

Methicillin-resistant *Staphylococcus aureus* (MRSA)
Methicillin-resistant coagulase-negative staphylococci (MRCNS)

Resistance:
 β -Lactum agents,
Others

Nontuberculous (atypical) mycobacteria
(e.g.) MAC

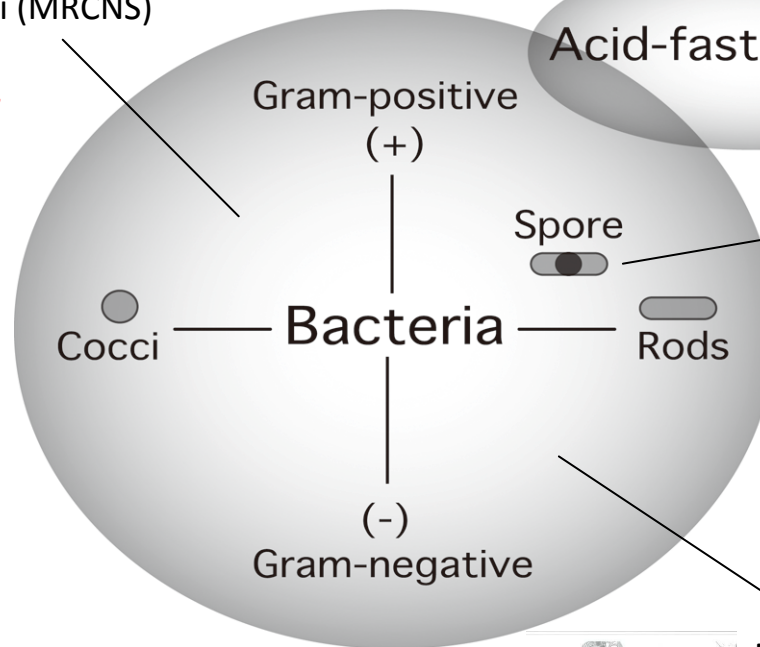


M. avium
Pinedo PJ et al.

Resistance:
Isoniazide

CAM
RFP
EB

Acid-fast bacteria



Clostridium difficile



Yoshichika Arakawa
<http://idsc.nih.gov/training/19kanri/005.html>

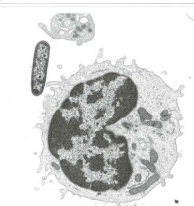


http://www.musee-afrappier.qc.ca/fr/index.php?pageid=3330&image=3330_clostridium

Resistance:
Fluoroquinolones (2000s)

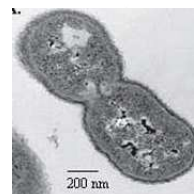
Multiple drug-resistant *Pseudomonas aeruginosa* (MDRP)

Resistance:
Fluoroquinolones
Carbapenems
Aminoglycosides



Multiple drug-resistant *Acinetobacter*

Resistance:
Carbapenems



Sullivan E. University of New Hampshire

**Antibiotic-resistant
opportunistic bacteria**

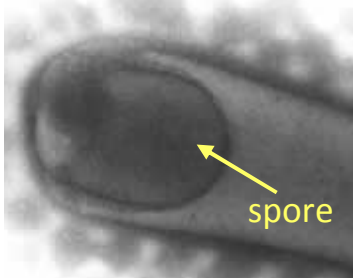
Tatsuo Yamamoto, Niigata, Japan

Clostridium difficile

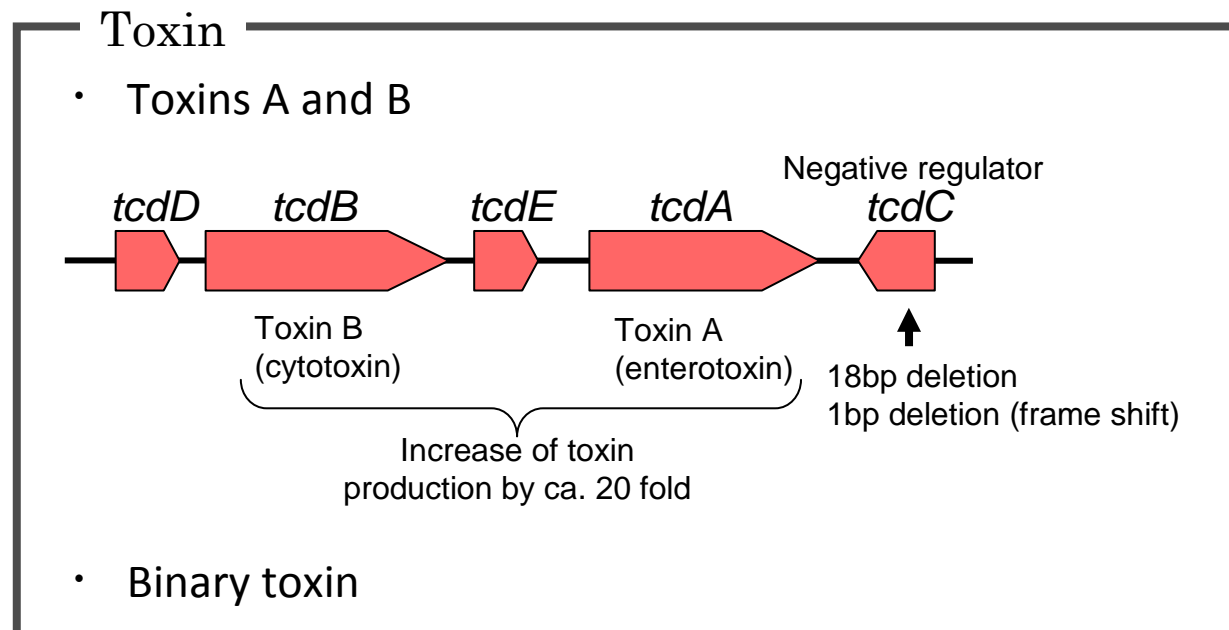
- The leading cause of nosocomial diarrhea
- Asymptomatic carriage
- Emergence of PCR ribotype 027
 - Hypervirulent (highly-transmissible)
 - Fluoroquinolone-resistant in 2000s
 - (Cephem-resistant in 1980s
Clindamycin-resistant in 1970s)

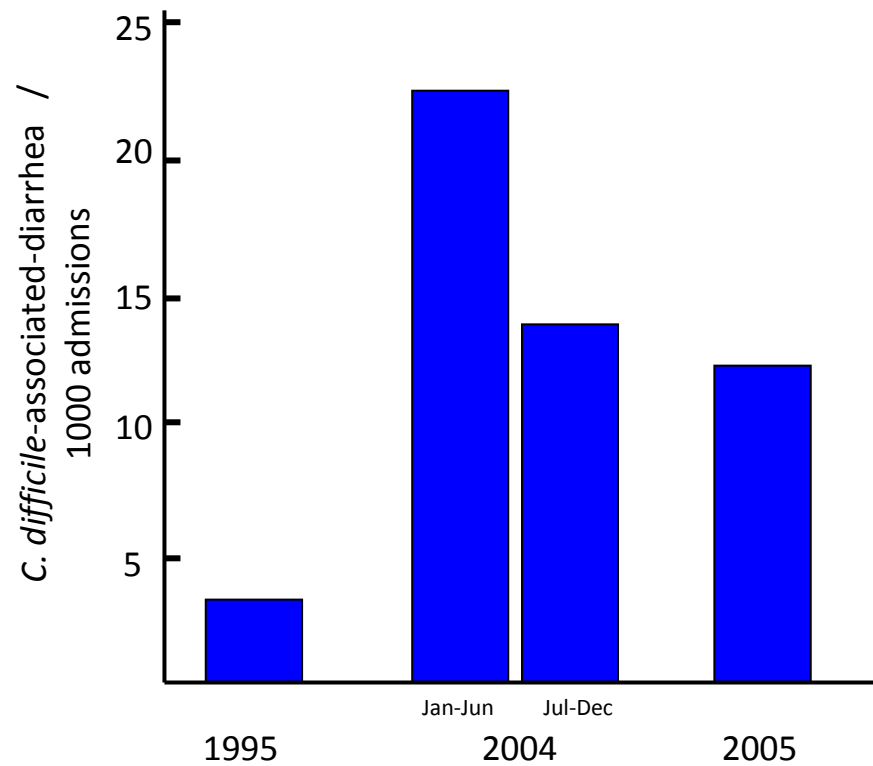


Ref: Y Arakawa.
<http://idsc.nih.go.jp/training/19kanri/005.html>

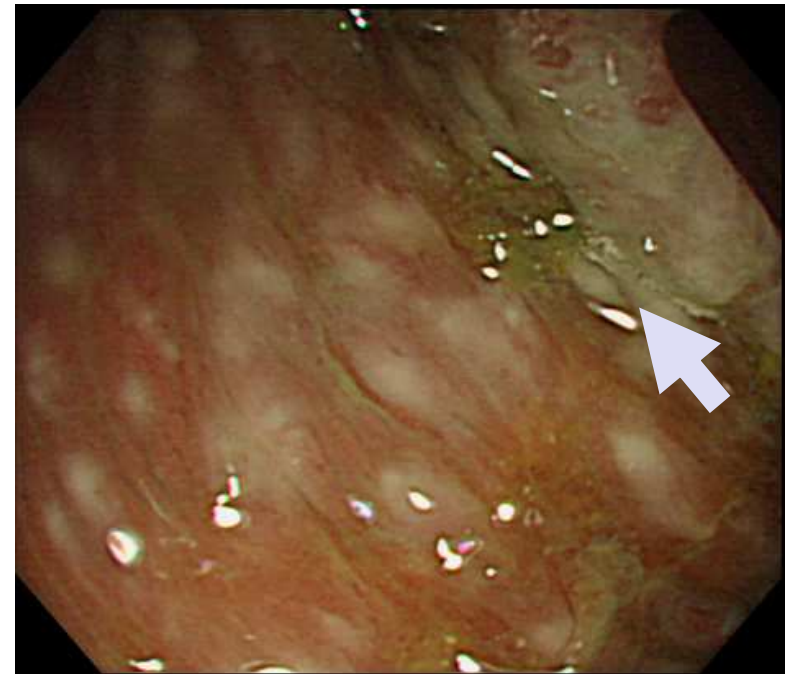


Ref: http://www.musee-afrappier.qc.ca/fr/index.php?pageid=3330&image=3330_clostridium





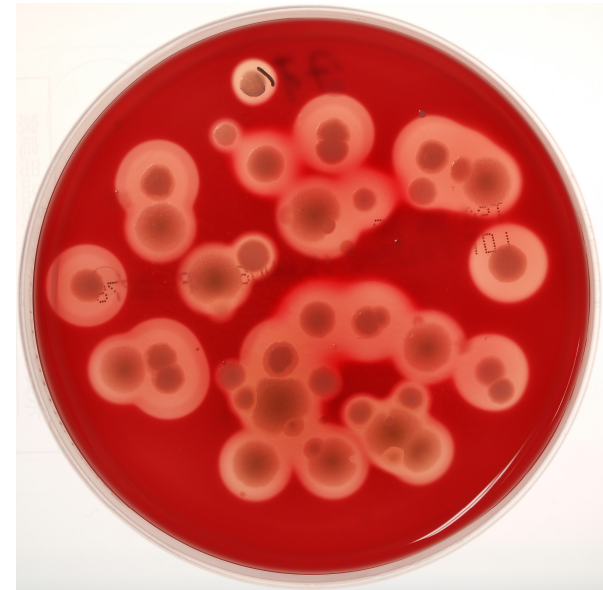
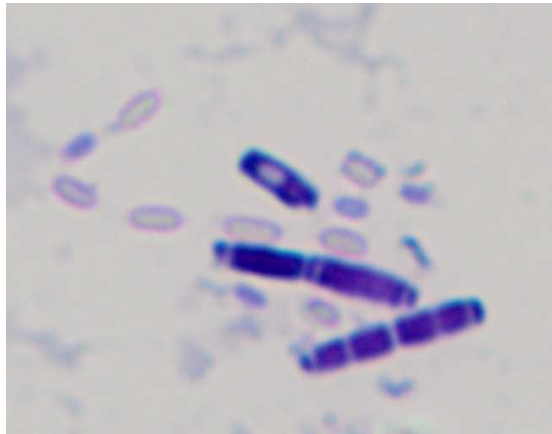
Change of number of *C. difficile*-associated-diarrhea (CDAD) in Quebec, Canada



Bacillus cereus nosocomial infection from reused towels in Japan

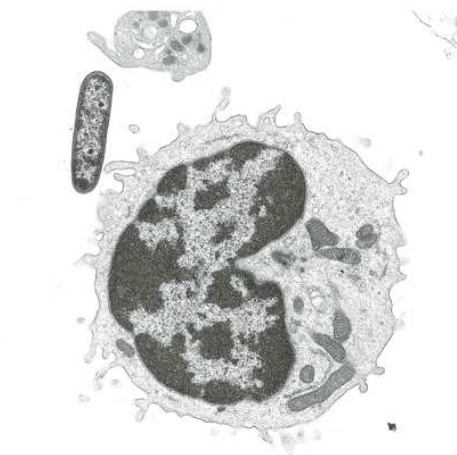
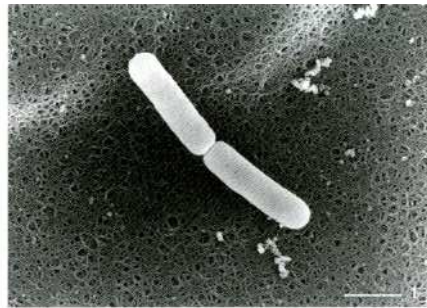
J Hosp Infect. 2008 69:361

- Blood stream infection
- Spiking fever ($>38.5^{\circ}\text{C}$)



Multiple drug-resistant *Pseudomonas aeruginosa* (MDRP)

- Resistance to carbapenems, aminoglycosides and fluoroquinolones

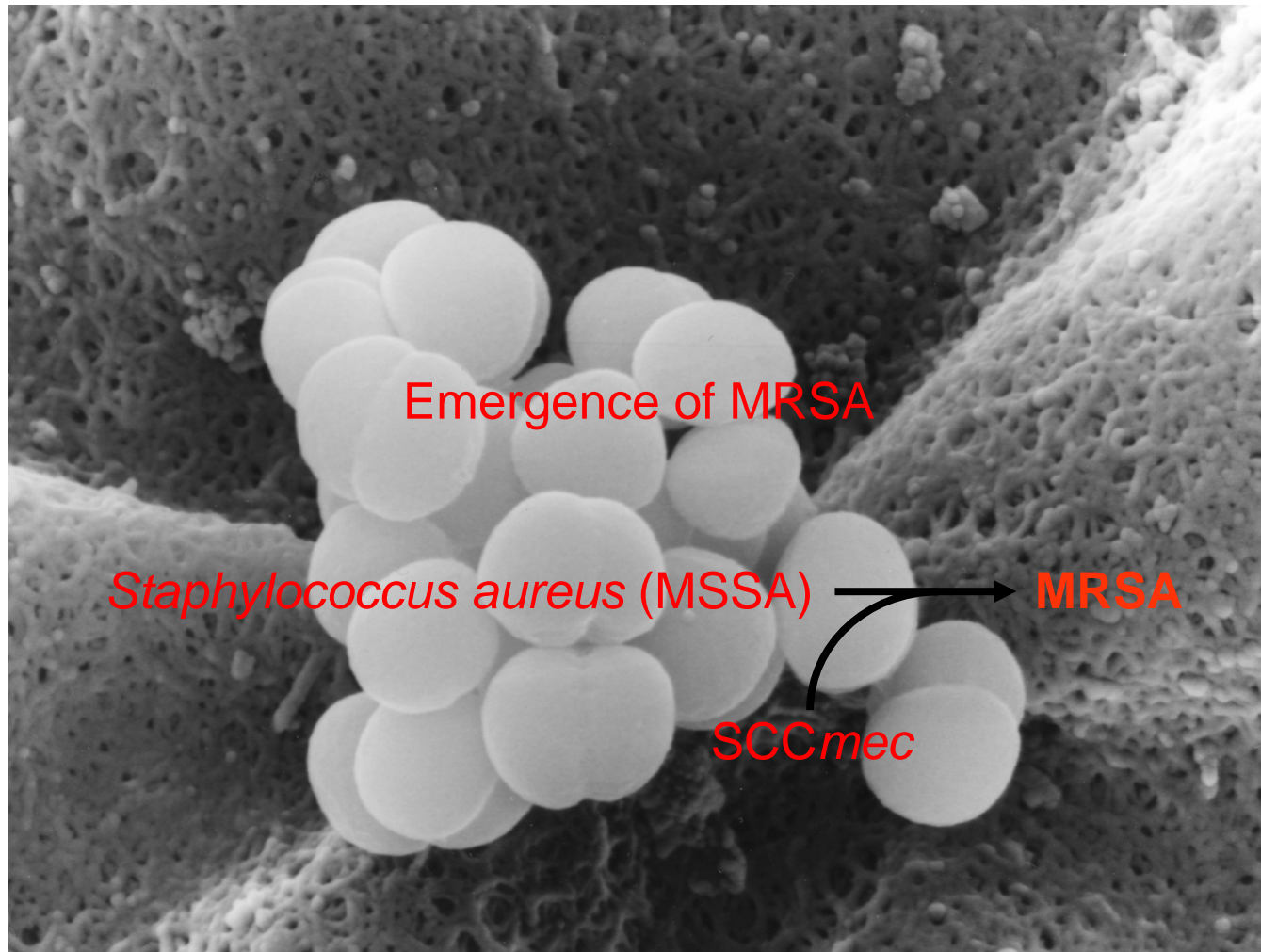


Infections in Niigata University Hospital

Infection	Age (Avg.)	Underlying disease	Death
Urinary tract infection	24-74 (49)	Diabetes mellitus, malignant disease, hematological disease <i>et al.</i>	2/6
Pneumonia	36-73 (58)	Malignant disease, hematological disease, AIDS <i>et al.</i>	1/3
Sepsis	25-34 (30)	Malignant disease, hematological disease, renal fistula <i>et al.</i>	1*/3

* Antibiotic treatment: vancomycin, cefozopran → meropenem, aztreonam

Methicillin-resistant *Staphylococcus aureus* (MRSA)



Nasal carriage in healthy individuals

① Staphylococci	>90%
② Coagulase-negative staphylococci (CNS)	>60%
③ <i>S. aureus</i>	~30%
④ MRSA	
University students	<0.1%
Healthy children	1-4%

Two types of MRSA

Hospital-acquired MRSA (HA-MRSA) Community-acquired MRSA (CA-MRSA)

① Age

- Inpatients (age >50)

② Heavy resistance

- SCC*meclI*
- High OXA resistance
- Resistant to multiple drugs

③ Invasive infections

- Medical devices, etc.

① Age

- Athlete, children

② Light resistance

- SCC*meclIV*
- Low OXA resistance
- Resistant to limited drugs

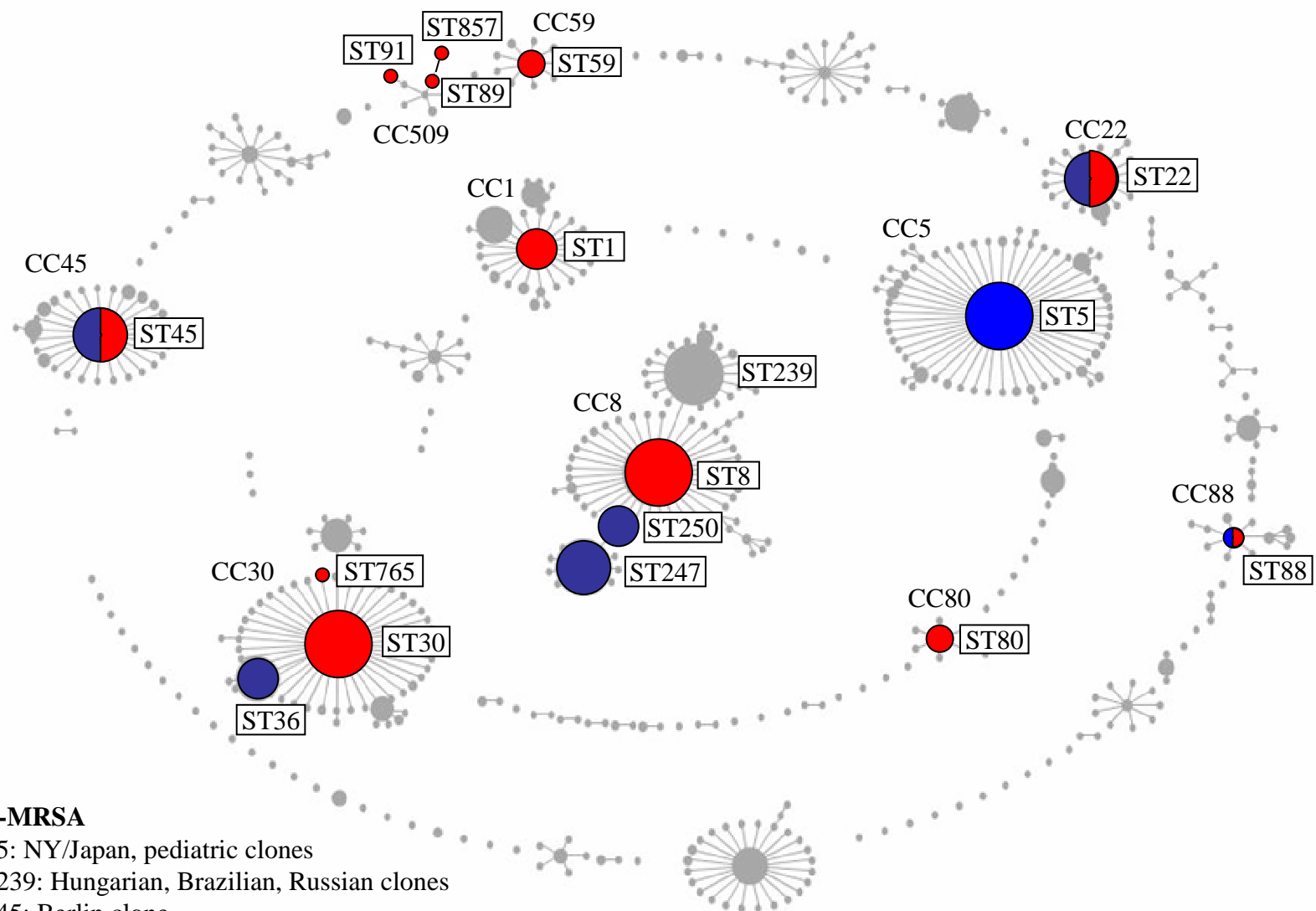
③ SSTIs

- Immuno-resistant
(PVL, ACME, peptide toxins)

Now, why MRSA?

The United States

- MRSA isolation rate was 64.4% of *S. aureus* clinically isolated (2003). Klevens *et al.*, Clin. Infect. Dis., 2006
- There were 94,360 cases of MRSA invasive infection and, of those, 18,650 cases (19.7%) were fatal (2005).
Klevens *et al.*, JAMA, 2007 ; JAMA, 2008
- Community-acquired MRSA (CA-MRSA) emerged and CA-MRSA infection of young age including healthy children and athletes were expanded. CA-MRSA caused serious pneumonia during influenza season (influenza-associated MRSA CAP).
CDC, MMWR, 2007
- As adult community-acquired pneumonia (CAP) that is important to verify with diagnostic study, CA-MRSA infection is listed in addition to SARS, avian (H5N1) influenza, and others.
Mandell *et al.*, Clin. Infect. Dis., 2007 (IDSA, ATS)



HA-MRSA

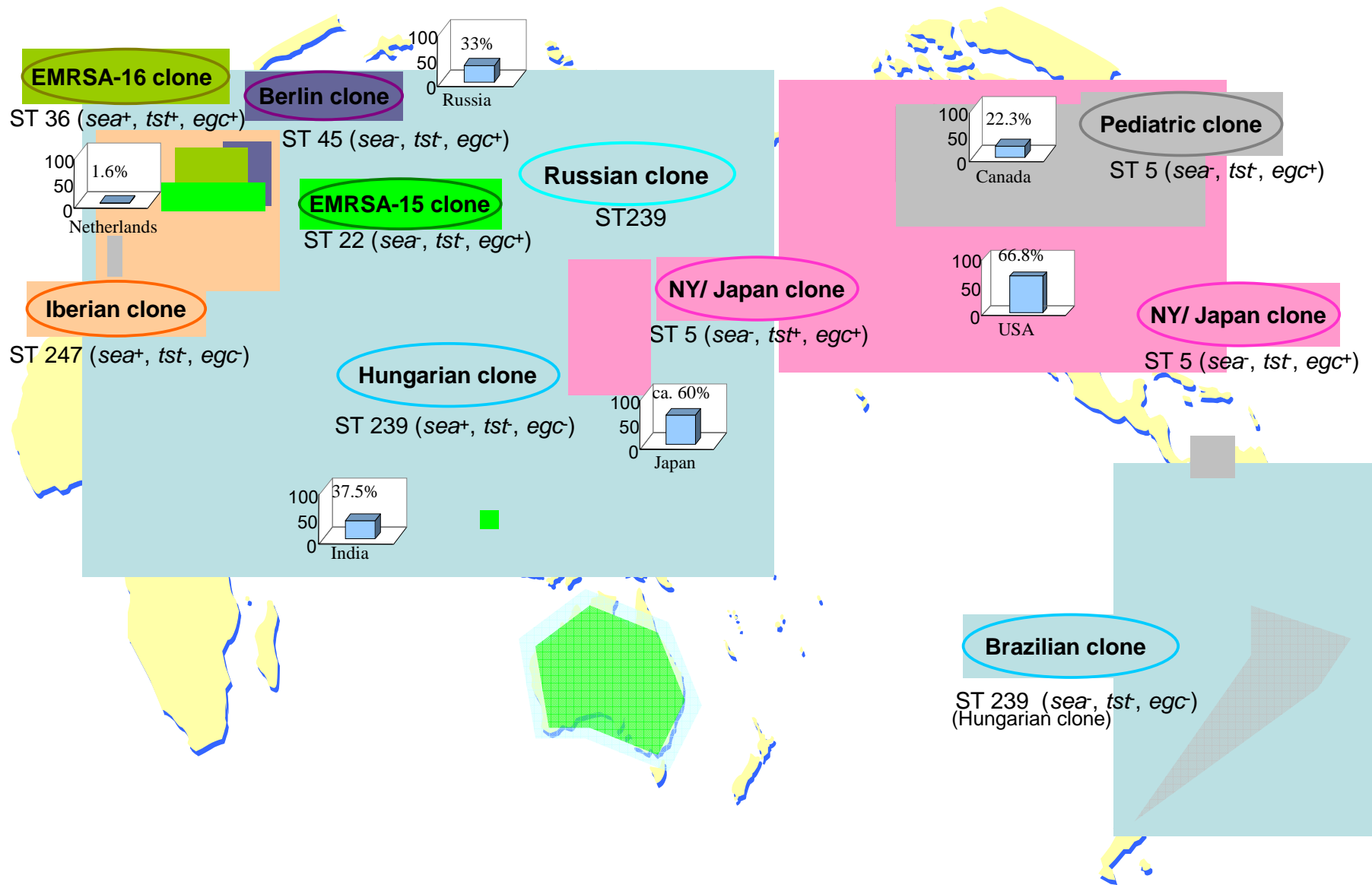
ST5: NY/Japan, pediatric clones
 ST239: Hungarian, Brazilian, Russian clones
 ST45: Berlin clone
 ST250, 247: Iberian clone
 ST22: EMRSA-15 clone
 ST36: EMRSA-16 clone

● CA-MRSA
 ● HA-MRSA

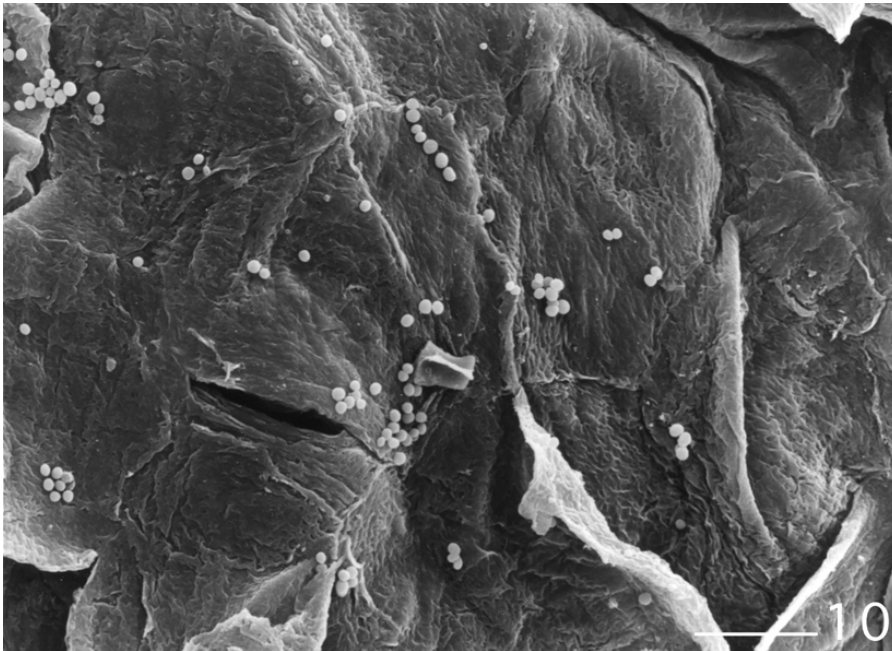
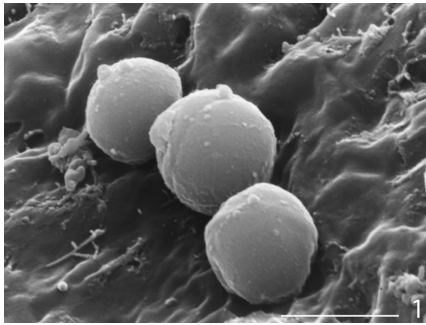
HA-MRSA

Epidemic MRSA clone	ST type	<i>spa</i> type	SCC <i>mec</i> type	<i>agr</i> type
New York/Japan	5	2	II	2
Pediatric	5	45	IV (VI)	2
Hungarian	239	6	III	1
Brazilian	239	390	IIIA	1
Russian	239	351	IIIx	1
EMRSA-15	22		IV	
EMRSA-16	36	16	II	3
Berlin	45	15	IV	1
Iberian	247	5	I	1

HA-MRSA



CA-MRSA



Jerome Etienne

Definition of CA-MRSA

Epidemiological definition:

- Isolation from outpatient or within 48 h of hospital admission.
- Isolation from the patient without known risk factors for MRSA infection (absence of hospitalization, surgery, dialysis etc. within the previous 1 year).

Bacteriological definition:

- ST type, etc as those of known CA-MRSA
- PFGE pattern as that of known CA-MRSA.
- Possessing of specific genes.
- PVL-positive (prevalent).
- *SCCmec* type IV - VII (mainly).
- Resistance to only β -lactams (in some regions or countries).

Risk factors for MRSA infections

HA-MRSA

*infection: mainly compromised host

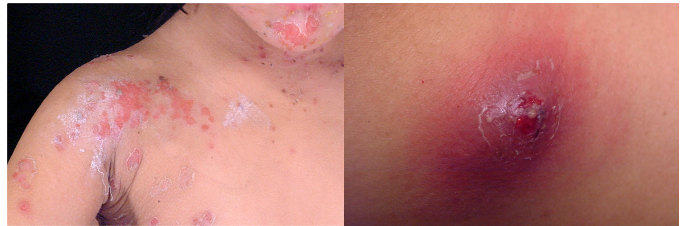
1. Hospitalization
2. Surgery
3. Residence
in a long-term care facility
4. Dialysis
5. Indwelling catheters and
percutaneous medical devices

CA-MRSA

*infection: healthy individual

1. University, school students
2. Military trainee
3. Athletic activity
(football teams, etc.)
4. Jail inmates
5. MSM
(men who have sex with men)
6. Infected family member
7. Hurricane evacuees
8. Tattoo

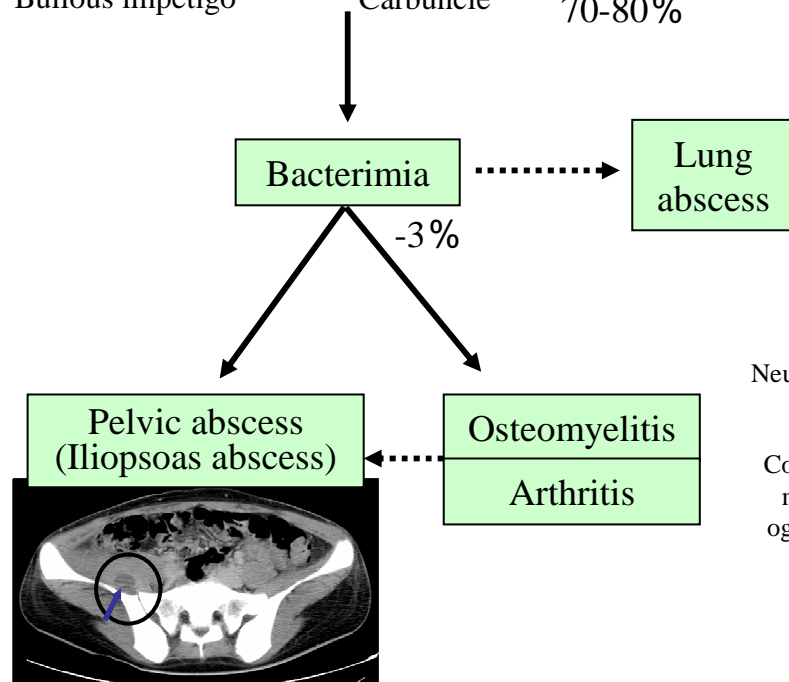
Skin & soft-tissue infection (SSTI)



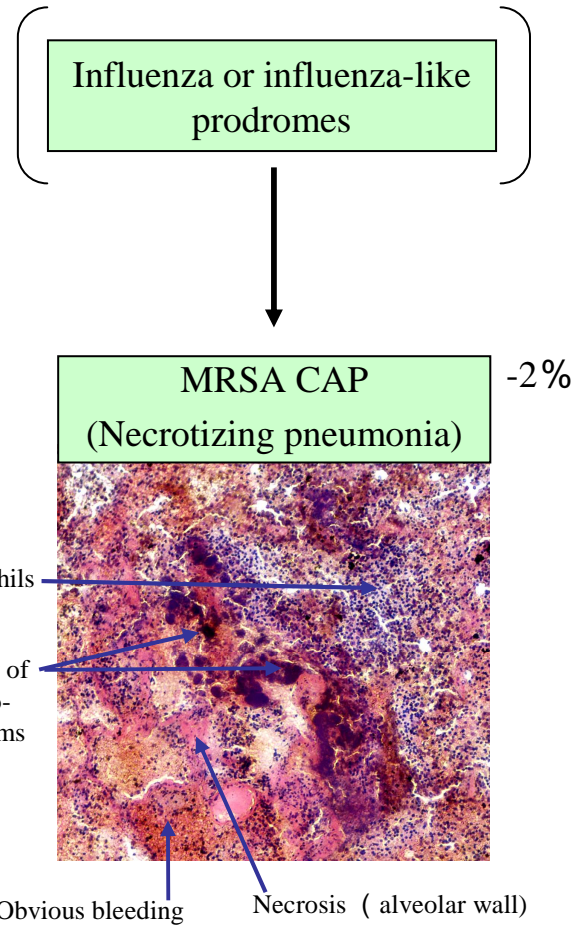
Bullous impetigo

Carbuncle

70-80%



Respiratory infection



Others

Wound infection -10%
Surgical site infection

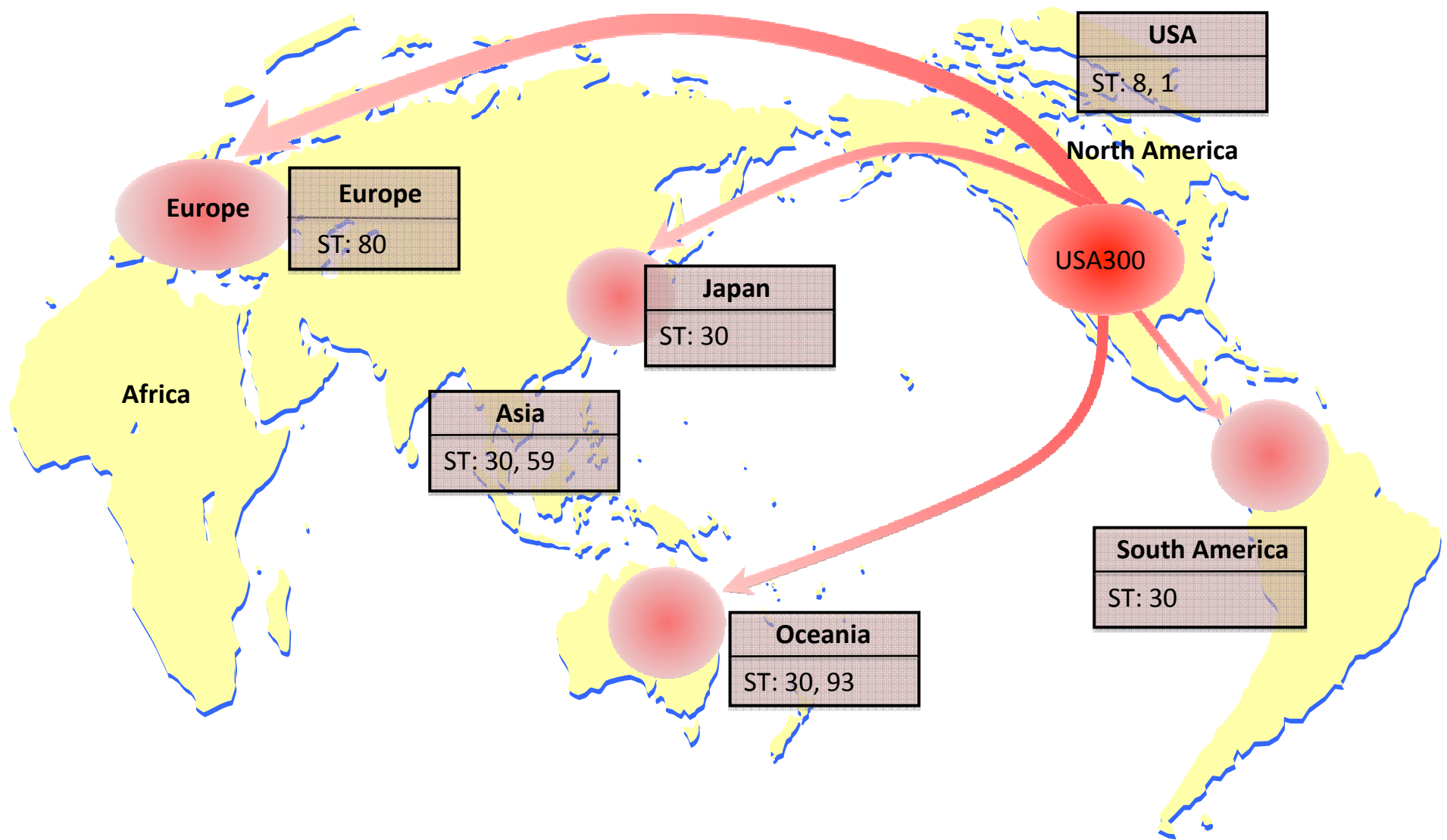
Necrotizing fasciitis

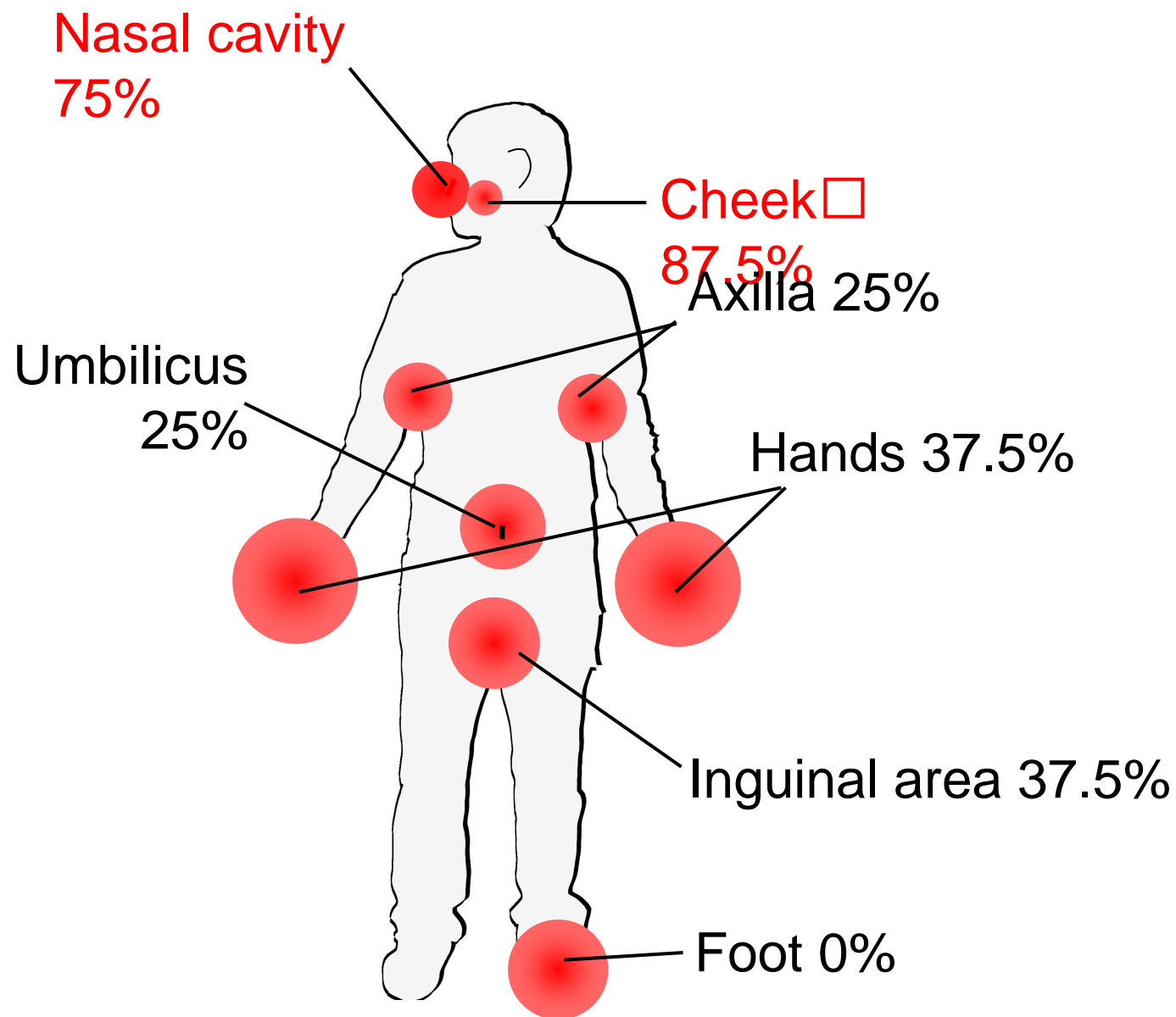
Sepsis with Waterhouse-Friderichsen syndrome

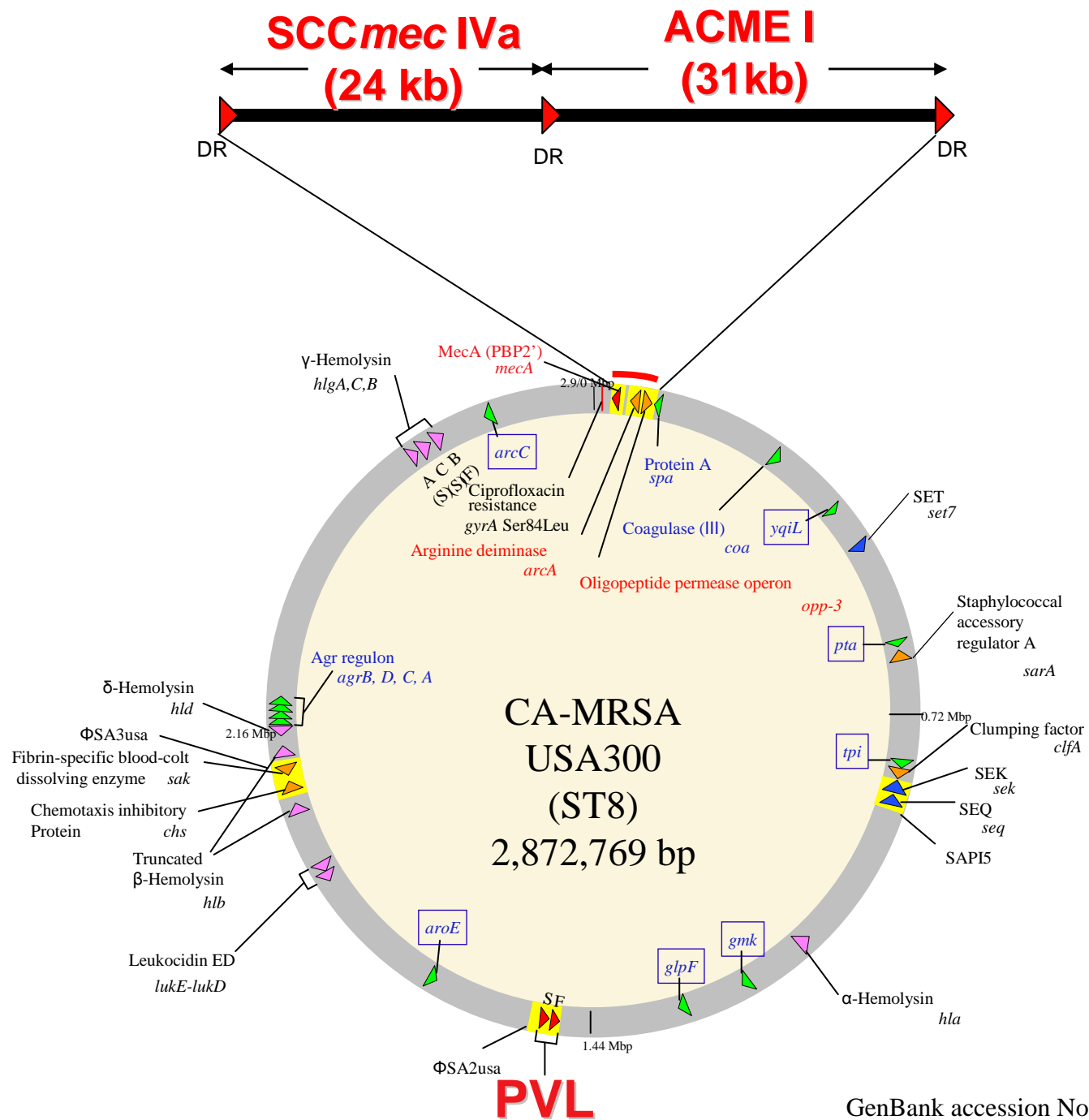
UTI -4%

Sinusitis -4%

PVL-positive CA-MRSA

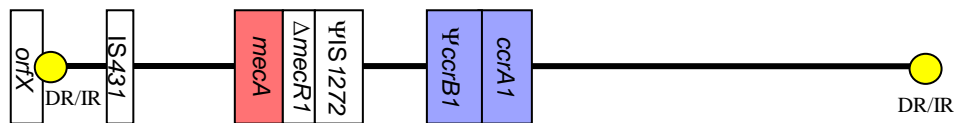




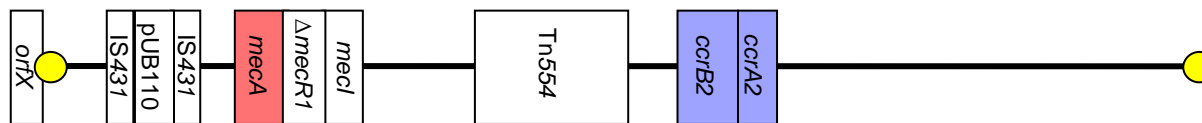


GenBank accession No. NC 007793

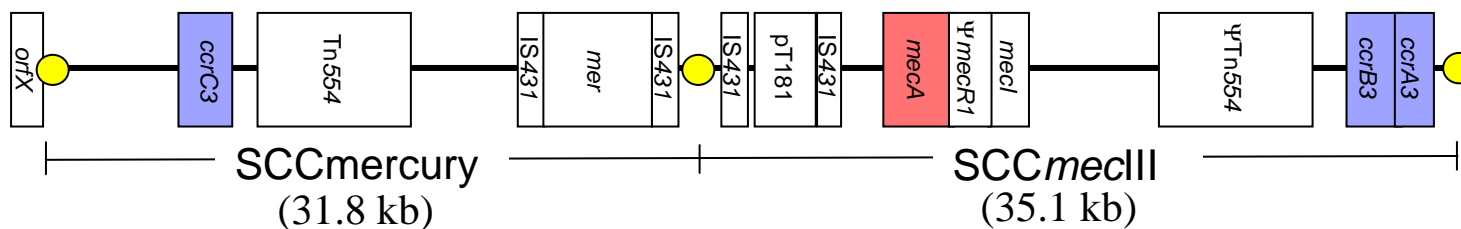
SCC*mecI*
(34.3 kb)



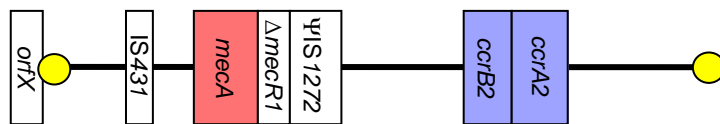
SCC*mecII*
(53.0 kb)



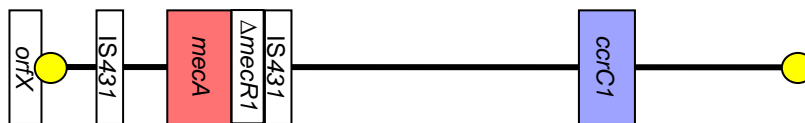
SCC*mercury*/
SCC*mecIII*
(66.9 kb)



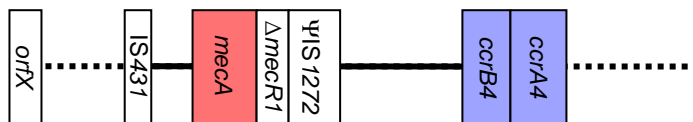
SCC*mecIV*
(24.2 kb)



SCC*mecV*
(27.6 kb)

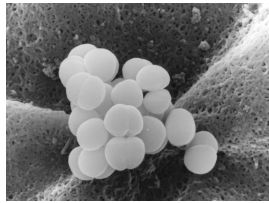


SCC*mecVI*



SCC*mecVII*
(41.3 kb)





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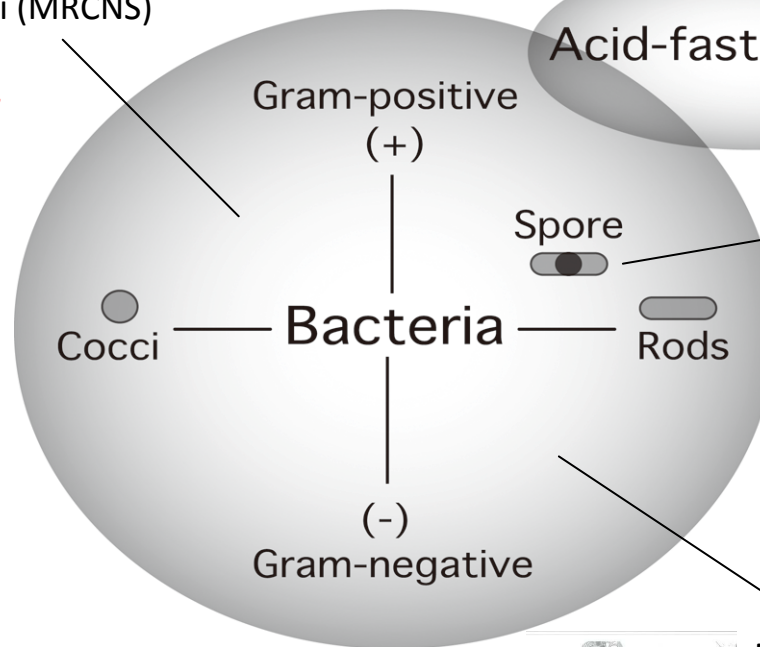


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Pinedo PJ et al.

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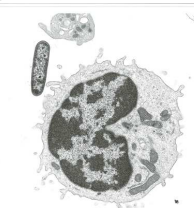


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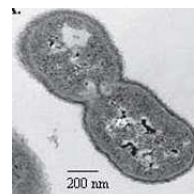
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Resistance:
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Carbapenems
Aminoglycosides



Multiple drug-resistant *Acinetobacter*

Resistance:
Carbapenems



Sullivan E. University of New Hampshire

Thank you!