Combating The Superbug: MRSA INFECTION IN BURN

The Challenge of Burn

- Burn is an injury to the skin or other organic tissue primarily caused by heat or due to radiation, radioactivity, electricity, friction, or contact with chemicals.

- It causes damage to the largest organ in the human body, the skin, which serves as a protective physical barrier against microorganisms.

- Burns are a global public health problem, accounting for an estimated 180,000 deaths annually. The majority of these occur in low and middle-income countries, and almost two-thirds occur in the African and South-East Asian region.
- The incidence of burn injuries is getting high in Bangladesh. About 3,65,000 people suffer from burn injuries yearly, and for about 5,600 people, this becomes fatal.

- Approximately 75% of burn-related deaths are due to infections, particularly in developing countries.

Burn Wound Infection:

- Burn wound infection is defined as the presence of high concentrations (>10^5 organisms/g of tissue) of bacteria in the burn wound and scab. The presence of cellulitis is the foundation of the clinical diagnosis.

- Burn wound cellulitis occurs when redness extends beyond what is typical for the injury itself. This condition is caused by an infection in the healthy tissues surrounding the burn. Symptoms often include increased warmth, pain or tenderness, swelling, and hardening of the area.

Also, the American Burn Association (ABA) has established criteria for identifying infections in burn wounds. Local signs of infection may include the conversion of a partial-thickness burn into a full-thickness wound, worsening cellulitis in the surrounding normal tissue, separation of the eschar, and tissue necrosis.

Pathogenesis of burn wound infection:

- Human skin acts as an excellent mechanical barrier against microbial infection. Thermal damage to the skin barrier and the resulting suppression of local and systemic immune responses are key factors in the infectious complications seen in severe burn patients.

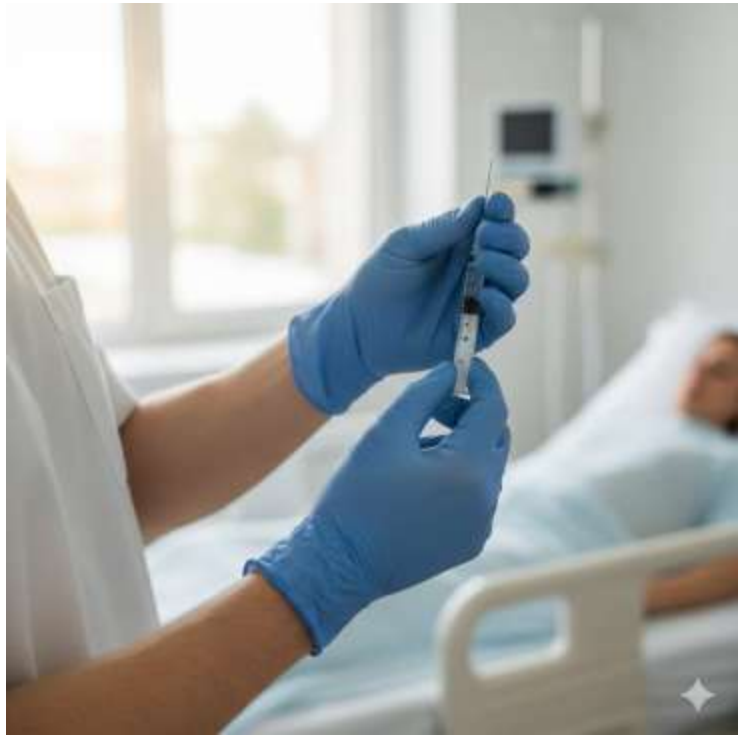
- The burn wound surface (in deep partial-thickness and in all full-thickness burns) is a protein-rich environment consisting of avascular necrotic tissue (eschar) that provides a favorable environment for microbial colonization and proliferation.

Burn wound infection: Source & Etiology

- Burn wounds are initially sterile but typically become colonized or infected within 3 to 5 days after admission.
- Microorganisms that are linked to infections in burn wounds can originate from either the body's own flora (endogenous sources) or from external environments (exogenous sources).

Exogenous Source:

Healthcare workers



Contaminated medical equipments

Other infected patients in the same ward

Endogenous Source:

Staphylococcus epidermidis

Staphylococcus aureus

Escherichia coli

Propionibacterium acnes

Streptococcus spp.

Bacteroides spp.

Micrococcus spp.

Moraxella catarrhalis

Lactobacillus spp.

Bacterial Etiology:

Gram-positive bacteria:

- 1. Staphylococcus spp.
- 2. Streptococcus spp.
- 3. Enterococcus spp.

Gram-negative bacteria

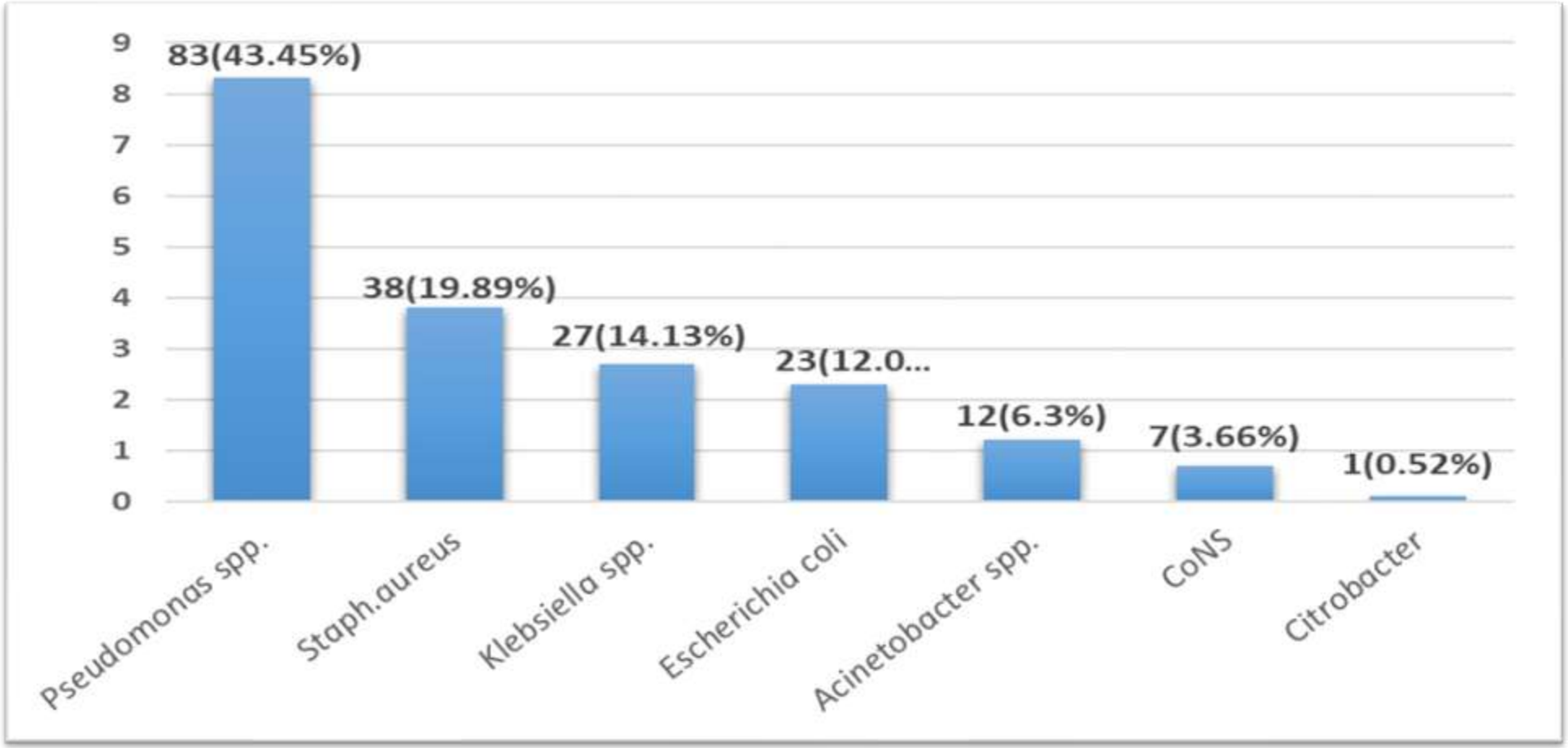
- 1. *Pseudomonas aeruginosa*
- 2. *Acinetobacter baumannii*
- 3. *Escherichia coli*

4. *Klebsiella pneumoniae*

5.*Enterobacter cloacae*

Key Pathogens in Burn Wound Infections:

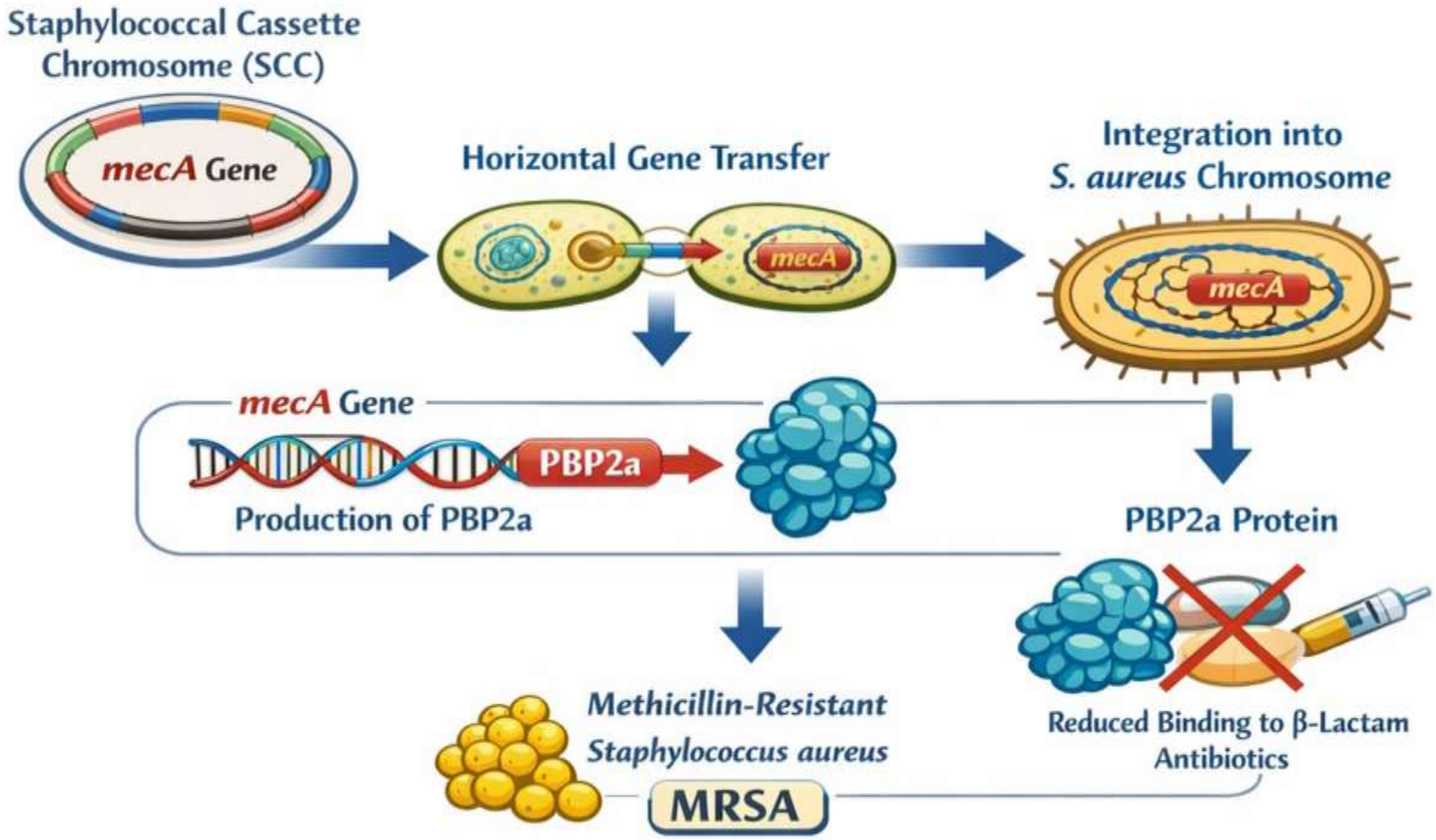
A recent study identified a total of 65.4% infections, and this presents the bacteriological profile.



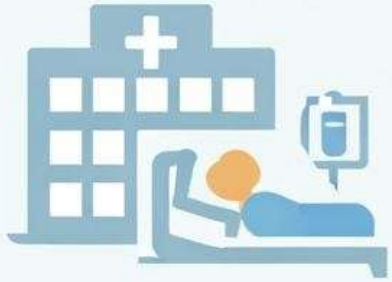
Methicillin-resistant *Staphylococcus aureus* (MRSA)

- Methicillin-resistant Staphylococcus aureus (MRSA) is a type of bacteria that is resistant to most β-lactam agents, including Cephalosporins and Carbapenems, except Ceftaroline, a fifth-generation Cephalosporin.

How does *S.aureus* develop methicillin resistance?



Types of MRSA:



HA-MRSA
(Hospital-Associated)

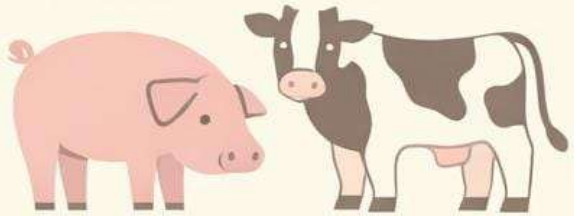
In Healthcare Settings

Drug Resistant

CA-MRSA
(Community-Associated)

Skin Infections in Community

Carries PVL Toxin



LA-MRSA
(Livestock-Associated)

In Animals & Farms

Can Spread to Humans

Healthcare-Associated Community-Onset MRSA (HA-CO-MRSA)

- MRSA infections that originate in the community may display characteristics usually associated with strains found in healthcare settings.
- These infections are often linked to previous hospital stays, medical procedures, or the use of antibiotics, and can cause conditions such as skin abscesses, pneumonia, and bacteremia.

Carrier state of MRSA:

- MRSA most commonly colonizes the anterior nares (nose), but can also be found in the groin, axillae, throat, rectum, and on skin surfaces.
- Colonized areas, especially anterior nares, serve as a source for self-infection or transmission to others.
- In Bangladesh, various studies indicate that the MRSA carriage rate among healthcare staff varies from 3.53% to 4.93%. Although this rate is lower, it is significant given their profession.

Mode of Transmission:

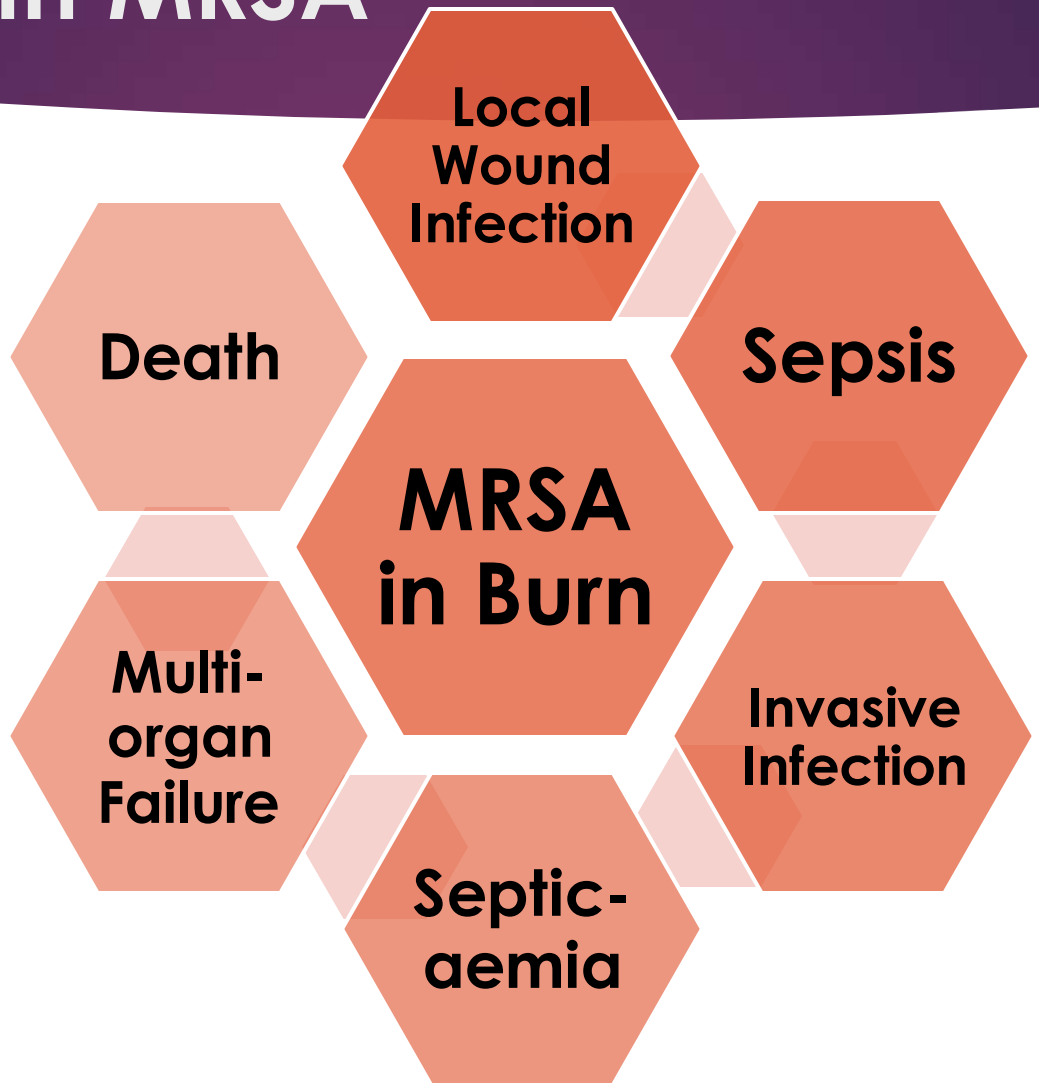
MRSA is transmitted through direct contact between individuals or indirectly through contaminated objects, hospital surfaces, household items, clothing, athletic gear, and personal hygiene products.

Prevalence of MRSA in burn wound infection in Bangladesh:

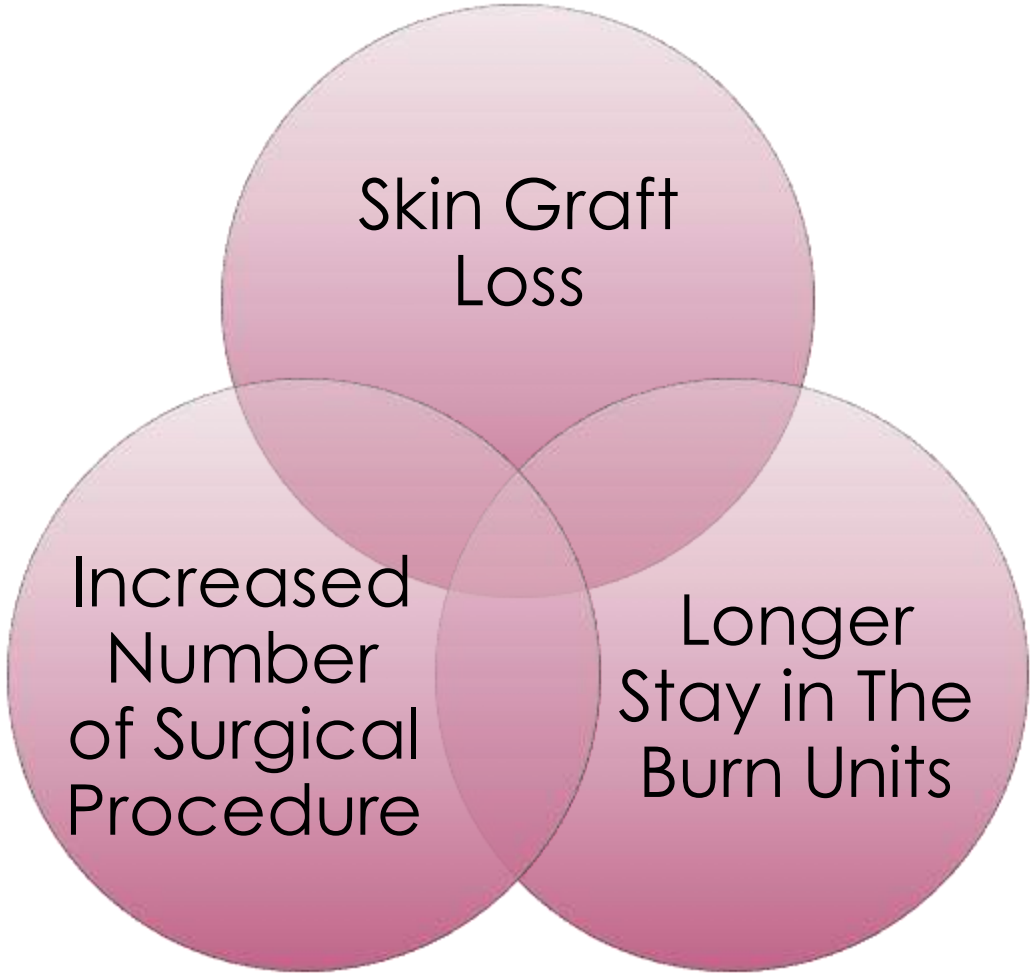
- In recent years, Bangladesh has seen an increase in the prevalence of MRSA.
- Subsequent research conducted in 2013 and 2020 revealed that the frequency of MRSA in burn wounds at a tertiary care hospital in Bangladesh was 22.5% and 33.33%, respectively.

- In 2024, a study conducted at both the National Institute of Burn and Plastic Surgery and Sir Salimullah Medical College and Hospital revealed that 34.21% of burn wounds were identified as MRSA, which is quite concerning.

Consequences of burn wounds infected with MRSA



- In addition to wound infections, studies have shown that MRSA colonization in burn patients can lead to other complications.



Laboratory Diagnosis of MRSA:

- Samples to be collected:

1. **Wound swab:**

The swab should be collected after cleaning away surface debris and exudate with saline.

Sufficient pressure should be applied to the swab tip to collect adequate cellular material from an area of at least 1 cm.

The swab is then placed in a sterile transport medium and sent to the laboratory for culture.

2. Nasal Swab: While not from the burn wound itself, nasal swabs are a standard part of general MRSA screening for all burn patients upon admission, as the anterior nares are the most common reservoir for MRSA colonization. A positive nasal swab is a strong predictor of a subsequent MRSA infection.

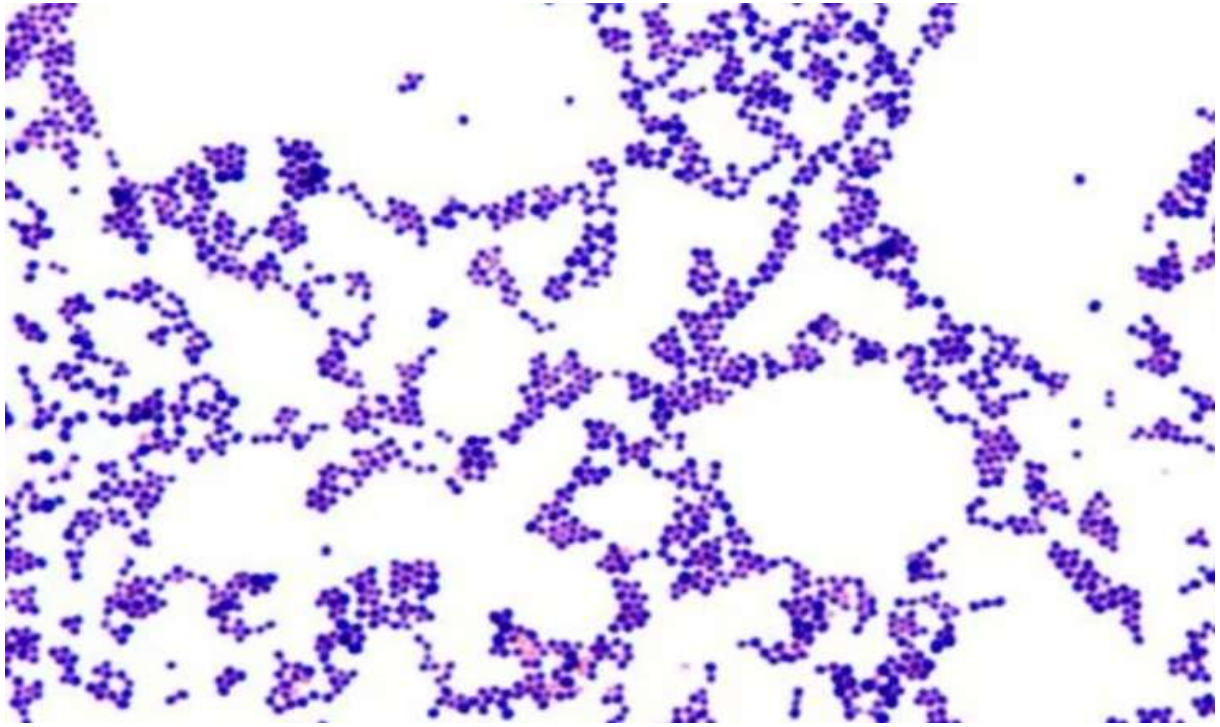
3. Blood: For suspected bacteremia or sepsis.

4. Urine: If a urinary catheter is in place

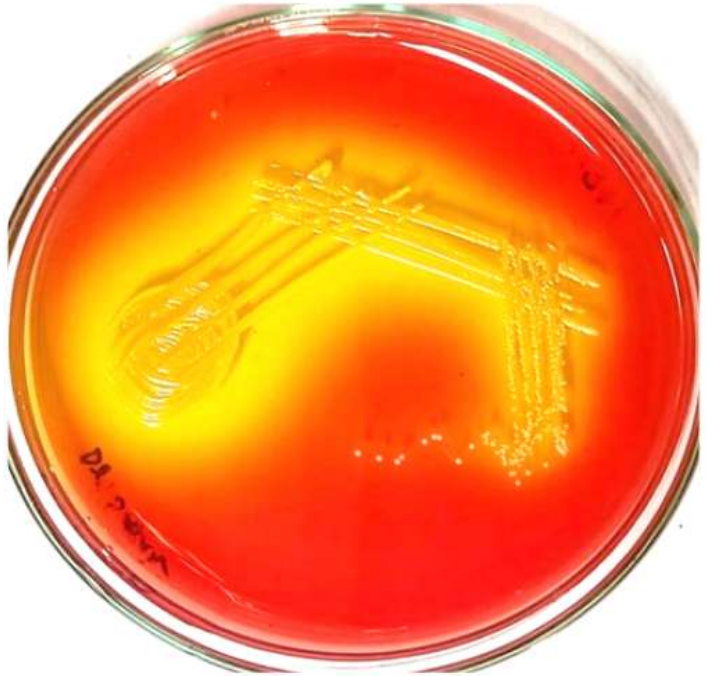
5. Endotracheal secretions/sputum: If a respiratory infection is suspected.

Laboratory Methods:

- **Microscopy**: done by Gram stain, which reveals Gram-positive cocci arranged in grape-like clusters.

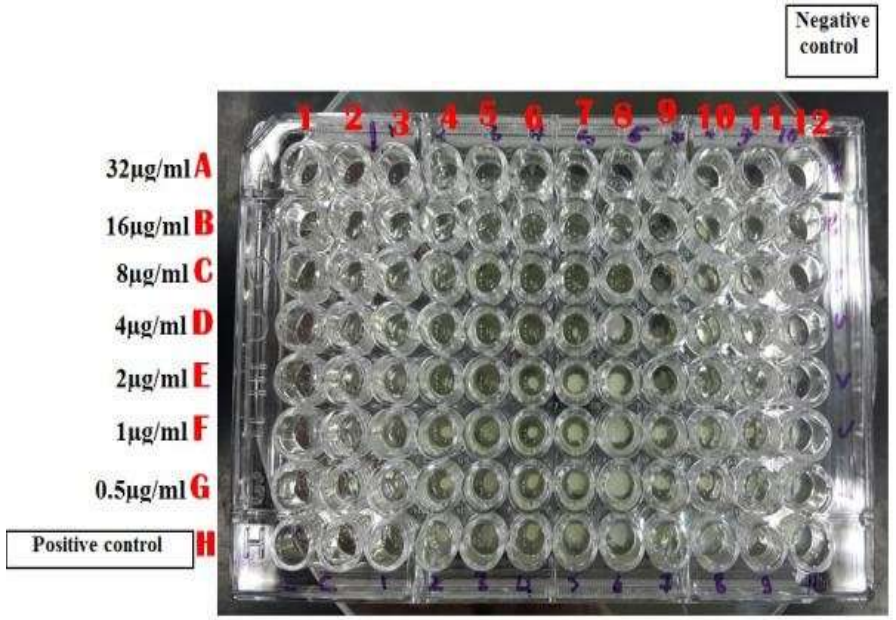


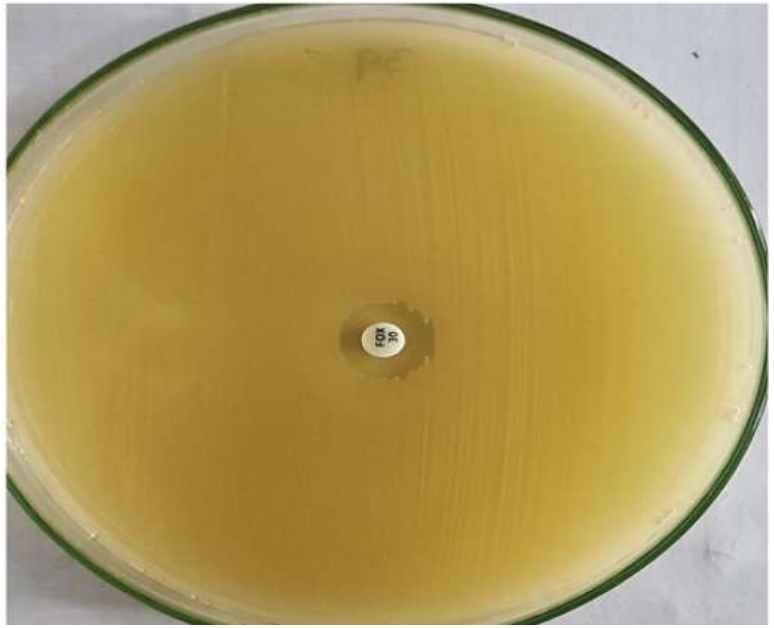
- **Culture**: On Blood agar, Nutrient agar, and Mannitol salt agar media.



Tests for detection of MRSA:

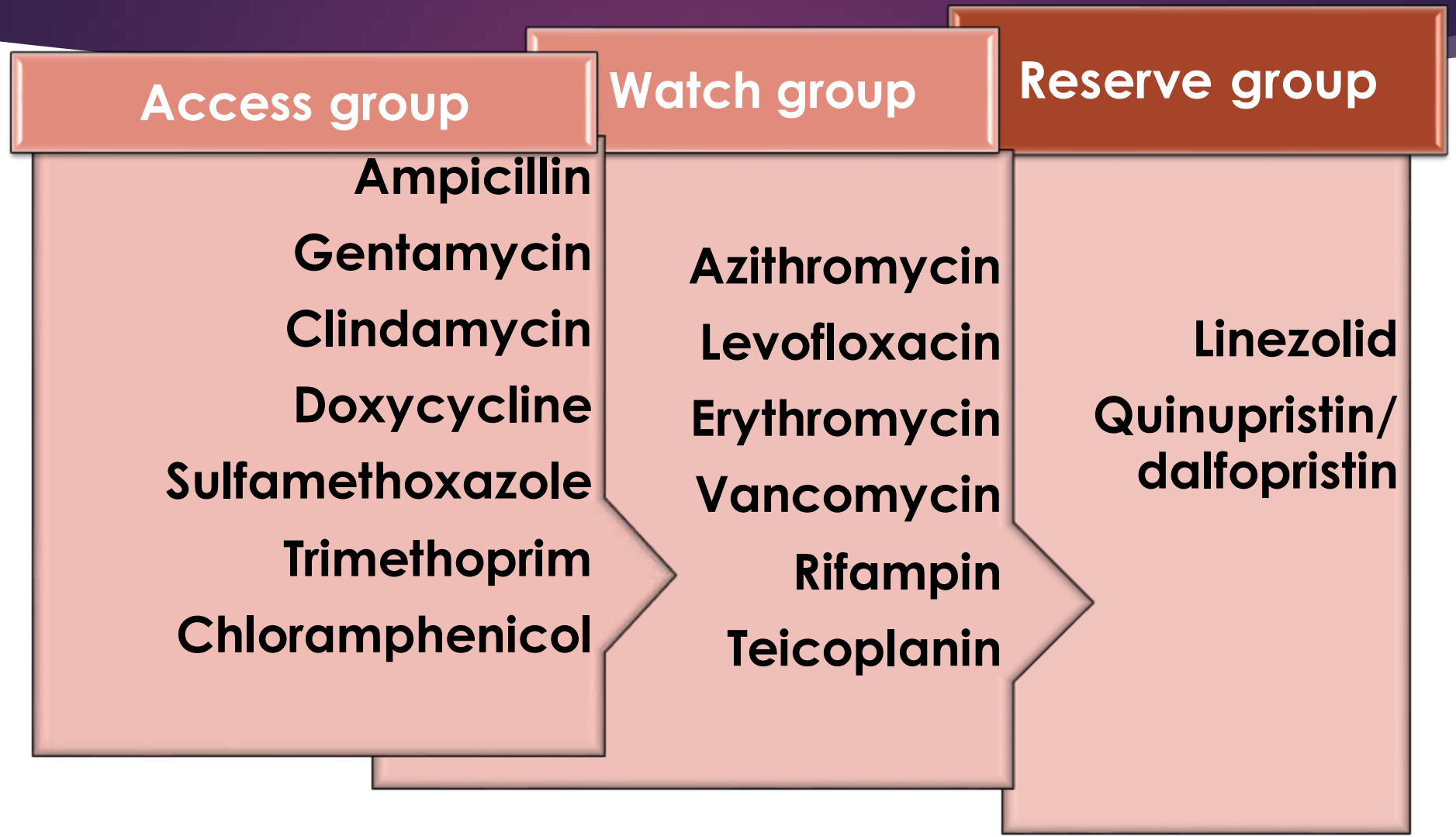
- Cefoxitin or oxacillin broth microdilution and agar-based test.
- The cefoxitin disk diffusion method.
- Oxacillin screen agar tests
- Nucleic acid amplification tests, such as the polymerase chain reaction (PCR), to detect the mecA gene,
- Anti-PBP2a monoclonal antibodies available as latex agglutination or immunochromatographic membrane assays.
- Commercially available chromogenic agars.


Negative control
1 2 3 4 5 6 7 8 9 10 11 12
32µg/ml A
16µg/ml B
8µg/ml C
4µg/ml D
2µg/ml E
1µg/ml F
0.5µg/ml G
Positive control H




1 2 3 4 5 6 7

Treatment options for MRSA:



Decolonisation treatment for MRSA

Decolonization is the process of eliminating or reducing asymptomatic carriage of MRSA. This is achieved by using a combination of a topical body wash and an antibiotic nasal ointment for a duration of 5 days.

- **Nasal Ointment**: Mupirocin 2% ointment inside both nostrils twice daily for 5 days.
- **Antiseptic Body Wash**: Shower daily using a special soap that contains 4% chlorhexidine gluconate (CHG) for 5 days.

Decolonization should be considered for individuals and their household contacts in the following situations:

- Recurrent MRSA or staphylococcal infections.
- Increased risk of infection (e.g., chronic skin disorders, diabetes, immunosuppression).
- Planned major surgery.
- Ongoing MRSA infections in closely associated groups (e.g., dormitories, daycare centers, sports clubs).
- Healthcare workers or caregivers.
- Persistent household infections despite treatment; all household members should start decolonization on the same day, even if some are not actively infected.

Trends in MRSA Sensitivity Patterns:

- **Vancomycin** and **linezolid** are the most effective antibiotics against MRSA in burn units worldwide, with studies showing susceptibility rates often above 90%. In some regions, quinupristin/dalfopristin also proves to be highly effective.

- This statement aligns with various studies conducted in recent years in Bangladesh, with vancomycin and linezolid remaining the most effective drugs.

- So, the last-resort antibiotics remain largely effective against MRSA, making them the primary treatment options for severe infections.

Trends in MRSA Sensitivity Patterns: (continue…)

- MRSA isolates from burn units in Bangladesh demonstrate widespread resistance to many first-line and commonly used antibiotics.

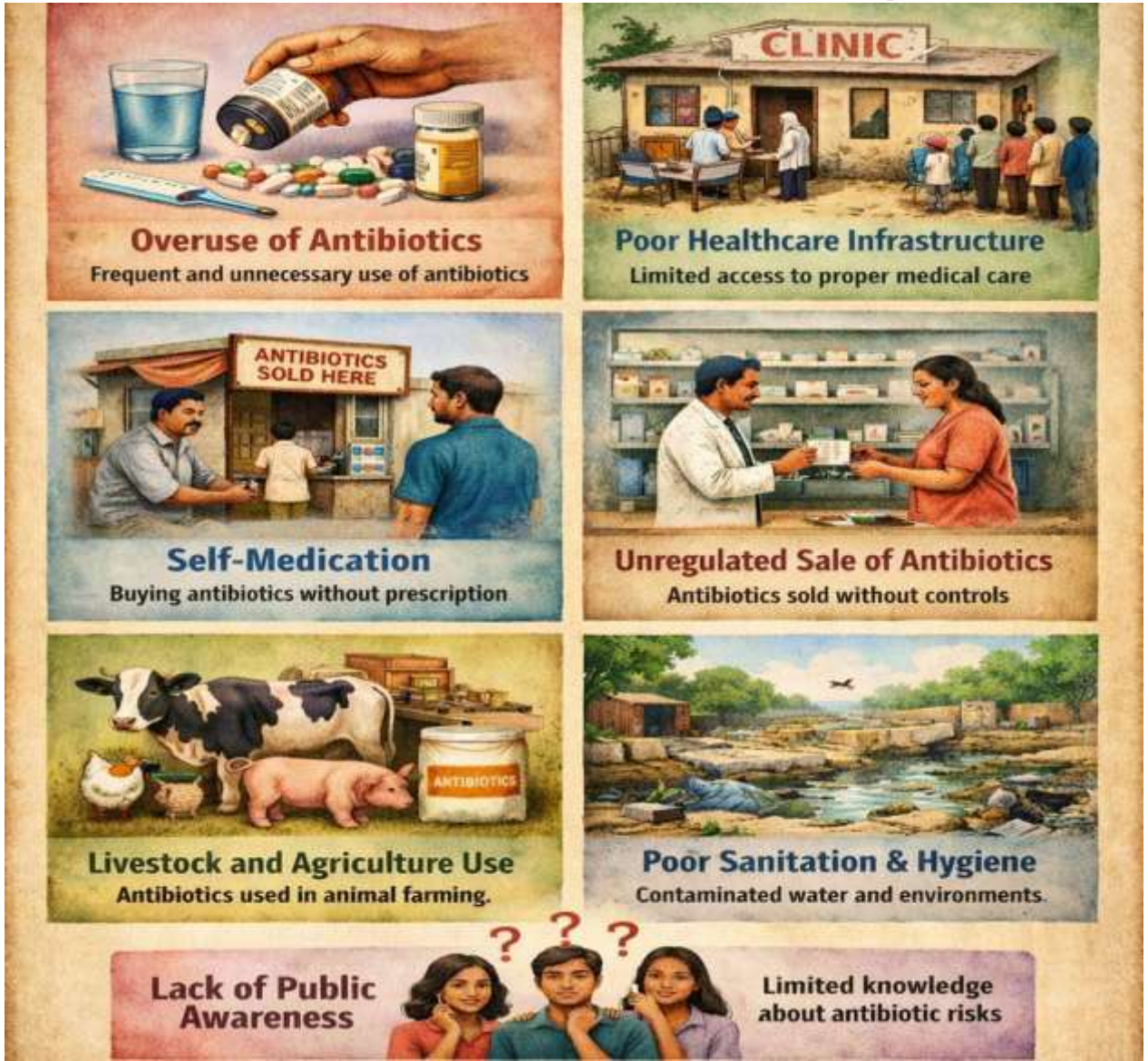
- There has been a significant increase in resistance to fluoroquinolones (such as levofloxacin and ciprofloxacin), clindamycin, erythromycin, azithromycin, and doxycycline, which makes empirical treatment options limited.

Trends in MRSA Sensitivity Patterns: (continue…)

- Due to this high level of resistance, clindamycin, azithromycin, and erythromycin are often not recommended for the empirical treatment of MRSA.

- Gentamicin, rifampin, and trimethoprim-sulfamethoxazole (TMP-SMX) exhibit varying degrees of susceptibility, frequently displaying reduced efficacy, with evidence of developing resistance.

Factors Responsible for The Upsurge of Antibiotic Resistance in Bangladesh:



How to overcome this situation?

- Prescribing antibiotic in accordance with the results of the Culture and Sensitivity report
- Performing a continuous, local antimicrobial resistance surveillance program
- Implementation of strong infection prevention and control (IPC) measures
- Thorough implementation of antimicrobial stewardship programs

Preventive Approaches for Burn Accidents:

Preventive Approaches for Burn Accidents: (Continue…)

Key Prevention Strategies of MRSA in Burn Units:

1. Hand Hygiene & PPE:

- Strict handwashing/alcohol rub before and after every patient contact.
- Wear gowns, gloves, and masks (or PAPRs) when entering patient rooms, especially for contact with the patient or contaminated surfaces.

2. Patient Isolation & Cohorting:

- Use single-patient rooms, ideally with negative-pressure/antechambers.

Key Prevention Strategies of MRSA in Burn Units: (Continue…)

3. Environmental Control:

- Regular, thorough disinfection of rooms, equipment (catheters, instruments, ventilators), and high-touch surfaces.
- Dedicate non-critical items (stethoscopes, blood pressure cuffs) to individual patients.

4. Surveillance & Screening:

- Screen patients on admission and regularly for MRSA colonization (nares, groin swabs).
- Isolate patients until cleared to minimize spread.

Key Prevention Strategies of MRSA in Burn Units: (Continue…)

5. Staff Education & Practices:

- Mandatory, ongoing training on infection control protocols.
- Monitor healthcare worker compliance with hygiene and precautions.

6. Wound & Patient Management:

- Timely surgical closure (grafting) of burn wounds.
- Administer prophylactic antibiotics judiciously.
- Consider intranasal mupirocin for decolonization, but be aware of resistance.

Hand Hygiene

Wash Hands Frequently

Contact Precautions

Patient Isolation

Single Rooms or Cohorting

Dedicated Equipment

Separate Medical Equipment

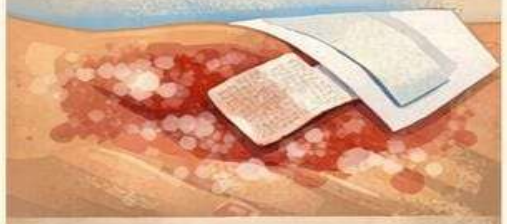
Environmental Cleaning

Disinfect Surfaces Regularly

Surveillance & Screening

Monitor & Test for MRSA

Wound Care



Early Grafting of Burns

Staff Education

Decolonization

Mupirocin Treatment

Eliminate Sources & Transmission Routes: Crowding, Skin Breaks, Contaminated Surfaces

Addressing the “5 Cs’ of Spread:

Minimize Crowding

Maximize Cleanliness

Prevent Contact with contaninated items

Protect Compromised skin

Reduce Skin-to-Skin Contact

1. Slide 1 : The background need to be faded.
2. Cause : You have mentioned viral, fungal and parasitic cause of burn infection(slide 10). What are those organisms? Is there any virus associated with infections from endogenous source?
3. Slide no 10 is confusing to me.
4. Can you please add some points for prevention in our perspective? (Slide 32)
5. In addition to MRSA(from your thesis), you can add some slide of other important bacteria causing life threatening burn infections like Pseudomonas.
6. Please add another slide from your thesis findings of other organisms isolated.
7. Can you collect any information of burn infection rate/incidence in Burn unit of DMCH and the Burn institute and show the comparison
8. Slide 16: why the frequency is decreased. Are these studies done in same hospital?

9. Slide 18: can be animated
10. Slide 19 –same(can be animated)
11. Slide 20: Background need to be changed to make the writings more visible.
12. Slide 21: alignment
13. Slide 22: the Gram staining slide became Gram negative, needs to be changed
14. Slide 23, 25: you used background from another presentation, so background became different.
15. Slide 26: A brief about MRSA: Just one slide can be added. Take opinion from others.
16. Slide 27: Availability of quinupristin/dalfopristin in Bangladesh? (Web search)
17. What might be the alternative for poor patient?

18. No heading in the slide 30
19. Can you add, how can we prevent burn accident
20. Can you give any focus on acid burn? No need to add, but please be prepared if anyone ask.
21. Do you know the microbiologist working at burn institute? She is the chief of IPC team of the institute. Is she Jannatul Mustary ?

- Assalamu alaikum mam, I have given Quinupristin/Dalfopristin following the CLSI guideline. These medications are not widely available commercially for treatment purposes.
- As for poor patients, there are limited treatment options for resistant organisms. I couldn't find any information regarding that.