Multidrug-resistant Gram negative pathogens

Epidemiology & Control

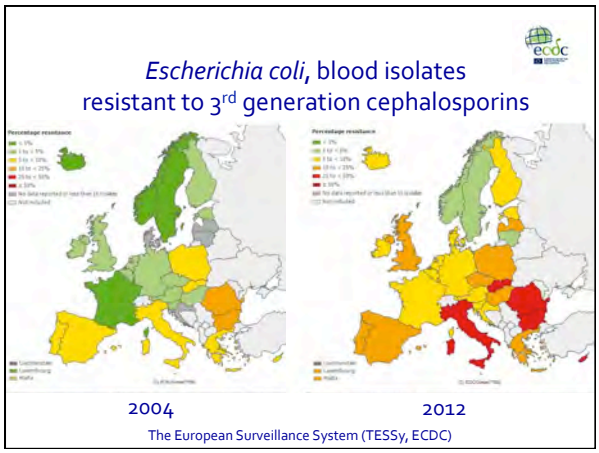
ESBL-producing Enterobacteriaceae

Carbapenem-resistant Enterobacteriaceae

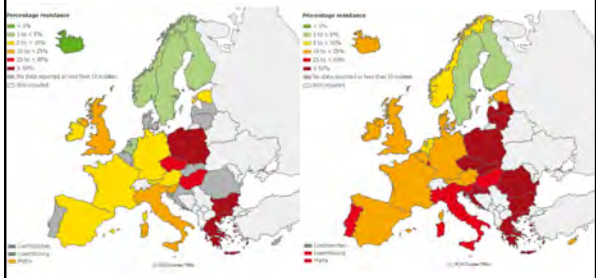
Carbapenem-resistant *Pseudomonas/Acinetobacter*

Multidrug-resistant Gram negative pathogens

Epidemiology



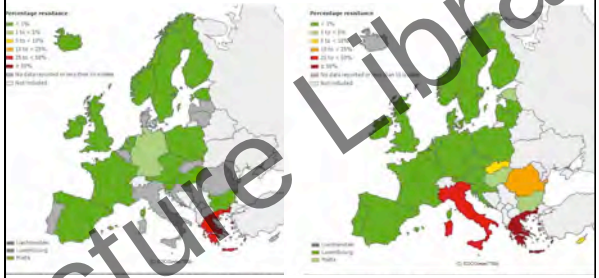
Klebsiella pneumoniae, blood isolates resistant to 3rd generation cephalosporins



2005 2012

The European Surveillance System (TESSy, ECDC)

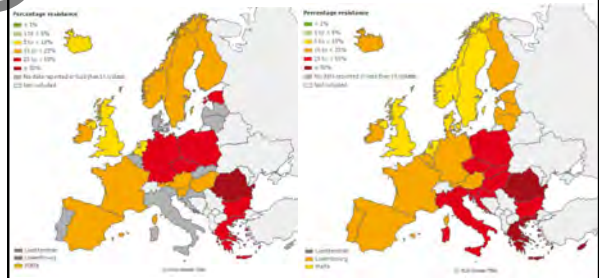
Klebsiella pneumoniae, blood isolates resistant to carbapenems



2005 2012

The European Surveillance System (TESSy, ECDC)

Pseudomonas aeruginosa, blood isolates resistant to carbapenems (R+I)



2005 2012

The European Surveillance System (TESSy, ECDC)

Global epidemiology of multidrug-resistant Gram negative bacteria in Europe

North → South
West → East

gradient of increasing resistance

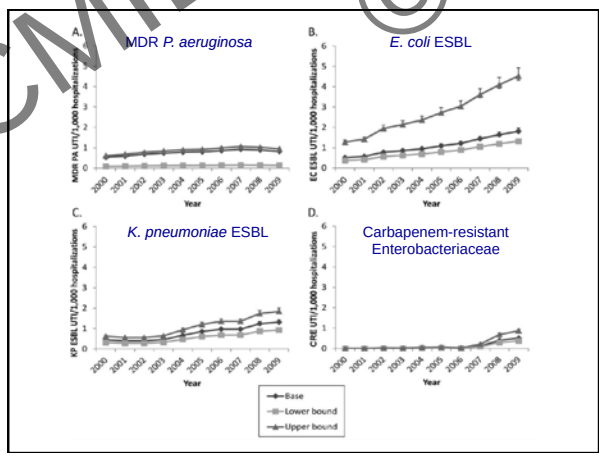
United States

INFECTION CONTROL AND HOSPITAL EPIDEMIOLOGY SEPTEMBER 2013, VOL. 34, NO. 9

Secular Trends in Gram-Negative Resistance among Urinary Tract Infection Hospitalizations in the United States, 2000–2009

Marya D. Zilberberg, MD, MPH; Andrew F. Shorr, MD, MPH

- UTI hospitalizations from the Healthcare Cost and Utilization Project Nationwide Inpatient Sample database 2000-2009
- Prevalence of resistance for each pathogen: Eurofins Surveillance Network database 2000-2009



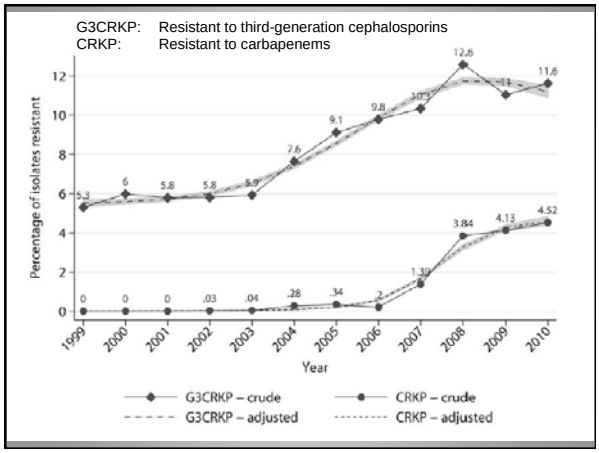
United States

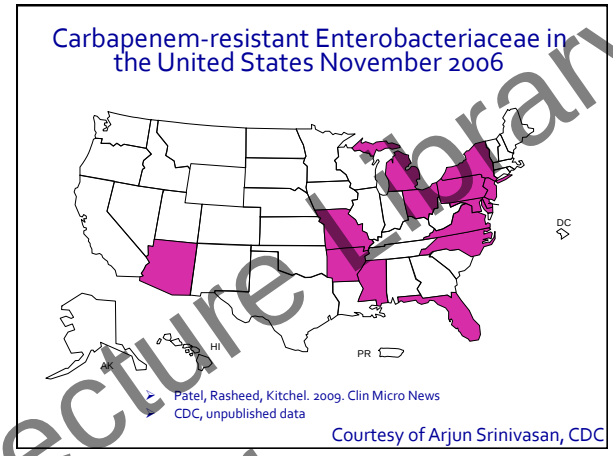
INFECTION CONTROL AND HOSPITAL EPIDEMIOLOGY MARCH 2013, VOL. 34, NO. 3

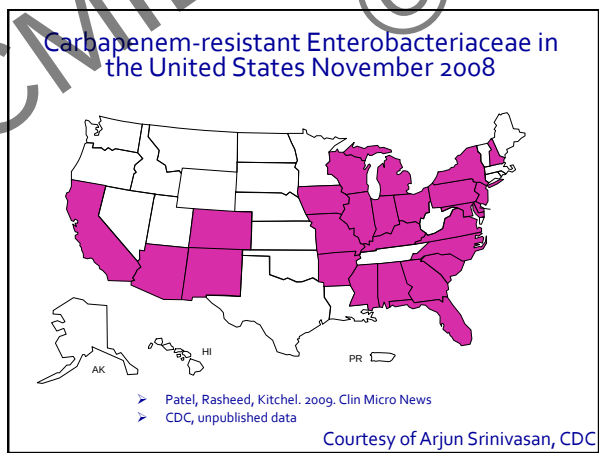
Trends in Resistance to Carbapenems and Third-Generation Cephalosporins among Clinical Isolates of *Klebsiella pneumoniae* in the United States, 1999–2010

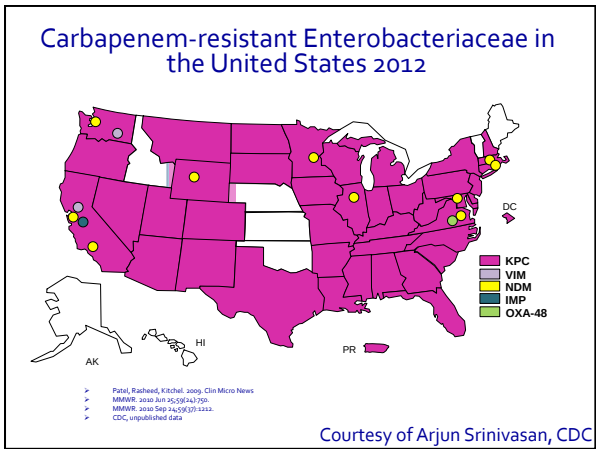
Nikolay P. Braykov, BSE;[1] Michael R. Eber, BSE;[2] Elli Y. Klein, PhD;[1,3] Daniel J. Morgan, MD, MS;[4,5] Ramanan Laxminarayan, PhD, MPH[1,6,7]

- 500.000 *K. pneumoniae* isolates
- 287 clinical laboratories in US









Resistance rates among microorganisms causing blood stream infections

Microorganism	Year	Scenario	Resistance rate (%)	Country or region
Oxacillin-resistant *S. aureus*	1997-2002	Hospital	32.6	Latin America
	2001-2007	ICU	47.3	Colombia
E. coli (ESBL)	2000-2004	Hospital	2.0	Argentina
	2001-2007	ICU	7.7-8.7	Colombia
Klebsiella spp. (ESBL)	1997-2002	ICU	31.1	Latin America
	2001-2007	ICU	31.3-35.3	Colombia
Pseudomonas aeruginosa (imipenem-resistant)	1997-2002	ICU	10.4	Latin America
	2001-2007	ICU	21.0	Colombia
Acinetobacter baumannii (imipenem-resistant)	1997-2001	ICU	13.5	Latin America
	2001-2007	ICU	41.4	Colombia

Cortes et al, Rev Argen Microbiol Res Latin America, 2010, 42:230

Infect Chemother 2013;45(1):22-31

Infection & Chemotherapy

Antimicrobial Resistance in Asia: Current Epidemiology and Clinical Implications

Cheol-In Kang[1], and Jae-Hoon Song[1,2]

[1]Division of Infectious Diseases, Samsung Medical Center, Sungkyunkwan University School of Medicine; [2]Asia Pacific Foundation for Infectious Diseases (APFID), Seoul, Korea

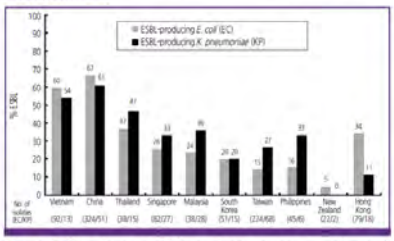


Figure 2. Prevalence of ESBL-producers among *E. coli* and *K. pneumoniae* isolates causing urinary tract infections by country in the Asia-Pacific region, adopted from reference [44].

Antimicrobial resistance in India: A review

S. Ganesh Kumar, C. Adithan[1], B. N. Harish[2], S. Sujatha[2], Gautam Roy, A. Malini[3]

Departments of Preventive and Social Medicine, [1]Pharmacology, [2]Microbiology, Jawaharlal Institute of Postgraduate Medical Education and Research, [3]Department of Microbiology, Indira Gandhi Medical College and Research Institute, Puducherry, India

Address for correspondence: Dr. S. Ganesh Kumar, Department of Preventive and Social Medicine, JIPMER, Puducherry, India. E-mail: ssgen@yahoo.com

Journal of Natural Science, Biology and Medicine | July 2013 | Vol 4 | Issue 2

- Many small studies show high prevalence of resistance in Gram negatives
- Examples:
  - Various centres across India: 43% carbapenem resistance in P. aeruginosa
  - A tertiary care centre in New Delhi: 88% resistance to 3rd gen cephalosporins 50% resistance to carbapenems

Antibiotic resistance amongst healthcare-associated pathogens in China

Saber Yezli[a,*], Han Li[b]

International Journal of Antimicrobial Agents 40 (2012) 389–397

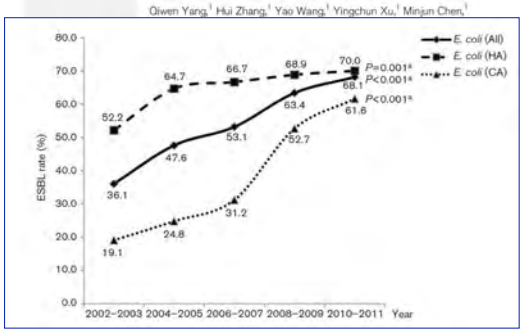
Rates of extended-spectrum β-lactamase (ESBL)-producing *Escherichia coli* and *Klebsiella* in China.

Location	Rate (%)		Study date
	E. coli	*Klebsiella*	
8 hospitals in six Chinese cities	64.9	31.9	2009
14 hospitals across China (CHINET 2009)	56.5	41.4	2009
Shanghai hospitals, China	58.9	49.6	2008
A children's hospital in Beijing, China	77.0	7[illegible]	2003–2008
12 hospitals across China (CHINET 2007)	55.0	45.0	2007
A hospital ICU in Wuhan, China	70.2	34.8	2007
Shanghai hospitals, China	53.0	53.9	2007
Shanghai hospitals, China	53.0	51.1	2006
8 hospitals across China (CHINET 2005)	38.5	39.1	2005
A hospital in Shanghai, China	47.6	69.6	2005
A hospital in Hangzhou, China	55.8	43.5[a]	2005
A hospital in Chongqing, China	37.5	31.4[a]	2004–2005
14 hospitals in Shanghai, China	36.5	45.0	2004
A hospital respiratory ICU in Guangzhou, China	–	47.8[a]	2004
A hospital ICU in Changsha, China	34.0	30.7[a]	2002–2004
A hospital surgical ICU in Guangzhou, China	66.2	58.5	2001–2004
Guangzhou hospitals, China	39.2	44.7	2003
Shanghai hospitals, China	33.6	44.2	2003
ICUs from 19 hospitals in seven Chinese central cities	45.7	34.9[a]	2002
4 hospitals in Shenyang, China	37.9	36.3	2002
15 tertiary hospitals in Hubei, China	31.3	34.7	2002
ICUs from 19 hospitals in seven Chinese central cities	28.6	25.7[a]	2001

ICU, Intensive Care Unit.
[a] *Klebsiella pneumoniae*.

A 10 year surveillance for antimicrobial susceptibility of *Escherichia coli* and *Klebsiella pneumoniae* in community- and hospital-associated intra-abdominal infections in China

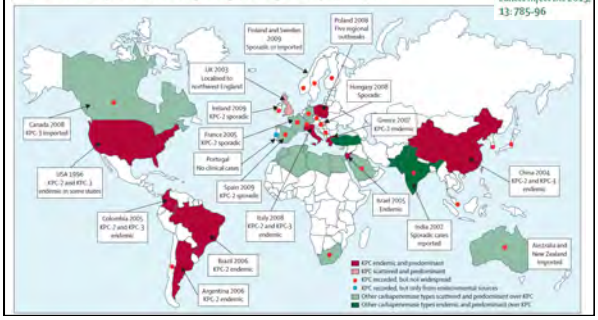
Qiwen Yang,[1] Hui Zhang,[1] Yao Wang,[1] Yingchun Xu,[1] Minjun Chen[1]



Clinical epidemiology of the global expansion of *Klebsiella pneumoniae* carbapenemases

L Silvia Munoz-Price, Laurent Poirel, Robert A Bonomo, Mitchell J Schwaber, George L Daikos, Martin Cormican, Giuseppe Cornaglia, Javier Garau, Marek Gniadkowski, Mary K Hayden, Kurthikeyan Kumarasamy, David M Livermore, Juan J Maya, Patrice Nordmann, Jean B Patel, David L Paterson, Johann Pitout, Maria Virginia Villegas, Hui Wang, Neil Woodford, John P Quinn

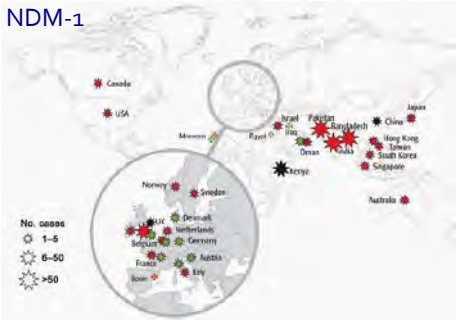
Lancet Infect Dis 2013; 13: 785–96



Global Spread of Carbapenemase-producing *Enterobacteriaceae*

Patrice Nordmann, Thierry Naas, and Laurent Poirel

NDM-1



Emerging Infectious Diseases • www.cdc.gov/eid • Vol. 17, No. 10, October 2011

Multidrug-resistant
Gram negative pathogens

Control

ESCMID PUBLICATIONS

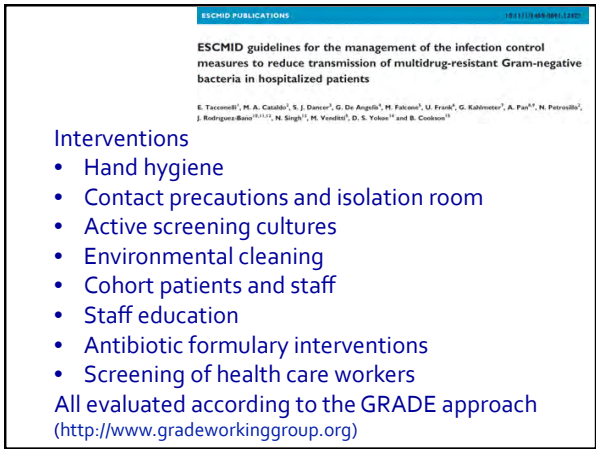
ESCMID guidelines for the management of the infection control measures to reduce transmission of multidrug-resistant Gram-negative bacteria in hospitalized patients

E. Tacconelli[1], M. A. Cataldo[2], S. J. Dancer[3], G. De Angelis[4], M. Falcone[5], U. Frank[6], G. Kahlmeter[7], A. Pan[8,9], N. Petrosillo[2], J. Rodríguez-Baño[10,11,12], N. Singh[13], M. Venditti[5], D. S. Yokoe[14] and B. Cookson[15]

55 pages!!

- Very comprehensive
- Best practices for acute care facilities
- Additional special approaches for ongoing transmission
- Stratified by microbial species and type of intervention

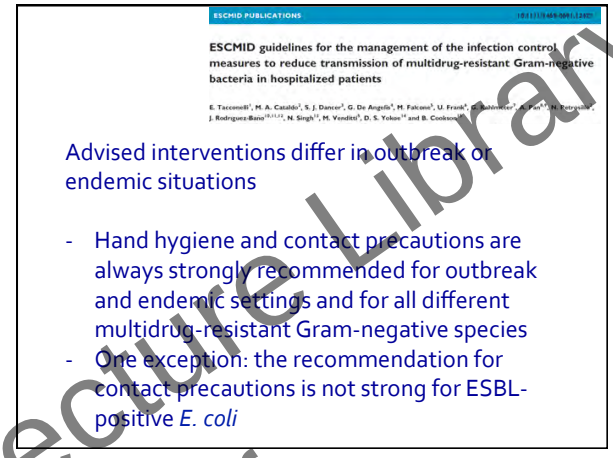
Level of evidence: all moderate to very low



Interventions

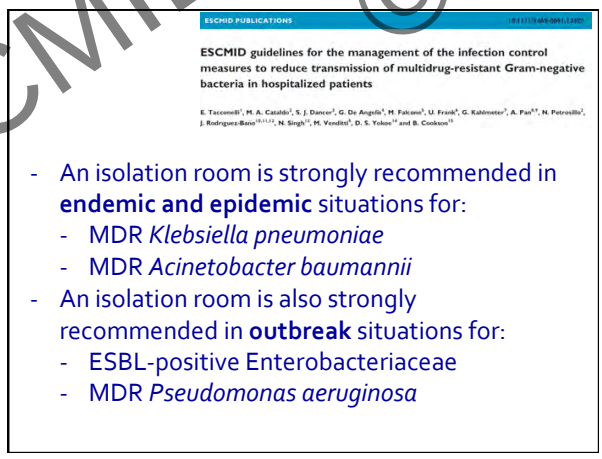
- Hand hygiene
- Contact precautions and isolation room
- Active screening cultures
- Environmental cleaning
- Cohort patients and staff
- Staff education
- Antibiotic formulary interventions
- Screening of health care workers

All evaluated according to the GRADE approach (http://www.gradeworkinggroup.org)

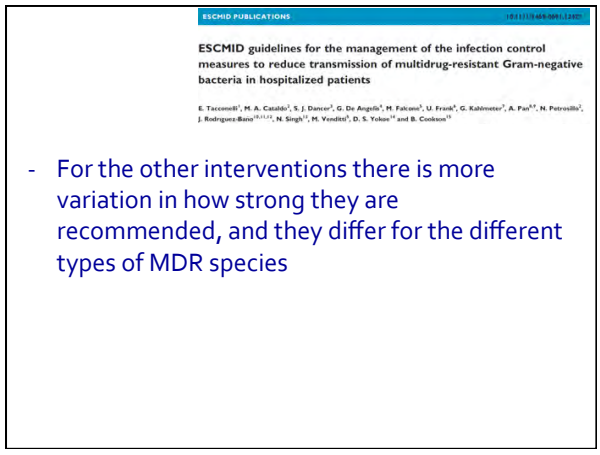


Advised interventions differ in outbreak or endemic situations

- Hand hygiene and contact precautions are always strongly recommended for outbreak and endemic settings and for all different multidrug-resistant Gram-negative species
- One exception: the recommendation for contact precautions is not strong for ESBL-positive *E. coli*



- An isolation room is strongly recommended in **endemic and epidemic** situations for:
  - MDR *Klebsiella pneumoniae*
  - MDR *Acinetobacter baumannii*
- An isolation room is also strongly recommended in **outbreak** situations for:
  - ESBL-positive Enterobacteriaceae
  - MDR *Pseudomonas aeruginosa*



- For the other interventions there is more variation in how strong they are recommended, and they differ for the different types of MDR species

INVITED ARTICLE ANTIMICROBIAL RESISTANCE

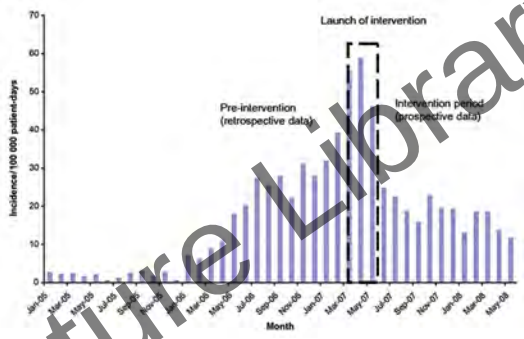
George M. Eliopoulos, Section Editor

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

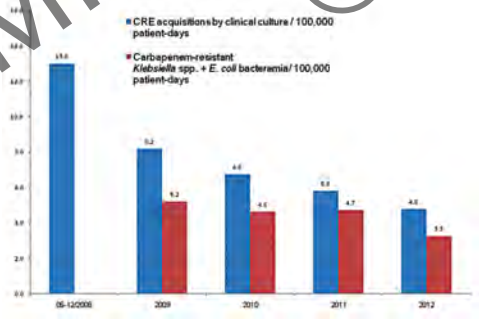
Mitchell J. Schwaber and Yehuda Carmeli
National Center for Infection Control, Tel Aviv, Israel

CID 2014:58 (1 March) • 697

- 2006: nationwide spread of CRE (*K. pneum* ST-258)
- March 2007: Ministry of Health → guidelines
  - Isolation, cohorting, proactive screening
  - Dedicated nursing
  - Specific guidelines for long term care facilities and post-acute care facilities
  - Guidelines for laboratory detection



Monthly incidence (clinical cultures)



Annual incidence (clinical cultures) and annual incidence of bacteremia

Mitchell J. Schwaber and Yehuda Carmeli
National Center for Infection Control, Tel Aviv, Israel

CID 2014:58 (1 March) • 697

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Changing Trends in Antimicrobial Susceptibility and Hospital Acquired Infections Over an 8 Year Period in a Tertiary Care Hospital in Relation to Introduction of an Infection Control Programme

Ram Gopalakrishnan[1], Dorairajan Sureshkumar[2]

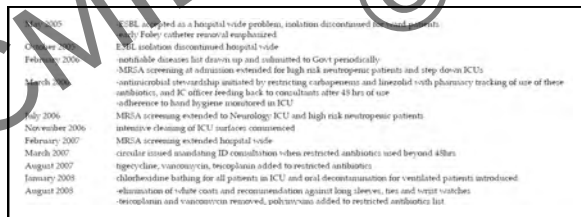
Apollo Speciality Hospital, Chennai, India

- Review of surveillance and hospital antibiogram data 2001-2008
- Documentation of infection control protocols and modifications over the same period

- 65% ESBL production among *E. coli* and *Klebsiella*
- Up to 40% and 70% of *Pseudomonas* and *Acinetobacter* resistant to carbapenems
- MRSA : 40-50% of all *S. aureus* isolates
- VRE and *C.difficile* rare.
- Carbapenem resistance in *Klebsiella* has begun to emerge from 2005
- CRBSI: largely Gram negative with MRSA contributing 6% of all isolates.
- Over the 8 year study period, infection control efforts resulted in reduced CRBSI/VAP rates, fewer MRSA infections and improved sensitivities for *Pseudomonas* but not for other organisms.

April 2001:
- Establishment of IC committee and program
- One ID physician and 3 IC nurses appointed
- Policy on contact isolation for MDRO (MRSA, ESBL, carba res Pseudomonas
- Alcohol dispensers
- Surveillance for central lines and VAP

Successively, more and more IC measures:
- Better gloves, disposable towels, surgical prophylaxis, IC manual, care for IV lines....
- 100 ml handrub dispenser on each bedrail
- .....



- March 2005: ESBL accepted as hospital wide problem, isolation discontinued
- March 2006: antimicrobial stewardship (restriction of carbapenems and linezolid, feedback to consultants on antibiotic use)
- April 2008: elimination of white coats and long sleeves, ties and wrsit watches
- .....

- Over the 8 year study period, infection control efforts resulted in
  - reduced CRBSI/VAP rates,
  - fewer MRSA infections
  - improved sensitivities for *Pseudomonas*
  - no improved sensitivities for other organisms
- Possible explanations:
  - Inadequate adherence to protocols
  - No effective policing of clinicians when antimicrobials were inappropriately used
  - Widespread ESBL in the community
  - Importation from other hospitals

No control group: it is possible that resistance rates may have been even higher without interventions

Conclusion

Impressive efforts are needed for control of MDR Gram negative pathogens, that require an overall concerted approach of infection control measures and antibiotic stewardship

http://www.wip.nl

WERKGROEP INFECTIE PREVENTIE

Dutch Workingparty on Infection Prevention (WIP)

In 1981 the WIP was founded to stimulate infection prevention in the Netherlands. Professionals from four Dutch societies are participating in this working party:

- The Infectious Diseases Society of the Netherlands and Flanders
- The Dutch Society of Medical Microbiology
- The Dutch Society of Microbiology
- The Society for Hygiene and Infection Prevention in Health Care

The aim is to develop and publish up-to-date, scientifically based guidelines for infection prevention in hospitals, nursing homes, institutions for the mentally handicapped, dental care and homecare.

The guidelines are drawn up by special committees that include members of the working group and professionals from the field, who cooperate and advise if necessary.

The guidelines aim at the prevention of infection in patients and in hospital staff and are meant to be a helping hand in the preparation of local guidelines. The guidelines cover a wide range of topics, including general personal hygiene, disinfection and sterilization, tuberculosis and AIDS. Besides these there are guidelines for the prudent use of medical equipment and appliances such as catheters, scopes and nebulizers and guidelines for infection prevention in specific departments in a hospital such as neonatology, operating rooms etc.

The guidelines are considered professional standards and are used as such by the Public Health Inspector.

Besides making guidelines the working party also has an advice centre. This advice centre answers questions on infection prevention and hospital epidemiology either by phone, letter or e-mail.

The guidelines are written in the Dutch and in the English language.

For information you can contact us either by e-mail, telephone, fax or by post.

WERKGROEP INFECTIE PREVENTIE

MRSA Hospital

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WERKGROEP INFECTIE PREVENTIE

Measures to prevent transmission of highly resistant microorganisms (HRMO)

Table of contents

WERKGROEP INFECTIE PREVENTIE

1 Detection of highly resistant microorganisms

HRMO can be identified through microbiological screening of clinical samples, or by searching for it specifically.

It is recommended that HRMO be tested for specifically in the event of admission in a high-risk department, such as the intensive care department. This concerns the following patients:

- patients who were treated in a foreign hospital for more than 24 hours less than 2 months ago, or who underwent surgery or were given a drain or a catheter abroad, or who were intubated, or who have skin lesions or possible sources of infection such as abscesses or furuncles.
- a patient from another Dutch hospital, from a department experiencing an HRMO epidemic that has not yet been brought under control.
- a patient who has been in contact with a patient with HRMO.

Measures to prevent spreading are not only indicated if HRMO has led to infection, but also in the event of colonisation alone.

WERKGROEP INFECTIE PREVENTIE

Table 1: Resistance criteria for isolation of patients with highly resistant *Enterobacteriaceae*

Enterobacteriaceae	ESBL	Quinolones	Aminoglycosides	Carbapenem	Cotrimoxazole
Escherichia coli	A	B*	B*	A	n/a
Klebsiella species	A	B*	B*	A	n/a
Other	A	B*	B*	A	B*

B* = no isolation measures for nursing departments

A. Resistance is an indication for isolation of the patient.

B. Combination of resistance to antibiotics from at least two of the antibiotic groups or drugs specified is an indication for isolation of the patient.

WERKGROEP INFECTIE PREVENTIE

Table 2: Resistance criteria for isolation of patients with highly resistant non-fermenters

Non-fermenters	Ceftazidime	Quinolones	Aminoglycosides	Carbapenem	Piperacillin	Cotrimoxazole
Acinetobacter species	B	B	B	A	n/a	n/a
Stenotrophomonas maltophilia	n/a	n/a	n/a	n/a	n/a	A
Other (including *Pseudomonas aeruginosa*)	C	C	C	C	C	n/a

A. Resistance is an indication for isolation of the patient.

B. Combination of resistance to antibiotics from at least two of the antibiotic groups or drugs specified is an indication for isolation of the patient.

C. Combination of resistance to antibiotics from at least three of the antibiotic groups or drugs specified is an indication for isolation of the patient.

WERKGROEP INFECTIE PREVENTIE

Table 3: Resistance criteria for isolation of patients with highly resistant Gram-positive bacteria

Gram-positive bacteria	Penicillin group	Vancomycin
Streptococcus pneumoniae	A	A
Enterococcus faecium	B	B

A. Resistance is an indication for isolation of the patient.

B. Combination of resistance to antibiotics from at least two of the antibiotic groups or drugs specified is an indication for isolation of the patient.

WERKGROEP INFECTIE PREVENTIE

4.1 The form of isolation

The form of isolation depends on the type of microorganism, the site of infection/colonisation, the department to which the patient has been admitted, and whether or not an outbreak situation exists. The recommended forms of isolation for each HRMO are shown in Table 4. The isolation measures are described in the WIP guideline 'Isolation guidelines' [5].

WERKGROEP INFECTIE PREVENTIE

4.1 The form of isolation

The form of isolation depends on the type of microorganism, the site of infection/colonisation, the department to which the patient has been admitted, and whether or not an outbreak situation exists. The recommended forms of isolation for each HRMO are shown in Table 4. The isolation measures are described in the WIP guideline 'Isolation guidelines' [5].

WERKGROEP INFECTIE PREVENTIE

Table 4: Forms of isolation per highly resistant microorganism

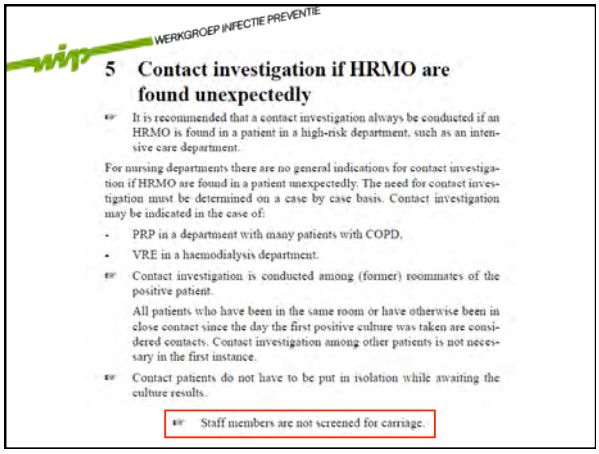
Microorganism	Nursing department, including Intensive Care	Epidemic/outbreak
Enterobacteriacae	contact	contact/droplet in single-patient room or cohort
Acinetobacter species	strict	strict
Stenotrophomonas maltophilia	contact	contact/droplet in single-patient room or cohort
Other non-fermenters (including *Pseudomonas aeruginosa*)	contact	contact/droplet in single-patient room or cohort
Streptococcus pneumoniae	contact/droplet in single-patient room	contact/droplet in single-patient room or cohort
Enterococus faecium	contact in single-patient room	contact in single-patient room or cohort

WERKGROEP INFECTIE PREVENTIE

5 Contact investigation if HRMO are found unexpectedly

- It is recommended that a contact investigation always be conducted if an HRMO is found in a patient in a high-risk department, such as an intensive care department.

→ To determine whether the case is unique or whether cross-infection has occurred
→ To determine the extent of a possible outbreak



WERKGROEP INFECTIE PREVENTIE

5 Contact investigation if HRMO are found unexpectedly

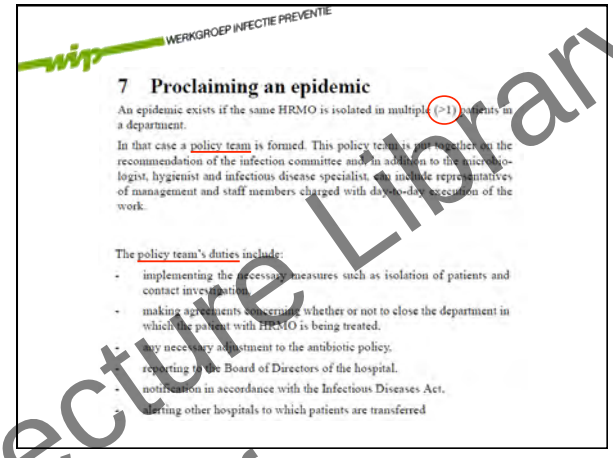
- It is recommended that a contact investigation always be conducted if an HRMO is found in a patient in a high-risk department, such as an intensive care department.

For nursing departments there are no general indications for contact investigation if HRMO are found in a patient unexpectedly. The need for contact investigation must be determined on a case by case basis. Contact investigation may be indicated in the case of:

- PRP in a department with many patients with COPD,
- VRE in a haemodialysis department.

- Contact investigation is conducted among (former) roommates of the positive patient.

  All patients who have been in the same room or have otherwise been in close contact since the day the first positive culture was taken are considered contacts. Contact investigation among other patients is not necessary in the first instance.
- Contact patients do not have to be put in isolation while awaiting the culture results.
- Staff members are not screened for carriage.



WERKGROEP INFECTIE PREVENTIE

7 Proclaiming an epidemic

An epidemic exists if the same HRMO is isolated in multiple (>1) patients in a department.

In that case a policy team is formed. This policy team is put together on the recommendation of the infection committee and in addition to the microbiologist, hygienist and infectious disease specialist, can include representatives of management and staff members charged with day-to-day execution of the work.

The policy team's duties include:

- implementing the necessary measures such as isolation of patients and contact investigation,
- making agreements concerning whether or not to close the department in which the patient with HRMO is being treated,
- any necessary adjustment to the antibiotic policy,
- reporting to the Board of Directors of the hospital,
- notification in accordance with the Infectious Diseases Act,
- alerting other hospitals to which patients are transferred

What to do if an HRMO is detected in a patient transferred from a foreign hospital?

- Depends on your policy for transferred patients!
  - If quarantine (pre-emptive isolation) for screening is routine
    - Keep patient in isolation according to local guidelines
  - If no quarantine for screening is routine

Outbreak management

1. Make a case definition
   - E.g. patient with culture from any site positive with *Klebsiella pneumoniae* with MIC for meropenem > 0.5 mg/L
   - Or: patient with positive blood culture with KPC-producing *K. pneumoniae*
   - Or:.....

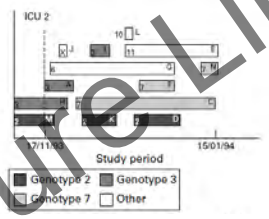
Outbreak management

1. Make a case definition
2. Isolate patients
3. Molecular epidemiology of case strains

Why molecular typing?

Cross-colonisation with *Pseudomonas aeruginosa* of patients in an intensive care unit

Dennis C J J Bergmans, Marc J M Bonten, Frank H van Tiel, Carlo A Gaillard, Siebe van der Geest, Rob M Wilting, Peter W de Leeuw, Ellen E Stobberingh



Colonization of patients in an ICU with *P. aeruginosa* of different genotypes

Nosocomial outbreak of gentamicin-resistant *K. pneumoniae* in a neonatal intensive care unit

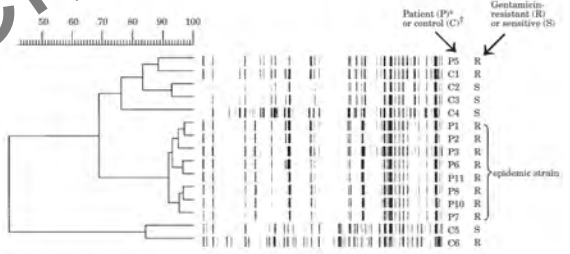


Figure 3 AFLP fingerprints.
* Patient numbers correspond with those in Figure 1.
† C1 = gentamicin-resistant *K. pneumoniae* from Pediatric Intensive Care Unit (November 1997)
C2 = gentamicin-sensitive *K. pneumoniae* from NICU (September 1997)
C3 = gentamicin-sensitive *K. pneumoniae* from NICU (October 1997)
C4 = gentamicin-sensitive *K. pneumoniae* from NICU (January 1997)
C5 = gentamicin-sensitive *K. oxytoca* from NICU (September 1997)
C6 = gentamicin-resistant *K. oxytoca* from NICU (October 1997)

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Outbreak management

1. Make a case definition
2. Isolate patients
3. Molecular epidemiology of case strains
4. Draw epidemic curve

Outbreak of vancomycin-resistant *Enterococcus faecium* in a haematology unit: risk factor assessment and successful control of the epidemic

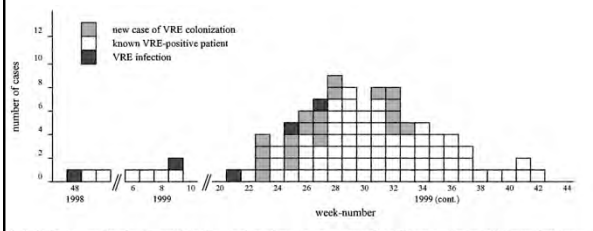

Fig. 1. Epidemic curve, showing the weekly incidence and prevalence of vancomycin-resistant *Enterococcus faecium* (VRE) cases. Each patient present on the ward, known to be VRE positive, is represented by one square.

Timmers et al. *British Journal of Haematology*, 2002, 116, 826–833

Outbreak management

1. Make a case definition
2. Isolate patients
3. Molecular epidemiology of case strains
4. Draw epidemic curve
5. Perform risk factor analysis
   - Case-control study

An outbreak of *Serratia marscecens* in an Intensive Care Unit

- surgical ICU
- profylaxis: selective decontamination of digestive tract (SDD)
- *Serratia* strain resistant to SDD antibiotics (colistine, neomycin, cefuroxime)
- Cases: all patients colonized or infected with outbreak strain
- Controls: random patients on the ICU without *Serratia*

Table III. *Risk factors for acquisition of* S. marcescens

	Cases ($N=7$)	Controls ($N=25$)	Relative risk	95% confidence limits
SDD*	7	17	7·28	0·37–141
Antibiotics†	7	25	0·29	0·01– 16
Corticosteroids	0	1	1·09	0·04– 29
Ventilation‡	7	22	2·33	0·11– 50
Bronchoscopy§	6	5	24·00	2·15–228**
ICU-bronchoscopy¶	6	3	44·00	3·18–502**

* SDD = Selective decontamination of the digestive tract.
† Use of any therapeutic antibiotic during ICU-stay (until colonization with *S. marcescens* for case patients, until discharge for control patients).
‡ Mechanical ventilation.
§ Any bronchoscopy (acute or other).
¶ Acute bronchoscopy.
** $P<0{\cdot}05$.

Nosocomial outbreak of gentamicin-resistant *K. pneumoniae* in a neonatal intensive care unit

- Case-control study → no clear risk factors besides birth weight and gestational age
- Antibiotic policy change: gentamicin replaced by amikacin

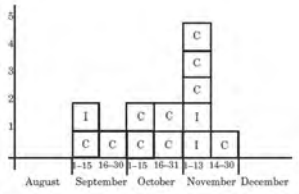

Figure 2 Pattern of the epidemic. Ten neonates became colonized (C) and three infected (I) with gentamicin-resistant *K. pneumoniae*. Change of antibiotic policy began on November 13th.

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