Microbiology in Intensive Care

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Infectious diseases in intensive care

1. Life- threatening course of an infectious disease (community-acquired)
Microbiology: Rapid detection of the causative agent
Treatment

2. Infection complicating another life-threatening condition (health-care asoociated)
Microbiology: Monitoring of the colonizing microbes and their antimicrobial susceptibility, detection of possible causative agent/s and epidemiologically signficant resistance phenotypes/genotypes
Prophylaxis, treatment

1. Life- threatening course of an infectious disease (community-acquired)

Diagnosis

- **Suspection of infectious etiology** – ICU clinician, biochemistry and haematology laboratory

Clinical signs, inflammatory markers elevation (leukocytes, thrombocytes, CRP, procalcitonin, lactate, IL-6)

- **Detection of the etiological agent** – ICU clinician, infectious diseases specialist, clinical microbiologist

Specimen collection – possible causative agent/s, site of infection, incubation period, pathogenesis
Proper diagnostic method, correct procedure and interpretation
Correct and rapid pathogen detection, treatment.

- **Determining the focus of infection** – clinician, radiology/imaging specialist

Support or change in diagnosis, specimen collection

Infections requiring intensive care

- Systemic/local with systemic impact
- Causing single or multiple organ dysfunction
- Possibly leading to life-threatening condition

- **Sepsis, septic shock**

- **Severe infectious diseases affecting multiple organ systems**

- **Severe infectious diseases affecting single organ system**

Sepsis, septic shock

Sepsis

Sepsis is life-threatening organ dysfunction caused by a dysregulated host response to infection

New bedside clinical score: quickSOFA (qSOFA):
Respiratory rate 22/min or greater
Blood pressure 100 mm Hg or less
Altered mentation

C. DIAGNOSIS

1. We recommend that appropriate routine microbiologic cultures (including blood) be obtained before starting antimicrobial therapy in patients with suspected sepsis or septic shock if doing so results in no substantial delay in the start of antimicrobials. Appropriate routine microbiologic cultures always include at least two sets of blood cultures (aerobic and anaerobic).

D. ANTIMICROBIAL THERAPY

1. We recommend that administration of IV antimicrobials should be initiated as soon as possible after recogntiion and within one hour for both sepsis and septic shock.
2. We recommend empiric broad-spectrum therapy with one or more antimicrobials for patients presenting with sepsis or septic shock to cover all likely pathhogens.

Severe infectious diseases affecting multiple organ systems

- Tuberculosis, disseminated form
- Morbilli
- Varicella
- Leptospirosis
- Brucellosis
- Lyme disease
- *Mycoplasma pneumoniae* severe disease course
- Malaria, schistosomiasis, trichinellosis, amoebiasis, other conditions caused by parasites

Severe infectious diseases affecting single organ system

May lead to sepsis/septic shock development

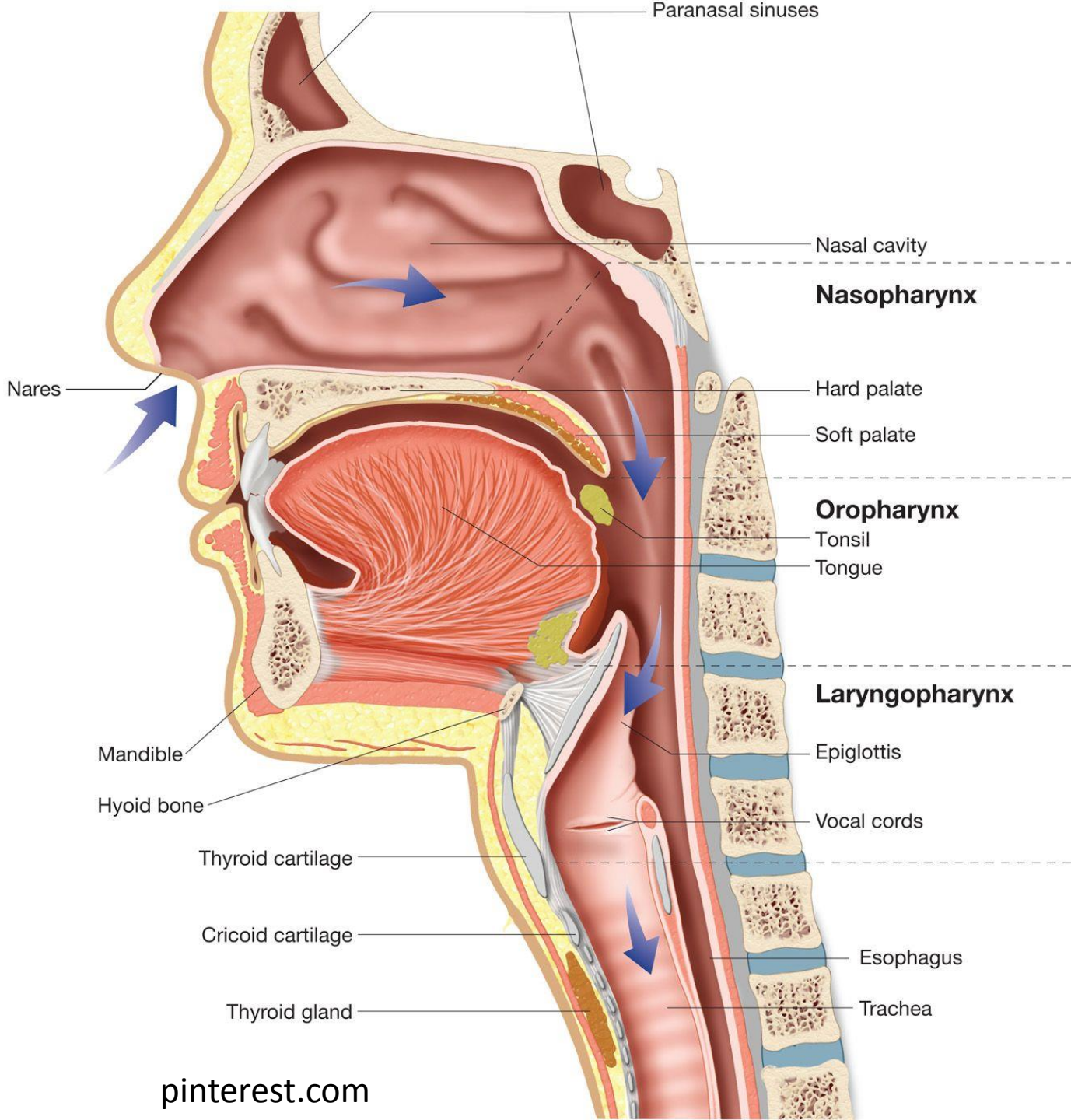
Single/multiple organ failure – different pathogenetic pathways

Upper respiratory tract

- conditions leading to obturation of the airways

Laryngitis, epiglottitis, diphtheria, peritonsillar, para- and retropharyngeal abscess/phlegmona.

- localized focuses of infection with the possibility of spreading into intracranial space or thoracic cavity: hematogenous, per continuitatem (sinuses, middle ear, para- and retrpharyngeal space)



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Lower respiratory tract

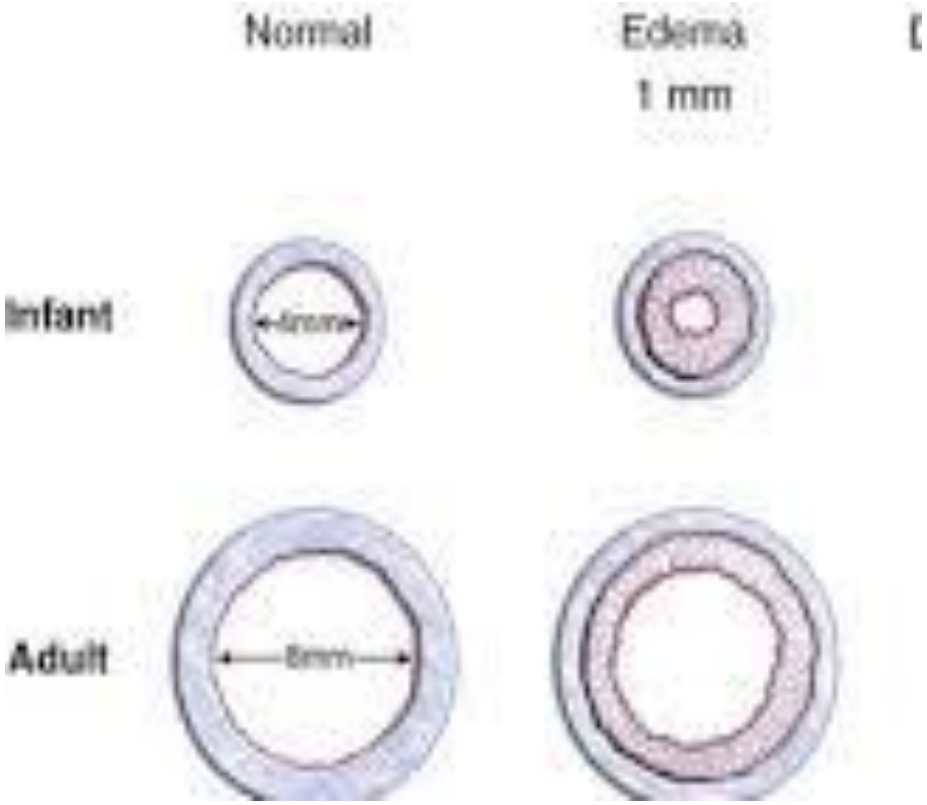
Bronchitis/bronchiolitis – infants, viruses

COPD exacerbation – adults, bacteria

Pneumonia

- Bronchopneumonia – *S. pneumoniae, S. aureus*, aerobic/anaerobic (aspiration)
- Alveolar pneumonia - *Legionella*
- Interstitial pneumonia – influenza, RSV, morbilli, varicella, SARS, MERS, *Mycoplasma pneumoniae*, *Chlamydophila pneumoniae/psittaci/trachomatis*
- Pleuropneumonia
- Abscess – bacterial, aerobic/anaerobic

Systemic response (alveolar area 40 – 80 m^2), respiratory failure



Urinary tract infections

- Bacterial – endogenous, ascendent, hematogenous, threat of sepsis, renal failure
- Bacterial exogenous - leptospirosis
- Viral - hantaviruses

Heart and bloodstream infections

Pericarditis, myocarditis

Viruses – coxsackie, echoviruses, influenza,
Bacteria – *Borrelia burgdorferi, Leptospira*, diphtheric myocarditis
Postinfectious (pancarditis) – *S. pyogenes*

Infective endocarditis – blood culture positive, negative
Septic arteriitis
Thrombophlebitis

Soft tissue infections

Bacterial, threat of severe sepsis and septic shock

Streptococcus pyogenes
Clostridium perfringens
Staphylococcus aureus – TSST, enterotoxins, PVL

Bone and joint infections

Hematogenous, per continuitatem, exogenous – wound contamination
Bacterial

Septic arthritis
Osteomyelitis, spondylodiscitis

Infections of central nervous system

- Bacterial
- Viral – enteroviruses, HSV, Central European tick-borne encephalitis, varicella, parotitis, HIV, rabies
- Mycobacterial/fungal – disseminated tuberculosis, *Cryptococcus neoformans*
- Polyradiculoneuritis - postinfectious
- Neuroborreliosis
- Neurotoxin-related diseases – botulism, tetanus

Intraabdominal infections

Bacterial, endogenous, threat of sepsis/septic shock development

Gastroenteritis, enterocolitis

Bacterial, viral, threat of dehydration and hypovolemia – rotaviruses, *Vibrio cholerae, Shigella* sp.
Systemic complications – sepsis (*Salmonella*), *Entamoeba histolytica* (abscesses)
Pseudomembranous colitis – *Clostridioides difficile*

Typhus abdominalis – typhoid fever, paratyphi

Hemolytic-uremic syndrome (HUS)

Infections of the liver, and biliary tract

Hepatitis

Viruses – HAV, HBV, HCV, HEV, - fulminant/malignant form, chronic/progressive form

Biliary tract – bacterial, endogenous

Hospital – associated infections, ICU

Complicating both infectious and non-infectious conditions requiring intensive care

Onset 72 h or later after hospital admission

Primary and opportunistic pathogens, often with acquired antimicrobial resistance

Source: Patients, (staff, environment/setting)

Vehicle: Staff (hands), (fomites, air)

HAI – risk factors

Sepsis/injury-induced immunosuppression

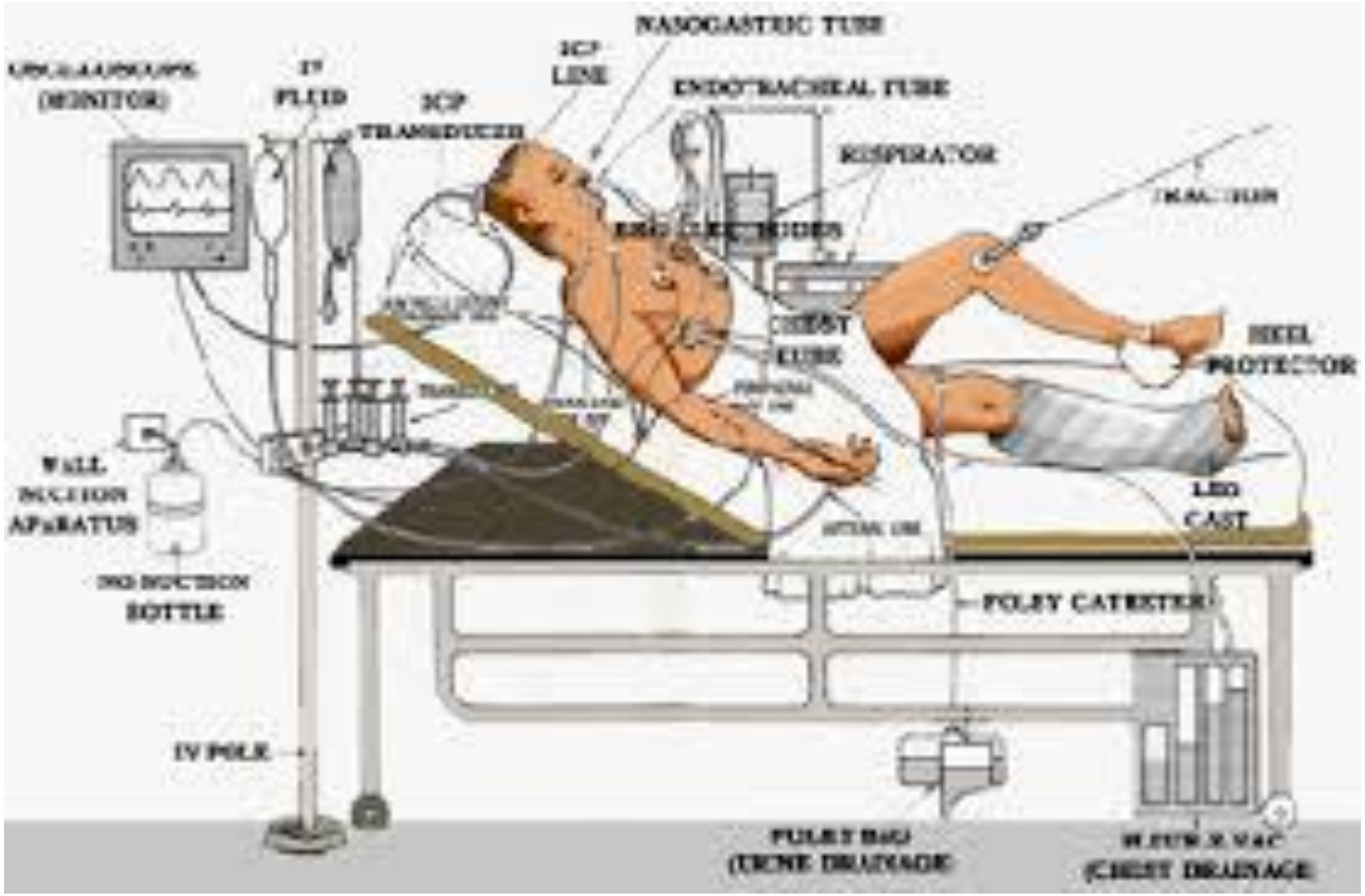
Underlying condition (diabetes mellitus, neutropenia, malignancy)

(Poly)trauma, necrotic tissue, craniotrauma

Cardiac arrest, organ hypoperfusion (GIT)

Foreign material, biofilm formation

Mechanical ventilation



ICU-associated infection

Ventilator-associated pneumonia

Urinary Tract Infections

Catheter-related sepsis

Wound infections

Enterocolitis – *Clostridioides difficile*

Other/specific

Infectious agents

G+ cocci – *S. aureus*/MRSA, enterococci/VRE, coagulase-negative staphylococci

Enterobacterales – ESBL/AmpC producers, CRE, colistin, aminoglycoside resistance

Non-fermenters: *P. aeruginosa*, *Stenotrophomonas*, *Burkholderia*, *Acinetobacter* – intrinsic and acquired resistence, MDR, XDR

Legionella (water)

Fungi – yeasts, intrinsic and acquired resistence to antifungals, molds (air-borne conidia)

Viruses – HSV, CMV, influenza

Diagnosis

Inflammatory markers
Site of infection
Infectious agent

Regular/continuous **microbiological monitoring**, all available material
Treatment based on identification and susceptibility of detected colonizing agents

Antimicrobial treatment

Infection x colonization

Efficient agaist all/most of possible agents, including fungi and viruses

Sufficient drug concentration at the site of infection

Monotherapy preferred (resistance, allergy)

Procalcitonin levels correspond best with efficiency

Consider possible adverse effects

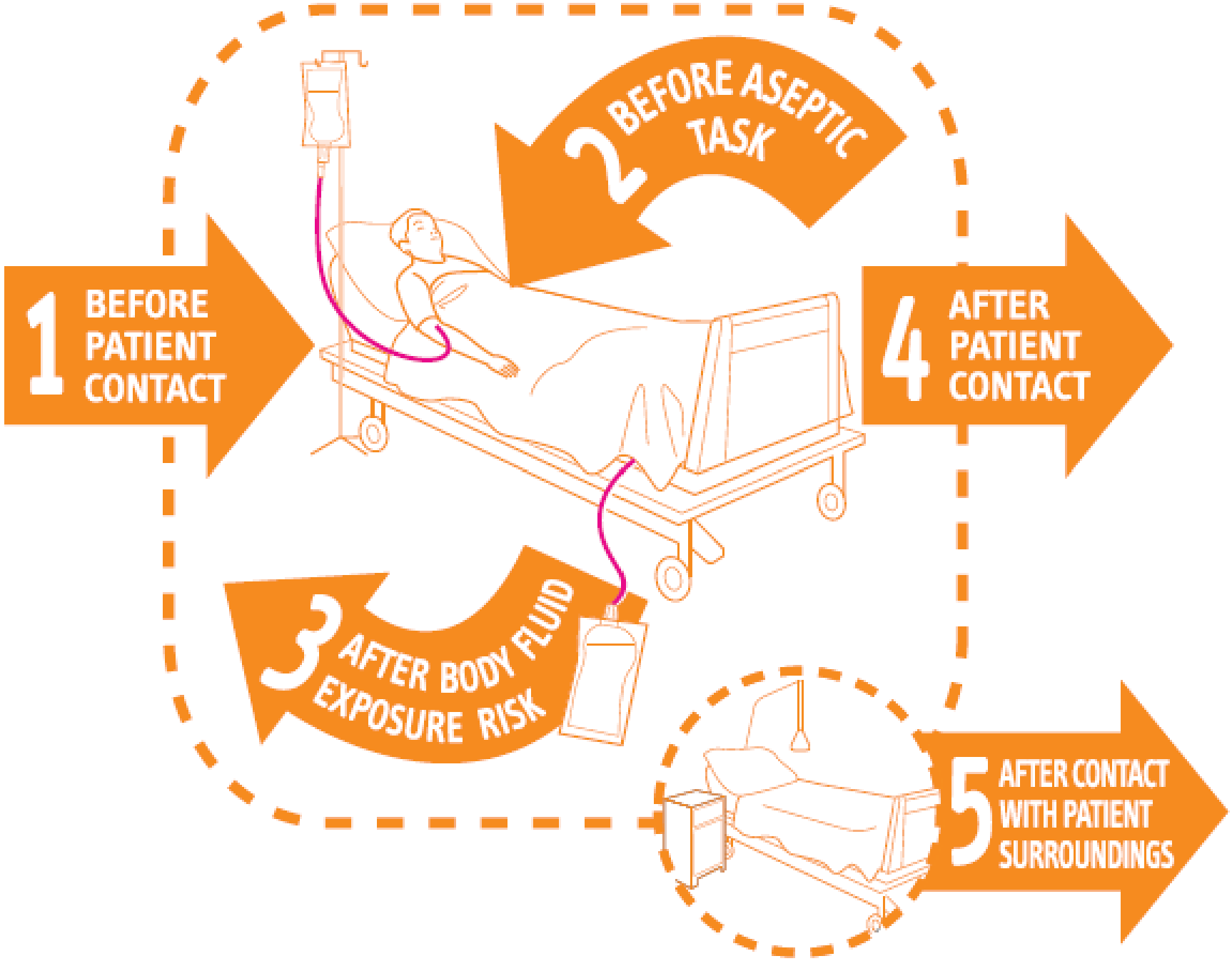
Consider local therapy (wounds, respiratory)

Therapeutic drug monitoring

Antimicrobial prophylaxis

Early recovery of the organ functions
Work organization – 1patient, 1 nurse
Protective garments, hand hygiene
Each patient in separate room/box
Disinfection/sterilization programme
Isolation of patients colonized with virulent or resistant agents
Minimum foreign material, mind the quality

Administration of antimicrobials
Wounds – trauma, surgery
Aspiration
Virulent infectious agent detected
Community x HAI (history) - choice


1 BEFORE PATIENT CONTACT
2 BEFORE ASEPTIC TASK
3 AFTER BODY FLUID EXPOSURE RISK
4 AFTER PATIENT CONTACT
5 AFTER CONTACT WITH PATIENT SURROUNDINGS

1.Singer M, Deutschman CS, Seymour CW et al (2016) The Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3). *JAMA 315(8):801–810*
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3. Seymour CW, Liu VX, Iwashyna TJ et al (2016) Assessment of clinical criteria for sepsis: for the Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3). *JAMA 315(8):762–774*
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5. Kolář M. Infekce u kriticky nemocných, Galén 2008

Thank you for your attention