Antimicrobial prophylaxis in surgery

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History

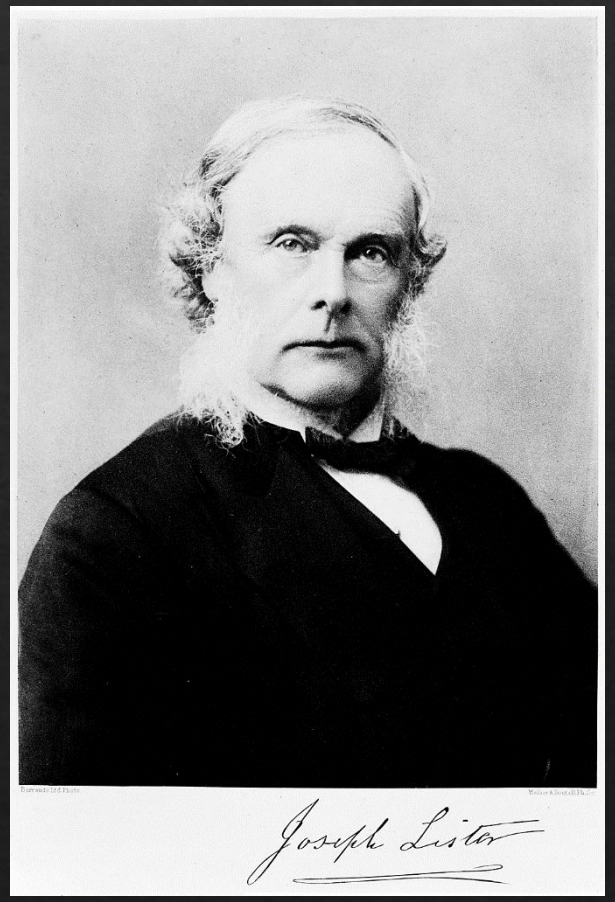
- Dates back to 350-550 CE(traces of tetracycline found in skeletal remains of Sudanese Nubia)
- Also found in late Roman period
- Traditional Chinese medicine (TCM)

Pre-antibiotic era in London, in 1932 – it shows children being treated for tuberculosis in three rows of beds outside a building. In those days whether you lived or died was sheer luck – the only treatment was fresh air.

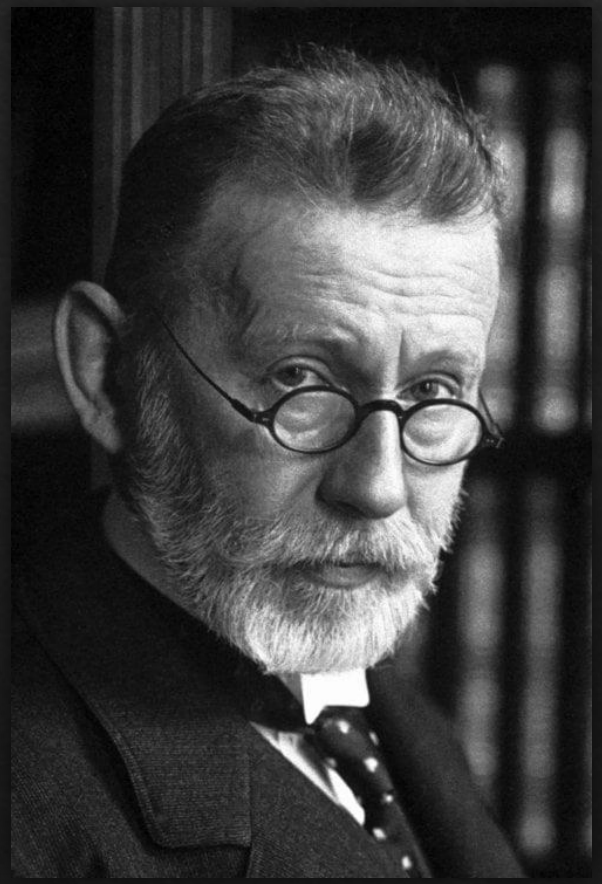
- High morbidity and mortality worldwide before the antibiotic era.
- The average life expectancy at birth
- Infectious diseases such as smallpox, cholera, diphtheria, pneumonia, typhoid fever, plaque, tuberculosis, typhus, syphilis, etc. were rampant.
- Antibiotic era revolutionized the treatment of infectious diseases worldwide
- A significant threat to the achievements of the antibiotic era is the antibiotic resistance

A woodcut from 1689 showing various methods of syphilis treatment including mercury fumigation.

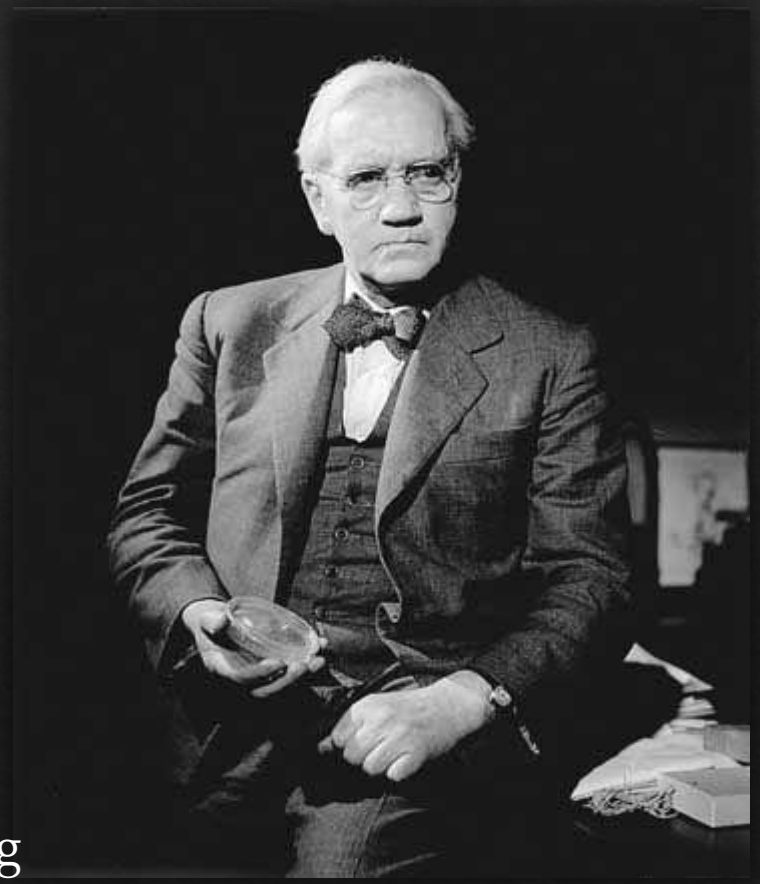
- Joseph Lister (1827-1912)
  - Established the study of antisepsis
  - Promoted the idea of sterilization in surgery using carbolic acid (phenol) as an antiseptic



- Modern “antibiotic era” - Paul Ehrlich and Alexander Fleming



Paul Ehrlich



Alexander Fleming

- 1877- Louis Pasteur inhibition of some microbes by other-anthrax
- 1899 - first hospital use of a drug-Pyocyanase prepared by Emmerich and Löw from *Pseudomonas aeruginosa* (formerly *Bacillus pycyaneus*)
- 1909- Salvarsan, drug again Treponema pallidum discovered by Ehrlich and Fleming
- 1928- discovery of Penicillin by Fleming
- 1932- sulfonamide antimicrobial activity discovered (Ehrlich)
- 1943- drug companies begin mass production of penicillin
- 1948- cephalosporins precursor sent to Oxford for synthesis

- 1950s and 1970s - golden era of discovery of novel antibiotics classes; No new classes discovered since then
- 1952- Erythromycin derived from Streptomyces erythreus
- 1956- Vancomycin introduced for penicillin resistant Staphylococcus
- 1962- Quinolone antibiotics first discovered
- 1970s- Linezolid discovered but not pursued
- 2000- Linezolid introduced into clinical practice

Surgical Site Infections

- Common
- Costly
- Increase morbidity and mortality

Antimicrobial Surgical Prophylaxis

10%-20% of inpatient antimicrobial use

Often sub-optimally administered

Appropriate SAP

Preventing surgical site infections.

Improving patients' outcomes.

Reducing adverse effects:

Limiting opportunistic infections such as CDI.

Reducing risk of AKI

Reducing the consequences for patients' microbiota. Limiting the emergence of antibiotic-resistant bacteria.

Reducing the duration and cost of health care.

Selected antibiotic

- Being active against the bacteria likely to contaminate the surgical site.
- Having the narrowest possible spectrum of activity.
- Being administered appropriately
- in an appropriate dosage and at the correct time.
- for the shortest period possible.
- Being safe

Other risk factors for SSIs

Intrinsic/patient factors

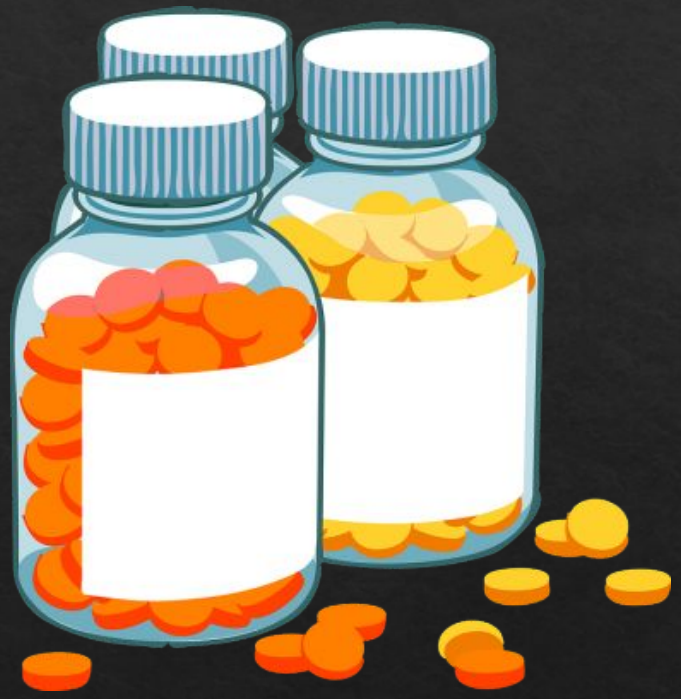
- co-morbid conditions
- skin preparation
- glucose control
- temperature

Other risk factors for SSIs

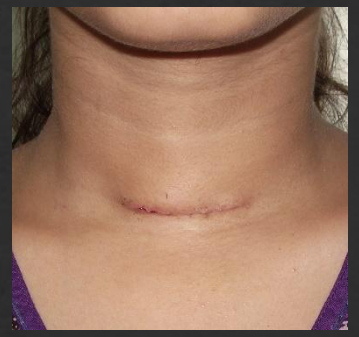
Extrinsic/system factors

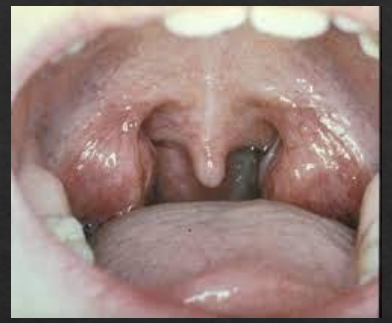
- infection control practices
- pre-operative preparation
- duration of the procedure
- surgeon technique

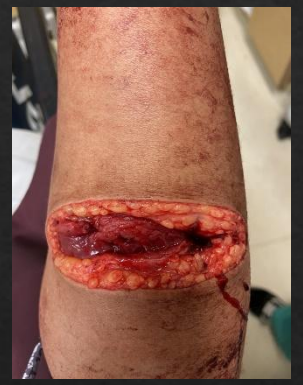
- Prophylaxis
  - Prevention of an infection
    - primary prophylaxis
      - Prevention of an initial infection
    - secondary prophylaxis
      - Prevention of recurrence or reactivation of a preexisting infection
    - Eradication
      - Elimination of a colonized organism to prevent the development of an infection

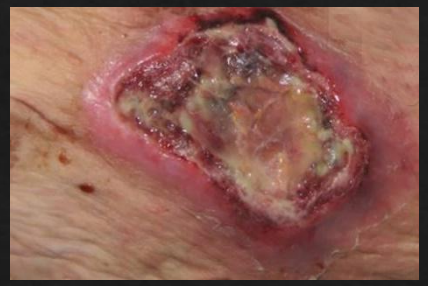


1-Clean	•An uninfected operative wound in which no inflammation is encountered and the respiratory, alimentary, genital, or uninfected urinary tract is not entered. •Clean wounds are primarily closed and, if necessary, drained with closed drainage.
2-Clean/Contaminated	•An operative wound in which the respiratory, alimentary, genital or urinary tracts are entered under controlled conditions and without unusual contamination.
3-Contaminated	•Open, fresh, accidental wounds. •In addition, operations with major breaks in sterile technique or gross spillage from the gastrointestinal tract, and incisions in which acute, nonpurulent inflammation is encountered including necrotic tissue without evidence of purulent drainage.
4-Dirty/Infected	•Old traumatic wounds with retained devitalized tissue and those that involve existing clinical infection or perforated viscera. •The organisms causing postoperative infection were present in the operative field before the operation.



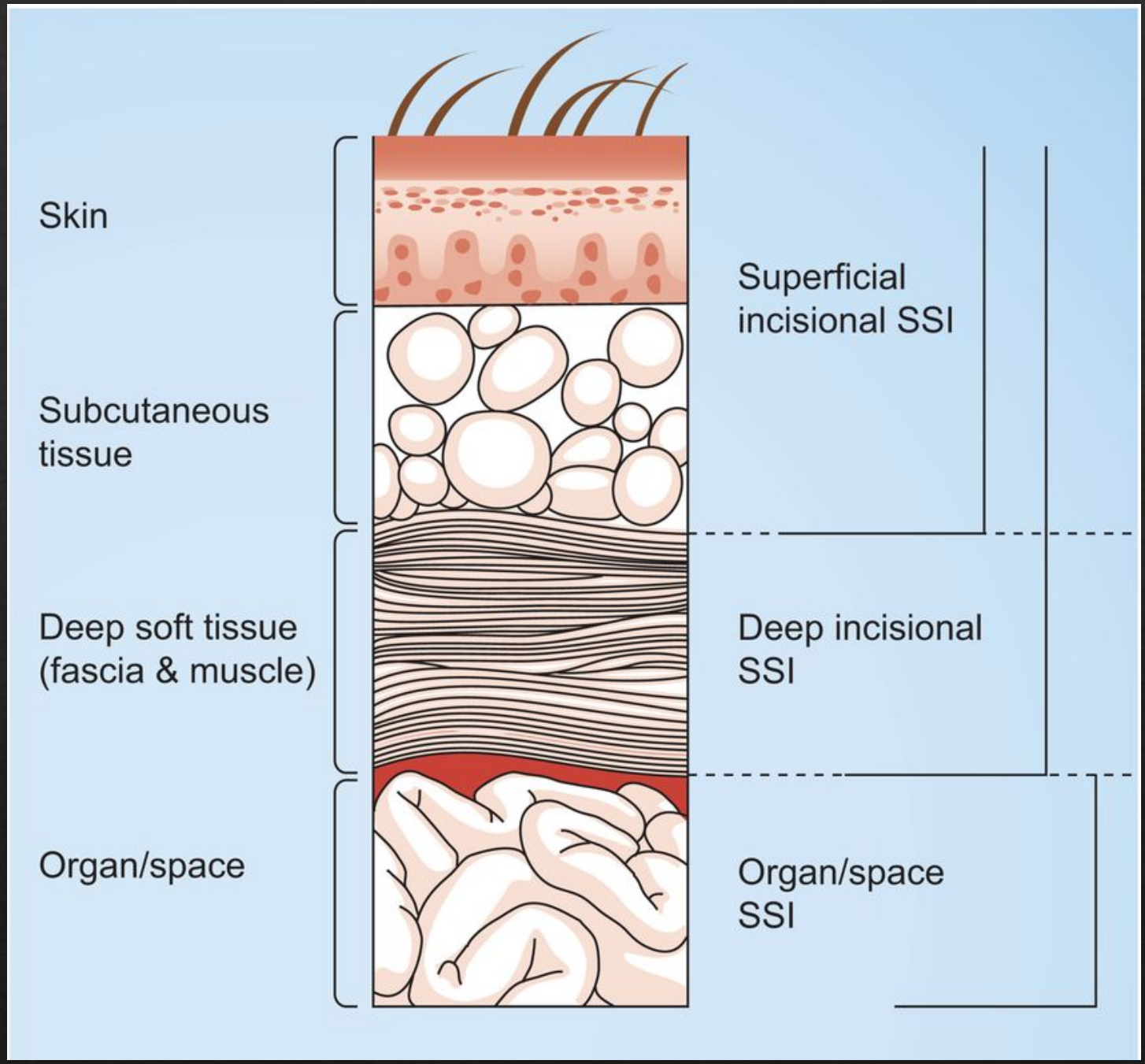






Rate of infection

CATEGORY	DESCRIPTION	INFECTION RISK
Clean	Incising uninfected skin without opening a viscus	<2%
Clean-contaminated	Intra-operative breach of a viscus (but not colon)	8-10%
Contaminated	Breach of a viscus + spillage *or* opening of colon	12-20%
Dirty	Site already contaminated with pus, faeces or exogenous contaminant, eg trauma	25%


Skin
Subcutaneous tissue
Deep soft tissue (fascia & muscle)
Organ/space
Superficial incisional SSI
Deep incisional SSI
Organ/space SSI

- For which patients should SAP be administered?
- Which antibiotics should be chosen for SAP?
- When should SAP be administered?
- How should the dose be chosen for SAP?
- When should SAP be re-dosed intra-operatively?
- Should SAP be prolonged after the surgical intervention?

For which patients should SAP be administered?

With a high rate of SSIs

With prosthetic implants

In patients with medical conditions associated with a higher risk of SSIs i.e., immunosuppression or morbid obesity.

Which antibiotics should be chosen for SAP?

Surgical category	Likely pathogens	Spectrum of coverage
Clean	Gram- positives, esp GPCs	Skin flora including staphylococci
Clean- contaminated	Gram- negative bacilli and enterococci	Enterics/GU dictated by site

Skin florae (eg, Staphylococcus organisms) are the usual target, so first-generation cephalosporins are recommended (cephalexin, cephalothin) in most studies. Few studies also recommend cefuroxime

When should SAP be administered?

ideally within 60 min

. Vancomycin and fluoroquinolone, the use of which should both be rare, must be infused over a minimum of one hour

How should the dose be chosen for SAP?

A single dose of SAP generally is sufficient.

When should SAP be re-dosed intra-operatively?

extend >2–4 h past the time of prophylactic administration (i.e., where duration exceeds two half-lives of the chosen antibiotic) or
with associated major blood loss (>1.5 L).

Should SAP be prolonged after the surgical intervention?

There is no evidence to support continuing SAP postoperatively. The practice must be abandoned

References

- ICMR Antimicrobial Guidelines For Prophylaxis And Treatment Of Surgical Site Infections, published in 2017, updated in 2021
- Aminov RI. A brief history of the antibiotic era: lessons learned and challenges for the future. Front Microbiol. 2010 Dec 8;1:134. doi: 10.3389/fmicb.2010.00134. PMID: 21687759; PMCID: PMC3109405.