Measuring the impact of antibiotic stewardship in healthcare settings

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APUA Webinar
July 2, 2013
Today’s Presentation

- How the problem developed
- A Basic Approach to Healthcare Antimicrobial Stewardship

Four Elements:
1. Measure IV antibiotic use
2. Optimize IV to oral switch
3. Teach the core concepts of antibiotic use
4. Measure success and escalate the program
Sir Alexander Fleming

“The time may come when penicillin can be bought by anyone in the shops. Then there is the danger that the ignorant man may easily under dose himself and, by exposing his microbes to non-lethal quantities of the drug, educate them to resist penicillin.”

-Nobel lecture, 1945
Antimicrobial Stewardship: Objectives

- Achieve optimal clinical outcomes
- Minimize toxicity and other adverse events
- Minimize development of antimicrobial resistance

May also reduce excessive costs attributable to:
- inappropriate/unnecessary therapy
- suboptimal outcomes
- toxicity and other adverse events
- antimicrobial resistance
Usage of Antibiotics in a General Hospital: Effect of Requiring Justification

John E. McGowan, Jr. and Maxwell Finland

From the Chan Thorndike Memorial
Boston City Hospital
Harvard Medical School

The amounts of certain antibiotics used at Boston City Hospital during the past 2 years have been reviewed and correlated with the requirement for antibiotic therapy. This has led to a decrease in the number of antibiotics prescribed, and a decrease in the cost of antibiotics. The decrease in the number of antibiotics prescribed has also resulted in a decrease in the number of adverse reactions to antibiotics. The decrease in the cost of antibiotics has resulted in a decrease in the cost of hospitalization. The decrease in the number of adverse reactions to antibiotics has resulted in a decrease in the number of deaths from adverse reactions to antibiotics.
Septicemia:*
A crucial test of antibiotic efficacy
Timeless classic

The standard by which all cephalosporins are measured

Keflin®
cephalothin sodium
Neutral

2 gm* in
20 and 100-ml-size vials
Equivalent to cephalothin.

See reverse side for brief summary of prescribing information.

Lilly
A new horizon in cephalosporin therapy
What would Duke have said about our naïve optimism about antibiotic use over the past 60 years?
Life is tough!

And life is real tough when you’re stupid!
REVENGE OF THE KILLER MICROBES
Are we losing the war against infectious diseases?
Antimicrobial Stewardship – The Hospital Problem and the World Wide Problem

Coming to a hospital near you!
9 Isolates
   K. pneumoniae (5), E. coli (2), Enterobacter cloacae (1), Salmonella (1)
   ▪ Resistant to all β lactams + carbenipenems, all aminoglycosides, all quinolones
     Colistin sens. Tygecycline – variable
   ▪ All isolates also carried other resistance genes

8 Patients hospitalized in India or Pakistan (none medial tourists)
   ▪ 15 countries and 5 continents
   ▪ North Africa ➔ France this spring
New Antibacterial Agents Approved 1983-2011

The Pipeline is Dry

- Only 15-16 antibiotics are in development
- Only 8 of these have activity against key Gram negative bacteria
- None have activity against bacteria resistant to all current drugs
Timeline for New Antibiotic Development

- **Discovery**
- **Pre-clinical**
- **Phase 1**
- **Phase II**
- **Phase III**
- **FDA Review**
- **IND Filing**
- **NDA Filing**
- **Product Launch**
An obituary- On the Death of antibiotics!

Abdul Ghafur K
Consultant in Infectious Diseases, Apollo Hospital, Chennai

The art of war is deception, that is deceiving the enemy. But in the war against microbes we have deceived ourselves by misusing, under using and overusing antibiotics….Why should we Indians worry? We can always depend on honey, yoghurt and cow’s urine….

http://www.japi.org/march_2010/article_01.html
What can be done?
What did Bill Gates say about Antimicrobial Stewardship?
What did Bill Gates say about Antimicrobial Stewardship?

“You can achieve incredible progress if you set a clear goal and find a measure that will drive progress toward that goal.”
A Basic Approach to Healthcare Antimicrobial Stewardship

Four Elements:

1. **Measure IV antibiotic use**
2. Optimize IV to oral switch
3. Teach the core concepts of antibiotic use
   - A. Don’t treat unnecessarily
   - B. Higher dose shorter duration
   - C. Consult ID early and often
4. Measure success and escalate the program
Approaches to antimicrobial use measurement

- Hospital purchase data
  - Easiest data to obtain
  - All Pharmacies know their COSTS

- Pharmacy dispensing data from billing records
  - Closer to actual “use”
  - Are pharmacy returns counted?

- Antibiotic administration data
  - Most difficult to get
  - Presumably represents true antibiotic use
An Example
IV Antibiotic Expenditures
Carney Hospital, Boston
What was going on?

The equation was simple.
What was going on?
What was going on?
What was going on?

The hospital was shrinking!!
# Quantify Antibiotic Use

<table>
<thead>
<tr>
<th>Antibiotic</th>
<th>Cost Per Gram</th>
<th>Grams Used</th>
<th>Defined Dose Day (DDD)</th>
<th>Treatment Days</th>
<th>Annual Expenditure</th>
<th>Patient Days</th>
<th>DDD/1000 PT Days</th>
<th>Cost/1000 PT Days</th>
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<tbody>
<tr>
<td>Amikacin</td>
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<td>$40,516.08</td>
<td>57,000</td>
<td>19.88</td>
<td>$710.81</td>
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</tbody>
</table>

**Total**

<table>
<thead>
<tr>
<th>Cost Per Gram</th>
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<th>Patient Days</th>
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<th>Cost/1000 PT Days</th>
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</thead>
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<td>$33,949.77</td>
<td>$911,532.10</td>
<td>595.62</td>
<td>$15,991.81</td>
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<td></td>
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</tbody>
</table>
Broad spectrum antibiotic use

Defined Dose Days / 1000 PT DAYS

> 200 % increase

IV Antibiotic Utilization

![Graph showing the percent change in DDD/1000 PT Days, Cost/1000 PT Days, and Medicare Case Mix Index from 1991 to 1993.](image-url)

- **Percent Change**
  - DDD/1000 PT Days
  - Cost/1000 PT Days
  - Medicare Case Mix Index

- **Years**
  - 1991
  - 1992
  - 1993

- **Legend**
  - DDD/1000 PT DAYS
  - COST / 1000 PT DAYS
  - MEDICARE CASE MIX INDEX
Impact of the Program

![Graph showing percent change in DDD/1000 PT Days, Cost/1000 PT Days, and Medicare Case Mix Index from 1991 to 1998.](image-url)
Comparison of Antibiotic Costs

ANTIBIOTIC COSTS / 1000 PT DAYS IN 14 ACUTE CARE HOSPITALS

Carling PC, Fung T, Coldiron JS.
**Basics: Antibiotic Use (DDD vs. DOT)**

- **Defined daily dose (DDD):** the *usual daily dose for adults* as defined by the World Health Organization (WHO)
  - Vancomycin DDD = 2 grams.
  - A patient receives 2 grams/day for 5 days; total use (10 grams) = DDD (2 grams) = 5 DDDs
  - A hospital “uses” 1000 grams of vancomycin (e.g., purchases, dispenses, administers) in the 1st quarter of 2010, for a total of 4500 patient days, then: 
    \[
    \frac{1000 \text{ grams}}{2 \text{ grams} / 4500 \text{ patient days}} \times 1000 = 111 \text{ DDD/1000 patient days}
    \]

- **Days of therapy (DOT):** 1 DOT is administration of a single agent at least once that day
  - If a patient receives 2 agents, she receives one DOT for each
  - Normalize to 1000 patient days
A Basic Approach to Healthcare Antimicrobial Stewardship

Four Elements:

1. Measure IV antibiotic use
2. **Optimize IV to oral switch**
   - A. Pick the low-hanging fruit
   - B. IV treatment is not needed
3. Teach the core concepts of antibiotic use
   - A. Don’t treat unnecessarily
   - B. Higher dose shorter duration
   - C. Consult ID early and often
4. Measure success and escalate the program
Optimize IV to oral switch:
A. Pick the low hanging fruit
A. Pick the low hanging fruit

- IV Quinolones:
  Often begun empirically in the ED
  Patient improves – Why change Rx?
  *Because* PO = IV blood levels
  PO costs 25% as much!!

- Linezolid
  Empiric use varies between hospitals
  PO = IV blood levels
  Both cost > $200. / day
  IV is more costly
B. IV treatment is not needed

- PO often very effective...especially when you don’t really need to continue antibiotic therapy
B. IV treatment is not needed

- PO often very effective...especially when you don’t really need to continue antibiotic therapy

**Good News:**
80% of the cost savings in our program came from stopping unnecessary antibiotic therapy

**Bad news:**
It takes work, education and some time (varies)
A Basic Approach to Healthcare Antimicrobial Stewardship

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Teach the core concepts of antibiotic use

A. Don’t treat unnecessarily
Most Common Reasons for Unnecessary Days of Therapy

30% of 1941 antimicrobial days of therapy deemed unnecessary

- Duration of therapy longer than necessary: 192 days
- Noninfectious or nonbacterial syndrome: 187 days
- Treatment of colonization or contamination: 94 days

A. Don’t treat unnecessarily

Empiric treatment should be for evident serious infection in hospitalized patients....pneumonia, occult sepsis, documented meningitis, urosepsis.
Teach the core concepts of antibiotic use

A. Don’t treat unnecessarily

Empiric treatment should be for evident serious infection in hospitalized patients....pneumonia, occult sepsis, documented meningitis, urosepsis.

Use positive non-culture testing:

CASE STUDY
The Case

- 56 y.o. man, no meds, moderate alcohol, smoker
- 1 wk. - fevers, myalgias, cough
- 3d. - PCP visit 102 fever, CXR ? +, moderate diarrhea
- Rxd - Levofloxacin
- 1d. - Fever to 103, worse SOB
- PE - 103.4, R 32, Toxic appearing
  - Chest - Poor breath sounds RA SaO² 82%
  - WBC 10.7 - 82p 15B
  - Na⁺ 127  k⁺ 3.4  Cl⁻ 85  HCo₃ 25.6
  - Cr 1.4  UA SG 1.30, 5-10 WBC, 10-15 RBC
Differential Diagnosis – Extensive

Viral pneumonia – Influenza, Adenovirus Rhinovirus, Severe sepsis with evolving respiratory failure
Evolving bacterial pneumonia on top of preceding viral pneumonia
Legionnaire's disease
Pneumocystis pneumonia
New Coronavirus (SARS)

Antibiotic Therapy
Ticaricillin-sulbactam, Levofloxacin, Tamiflu and bactrim

Rapid antigen testing implemented
The Case

- **Course**
  - Intubated with progressive pneumonia x6d
  - ARF necessitating dialysis x2 wk.
  - Gradual Improvement
  - D/C after 3wk. hospitalization
The Case

Your Answer?
The Case

Your Answer?

Urine Legionella Antigen positive
A. Don’t treat unnecessarily

Empiric treatment should be for evident serious infection in hospitalized patients....pneumonia, occult sepsis, documented meningitis, urosepsis.

Use positive non-culture testing:
- Legionella urine Ag.
- Urine Pneumococcal Ag
- Influenza rapid diagnostic tests
(Stay tuned...lots more coming)
B. Think - Higher dose – Shorter duration

Higher doses are safe...with exceptions
Continuous IV Rx – Beta Lactams – gaining acceptance

Shorter Duration

CAP – 3d. = 8d.
VAP – 8d. = 15d.
Cellulitis – 5d. = 10d.
Cystitis – 3 to 5d. Fine in many studies
Pyelonephritis – 5 to 7 d.
Teach the core concepts of antibiotic use

c. Consult ID early and often

Providers who try to use antibiotics need support!
Share the worry
Different perspectives are valuable
Education is pragmatic not didactic
Provides for next step planning of treatment
Share the liability risk

It is CHEAP
½ the cost of a dose of newer IV antibiotics
A Basic Approach to Healthcare Antimicrobial Stewardship

Four Elements:

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   A. Don’t treat unnecessarily
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   C. Consult ID early and often
4. Measure success and escalate the program
Measure success and escalate the program

- Put antimicrobial use / cost front and center for the medical staff and administration...it’s a win / win proposition
- As Bill Gates said...objective measurement is the basic element
- Celebrate success and use the $$$ saved to enhance the depth of the program
Thanks for joining the program!

Questions Comments? Philip.Carling.MD@steward.org