The Multi-Resistant Organism Alphabet Soup
Common Sense from the Chaos

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Disclosure

Jim is employed by Diversey. His expenses to attend this meeting (travel, accommodation, and salary) are paid by this company. Diversey has had no input into this presentation from a commercial interest.
Objectives

Review MSRA, VRE, CDI, ESBL and CRE
Discuss screening, illnesses
Take a look at spread within our healthcare facilities
Methicillin Resistant *Staphylococcus aureus*

Still just a Staph bug which can cause boils, abscesses, wound infections, or just colonize body areas

Has developed resistance to cloxacillin (methicillin is a British term)

Regular *Staph. aureus* will be in 30 - 40 % of noses in this room
Penicillin

Beta lactam ring
Penicillin

Methicillin
All Staphylococcus species

Spread by contact with infected secretions or colonized skin or environmental surfaces
Easily killed with hospital disinfectants
Easily washed off of hands!
Staph

Still one of the leading causes of sepsis in hospitals
>95% are now resistant to Penicillin

• Yawn-able in most hospitals, clinics, etc.
Figure 3A: Regional MRSA rates, CNISP 1995 to 2009 (per 1,000 patient-admissions)
ECDC 2012 Data

This report has been generated from data submitted to TESSy, The European Surveillance System on 2014-07-16. The report reflects the state of submissions in TESSy as of 2014-07-15 at 16:30.
Vancomycin Resistant Enterococci

Gram positive cocci

*Enterococcus faecalis, Enterococcus faecium*
- Have acquired new genes for resistance

*E. casselilavus, E. gallinarum*
- Can be intrinsically resistant to vancomycin
- Not tracked
Enterococci

Enterococci are normal flora in the gut, and female genital tract.

Enterococci can cause disease, but these are not a common occurrence in the hospital.

Can make up over half the flora of feces.

One microgram of feces can contain one million organisms!
VRE

First seen in 1986, reported in 1988 (Uttley 1988)

• Cluster, probably related to the use of Vancomycin and Ceftazidime as treatment of acute undiagnosed sepsis

Spread went worldwide

http://www.chromagar.com/clinical-microbiology-chromagar-vre-focus-on-vre-29.html#.VAtoMGMkU3U
Enterococci

Survive on environmental surfaces (up to 7 days)
• One study was 42 days on a bench!
Rides around on hands, bed rails, thermometers, equipment.
Ends up in the environment through poor handling of feces
VRE

Colonize patients in 98% of cases
Not harmful in healthy people
No more capable of causing disease than other enterococci
Killed by hospital grade disinfectants
Easily washed off of hands!
VRE Around the World

East Asia and the Pacific
• 1992 Korea
• 1996 Japan

Europe and Central Asia
• 1996 Poland
• 2001 Turkey
• 2004 Serbia (reported in article)

(Mir 2010)
VRE Around the World

Latin America and Caribbean
• 1996 Brazil
• 1996 Argentina
• 1998 Columbia
• 2000 Peru
• 2001 Ecuador

en.wikipedia.org
VRE Around the World

Middle East and North Africa
- ~2002 Iran
- ~1999 Egypt
- ~2001 Kuwait

South Africa
- 1999
Clostridium difficile

First identified in culture in 1935
First reported as cause of pseudomembranous colitis in 1974
Has toxin mediated issues
Spore allows long environmental survival
  (Bartlett 1994)
**C. difficile**

Anaerobic Gram positive rod

Relative of *C. perfringens, C. tetani*

Has that spore that can survive harsh environmental conditions

Not truly an antibiotic resistant organism

- Treatment failures being seen and reasons being sought
**C. difficile**

Carried as normal flora in half of all healthy neonates, up to about 2 years old

4% of healthy adults may carry organism asymptomatically

Has been found in sand; hay; soil; dung of horses, cows, donkeys, dog (50%), cat, rodents, and humans
Spores
**Clostridium difficile** Spores

Resistant to heat and cold
- Can be boiled, frozen

Resistant to drying and UV radiation

Resistant to most chemicals
- Need ‘sporicidal’ to kill
- Chlorine, Hydrogen Peroxide, Peracetic acid

Can be easily washed off
VRE versus *C. difficile*

VRE just add regular disinfectant
Different Disinfectants

C. diff just add regular disinfectant
QUARTERLY COUNTS OF *C. DIFFICILE*
INFECTION BY AGE AND NHS TRUST Public Health England
The Canadian Nosocomial Infection Surveillance Program

*Clostridium difficile* Associated Disease (CDAD) Surveillance

Healthcare-Associated-*Clostridium difficile* Infection (HA-CDI) 2007 - 2011
## Number of Healthcare-Associated-*Clostridium difficile* infection cases and incidence rates per 1,000 patient admissions by type of facility

<table>
<thead>
<tr>
<th>Type of Facility</th>
<th>Adult and mixed sites</th>
<th>Pediatric stand-alone sites</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.cases</td>
<td>Rate</td>
<td>No.cases</td>
</tr>
<tr>
<td>2007</td>
<td>3,207</td>
<td>4.61</td>
<td>64</td>
</tr>
<tr>
<td>2008</td>
<td>2,816</td>
<td>5.66</td>
<td>97</td>
</tr>
<tr>
<td>2009</td>
<td>2,164</td>
<td>4.95</td>
<td>81</td>
</tr>
<tr>
<td>2010</td>
<td>2,570</td>
<td>4.69</td>
<td>102</td>
</tr>
<tr>
<td>2011</td>
<td>3,053</td>
<td>5.65</td>
<td>128</td>
</tr>
</tbody>
</table>

Adult and mixed sites are comprised of hospitals that provide services to both adult and pediatric patients. Typically, the pediatric patients represent less than 10% of the hospital population.


**Clostridium difficile Carriers**

Can play a role in transmission of CDI (Alfa 2010, Curry 2013)

Must handle feces

• Consistently!

• With respect!
ESBL

What is it?
Extended Spectrum Beta Lactamase

So?
• Many antibiotics have a beta lactam ring in them
  – Penicillins, Cephalosporins
ESBL

A beta lactamase is an enzyme produced by an organism that breaks the beta lactam ring, rendering the antibiotic useless against that bacteria.

We developed beta lactamase inhibitors (e.g. clavulanic acid) to overcome this problem.

We developed antibiotics that were more resistant to the beta lactamases (third generation cephalosporins).
ESBL

Now we have extended spectrum Beta Lactamase is rendering some of these antibiotics useless. The gene is carried on a plasmid, a mobile piece of genetic material. We can name them (TEM, SHV to name just a few).
ESBL

It seems that the plasmid can be transmitted without a bacteria wrapped around it or get transferred between bacteria

Being seen in more and more bacteria (*Proteus mirabilis*, Enterobacter, Serratia, Citrobacter, etc.)
Gram Negative Resistance

South America
• 2004 ESBL  *E. coli* Bolivia and Peru

Latin America
• 1997-2000 ESBL  *E. coli* (6.7%) *K. pneumo* (47.3%)

Carbapenem Resistance
• Turkey, Brazil, Columbia and Taiwan (2005-2007) (Mir 2010)
ESBL

As this ESBL makes almost all the cephalosporins useless, we must turn to imipenem, aminoglycosides, Septra, etc. to treat infections.

Many times this gene seems to get “turned on”, the patient starts to get better, then relapses.
ESBL and Infection Control

There have been outbreaks with these organisms, usually in ICU’s or LTC facilities.

LTC facilities are thought to be the reservoirs for the organisms.

Outbreak in Durham region of Ontario 2000. *E. coli* still present in nursing home, still seeing infections with the outbreak strain.
CRE / CPE

CRE: Carbapenem Resistant Enterobacteriaceae
CPE: Carbapenemase Producing Enterobacteriaceae
CPO: Carbapenemase producing Organisms
Antibiotics include Imipenem, Meropenem, Ertopenem, Doripenem
CRE

Resistant to carbapenems
May be various mechanisms for this resistance
CPE

Produces an enzyme (carbapenemase) rendering the carbapenems inactive

Enterobacteriaceae usually *E. coli* and *Klebsiella pneumonia* (Serratia, Enterobacter)

New Delhi Metallo-betalactamase one of the first recognized (NDM)

*Klebsiella pneumonia* carbapenemase (KPC) (originated in US)
CPO

Have the enzyme, but include Acinetobacter and Pseudomonas species
Many of the organisms are resistant to almost all antibiotics
Trying colistin, chloramphenicol
Not many new antibiotics coming soon
Screening

MRSA: in another healthcare facility in previous 12 months
• Nares, and possibly perianal, axilla, wound

VRE: under review in province
• PIDAC vs. 4 breakaway hospitals

CDI: no screening performed
• Quick isolation of patients with diarrhea
Screening

ESBL: varies around province
CRE: from high risk areas of world
• Issues with media to use
STOP THE SPREAD OF GERMS!
FOLLOW THESE SIMPLE RULES!

IN THE WORKPLACE:

1. Avoid bare skin-to-skin contact! Shake hands using a stick.

IN THE RESTROOM:

1. Avoid contact with the faucet. Wash hands wearing gloves.
Back to Basics

All of these organisms can be fecal organisms (including MRSA)
Spread seems to be rapid within facilities
Bed Pan Washing

- Pipe or wand on back of toilet
- Still some in general use
- Huge risk of splashing
- Only rinses pan, no disinfection
Clostridium Difficile Infection

Infection Prevention and Control Guidance for Management in Acute Care Settings
1. Organizational Controls

a) Engineering Measures

iv. To avoid contamination of the environment with *C. difficile* spores, systems should be in place to manage the disposal of fecal matter when bedpans or commodes are required. Some options for consideration are:

- Installation of bedpan washers/disinfector systems on patient units;
- Utilization of disposable bedpans for patients with acute diarrhea and the installation of macerator systems for the disposable bedpans.
12. Management of Fecal Matter

When bedpans and commodes are required:

• Bedpans and commodes should be handled in such a way as to avoid contamination of the environment with *C. difficile* spores;

• Spray wands for cleaning bedpans and commode pans/buckets should not be used.

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Rutala 2008
Flushing- and Washer-Disinfectors

- manual cleaning is eliminated, fewer disposable items are needed, and fewer chemical germicides are used.
- These machines are available and used in many European countries.
Use of WD (%)

- Netherlands and Belgium: 100%
- USA, Canada: 32%
- West Europe: 97%
- South- and East-Europe: 34%
- Asia, Africa, Latin-America, Middle east: 24%
- Australia, New Zealand: 83%

Survey 2010  Bedpan management KNIP Consultancy Infection Prevention www.info@knip-consult.eu
What Are We Seeing?

Outbreaks of some ‘marker’ organisms

Google Scholar:

- CDI – 358,000
- CRE – 37,200
- VRE – 106,000
What Are We NOT Seeing?

Focus on the importance of incontinence

- Most articles reviewed do not indicate continent/incontinent
- None indicate how patient toilets
HICPAC


No mention of bedpans, washer-disinfector
v) washer-disinfectors are strongly recommended for medical equipment / devices that can withstand mechanical cleaning, to achieve the required exposure for cleaning and to reduce potential risk to personnel:

• washer-disinfectors must meet the requirements of the CSA
Patients

Patient hand hygiene
• Stopped almost all nosocomial infections (Gagne 2010)

Indication of patients who require assistance with hand hygiene
• “Help Wanted: With Hand Hygiene!”
Summary

New acronyms will be coming as we overuse antibiotics, and new pathogens emerge
• MERS CoV, EHF, C. auris, Zika

Look at the reservoir
Look at mode of transmission from reservoir to portal of entry of susceptible host
References


Gagne D, Bedard G, Maziaide PJ. Systematic patients’ hand disinfection: impact on meticillin-resistant Staphylococcus *aureus* infection rates in a community hospital. JHI 2010;75:269-272

Mir F, Zaidi A. Hospital infections by antimicrobial-resistant organisms in developing countries. Antimicrobial Resistance in Developing Countries. Springer New York, 2010

Public Health England. Results from the mandatory reporting of *Clostridium difficile* reporting scheme.
Accessed August 25, 2017
