Barriers and facilitators: challenges to implementing infection control bundles
The case of MDR Gram negatives

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Spanish Network for Research in Infectious Diseases (REIPI)
Conflicts of interest

- None for this talk
- Research grants
  - REIPI, Spanish Ministry of Economy
  - COMBACTE, COMBACTE-CARE, COMBACTE-MAGNET. Innovative Medicines Initiative, EU and EFPIA
Outline

• Barriers
  – Evidence
  – Epidemiological complexity
  – Applicability

• Facilitators
  – Positive experiences
  – Epidemiological knowledge
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Looking for evidence in infection control

Hierarchy in the design of studies

– Randomized cluster trials
– Quasiexperimental designs
  • Interrupted time series
  • Before-after
– Outbreaks reports
Randomisation

Drug A

Drug B

Non-differential bias

Studies on screening/contact precautions/isolation if patients or their close surfaces are not a key reservoir
Infection control

Hospital wide, clonal ESBL-producing *K. pneumoniae*

Calbo et al, Clin Infect Dis 2011
Positive environmental samples in kitchen

Calbo et al, Clin Infect Dis 2011
Outbreak of Extended-Spectrum β-Lactamase–producing *Klebsiella oxytoca* Infections Associated with Contaminated Handwashing Sinks

Christopher Lowe, Barbara Willey, Anna O’Shaughnessy, Wayne Lee, Ming Lum, Karen Pike, Cindy Larocque, Helen Dedier, Lorraine Dales, Christine Moore, Allison McGeer, and the Mount Sinai Hospital Infection Control Team

Reinforcement of infection control practices, screening + contact precautions

Attempts to decontaminate sinks

Daily sink cleaning

2x daily sink cleaning

3x daily sink cleaning

Audit + reinforcement of sink cleaning #1

Audit + reinforcement of sink cleaning #2

Audit + reinforcement of sink cleaning #3

Antimicrobial stewardship program

Sink drain modifications (see text)

Reinforcement of active screening

Emerg Infect Dis 2012
Wastewater drainage system as an occult reservoir in a protracted clonal outbreak due to metallo-β-lactamase-producing Klebsiella oxytoca

Main reservoir: patients

Main reservoir: environment

Eradication of an extensive outbreak in a neonatal unit caused by two sequential *Klebsiella pneumoniae* clones harbouring related plasmids encoding an extended-spectrum β-lactamase

C. Velasco a,*; J. Rodríguez-Baño b; L. García b; P. Díaz a; C. Lupión b; L. Durán c; A. Pascual a,d


![Graph showing colonization and bacteremia of two clones over weeks](image-url)
Randomisation

Drug A

Placebo

Differential bias against Drug A

Studies on screening/contact precautions/isolation if adherence to measures is lower than predicted
• Evidence-based approach
  vs
• Epidemiology based approach
Outline

• Barriers
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Multidrug-resistant Acinetobacter baumannii

Aharon Abbo,* Shiri Navon-Venezia,* Orly Hammer-Muntz,* Tami Krichali,* Yardena Siegman-Igra,* and Yehuda Carmeli*

Emerging Infectious Diseases • www.cdc.gov/eid • Vol. 11, No. 1, January 2005

Despite the large number of cases that we identified, we were unable to understand the mode of spread and the reason for emergence of these organisms in our institution.
In conclusion, the identification and surveillance of MBL-PA isolates should not be considered trivial. The difficulty of their identification in an outbreak setting, or in an endemic setting with a low attack rate, requires a high index of suspicion and the systematic inclusion of DDST and genotyping studies in nosocomial surveillance programmes for multiresistant P. aeruginosa.
Multilevel epidemiology

Patient/setting

Microorganism/clone

Mobile genetic element

bla genes
Transmission mechanisms

• Direct contact (person to person)
  – *E. coli*: households (+++), LTCF (++) , hospitals (+/-)
  – *K. pneumoniae*: hospitals (+++), LTCF (++)

• Indirect contact (environmental contamination)
  – *K. pneumoniae* in hospitals

• Food
  – *E. coli, Salmonella* (but one nosocomial outbreak due to *K. pneumoniae*)

Tracking a Hospital Outbreak of Carbapenem-Resistant Klebsiella pneumoniae with Whole-Genome Sequencing

Evan S. Snitkin,1 Adrian M. Zelazny,2 Pamela J. Thomas,1 Frida Stock,2 NISC Comparative Sequencing Program,3 David K. Henderson,2 Tara N. Palmore,2* Julia A. Segre1*

Science Translational Medicine 2012
Outline

• Barriers
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• Facilitators
  – Positive experiences
  – Epidemiological knowledge
### Table of Reservoirs and Prevention Strategies

<table>
<thead>
<tr>
<th>Reservoir:</th>
<th>MRSA</th>
<th>VRE</th>
<th>ESBL Ec</th>
<th>ESBL Kp</th>
<th>MRD Pae</th>
<th>MDR Abau</th>
<th>Smalto</th>
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<tbody>
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</table>

**Screening, decolonisation**

**Cleaning, search for reservoirs**

**Hand hygiene, contact precautions**

**Antibiotic stewardship**
ESCMIID Guidelines
Control of MDR Gram negatives
ESBL-producing *Enterobacteriaceae*, non-epidemic situation

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Recommendation ESBL-E</th>
<th>Recommendation MDR-Kp</th>
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<tbody>
<tr>
<td>Hand hygiene</td>
<td>Strong</td>
<td>Strong</td>
</tr>
<tr>
<td>Contact precaution (except <em>E. coli</em>)</td>
<td>Strong</td>
<td>Strong</td>
</tr>
<tr>
<td>Alert code and pre-emptive CP (except <em>E. coli</em>)</td>
<td>Conditional</td>
<td>Conditional</td>
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<tr>
<td>Isolation room (with the exception of <em>E. coli</em>)</td>
<td>Conditional</td>
<td>Strong</td>
</tr>
<tr>
<td>Education</td>
<td>Conditional</td>
<td>Conditional</td>
</tr>
<tr>
<td>Environmental cleaning</td>
<td>Conditional</td>
<td>Conditional</td>
</tr>
<tr>
<td>Antimicrobial stewardship</td>
<td>Strong</td>
<td>Conditional</td>
</tr>
</tbody>
</table>

Tacconelli et al. Clin Microbiol Infect 2014
**ESCMIID Guidelines**

**Control of MDR Gram negatives**

**ESBL-producing *Enterobacteriaceae*, outbreak situation (1)**

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</tr>
<tr>
<td>Active screening</td>
<td>Strong</td>
<td>Strong</td>
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<tr>
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<td>Strong</td>
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<td>Alert code and pre-emptive CP (except <em>E. coli</em>)</td>
<td>Strong</td>
<td>Strong</td>
</tr>
<tr>
<td>Cohort patients and staff</td>
<td>Conditional</td>
<td>Conditional</td>
</tr>
<tr>
<td>Isolation room</td>
<td>Strong</td>
<td>Strong</td>
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<td>Education</td>
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ESCMID Guidelines: Control of MDR Gram negatives

**ESBL-producing *Enterobacteriaceae*, outbreak situation (1)**

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</tr>
<tr>
<td>Isolation room</td>
<td>Strong</td>
<td>Strong</td>
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<tr>
<td>Education</td>
<td>Strong</td>
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## ESCMID Guidelines

Control of MDR Gram negatives

ESBL-producing *Enterobacteriaceae*, outbreak situation (2)

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Recommendation ESBL-E</th>
<th>Recommendation MDR-Kp</th>
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<tr>
<td>Environmental cleaning</td>
<td>Strong</td>
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</tr>
<tr>
<td>Environmental screening</td>
<td>Conditional</td>
<td>Conditional</td>
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<tr>
<td>Antimicrobial stewardship</td>
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<tr>
<td>HCW screening</td>
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<td>Clorhexidine</td>
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Tacconelli et al. Clin Microbiol Infect 2014
## Bundle

<table>
<thead>
<tr>
<th>Measure</th>
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<tbody>
<tr>
<td>Hand hygiene</td>
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<tr>
<td>Contact precautions</td>
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<tr>
<td>Active screening</td>
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<tr>
<td>Environmental disinfection/cleaning</td>
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<tr>
<td>Antimicrobial stewardship</td>
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<td>Education</td>
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## Bundle

<table>
<thead>
<tr>
<th>Measure</th>
<th>Doubts</th>
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<tbody>
<tr>
<td>Hand hygiene</td>
<td>All wards?</td>
</tr>
<tr>
<td></td>
<td>Lower threshold?</td>
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<tr>
<td>Contact precautions</td>
<td>Isolation? Cohorting?</td>
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<tr>
<td></td>
<td>All MDR GNs? Needed at all?</td>
</tr>
<tr>
<td>Active screening</td>
<td>Needed? All microorganisms?</td>
</tr>
<tr>
<td></td>
<td>Universal? Targeted?</td>
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<tr>
<td>Environmental disinfection/cleaning</td>
<td>Surfaces, mobile objects?</td>
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<tr>
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<td>Hidden reservoirs?</td>
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<tr>
<td>Antimicrobial stewardship</td>
<td>Which drugs?</td>
</tr>
<tr>
<td></td>
<td>In which situations?</td>
</tr>
<tr>
<td>Education</td>
<td>To whom?</td>
</tr>
<tr>
<td></td>
<td>How?</td>
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</tbody>
</table>
“Standard bundle”: assumptions

• Expected epidemiological behaviour
• High adherence
• Staffing, structure
Are all wards/hospitals the same?
THE CHECKLIST

If something so simple can transform intensive care, what else can it do?

BY ATUL GAWANDE
Hospitals as amplifiers of community (undetected) problems

Admission of colonised patients (community, other hospitals)

HOSPITALS
High risk patients
High opportunities for transmission
High antibiotic exposure
Inadequate infection control

Transmission
McKenna, Nature 2013

Systematic review of the effectiveness of infection control measures to prevent the transmission of carbapenemase-producing Enterobacteriaceae through cross-border transfer of patients
Outline

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Long-term control of hospital-wide, endemic multidrug-resistant Acinetobacter baumannii through a comprehensive “bundle” approach

Published

Unpublished

Bundle:
- Education and feedback
- Active screening in areas with transmission
- Isolation
- Cleaning

Am J Infect Control 2009
Containment of a Country-wide Outbreak of Carbapenem-Resistant *Klebsiella pneumoniae* in Israeli Hospitals via a Nationally Implemented Intervention

Mitchell J. Schwaber,1 Boaz Lev,2 Avi Israeli,2 Ester Solter,1 Gill Smollan,1 Bina Rubinovitch,1 Itamar Shalit,1 Yehuda Carmeli,1 and the Israel Carbapenem-Resistant Enterobacteriaceae Working Group

1National Center for Infection Control, Israel Ministry of Health, Tel Aviv, and 2Israel Ministry of Health, Jerusalem, Israel

Clinical Infectious Diseases 2011;52(7):848–855

Active screening
Contact precautions
“If you know the enemy and know yourself, you need not fear the result of a hundred battles. If you know yourself but not the enemy, for every victory gained you will also suffer a defeat. If you know neither the enemy nor yourself, you will succumb in every battle.”
Acknowledgements

• Hospital Macarena Infection Control and Antimicrobial Stewardship teams
  – A Pascual, L López-Cerero, MD del Toro, J López, G Ramírez, C Lupión, C González, D Martín, C García-Briz
  – P Retamar, M de Cueto, S Sandoval, M Beltrán, M Núñez, P Terol, A Arenzana

• REIPI, COMBACTE investigators