before touching the person they are visiting.

Hand gel or hand wipe dispensers are often placed by patients' beds and at the entrance to clinical areas.

PREVENTION FOR PATIENTS:

Hospital patients can reduce their risk of infection by:

- Always washing their hands after using the toilet or commode (many hospitals now routinely offer hand wipes).
- Always washing their hands or cleaning them with a hand wipe immediately before and after eating a meal.
- making sure their bed area is regularly cleaned and reporting any unclean toilet or bathroom facilities to staff

IMMUNIZATION FOR MRSA ON THE HORIZON NEW HOPES FOR TOTAL JOINT REPLACEMENT PATIENTS.

San Francisco, Calif., February 7, 2012-Methicillin resistant *Staph aureus* (MRSA) infections are resistant to antibiotics and can cause a myriad of problems-bone erosion, or osteomyelitis, which shorten the effective life of an implant and greatly hinder replacement of that implant. MRSA can result in prolonged disability, amputation and even death.

Although only 2 percent of the American population that undergo total joint replacement surgery will suffer an infection, half of those infections are from MRSA. The results of a MRSA infection after a total joint replacement can be devastating. Currently, there is no effective treatment for MRSA-infected implants. With the increasing incidence of total joint replacement surgeries, the prevalence of MRSA-infected implants is expected to rise.

A team of investigators from the University of Rochester Medical Center has developed a vaccine that can prevent bacterial infection of orthopedic implants. Their findings were presented at the Orthopedic Research Society (ORS) 2012 Annual Meeting in San Francisco, California.

The team, led by Edward Schwarz, PhD, Professor of Orthopedics and Associate Director of the Center for Musculoskeletal Research, has generated an antibody that prevents MRSA bacteria from dividing properly.

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