Epidemiologically Important Pathogens are everywhere
Disclaimer

Disclosures: Employee of Clorox HealthCare and a volunteer with the Cdiff Foundation.

Views expressed are those of the presenter and do not necessarily reflect the organizations I belong too.
APRIL - JUNE 2018 REPORTS TO ProMED
Pathogens are Everywhere

- *Clostridioides difficile*
- Carbapenem-resistant *Enterobacteriaceae* (CRE)
- Drug-resistant *Neisseria gonorrhoeae*
- Multidrug-resistant *Acinetobacter*
- Drug-resistant *Campylobacter*
- Fluconazole-resistant *Candida*
- Extended-spectrum Beta-lactamase producing *Enterobacteriaceae*
- Vancomycin-resistant *Enterococcus* (VRE)
- Multidrug-resistant *Pseudomonas aeruginosa*
- Drug-resistant non-typhoidal *Salmonella*
- Drug-resistant *Salmonella* Serotype Typhi
- Drug-resistant *Shigella*
- Methicillin-resistant *Staphylococcus aureus* (MRSA)
- Drug-resistant *Streptococcus pneumoniae*
- Drug-resistant Tuberculosis

Source Stats and images https://www.cdc.gov/drugresistance/biggest_threats.html
Healthcare Facilities

*Clostridioides difficile*

- CPE
- C. Auris
- VRE

- MDR Pseudomonas
- MRSA
- Strep Pneumo

Source Stats and images https://www.cdc.gov/drugresistance/biggest_threats.html
MDR TB

MDR Salmonella

MDR Neisseria gonorrhoeae

MDR Campylobacter

Infections per year 2,000
Infections per year 100,000

Infections per year: 246,000

Drug-resistance infections per year: 310,000

Source Stats and images https://www.cdc.gov/drugresistance/biggest_threats.html
<table>
<thead>
<tr>
<th>Urgent Threats</th>
<th>Serious Threats</th>
<th>Concerning Threats</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Clostridioides difficile</em></td>
<td><em>Multidrug-resistant Acinetobacter</em></td>
<td><em>Vancomycin-resistant Staphylococcus aureus (VRSA)</em></td>
</tr>
<tr>
<td><em>Carbapenem-resistant Enterobacteriaceae (CRE)</em></td>
<td><em>Drug-resistant Campylobacter</em></td>
<td><em>Erythromycin-Resistant Group A Streptococcus</em></td>
</tr>
<tr>
<td><em>Drug-resistant Neisseria gonorrhoeae</em></td>
<td><em>Fluconazole-resistant Candida</em></td>
<td><em>Clindamycin-resistant Group B Streptococcus</em></td>
</tr>
<tr>
<td></td>
<td><em>Extended-spectrum Beta-lactamase producing Enterobacteriaceae</em></td>
<td></td>
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<td></td>
<td><em>Vancomycin-resistant Enterococcus (VRE)</em></td>
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<td></td>
<td><em>Drug-resistant Tuberculosis</em></td>
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</table>

**WHAT ACCOUNTS FOR MOST INFECTIONS?**
Streptococcus pneumoniae

Challenges

1. Widespread overuse of antibiotics
2. **Spread** of resistant strains
3. Underuse of the **vaccine** (PPSV23) recommended for adults at increased risk
4. Lack of adoption by some **clinical laboratories of standard** methods (NCCLS guidelines) for identifying and defining DRSP
5. Lack of **vaccine** availability to protect against all strains of pneumococcus

C. Auris
Rapid Emergence Since 2009
COUNTRIES WITH
- Multiple cases of Candida auris infection
- One reported case

UNITED STATES
The country has had at least 567 Candida auris infections since 2013.

CENTRAL AND SOUTH AMERICA
The first documented outbreak in the Americas was from 2012–13 at a medical center in Venezuela. Five of 18 infected patients died.

SOUTH AFRICA
A genetically distinct strain of Candida auris in South Africa infected at least 451 patients from 2012–18.

EUROPE
The first large outbreak in Europe involved 72 cases in a London hospital in 2015–16.

INDIA AND PAKISTAN
The two countries have some of the highest case counts in the world. A distinct strain appeared in Pakistan as early as 2008 and in Delhi by 2009.

JAPAN
Candida auris (left) was discovered in 2009 in the infected ear of a 70-year-old Japanese woman.

By The New York Times | Sources: Centers for Disease Control and Prevention; Emerging Infectious Diseases; Emerging Microbes & Infections; Clinical Infectious Diseases; Journal of Infection; Mycoses; Doherty Institute. Image from Kazuo Sato et al., Microbiology and Immunology
Detect

Protect

Interim Guide for Infection Prevention and Control of *Candida auris*

January 2019
Honorable Mention and Timely
Measles case distribution by month and WHO Region (2015-2019)

Notes: Based on data received 2019-03 - Data Source: IVB Database - This is surveillance data, hence for the last month(s), the data may be incomplete.
Measles cases: Canada

Canada age distribution, vaccination status, and incidence, 2018-02 to 2019-01

Incidence rate per 1,000,000

Year | Confirmed Cases
--- | ---
2008 | 62
2009 | 14
2010 | 99
2012 | 9
2013 | 83
2014 | 418
2015 | 196
2016 | 11
2017 | 45
2018 | 29
2019 | 14
Cases of Acute Flaccid Paralysis detected in Canada between January 1, 2018 to present

AFM is a type of acute flaccid paralysis, or AFP. Canada monitors for cases of AFP as a part the World Health Organization surveillance efforts. On average, there are between 27-51 cases of AFP reported annually in Canada.

As of 03/06/2019

<table>
<thead>
<tr>
<th>Cases Being Investigated</th>
<th>Confirmed Cases</th>
<th>Total cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>28</td>
<td>49</td>
<td>77</td>
</tr>
</tbody>
</table>
WHEN MEDICAL EQUIPMENT TRAVELS
Mycobacterium chimaera Infections Associated With Contaminated Heater-Cooler Devices for Cardiac Surgery: Outbreak Management

Alexandre R. Marra, Daniel J. Diekema, and Michael B. Edmond

Infection Control & Hospital Epidemiology (2019), 40, 171–177
doi:10.1017/ice.2018.319

Original Article

Molecular analysis of bacterial contamination on stethoscopes in an intensive care unit


1Pulmonary, Allergy and Critical Care Division, Department of Medicine, University of Pennsylvania Perelman School of Medicine, Philadelphia, Pennsylvania,
2Department of Microbiology, University of Pennsylvania Perelman School of Medicine, Philadelphia, Pennsylvania,
3Division of Infectious Diseases, University of Pennsylvania Perelman School of Medicine, Philadelphia, Pennsylvania,
4Department of Pediatrics, University of Pennsylvania Perelman School of Medicine, Philadelphia, Pennsylvania and
5The Children’s Hospital of Philadelphia, Philadelphia, Pennsylvania
Detect

Protect

CPE in DRAINS
This leads us to the conclusion that hospital ward design contributes to infection control measures.

The Hospital Water Environment as a Reservoir for Carbapenem-Resistant Organisms Causing Hospital-Acquired Infections—A Systematic Review of the Literature


Over the last 20 years there have been 32 reports of carbapenem-resistant organisms in the hospital water environment, with half of these occurring since 2010. The majority of these reports have described associated clinical outbreaks in the intensive care setting, affecting the critically ill and the immunocompromised. Drains, sinks, and faucets were most frequently colonized, and Pseudomonas aeruginosa the predominant organism. Imipenemase (IMP), Klebsiella pneumoniae carbapenemase (KPC), and Verona integron-encoded metallo-β-lactamase (VIM) were the most common carbapenemases found. Molecular typing was performed in almost all studies, with pulse field gel electrophoresis being most commonly used. Seventy-two percent of studies reported controlling outbreaks, of which just more than one-third eliminated the organism from the water environment. A combination of interventions seems to be most successful, including reinforcement of general infection control measures, alongside chemical disinfection. The most appropriate disinfection method remains unclear, however, and it is likely that replacement of colonized water reservoirs may be required for long-term clearance.

Keywords: carbapenem-resistant; carbapenemase; healthcare-associated infections; outbreak; water.
### Table 2. Water Reservoirs Containing Carbapenem-Resistant Organisms

<table>
<thead>
<tr>
<th>Water Reservoir</th>
<th>Studies, No. (N = 32)</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drains/drainage systems</td>
<td>17</td>
<td>Peña et al [35], Kotsanas et al [26], La Forgia et al [28], Betteridge et al [7], Leitner et al [20], Wendel et al [29], Breathnach et al [21], Leung et al [24], Snitkin et al [22], Tofteland et al [32], Vergara-López et al [33], Yomoda et al [9], Stjarne Aspelund et al [12], Odom et al [11], Knoester et al [25], Landelle et al [37], Seara et al [34]</td>
</tr>
<tr>
<td>Sink surfaces</td>
<td>14</td>
<td>Betteridge et al [7], Wendel et al [29], Knoester et al [25], Podnos et al [23], Wang et al [27], Biswal et al [8], Hong et al [30], Bukholm et al [31], Kouda et al [38], Landelle et al [37], Dewi et al [10], Kaiser et al [13], Ito et al [14], Leung et al [24]</td>
</tr>
<tr>
<td>Faucets</td>
<td>8</td>
<td>Odom et al [11], Knoester et al [25], Majumdar et al [17], Pitten et al [36], Hong et al [30], Bukholm et al [31], Alter et al [15], Leung et al [24]</td>
</tr>
<tr>
<td>Water</td>
<td>3</td>
<td>Knoester et al [25], Ambrogi et al [18], Bukholm et al [31]</td>
</tr>
<tr>
<td>Inflatable hair wash basin</td>
<td>2</td>
<td>Wendel et al [29], Knoester et al [25]</td>
</tr>
<tr>
<td>Sensor mixer taps</td>
<td>1</td>
<td>Durojaiye et al [16]</td>
</tr>
<tr>
<td>Water/tea dispenser</td>
<td>2</td>
<td>Wong et al [19], Ito et al [14]</td>
</tr>
<tr>
<td>Shower/shower equipment</td>
<td>3</td>
<td>Betteridge et al [7], Leung et al [24], Seara et al [34]</td>
</tr>
<tr>
<td>Toilet bowl/brush</td>
<td>2</td>
<td>Breathnach et al [21], Kouda et al [38]</td>
</tr>
</tbody>
</table>

*aSome studies had multiple water reservoirs, so categories are not mutually exclusive.*
Spread from the Sink to the Patient: In Situ Study Using Green Fluorescent Protein (GFP)-Expressing Escherichia coli To Model Bacterial Dispersion from Hand-Washing Sink-Trap Reservoirs

Shireen Kotay, a Weidong Chai, a William Guilford, b Katie Barry, a Amy J. Mathers a,c

Division of Infectious Diseases and International Health, Department of Medicine, University of Virginia Health System, Charlottesville, Virginia, USA; Department of Biomedical Engineering, University of Virginia, Charlottesville, Virginia, USA; Division of Infectious Diseases and International Health, Department of Medicine, University of Virginia Health System, Charlottesville, Virginia, USA; Clinical Microbiology, Department of Pathology, University of Virginia Health System, Charlottesville, Virginia, USA

FIG 4 Layout of the sink gallery comprising the 5 sink modules and the associated plumbing.
Spread from the Sink to the Patient: *In Situ* Study Using Green Fluorescent Protein (GFP)-Expressing *Escherichia coli* To Model Bacterial Dispersion from Hand-Washing Sink-Trap Reservoirs

Shireen Kotay, a Weidong Chai, a William Gulford, b Katie Barry, a Amy J. Mathers a,c

Division of Infectious Diseases and International Health, Department of Medicine, University of Virginia Health System, Charlottesville, Virginia, USA; Department of Biomedical Engineering, University of Virginia, Charlottesville, Virginia, USA; Clinical Microbiology, Department of Pathology, University of Virginia Health System, Charlottesville, Virginia, USA.

FIG 5 (a) Parts of the sink drain line: 1, faucet and handles; 2, sink counter; 3, strainer; 4, tailpipe; 5, sampling ports; 6, trap arm; 7, P-trap. (b and c) Schematic of the nutrient regimen (b) and offset drain tailpiece used for dispersion experiments (c).
Spread from the Sink to the Patient: In Situ Study Using Green Fluorescent Protein (GFP)-Expressing Escherichia coli To Model Bacterial Dispersion from Hand-Washing Sink-Trap Reservoirs

Shireen Kotay, Weidong Chai, William Gulliford, Katie Barry, Amy J. Mathers
Division of Infectious Diseases and International Health, Department of Medicine, University of Virginia Health System, Charlottesville, Virginia, USA

Department of Biomedical Engineering, University of Virginia, Charlottesville, Virginia, USA
Clinical Microbiology, Department of Pathology, University of Virginia Health System, Charlottesville, Virginia, USA

FIG 6 (a) Layout of the zones of the sink counter, bowl, and extension surface designated to monitor droplet dispersion and (b) layout of the TSA plates used for GFP-expressing E. coli droplet dispersion on the surfaces surrounding the sink.
Brief Report

The relevance of sink proximity to toilets on the detection of *Klebsiella pneumoniae* carbapenemase inside sink drains

Blake W. Buchan PhD, D(ABMM) a,*, Mary Beth Graham MD b, Jill Lindmaier-Snell RN, MSN, CIC d, Jennifer Arvan BSN, RN d, Nathan A. Ledeboer PhD, D(ABMM) a, Rahul Nanchal MD c, L. Silvia Munoz-Price MD, PhD b

a Department of Pathology, The Medical College of Wisconsin, Milwaukee, WI
b Division of Infectious Diseases, The Medical College of Wisconsin, Milwaukee, WI
c Division of Pulmonary and Critical Care Medicine, The Medical College of Wisconsin, Milwaukee, WI
d Froedtert Memorial Lutheran Hospital, Milwaukee, WI
OUTSIDE THE HOSPITAL
Public Health Notices

Active Health Investigations

Currently in effect

Food-related outbreaks

Outbreak of Salmonella infections – (NEW) – April 5, 2019
  ▶ Salmonella investigation overview (as of April 5, 2019)

Outbreaks of Salmonella infections linked to raw chicken, including frozen raw breaded chicken products - (update) - March 22, 2019
  ▶ Salmonella investigations overview (as of March 22, 2019)

Outbreak of Salmonella infections linked to raw turkey and raw chicken - (update) - January 31, 2019
  ▶ Salmonella investigation overview (as of January 31, 2019)

Antibiotic resistant and blood-borne infections

• Information for Canadians who have received or are considering medical procedures in Mexico - February 13, 2019
72 People Ill From E. Coli Outbreak, What Is The Cause?

Bruce Y. Lee  Contributor ©
Healthcare

Detect

Protect

Salmonella outbreak sees 63 cases in 6 Canadian provinces — but no one knows how it started yet

By Jesse Ferrero
Online Journalist  Global News

Public Health Agency of Canada says 63 sick following salmonella outbreak in 6 provinces
### Addressing the rising rates of gonorrhea and drug-resistant gonorrhea: There is no time like the present

M Bodie

<table>
<thead>
<tr>
<th>Recommendations</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normalize and increase screening and promote safer sex practices</td>
<td>• To reduce barriers and associated stigma, look for opportunities during routine medical care to have a conversation about STI risks, safer sex practices and the benefits of screening</td>
</tr>
<tr>
<td></td>
<td>• Samples should be taken from all sites of exposure, to increase diagnosis and ensure appropriate treatment is provided</td>
</tr>
<tr>
<td>Conduct pretravel counselling</td>
<td>• Counsel travellers on the importance of safer sex practices while travelling; depending on the destination, it may be appropriate to discuss the risk of AMR GC infection specifically</td>
</tr>
<tr>
<td></td>
<td>• If there is a history of unprotected sexual exposure during travel, maintain a heightened index of suspicion for potential AMR GC infection, and more specifically, a globally emerging resistant strain not currently circulating in Canada</td>
</tr>
<tr>
<td>Increase the use of cultures for diagnosis and test-of-cure</td>
<td>• NAAT is convenient and highly sensitive and can increase the diagnosis of GC. Culture provides information on antimicrobial susceptibilities prior to treatment and is critical for improved public health monitoring of antimicrobial resistance patterns and trends</td>
</tr>
<tr>
<td></td>
<td>• When signs and/or symptoms are consistent with gonococcal infection, the use of culture along with NAAT is extremely important</td>
</tr>
<tr>
<td>Provide up-to-date combination therapy for patients and their contacts</td>
<td>• Due to increasing antimicrobial resistance, combination therapy is the standard of care choice of combination therapy should be guided by infection site and patient history. AMR resistance patterns may show regional variation</td>
</tr>
<tr>
<td></td>
<td>• Consult the CGSTI or your jurisdiction's STI guideline for details on treatment recommendations</td>
</tr>
<tr>
<td></td>
<td>• Treatment of all sexual contacts from the previous 60 days is essential. Local public health professionals can assist with contact tracing and notification as needed</td>
</tr>
</tbody>
</table>

**Table 1: Four key recommendations needed to preserve options for remaining first-line treatment of antimicrobial resistant gonorrhea**

CCDR • February 7, 2019 • Volume 45-2 • Page 58

Methicillin-Resistant Staphylococcus aureus CC398 in Humans and Pigs in Norway: A “One Health” Perspective on Introduction and Transmission

Carl Andreas Granøe,1,5 Petter Elstrem,5 Marc Stegger,5,6 Robert Leo Skov,1 Paal Skytt Andersen,5,6 Kjersti Wik Larssen,2 Anne Margrete Urdahl,1 Øystein Aagen,5,6 Jesper Larsen,5 Solfrið Åmdal,4 Siri Margrete Lettvold,4 Marianne Sunde,2,1,5 and Jørgen Vildshoj Bjørnholt2,6
• Human occupational exposure, trade of pigs and livestock transport vehicles. These findings are essential for keeping pig populations MRSA free and, from a “One Health” perspective, preventing pig farms from becoming reservoirs for MRSA transmission to humans.
The Future successful ICP
Advancing infection prevention and antimicrobial stewardship through improvement science

Jerome A Leis¹,²,³

The role of the infection preventionist in a transformed healthcare system: Meeting healthcare needs in the 21st century

Katrina Crist, MBA, CAE⁸,*, Denise Murphy, RN, BSN, MPH, CIC, FAPIC, CPPS, FAAN⁹, Marc-Oliver Wright, MT (ASCP), MS, CIC, FAPIC⁵, Elizabeth Wallace, MPH, CIC, FAPIC⁵, Mary Lou Manning, PhD, CRNP, CIC, FAPIC, FAAN⁹

APIC Consensus Conference - AJIC Paper

Infection Prevention in the Hospital from Past to Present: Evolving Roles and Shifting Priorities

Michelle Doll¹ - Angela L. Hewlett² - Gonzalo Bearman³
Recap of Challenges

Hazards

- Poor Adherence to Protection Methods
- Lack of Guidance
- Change Management

Detection Difficulty

Widespread Problems

Multiple Stakeholders

Antimicrobial Resistance

Losses
THANK YOU FOR ALL YOU DO
Thank You
References


• Nagaraja, Aarathi et al. Clostridium difficile infections before and during use of ultraviolet disinfection American Journal of Infection Control , Volume 43 , Issue 9 , 940 - 945


References

• Department of Health (2012) Updated Guidance on the Diagnosis and reporting of Clostridium Difficile
References


Spread of \textit{mcr-1}–Driven Colistin Resistance on Hospital Surfaces, Italy

Elisabetta Caselli, Maria D'Accoliti, Irene Soffritti, Micol Piffanelli, Sante Mazzacane

Author affiliation: Università Degli Studi di Ferrara, Ferrara, Italy
DOI: https://doi.org/10.3201/eid2409.171386

Plasmid-mediated colistin resistance driven by the \textit{mcr-1} gene is of great clinical concern. Its diffusion in the hospital environment is unknown. We detected \textit{mcr-1}–driven resistance in 8.3\% of \textit{Enterobacteriaceae} isolates from hospital surfaces in Italy, which might represent a reservoir of threatening nosocomial pathogens.

Our data show that \textit{mcr-1}–carrying \textit{Enterobacteriaceae} can be detected on hospital surfaces with higher frequency than in clinical isolates, indicating that this plasmid has the ability to spread, not only in vitro (1), in key human pathogens. Persistent surface contamination in hospitals might thus favor colistin resistance spread among gram-negative bacteria, perhaps helped by selective pressure exerted by some antiseptics (i.e., chlorhexidine) (10). Although this finding might represent a potential reservoir of threatening nosocomial pathogens and favor their diffusion in hospitalized patients, currently no specific monitoring exists to control it. Thus, we suggest that surveillance for \textit{mcr-1}–driven colistin resistance might include not only clinical samples but also environmental analyses and all clinically relevant gram-negative species to control and counteract the increase of untreatable infections.