Northern Illinois University

Evidence Based Guidelines for Prevention, Screening and Management of Multiple Organ Dysfunction Syndrome

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Disclosure

- **Authors:** Manju Daniel and Gagandeep Singh

- **Learning objectives**:
  - To describe risk of poor clinical outcomes with organ dysfunction
  - To discuss evidence based clinical guidelines for early identification
  - To discuss impact of evidence based clinical guidelines for early interventions to improve survival

- There is no **conflict of interest** in this presentation
- **Employer**: Northern Illinois University, School of Nursing

Background

- **Sepsis:**
  - Life threatening organ dysfunction
  - Dysregulated host response to infection
- **Septic Shock**
  - Subset of sepsis
  - Profound circulatory, cellular, and metabolic abnormalities
  - Greater risk of mortality than with sepsis alone
- **Multiple Organ Dysfunction Syndrome (MODS)**
  - Worsening of sepsis and septic shock>>MODS
  - Progressive physiologic dysfunction ≥2 organs or organ systems

Background

- **Mortality :**
  - Worsening of sepsis into septic shock
    - Mortality rate of 54%.
  - Increases 8% every hour the treatment is delayed
  - About 80% is preventable with early diagnosis and treatment
- **ICUs Patients with Sepsis**
  - >50% with at least one organ system dysfunction
  - 20% with multiple organ dysfunction (MODS)
  - 50% mortality attributable to MODS

Case Study # 1: AB, 72 y/o F
Extracorporeal shock wave lithotripsy

- **Contributing factors in AB's case**
  - Multiple co-morbidities,
  - Compromised immune system- h/o breast ca, pancreatic ca
  - Infection
  - Lithotripsy-Trauma
    - **Increased AB's risk for** >>Septic shock
  - Hemodynamic instability requiring max dosages of vasopressors to keep her MAP >65
  - Progressive elevation of lactate level
    - **Increased AB's risk for** >> MODS (Kidney failure)
    - Died day 4 in ICU
  - Hemodynamic instability, Progressive elevation of lactate , and kidney failure >>**Increased AB's mortality risk**

Case Study # 2: CD, 50 y/o M
MVA – Died day 7 in ICU

- **Contributing factors in CD's case**
- HTN only, former smoker
  - Trauma from MVA
  - Trauma from surgery
    - **Increased CD's risk for** Septic shock
- Hemodynamic instability requiring max dosages of vasopressors to keep her MAP >65
  - **Increased CD's risk for :**
  - MODS
    - Kidney failure
    - Hepatic failure
- Complications by DIC **-Increased mortality risk**

Case Study # 3: EF, 80 y/o M; UTI -ICU >SNF on Hospice, Died after 2 months

- AMS and low BP- sent to ED
- **Contributing factors in EFs case**
- Multiple co-morbidities
- Infection
    - **Increased EF's risk for :**
    - Septic shock
- Hemodynamic instability requiring max dosages of vasopressors to keep her MAP >65
    - **Increased AB's risk for :**
    - MODS
        - Kidney failure
        - Complications by ARDS-**Increased mortality risk**

Background

- **Poor outcomes**
  - Sepsis worsening - risk of septic shock with organ failure
    - in-hospital mortality
  - Long-term
    - Physical, psychological, and cognitive disabilities
    - Prolonged intensive care unit stay
- **Promptness:** Patients presenting with modest dysfunction
    - Deteriorate further and fast
    - Need for prompt and appropriate interventions

Purpose

- To discuss :
  - Evidence based guidelines for:
    - Early detection of organ dysfunction utilizing:
      - Quick SOFA
      - Full SOFA
    - Quick interventions to manage sepsis
      - Three-hour bundle
      - Six-hour bundle
    - Prevent poor clinical outcomes R/T MODS

Surviving Sepsis Campaign (SSC) Guidelines

- **Surviving SepsisCampaign Consensus Committee**
  - Screening and management of infection
  - Screening for Sepsis (organ dysfunction)
  - Early identification of organ dysfunction
  - Early treatmentof organ dysfunction

SSC Guidelines (cont.2)

- **Screening and Management of Infection**
  - Early identification of infection
    - Suspected or confirmed infection
  - Management
    - Obtain blood and other cultures as indicated
    - Administer tailored antibiotics as appropriate
    - Simultaneously obtain lab results
      - to evaluate the patient for infection-related organ dysfunction.

Recommended Laboratory Tests

- CMP (electrolytes, renal and liver function)
- CBC with diff
- Lactic Acid -Serial in 6 hrs x 3 including baseline and daily
- Coagulation Studies(Fibrinogen, D Dimer assay, PT, PTT)
- Microbiology – Cultures and Gram stains from potential site of infection (central lines, g. tube)
- ABG's
- Urinalysis
- Acute Inflammatory Markers- ESR, CRP
- Procalcitonin level

q SOFA

Criteria	Point Value
Altered Mental Status	+1
Respiratory Rate ≥22	+1
Systolic Blood Pressure ≤100	+1

SSC: Screening for Organ Dysfunction

- **Quick sequential organ failure assessment**
  - Bedside prompt
  - Emergency departments
  - Primary care clinics
  - Skilled nursing facilities
- **Quick SOFA** (qSOFA):
  - Score of 2 or higher identifies
    - Adult patients with suspected infection
    - At greater risk for poor outcomes

Sequential [Sepsis-Related] Organ Failure Assessment (SOFA) Score

System	0	1	2	3	4
Respiration PaO2/FiO2, mmHg (kPa)	≥400 (53.3)	<400 (53.3)	<300 (40)	<200 (26.7) with respiratory support	<100 (13.3) with respiratory support
Coagulation Platelets, x10³/uL	≥150	<150	<100	<50	<20
Liver Bilirubin, mg/dL (umol/L)	<1.2 (20)	1.2 - 1.9 (20 - 32)	2.0 - 5.9 (33 - 101)	6.0 - 11.9 (102 - 204)	>12.0 (204)
Cardiovascular	MAP ≥70mmHg	MAP <70mmHg	Dopamine <5 or Dobutamine (any dose)	Dopamine 5.1 - 15 or Epinephrine ≤0.1 or Norepinephrine ≤0.1	Dopamine >15 or Epinephrine >0.1 or Norepinephrine >0.1
CNS GCS Score	15	13 - 14	10 -12	6 - 9	<6
Renal Creatinine, mg/dL (umol/L) Urine Output, mL/d	<1.2 (110)	1.2 - 1.9 (110 - 170)	2.0 - 3.4 (171 - 299)	3.5 - 4.9 (300 - 440) <500	>5.0 (440) <200

*Catecholamine Doses = ug/kg/min for at least 1hr

SOFA

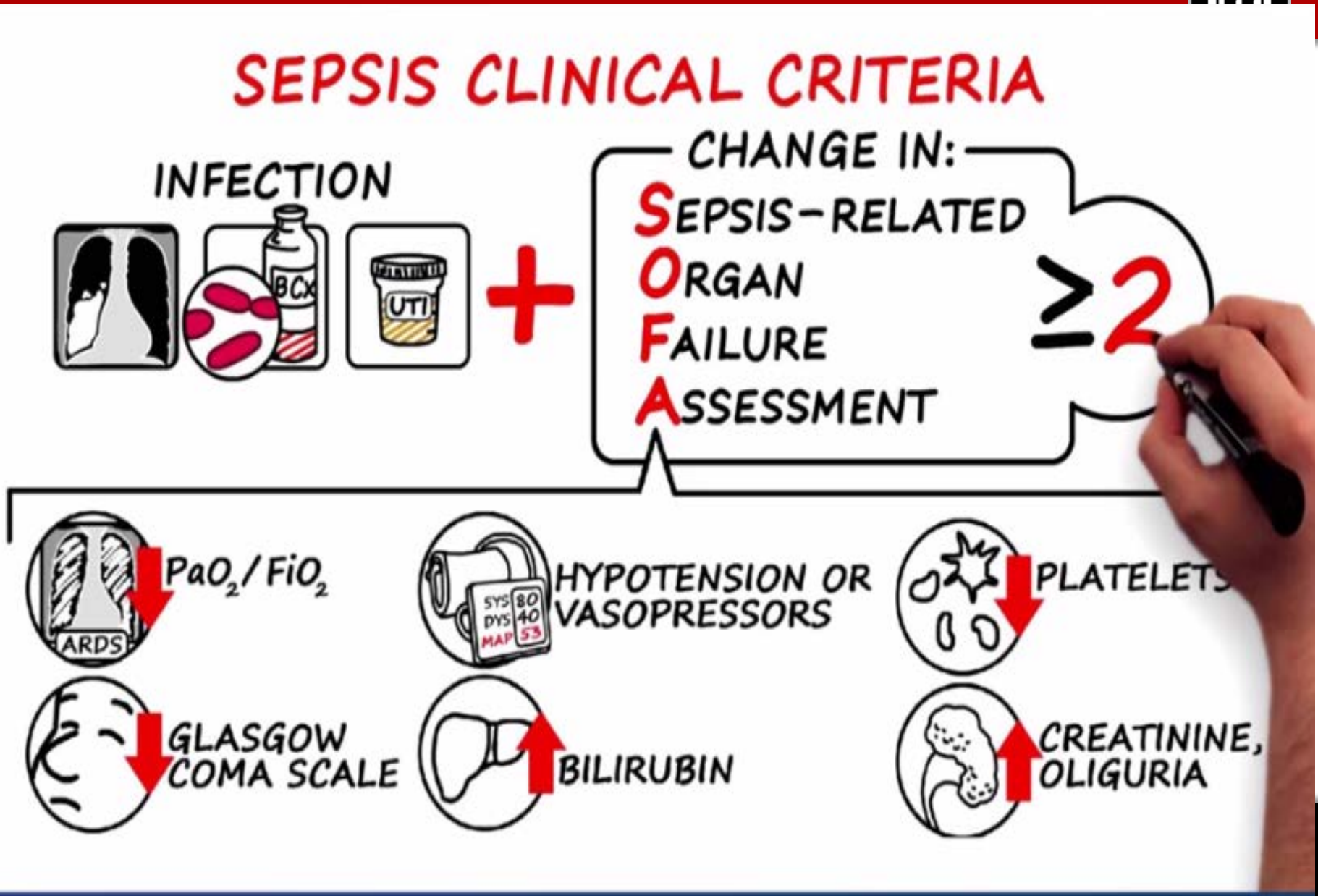
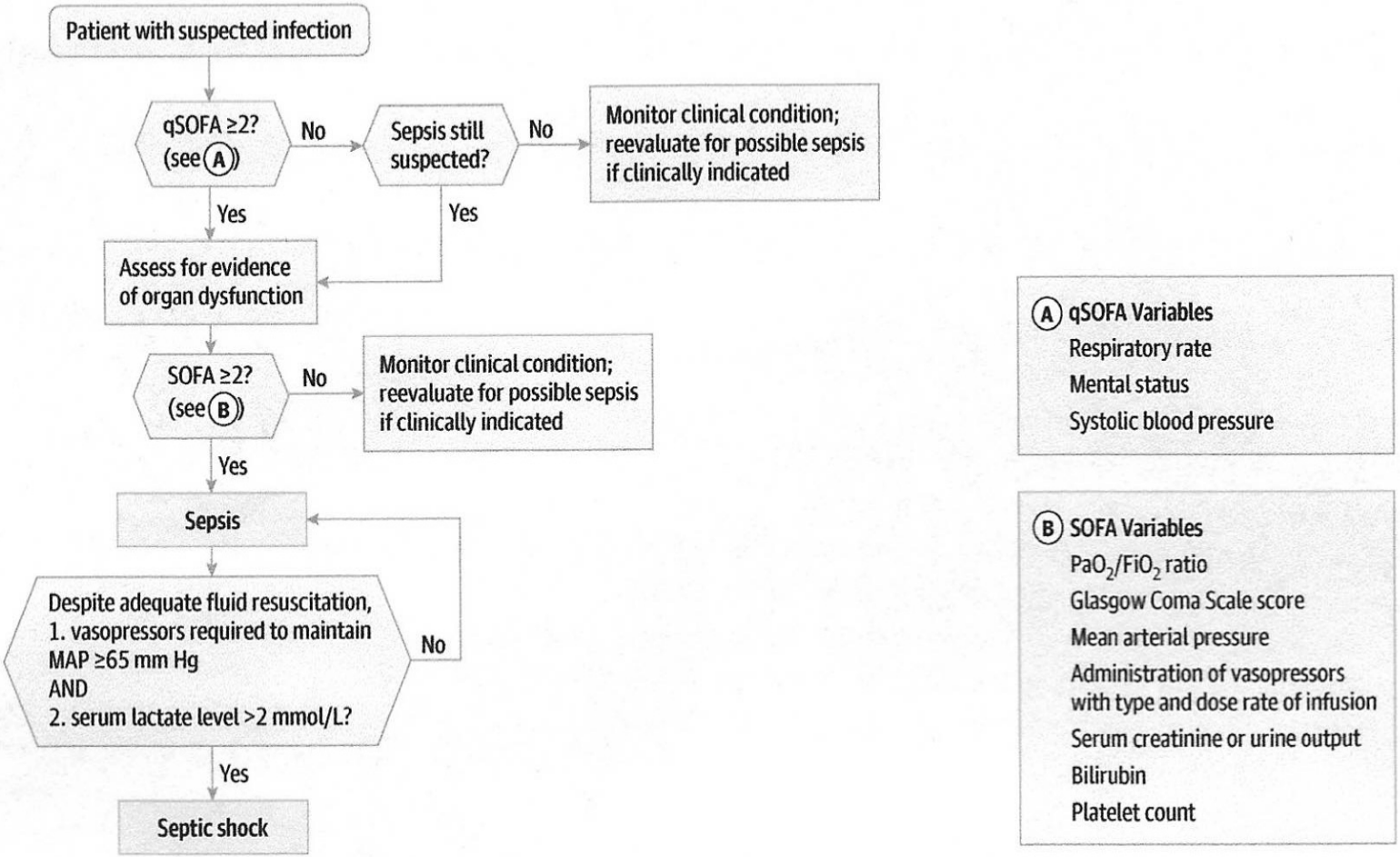

SEPSIS CLINICAL CRITERIA
INFECTION
BCx
UTI
+
CHANGE IN:
SEPSIS-RELATED
ORGAN
FAILURE
ASSESSMENT
≥2
ARDS
PaO2/FiO2
SYS 80
DYS 40
MAP 53
HYPOTENSION OR
VASOPRESSORS
PLATELETS
GLASGOW
COMA SCALE
BILIRUBIN
CREATININE,
OLIGURIA

Figure. Operationalization of Clinical Criteria Identifying Patients With Sepsis and Septic Shock



The baseline Sequential [Sepsis-related] Organ Failure Assessment (SOFA) score should be assumed to be zero unless the patient is known to have preexisting (acute or chronic) organ dysfunction before the onset of infection. qSOFA indicates quick SOFA; MAP, mean arterial pressure.

qSOFA/SOFA

- **Score of ≥2 on qSOFA or full SOFA**
  - Indicates risk of organ dysfunction
  - In-hospital mortality >10%
  - Worsening of SOFA over 72 hours
    - Statistical sig + relationship to in-hospital mortality
  - 30-day mortality:
    - + Glasgow coma scale
    - Older age
    - Comorbidities

Recommended Diagnostic Tests

May be ordered to evaluate health of organs, detect complications, & to identify location of infection.

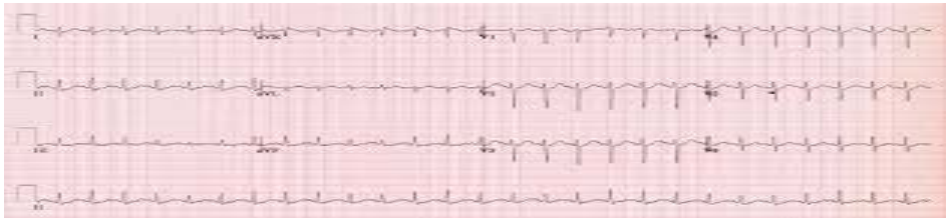
ECG

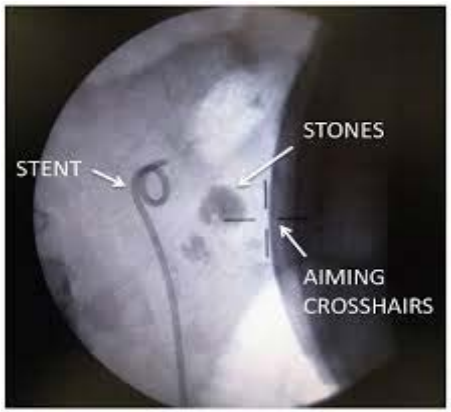
X Ray

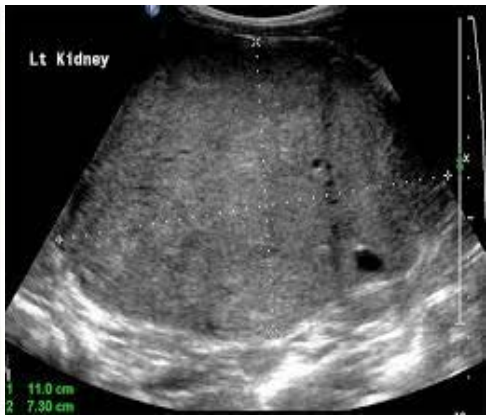
CT Scan

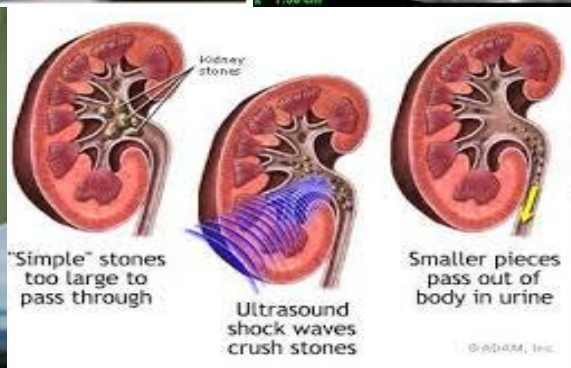
Ultrasound

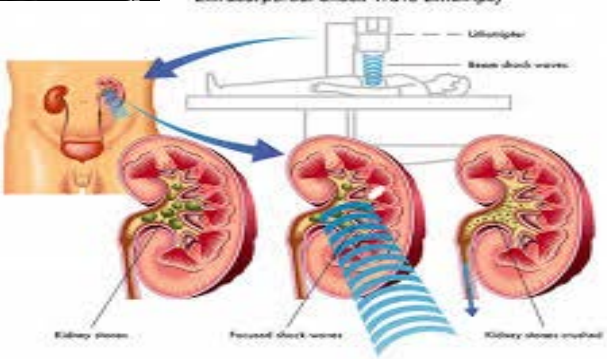
MRI



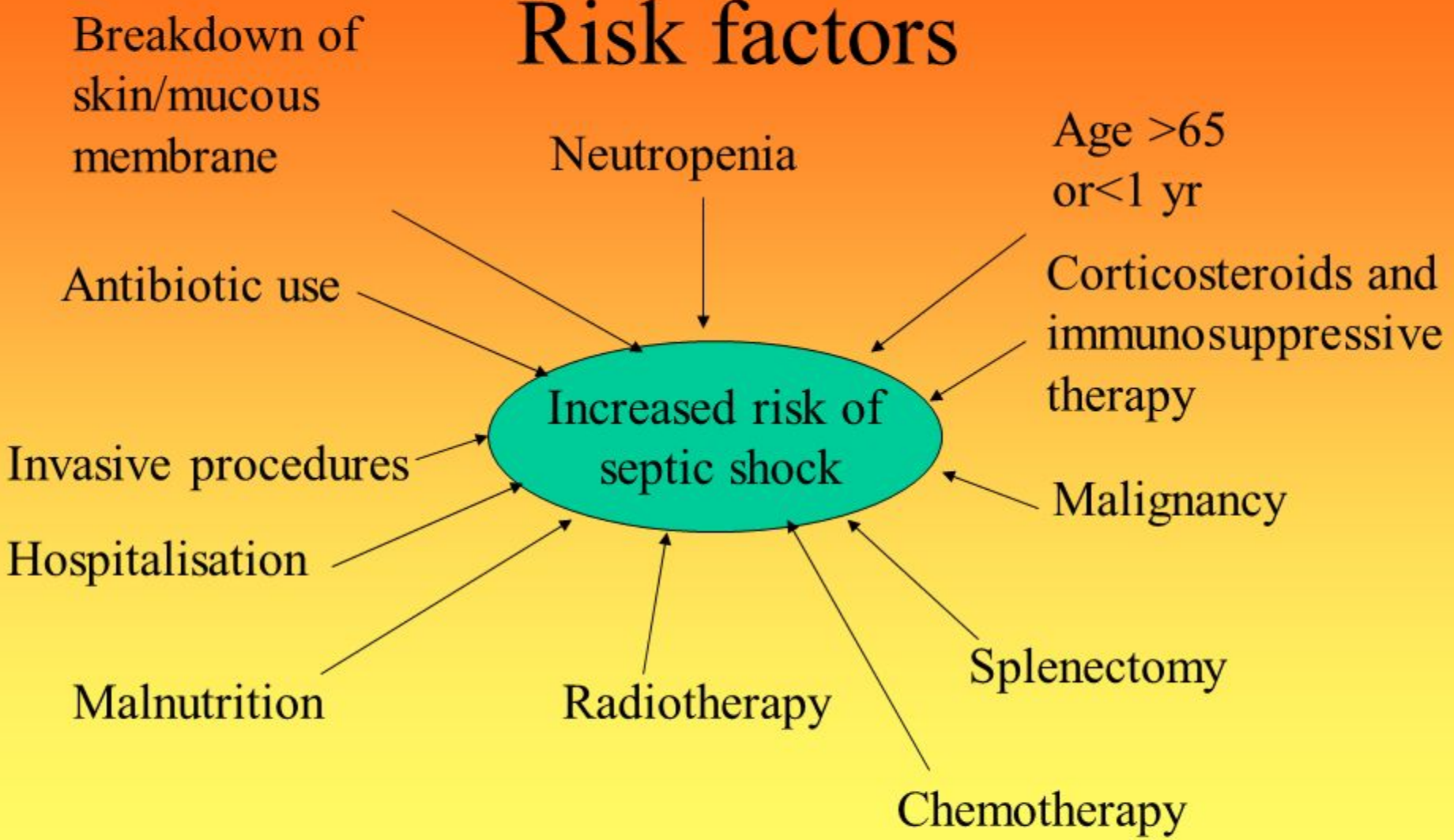






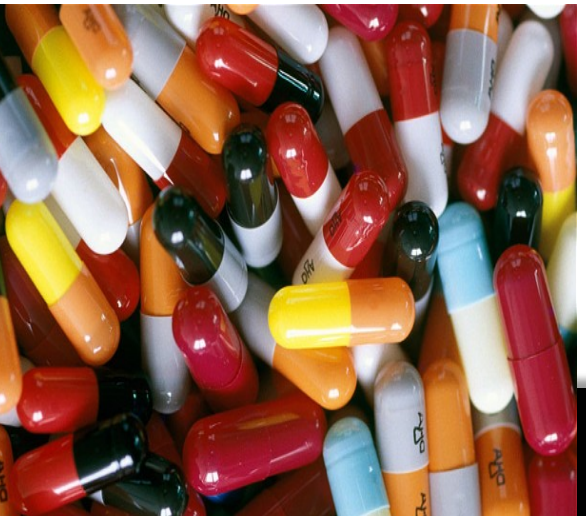


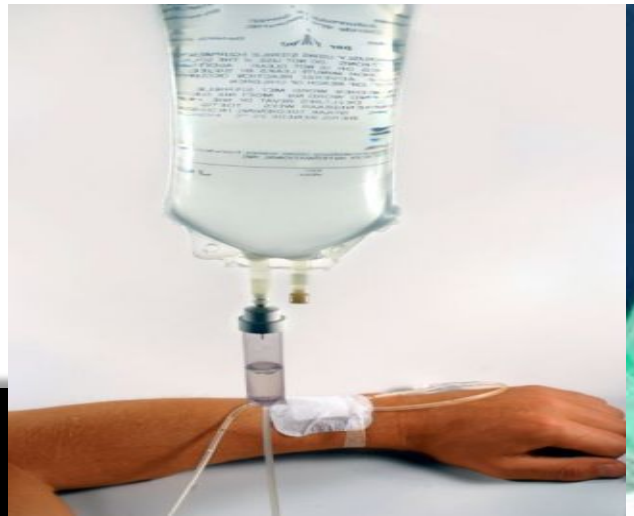
Risk factors



SSC: Management for Organ Dysfunction

- **Primary Focus of Management**
  - Early detection and quick interventions is the KEY to prevent progression to MODS
  - Antibiotics
  - Hemodynamic stabilization
  - Pulmonary stabilization





SSC : Management-Three-hour Bundle (cont. 2)

– **To be completed within 3 hours of time of presentation**

- Measure lactate level
- Obtain **blood cultures** prior to administration of antibiotics
- Administer **broad spectrum** antibiotics
- Administer 30ml/kg crystalloid for hypotension or lactate ≥4mmol/L

SSC : Management-Six-hour Bundle (cont. 3)

- To be completed within 6 hours
  - Apply vasopressors
    - For hypotension that does not respond to initial fluid resuscitation
    - Tomaintain a mean arterial pressure (MAP) ⩾65mmHg
- Re-assessvolume status and tissue perfusion
  - If persistent hypotension after initial fluid administration (MAP < 65 mm Hg) or
  - If initial lactate was ≥4 mmol/L, Re-measure lactate if initial lactate elevated
  - Re-measure lactate if initial lactate elevated

SSC : Management – Antimicrobial Therapy

- **Antibiotics**
- Timing in treatment initiation: gold prognostic factor
  - Initiate within 1 hour of recognition of sepsis
- Empirical or targeted – should be begun as soon as possible
- Local resistance rates & expected pathogen spectrum
- After C&S results: organism specific antibiotic for 7–10 days
- Discontinuance of antibiotics
  - Procalcitonin as biomarker
  - With clinical improvement
  - No further evidence of infection

Antimicrobial Therapy (cont.2)

- Combination empiric therapy recommendations
  - Suspected multidrug-resistant microorganisms (e.g. *Pseudomonas)*
  - Severe infections associated with respiratory failure and septic shock
  - Septic shock and bacteremia from pneumococci
  - Limit (broad-spectrum) to 3-5 days
    - Switch to coverage spectrum monotherapy
- Initially administer parenterally
  - In doses adequate to achieve bactericidal serum levels

Antimicrobial Therapy (cont.4)

- **Unknown source-** broad-spectrum agents and cover gram-positive, gram-negative, and anaerobic bacteria
- **Empiric therapy -** consider vancomycin or linezolid D/T
  - MRSA prevalence
  - history of IV drug use
  - indwelling vascular catheters or devices
  - with recent hospitalizations
  - **Intra-abdominal** or perineal infections
    - Anti-anaerobic coverage (e.g. metronidazole, clindamycin)

(Kalil & Bailey, 2017)

Antimicrobial Therapy (cont.5)

- Enterobacteriaceae – ESBL-producing bacteria
- (e.g. *Escherichia coli* and *Klebsiella pneumoniae*)
  - Select Beta-lactamase resistant antibiotics
    - (e.g. Unasyn, Zosyn)
- Immunocompetent patients: monotherapy adequate with:
  - Carbapenems
    - (e.g. imipenem and meropenem)
  - Third- or fourth-generation cephalosporins
    - (e.g. cefotaxime, cefoperazone, ceftazidime, cefepime)
  - Extended-spectrum penicillins
    - (e.g. ticarcillin and piperacillin)

Antimicrobial Therapy (cont.6)

- **Immunocompromised or at high risk** for multidrug-resistant organisms
  - Dual broad-spectrum with overlapping coverage
- ***Pseudomonas* not suspected:**
  - Vancomycin PLUS
  - Gram-negative coverage (3rd-generation cephalosporin, β-lactam/β-lactamase inhibitor, or carbapenem)
- ***Pseudomonas* suspected:**
  - Vancomycin PLUS
  - Two agents for resistant Gram-negative bacteria
    - ceftazidime/cefepime/carbapenem/piperacillin–tazobactam
    - + either fluoroquinolone (e.g. ciprofloxacin)
    - *or* aminoglycoside (gentamicin/amikacin

Antimicrobial Therapy (cont.7)

- Community- acquired pneumonia with MRSA
  - Vancomycin, Levofloxavin (or Moxifloxacin), and Cefotaxime (or ceftriaxone)
- UTI or intra abdominal/pelvic infection
  - Piperacillin-tazobactam and aminoglycosides
- Skin, soft tissue infection
  - Vancomycin , Piperacillin-Tazobactam and Clindamycin
- Meningitis
  - Vancomycin, cefotaxime (or ceftriaxone) + Ampicillin

If ESBL* use meropenem or imipenem instead of cephalosporin or piperacillin-tazobactam

Hemodynamic stability

- **Fluid management**
- Adequate volume resuscitation and vasopressors if required (within first 6 hours)
  - Target:
    - Central venous pressure (CVP) 8–12 mm Hg,
    - MAP ≥65 mm Hg,
    - urine output ≥0.5 mL/kg/hr
  - Isotonic crystalloid solution should be begun within 15 minutes (0.9 NS or LR)
    - Initial therapy: 30 mL/kg of crystalloids in the first hour

Hemodynamic stability (cont.2)

- **Fluid management**
  - Add albumin if requiring large volumes of crystalloid
    - Albumin 25% -25 gm IVq 8 hourly

- D50% 1 amp prn for blood sugar below 70; Low Dose insulin per SS as needed

- **Vasopressors: if remains hypotensive**
  - First choice-Norepinephrine (Levophed); dopamine;
  - Second line- phenylephrine (Neo-Synephrine)

Hemodynamic stability (cont. 3)

- IV hydrocortisone 200 mg per day
  - if the patient is poorly responsive to both IV fluid resuscitation and vasopressors
  - Hydrocortisone 50 mg IVP q 6 hourly
- Central/mixed venous O_2 saturation ⩾70%
  - Marker of cardiac output and tissue perfusion)
- Goal : (CVP 8–12 mm Hg) and vasopressors (MAP >65 mm Hg)
- If goals not met with fluid resuscitation
  - Transfuse PRBCs to achieve:
  - hematocrit >30%;
  - if MAP still <70%, add dobutamine

Hemodynamic stability (cont. 4)

- if Hgb <7.0: target Hgb of 7.0–9.9 g/dL
  - in absence of tissue hypoperfusion, ischemic coronary artery disease, or acute hemorrhage
- Transfuse PRBC, platelets, and/or fresh frozen plasma:
  - (also to help for co-agulopathic complications)
- Stress ulcer prophylaxis
  - Protonix 40 mg daily IVP
- DVT prophylaxis
  - SCD, Lovenox
  - Heparin not ordered

Pulmonary stabilization

- Assess oxygenation and supplement as needed
- Intubate for respiratory failure
- Achieve an arterial oxygen saturation above 93%
- Achieve central venous oxygen saturation of at least 70% (good marker of tissue perfusion)
- Controlled, lung-sparing ventilation at low tidal volumes (6 mL/kg of body weight) and peak pressures no higher than 30 mbar
  - whenever adequate oxygenation (>90% by pulse oximetry) cannot be achieved by hemodynamic stabilization and mask oxygen administration alone

Conclusion

- The importance of timing - gold prognostic factor
  - early identification of sepsis
  - early treatment initiation
- Appropriate first step in screening
  - Identification of infection.
- Management of sepsis
  - Focus on early initiation of antibiotics,
  - Hemodynamic stabilization
  - Pulmonary stabilization
  - to prevent progression of sepsis to MOD

Non pharmacological Management

- Regular hand washing
- Sterile technique for catheters, appropriate glove use
- Antibiotic prophylaxis for recommended surgical procedures
- Stop smoking
- Boost immune system by eating healthy diet.
- Getting plenty of rest
- Drinking plenty of fluids
- Eating a diet low in salt, fats, and cholesterol
- Limiting alcohol
- Getting exercise
- Reducing your stress
- Losing any excess weight
- Vaccination- Pneumococcal vaccine , Meningococcal, Influenza

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