**Incubation**
- Undetermined, • follows colonization or asymptomatic infection
- Colonization may last 6 months

**Complication**: Sepsis
**Death**: up to 40-50%

**HEALTH CARE FACILITY ASSOCIATION**
- 92% occur in patients with substantial exposures to HCF
- Reporting at least 1 case: 4% of acute care short stay, 18% of acute care long stay.
- 1% of *Enterobacteriaceae* cultured

**Personal Risk Factors**
- Severe underlying illness;
- High SOFA score
- ICU stay
- Diabetes
- Solid tumor

**HCF related Risk Factors**
- ICU stay
- Multiple HCF stays
- Wide spectrum antibiotic
- Tracheostomy
- Urinary cat insertion

**Microbiology**
- *Enterobacteriaceae* represent a large family of Gram-negative bacteria that includes genera such as
  - Klebsiella, Escherichia, Enterobacter that may become carbapenem resistant,
  - Some *Enterobacteriaceae* have intrinsic resistance to imipenem: Morganella, Proteus, Providencia
  - Other *Enterobacteriaceae* include Salmonella, Shigella...
- **Carbapenem resistance (CR)** was uncommon before 2001,
  - Resistance due to production of carbapenemase (special β lactamase); a porin mutation that limits penetration ability of carbapenems; on transferable plasmids
  - First to spread was Klebsiella pneumonia carbapenemase (KPC),
  - Now *E.coli*, Enterobacter
  - Metallo-β-lactamases (MBLs), have become the more prevalent mechanisms for CRE. MBLs include New-Dehli (NDM), Verona Integron Encoded (VIM), imipenemase (IMP)
  - Associated with resistance to other antibiotics: Pan-resistant strains

**Lab Diagnosis**
- Culture to identify the genus and species
- Use MIC method to determine status of resistance
- A DNA microarray enables detection of the most prevalent carbapenemases: NDM, VIM, KPC, OXA-48 and IMP and ESBLs SHV, TEM and CTX-M.

**Treatment**

**Treatment 3 Options**
1. Increase dose of carbapenem; risk of toxicity
2. Use a second-line antibiotic with Gram-negative activity for which resistance is not yet developed: colistin, tigecycline, gentamicin, fosfomycin but high toxicity
3. Combine first- and second-line antibiotics with the hope that synergistic interactions between antibiotics will lessen the need for extremely high antibiotic doses

**Microbio Definition**: *Enterobacteriaceae*
- Non-susceptible to doripenem, meropenem or imipenem AND
- Resistant to these 3rd generation cephalosporins: Ceftriaxone, cefotaxime, ceftazidime
- Ertapenem not yet included in definition

**Voluntary Report to LA health dept.**

**http://www.infectiousdisease.dhh.louisiana.gov**

(800)256-2748
**SURVEILLANCE**

Review clinical cultures and antibiograms of *K. pneumoniae* & *E. coli* to identify any presence of CRE; review archived results if not done previously.

- If none: continue such surveillance;
- If CRE presence detected:
  - As community acquired: Collect culture on all suspected infections, request antibiograms
  - As Facility-Acquired: Carry out investigation to identify additional cases and units affected; survey and screening may be indicated
- Alert staff to report patients not responding to carbapenem treatment

**CONTACT PRECAUTIONS (CP)**

- Any patient colonized, infected, with history of col/inf
- Rectal carriage major risk for long term carriage
- Pre-emptive contact precautions for patients from facilities with CRE pending screening results
- Short term stay: Contact precautions for the duration of the stay

**CONTACT PRECAUTIONS in LONG TERM FACILITIES**

- Indications modified for LTCF
- Keep CP for high risk patients:
  - Patients totally dependent on HCP for activities of daily living
  - Ventilator dependent patients
  - Stool incontinent
  - Wound drainage difficult to control
- Others:
  - Relax CP,
  - Enforce Standard precautions

**SCREENING & POINT PREVALENCE SURVEY**

- If review of clinical cultures is not sufficient to prevent CRE to be prevalent in a facility
- SCREENING is indicated to supplement clinical culture review
  - Start with epidemiologically linked patients,
  - Patients with close contact
  - Room mates
  - Patients who have shared the same HCPs
  - Sites: rectum, peri-rectal area, wound, urine

**ACTIVE SURVEILLANCE**

- Culture all high risk patients regardless of their provenance
- Culture all epidemiologically-linked patients (see above description)
- Culture all patients coming from high risk facilities
- Culture all patients admitted to high risk units/wards (ICU, Long Term Acute Care)
- Do at admission, or if warranted regularly

**ANTIBIOTIC STEWARDSHIP**

- In addition to usual antibiotic stewardship measures
- Minimize use of class of antibiotics known to increase risk of CRE colonization: fluoroquinolones
- Restrict use of carbapenems

**CHLORHEXIDINE BATHING**

- Chlorhexidine bathing (2%) or chlorhexidine wipes (2%) to bathe patients daily
- For high risk patients, for high risk units/wards

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