MRSA Infection Control in a Low-Endemic Area
Prof. Bjørg Marit Andersen, Oslo University, Norway
A Webber Training Teleclass

MRSA- infection control in a low-endemic area
Epidemiology
MRSA screening
Isolation
Sanitation/decolonization
Follow-up

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Oslo University Hospital- Ullevål, Norway

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Methicillin-resistant Staphylococcus aureus- MRSA
- S. aureus is the most common bacteria causing serious diseases in the community
- MRSA is S. aureus resistant to most good antibiotics like
  - Penicillins – (beta-lactam antibiotics),
  - Cephalosporins,
  - Carbapenems (imipenem/meropenem)
  - and other good antibiotics
- MRSA have special mecA genes and a few have mecC

Airborne infections- more than we believe - 30% of air samples may be positive!

MRSA is spread by air from MRSA positive cases
1. After 1 day the environment is contaminated – ca 80% of the area in PO08IS Friends et al 2004 and others.
2. MRSA – aerial dispersal - all over the room – 30% of air samples
3. Room-mates are at risk for being infected in 10-45%

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The skin flora is rich – and may contain MRSA in carriers

Skin - borne microbes –also MRSA- may be liberated in the air during movement


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MRSA inside and outside healthcare

<table>
<thead>
<tr>
<th>HA-MRSA = Healthcare associated</th>
</tr>
</thead>
<tbody>
<tr>
<td>• More resistant</td>
</tr>
<tr>
<td>• Less virulent</td>
</tr>
<tr>
<td>• Other SCC mec –’s</td>
</tr>
<tr>
<td>• Contact with healthcare</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CA-MRSA = Community associated</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Less resistant</td>
</tr>
<tr>
<td>• Can be more virulent-PVL</td>
</tr>
<tr>
<td>• SCC mec- IV</td>
</tr>
<tr>
<td>• No contact with healthcare</td>
</tr>
</tbody>
</table>

Today: Often a mixture of HA and CA inside and outside healthcare——HACO (healthcare associated community onset)———

MRSA may be found in chronic eczema and in abscesses

Impetigo and other skin diseases

Impetigo with attack rate 75% if HCW is the source of MRSA

Postoperative wound infections with MRSA are causing extra costs, extra days in hospital care and a higher risk of death
Andersen et al. 2003, J. Infect.

<table>
<thead>
<tr>
<th>Results from 90 days postoperative period</th>
<th>Patients with postop wound infect</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MRSA</td>
</tr>
<tr>
<td>Days in hospital/median</td>
<td>26 (15)</td>
</tr>
<tr>
<td>Transferred to other healthcare</td>
<td>34.3 %</td>
</tr>
<tr>
<td>Re-admitted</td>
<td>77.5 %</td>
</tr>
<tr>
<td>Death</td>
<td>16.70 %</td>
</tr>
</tbody>
</table>

• Extra cost per MRSA patient: 50,000 USD

Death from MRSA in high-endemic areas- like USA

• MRSA can cause a serious disease – attack rate ~25-30%
• MRSA is endemic in USA; ca 2 mill infections/year
• 19,000 die from MRSA in USA every year (Kessler 2010)
  • 6.3 per 100,000 of the population in USA
• More Americans die every year from MRSA than from HIV/AIDS and influenza H1N1!
• and from group A streptococci and pneumonia and meningitis, together!
• A reduction in deaths from MRSA is shown in 2011,
  • estimated to 11,300 cases; 3.4/100,000 (Bootsma et al.2013)

How have we fallen so far behind in the battle to beat MRSA? — in UK?

"A new strain of lung-eating MRSA is spreading rapidly through our hospitals, augmenting the 8,000-plus cases in the UK last year”

Kill 5,000/year in UK

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MRSA Epidemiology

Global infections with
- *Staphylococcus aureus*: 2 billions
- MRSA: >5-53 millions

MRSA was a global health threat -2006

And even more a health threat today

Worldwide prevalence of hospital-acquired meticillin-resistant *Staphylococcus aureus*
HK, Hong Kong. Stefanis et al, Int J Antimicrob Agents 2012

MRSA in Europe 2013

The French battle against MRSA started in 2001

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France reduced their MRSA infections from 2001 to 2006!

MRSA Trends (Prevalence of MRSA-infected Patients), France, 2001 - 2006

France is now trying to become MRSA-green like Norway in 2018!

While superbug-panicked britons are driven abroad for treatment in Scandinavia or Holland? 2005

The MRSA-problem is partly associated with overuse of antibiotics

There is a global increase of MRSA-reservoirs in Long-term care facilities

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Persistent MRSA predominates in nursing homes - without infection control
Mazer & Gudzol Clin Microbiol Infect 2009; 15:26-36

- More than half (60-65%) have persistent colonization
- Nearly 1/3 colonized develop infection
- Long-lasting
- Can transmit MRSA to others

Health care personnel is another important source of MRSA infections!
Morton et al. J Hosp Infect 2008; 70: 182-188

<table>
<thead>
<tr>
<th>Geographic regions</th>
<th>MRSA Carriers</th>
<th>prevalence (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northern Europe (including the Netherlands)</td>
<td>101</td>
<td>53</td>
</tr>
<tr>
<td>Western Europe</td>
<td>291</td>
<td>23</td>
</tr>
<tr>
<td>Southern Europe</td>
<td>153</td>
<td>48</td>
</tr>
<tr>
<td>Eastern Europe</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td>North America</td>
<td>338</td>
<td>47</td>
</tr>
<tr>
<td>South America</td>
<td>13</td>
<td>6</td>
</tr>
<tr>
<td>Africa</td>
<td>80</td>
<td>15</td>
</tr>
<tr>
<td>Middle East</td>
<td>130</td>
<td>6</td>
</tr>
<tr>
<td>South and central Asia</td>
<td>17</td>
<td>33</td>
</tr>
<tr>
<td>East Asia</td>
<td>137</td>
<td>13</td>
</tr>
<tr>
<td>Australia, New Zealand</td>
<td>195</td>
<td>93</td>
</tr>
<tr>
<td>Total</td>
<td>1545</td>
<td>46</td>
</tr>
</tbody>
</table>

| MRSA prevalence and spread from health-care workers

- >300 HCW from 37 l-lands
- 4.5% were MRSA carriers
- 5.1% with clinical infection

Risk factors:
- Chronic skin disease
- Low hygiene
- Work in countries with endemic MRSA

Outbreaks – associated with transient and persistent carrier state among HCW
- Spread of infection from HCW to the patients: 95% of 66 studies
- MRSA-decolonisation in 510 HCW: 88% completed negative result
- Extra nasal colonization – associated with persistent carrier state

Epidemiology in the ”green countries”

MRSA infections are increasing in the Nordic countries!
Robert Mover on behalf of the ILCA-MRSA Working Party: Eurosurveillance, Volume 10, Issue 31, 04 August 2005

Incidence of MRSA reported to the national surveillance institutes in the Nordic countries from 1997-2004, Denmark, Finland, Iceland and Sweden reported infections and colonizations. Norway only reported infections.

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The observed increase of MRSA----

- "has occurred despite --no changes in the strict infection control policies" in the Nordic countries.

"Major changes in MRSA epidemiology in the Nordic countries" (Skov et al 2005)

1. Most MRSA patients do not have a connection to foreign healthcare facilities.
2. Onset of MRSA infections is no longer confined to hospitals.
3. A significant proportion is community onset--
4. The increase of MRSA in the community in otherwise healthy people has led to increased introduction of MRSA to hospitals, which has resulted in an increasing number of intra-hospital transmissions or outbreaks.
5. Outbreaks of MRSA have been reported from nursing homes--

Skov et al: "observed that the MRSA increase---"

- "seems to be more limited in areas
  - where strict MRSA infection control policies have been upheld,
  - and in areas where there is vigorous eradication of MRSA carriage in community-acquired cases.
- This indicates that containment may be possible."

But, what did really happen in the Nordic countries after 2003?

- There were new guidelines – not so strict as earlier!
- Changed infection control strategy outside hospitals!
  - Lack of infection control routines in nursing homes
  - No infection control in primary health care
  - Increased prevalence of MRSA in health-care workers
  - More vacation - and “tourist medicine” – from abroad


New MRSA guidelines - reduced the infection control in the Nordic countries --from 2003!


Finland 2004-2012
Only MRSA in blood and CSF is registered, in addition to MRSA carriers.
Screening is usually not done in exposed HCW

MRSA registered in Finland 2004-2012

Blood and CSF
Carriers
Carriers and patients with MRSA in blood or CSF

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Sweden 2000-2012
MRSA infection in 21.9/100 000 inhabitants in 2012

Denmark 1994-2012
-including colonized and infected; 27.9/100 000 in 2012
- "This is the highest number of cases observed in over 25 years!"
- An increase of 24% since 2011!
- Among 1556 new cases, 29 (2%) were HCW

Denmark 2007-2012: Infections
Among the community-acquired MRSA, more than 50% had known exposure. The animal-associated CC398 is increasing and is 100% tetracycline resistant. mecC instead of mecA is found in 24 cases in Denmark in 2012.

MRSA belonging to the clonal complex CC398 has been closely connected to livestock animals, especially pigs, and increasingly affects people in direct contact with pigs, in Denmark
The prevalence of MRSA in pigs at slaughter has increased to 77%!

<table>
<thead>
<tr>
<th>spa type</th>
<th>CC group</th>
<th>No. of cases</th>
<th>No. causing infections (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CC398</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CC5</td>
<td></td>
<td>141</td>
<td>68 (62)</td>
</tr>
<tr>
<td>CC8</td>
<td></td>
<td>130</td>
<td>75 (56)</td>
</tr>
<tr>
<td>CC30</td>
<td></td>
<td>97</td>
<td>74 (76)</td>
</tr>
<tr>
<td>CC22</td>
<td></td>
<td>89</td>
<td>45 (51)</td>
</tr>
<tr>
<td>CC3</td>
<td></td>
<td>74</td>
<td>23 (31)</td>
</tr>
<tr>
<td>CC80</td>
<td></td>
<td>45</td>
<td>34 (76)</td>
</tr>
<tr>
<td>CC1</td>
<td></td>
<td>42</td>
<td>20 (48)</td>
</tr>
<tr>
<td>CC22</td>
<td></td>
<td>2</td>
<td>3 (35)</td>
</tr>
</tbody>
</table>

MRSA development in Norway 1995-2012
Data from: Norwegian Institute of Health Care 2012
Development of MRSA in Norway (nurses and infected)

MRSA development in Norway 1995-2012
Data from: Norwegian Institute of Health Care 2012

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Norway 2006-2012:
Still a high number is infected abroad
Total, including infections and colonized (NORM 2012)

Norway 2012
Data from: Norwegian Institute of Health Care 2013 and NORM 2012
- Humans
  - 21,6/100,000 inhabitants are infected!
  - MRSA cases: 50% are infected, 50% are carriers
  - Livestock/animal-associated MRSA has now been detected in five human cases in 2012
  - There is still only two cases with mecC instead of mecA.
- Animals
  - MRSA was not found in bovine mastitis
  - MRSA was in only one sample (CC398) from swine (0.6%)
  - But a slaughterhouse was contaminated with CC398!

The incidence of MRSA is still increasing in Sweden, Denmark and Norway

MRSA prevalence increases among HCW in Norway
MRSA-positive HCW may spread infections by hands, nose, uniforms, equipments, environment, air etc.

Among 3620 new cases of MRSA in Norway (2006-2010)
- 7% of all cases were HCW!
- 20% of cases in nursing homes (71356) were HCW!

The population, including HCW, are protected against MRSA infection by Law in Norway
- MRSA is hazardous to the public
- MRSA should be <1% of S. aureus strains
  - The population should not be exposed unnecessarily to MRSA
    - Infection control act/regulation in Norway
  - Health care workers should not be exposed unnecessarily to MRSA
    - Work environment act/regulation in Norway

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MRSA screening

- Nose
- Throat
- Perineum
- Hands/wrists
- Wounds, catheters, eczema etc.

Body site colonization may vary--
from time to time

Correspondence between rapid test and
growth test is 92.8% in MRSA cases from
Norway (prevalence 0.01%)

- Sensitivity, specificity, positive and negative predictive values for
  Xpert MRSA: 87%, 95.6%, 68.5%, 99.9%
  Growth: 76%, 100%, 100%, 99.8%
  (prevalence in Norway: 0.01%)
- Detection rate of MRSA in MRSA- cases
  was lower than 50% in samples from
  Xpert
growth
- nose: 44.6% 40%
- throat 38.2% 45.5%
- hands/wrists: 30.8% 11.5%
- perineum: 44% 38%
- combination of 4 sites: 87.5% 87.5%

Costs and savings of rapid tests

In a low-endemic country like Norway:

- The rapid test saved at least
  € 925 per personnel and
  € 550 per patient that were
  MRSA negative.

- The cost per test for the Xpert and growth
test was €50 and €6.25, respectively

MRSA contamination and density

Figure 1. Prevalence of contamination of commonly examined skin sites and environmental sites with methicillin-resistant Staphylococcus aureus (MRSA) and the density of colonization. Data at

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Therefore, screen from several anatomic sites!!

**MRSA Screening Saves Lives – MRSA Epidemic Spreading Globally**

Exposed or earlier MRSA??

<table>
<thead>
<tr>
<th>Table 1 MRSA screening – Ullevål Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients and personnel (HCW) are screened with the same procedure.</td>
</tr>
<tr>
<td>No examination or treatment is delayed because of suspected MRSA!</td>
</tr>
<tr>
<td><strong>Ask</strong> the patient/personnel</td>
</tr>
<tr>
<td>I believe the patient/personnel has been exposed to MRSA in healthcare clínics - ask 2 months ago?</td>
</tr>
<tr>
<td>2. Exposed to MRSA – person, event?</td>
</tr>
<tr>
<td>3. Exposure to MRSA during hospital stay?</td>
</tr>
</tbody>
</table>

*Examined/treated at hospital, as outpatient or in primary care abroad.

MRSA Screening

- **MRSA screening**
  - Exposure assessment: no exposure (L. a. c.)
  - Proactive screening before admission. In case of necessary, isolates and screen in hospital. Use personal protective equipment (PPE) when screening of suspected MRSA.
  - Personal and environmental MRSA

Screening procedure

- **Screening procedure**
  - **Preparation**
    - Materials: swab kit
    - Equipment: gloves

- **Screening**
  - **Specimen type**
    - Specimen: nasal, rectal, throat, mouth
  - **Swabbing/staging**
    - Swab the nose, rectum, and throat.
  - **Preparation**
    - Swab the nose, rectum, and throat. 

- **Testing**
  - **Testing**: rapid MRSA test

Testing the patient – use personal protective equipment! - PPP

Information to the laboratory - doctor in charge

**Laboratory information**

A single schema per test set (per patient/person). Write name, date, sampling site on the schema and on samples. Mark the schema MRSA (import etc.). The doctor in charge at the actual department is the subscriber on the laboratory schema. Infection control personnel are informed directly when positive results.

**Sample set**

- Schema and samples gathered together for each person.

**Direct delivery to the laboratory**
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Results of screening – what to do

Screening result
Negative test
1. No MRSA, treated as ordinary patient/personnel.
2. If earlier MRSA positive or the sampling is performed during treatment or sanitation: more follow-up tests/isolation will be done

Positive test
1. Further isolation and start disinfection of the patient and flag out the journal. Inform all MRSA contacts not having used PPE - to be screened
2. After 3 negative test sets (3-7 days apart) of the MRSA patient, starting 7 days after treatment. “inactive MRSA” - no further follow-up.
3. Further follow-up for 12 months (5, 6, 9, 12 months) - all consecutive test sets (15) are negative: probably MRSA negative

Isolation and the use of personal protective equipment

Isolation – is the specific infection control problem


However, patients in short-term isolation in hospitals had a positive attitude towards isolation. - Wasserberg J. Hosp Infect 2018:79: 124-8

Isolate and use PPE - when needed

- negative air pressure for airborne infections

PPE: Gown, gloves, cap and mask

Gloves with long cuff

-adjusted to the suspected microbe infection
Learn/train to dress and undress PPE! --

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Sanitation/ decolonization

Regular sanitation
Regular sanitation: 10 (14) days
1. Disinfect all body and hair x 1/day - 10 days
   - Disinfectant agent: Hlubac or Selectrac
   - Not to be used if dermatological side effects and not inside car!
   - Wash body washing two times - 2 minutes each time with thorough cleaning with water between and after each wash.
   - Hair: percutaneous, between toes, axillae is important, use Q-tip in narrow sites.
   - Disinfect the outside of the bottle after use.
   - Rinse the walls of the container with warm water. Place the feet on a clean towel or a disinfected area - dry with a clean towel. Both towels are treated as contaminated.
   - Change to clean personal and bed clothes after each body disinfection.
   - Textiles (personal, bed, towels etc) should be washed at 65-85°C

Disinfection of nose and throat
2. Disinfect the nose with Bacteroid nasal (Propionibacterium) 3/day in 10 days
   - Disinfect the hands and the outside of the tube with alcoholic hand disinfection.
   - Use a Q-tip or a single glove to treat the nasal cavity with Bacteroid.
   - Rinse the mouth thoroughly, place the hand backwards while gargling the rinsing water. Do not swallow.

Toothbrushing, combs, glasses etc
3. Toothbrushing and cleaning of teeth problems. etc x 2 in 10 days
   - Disinfect hands and outside of the tooth paste - for tooth paste in small single caps.
   - New cap or single cap for mouth care each time.
   - Rinse the toothbrush in water at 65°C for 1-3 minutes or in alcoholic disinfectant (70% alcohol, 5 mg/ml chlorhexidine) followed by rinse in water afterwards etc.

4. Disinfect all personal equipment x 2/day in 10 days
   - Combs, glasses, eye lenses, and avoid wearing watch, jewellery, makeup etc.
   - Use skin cream in small single cap portions to avoid contamination
   - Hand soap may be contaminated

Hand hygiene, environmental hygiene, change of beds and own textiles
6. Hand hygiene with alcoholic based disinfectants with glycerol
   - Alcohol based disinfectant (70% alcohol, 5 mg/ml chlorhexidine with glycerol) or other alcohol based disinfectants with glycerol: 10-20 seconds, or use hand towels with disinfectants

7. Environmental disinfection (70% alcohol used x 1/day in 10 days)
   - Surfaces, bed railings, door handles, knobs etc

8. Remember, change of bed and personal textiles each time other patients!

Sanitation of MRSA-positive cases
- all cases should be offered decolonization!

Table II. Sanitation of MRSA-positive cases
- Screen all relevant anatomical sites (nose, throat, perium, hands, axillae lesions, perineum etc) with one or more test sets for MRSA before sanitation to confirm the finding and for tracing out positive sites.
- Antibiotic sensitivity schema for nasal MRSA isolate is present.
- Inform patients and relatives.
- Start all sanitation procedures as soon as early as possible, with or without addition of antibacterial treatment.
- Disinfect environment each day to reduce recontamination from environment.
- Follow-up with control test sets, starting 7 days after finished sanitation/treatment (see screening).

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Decolonize MRSA positive carriers

Before birth and before elective operations

Be care of possible soap-inactivation when using Hibiscrub

- Hibiscrub = Chlorhexidine gluconate 40 mg/ml
- Use no soaps in addition – may inactivate the disinfectant!
- Use no anion containing lotions at the same time
For body lotion- use Sterisol or DAX bodylotion

Gas disinfection –
5% hydrogen peroxide dry mist

Disinfect medical equipments
- internal parts –dry hydrogen peroxide gas

Respirator
Pulse oximeter
CPAP

Disinfection in clinical departments, ambulances
and operation theatres- after MRSA outbreak
hydrogen peroxide dry gas

References

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Follow-up

Follow-up after sanitation
- 7-14 days after completed sanitation
- Screening (nose, throat, perineum, hands, other) once a week in one month
- If MRSA negative samples: screening after 3, 6, 9 and 12 months. Each time three sample sets taken with 1-2 days interface.

The effect of strict infection control
Nursing home A and B – with the same MRSA strain

<table>
<thead>
<tr>
<th>A STRICT</th>
</tr>
</thead>
<tbody>
<tr>
<td>January 2004 – an index case from hospital in Oslo to a nursing home</td>
</tr>
<tr>
<td>National guideline used</td>
</tr>
<tr>
<td>November 2004: ca 20 new MRSA cases; 7 HCW</td>
</tr>
<tr>
<td>Ultrasound: standard from media</td>
</tr>
<tr>
<td>November 2004</td>
</tr>
<tr>
<td>0 more cases</td>
</tr>
<tr>
<td>All were negative after one year</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>B NOT STRICT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Springtime 2004 – a few cases</td>
</tr>
<tr>
<td>National guideline used</td>
</tr>
<tr>
<td>2005 even more cases</td>
</tr>
<tr>
<td>National guideline still used</td>
</tr>
<tr>
<td>2006 summer – more than 60 cases, including personnel</td>
</tr>
<tr>
<td>2006 autumn still ongoing outbreak</td>
</tr>
<tr>
<td>2009 still a huge problem</td>
</tr>
<tr>
<td>National guideline still used</td>
</tr>
<tr>
<td>This ended in closure of the health institution – and still problems in several nursing homes in and around Oslo</td>
</tr>
</tbody>
</table>

MRSA in the green countries - like Norway
- Prevalence of MRSA is still low, but increasing
- According to the Norwegian infection control law, patients and healthcare workers (HCW) from healthcare abroad are screened for MRSA, and also when exposed to MRSA in Norway.
- MRSA carriage may lead to unemployment in Norwegian healthcare.
- Identification and sanitation is therefore important

Thank you, for your attention!

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21 October  TEN TIPS FOR INCORPORATING SCIENTIFIC QUALITY IMPROVEMENT INTO EVERYDAY WORK
Dr. Carmen Luís Pessoa da Silva, World Health Organisation, Geneva

66 November  IFREE - IMO Teleclass - France
ANTIMICROBIAL RESISTANCE ISSUES WORLDWIDE AND THE WHO APPROACH TO COMBAT IT
Dr. Carmen Luís Pessoa da Silva, World Health Organisation, Geneva

67 November  OCCUPATIONAL INFECTION CONTROL IN CORRECTIONAL SETTINGS
Robert Marion, Miami-Dade County, Florida

14 November  DENTAL UNIT WATER CONTAMINATION - HEALTH RISKS AND METHODS OF CONTROL
Prof. Ralph Putzash, Managed Care Concepts, LLC.