Using the right model to calculate the financial implications of *Clostridium difficile* infection

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Hosted by Paul Webber
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Using the Right Model to Calculate the Financial Implications of *Clostridium difficile* Infection  
Dr. Mairead Skally, Beaumont Hospital, Dublin, Ireland  
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**CDI Definitions**

**New Case**
- 2+ years
- Positive laboratory result for toxin producing *C. difficile* organism detected in stool
  and / or
- Colonic histopathology characteristic of *C. difficile* infection (with or without diarrhoea) on a specimen obtained during *endoscopy*, colectomy or autopsy.

**Recurrent case**
- Symptoms < eight weeks since first infectious episodes

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**Caring for patients with *C. difficile***

- **Test for CDI**
  - Two step testing with PCR for toxin B gene and 2nd test for toxin
  - Send for ribotyping to UK

- **Clinical Micro Team phone team**
  - Assess cause of symptoms

- **Treat with anti CDI medication**
  - Fidaxomicin
  - Vancomycin
  - Metronidazole

- **Isolate patient while symptomatic**
  - With Contact precautions
  - Wait until 48 hours symptom free

- **Hydrogen Peroxide Vapour decontamination of room**
  - On discharge or after extended period of time

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**Governance and accountability arrangements for the Infection Prevention Control Committee**

**Money talks**

.....COSTING C. DIFFICILE INFECTION

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How much does a case cost?

**UK**
€4,655 to €12,751
 (£4,000 to £10,956)

**Europe**
€5,798 to €11,202

**USA**
$2,992 to $29,000
 ($2,485 to $24,092)*

20 new hospital acquired cases CDI

@ €4,655 = €93,100
@ €24,092 = €481,840

* Conversion figures correct as of 02nd January 2018 courtesy of www.xe.com
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ECONOMICS

- **COST UTILITY ANALYSIS (CUA)** - OUTCOMES EXPRESSED IN UNITS OF UTILITY (E.G., QALYS)

- **COST EFFECTIVE ANALYSIS (CEA)** - ESTIMATES COSTS AND OUTCOMES OF INTERVENTION

- **COST BENEFIT ANALYSIS (CBA)** - ESTIMATE COSTS AND BENEFITS IN THE SAME UNITS

- **COST IDENTIFICATION - MICRO COSTING ANALYSIS**
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**ECONOMICS**

- Cost Utility Analysis (CUA), Benefits Expressed in Utility Analysis
- Cost Analysis
- Cost Identification
- Cost Analysis and its Relationship to Costs and Benefits
- Cost Micro Costing Analysis

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**REALITY**

Limited knowledge due to:

- Limited manpower
- Limited funding

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Article
November 24, 1993

Clinical Economics
A Guide to the Economic Analysis of Clinical Practices
John W. M. O'Connell, MD, MHA
3 Philadelphia Ave.

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Health Economic Analysis

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Our objective

Analyse cost of *Clostridium difficile* infection in Beaumont Hospital in August 2015
- ‘Routine’ cost
- Additional costs associated with an outbreak on one ward

Perspective: Hospital decision-makers

Caring for patients with *Clostridium difficile*

- Test for CDI
  - In house
  - UK reference lab

- Clinical Micro Team/phone team
  - Staff time

- Treat with anti CDI medication
  - Medication costs

- Isolate patient while symptomatic
  - Single room cost
  - PPE cost

- Hydrogen Peroxide Vapour decontamination of room
  - HPV cost
  - Bed days lost

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Methods - 1

• Resource use collection
  – Chart review
  – Patient transfer history – length of stay, time in isolation
  – Prescribing & cleaning records

• Unit costs
  – Beaumont Hospital Patient-Level Costing project
  – Health Services Executive (HSE)

Methods - 2

• Outbreak analysis
  – Additional personnel time (outbreak meetings)
  – Additional cleaning
  – Bed closures = bed-days lost

• Return on investment
  – Break even analysis using
Methods -3

• Calculating additional length of stay (LOS)
  – Disregard > 10 days in isolation
  – Compared to *Clostridium difficile* LOS to cohort with same DRG / ICD codes = incremental LOS due to CDI
  – Cost of additional LOS derived from national DRG estimates (sensitivity analysis)

• Conducting a sensitivity analysis varying key parameters of the study

Results

- 317 specimens tested for CDI
- 20 positive samples
  - 8 PCR +, Toxin –
  - 12 PCR +, Toxin +
- 16 samples sent for ribotyping
- 13 inpatients managed as per *Clostridium difficile* infection protocol
- 11 new cases
  - 2 recurrent cases
- 6 (47%) treated with Fidaxomicin
  - 4 (30%) treated with Vancomycin
  - 3 (23%) treated with Metronidazole
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### Cost of routine *C. difficile* patient

<table>
<thead>
<tr>
<th>Expenditure category</th>
<th>Aggregate cost / variable cost (€)</th>
<th>Mean per patient cost / variable cost (€)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>75,680 / 13,338</td>
<td>5,820 / 1,026</td>
</tr>
<tr>
<td>Personnel</td>
<td>3,199 / 0</td>
<td>246 / 0</td>
</tr>
<tr>
<td>Radiology and endoscopy</td>
<td>2,002 / 0</td>
<td>154 / 0</td>
</tr>
<tr>
<td>Surgery</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Anti-CDI medication</td>
<td>10,057 / 10,057</td>
<td>773 / 773</td>
</tr>
<tr>
<td>Cleaning/decontamination</td>
<td>2,011 / 2,011</td>
<td>155 / 155</td>
</tr>
<tr>
<td>Laboratory diagnosis and ribotyping</td>
<td>6,437 / 1,274</td>
<td>495 / 98</td>
</tr>
<tr>
<td>Length of stay</td>
<td>32,713 / 0</td>
<td>2,516 / 0</td>
</tr>
<tr>
<td>Isolation room</td>
<td>19,261 / 0</td>
<td>1,481 / 0</td>
</tr>
</tbody>
</table>

### Cost of *C. difficile* decontamination

<table>
<thead>
<tr>
<th>Expenditure category</th>
<th>Routine cost (€)</th>
<th>Outbreak cost (€)</th>
<th>Total cost (€)</th>
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</thead>
<tbody>
<tr>
<td>Total cost</td>
<td>2,011</td>
<td>9,654</td>
<td>11,665</td>
</tr>
<tr>
<td>'Deep' cleaning on CDI discharge</td>
<td>95</td>
<td>1,243</td>
<td>1,338</td>
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<tr>
<td>HPV decontamination</td>
<td>1,815</td>
<td>3,712</td>
<td>5,527</td>
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<tr>
<td>Curtain exchange</td>
<td>101</td>
<td>824</td>
<td>925</td>
</tr>
<tr>
<td>Bed linen</td>
<td>-</td>
<td>124</td>
<td>124</td>
</tr>
<tr>
<td>Fire blankets</td>
<td>-</td>
<td>62</td>
<td>62</td>
</tr>
<tr>
<td>Shower curtains</td>
<td>-</td>
<td>22</td>
<td>22</td>
</tr>
<tr>
<td>Hypochlorite tablets</td>
<td>-</td>
<td>2,048</td>
<td>2,048</td>
</tr>
<tr>
<td>Mattress replacement</td>
<td>-</td>
<td>1,033</td>
<td>1,033</td>
</tr>
<tr>
<td>Commodes</td>
<td>-</td>
<td>517</td>
<td>517</td>
</tr>
</tbody>
</table>
Cost of our *C. difficile* outbreak

- 58 bed days lost due to bed closures ≈ €34,585
- Outbreak control team meetings:
  - 5 x meetings, mean personnel cost: €546
  - Aggregate cost: €2,728
- Outbreak-related cleaning: Total = €9,654

Total = €88,049 (€6,773 per patient)

Return on investment / Break even analysis

- Antimicrobial pharmacist = €87,712 per year
  - Using variable costs only, preventing 47 CDI cases annually would offset this cost
  - If mean cost was used for this calculation preventing only 12 CDI cases would be required to break even

- The pharmacist would also potentially contribute to other HAI reductions
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### International comparisons

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<thead>
<tr>
<th></th>
<th>Our hospital</th>
<th>Europe</th>
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<tbody>
<tr>
<td>Cost</td>
<td>€5,820</td>
<td>€5,000 to €11,000</td>
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<tr>
<td>Additional Length of stay</td>
<td>4.2 days</td>
<td>7 days</td>
</tr>
<tr>
<td>20 new cases</td>
<td>€116,400</td>
<td></td>
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<tr>
<td>Of which is variable</td>
<td>€19,788</td>
<td></td>
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### Sensitivity analysis

**Parameter varied**
- Incremental length of stay due to *C. difficile* infection: 1.75 days to 22.55 days (average = 4.2)
- Preventing 5%, 10% and 20% of our *C. difficile* cases

**Sensitivity analysis**
- Increasing length of stay from 4.2 to 7.0 days:
  - Cost increase from €2,516 to €4,147
- Reduce attributable cost by €4,403, €8,806 and €17,612
To conclude

• Preventing CDI = some cash savings
• Other “cost savings” are notional i.e. resources directed elsewhere
• It is possible to count the cost of CDI in your hospital but you should focus on variable costs
• Investing in CDI prevention can offer net financial benefit
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<table>
<thead>
<tr>
<th>Date</th>
<th>Title</th>
<th>Speaker</th>
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<tr>
<td></td>
<td>Sponsored by the World Health Organization, Infection Prevention and Control Global Unit</td>
<td></td>
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<tr>
<td>January 25, 2018</td>
<td>PRACTICAL APPROACHES FOR MONITORING CLEANING IN HEALTHCARE FACILITIES</td>
<td>Prof. Curtis Donakoy, Case Western Reserve University, Cleveland</td>
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<tr>
<td>February 6, 2018</td>
<td>PATIENTS ARE YOUR PARTNERS - WHY AND HOW THIS PARTNERSHIP WORKS</td>
<td>Ioana Popescu, Canadian Patient Safety Institute, Judy Birdsell and Kim Neudorf, Patients for Patient Safety Coalition</td>
</tr>
<tr>
<td>February 15, 2018</td>
<td>REFUGEE HEALTH: A NEW PERSPECTIVE FOR INFECTION PREVENTION AND CONTROL</td>
<td>Prof. Ruth Carrico, University of Louisville</td>
</tr>
</tbody>
</table>

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