



# Infection Prevention and Control A Foundation Course

2014



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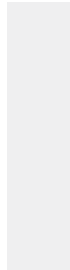
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## What is healthcare-associated infection (HCAI), antimicrobial resistance (AMR) and multi-drug resistant organisms (MDROs)?

### Why we should be worried?

**Dr. Deirdre O'Brien**  
Consultant Microbiologist  
Mercy University Hospital and  
South Infirmary Victoria University  
Hospital



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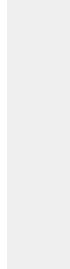
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## Talk outline

- What is healthcare associated infection?
- Why is antimicrobial resistance such an important issue?
- Discussion of resistant bacteria (MRSA, VRE, ESBLs, CRE)
- What can be done?



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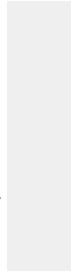
### HCAI definitions

#### Nosocomial infection

- Develops 48 hours or more after admission to a hospital and not present or incubating on admission

#### Health care associated infection (HCAI)

- An infection acquired following a health care intervention e.g. hospital, outpatients, long term care facility/nursing home, GP surgery




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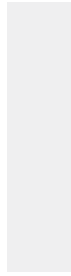
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### Health care associated infection

#### • Patient may have received:

- Hospital care for 2 days in the previous 90 or be an inpatient
- received outpatient care e.g. haemodialysis in previous 30 days
- homecare e.g. wound care
- reside in a nursing home or long term care facility




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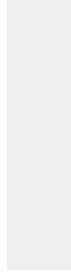
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### HCAI definitions

#### • May be classified by:

- Pathogen – bacterial, viral, fungal
- How it was acquired i.e. exogenous or endogenous
- By site of infection e.g. organ specific, device specific
- By resistance phenotype e.g.
  - Meticillin resistant *S. aureus* (MRSA)
  - Vancomycin resistant Enterococcus (VRE)
  - Extended spectrum B-lactamase (ESBL) producing gram-negatives
  - Carbapenem resistant *Enterobacteriaceae* (CRE)




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- **Urinary tract infection**
    - Urinary catheter
    - Urinary invasive procedures
    - Advanced age
    - Urolithiasis
    - Pregnancy
    - Diabetes
  - **Lower respiratory tract infection**
    - Mechanical ventilation
    - Aspiration
    - Nasogastric tube
    - Advanced age
    - Surgery
    - Underlying medical condition
      - Diabetes, immunosuppression, malnutrition
  - **Surgical site infection**
    - Inadequate prophylaxis
    - Inadequate skin prep
    - Inappropriate wound care
    - Type of wound
    - Poor surgical asepsis
    - Underlying medical condition
      - Diabetes, immunosuppression, malnutrition
  - **Blood stream infection**
    - Vascular catheter
    - Neonates
    - Critical care
    - Severe underlying condition
    - Immunocompromise e.g transplant, neutropenia
    - New invasive techniques
- Gastro-intestinal infection**
- Antibiotics
  - Proximity to known cases of CDI
  - Advanced age, PPIs, surgery

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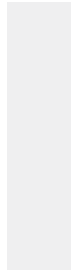
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## The impact of HCAI

- **Increased mortality**
  - Rate of 16-40% in critically ill patients with blood stream Infection
  - Up to 30% mortality with *S. aureus* infection
  - Up to 70% mortality with CRE infection
- **Increased morbidity**
- **Increased hospital length of stay**
  - An average of 4 days per infection
- **Increased costs**
- **Patient impact** – suffering, pain, loss of income
- **Increase in antimicrobial resistance and multi-drug resistant organisms**




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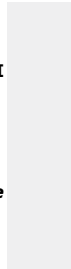
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## HCAI surveillance in Ireland

- **National initiative - HPSC**
  - Development of guidelines, standards, agreed definitions for surveillance
  - Prevalence surveys MRSA 1999 and HCAI 2006, nursing homes HALT 2010, 2011, 2013.
  - **Surveillance**
    - EARS-net and enhanced bloodstream infections
    - Notifiable diseases including *C. difficile*
    - HALT survey
    - Antimicrobial use/alcohol gel use
    - Surgical site infection surveillance




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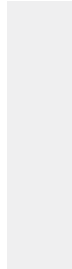
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## What is the burden of HCAI in Ireland?




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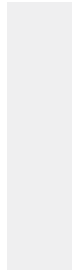
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## European Point Prevalence Survey 2012




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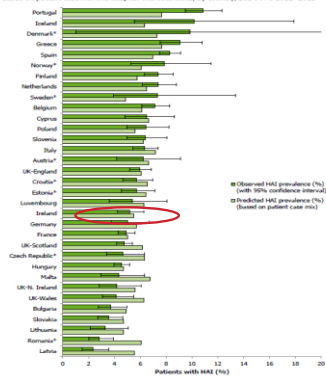
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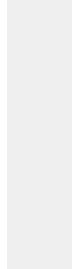
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Figure 20. Observed HAI prevalence with 95% confidence intervals and predicted HAI prevalence based on patient case mix and hospital characteristics, by country, ECDC PPS 2011–2012



\*95% data non-reportable due poor fit. Austria, Croatia, Czech Republic, Estonia, Hungary and Romania are not shown in Denmark and Sweden. Denmark: upper limit of 95% confidence interval not included. HAI prevalence: 3.6% (95% CI 2.8-4.2%).




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Figure 25. Prevalence of HAI (percentage of patients with an HAI) (left) and distribution of HAI types (right) by patient/consultant speciality, n=231 459 patients, ECDC PPS 2011–2012

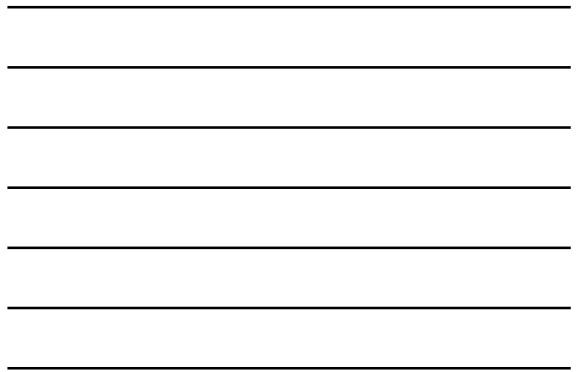
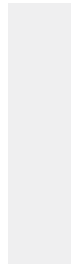
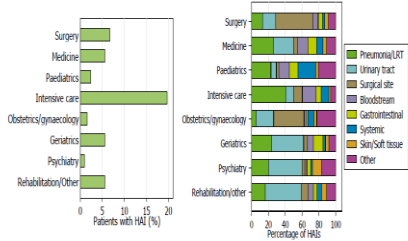


Figure 34. Distribution of HAI types, by country, ECDC PPS 2011–2012

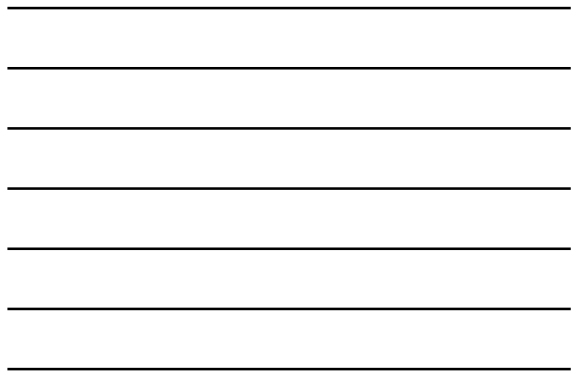
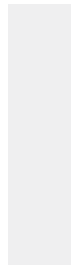
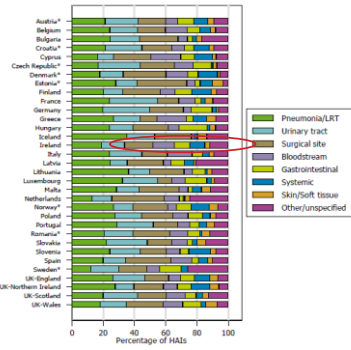


Figure 25. Prevalence of HAI (percentage of patients with an HAI) (left) and distribution of HAI types (right) by patient/consultant speciality, n=231 459 patients, ECDC PPS 2011–2012

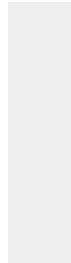
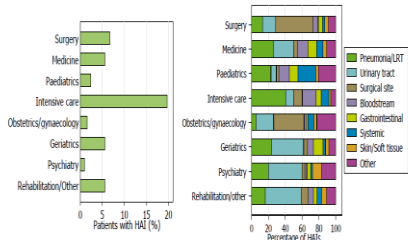


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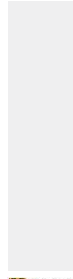
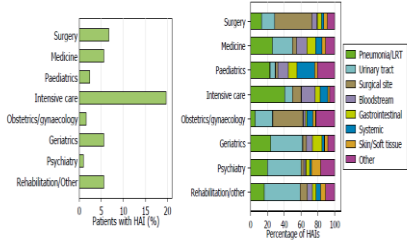
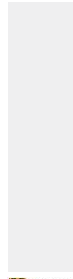
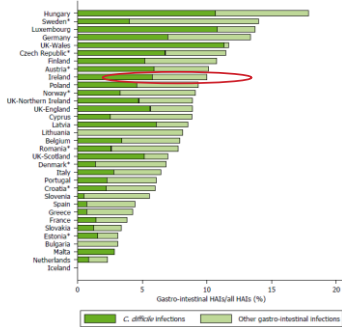
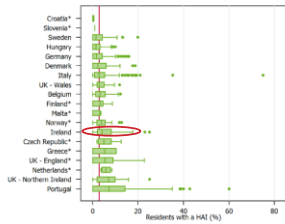


Figure 35. *Clostridium difficile* infections and other gastro-intestinal infections (excluding hepatitis) as a percentage of all HAIs, by country, ECDC PPS 2011–2012



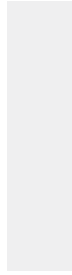
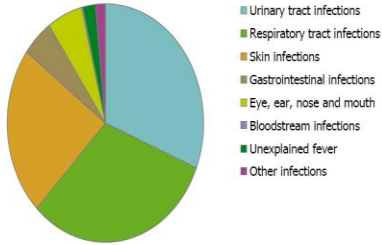
## HALT-2 Point Prevalence Survey 2013

Figure 22. Prevalence of eligible LTCF residents with at least one HAI, by country, HALT-2, 2013



## Types of infection in LTCF

Figure 23. Distribution of types of HAI in the included LTCFs, HALT-2, 2013




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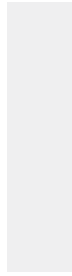
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## Why is antimicrobial resistance an issue?




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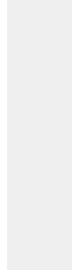
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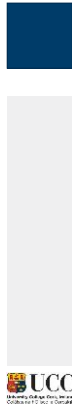
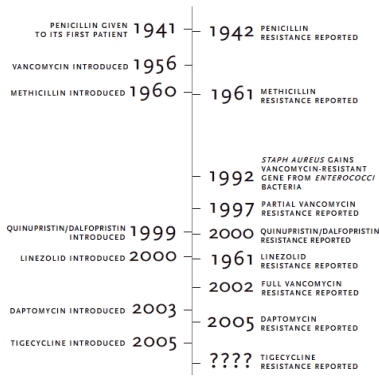
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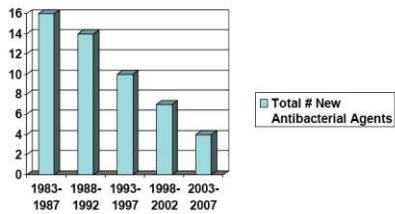
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Antibacterial agents approved, 1983-2007



Spillberg, et. al., CID May 1 2004, Modified




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theguardian

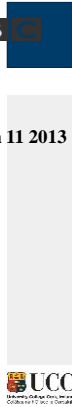
The INDEPENDENT

BBC



March 11 2013

The chief medical officer, Dame Sally Davies, warns of a major increase in the number of bugs resistant to antibiotics. In a report published on Monday she says antibiotic-resistant bacteria with the potential to cause untreatable infections pose 'a catastrophic threat' to the population ranked alongside terrorism on a list of threats to the nation




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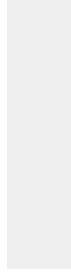
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## Enterobacteriaceae

- **Enterobacteriaceae family:** *E coli*, *Klebsiella* spp, *Enterobacter* spp.
- Normal gut flora
- Common cause UTI in community
- Hospital acquired infections: UTI, pneumonia, intra-abdominal infections, wound infections, bloodstream infections



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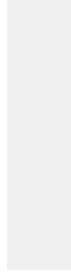
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## Carbapenems

- Carbapenems are **invaluable** for the treatment of infection due to multi-resistant Gram negative bacteria
- Meropenem, ertapenem, doripenem, imipenem



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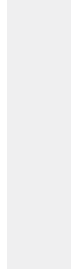
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## Treatment Options for CRE



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Infections with Penicillinase  $\beta$ -Lactamase-producing *S. aureus*: A Report of 2 Cases and a Brief Review of the Literature

David M. Lioransky, David M. Lioransky and David M. Lioransky

Journal of Antimicrobial Chemotherapy 2005; 56: 1201-1205

doi:10.1093/ajph/95/10/1201

Has the era of untreatable infections arrived?

David M. Lioransky\*

Author: Resistance Monitoring and Reference Laboratory, Health Protection Agency Centre for Infections, 61 Colindale Avenue, London NW9 5EQ, UK

Antibiotic resistance is a major public health concern, with many organisms that we already rely on for the treatment of infection, no longer effective. The greatest concern is the emergence of untreatable infections, which are those infections for which no effective antibiotic therapy is available. The emergence of untreatable infections is a real possibility, and this is a major concern for public health. The emergence of untreatable infections is a real possibility, and this is a major concern for public health.

\*Correspondence: D. M. Lioransky, Resistance Monitoring and Reference Laboratory, Health Protection Agency Centre for Infections, 61 Colindale Avenue, London NW9 5EQ, UK.

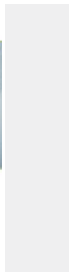
BRIEF REPORT

BAD BUGS, NO DRUGS

An antibiotic-resistant *Staphylococcus aureus* (MRSA) is a public health crisis.

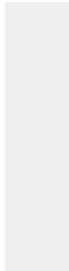


July 2005



Multi-drug resistant organisms

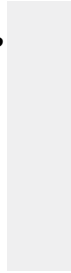
- MRSA
- VRE
- Multi-resistant Gram negative bacteria (ESBLs, CRE)
- Penicillin resistant *Streptococcus pneumoniae*
- Extensively drug resistant TB
- Multi-drug resistant gonorrhoea.....



A series of horizontal lines for writing, spanning the right side of the page.

**What levels of antimicrobial resistance are present in Ireland?**

**How do we compare to other countries?**



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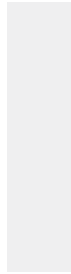
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### EARS-net

- EU Surveillance network for antimicrobial resistance
- Key pathogens
- Began 1999
- Excellent participation by Irish laboratories



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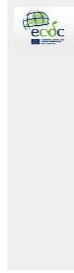
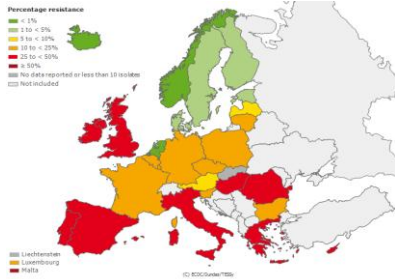
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**Distribution of MRSA in EARS-Net countries in 2009**



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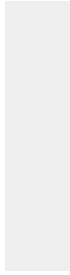
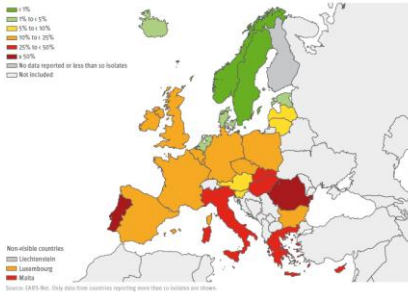
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### MRSA 2011

Figure 2.4.5: *Staphylococcus aureus*: percentage (%) of invasive (blood and cerebrospinal fluid) isolates resistant to methicillin (MRSA), EU/EEA, 2011




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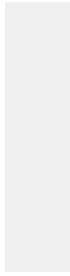
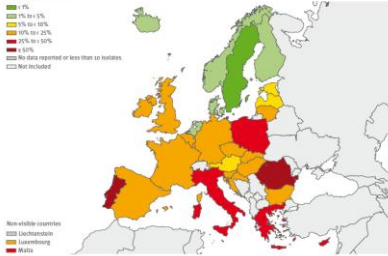
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### MRSA 2012

Figure 3.4.1: *Staphylococcus aureus*. Percentage (%) of invasive isolates resistant to methicillin (MRSA), by country, EU/EEA countries, 2012




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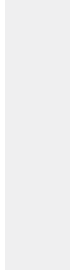
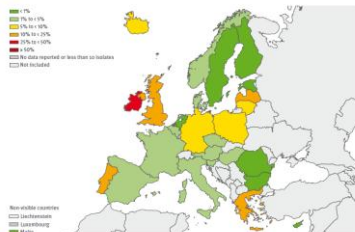
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### VRE 2010

Figure 3.0.2: *Enterococcus faecium*: proportion of invasive isolates resistant to vancomycin in 2010




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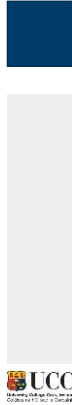
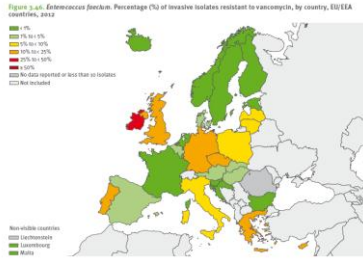
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VRE 2012




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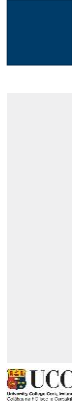
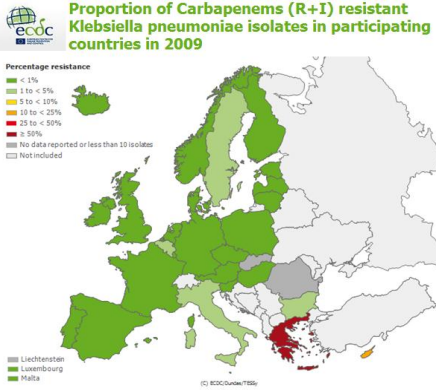
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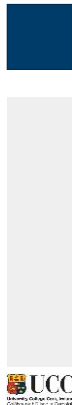
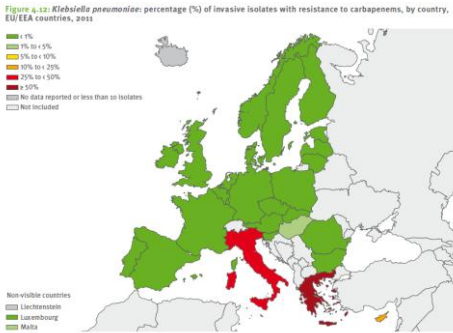
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**Carbapenem resistant *Klebsiella pneumoniae* 2011**




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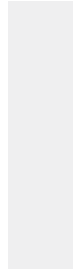
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### 2012...

Figure 3.13. *Klebsiella pneumoniae*. Percentage (%) of invasive isolates with resistance to carbapenems, by country, EU/EEA countries, 2012




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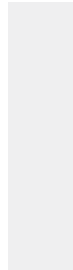
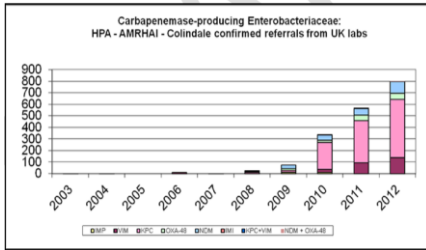
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Map of Carpenemase-Producing Enterobacteriaceae (CPE) confirmed and tested




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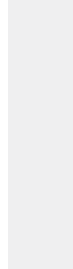
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### What can be done?




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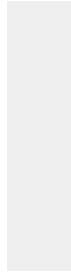
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- Awareness and communication
- Antimicrobial stewardship
- Infection prevention and control




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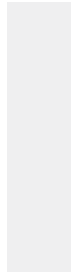
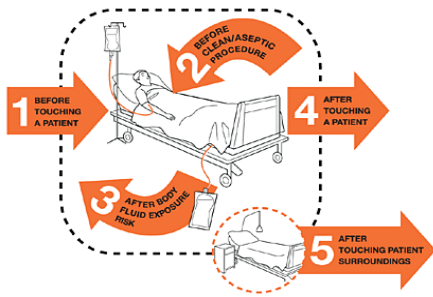
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### How can the spread of MDROs and HCAI be prevented?




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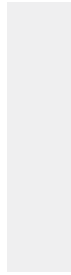
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### SENIC study

Appropriate infection control input resulted in a:

- 32% reduction in overall HCAI
- 27% reduction in Lower Respiratory Tract Infection
- 35% reduction in Surgical Site Infection
- 35% reduction in Blood Stream Infection
- 31% reduction in Urinary Tract Infection

\*Haley RW et al Am J Epidemiol 1985




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- A more recent review found a minimum reduction effect of 10% to a maximum of 70%
- It is accepted that on average 20–30% of all nosocomial infections can be prevented
- An even larger proportion (>50%) of device-associated bloodstream infections can be prevented
  - in catheter-related bloodstream infections can range from 29% to 95%
- In case of ventilator-associated pneumonia, studies suggest that average reductions of more than 40 % are possible

J Hosp Infect. 2003;54:258-266.  
 J Hosp Infect. 2006;64:328-335.  
 J Hosp Infect. 2006;64:328-335.




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### An Ongoing National Intervention to Contain the Spread of Carbapenem-Resistant Enterobacteriaceae

Mitchell J. Schwaber and Yehuda Carmeli

National Center for Infection Control, Tel Aviv, Israel

Clinical Infectious Diseases 2014;58(5):697–703

- Nationwide spread of CRE in Israel 2006-failure to contain a local levels
- Acquisition rate of 55.5 cases per 100,000 patient days
- National intervention for CRE containment




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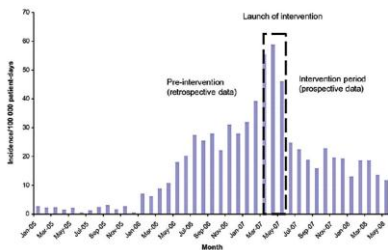
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### Acquisition rate now 4.8 cases per 100,000 patient days..




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## What worked?

TABLE 1. Compliance with Infection Control Guidelines in 13 Post-Acute Care Hospitals as Noted on 3 Site Visits

Variable	2008	2010	2011	P
Infection control consultant	62	85	92	.055
Hand hygiene <sup>a</sup>				
Presence of ABHR in each room	85	92	100	.146
ABHR at site of care	15	54	85	<.001
Presence of antiseptic soap	15	92	85	<.001
Presence of sink in each room	23	31	46	.164
Paper towel availability	69	85	100	.032
Compliance audits	0	46	77	<.001
Appropriate use of barrier precautions in context of standard precautions <sup>b</sup>				
Gloves	31	69	92	.001
Gowns	54	77	77	.208
Masks	38	62	69	.118
CRE prevention program				
Placement of colonized patients in single rooms or cohorting	77	85	100	.082
Use of gowns and gloves in contact isolation	46	92	100	.001
Designated medical equipment	92	100	100	.221
Admission screening cultures	15	49	77	.002
Contact screening	38	77	100	.001
Discontinuation of isolation per standard protocol	15	46	100	<.001
Total infection control score (average, out of possible 16)	6.8	11.6	14.8	<.001

NOTE. Data are percentage of compliant hospitals (n = 13), unless otherwise indicated. ABHR, alcohol-based hand rub; CRE, carbapenem-resistant Enterobacteriaceae.



TABLE 2. Israeli National Guidelines for the Care of Patients with Carbapenem-Resistant Enterobacteriaceae in Acute Care versus Post-Acute Care Hospitals

Variable	Post-acute care hospitals		
	Acute care hospitals	Skilled nursing/chronic ventilated/subacute wards	Rehabilitation wards
Room assignment	Private or cohorting with other CRE carriers	Private or cohorting with other CRE carriers	No regulation regarding room assignment
Dedicated nursing staff for CRE carriers	Required	Not required	Not required
Use of gloves and gowns in care of CRE carriers	Mandatory on room entrance	Mandatory on room entrance	According to standard precautions
Admission CRE screening of high-risk groups <sup>a</sup>	Required	Required	Not required, except in outbreak setting
CRE screening of patient contacts	Required	Required	Required
Participation in group activities	Prohibited	Allowed	Allowed
Standard protocol for discontinuation of contact isolation	Yes	Yes	Yes
Regular mandatory census reporting to NCG	Yes	Yes	Yes

NOTE. CRE, carbapenem-resistant Enterobacteriaceae; NCG, National Center for Infection Control.  
<sup>a</sup> High-risk groups were defined as patients transferred from other facilities or patients with earlier hospitalization within the previous 6 months.



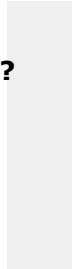
## Local strategies we can all do\*

- Hand hygiene audits
- Environmental cleaning and audits
- Central line surveillance
- Ventilator associated pneumonia surveillance
- Surgical Site Infection surveillance
- Catheter associated UTI surveillance
- Local monitoring of MRDOs
- Implementation of care bundles and guidelines...
- .....Feedback above results to local teams

\*but might need more resources



### What about antimicrobial use?



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### Antimicrobial use in Europe

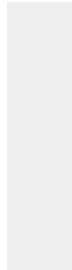
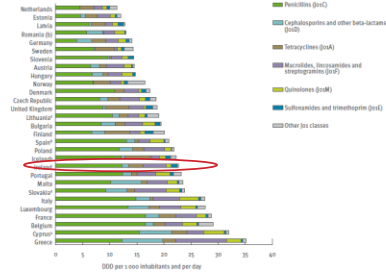


Figure 2.6.6. Distribution of consumption of antibacterials for systemic use (ATC group J01) in the community (outside of hospitals) at ATC group level 3, ESEEA, 2011, expressed as DDD per 1 000 inhabitants and per day



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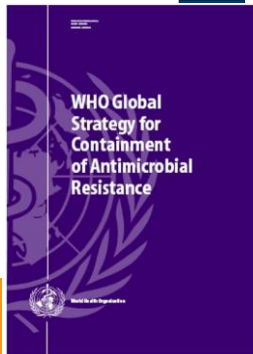
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Department of Health  
Advisory Committee on Antimicrobial Resistance  
and Healthcare Associated Infection (ARHAI)

**ANTIMICROBIAL  
STEWARDSHIP:**  
"START SMART - THEN  
FOCUS"

Scottish Medicines Consortium  
Scottish Antimicrobial Prescribing Group (SAPG)  
Delta House  
50 West Nile Street  
Glasgow  
G1 2NP



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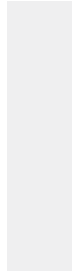
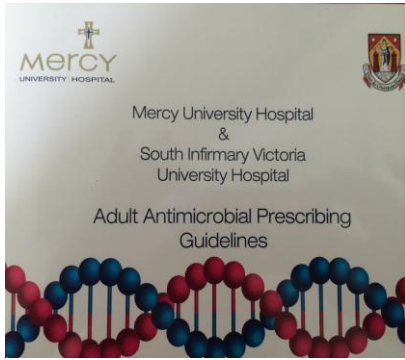
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**Get better without using antibiotics**

This leaflet explains the need to get the right treatment for common illnesses such as colds and coughs without encouraging antibiotic resistance.



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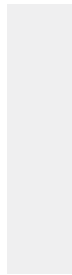
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**Take home messages**

- HCAI and MDRO a significant burden in Irish healthcare
- Antimicrobial resistance a real threat to how we all practice medicine
- Stewardship and adherence to infection prevention and control practices our best (only) means to limit the spread



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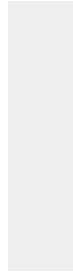
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**Thank you!**

**Questions.....**



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