


Emerging Infections ? New Plagues

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A TRADITION OF INDEPENDENT THINKING
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Coláiste na hOllscoile Corcaigh

Outline

- Antimicrobial resistance
- Acronyms explained
- Overall guidelines addressed
- Individual pathogens
  - Antimicrobial resistant *Enterobacteriaceae* (ESBL, CRE)
  - Multi drug resistant *Acinetobacter* and *Pseudomonas aeruginosa*
  - Vancomycin Resistant Enterococci (VRE)

Antimicrobial Resistance

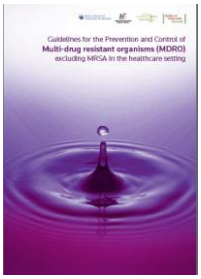
- Antimicrobial resistance occurs when an antimicrobial has lost its ability to control bacterial growth or kill bacteria
- Resistant bacteria continue to multiply in the presence of therapeutic levels of an antimicrobial
- Antimicrobial resistance is a natural phenomenon: natural antimicrobials exist in the environment and adapting to them is a bacterial survival trait
- Increasing levels of antimicrobial resistance in bacterial pathogens infecting humans and domestic animals are **not** natural but result from unprecedented industrial production and use of antimicrobials

Multi-drug resistant organism (MDRO) other than MRSA in Ireland identified by HPSC/HSE

- Resistant *Enterobacteriaceae* e.g. Extended Spectrum Beta Lactamase producers (ESBLs), Carbapenem Resistant *Enterobacteriaceae* (CRE)
- Multi-drug Resistant *Acinetobacter spp. and Pseudomonas aeruginosa*
- Vancomycin Resistant Enterococci VRE

MDRO Guidelines 2012-14

Common management



Updated June 2014

All patients colonised or infected should be isolated in a single en-suite room

Source precautions

If isolation facilities limited, risk assessment prioritisation

Patients informed of colonisation/infection status by clinician (leaflet)

Notes record colonisation/infection status (no decolonisation, contact precautions generally remain for duration of admission)

Screening of health care workers generally not appropriate

Contact precautions

- Patient placement in single room with facilities
  - Door closed where possible
- **Hand hygiene** on entering and leaving room
  - Gloves
  - Apron
  - Gown if close patient contact anticipated

  } Removed before exit
- Masks and eye protection if splash generating procedures anticipated
- On transfer inform recipient ward of status

Other prevention of MDRO: antimicrobial stewardship

- Avoidance of inappropriate or excessive antimicrobial therapy in all healthcare settings
- Ensuring that antimicrobials are given at the correct dosage and for the shortest duration required for efficacy.
- Reducing the use of broad-spectrum antimicrobials, particularly third generation cephalosporins,fluoroquinolones and carbapenems.
- Limiting the use of glycopeptide antimicrobials to situations where their use is shown to be appropriate

Long Term Care Facilities (LTCF) and MDRO

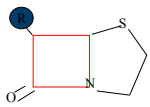
- Key infection control recommendations for settings outside the hospital applicable to all MDRO
- MDRO colonised patients should not be declined admission to a long-term care facility (LTCF), day care facilities or rehabilitation services or have their admission delayed on the basis of positive MDRO colonisation status.
- Isolation of a resident with MDRO is generally not required in LTCF.
- Standard Precautions are required for the care of all patients, including patients colonised with MDRO in LTCF.
- The need to place a MDRO colonised patient in a single room or to use Contact Precautions should be determined based upon local risk assessment on a case-by-case basis
- Routine screening for MDRO is not recommended for LTCF.

Enterobacteriaceae

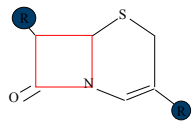
- **Gram negative bacteria**
  - *Escherichia coli*,
  - *Klebsiella pneumoniae*,
  - *Enterobacter cloacae*,
  - *Citrobacter freundii*
- Resident in the gut
- Cause UTI, bacteraemia (most frequent cause of bacterial infections in patients of all ages)
- Readily exchange DNA
- Can easily acquire and spread antimicrobial resistance

β-lactam antibiotics

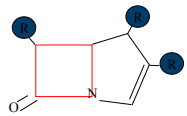
Penicillin



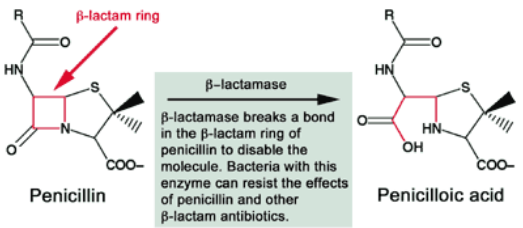
Cephalosporin



Carbapenem



Beta lactamase enzyme



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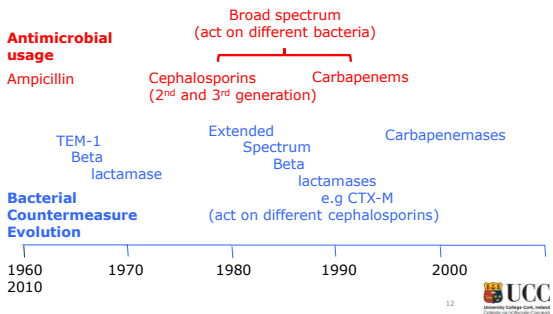
Arms Race / Beta lactam cycle in Gram negative bacteria



Broad Spectrum β-lactamase producing *Enterobacteriaceae*

- Extended spectrum β-lactamase producer (ESBL)
  - Grand-daddy 1960s β-lactamase TEM-1 was narrow spectrum – hydrolysed ampicillin only (not new cephalosporins)
  - 1980s onward, evolution of narrow spectrum β-lactamases TEM and SHV (and others) **extended their spectrum** to hydrolyse 3rd and 4th generation cephalosporins (broad spectrum antibiotics)
  - May also confer resistance to beta-lactam/beta-lactamase inhibitor combinations like amoxicillin-clavulanate
  - Genes plasmid-located so easily transmitted between bacteria (infectious drug resistance)
- AmpC β-lactamase producer
  - normally inducible, may only appear when exposed to antibiotic
  - De-repressed by regulatory mutation – evolved to always be made in large quantities
  - Genes originally chromosomally located, less transmissible but now on plasmids

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Carbapenem resistant Enterobacteriaceae (CRE)

- Two pathways to CRE

1. Broad spectrum β-lactamase enzyme (carbapenemase)
   - *Klebsiella pneumoniae* carbapenemase (KPC)
   - New Delhi metallo-b-lactamase (NDM)
   - Verona Integron-encoded metallo-β-lactamase (VIM)
   - Oxacillinase (OXA)
   - Potential plasmid spread – infectious resistance
2. Combination of mechanisms
   - ESBL/AmpC plus decreased cell wall passage (porin loss)
   - Not readily transmissible to other bacteria

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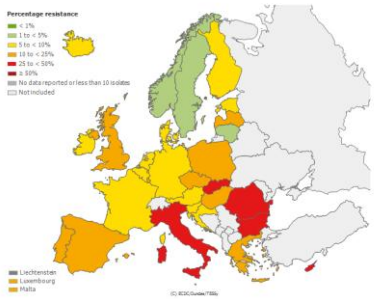
Proportion of 3rd gen. cephalosporins Resistant (R) *Escherichia coli* Isolates in Participating Countries in 2012



ESBL: amber for Ireland

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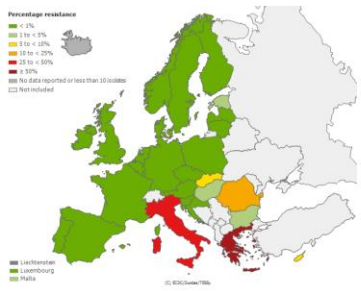
Proportion of Carbapenems Resistant (R) *Klebsiella pneumoniae* Isolates in Participating Countries in 2012



CRE: green is good, but all the red countries started with sporadic cases

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CRE and ESBL in Ireland

- CRE

Between 2011 and early 2014, 19 hospitals had reported 89 CRE cases (increasing)

- ESBL

Long-term care facility in western region 56% of residents colonised with resistant Enterobacteriaceae carrying ESBL genes (M. Cormican)

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Routine CRE screening of the following at-risk patient groups:HPSC guidelines July 2014

- Patients epidemiologically linked to other cases of resistant Enterobacteriaceae infection or carriage (e.g. sharing an inpatient area with a colonised or infected patient or transferred from a unit with a known resistant Enterobacteriaceae outbreak)
- Patients directly transferred/repatriated from a healthcare facility
- in another jurisdiction (including Northern Ireland)
- Patients with a history of admission as an inpatient in another jurisdiction (including Northern Ireland)
- Patients admitted to high risk areas (critical care unit, neonatal intensive care unit, haematology, oncology or transplant ward), and weekly thereafter
- Patients admitted from long-term care residences
- Patients with a history of admission to another Irish hospital, after consideration of the source hospital history and unit/s to which the patient will be admitted. Advice should be obtained from the local infection prevention and control team

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Multi-drug Resistant *Acinetobacter spp.*

- *Acinetobacter*: gram negative cocco-bacilli skin/environmental organisms
- Rapidly accumulate resistance genes/mechanisms, including those for carbapenems
- Colonise respiratory tract, airborne spread as well as direct contact, shared devices
- ICU outbreaks in UK
- Most resistant in Greece, Italy, Turkey, Spain (repatriation issue, esp with tracheostomies)

Multi drug resistant *Acinetobacter* and *Pseudomonas aeruginosa*

- Resistant to one or more agents in three or more different classes of antimicrobials that the isolate is expected to be susceptible to
  - beta-lactam-inhibitor combinations
  - cephalosporins
  - aminoglycosides
  - fluoroquinolones
  - carbapenems.

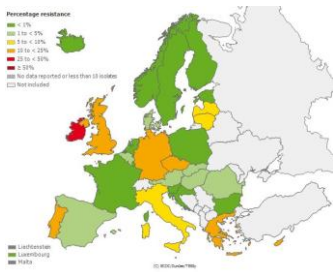
Pseudomonas aeruginosa

- Gram negative environmental bacterium
  - Biofilm forming, moist areas
  - 3- 15% blood culture isolates across europe
  - Colonises hospital patients (respiratory + GI tracts)
  - External source (e.g. taps) or no external source
  - 20-30% Ventilator associated pneumonia
  - In Ireland 5% Multi Drug resistant, 8% carbapenem resistant
  - More resistance in Southern Europe

VRE: **V**ancomycin **R**esistant **E**nterococci

- Enterococci are normal members of the enteric microbiota (screening by rectal swabs)
- ALWAYS resistant to cephalosporins, macrolides
- Very good at exchanging antimicrobial resistance mechanisms (in this case an altered drug target)
- Increasing exposure to glycopeptides in the gut (partly because of MRSA + *C. difficile,* avoparcin in animals) led to increasing incidence of various forms of vancomycin and teicoplanin resistance (particularly in *E. faecium*) from 1988.
- Ireland has the highest incidence in Europe @ 40% inpatient stools colonised in one tertiary referral centre
- Can cause: UTI, bacteraemia ,intra-abdominal infection, endocarditis

Ireland leading Europe on VRE (in a bad way) – 2012



VRE – Infection Control

- Considering the local epidemiology and available resources, active surveillance cultures should be undertaken on the following patient groups:
- Patients admitted to high risk areas (ICU, haematology/oncology, transplantation) with weeklyscreening thereafter.
- Patients known to be previously VRE positive, upon re-admission to hospital to facilitate an infection control risk assessment.
- Patients transferred from another Irish hospital or patients transferred from any hospital abroad.
- Where appropriate, 'at risk' patients who have been contacts of known VRE positive patients during an outbreak of VRE.

Key Points

- Antibiotic stewardship important in minimising selection of MDRO
- Hand Hygiene
- Source isolation