Staphylococcal infection in children

Prof. Saw Win

History of Staphylococcus

- Discovery. In 1880,
- **Alexander Ogston**, a Scottish surgeon,
- after noticing groups of bacteria in pus from a surgical abscess.
- named it Staphylococcus after its clustered appearance evident under a microscope.

Photo- The Internet

Ref:
Licitra, G., 2022. *Etymologia:Staphylococcus*. [online] ncbi.nlm.nih.gov. Available at: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3810938/#:~:text=In%201880%2C%20Scottish%20surgeon%20Sir,color%20of%20their%20colonies%3A%20S.> [Accessed 12 August 2022].

Classification of Staphylococcus

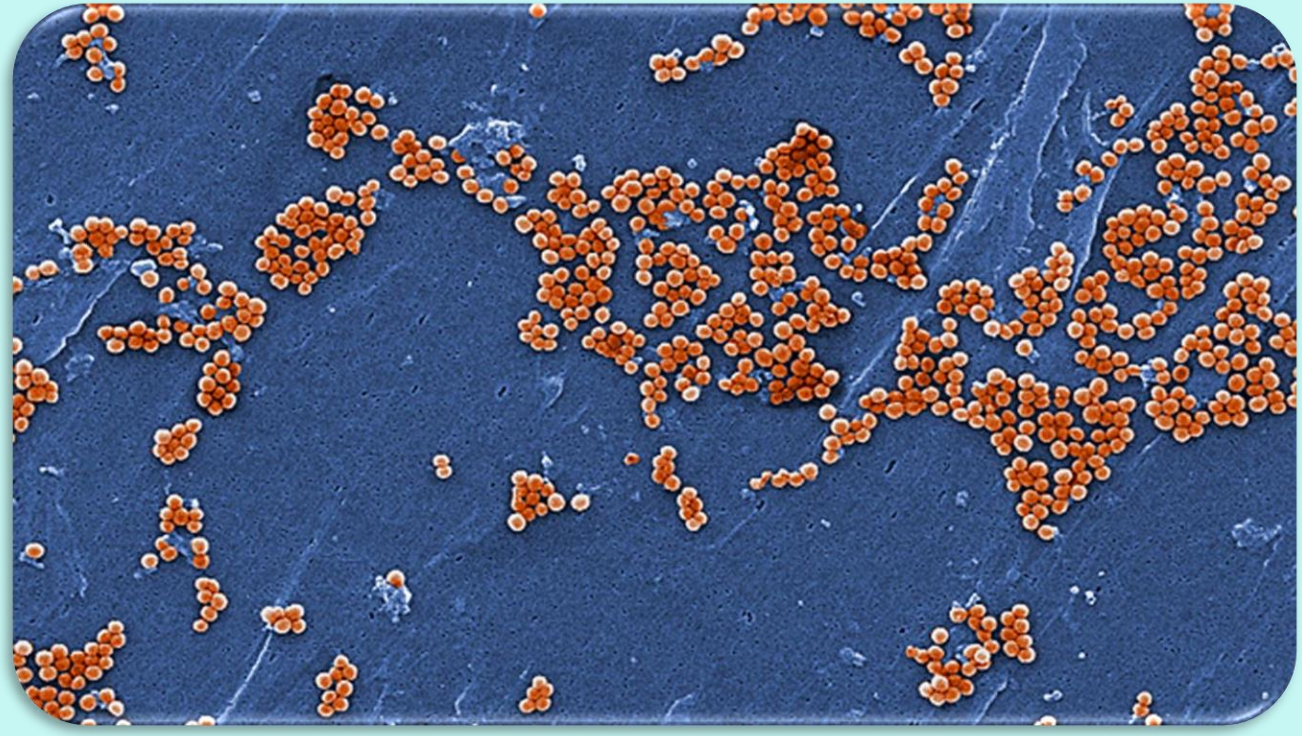


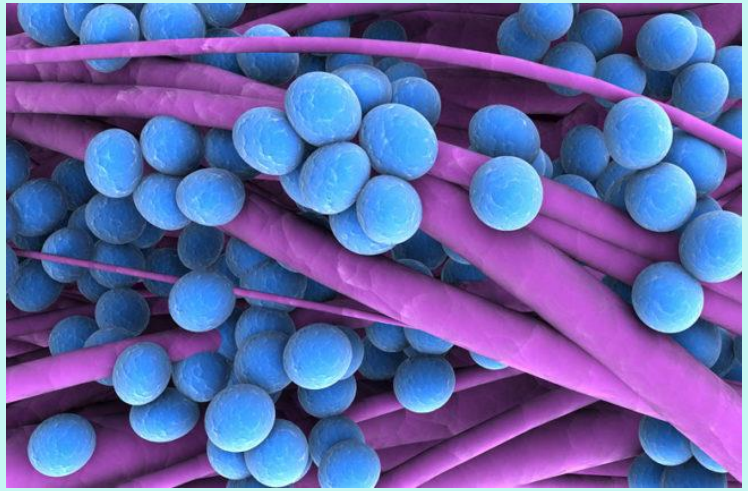
Photo- The Internet

- Family – Micrococceae
- Genus – Staphylococcus
- Species
  - S. argenteus
  - S. arlettae
  - S. agnetis
  - S. aureus
  - S. auricularis
  - S. borealis and etc

Staphylococcal Infections

- gram-positive aerobic organisms.
- *Staphylococcus aureus* is the most pathogenic;
- typically causes skin infections and sometimes pneumonia, endocarditis, and osteomyelitis.
- commonly leads to abscess formation
- Some strains elaborate toxins that cause gastroenteritis, scalded skin syndrome, and toxic shock syndrome.

Photo- The Internet



Ref:
Bush, . L. M. & Vazquez-Pertejo, M. T., 2021. *msdmanuals.com.* [Online]
Available at: https://www.msdmanuals.com/professional/infectious-diseases/gram-positive-cocci/staphylococcal-infections
[Accessed 24 Aug 2022].

Carrier State

- Ubiquitous
- Carried, usually transiently in anterior nares (30 % of healthy adults) , skin (20 %)
- Carriage rate – higher in hospital – patients and health care personals
- Can cause infections in – Host and Others
- S. aureus infection – more common in carriers than noncarrier
- Caused by the same species

Risk Factors

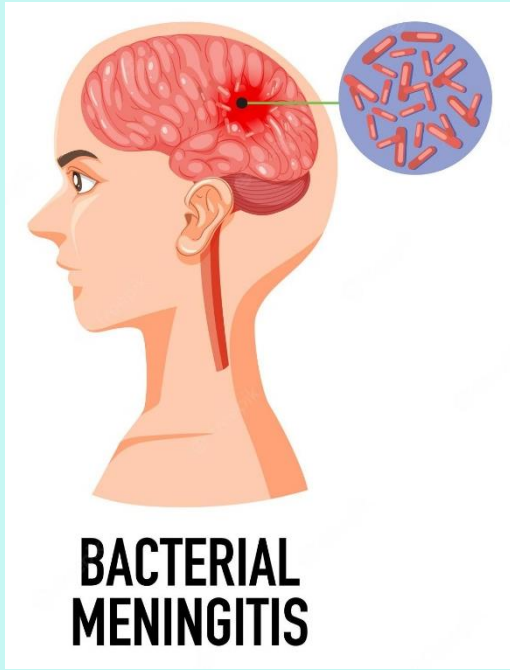
- Neonates and breastfeeding mothers
- influenza, chronic bronchopulmonary disorders (eg, cystic fibrosis, emphysema), leukemia, tumors, chronic skin disorders, or diabetes mellitus
- Patients with a transplant, an implanted prosthesis, other foreign bodies, or an indwelling intravascular plastic catheter
- Patients receiving a steroids, irradiation, immuno-suppressants, or antitumor chemotherapy
- Injection drug users
- chronic kidney disease on dialysis
- surgical incisions, open wounds, or burns

Ref:
Bush, . L. M. & Vazquez-Pertejo, M. T., 2021. *msdmanuals.com.* [Online]
Available at: https://www.msdmanuals.com/professional/infectious-diseases/gram-positive-cocci/staphylococcal-infections
[Accessed 24 Aug 2022].

Common Staphylococcal Infections in Children

- Staphylococcal skin infection and

  Toxic shock syndrome
- Staphylococcal neonatal infection
- Staphylococcal pneumonia
- Staphylococcal meningitis
- Staphylococcal food poisoning
- Multi-drug-resistant *Staphylococcus aureus*



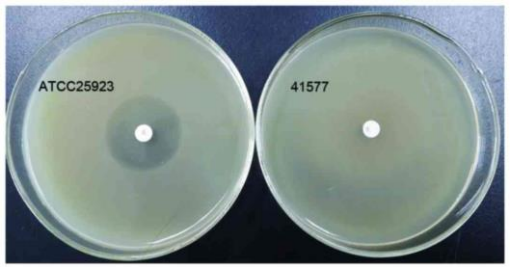


Photo- The Internet

Staphylococcal Skin Infection

Staphylococcal skin infections include

- folliculitis, furuncles, carbuncles,
- cellulitis,
- staphylococcal scalded skin syndrome, and
- toxic shock syndrome

Photo- The Internet

Ref:
Ladhani, S., Garbash, M. Staphylococcal Skin Infections in Children. *Pediatr-Drugs* **7,** 77–102 (2005)

Folliculitis, Furuncles, and Carbuncles

Photo- The Internet

- S. aureus is the most common cause
- Associated with poor hygiene, maceration, and drainage from wounds and abscesses, obesity, malnutrition, diabetes, immunosuppression
- Hair follicles can become inflamed after physical injury, chemical irritation, or infection, which can lead to folliculitis.
- Furuncles and carbuncles may develop from existing folliculitis when the infection progresses deeper and extends out from the follicle.

Ref
Ladhani, S., Garbash, M. Staphylococcal Skin Infections in Children. *Pediatr-Drugs* **7,** 77–102 (2005)

Treatment

- mild, localized lesions usually only requires topical antibacterial cleansers such as chlorhexidine or topical antibacterial such as mupirocin.
- More severe and recurrent cases require oral systemic ant staphylococcal antibiotics
- Large or deep nodular lesions may also require incision and drainage.
- Isevere cases, parenteral anti-bacterials may be required, and particular care must be taken to ensure that necrotizing fasciitis, which requires immediate surgical debridement and aggressive management, is not missed

Ref:
Ladhani, S., Garbash, M. Staphylococcal Skin Infections in Children. *Pediatr-Drugs* **7,** 77–102 (2005)

Cellulitis

- *S. aureus* and *S. pyogenes* are the most common organisms
- Painful erythematous infection of the subcutaneous tissues with involvement of the dermis and relative sparing of the epidermis
- More common in children with diabetes or immunosuppression
- Present with erythema, swelling, and tenderness over the affected area
- Fever and rigors may accompany the infection and there may be regional lymphadenopathy

Photo- The Internet

Ref: Ladhani, S., Garbash, M. Staphylococcal Skin Infections in Children. *Pediatr-Drugs* **7,** 77–102 (2005)

Treatment

- Localized cellulitis can be treated with oral antibacterials that cover both S. aureus and S. pyogenes.
- Marking the margins of erythema may be useful for following the progress of cellulitis.
- In most patients, the lesions should stop progressing within 24 hours, but may take longer if deeper tissues of the dermis are involved
- Extensive lesions or those not responding to oral antibacterials should be treated with parenteral antibacterials, which should continue for at least 3 days after resolution of acute inflammation

Ref:
Ladhani, S., Garbash, M. Staphylococcal Skin Infections in Children. *Pediatr-Drugs* **7,** 77–102 (2005)

Treatment

- In patients with diabetes or immunosuppression, young infants, and those not responding to first-line antibacterial therapy, a broad-spectrum cephalosporin with or without aminoglycosides should be considered
- **orbital cellulitis** require rapid attention because of **potentially severe complications,** including abscess formation, blindness, and meningitis.

Ref:
Ladhani, S., Garbash, M. Staphylococcal Skin Infections in Children. *Pediatr-Drugs* **7,** 77–102 (2005)

Staphylococcal Scalded Skin Syndrome

- A spectrum of **blistering skin disorders** caused by the exfoliative toxins of *S. aureus*
- The exfoliative toxins are atypical serine proteases that specifically bind and cleave desmoglein-1, which forms part of the intercellular cytoskeleton structure in the epidermis, resulting in the development of superficial blisters.

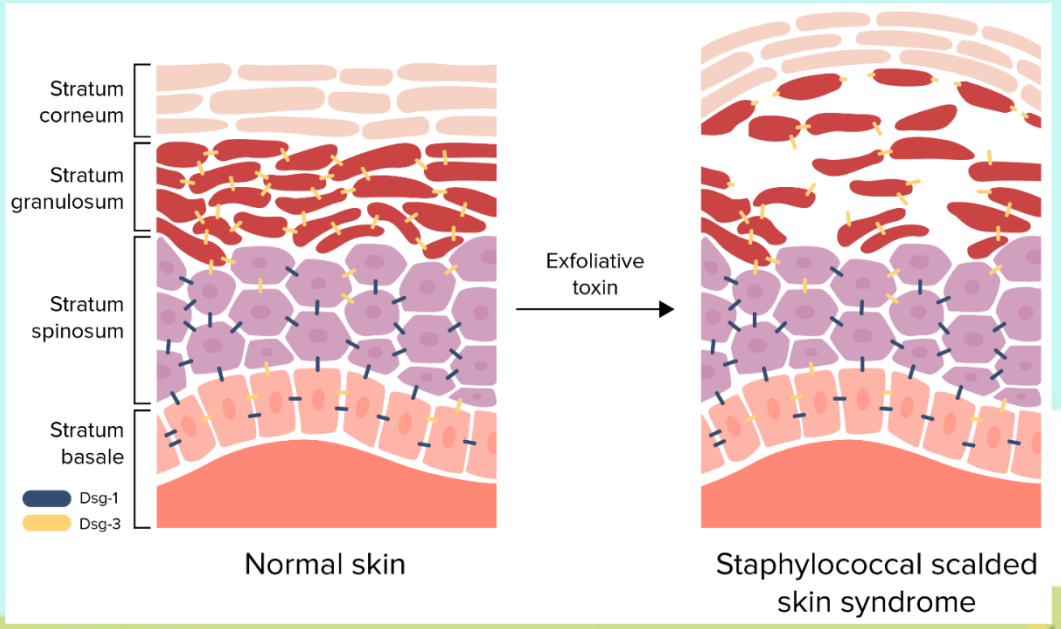


Photo- The Internet

Ref:
Ladhani, S., Garbash, M. Staphylococcal Skin Infections in Children. *Pediatr-Drugs* **7,** 77–102 (2005)

Staphylococcal Scalded Skin Syndrome

- In the **localized form** (bullous impetigo), children usually present with flaccid transparent bullae most commonly on the face, buttocks, trunk, perineum and the extremities, without systemic symptoms.
- In **generalized staphylococcal scalded skin syndrome** (Ritter disease), lack of protective antitoxin antibodies allows the exfoliative toxin to spread extensively and affect the entire body surface.
- Children usually present with fever and erythema, which rapidly develops into superficial blisters that rupture on the slightest pressure, leaving areas of denuded skin.
- The diagnosis is mainly clinical. Biopsy of the lesion if necessary.

Photo- The Internet

Ref:
Ladhani, S., Garbash, M. Staphylococcal Skin Infections in Children. *Pediatr-Drugs* **7,** 77–102 (2005)

Staphylococcal Scalded Skin Syndrome

Diagnosis

- When staphylococcal scalded skin syndrome is suspected, **cultures** should be obtained from blood, urine, the nasopharynx, the umbilicus, abnormal skin, or any suspected focus of infection; the intact bullae are sterile.
- Although the diagnosis is usually **clinical,** a **biopsy** of the affected skin may help confirm the diagnosis.

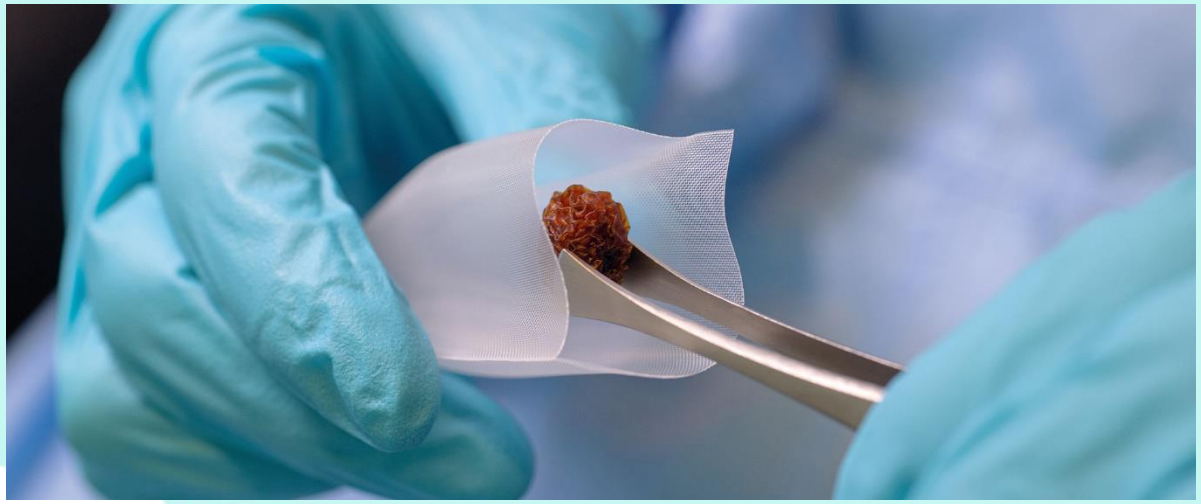


Photo- The Internet

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Available at: https://www.msdmanuals.com/professional/infectious-diseases/gram-positive-cocci/staphylococcal-infections [Accessed 24 Aug 2022].

Treatment

- Children with a **few localized lesions** of bullous or non-bullous impetigo and no systemic symptoms can be treated with **topical antibacterials**, such as **mupirocin or fusidic** acid ointment.
- Children with **extensive lesions** should be treated with **intravenous antistaphylococcal antibacterials** and carefully assessed for pain, temperature, and hydration status, particularly in young infants.
- **Severe cases** should also be **covered for possible secondary Gram-negative infection**
- toxin mediated, exfoliation usually continues for 24–48 hours after initiating antibacterials

Ref:
Ladhani, S., Garbash, M. Staphylococcal Skin Infections in Children. *Pediatr-Drugs* **7,** 77–102 (2005)

Toxic Shock Syndrome

Ref:
Ladhani, S., Garbash, M. Staphylococcal Skin Infections in Children. *Pediatr-Drugs* **7,** 77–102 (2005)

- An acute-onset, superantigen-mediated disease with fever, rash, and hypotension that can rapidly lead to disseminated intravascular coagulation, myocardial suppression, acute renal failure, and multi-organ failure.
- The rash in toxic shock syndrome is usually diffuse, non-pruritic, and scarlatiniform in appearance, and is most prominent on the trunk and extremities.
- Peeling of the palms of the hands and soles of the feet can also occur 1–2 weeks after the onset of disease.

Photo- The Internet

Toxic Shock Syndrome

The diagnosis of toxic shock syndrome includes

- the presence of fever; diffuse macular rash; hypotension;
- Involvement of at least three organ systems, including the gastrointestinal tract (diarrhea and vomiting), musculoskeletal system (myalgia), hematologic system (thrombocytopenia), or CNS (irritability or drowsiness with no focal neurologic signs);
- inflammation of the mucosal membranes; and
- biochemical evidence of renal or liver failure.

Ref:
Ladhani, S., Garbash, M. Staphylococcal Skin Infections in Children. *Pediatr-Drugs* **7,** 77–102 (2005)

Treatment

- The management of toxic shock syndrome involves aggressive cardiorespiratory support requiring resuscitation with large volumes of intravenous fluids and inotropes, and removal of any source of toxin-producing infection, which may include incision and drainage of any infected wounds or localized infections
- Appropriate management of associated problems such as acute renal failure and adult respiratory distress syndrome is also critical.
- the intravenous antibacterial chosen should cover both *S. aureus* and *S. pyogenes*
- There is also some evidence that intravenous immunoglobulin decreases mortality in toxic shock syndrome by neutralizing the activity of the superantigens

Ref:
Ladhani, S., Garbash, M. Staphylococcal Skin Infections in Children. *Pediatr-Drugs* **7,** 77–102 (2005)

Treatment Summary of Staphylococcal Skin Infection

- Skin and soft tissue infections are among the most common infections in children and are nearly always caused by S. aureus or S. pyogenes
- localized lesions may be treated with topical antibacterials such as mupirocin or fusidic acid, but multiple and/or extensive lesions require systemic antibacterials
- The treatment of choice is penicillinase-resistant penicillins such as **cloxacillin** and **flucloxacillin**.
- Cefalexin and erythromycin are suitable cost-effective alternatives, with broader cover in children
- macrolides should be used judiciously because of the risk of development of resistance to other groups of antibacterials, particularly clindamycin.

Ref:
Ladhani, S., Garbash, M. Staphylococcal Skin Infections in Children. *Pediatr-Drugs* **7,** 77–102 (2005)

Treatment Summary of Staphylococcal Skin Infection

- In children requiring intravenous therapy, sulbactam/ampicillin and cefuroxime are both suitable
- ceftriaxone has a major advantage in that it can be given once daily for outpatient treatment of moderate-to-severe skin infections.
- higher-generation cephalosporins and loracarbef effective in pediatric skin and soft tissue infections and have a much broader spectrum of activity
- Well children with community-acquired MRSA infections can be treated with clindamycin or trimethoprim-sulfamethoxazole, but must be observed closely for potentially severe adverse effects.
- In severe infections, vancomycin remains the treatment of choice, while intravenous teicoplanin and clindamycin are suitable alternatives.

Ref:
Ladhani, S., Garbash, M. Staphylococcal Skin Infections in Children. *Pediatr-Drugs* **7,** 77–102 (2005)

Staphylococcal Neonatal Infections

- **6 weeks after birth** and include


Photo- The Internet

- Skin lesions with or without exfoliation
- Bacteremia (Neonatal Sepsis)
- Meningitis (Neonatal Bacterial Meningitis)
- Pneumonia (Neonatal Pneumonia)

- Less than 10 – topical antibiotics
- More than 10 – oral or systemic antibiotics

Ref:
Bush, . L. M. & Vazquez-Pertejo, M. T., 2021. *msdmanuals.com.* [Online]
Available at: https://www.msdmanuals.com/professional/infectious-diseases/gram-positive-cocci/staphylococcal-infections
[Accessed 24 Aug 2022].

Staphylococcal Pneumonia

- requires prompt diagnosis, as sequelae can lead to complications

  such as

- severe necrotizing pneumonia,
- bacteremia, or sepsis with or without shock.

Photo- The Internet

Ref:
Clark, S. and Hicks, M., 2022. *Staphylococcal Pneumonia*. [online] Ncbi.nlm.nih.gov. Available at: <https://www.ncbi.nlm.nih.gov/books/NBK559152/#:~:text=Staphylococcal%20pneumonia%20is%20a%20disease,in%20a%20post%2Dviral%20state.> [Accessed 12 August 2022].

Risk Factors

- Usually seen in patients that are recovering from influenza
- *S. aureus* on the skin or in nares, and this can also lead to pulmonary infections
- Upper respiratory tract infection
- Children with poor général health (malnutrition, skin lesions, etc.)

Ref:
Clark, S. and Hicks, M., 2022. *Staphylococcal Pneumonia*. [online] Ncbi.nlm.nih.gov. Available at: <https://www.ncbi.nlm.nih.gov/books/NBK559152/#:~:text=Staphylococcal%20pneumonia%20is%20a%20disease,in%20a%20post%2Dviral%20state.> [Accessed 12 August 2022].

Photo- The Internet

Symptoms

General signs: change in overall condition, pallor, high fever or hypothermia, frequently signs of shock; presence of skin lesions (point of bacterial entry), however, skin lesions may be absent.

Gastrointestinal signs: nausea, vomiting, diarrhoea, painful abdominal distention.

Respiratory signs: dry cough, tachypnoea, signs of distress (nasal flaring, chest indrawing). Pulmonary auscultation is often normal; sometimes dullness indicating pleural effusion.

Ref:
Medicalguidelines.msf.org. 2022. *Staphylococcal pneumonia | MSF Medical Guidelines*. [online] Available at: <https://medicalguidelines.msf.org/en/viewport/CG/english/staphylococcal-pneumonia-16689565.html> [Accessed 12 August 2022].

Diagnosis

- Chest x-ray : may show multilobar consolidation, cavitation, pneumatoceles, spontaneous pneumothorax.
- A complete blood count (CBC) will likely show leukocytosis with a neutrophilic predominance

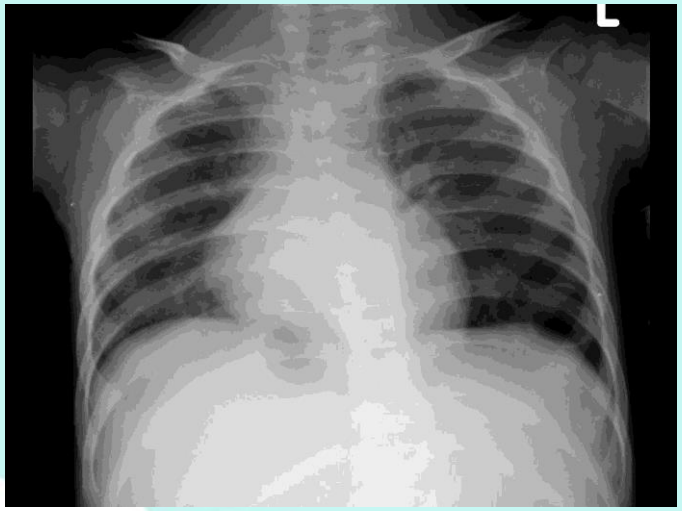


Photo- The Internet

Ref:

1. Clark, S. and Hicks, M., 2022. *Staphylococcal Pneumonia*. [online] Ncbi.nlm.nih.gov. Available at: <https://www.ncbi.nlm.nih.gov/books/NBK559152/#:~:text=Staphylococcal%20pneumonia%20is%20a%20disease,in%20a%20post%2Dviral%20state.> [Accessed 12 August 2022].
2. Medicalguidelines.msf.org. 2022. *Staphylococcal pneumonia | MSF Medical Guidelines*. [online] Available at: <https://medicalguidelines.msf.org/en/viewport/CG/english/staphylococcal-pneumonia-16689565.html> [Accessed 12 August 2022].

Treatment

- Treatment for staphylococcal pneumonia depends on either **MRSA or MSSA**
- If MRSA is suspected or confirmed, either **vancomycin** or **linezolid** should be initiated at the start of treatment and be promptly discontinued if MRSA is ruled out.
- Both vancomycin and linezolid have similar efficacy, and selection should be based on patient tolerance, antibiotic allergy profile, renal function, drug interaction, and intravenous access. Vancomycin is preferred if the patient is cytopenic or taking selective serotonin reuptake inhibitors (SSRIs)
- **Ceftaroline** can be used if vancomycin or linezolid are contraindicated

Ref:
Clark, S. and Hicks, M., 2022. *Staphylococcal Pneumonia*. [online] Ncbi.nlm.nih.gov. Available at: <https://www.ncbi.nlm.nih.gov/books/NBK559152/#:~:text=Staphylococcal%20pneumonia%20is%20a%20disease,in%20a%20post%2Dviral%20state.> [Accessed 12 August 2022].

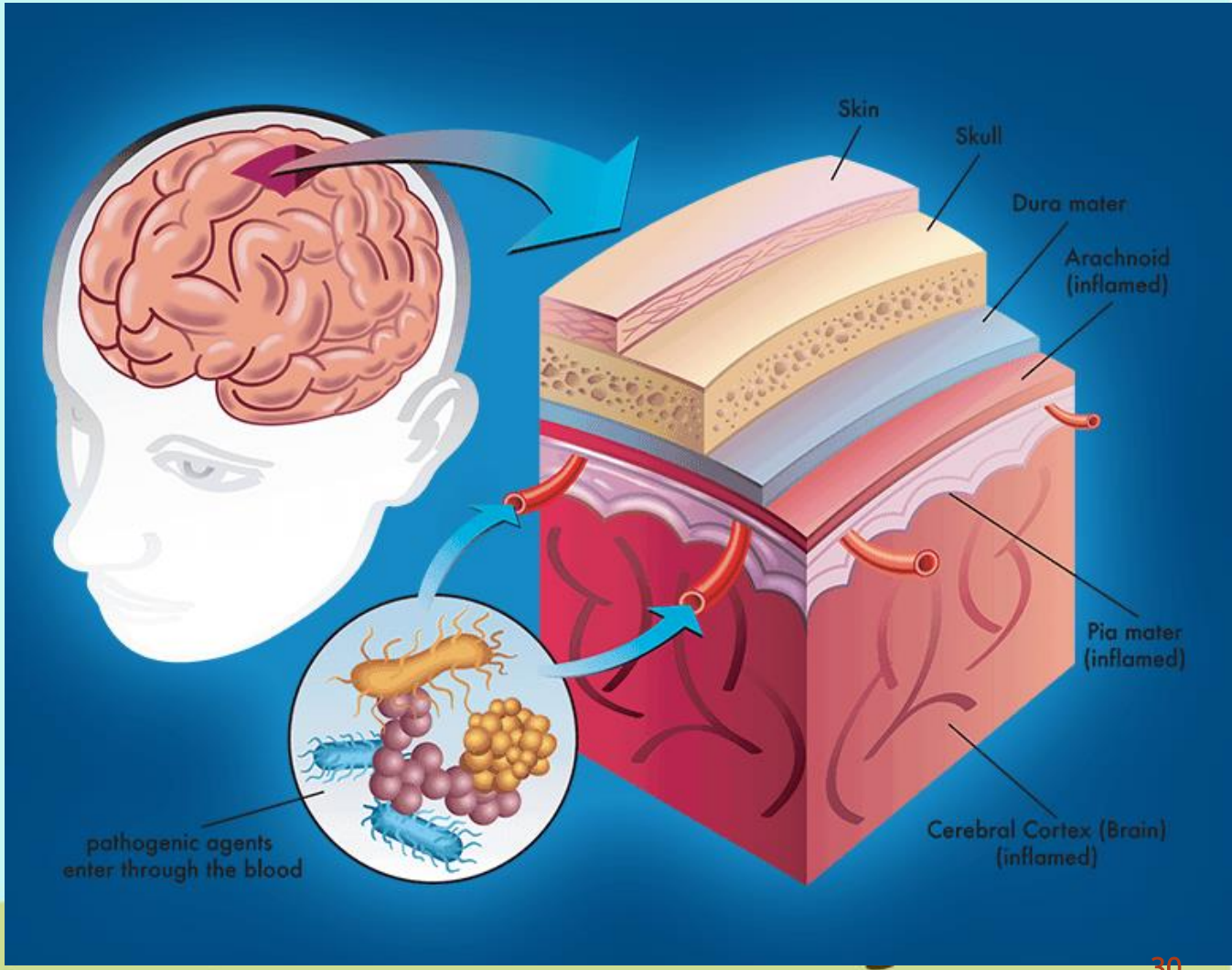
Treatment

- **Clindamycin** is also an alternative, but it is also less efficacious in hospital-acquired and ventilator-associated pneumonia.
- If culture results grow **MSSA** and rule out other causes of pneumonia, then therapy can be de-escalated to **flucloxacillin / dicloxacillin, nafcillin, oxacillin, or cefazolin**.
- **Supportive measures** for staphylococcal pneumonia include bronchodilation to help those with underlying lung diseases such as asthma or chronic obstructive pulmonary disease (COPD).
- **Supplemental oxygenation** may also be needed due to the restrictive lung disease caused by the pneumonia disease process. This can begin with a nasal cannula. However, if the disease process is severe enough, then mechanical ventilation may be necessary.

Ref:
Clark, S. and Hicks, M., 2022. *Staphylococcal Pneumonia*. [online] Ncbi.nlm.nih.gov. Available at: <https://www.ncbi.nlm.nih.gov/books/NBK559152/#:~:text=Staphylococcal%20pneumonia%20is%20a%20disease,in%20a%20post%2Dviral%20state.> [Accessed 12 August 2022].

Staphylococcal meningitis

- Staphylococcal one type of bacteria that can cause meningitis
- < 6 % of all Meningitis in US
- May become more as H influenzae and Pneumococcal vaccines are used



Ref:
Medlineplus.gov. 2022. *Staphylococcal meningitis: MedlinePlus Medical Encyclopedia*. [online] Available at: <https://medlineplus.gov/ency/article/000613.htm> [Accessed 12 August 2022].

Photo- The Internet

- *Staphylococcus aureus* or *Staphylococcus epidermidis* bacteria, it usually develops as a complication of surgery or as an infection that spreads through the blood from another site.

Risk factors include:

- Infections of heart valves
- Past infection of the brain
- Past meningitis due to spinal fluid shunts
- Recent brain surgery
- The presence of a spinal fluid shunt
- Trauma

Photo- The Internet

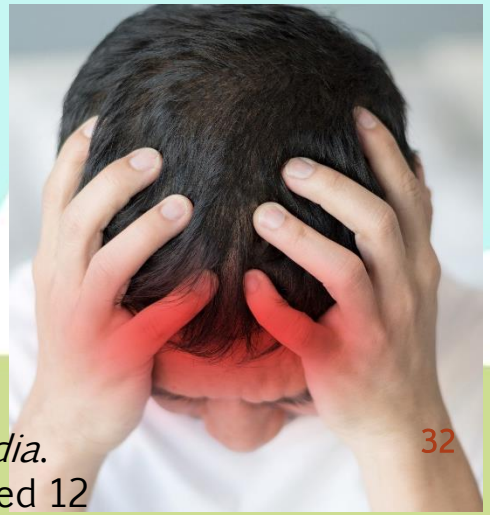
Ref:
Medlineplus.gov. 2022. *Staphylococcal meningitis: MedlinePlus Medical Encyclopedia*. [online] Available at: <https://medlineplus.gov/ency/article/000613.htm> [Accessed 12 August 2022].

Symptoms

Symptoms may come on quickly, and include

- Fever and chills
- Mental status changes
- Nausea and vomiting
- Sensitivity to light (photophobia)
- Severe headache
- Stiff neck

Photo- The Internet



Ref:
Medlineplus.gov. 2022. *Staphylococcal meningitis: MedlinePlus Medical Encyclopedia*. [online] Available at: <https://medlineplus.gov/ency/article/000613.htm> [Accessed 12

Other symptoms that can occur with this disease:

- Agitation
- Bulging fontanelles in infants
- Decreased alertness
- Poor feeding or irritability in children
- Rapid breathing
- Unusual posture, with the head and neck arched backwards (opisthotonos)

Photo- The Internet

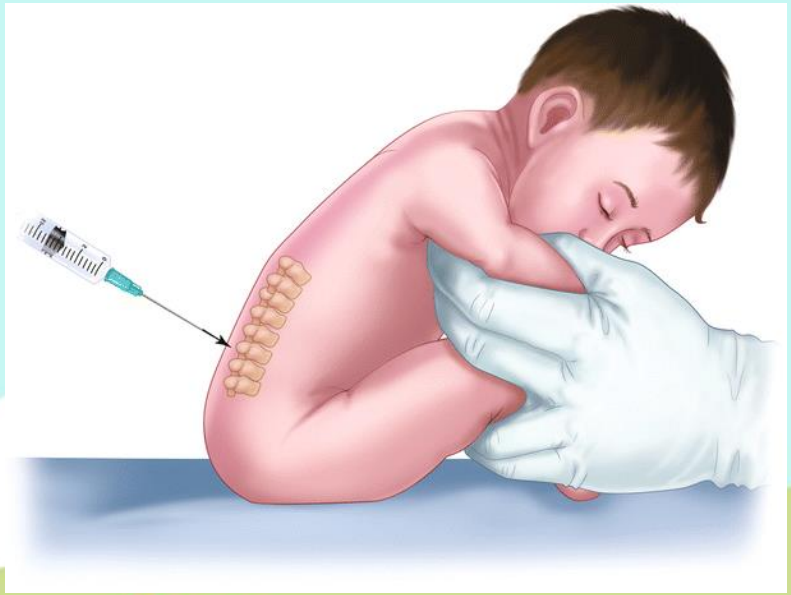
Ref:
Medlineplus.gov. 2022. *Staphylococcal meningitis: MedlinePlus Medical Encyclopedia*. [online] Available at: <https://medlineplus.gov/ency/article/000613.htm> [Accessed 12 August 2022].

Diagnosis

- Initial diagnosis of can be made by clinical examination followed by a lumbar puncture
- Blood Culture
- Chest X-ray
- CT Head

Photo- The Internet

Ref:
Who.int. 2022. *Meningitis*. [online] Available at: <https://www.who.int/health-topics/meningitis#tab=tab_2> [Accessed 12 August 2022].



Treatment

- Timely administration of antibiotics is essential
- Delays in the administration of 3 to 6 hours are associated with increased mortality
- Empiric treatment with **ceftriaxone** and **vancomycin** should strongly be considered if the diagnosis is going to be delayed
- Patients with bacterial meningitis due to **head trauma** or **post-neurosurgical procedure need to be covered for** methicillin resistant *Staphylococcus aureus* **and** aerobic gram-negative organisms**.** They should receive **Flucloxacillin**, **vancomycin** and **ceftazidine** or **cefepime**

Ref:
Runde, T., Anjum, F. and Hafner, J., 2022. *Bacterial Meningitis*. [online] Ncbi.nlm.nih.gov. Available at: <https://www.ncbi.nlm.nih.gov/books/NBK470351/> [Accessed 12 August 2022].
Ritchie, S., Rupali, P., Roberts, S. and Thomas, M., 2007. Flucloxacillin treatment of Staphylococcus aureus meningitis.

Treatment

- Antibiotics can then be **narrowed once the culture and sensitivities have resulted**.
- **Dexamethasone** may increase survival if given at the time of antibiotic administration for ***S. pneumoniae*** infections. It has not been shown to improve outcomes for meningitis caused by other bacteria.
- **Ciprofloxacin**, **rifampin**, or **ceftriaxone** may be used

Ref:
1. Runde, T., Anjum, F. and Hafner, J., 2022. *Bacterial Meningitis*. [online] Ncbi.nlm.nih.gov. Available at: <https://www.ncbi.nlm.nih.gov/books/NBK470351/> [Accessed 12 August 2022].
2. Ritchie, S., Rupali, P., Roberts, S. and Thomas, M., 2007. Flucloxacillin treatment of Staphylococcus aureus meningitis.

Staphylococcal Food Poisoning

- Caused by ingesting a **preformed heat-stable staphylococcal enterotoxin**.
- Food can be **contaminated by staphylococcal carriers or people with active skin infections.**
- In food that is **incompletely cooked or left at room temperature**, staphylococci reproduce and elaborate enterotoxin.
- Many foods can **serve as growth media**, and despite contamination, they **have a normal taste and odor.**
- **Severe nausea and vomiting** begin **2 to 8 hours after ingestion**, typically followed by **abdominal cramps** and **diarrhea.** The attack is brief, often **lasting < 12 hours**.

Ref:
Bush, . L. M. & Vazquez-Pertejo, M. T., 2021. *msdmanuals.com.* [Online]
Available at: https://www.msdmanuals.com/professional/infectious-diseases/gram-positive-cocci/staphylococcal-infections
[Accessed 24 Aug 2022].

Staphylococcal Food Poisoning

Diagnosis

- Staphylococcal food poisoning is usually suspected because of case clustering (eg, within a family, attendees of a social gathering, or customers of a restaurant).
- Confirmation (typically by the health department) entails isolating staphylococci from suspect food and sometimes testing for enterotoxins

Treatment

- Drink plenty of fluids
- Treat vomiting and nausea
- severe illness may require intravenous fluids
- **Antibiotics are not useful** because the toxin is not affected by antibiotics

Ref:
Bush, . L. M. & Vazquez-Pertejo, M. T., 2021. *msdmanuals.com.* [Online]
Available at: https://www.msdmanuals.com/professional/infectious-diseases/gram-positive-cocci/staphylococcal-infections
[Accessed 24 Aug 2022].

CDC, 2018. cdc.gov. [Online]
Available at: https://www.cdc.gov/foodsafety/diseases/staphylococcal.html#:~:text=The%20most%20important%20treatment%20is,is%20not%20affected%20by%20antibiotics.
[Accessed 24 Aug 2022].

Photo- The Internet

Anti-Staphylococcal (Penicillinase resistant Penicillin)

- **Natural penicillins**
  - C pen, Pen V,
- **Broad spectrum penicillin**
  - Amoxicillin, Ampicillin
- **Penicillinase resistant penicillins (Anti-staphylococcal)**
  - Cloxacillin, Flucloxacillin
- **Anti-pseudomonal penicillin (Extended spectrum)**
  - Ticarcillin, Piperacillin

Flucloxa

CAPSULE 250/500 mg | INJECTION 500/1000 mg

Flucloxacillin (Anti-Staphylococcal Penicillin)

- Actively against Beta-lactamase producing Staphylococci
- Undisputed choice for Skin and Soft Tissue Infections
- One of the most widely prescribed first line antibiotics in UK

Francis, N. A., Hood, . K., Lyons, R. & Butler, . C. C., 2016. Understanding flucloxacillin prescribing trends and treatment non-response in UK primary care: a Clinical Practice Research Datalink (CPRD) study. *J Antimicrob Chemother,* pp. 1-10.

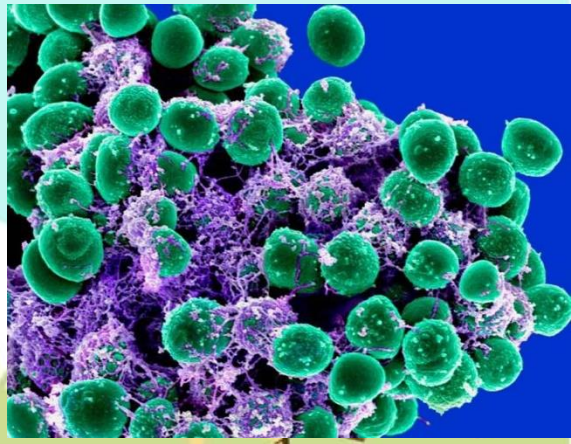
Targeted Approach for Staphylococcal Infections

Flucloxa

CAPSULE 250/500 mg | INJECTION 500/1000 mg

Multi-drug-resistant *Staphylococcus aureus*

- **1961 - first MRSA** : methicillin-resistant Staphylococcus *(S.) aureus* was found among *S. aureus* clinical isolates. Resistance to penicillin usually mediated by beta-lactamase. Due to acquisition of the mecA gene
- **Ability to outwit our immune system, Multi-drug resistance phenotype**
- MRSA—can spread in **hospitals,** other **healthcare facilities**, and in the **community** where you live, work, and go to school.
- 70–90% of all community-acquired MRSA infections are more likely to cause **superficial skin and soft tissue infections.**



Ref:
CDC. 2022. [online] Available at: <https://www.cdc.gov/mrsa/community/index.html> [Accessed 12 August 2022].
Ladhani, S., Garbash, M. Staphylococcal Skin Infections in Children. *Pediatr Drugs* **7**, 77–102 (2005).

Photo- The Internet

- **HA-MRSA** occurs during a stay in or immediately after the discharge from a hospital.
- **CA-MRSA** is community-acquired, spreading in families or other groups with no any prior of healthcare exposure.

Box 1: HA-MRSA versus CA-MRSA SSTIs

	HA-MRSA	CA-MRSA
Age	>65 years	Children and young adults
Co-morbidity	Yes	No
In-dwelling devices (catheters or IV devices)	Often	No
History of hospital admission	Yes	No
Presenting from community	Possibly	Yes
SSTI types	Surgical site and device-related infections	Furuncles, carbuncles, abscesses, cellulitis and, rarely, necrotic infections
PVL expression	Infrequent	Characteristic
Clindamycin resistance	Usual	Variable
Treatment	IV glycopeptide first-line	Incision and drainage ± oral therapy usual

Photo Source – https://pharmaceutical-journal.com/article/ld/skin-and-soft-tissue-infection-focus-on-meticilllin-resistant-s-aureus

Risk Factors

- Anyone can get MRSA
- Crowding, skin-to-skin contact, and shared equipment or supplies
- Non-intact skin, such as when there are abrasions or incisions

Ref:
CDC. 2022. [online] Available at: <https://www.cdc.gov/mrsa/community/index.html> [Accessed 12 August 2022].

Photo- The Internet

The symptoms of a MRSA skin infection

- Bump that is painful, red, leaking fluid, or swollen. It may look like a spider bite, pimple, or boil.
- Bumps under the skin that are swollen or firm
- Skin around a sore that is warm or hot
- Bump that gets bigger quickly or doesn't heal
- Painful sore along with a fever
- Rash or fluid-filled blisters
- Boil or sore (abscess) that leaks fluid

Signs of a systemic infection

Any of the described symptoms plus

- Fever
- Chills
- Severe headache
- Sleepiness
- Dizziness or fainting

Ref:
Stanfordchildrens.org. 2022. *default - Stanford Medicine Children's Health*. [online] Available at: <https://www.stanfordchildrens.org/en/topic/default?id=mrsa-and-children-what-you-should-know-160-49#:~:text=Symptoms%20include%20painful%20red%20bumps,out%20the%20fluid%20(pus).> [Accessed 12 August 2022].

Diagnosis

1. **Physical Examination**

- Symptoms depend on where the infection is located. Most MRSA infections are in the skin, but the bacteria can spread to the bloodstream, lungs, and other organs.
- A MRSA infection on the skin may look like a type of rash. A MRSA rash looks like red, swollen bumps on the skin. Some people may mistake a MRSA rash for a spider bite. The infected area may also be:
- Warm to the touch
- Painful

Photo- The Internet

Ref:
NIH, 2021. medlineplus.gov. [Online]
Available at: https://medlineplus.gov/lab-tests/mrsa-tests/
[Accessed 23 Aug 2022].

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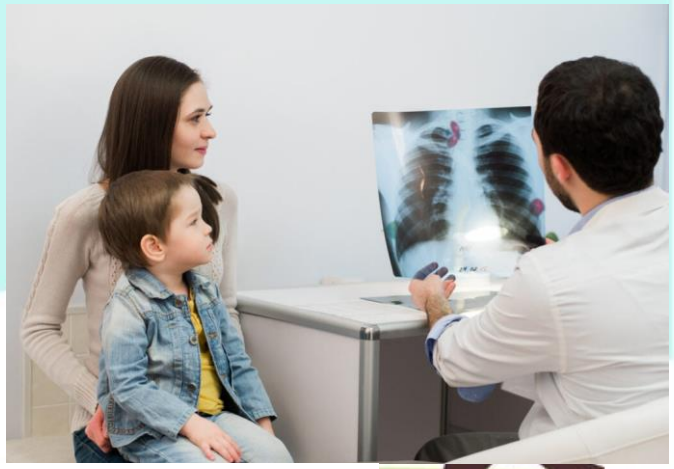
Diagnosis

Photo- The Internet



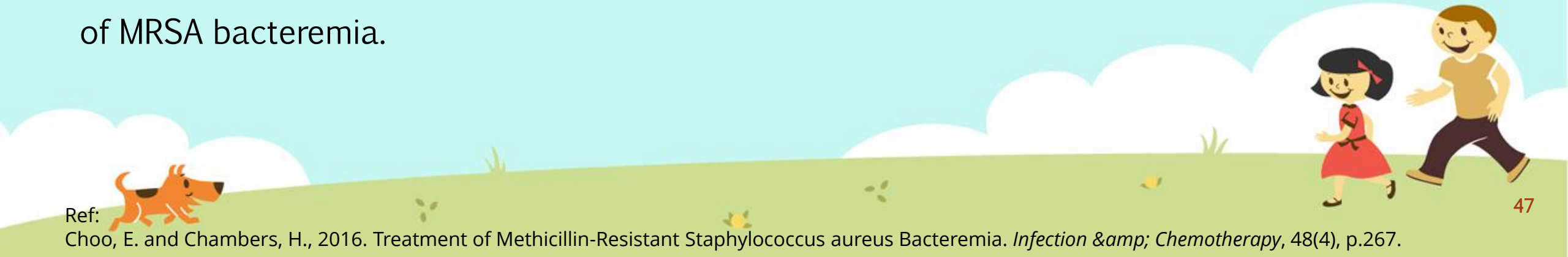
2. Other tests

- A skin swab & Nasal swab, to check for MRSA
- Cultures of samples of blood, spit, or fluid from a sore to check for MRSA
- X-ray of the lungs, to see if the lungs may be infected
- Echocardiogram of the heart, to see if the heart may be infected
- CT scan or MRI, to see if any other tissue, bones, or joints are infected

Ref:
Stanfordchildrens.org. 2022. *default - Stanford Medicine Children's Health*. [online] Available at: <https://www.stanfordchildrens.org/en/topic/default?id=mrsa-and-children-what-you-should-know-160-49#:~:text=Symptoms%20include%20painful%20red%20bumps,out%20the%20fluid%20(pus).> [Accessed 12 August 2022].

Treatment

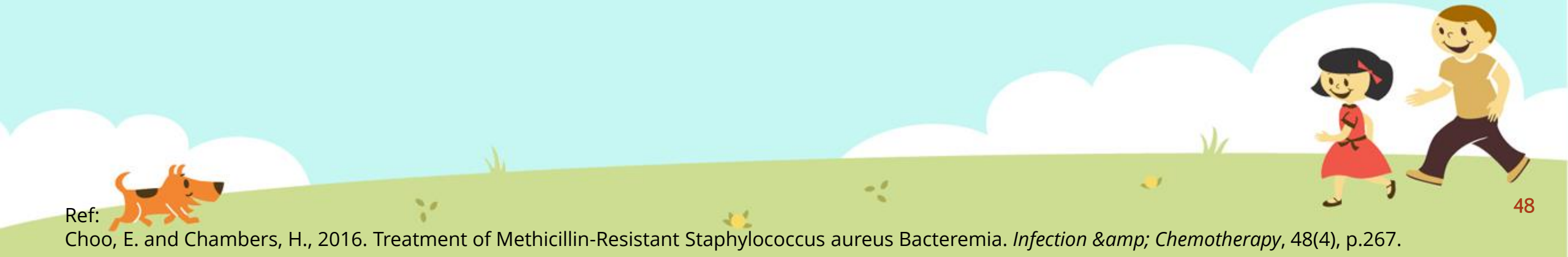
- **Vancomycin :** the greatest cumulative clinical experience for the treatment of MRSA bacteremia
- **Teicoplanin :** Teicoplanin is a glycopeptides with slow bactericidal activity and a spectrum of activity and efficacy camparable to vancomycin.
- **Telavancin :** may prove effective for treatment of MRSA bacteremia.
- **Daptomycin :** the only antibiotic to have shown non-inferiority to vancomycin in the treatment of MRSA bacteremia.



Ref:
Choo, E. and Chambers, H., 2016. Treatment of Methicillin-Resistant Staphylococcus aureus Bacteremia. *Infection & Chemotherapy*, 48(4), p.267.

Treatment

- **Ceftaroline :** a **fifth-generation cephalosporin** with bactericidal activity against MRSA and VISA as well as Gram-negative pathogens
- **Oxazolidinones: Linezolid, Tedizolid**
- **Tigecycline :** insufficient data available specifically assessing the role of tigecycline in invasive MRSA infections
- **Combination Therapy >> (Vancomycin + β-lactam) or (Daptomycin + β-lactam)**



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Thank You