



# Prevalence of Methicillin Resistant *Staphylococcus aureus* among Isolates from Wounds in Surgical Wards at Kabale Regional Referral Hospital, South Western Uganda

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## Authors' contributions

*This work was carried out in collaboration between all authors. Author BA designed the study, performed the statistical analysis, wrote the protocol, wrote the first draft of the manuscript and managed literature searches. Authors BA, KA and JB managed the analyses of the study and literature searches. All authors read and approved the final manuscript.*

## Article Information

DOI: 10.9734/BMRJ/2016/27807

### Editor(s):

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Complete Peer review History: <http://www.sciencedomain.org/review-history/16945>

**Original Research Article**

**Received 20<sup>th</sup> June 2016**  
**Accepted 28<sup>th</sup> October 2016**  
**Published 17<sup>th</sup> November 2016**

## ABSTRACT

**Background:** Methicillin resistant *S. aureus* (MRSA) is a multidrug resistant organism that threatens the continued effectiveness of antibiotics worldwide and causes a threat almost exclusively in hospitals and long-term care settings. This study sought to determine the prevalence and antimicrobial susceptibility pattern of MRSA at Kabale Regional Referral Hospital (KRRH) in

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South Western Uganda.

**Methods:** This was a cross sectional study conducted between June and November 2014 involving 350 pus swabs from infected surgical sites. The samples were cultured on Mannitol salt agar at 37°C for 17- 24 hours and the colonies were tested and confirmed as *S. aureus* using API staph testing kit. Screening for MRSA was performed using the Cefoxitin (30 µg) disc on Muller Hinton agar medium. MRSA susceptibility was performed by the Kirby Bauer disc diffusion on MHA for the following antibiotics: Ceftriaxone, Ciprofloxacin, Erythromycin, Imipenem, Trimethoprim – sulfamethoxazole, Levofloxacin and Gentamycin. The zones of inhibition were measured using a ruler and compared with the CLSI guidelines 2012.

**Results:** From the 350 pus swabs, 331 isolates of *S. aureus* were obtained, of which 179 (54%) isolates were Methicillin resistant. Majority (54%) of the MRSA isolates were highly sensitive to Gentamycin and Levofloxacin but highly resistant to Ceftriaxone (100%), Imipenem (100%), Trimethoprim – sulfamethoxazole (85%), and Erythromycin (67%).

**Conclusion:** The prevalence of MRSA in KRRH is high with high resistance to Ceftriaxone, Imipenem, Trimethoprim – sulfamethoxazole and Erythromycin. However, good sensitivity to gentamycin and Levofloxacin is still observed.

**Keywords:** Methicillin resistant *Staphylococcus aureus* (MRSA); Kabale Regional Referral Hospital (KRRH); surgical ward.

## 1. BACKGROUND

*S. aureus* is a versatile pathogen capable of rapidly acquiring antibiotic resistance and a notable characteristic of this bacterium is the Methicillin resistant *S. aureus* (MRSA) which has adapted to survive treatment with beta lactam based antibiotics including Methicillin or Nafcillin. MRSA is now responsible for several difficult-to-treat infections in humans [1]. Infections with MRSA are of special concern because these infections are associated with prolonged hospital stay, increased hospital costs, and have a few therapeutic options for affected patients [2].

Although MRSA is reportedly becoming a predominant cause of nosocomial infection in the Ugandan hospital settings resulting in considerable morbidity and mortality, its prevalence in rural settings has not been properly studied. Therefore, this study sought to determine the prevalence of MRSA among the *S. aureus* isolates and its antimicrobial susceptibility pattern on the commonly used antibiotics at KRRH, which is located in rural South Western Uganda, bordering Uganda and Rwanda and not very far from the Democratic Republic of Congo.

## 2. MATERIALS AND METHODS

This was a cross sectional study conducted in a period of six months, between June and November 2014 involving 350 pus swabs from female and male patients of all ages with septic surgical site and admitted at the surgical ward of

KRRH. Sterile dry cotton swabs were used to collect pus from patients who consented. The swabs were rolled gently but firmly on the base of the surgical wound while applying an even pressure. The pus swabs were then transported to the KRRH laboratory immediately where they were directly inoculated onto Mannitol Salt Agar (Mast Group Ltd) and incubated at 35 - 37°C for 18 – 72 hours. *S. aureus* bacteria were identified by Gram staining, Catalase, Coagulase reactions and confirmed with API staph testing kit [3]. The isolated *S. aureus* were subjected to cefoxitin (30 µg) antibiotic disc to determine the Methicillin resistance by the disc diffusion method on Mueller–Hinton agar plates, using *S. aureus* bacterial suspension with the turbidity adjusted to a 0.5 McFarland standard. Plates were also incubated at 35 – 37°C for 24 hours. Results were interpreted according to clinical and laboratory standard institute (CLSI) guidelines where interpretive criteria for cefoxitin sensitive or resistant *S. aureus* was  $\geq 25$  mm and  $\leq 24$  mm zones of diameter respectively. We used the modified Kirby-Bauer technique, [4,5], to determine susceptibilities of MRSA isolates on to the commonly used antibiotics at KRRH. The antibiotics included Ceftriaxone (30 µg), Ciprofloxacin (5 µg), Imipenem (10 µg), Erythromycin (15 µg), Cotrimaxazole (1.25/23.75 µg) and Levofloxacin (5 µg). The zones of inhibition were read and measured using a meter ruler in mm [4] and later recorded into the data collection form. The generated data was analyzed using SPSS 21.0 Armonk: NY BM Corp. to give descriptive statistics which included frequencies, percentiles and ratios.

## 2.1 Quality Control

For quality control, we used standard *S. aureus* reference strains, including the methicillin sensitive strains *S. aureus* (MSSA) ATCC 25923 and ATCC 29213, and a methicillin resistant strain *S. aureus* (MRSA) ATCC 43300. These controls were procured from the Uganda National Health Laboratories (UNHLs) formerly known as Central public health laboratories (CPHL).

## 2.2 Ethical Considerations

Ethical approval was obtained from the Institutional Research ethics committee (IREC) of Kampala international University (KIU) as well as ethics and research committee of KRRH. Informed consent was also sought and obtained from the patients. All results were treated with utmost confidentiality.

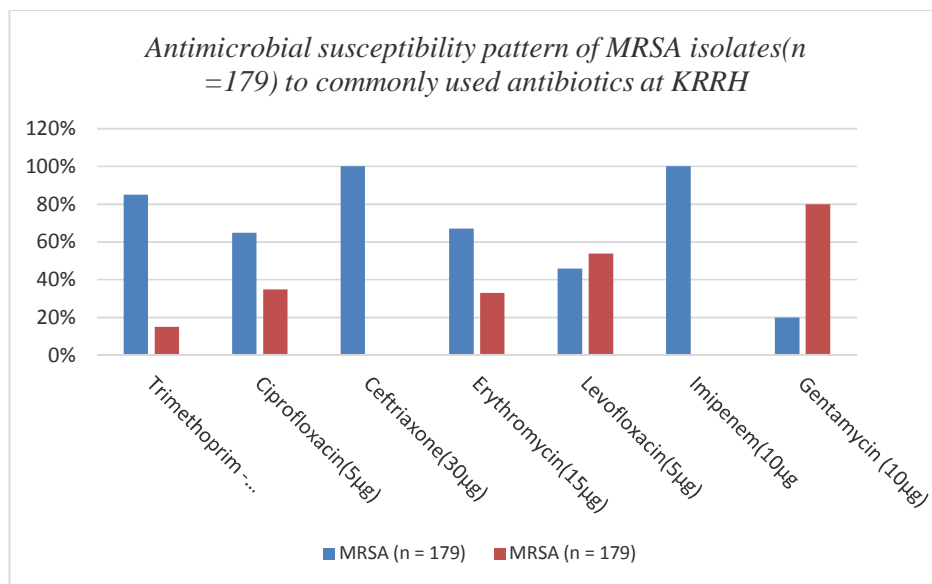
## 3. RESULTS

In this study, 350 pus swabs were collected from patients admitted on surgical wards of KRRH. Three hundred and thirty one (94.6%) isolates were *S. aureus*, among which 179 (54%) were phenotypically resistant to methicillin (MRSA). All MRSA were later tested for susceptibility to seven commonly used antibiotics (Ceftriaxone, Imipenem, Erythromycin, Ciprofloxacin, Cotrimaxazole, Levofloxacin and Gentamycin). MRSA isolates showed high range of cross-

resistance to the seven tested antibiotics (Fig. 1). As illustrated in Fig. 1, ninety six [96 (54%)] of the MRSA isolates were most susceptible to Levofloxacin and least susceptible to Ceftriaxone, Imipenem and Erythromycin. All the 179 MRSA isolates were resistant to Ceftriaxone and Imipenem; while 152 (85%), 120 (67%) and 117 (65%) were resistant to Trimethoprim – sulfamethoxazole, Erythromycin, and Ciprofloxacin, respectively. It was observed that most MRSA isolates were susceptible to Levofloxacin (96 isolates, 54%) and Gentamycin (142 isolates, 80%).

## 4. DISCUSSION

*S. aureus* is one of the common bacterial pathogen causing infection in the hospital settings and the individuals at risk are especially those with surgical wounds [6]. In a duration of 4 months, 350 pus swab specimen were cultured and one hundred and seventy nine (54%) of the bacterial isolates were *S. aureus*, indicating the colonization nature of this bacterium to the hospitalized patients and that the patients with surgical wounds are at an increased risk [7]. *S. aureus* is a common pathogen that has hindered antibiotic therapy and MRSA is the most common pathogen in surgical site infections causing extended hospital stays and increased health-care costs [6]. This nature of colonization has been reported previously [7]



**Fig. 1. Antimicrobial Susceptibility pattern of *S. aureus* isolates (n = 179)**  
*n* = total number of isolates; MRSA = Methicillin resistant *S. aureus*

In this study we observed a high ratio of MRSA among the isolated *S. aureus*, similar to what was reported previously in Ugandan hospitals like Mulago National hospital [4] and Mbarara Regional referral Hospital [5]. To control MRSA, patients should be treated with appropriate antibiotics and strict implementation of infection control measures. These actions are currently not being implemented in our hospital settings probably due to attitude of prescribers like clinicians and the nursing staff.

MRSA isolates were less susceptible to commonly used antibiotics like Ceftriaxone, Imipenem, Ciprofloxacin, Erythromycin and Trimethoprim – sulfamethoxazole. However, most of them were still susceptible to the antibiotics Gentamycin and Levofloxacin, but this susceptibility is steadily decreasing at KRRH which is alarming since the two antibiotics are always used to treat MRSA [8]. Several factors could be associated with this high degree of resistance, which is pertinent with other rural hospitals in Uganda. These factors may include lack of access to clean water for frequent bathing, poly pharmacy, and ward overcrowding [9]. These scenarios are of serious public health concern and continue to signify a therapeutic challenge to clinicians while treating patients. However, improved hygiene through frequent patient bathing and hand washing by health care workers can greatly reduce MRSA spread [10]. In situations where diagnostic tools are limited, clinicians are left with no choice but to irrationally prescribe many antibiotics to patients for quicker prognosis. However, resistance to antibiotics is a major public-health concern and irrational use antibiotic is the major driving force to resistance [11]. Therefore, the antibiotic prescription tradition with correct diagnosis and the usage of antibiotics requires to be critically considered. Overcrowding is a relevant factor in MRSA spread within hospitals [12], which lead to failure of MRSA control programs. This can result into high MRSA incidences leading to increased inpatient length of stay exacerbating, the situation leading further infection control failure.

## 5. CONCLUSIONS

*S. aureus* is a common clinical bacterium isolated from patients at surgical ward at KRRH, with a high prevalence of MRSA. Most of the MRSA isolates are resistant to Ceftriaxone, Imipenem, Trimethoprim – sulfamethoxazole and Erythromycin, but present good sensitivity to gentamycin and Levofloxacin.

## 6. RECOMMENDATION

We recommend proper antibiotic prescription policies based in local resistance data and enforced by the appropriate authorities to reduce the abuse of antibiotics and reduce the acquisition of resistance by pathogens. More to that, a stronger antibiotics effective to MRSA should be included on the treatment menu and be procured for availability to prescribing health care workers. An effective infection control team should be formed and be given mandate to function.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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