A Retrospective Outcome Study on Multi Drug Resistant Organisms

Executive Patient Safety Forum:
HAI Prevention for Healthcare Professionals
The Harvard Club
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Introduction

“If it is a terrifying thought that life is at the mercy of the multiplication of these minute bodies [microbes], it is a consoling hope that Science will not always remain powerless before such enemies”

— Louis Pasteur

Infectious diseases projected to pass cancer in cases and mortality

Cancer – high concern about mortality and new cases:

- *600,000 estimated deaths*¹
- *1.7 million estimated new cases*¹

On the other hand, mortality and new cases for selected resistant organisms and *C. difficile* infections² hardly attracts attention

<table>
<thead>
<tr>
<th>Infection</th>
<th>Mortality</th>
<th>New Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Streptococcus pneumoniae</td>
<td>7,000</td>
<td>1,200,000</td>
</tr>
<tr>
<td>MRSA</td>
<td>11,000</td>
<td>80,000</td>
</tr>
<tr>
<td>Clostridium difficile</td>
<td>14,000</td>
<td>250,000</td>
</tr>
</tbody>
</table>

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¹ 2016 “Cancer Facts and Figures” – American Cancer Society Inc., 2016 Surveillance Research
Infectious diseases projected to pass cancer in cases and mortality

Yet, long term projections\(^3\) indicate the opposite

Slower introduction of new antibiotics, faster microbial resistance development likely to impact surgeries

Selected Surgical Interventions*

<table>
<thead>
<tr>
<th>Procedure</th>
<th>2010 US Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>C-Section</td>
<td>1.30 M</td>
</tr>
<tr>
<td>Joint Replacement (hip and knee)</td>
<td>1.05</td>
</tr>
<tr>
<td>Broken Bone Repair</td>
<td>.67</td>
</tr>
<tr>
<td>Angioplasty</td>
<td>.50</td>
</tr>
<tr>
<td>Stent</td>
<td>.50</td>
</tr>
<tr>
<td>Hysterectomy</td>
<td>.50</td>
</tr>
<tr>
<td>Gall Bladder</td>
<td>.40</td>
</tr>
<tr>
<td>Bypass</td>
<td>.40</td>
</tr>
</tbody>
</table>

A study of Multi Drug Resistant Organisms - MDRO

MDRO growth stimulated retrospective outcome study with a statistically significant population at *Intermountain Healthcare*, Salt Lake City, Utah

<table>
<thead>
<tr>
<th>Highlights</th>
<th>All In-Patients</th>
<th>MDRO Cohort</th>
</tr>
</thead>
<tbody>
<tr>
<td>Starting date for admissions to study</td>
<td>January 1, 2008</td>
<td></td>
</tr>
<tr>
<td>Ending date for admissions to study</td>
<td>December 31, 2015</td>
<td></td>
</tr>
<tr>
<td>Calendar time covered by study</td>
<td>8 years</td>
<td></td>
</tr>
<tr>
<td>Total encounters (in-patient admissions)</td>
<td>900,000</td>
<td>12,750</td>
</tr>
<tr>
<td>Overall average length of stay</td>
<td>4.1 days</td>
<td>10.2 days</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>ESBL E. Coli</th>
<th>ESBL Klebsiella</th>
<th>CRE</th>
<th>Pan Resistant</th>
<th>VRE</th>
<th>MRSA</th>
<th>Carbapenem Resistant E. Coli</th>
<th>Acinetobacter</th>
<th>Enterobacter</th>
<th>Pseudomonas</th>
<th>C. difficile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Census</td>
<td>772</td>
<td>132</td>
<td>75</td>
<td>41</td>
<td>1,197</td>
<td>5,218</td>
<td>15</td>
<td>163</td>
<td>127</td>
<td>317</td>
<td>5,411</td>
</tr>
<tr>
<td>1/10,000</td>
<td>9</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>13</td>
<td>58</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>4</td>
<td>60</td>
</tr>
<tr>
<td>1/100,000</td>
<td></td>
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</tr>
</tbody>
</table>

- **Found 5 in 100,000 admissions**
- **Found 2 in 100,000 admissions**
- **Found 1 in 10,000 admissions**

Principal Investigator Bert Lopansri, Head of Infectious Diseases and Epidemiology, Intermountain Healthcare, Salt Lake City, UT. Study funded by OpGen, Gaithersburg, MD
Figure 6: Location of MDRO Acquisition in Hospitalized Patients

Source of Admission for Patients Testing Positive for Drug Resistances

Home, 6,488, 51%

Clinic or Physician Office Referral, 2,238, 18%

Court/Law Enforcement Transfer, 19, 0%

Rehab, 1,781, 14%

Hospital Transfer, 1,484, 12%

Skilled Nursing Facility Transfer, 682, 5%

Other Health Care Facility Transfer, 47, 0.37%

Other, 11, 0.09%

Source: MDRO Retrospective Outcome Study at Intermountain Healthcare
Extension of LOS as Result of Continued Empiric Therapy

LOS increases by 2.2 days for every additional day on empiric therapy

Model used in projections

Source: MDRO Retrospective Outcome Study at Intermountain Healthcare
Estimated Increase in C. Difficile Mortality as Result of Continued Empiric Therapy

C. Diff mortality increases by 4.4% for every additional day on empiric therapy

Source: MDRO Retrospective Outcome Study at Intermountain Healthcare
21 Classes of Antibiotics Administered to MDRO Cohort Patients

- Glycopeptide
- Cephalosporin
- Penicillin
- Nitroimidazole
- Fluoroquinolone
- Carbapenem
- Oxazolidinones
- Macrolide
- Folate pathway inhibitor
- Polymixin
- Aminoglycoside
- Daptomycin
- Antitubercular agent
- Antifungal
- Nitrofurans
- Tetracycline
- Neuraminidase inhibitors
- Monobactam
- Quinoline
- Macrocyclic
- Quinu/Dalfopristin

Source: MDRO Retrospective Outcome Study at Intermountain Healthcare
Number of Classes of Antibiotics Administered vs. Average Length of Stay

Average Length of Stay (Days)

- 1 Class: 4.6
- 2 Classes: 5.8
- 3 Classes: 8.2
- 4 Classes: 10.9
- 5 Classes: 15.6
- 6 or More Classes: 30.7

Source: MDRO Retrospective Outcome Study at Intermountain Healthcare
What if we do nothing?

**Intermountain MDRO 2008-2015 History and 2015-2028 Projection**

**Incidence - Historical and Projected**

**History**
- Intermountain MDRO 2008-2015
- 2015-2028 Projections

**Source:** MDRO Retrospective Outcome Study at Intermountain Healthcare
“The observed increased risk for subsequent sepsis following receipt of antibiotics that significantly disrupt the microbiome, including a dose-response effect, supports the idea that microbiome disruption confers increased risk for subsequent severe infections. Better understanding the role of antibiotic-mediated microbiome disruption in sepsis will be important for future sepsis prevention”
Shifting from empiric to targeted antibiotic therapy is the solution and rapid diagnostics are key in that pathway.

Length of Stay Distribution: All Cohort Patients; n=12,750

Conservative criteria for inclusion:
- Length of stay between 2 and 45 days
- Received more than 1 class of antibiotic
- Did not have more than 4 underlying co-morbidities

Source: MDRO Retrospective Outcome Study at Intermountain Healthcare
Summary

At minimum, medicine needs new, rapid diagnostics for Antimicrobial Sensitivity, and new, narrow-spectrum Antibiotics to handle multi drug resistant organisms

“... it is a consoling hope that Science will not always remain powerless before such enemies”

— Louis Pasteur, 1878