ANTIMICROBIAL STEWARDSHIP AROUND THE GLOBE

VIENNA 2017

Dilip Nathwani
Ninewells Hospital and Medical School
Dundee, UK
CONFLICT OF INTEREST

• Has participated in commercial advisory boards for: – Astellas, Janssen, Novartis, Pfizer, Wyeth,
• Has received lecture funds from: – Astellas, Bayer, Novartis, Pfizer
• Has received research/education funds from: – Bayer, Pfizer, Biomerieux
• Has non-commercial positions as:
  • Recent Chair of Scottish Antimicrobial Prescribing Group [SAPG] – Scottish Government Stewardship Programme
  • Previous Chair ESGAP
  • President BSAC
UN Classifies Antibiotic Resistance as a Crisis, Putting It on Par With Ebola and HIV

The plan. Each country will come up with a plan to monitor antibiotic use in healthcare and in agriculture, start reducing the drugs’ use and also begin developing new antibiotics, according to NPR coverage. They will present their plans to the U.N. General Assembly in 2018 for a progress assessment.

Potential weaknesses. the declaration did not set solid goals for antibiotic use reduction, and it is nonbinding, The New York Times reports.
ANTIBIOTIC RESISTANCE IS THE QUINTESSENTIAL
ONE HEALTH ISSUE

The focus today – human prescribing

TOWARDS THE JUST AND SUSTAINABLE USE OF ANTIBIOTICS

The focus today – human prescribing

Fig. 1 A complex system: human drivers of antibiotic resistance in pluralistic health systems
THE TWO WORLDS?
Understanding the Worlds for a global Approach

High income Countries
- Respectable taxation systems
- Controllable corruption
- Appropriate funded healthcare (usually public)
- Decent sanitation
- Clean portable water
- Industrial waste controlled
- Antibiotic stewardship - variable
- Microbiology support - good

Low-Middle income Countries
- Broken taxation system
- Corruption is the norm
- Healthcare systems are invariably private (even public hospitals)
- Poor sanitation
- Contaminated portable water
- Industrial waste uncontrolled
- Antibiotic stewardship - poor
- Microbiology support - weak

T WALSH, BSAC 2017
ANTIMICROBIAL RESISTANCE: THE MAJOR CONTRIBUTION OF POOR GOVERNANCE AND CORRUPTION TO THIS GROWING PROBLEM

Peter Collignon¹,²*, Prema-chandra Athukorala³,⁴, Sanjaya Senanayake⁵,⁶, Fahad Khan³

¹ ACT Pathology, Canberra Hospital, Australian National University, Garran, Australia, ² Canberra Clinical School, Australian National University, Garran, Australia, ³ Arndt-Corden Department of Economics, Australian National University, Acton, Australia, ⁴ School of Environment and Development, University of Manchester, Manchester, England, ⁵ Australian National University, Garran, Australia, ⁶ Canberra Hospital, Garran, Australia

* peter.collignon@act.gov.au
FIGHTING BACK AGAINST ANTIBIOTIC RESISTANCE

1. Preventing Infections, Preventing the Spread of Disease
2. Tracking
3. Improving Antibiotic Prescribing and Use, AKA "Stewardship"
4. Developing New Drugs
LACK OF ACCESS TO ANTIBIOTICS STILL KILLS MORE CHILDREN UNDER 5 THAN DOES ABR BACTERIA

Figure 1: Estimated pneumonia deaths avertable in under-5 populations with improved antibiotic access

FROM: REVIVING OLD ANTIBIOTICS


Figure Legend:

Actions needed to revive useful antibiotics

- Prioritize old antibiotics that are still useful and need to be ‘re-developed’ and made more widely available.
- Identify the knowledge gaps and define the necessary high-quality studies.
- Form collaborative groups with extensive complementary skills to ‘re-develop’ the prioritized antibiotics.
- Utilize existing initiatives and networks by coordinating the needed initiatives and merge them into concerted global action.
- Raise awareness and assure public funding for these programmes.
- Create an open information and data hub for existing and new information about revived antibiotics.

- Organize dissemination and communication to all stakeholders.
- Inform and engage regulatory agencies as well as governments, policy makers and payers to ensure the availability of good quality drugs and information to guide their use.
- Generate guidelines for the rational use of each old antibiotic and integrate them into clear stewardship programmes.
- Engage pharmaceutical producers to avoid the risk of shortage.
- Monitor appropriate use of revived antibiotics by consumption and resistance surveillance programmes.
- Integrate the ‘re-development’ of old antibiotics into the global actions to fight antibacterial resistance.

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Date of download: 04/04/2017
MAXIMISING ACCESS TO ACHIEVE APPROPRIATE HUMAN ANTIMICROBIAL USE IN LOW-INCOME AND MIDDLE-INCOME COUNTRIES

Marc Mendelson, John-Arne Rettingen, Unni Gopinathan, Davidson H Hamer, Heiman Warheim, Buddhika Basnyat, Christopher Butler, Gårman Tomson, Manica Balasegaram

Key messages

• Access to quality-assured antimicrobials is part of the human right to health, yet universal access is often undermined in low-income and middle-income countries (LMICs).
• No model exists that increases access while minimising excess; hence, access programmes need to be context-adjusted and applied across a range of health-care settings.

To achieve appropriate antimicrobial prescribing, LMICs have to strengthen their health systems, including health insurance, provision of laboratory support, and increased access to diagnostics and primary prevention measures.

• Delinkage to uncouple sales from innovation in research and development (R&D) should be adopted, so that public health needs drive advances in antimicrobials and diagnostics.
• As a global challenge, universal access demands a long-term commitment, with sustained financing from all affected countries, to move away from present donor-driven models in resource-poor states.

The key enablers of access to antimicrobials—ie, financing, R&D, equitable management of knowledge and intellectual property, so-called managed marketing, and procurement and distribution of antimicrobials—should be strengthened to support the World Health Assembly Global Action Plan to combat antimicrobial resistance.

*Lancet* 2016; *387*: 188–98
Editorial

A Global Antimicrobial Conservation Fund for Low- and Middle-Income Countries

Mendelson et al. Int J Infect Dis 2016;51:70-72
Antibiotic effectiveness: Balancing conservation against innovation

Ramanan Laxminarayan*

Antibiotic effectiveness is a natural societal resource that is diminished by antibiotic use. As with other such assets, keeping it available requires both conservation and innovation. Conservation encompasses making the best use of current antibiotic effectiveness by reducing demand through vaccination, infection control, diagnostics, public education, incentives for clinicians to prescribe fewer antibiotics, and restrictions on access to newer, last-resort antibiotics. Innovation includes improving the efficacy of current drugs and replenishing effectiveness by developing new drugs. In this paper, I assess the relative benefits and costs of these two approaches to maintaining our ability to treat infections.

The benefits of conserving existing drugs are significant. A 1-year delay in the need for a $1 billion investment in a new antibiotic is worth roughly $60 million, even at a modest 6% discount rate (according to my calculations). We should therefore be willing to collectively spend at least that amount to shift the resistance curve back 1 year for a single antibiotic. It would cost

<table>
<thead>
<tr>
<th>Year</th>
<th>Product Name</th>
<th>Company</th>
</tr>
</thead>
<tbody>
<tr>
<td>1994</td>
<td>Meropenem</td>
<td>AstraZeneca</td>
</tr>
<tr>
<td>1999</td>
<td>Moxifloxacin</td>
<td>Bayer</td>
</tr>
<tr>
<td>2000</td>
<td>Linezolid</td>
<td>Pfizer</td>
</tr>
<tr>
<td>2001</td>
<td>Telithromycin</td>
<td>Merck</td>
</tr>
<tr>
<td>2002</td>
<td>Biapenem</td>
<td>Wyeth</td>
</tr>
<tr>
<td>2002</td>
<td>Ibapenem</td>
<td>Merck</td>
</tr>
<tr>
<td>2002</td>
<td>Priorabux</td>
<td>Nippon Shinshu Co, Ltd</td>
</tr>
<tr>
<td>2004</td>
<td>Gatifloxacin</td>
<td>Chongva Pharma</td>
</tr>
<tr>
<td>2004</td>
<td>Ipcempen</td>
<td>Toyama Chemical Co, Ltd</td>
</tr>
<tr>
<td>2005</td>
<td>Tigecycline</td>
<td>Wyeth</td>
</tr>
<tr>
<td>2006</td>
<td>Daptomycin</td>
<td>Cubist Pharmaceuticals</td>
</tr>
</tbody>
</table>

Fig. 3. Antibiotic pipeline for the past 20 years.
Vital Signs: Estimated Effects of a Coordinated Approach for Action to Reduce Antibiotic-Resistant Infections in Health Care Facilities — United States

Rachel B. Slayton, PhD1; Damon Toth, PhD2; Bruce Y. Lee, MD1; Marcy Tanner, PhD2; Sarah M. Bartsch, MPH1; Karim Khader, PhD2; Kim Wong, PhD2; Kevin Brown, PhD2; James A. McKinnell, MD1; William Ray2; Loren G. Miller, MD6; Michael Rubin, MD; PhD7; Diane S. Kim2; Fred Adler, PhD8; Chenghua Cao, MPH1; Lacey Avery, MA1; Nathan T.B. Stone, PhD9; Alexander Kallen, MD1; Matthew Samore, MD1; Susan S. Huang, MD7; Scott Fridkin, MD1; John A. Jernigan, MD1.

* If best infection control practices and antibiotic stewardship were nationally adopted, more than 600,000 infections and 37,000 deaths could be prevented over 5 years.

FIGURE 1. Comparison between the projected number of annual health care–associated infections from selected antibiotic-resistant bacteria* and Clostridium difficile with no intervention and the projected number with an aggressive national intervention — United States, 2014–2019†

FIGURE 2. Projected regional prevalence of carbapenem-resistant Enterobacteriaceae (CRE) over a 5-year period under three different intervention scenarios — 10-facility model, United States*

* Methicillin-resistant Staphylococcus aureus, carbapenem-resistant Enterobacteriaceae, and multidrug-resistant Pseudomonas aeruginosa.
† Additional information available at http://www.cdc.gov/drugresistance/resources/publications.html.
Vital Signs: Estimated Effects of a Coordinated Approach for Action to Reduce Antibiotic-Resistant Infections in Health Care Facilities — United States

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PREVENTION AND PRESERVATION ARE EFFECTIVE Are they cost-effective?

* Methicillin-resistant Staphylococcus aureus, carbapenem-resistant Enterobacteriaceae, and multiresistant Pseudomonas aeruginosa.
† Additional information available at http://www.cdc.gov/drugresistance/resources/publications.html.
Projected cost savings if antimicrobial-resistant infection (ARI) rates were reduced from 13.5% to 10%.

Savings for 1391 patients: $2.7 million total
$1948 per patient
Financial evaluations of antibiotic stewardship programs—a systematic review

<table>
<thead>
<tr>
<th>GEOGRAPHY</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>North America</td>
<td>51</td>
<td>52%</td>
</tr>
<tr>
<td>South America</td>
<td>3</td>
<td>3%</td>
</tr>
<tr>
<td>Europe</td>
<td>28</td>
<td>28%</td>
</tr>
<tr>
<td>Asia</td>
<td>14</td>
<td>14%</td>
</tr>
<tr>
<td>Africa</td>
<td>2</td>
<td>2%</td>
</tr>
<tr>
<td>Australia</td>
<td>1</td>
<td>1%</td>
</tr>
</tbody>
</table>

**TABLE 4 | Scored outcome parameters of the reviewed papers.**

<table>
<thead>
<tr>
<th>Outcome measures</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Implementation costs</td>
<td>11</td>
<td>11%</td>
</tr>
<tr>
<td>Antimicrobial costs</td>
<td>97</td>
<td>98%</td>
</tr>
<tr>
<td>Operational costs</td>
<td>23</td>
<td>23%</td>
</tr>
<tr>
<td>LOS costs</td>
<td>18</td>
<td>18%</td>
</tr>
<tr>
<td>Morbidity/mortality costs</td>
<td>14</td>
<td>14%</td>
</tr>
<tr>
<td>Other hospital costs</td>
<td>19</td>
<td>19%</td>
</tr>
<tr>
<td>Societal costs</td>
<td>0</td>
<td>0%</td>
</tr>
</tbody>
</table>

“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 underdose himself and, by exposing his microbes to non-lethal quantities of the drug, educate them to resist penicillin.”

Sir Alexander Fleming
Nobel lecture, 1945
A SENSE OF PERSPECTIVE

WHERE USED

50% HUMAN
50% ANIMAL

TYPES OF USE

20% HOSPITAL
80% COMMUNITY
20% THERAPEUTIC
80% PROPHYLAXIS/GROWTH PROMOTION

QUESTIONABLE USE

20-50% UNNECESSARY
40-80% HIGHLY QUESTIONABLE

Wise et al. BMJ 1999; 317: 609-610
• 6 US HOSPITALS
• Antibiotic use was prevalent in 60.4% of patients
• 2/3 of patients started on empirical antibiotics 
  one third did not have a fever or increased white cell count
• By the fifth day of therapy 66.4% of therapy was unchanged and
• 21.5 de-escalated [ more likely to happen in those who had cultures]
• Only 59% had cultures taken
The Jigsaw challenge of Global Antimicrobial Stewardship

Global stewardship - is defined as a "commitment to the responsible management of world resources (natural, human, and economic) through informed leadership."
Antimicrobial stewardship has been defined as “the optimal selection, dosage, and duration of antimicrobial treatment that results in the best clinical outcome for the treatment or prevention of infection, with minimal toxicity to the patient and minimal impact on subsequent resistance.”

The term ‘antimicrobial stewardship’ is defined as ‘an organisational or healthcare-system-wide approach to promoting and monitoring judicious use of antimicrobials to preserve their future effectiveness’.
Getting the message right....

Need to address ‘protection’ of antibiotics within healthcare

Drug Resistant Infection

DRI vs AMR ?
GOALS OF ANTIMICROBIAL STEWARDSHIP PROGRAMS

Antimicrobial stewardship: Importance for patient and public health

- Optimize patient safety
- Improve clinical outcomes
- Control costs
- Reduce resistance, CDI, toxicity

Prevent unintended Consequences

ESCMID eLibrary © by author
"ALONE WE CAN DO SO LITTLE; TOGETHER WE CAN DO SO MUCH"

- Helen Keller, lecturer, activist
Panel: Next steps for global antibiotic stewardship collaboration

- Global antibiotic stewardship starts with individual stewards reaching out to each other to share experiences, education, and resources; to collaborate in research and publication; and to set up mentoring programmes.
- Antibiotic policies to optimise antibiotic use are not enough; individual stewards need to have a global perspective and contribute to coordinating activities.
- Although each country’s approach to antimicrobial stewardship is different, and when nurtured, individual effort can positively affect local and national antibiotic stewardship programmes.
- Antibiotic stewardship models need to evolve from infection specialist-based teams to develop and use cadres of health-care professionals—including pharmacists, nurses, and community health workers—to meet the needs of the global population.
- All health-care providers who prescribe antibiotics should take ownership and understand the societal burden of suboptimal antibiotic use.
ONE SIZE DOES NOT FIT ALL

ADOPT

ADAPT

TRANSFORM
Antimicrobial Stewardship

The CIDRAP Antimicrobial Stewardship Project (ASP) offers freely available, high-quality information and educational resources on antimicrobial stewardship practice, research, and policy. It features a dynamic, content-rich Web site designed to actively engage a diverse, international audience. For more information, view our brochures: (1) for healthcare systems and (2) for public health.

This project capitalizes on CIDRAP's existing internationally recognized expertise, infectious disease news and information system, Web site infrastructure, and strong national and international audiences. Activities include the following:

**Podcasts and Webinars:** This content series involves webinars and audio podcasts provided by our world-renowned ASP Advisory Committee members. Each focuses on a specific area of interest within the topics of antimicrobial resistance and antimicrobial stewardship. The live webinars provide an interactive opportunity to viewers, and the recorded audio podcasts include short question-and-answer sessions.

**ASP News:** As a world-leading source of current, comprehensive, and authoritative information, CIDRAP's news publishing division produces original news stories and maintains in-depth information on a wide range of infectious disease topics. We have now added antimicrobial resistance and stewardship as a priority infectious disease topic.

**Online Journal Club:** The ASP online journal club highlights important new published research in the area of antimicrobial resistance and stewardship. Viewers have the opportunity to share comments on each highlighted research study.

**Policy Updates:** Several times each year, CIDRAP prepares summaries of key legislative and policy issues pertinent to antimicrobial resistance and stewardship.

**Bibliographies and Online Resources:** CIDRAP maintains lists of current literature by various topic areas and continuously searches for new online resources. These are compiled in the Resources area.

**Events Calendar and Conference Summaries:** CIDRAP maintains an ongoing list of upcoming conferences on antimicrobial resistance and stewardship and provides in-person news coverage of several selected conferences each year.

**Social Media Outreach:** CIDRAP provides ongoing contact with site users via Twitter, Facebook, and LinkedIn to ensure they have current and up-to-date information.

**AMR Data Map** is a collection of data visualization tools that allows users to explore antimicrobial consumption and resistance trends at the national, subnational, and regional level. Developed by the Center for Disease Dynamics, Economics & Policy, ResistanceMap includes resistance data from 49 countries and consumption data from 75 countries.

Join us on April 18 at 11:30am Central Daylight Time for a webinar on the role of infection prevention in the era of antibiotic stewardship. The webinar will be hosted by Trish Perl, MD, of the University of Texas Southwestern Medical School and Medical Center. You can find our previous webinars on the CIDRAP ASP YouTube page.

In collaboration with Ohio State, Debra Goff, PharmD, made a short animated video demonstrating the mechanisms of antibiotic resistance and its relationship to inappropriate antibiotic use, offering viewers ways they can become “antibiotic protectors.”
Faces of **ANTIMICROBIAL RESISTANCE**

IDSA
Infectious Diseases Society of America

ROGER POSER
Houston, TX

"...He was infected with an extremely antibiotic-resistant strain of *Pseudomonas.*"

72 years after Fleming
27Y FEMALE delivered a baby boy
Complicated protracted breech delivery
EMERGENCY C – SECTION
March 1961 Masindi General Hospital, Uganda
Neonatal Sepsis – HAI
Scarce Antibiotics administered

Reconstruction of Maternity Theatre, MGH, Uganda
THIS IS A HEALTH CARE ACQUIRED INFECTION

- What is the likely level of staffing and available “infection expertise”?
- Levels of hand hygiene and good infection prevention practice?
- What is the likely availability and access to antibiotics and also range of antibiotics?
- How likely was it that there is a guideline/policy/protocol for this?
- How likely was a culture taken and lab available?
- How likely would they be used/implemented?
- How likely was this based on surveillance data?
- How effective would the treatment be?
ACCEPTABILITY OF EVIDENCE-BASED NEONATAL CARE PRACTICES IN RURAL UGANDA – IMPLICATIONS FOR PROGRAMMING

In Uganda, the neonatal and maternal mortality rates remain high at 29/1000 and 435/100,000 live births respectively [14]. Only 42% of pregnant women get a supervised delivery (defined here as a delivery by a trained health professional – that is, a doctor, nurse, midwife, medical assistant or clinical officer); and emergency obstetric care (EmOC) met need is only 14% [15, 16]. Birth preparedness (BP) – a package that promotes planning...
DO GUIDELINES INFLUENCE THE IMPLEMENTATION OF HEALTH PROGRAMS? – UGANDA’S EXPERIENCE

Juliet Nabyonga Orem¹, Juliet Bataringaya Wavamunno¹, Solome K Bakeera² and Bart Criel³

POOR USE OF GUIDELINES

Results: There were 137 guidelines in the health sector, with programs related to Millennium Development Goals having the highest number (n = 83). The impetus for guideline development was stated in 78% of cases. Several guidelines duplicated content, and some conflicted with each other. The level of consultation varied, and some guidelines did not consider government-wide policies and circumstances at the service delivery level. Booklets were the main format of presentation, which was not tailored to the service delivery level. There was no framework for systematic dissemination, and target users were defined broadly in most cases. Over 60% of guidelines available at the central level were not available at the service delivery level, but there were good examples in isolated cases. There was no framework for systematic monitoring of use, evaluation, and review of guidelines. Suboptimal performance of the supervision framework that would encourage the use of guidelines, assess their utilization, and provide feedback was noted.
2. WHO African Region

Regional facts

Number of Member States: 47
Number of Member States for which information was available for the analysis: 8 (17%)
Regional population: 805 million
Life expectancy in the Region: average: 58 years; range: 51–62 years

2.3 Surveillance and laboratory capacity

Standardized diagnostics are critical for tracking antimicrobial resistance and laboratory training programmes established in capacity of health care professionals in laboratory management (Ghana AMR Project, 2014). Six of the eight responding surveillance (Figure 2.2); however, in many, it was not clear of its effectiveness. As MDR-TB is present in a number of countries, this disease is reasonably frequent.

Table 2.1 – Monitoring of use of antimicrobial medicines, WHO African Region

<table>
<thead>
<tr>
<th></th>
<th>Yes (%)</th>
<th>No (%)</th>
<th>Unknown (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antimicrobial medicines are available without a prescription.</td>
<td>17</td>
<td>0</td>
<td>83</td>
</tr>
<tr>
<td>Restriction of prescription-only medicines can be enforced.</td>
<td>11</td>
<td>4</td>
<td>85</td>
</tr>
<tr>
<td>Standard treatment guidelines could be drawn up.</td>
<td>11</td>
<td>4</td>
<td>85</td>
</tr>
<tr>
<td>Use of antimicrobial medicines was monitored in the previous 5 years.</td>
<td>6</td>
<td>6</td>
<td>88</td>
</tr>
</tbody>
</table>

Figure 2.1 – Percentages of Member States that had a national antimicrobial resistance plan, coordinating mechanism, focal point, policy or strategy and had prepared a report in the previous 5 years, WHO African Region

(Note: numbers above the bars represent the numbers of responses)
WHAT HAPPENED TO THE BABY?
THE BABY SURVIVED...

The Global Antibiotic Resistance Partnership (GARP)

- GARP is a network of interdisciplinary working groups catalyzing the development and implementation of national action plans to address antimicrobial resistance.
SOLUTIONS

• Regulation and legislation
• Accreditation
• Surveillance - resistance and consumption
• Stewardship
  - Structures + processes = outcomes \[S + P = O\]
    - Implementation [changing systems, cultures and behaviors]
    - Evaluation
    - Feedback
    - Reflect/review/renew
    - Sustainable
Impact of Over-the-Counter Restrictions on Antibiotic Consumption in Brazil and Mexico

PLoS ONE 8(10): e75550. doi:10.1371/journal.pone.0075550

trend in Venezuela [6]. Ultimately, two of the largest countries in Latin America, Brazil and Mexico, implemented a similar policy during 2010 enforcing the prohibition of all systemic antibiotic sales without prescription.

**Figure 1.** Trends in consumption in DDD/TID for Brazil and Mexico (2007–2012).
doi:10.1371/journal.pone.0075550.g001
A RED LINE TO STOP ANTIBIOTIC MISUSE

Government notifies Schedule H1 drugs

Schedule H1: Hope or Hype?

Monitoring the impact of Schedule H1 is a challenge.

Linezolid, Pip-tazo, Tigecycline not included
Changes in Chinese Policies to Promote the Rational Use of Antibiotics

Yonghong Xiao*, Jing Zhang, Beiwen Zheng, Lina Zhao, Sujuan Li, Lanjuan Li*

Collaborative Innovation Center for Diagnosis and Treatment of Infectious Diseases, State Key Laboratory for Diagnosis and Treatment of Infectious Diseases, The First Affiliated Hospital, College of Medicine, Zhejiang University, Hangzhou, China

In 2011, coupled with new healthcare reforms, the Chinese Ministry of Health changed strategy and launched a special campaign to promote the rational use of antimicrobials in healthcare settings. This mainly consisted of establishing mandatory management strategies, such as target setting, taskforce organization, and the development of audit and inspection systems.

According to the protocols, hospitals that fail to meet targets would be downgraded to a lower classification level, and the leaders of the institutes involved would be dismissed. Medical staff who seriously violate the regulations could lose their accreditation to prescribe antibacterial agents, have their professional qualification revoked, or even be prosecuted if their actions have serious consequences [14].
SOLUTIONS

• Regulation and legislation
• **Accreditation**
• Surveillance - resistance and consumption
• Stewardship
  - Structures + processes = outcomes \([S+P=O]\)
    - Implementation [changing systems, cultures and behaviors]
    - Evaluation
    - Feedback
    - Reflect/review/renew
    - Sustainable
QUALITY AND ACCREDITATION IN HEALTH CARE SERVICES  
A GLOBAL REVIEW

New Antimicrobial Stewardship Standard

Applicable to Hospitals and Critical Access Hospitals

Effective January 1, 2017

Medication Management (MM)

Standard MM.09.01.01

The [critical access] hospital has an antimicrobial stewardship program based on current scientific literature.

Elements of Performance for MM.09.01.01

1. Leaders establish antimicrobial stewardship as an organizational priority. (See also LD.01.03.01, EP 5)

   Note: Examples of leadership commitment to an antimicrobial stewardship program are as follows:
   - Accountability documents
   - Budget plans

2. The [critical access] hospital educates staff and licensed independent practitioners involved in antimicrobial ordering, dispensing, administration, and monitoring about antimicrobial resistance and antimicrobial stewardship practices. Education occurs upon hire or granting of initial privileges and periodically thereafter, based on organizational need.

3. The [critical access] hospital educates patients, and their families as needed, regarding the appropriate use of antimicrobial medications, including antibiotics. (For more information on patient education, refer to standard...)

ROP: The organization has a program for antimicrobial stewardship to optimize antimicrobial use.

- For organizations providing acute care services
- Introduced in 2012, evaluation begins in 2013
- Managing Medications standards

Continued on page...
SOLUTIONS

• Regulation and legislation
• Accreditation
• **Surveillance - resistance and consumption**
• Stewardship
  - Structures + processes = outcomes \([S+P=O]\)
    - Implementation [changing systems, cultures and behaviors]
    - Evaluation
    - Feedback
    - Reflect/review/renew
    - Sustainable
WILL 10 MILLION PEOPLE DIE A YEAR DUE TO ANTIMICROBIAL RESISTANCE BY 2050?

Marlieke E.A. de Kraker¹*, Andrew J. Stewardson², Stephan Harbarth¹

PLOS Medicine | DOI:10.1371/journal.pmed.1002184  November 29, 2016

Summary Points

- A recent high profile report estimates that, by 2050, 10 million people will die every year due to antimicrobial resistance (AMR) unless a global response to the problem of AMR is mounted.
- There is undoubtedly a large clinical and public health burden associated with AMR, but it is challenging to quantify the associated excess morbidity and mortality.
- When estimates of the burden of AMR are provided, they should be accompanied by clear acknowledgment of the associated uncertainties regarding the incidence of infections, the prevalence of resistance, and the attributable mortality.
- Predictions always require assumptions, but modeling future scenarios using unreliable contemporary estimates is of questionable utility.
- Current global estimates of the burden of AMR are not very informative; we need detailed, reliable data to be able to improve AMR control measures, preferably based on comprehensive, population-based surveillance data from low-, middle-, and high-income countries.
TRENDS IN ANTIBIOTIC RESISTANCE AMONG MAJOR BACTERIAL PATHOGENS ISOLATED FROM BLOOD CULTURES TESTED AT A LARGE PRIVATE LABORATORY NETWORK IN INDIA, 2008-2014

Sumanth Gandra, Nestor Mojica, Eili Y. Klein, Ashvin Ashok, Vidya Nerurkar, Mamta Kumari, Uma Ramesh, Sunanda Dey, Viral Vadwai, Bibhu R. Das, Ramanan Laxminarayan

Conclusion: Increasing resistance to antibiotics of last-resort, particularly among Gram-negatives, suggests an urgent need for new antibiotics and improved antimicrobial stewardship programs in India.

International Journal of Infectious Diseases 50 (2016) 75–82
RESISTANCE MAP

Resistance map is an interactive collection of charts and maps that summarize national and subnational data on antimicrobial use and resistance worldwide.

Antibiotic Resistance of *Escherichia coli* in India

Source: IMS Health

http://resistancemap.cddep.org/resmap/c/in/India

James Baggs, PhD; Scott K. Fridkin, MD, MPH; Lori A. Pollack, MD, MPH; Arjun Srinivasan, MD, MPH; John A. Jernigan, MD, MS

RESULTS During the years 2006 to 2012, 300 to 383 hospitals per year contributed antibiotic data to the HDD. Across all years, 55.1% of patients received at least 1 dose of antibiotics during their hospital visit. The overall national DOT was 755 per 1000 patient-days. Overall antibiotic use did not change significantly over time. The multivariable trend analysis of data from participating hospitals did not show a statistically significant change in overall use (total DOT increase, 5.6; 95% CI, −18.9 to 30.1; P = .65). However, the mean change (95% CI) for the following antibiotic classes increased significantly: third- and fourth-generation cephalosporins, 10.3 (3.1-17.5); macrolides, 4.8 (2.0-7.6); glycopeptides, 22.4 (17.5-27.3); β-lactam/β-lactamase inhibitor combinations, 18.0 (13.3-22.6); carbapenems, 7.4 (4.6-10.2); and tetracyclines, 3.3 (2.0-4.7).
QUALITY OF ANTIMICROBIAL DRUG PRESCRIPTION IN HOSPITAL

J. W. M. van der Meer and I. C. Gyssens

Clin Microbiol Infect 2001; 7 (Supplement 6): 12–15

Figure 1. Flow chart for assessment of quality of antimicrobial drug prescription. (Adapted from [8].) An antibiotic prescription can be assessed as any of the numbers (0 through VI) or a combination.
The Global-PPS development group

Isabelle Caniaux, biomérieux | Marie Françoise Gross, biomérieux | Mark Miller, biomérieux | Peter Zarb, Mater Dei Hospital, Msida, Malta | Vincent Jarlier, Laboratoire de Bactériologie-Hygienie, Faculté de Médecine Pitié-Salpêtrière, Paris, France | Dilip Nathwani, Ninewells Hospital and Medical School, Dundee, Scotland | Herman Goossens, Laboratory of Medical Microbiology, University of Antwerp, Belgium

Ann Versporten
prof. Herman Goossens
Laboratory of Medical Microbiology
University of Antwerp

For the Global-PPS network

N = 53 C (countries)
N = 335 H (hospitals)
QUALITATIVE PRESCRIBING DATA AND RESISTANCE

GLOBAL-PPS PATIENT Form (Please fill in one form per patient on antimicrobial treatment/prophylaxis)

<table>
<thead>
<tr>
<th>Ward Name/code</th>
<th>Activity (M, S, IC)</th>
<th>Patient Identifier</th>
<th>Survey Number</th>
<th>Years (if ≥ 2 years)</th>
<th>Patient Age Months (1-23 month)</th>
<th>Patient Age Days (if &lt; 1 month)</th>
<th>Weight in kg (decimals)</th>
<th>Gender M or F</th>
</tr>
</thead>
</table>

**Antimicrobial Name**

**Single Unit Dose** (g, mg, or IU)

**Doses/ day**

**Route (P, O, R, I)**

**Diagnosis** (see appendix II)

**Type of indication** (see appendix III)

**Reason in Notes** (Yes or No)

**Guideline Compliance** (Y, N, NA, Ni)

**Is a stop/review date documented?** (Yes/No)

**Treatment** (E: Empirical; T: Targeted)

The next section is to be filled in only if the treatment choice is based on microbiology data (Treatment=treatment) AND the organism is one of the following:

- **MRSA** (Yes or No)
- **MRCNS** (Yes or No)
- **VRE** (Yes or No)
- **ESBL-producing Enterobacteriaceae** (Yes or No)
- **3rd generation cephalosporin resistant Enterobacteriaceae non-ESBL producing or ESBL status unknown** (Yes or No)
- **Carbapenem-resistant Enterobacteriaceae** (Yes or No)
- **ESBL-producing non fermenter Gram-negative bacilli** (Yes or No)
- **Carbapenem-resistant non fermenter Gram-negative bacilli** (Yes or No)
- **Targeted treatment against other MDR organisms** (Yes or No)

**Treatment based on biomarker data** (Yes or No)

If yes, which biomarker (CRP, PCT or other)

<table>
<thead>
<tr>
<th>Type of biological fluid sample (Blood/urine/other)</th>
<th>Most relevant value of biomarker on the day of the PPS Value Unit (in μg/L, mg/L, ...)</th>
</tr>
</thead>
</table>

Ann Versporten

BSAC
BRITISH SOCIETY FOR ANTIMICROBIAL CHEMOTHERAPY
Antibiotic quality indicators for treatment of GNB infections in adult wards, by region

<table>
<thead>
<tr>
<th>Region</th>
<th>No guidelines (%)</th>
<th>compliant to guidelines (%)</th>
<th>Reason in notes (%)</th>
<th>Stop review date documented (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>East Europe (n=71)</td>
<td>0</td>
<td>94.4</td>
<td>95.8</td>
<td>62.0</td>
</tr>
<tr>
<td>North Europe (n=46)</td>
<td>10.9</td>
<td>90.2</td>
<td>91.3</td>
<td>60.9</td>
</tr>
<tr>
<td>South Europe (n=254)</td>
<td>24.4</td>
<td>86.0</td>
<td>68.1</td>
<td>37.0</td>
</tr>
<tr>
<td>West Europe (n=314)</td>
<td>9.6</td>
<td>87.4</td>
<td>89.2</td>
<td>43.6</td>
</tr>
<tr>
<td>Africa (n=22)</td>
<td>40.9</td>
<td>100</td>
<td>90.9</td>
<td>27.3</td>
</tr>
<tr>
<td>East &amp; South Asia (n=247)</td>
<td>11.7</td>
<td>92.6</td>
<td>95.5</td>
<td>71.3</td>
</tr>
<tr>
<td>Australia &amp; New Zealand (n=59)</td>
<td>10.2</td>
<td>94.3</td>
<td>94.9</td>
<td>42.4</td>
</tr>
<tr>
<td>West &amp; Central Asia (n=127)</td>
<td>39.4</td>
<td>86.4</td>
<td>76.4</td>
<td>32.3</td>
</tr>
<tr>
<td>South America (n=211)</td>
<td>17.1</td>
<td>78.5</td>
<td>95.7</td>
<td>44.5</td>
</tr>
<tr>
<td>North America (n=61)</td>
<td>42.6</td>
<td>100</td>
<td>96.7</td>
<td>44.3</td>
</tr>
<tr>
<td>Total Gram neg (n=1,412)</td>
<td>17.9</td>
<td>88.2</td>
<td>87.3</td>
<td>47.6</td>
</tr>
<tr>
<td>Total for therapeutic use (n=30,691)</td>
<td>17.7</td>
<td>80.3</td>
<td>85.5</td>
<td>38.0</td>
</tr>
</tbody>
</table>
FROM INTERMITTENT ANTIBIOTIC POINT PREVALENCE SURVEYS TO QUALITY IMPROVEMENT: EXPERIENCE IN SCOTTISH HOSPITALS

William Malcolm¹, Dilip Nathwani², Peter Davey³, Tracey Cromwell⁴, Andrea Patton⁵, Jacqueline Reilly¹, Shona Cairns¹ and Marion Bennie⁴,⁶

Malcolm et al. Antimicrobial Resistance and Infection Control 2013, 2:3

Figure 1 Time line showing progress from Point Prevalence Survey to Continuous Quality improvement.

Table 1 Overview of prescribing from baseline PPS (May 2009) and follow up PPS (September 2011)

<table>
<thead>
<tr>
<th>Measure</th>
<th>Baseline PPS (May 2009)</th>
<th>Follow up PPS (Sept 2011)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scotland acute hospitals</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of patients surveyed</td>
<td>7,573</td>
<td>11,604</td>
</tr>
<tr>
<td>Number of patients (%) prescribed antimicrobials</td>
<td>2,289 (30.2%)</td>
<td>3,728 (32.3%)</td>
</tr>
<tr>
<td>Number of patients (%) prescribed single antimicrobial</td>
<td>1,432 (62.6%)</td>
<td>2,268 (60.8%)</td>
</tr>
<tr>
<td>Number of prescriptions (%) for parenteral antimicrobials</td>
<td>1,731 (51.8%)</td>
<td>2,147 (47.8%)</td>
</tr>
<tr>
<td>Number of prescriptions (%) with indication recorded in notes</td>
<td>2,538 (75.9%)</td>
<td>3,811 (86.8%)</td>
</tr>
<tr>
<td>Number of prescriptions (%) compliant with local policy</td>
<td>1,939 (81.0%)</td>
<td>2,245 (82.8%)</td>
</tr>
<tr>
<td>Number of surgical prophylaxis prescriptions (%) with duration single dose</td>
<td>146 (49.3%)</td>
<td>287 (59.5%)</td>
</tr>
<tr>
<td>Number of surgical prophylaxis prescriptions (%) with duration = 1 day</td>
<td>57 (19.3%)</td>
<td>81 (16.8%)</td>
</tr>
<tr>
<td>Number of surgical prophylaxis prescriptions (%) with duration &gt;1 day</td>
<td>93 (31.4%)</td>
<td>114 (23.7%)</td>
</tr>
</tbody>
</table>

Scotland acute hospitals: Scotland acute hospitals; Europe: Europe; Odds ratio (p value): Odds ratio (p value)
SOLUTIONS

• Regulation and legislation
• Accreditation
• Surveillance - resistance and consumption
• **Stewardship**
  - Structures + processes = outcomes \([S+P=O]\)
    - Implementation [changing systems, cultures and behaviors]
    - Evaluation
    - Feedback
    - Reflect/review/renew
    - Sustainable
## TRADITIONAL MODEL OF STEWARDSHIP

### Table 1. Core Elements of Hospital Antibiotic Stewardship Programs

<table>
<thead>
<tr>
<th>Leadership commitment</th>
<th>Dedicating necessary human, financial, and information technology resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accountability</td>
<td>Appointing a single leader responsible for program outcomes and accountable to an executive-level or patient quality-focused hospital committee. Experience with successful programs shows that a physician or pharmacist leader is effective</td>
</tr>
<tr>
<td>Drug expertise</td>
<td>Appointing a single pharmacist leader responsible for working to improve antibiotic use</td>
</tr>
<tr>
<td>Action</td>
<td>Implementing at least 1 recommended action, such as systemic evaluation of ongoing treatment need after a set period of initial treatment (i.e., antibiotic &quot;time-out&quot; after 48 h)</td>
</tr>
<tr>
<td>Tracking</td>
<td>Monitoring process measures (e.g., adherence to facility-specific guidelines, time to initiation or de-escalation), impact on patients (e.g., <em>Clostridium difficile</em> infections, antibiotic-related adverse effects and toxicity), antibiotic use and resistance</td>
</tr>
<tr>
<td>Reporting</td>
<td>Regular reporting of the above information to doctors, nurses, and relevant staff</td>
</tr>
<tr>
<td>Education</td>
<td>Educating clinicians about disease state management, resistance, and optimal prescribing</td>
</tr>
</tbody>
</table>

Source: Centers for Disease Control and Prevention [4].

CDC Core Elements of Stewardship • CID 2014:59 (Suppl 3) • S97
THE MANY FACES OF GLOBAL STEWARDSHIP
CONSIDER THE BROADER LEADERSHIP

• Much focus on leadership……
• but less on how to use clinical leaders…..
• **Actively involve clinical leaders in antibiotic stewardship**

Clinical leaders
MDT leaders
Rational use

The RATIONAL USE focus area of the Toolbox describes the practical steps to begin or strengthen work to improve rational use of antibiotics.

The Health care section gives guidance on setting up rational use initiatives at health care facilities, describes core components for promoting rational use and possible interventions. The Non-human section provides an overview of what can be done to improve Antimicrobial Stewardship in Australian Hospitals 2011

Editors: Margaret Duguid and Marilyn Cruickshank

Core Elements of Hospital Antibiotic Stewardship Programs
<table>
<thead>
<tr>
<th>Antimicrobial stewardship characteristic</th>
<th>United Kingdom</th>
<th>France</th>
<th>United States</th>
</tr>
</thead>
<tbody>
<tr>
<td>Legislation</td>
<td>Health and Social Care Act of 2008 mandates hospitals implement antimicrobial stewardship practices</td>
<td>French Ministry of Health has required hospital antimicrobial stewardship programs since 2002 and annual public reporting of the hospital's compliance with specific antimicrobial stewardship performance indicators since 2007: financial penalty up to 0.1% of the hospital’s annual budget may be levied if indicators are not disseminated by hospitals.</td>
<td>Limited to California where the judicious use of antibiotics is required in general acute care hospitals since 2008 and also in Department of Veterans Affairs (VA) medical facilities where antimicrobial stewardship programs are required since 2014.</td>
</tr>
<tr>
<td>Infrastructure</td>
<td>Infection specialists manage and guide antimicrobial stewardship committees; on occasion, clinical pharmacists without ID training are involved with implementation</td>
<td>Antibiotic advisor (physician, pharmacist, microbiologist, or infection preventor with or without ID training) is responsible for implementation, in close collaboration with hospital pharmacists, microbiologists, and the antimicrobial stewardship committee</td>
<td>Supported by ID physicians and ID pharmacists, but increasing number of non-ID physicians and clinical pharmacists are leading programs when ID expertise may not be available</td>
</tr>
<tr>
<td>Local strategies</td>
<td>Local implementation of antimicrobial stewardship guidance provided in the Start Smart-Then Focus program; recommends broad range of strategies including guidelines and suggested content, intravenous-to-oral conversions, de-escalation, dose optimization, quality assurance audits, education and training</td>
<td>Local implementation of national guidance includes utilization of information technology resources, restricted antibiotic dispensation, practice audits, and education and feedback to prescribers</td>
<td>Varies depending on personnel and administrative support; strategies range from post-prescription review and feedback performed by team to “low-hanging fruit” such as parenteral-to-oral conversion protocols implemented by clinical pharmacists</td>
</tr>
<tr>
<td>Outcomes</td>
<td>Recommended that hospitals monitor outcomes as outlined in the Start Smart-Then Focus program; including annual monitoring and reporting of antimicrobial consumption trends and reporting compliance with antimicrobial stewardship algorithms and best practices for antimicrobial prescribing</td>
<td>Structure and process measures are included in composite indicator that is publicly reported annually; monitoring of antimicrobial utilization is required but not publicly reported; rates of specific resistant organisms are monitored as a component of the national infection control program</td>
<td>Most hospitals monitor antimicrobial expenditures; other outcomes vary depending on available electronic systems; many hospitals follow process measures, some follow antimicrobial susceptibility patterns, <em>Clostridium difficile</em> infection rates, and antimicrobial utilization if data accessible</td>
</tr>
</tbody>
</table>

**Table 1. Comparison of Hospital Antimicrobial Stewardship Legislative Requirements, Infrastructure, Local Strategies, and Outcomes in the United Kingdom, France, and the United States**
Maximising access to achieve appropriate human antimicrobial use in low-income and middle-income countries

Panel 2: Persuasive and restrictive interventions from economically developed settings that could be adapted for possible use in low-income and middle-income countries

Community practitioners
- Multifaceted interventions are most effective at achievement of overall reduction in antibiotic use, and interactive educational approaches outperform didactic education.\(^{66}\)
- Blended learning programmes with a combination of online, seminar-based, and context-bound learning with practice using simulated patients might be beneficial in settings where relevant facilities (e.g., reliable internet connection with sufficient bandwidth) are available. This approach safely reduced all-cause antibiotic prescribing at a general medical practice level over a year.\(^{71}\)
- Group education meetings that included general practitioners and their collaborating pharmacists resulted in decreased antibiotic prescribing.\(^{73}\)
- Training of clinicians in enhanced consultation skills and point-of-care tests of C-reactive protein have an additive effect on safe appropriate antibiotic use, and both are cost effective, an important factor in resource-poor settings.\(^{73,74}\)

Hospital practitioners
- The UK Start Smart Then Focus campaign,\(^ {75}\) which aims to achieve optimum antimicrobial stewardship by ensuring rapid prescription of the right antibiotic at the right dose at the right time followed by active review at 48 h, Thailand's Antibiotics Smart Use programme,\(^ {76}\) and Vietnam's VINARES programme\(^ {77}\) could be adopted in low-income and middle-income countries that have adequate surveillance and stewardship programmes.

*Lancet 2016; 387: 188-98*
A valiant effort for a national Guideline

IMPLEMENTATION?

CHALLENGING

SCALE

IMPACT

MEASUREMENT?
A valiant effort for a national Guideline

IMPLEMENTATION? CHALLENGING SCALE IMPACT MEASUREMENT?
Antibiotic policy of State to be floated soon

**IMPLEMENTATION?**

**CHALLENGING SCALE IMPACT MEASUREMENT?**

Value of step wise “state” driven Approach

Kerala: Antibiotic awareness to be a part of MBBS curriculum
**PRINCIPLES OF OPTIMAL PRESCRIBING**

**Start Smart**
- Do not start antibiotics in the absence of evidence of bacterial infection
  - Take history of relevant allergies
  - Initiate prompt effective antibiotic treatment within one hour of diagnosis (or as soon as possible) in patients with life threatening infections
  - Comply with local prescribing guidance
  - Document clinical indication and dose on drug chart and clinical notes
  - Include review/stop date or duration
  - Ensure relevant microbiological specimens taken

**Then Focus**
- Clinical review check microbiology, make and document decision*
  - **1. STOP**
  - **2. IV/oral switch**
  - **3. Change** to narrow spectrum agent
  - **4. Continue and review** after 4 hours after 24 hrs
  - **5. OPAT**

**Focus = Clinical review and antimicrobial decision making at 48 hrs**


Pulcini C, Defres S, Aggarwal I, Nathwani D, Davey P. Design of a 'day 3 bundle' to improve the reassessment of inpatient empirical antibiotic prescriptions. JAC. 2008
TARGET: The TARGET antibiotic toolkit

This toolkit is here to help clinicians and commissioners to use antibiotics responsibly and meet CQC requirements.

- Background information
- Resources for commissioners
- Leaflets to share with patients
- Audit Toolkits
- National Antibiotic Management Guidance
- Training resources
- Resources for clinical and waiting areas
- Self assessment checklist
- Useful links

www.rcgp.org.uk/TARGETantibiotics
IMPLEMENTATION OF ANTIMICROBIAL STEWARDSHIP INTERVENTIONS RECOMMENDED BY NATIONAL TOOLKITS IN PRIMARY AND SECONDARY HEALTHCARE SECTORS IN ENGLAND: TARGET AND START SMART THEN FOCUS

*J Antimicrob Chemother* 2016; **71**: 1408–1414

**Results:** The majority of CCGs and acute trusts reported reviewing national AMS toolkits formally or informally (60% and 87%, respectively). However, only 13% of CCGs and 46% of acute trusts had developed an action plan for the implementation of these toolkits. Only 5% of CCGs had antimicrobial pharmacists in post; however,

<p>| Table 2. Joint AMS-related materials or training being produced by CCGs in collaboration with acute trusts |</p>
<table>
<thead>
<tr>
<th>AMS-related materials or training produced in collaboration with acute trusts</th>
<th>Percentage of CCGs (n=82)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Joint anti-infective guidelines/policies</td>
<td>54</td>
</tr>
<tr>
<td>Joint anti-infective formulary</td>
<td>48</td>
</tr>
<tr>
<td>Joint anti-infective education for doctors</td>
<td>23</td>
</tr>
<tr>
<td>Joint anti-infective education for nurses</td>
<td>21</td>
</tr>
<tr>
<td>Joint anti-infective education for other healthcare professionals</td>
<td>15</td>
</tr>
</tbody>
</table>

© by author
IMPLEMENTATION OF ANTIMICROBIAL STEWARDSHIP INTERVENTIONS RECOMMENDED BY NATIONAL TOOLKITS IN PRIMARY AND SECONDARY HEALTHCARE SECTORS IN ENGLAND: TARGET AND START SMART THEN FOCUS


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Stewardship need to developed across health care communities: a continuing challenge
PROVIDING IMPETUS, TOOLS AND GUIDANCE TO STRENGTHEN NATIONAL CAPACITY FOR ANTIMICROBIAL STEWARDSHIP IN VIETNAM

Heiman F. L. Wertheim¹², Arjun Chandna¹⁰, Phu Dinh Vu³, Ca Van Pham³, Phong Dai Thi Nguyen³, Yen Minh Lam⁴, Chau Vinh Van Nguyen²⁴, Mattias Larsson¹, Ulf Rydell⁵, Lennart E. Nilsson⁵, Jeremy Farrar¹², Kinh Van Nguyen²³, Håkan Hanberger⁵⁶

• IPC and HAI
  – Month point prevalence surveys in ICUs
  – ECDC software package translated into Vietnamese
  – Traditional HAIs and Vietnam-specific issues e.g., families

• Antibiotic consumption
  – Simple database to help pharmacists calculate DDDs
  – Monthly PPS – indication, dose, route

• Microbiological surveillance and reporting
  – labs provided with WHONET database, CLSI guidelines
  – External quality control programme

Table 1. Drivers of antibiotic resistance, hospital-related WHO policy package priorities, and how these are met by the VINARES project [10].

<table>
<thead>
<tr>
<th>Resistance Driver</th>
<th>WHO Priority</th>
<th>VINARES Project</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fragmented, non-comprehensive action</td>
<td>Comprehensive, financed, concerted national action</td>
<td>Doctors, microbiologists, and pharmacists brought together; data from 16 hospitals collated and fed back to hospitals for concerted action</td>
</tr>
<tr>
<td>Paucity of data</td>
<td>Strengthen surveillance</td>
<td>Surveillance tools installed, and data submitted to central database each month</td>
</tr>
<tr>
<td>Lack of STGs</td>
<td>Promote rational use of medicines</td>
<td>Create a committee to use primary data and existing literature to formulate the first evidence-based STGs for Vietnam</td>
</tr>
<tr>
<td>Weak infection prevention and control</td>
<td>Enhance infection prevention and control</td>
<td>PPSIs to identify problematic areas in infection control and HAIs, and establish priorities accordingly</td>
</tr>
<tr>
<td>Inadequate laboratory capacity</td>
<td>Strengthen laboratory capacity</td>
<td>Each laboratory provided with computer, translated current susceptibility testing guidelines, external quality assurance, and surveillance database software</td>
</tr>
</tbody>
</table>

Figure 1. Location, speciality, and type of the 16 participating hospitals in the VINARES project.
doi:10.1371/journal.pmed.1001429.g001
THE TWO WORLDS?
Understanding the Worlds for a global Approach

High income Countries
- Respectable taxation systems
- Controllable corruption
- Appropriate funded healthcare (usually public)
- Decent sanitation
- Clean portable water
- Industrial waste controlled
- Antibiotic stewardship - variable
- Microbiology support - good

Low-Middle income Countries
- Broken taxation system
- Corruption is the norm
- Healthcare systems are invariably private (even public hospitals)
- Poor sanitation
- Contaminated portable water
- Industrial waste uncontrolled
- Antibiotic stewardship - poor
- Microbiology support - weak

T WALSH, BSAC 2017
Engaging the private sector to improve antimicrobial use in the community: experience from accredited drug dispensing outlets in Tanzania


Table 2 Percentage of ADDOs stocking antimicrobials not on the ADDO approved medicine list

<table>
<thead>
<tr>
<th>Number of unauthorized products available</th>
<th>Monitoring visit 1 (%)</th>
<th>Monitoring visit 2 (%)</th>
<th>Monitoring visit 3 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(N = 81)</td>
<td>(N = 93)</td>
<td>(N = 88)</td>
</tr>
<tr>
<td>0</td>
<td>47</td>
<td>79</td>
<td>87*</td>
</tr>
<tr>
<td>1–3</td>
<td>38</td>
<td>14</td>
<td>13*</td>
</tr>
<tr>
<td>4–6</td>
<td>13</td>
<td>5</td>
<td>0*</td>
</tr>
<tr>
<td>7–9</td>
<td>2</td>
<td>2</td>
<td>0</td>
</tr>
</tbody>
</table>

*Statistically significant (p < 0.05).

Figure 1 Percentage of ADDO dispensers who appropriately did not dispense antibiotics for common conditions.
Village women trained in neonatal care & sepsis management
Gentamicin + cotrimoxazole for 7 days for parents unwilling to be referred

Table 3: Home-based case management of suspected neonatal sepsis and outcome (1995–98)

- One death was averted for every 18 neonates cared for
- Cost of care was $5.3 per neonate (1997)

Give urgent attention to the client with headache and one or more of:

- Sudden onset of severe headache
- New onset persistent, different to usual headache, increasing frequency or severity
- Headache that wakes client or is worse in morning
- Neck stiffness/meningism and/or vomiting
- Temperature ≥38°C
- Worsening/persistent headache in HIV recently started on ART
- BP ≥ 180/110 and non-pregnant
- Pregnant, or 1 week postpartum and BP ≥ 140/90
- Decreased level of consciousness
- Confusion
- Vision problems (e.g. double vision) or eye pain
- Following a first seizure
- Sudden onset weakness or numbness of face, arm or leg
- Speech disturbance
- Pupils different size

Management:

- If temp ≥38°C and neck stiffness, treat for meningitis. Give Ceftriaxone 2g iv/im
- Refer same day to hospital

http://knowledgetranslation.co.za/programmes/pack-adult/
Stewardship : Structure + Process = Outcomes

S + P = O
CONTROL OF INFECTION DUE TO KLEBSIELLA AEROGENES IN A NEUROSURGICAL UNIT BY WITHDRAWAL OF ALL ANTIBIOTICS

D. J. E. Price  J. D. Sleigh *
Division of Neurosurgery, Institute of Neurological Sciences, and Department of Bacteriology, Killearn Hospital, Glasgow

Summary  Klebsiella aerogenes infection became epidemic in a neurosurgical intensive-care ward. 1 patient in 4 had chest infections, 1 in 8 had urinary infections, and 8 patients died with klebsiella meningitis. Even isolation of infected cases and treatment with massive doses of colistin failed to control the outbreak. Once antibiotics, both prophylactic and therapeutic, were discontinued in the unit, the incidence of klebsiella infection fell dramatically with no obvious ill-effects on the outcome of infections due to this or other organism. In fact, the infection-rate from all organisms was considerably reduced.

Authors' conclusions:

We found high-certainty evidence that interventions are effective in increasing compliance with antibiotic policy and reducing duration of antibiotic treatment. Lower use of antibiotics probably does not increase mortality and likely reduces length of stay. Additional trials comparing antibiotic stewardship with no intervention are unlikely to change our conclusions. Enablement consistently increased the effect of interventions, including those with a restrictive component. Although feedback further increased intervention effect, it was used in only a minority of enabling interventions. Interventions were successful in safely reducing unnecessary antibiotic use in hospitals, despite the fact that the majority did not use the most effective behaviour change techniques. Consequently, effective dissemination of our findings could have considerable health service and policy impact. Future research should instead focus on targeting treatment and assessing other measures of patient safety, assess different stewardship interventions, and explore the barriers and facilitators to implementation. More research is required on unintended consequences of restrictive interventions.
PARACHUTE APPROACH TO EVIDENCE BASED MEDICINE

Malcolm Potts, Ndola Prata, Julia Walsh, Amy Grossman

Waiting for the results of randomised trials of public health interventions can cost hundreds of lives, especially in poor countries with great need and potential to benefit. If the science is good, we should act before the trials are done.


*BMJ* 2006;333:701–3
We found 221 relevant studies. Ninety-six studies were from North America. The remaining 125 studies were from Europe (87), Asia (19), South America (8), Australia (8), and East Asia (3). The studies tested interventions that fell broadly into two categories: restrictive techniques, which apply rules to make physicians prescribe properly, and enablement techniques, which provide advice or feedback to help physicians prescribe properly.

Interventions providing advice or feedback to physicians were more effective in improving prescribing practices than those interventions that did not provide this information to physicians.

Both enablement and restriction were independently associated with increased compliance with antibiotic policies, and enablement enhanced the effect of restrictive interventions (high-certainty evidence). Enabling interventions that included feedback were probably more effective than those that did not (moderate-certainty evidence).
INTERVENTIONS TO IMPROVE ANTIBIOTIC PRESCRIBING PRACTICES FOR HOSPITAL INPATIENTS

Authors' conclusions:

We found high-certainty evidence that interventions are effective in increasing compliance with antibiotic policy and reducing duration of antibiotic treatment. Lower use of antibiotics probably does not increase mortality and likely reduces length of stay. Additional trials comparing antibiotic stewardship with no intervention are unlikely to change our conclusions. Enablement consistently increased the effect of interventions, including those with a restrictive component. Although feedback further increased intervention effect, it was used in only a minority of enabling interventions. Interventions were successful in safely reducing unnecessary antibiotic use in hospitals, despite the fact that the majority did not use the most effective behaviour change techniques. Consequently, effective dissemination of our findings could have considerable health service and policy impact. Future research should instead focus on targeting treatment and assessing other measures of patient safety, assess different stewardship interventions, and explore the barriers and facilitators to implementation. More research is required on unintended consequences of restrictive interventions.
STEWARDSHIP IMPLEMENTATION

But with measurement of effect, feedback and measure unintended harm
### AN INTERNATIONAL CROSS-SECTIONAL SURVEY OF ANTIMICROBIAL STEWARDSHIP PROGRAMMES IN HOSPITALS

#### What processes are people using?

<table>
<thead>
<tr>
<th>Antimicrobial stewardship worldwide survey</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Table 4. AMS strategies—all or some wards (actual or planned AMS programme), n=422</strong></td>
</tr>
<tr>
<td> </td>
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<tr>
<td>-------------------------------------------</td>
</tr>
<tr>
<td>Treatment guidelines</td>
</tr>
<tr>
<td>Surgical prophylaxis guidelines</td>
</tr>
<tr>
<td>Approved antibiotics (formulary)</td>
</tr>
<tr>
<td>Reserve antibiotics needing authorization</td>
</tr>
<tr>
<td>by indication</td>
</tr>
<tr>
<td>Infectious diseases/microbiology advice</td>
</tr>
<tr>
<td>by telephone</td>
</tr>
<tr>
<td>Infectious diseases/microbiology advice</td>
</tr>
<tr>
<td>on ward rounds</td>
</tr>
<tr>
<td>Systematic advice for bacteraemia by infectious diseases/microbiology</td>
</tr>
<tr>
<td>Dose optimization on request</td>
</tr>
<tr>
<td>Intravenous-to-oral switch guidance</td>
</tr>
<tr>
<td>Review of intravenous therapy at Day 3</td>
</tr>
<tr>
<td>Care bundles (e.g. ventilator)</td>
</tr>
<tr>
<td>Automatic stop/review policy</td>
</tr>
<tr>
<td>Pre-authorized pharmacy-driven dose optimization</td>
</tr>
<tr>
<td>(e.g. automatic renal dose adjustments, intravenous-to-oral conversions etc.)</td>
</tr>
<tr>
<td>Separate antimicrobial chart or section</td>
</tr>
<tr>
<td>Inflammatory markers to prevent initiation of antibiotics, e.g. procalcitin</td>
</tr>
<tr>
<td>Inflammatory markers to stop antibiotics early, e.g. procalcitin</td>
</tr>
<tr>
<td>Restrictions on access by pharmaceutical representatives</td>
</tr>
<tr>
<td>Antibiotic cycling programme</td>
</tr>
</tbody>
</table>
SYSTEMATIC REVIEW AND META-ANALYSIS:
IMPACT OF KEY TECHNICAL INTERVENTIONS

- Adherence to local guidelines
  - Mortality: RRR 35% [RR 0.65, 95% CI 0.54–0.8; P<0.0001]
- Culture driven de-escalation
  - Mortality: RRR 65% [RR 0.44, 95% CI 0.3–0.66; P<0.0001]
- *S.aureus* bacteraemia clinical review
  - Mortality: RRR 66% [RR 0.34, 95% CI 0.25–0.75; P<0.008]
- IVOST No difference in mortality? Reduced LOS
- Restriction of antibiotics decreased consumption and in many studies resistance to the drug-bug profile
- TDM decreased nephrotoxicity

The Ethics of Antimicrobial Stewardship

- Stewardship guidelines
- Technical focus - infection prevention/control, optimising consumption, diagnostics, treatments, impact etc

- Stewardship guidelines have little or no information about the moral/ethical questions underpinning or guiding good stewardship
- Making value judgements
- Prioritise health outcomes above all other goods
- Access to all v preference for some
- Individual rights and autonomy or collective interests
- Obligation to patients
- Personal v organisational legal risk
DOING STEWARDSHIP: ADDRESSING THE IMPLEMENTATION GAP – CHANGING PRESCRIBING BEHAVIOUR
Imipenem + Vanco

Meropenem + Vanco

Pip-Tazo + Cipro

Cefepime

Ceftazidime + Clindamycin + Gentamicin + Caspofungin + linezolid

watch and wait a bit
UNDERSTANDING THE DETERMINANTS OF ANTIMICROBIAL PRESCRIBING WITHIN HOSPITALS: THE ROLE OF “PRESCRIBING ETIQUETTE”

Clinical Infectious Diseases 2013;57(2):188–96
Table 3. Rules of Antimicrobial Prescribing Etiquette

1. Noninterference with the prescribing decisions of colleagues: reluctance to interfere with the prescribing decisions of colleagues. In the case of antimicrobial prescribing, there is a reluctance to intercept antimicrobial prescriptions started by colleagues. This recognizes the autonomous decision-making process of prescribing.

2. Accepted noncompliance to policy: Deviations from policy recommendations are tolerated and put in the context of the prescriber’s experience and expertise and the specific clinical scenario. This leads to hierarchy and expertise, and not policy as determinants of prescribing practice behaviors.

3. Hierarchy of prescribing: Prescribing as an activity is performed by junior doctors. But it is the senior doctors who decide what is prescribed.
WHAT DO WE NEED FOR GLOBAL SUCCESSFUL ANTIMICROBIAL STEWARDSHIP IMPLEMENTATION?

- Strategy
- Leadership
- Structure
- Human & Technical support & cross specialty engagement
- Evidence and learning
- Context and Culture
- Mentorship / support
THE ANTIMICROBIAL MANAGEMENT TEAM AND ITS RELATIONSHIPS WITHIN THE ORGANISATION

Need for alternative models
Based on geography, resources, needs and seek broader engagement

http://www.scotland.gov.uk
LACK OF HUMAN RESOURCES

http://www.worldmapper.org/display.php?selected=219#
ANTIMICROBIAL STEWARDSHIP ACROSS 47 SOUTH AFRICAN HOSPITALS: A PHARMACIST LED IMPLEMENTATION STUDY

Adrian J Brink, Angeliki P Messina, Charles Feldman, Guy A Richards, Piet J Becker, Debra A Geoff, Karri A Bauer, Dilip Nathwani, Dena van den Bergh, on behalf of the Netcare Antimicrobial Stewardship Study Alliance

Define goals and process measures

| Define collective antimicrobial stewardship programme goals for the hospital group. |
| Reduction in overall antibiotic consumption (outcome goal). |
| Implementation in all institutions (spread goal). |
| Define process measures on the basis of local and international guidelines and best practice adapted to the South African setting (panel 1). |

Targeted process measures

- Cultures not done before commencement of empirical antibiotics
- More than 7 days of antibiotic treatment
- More than 14 days of antibiotic treatment
- Use of more than four antibiotics concurrently
- Redundant or so-called double antibiotic coverage

Seek endorsement of the antimicrobial stewardship programme

- Form multidisciplinary antimicrobial stewardship programme committees
- Presentation of the model to each participating institution by the quality improvement director
- Adapt and modify the measures, if needed
- Seek consensus and endorsement from doctors, nurses, and hospital pharmacy, and nursing management

Implement learning cycles

| Learning session 1:
- Show the implementation at each hospital. |
| Pharmacists measurement and data submissions. |
| Project manager feedback to hospitals. |
| Provide support in between learning session. |
| Learning sessions 2 and thereafter. |

Aims of the joint learning cycles

- Collaborative learning between hospitals
- Clarify requirements of antimicrobial stewardship programme implementation
- Brainstorm ideas to overcome obstacles to implementation
- Share success
- Evaluate accuracy and consistency of data
- Provide comparative feedback on progress and improvements or otherwise

Aims of feedback by the project manager to hospitals

- Provide monthly feedback to each hospital and their managers to facilitate adjustments to hospital action plans following self-monitoring, specifically regarding:
  - Improvements in compliance with the measures (or otherwise)
  - Improvements in antibiotic consumption data (or otherwise)
- Individualised goals

- Followed by feedback to doctors, hospital management, and the antimicrobial stewardship programme committee, including infection prevention practitioners of each hospital.

Figure 1: Netcare antimicrobial stewardship Breakthrough Series Collaborative model for group-wide implementation and monitoring process (47 hospitals)
NURSES ARE THE LARGEST HEALTHCARE WORKFORCE

Ratio of nursing and midwifery personnel to physicians

Courtesy of E. Sanchez
Key nursing activities include:

- Triage, and initial infection control precautions
- Medication allergy assessment and reconciliation
- Timely ordering and administration of antibiotics
- Early and appropriate collection and submission of specimens for culture
  - Antibiotic timeout and de-escalation
  - Implementation of quality and safety bundle measures
- Central communicator among prescribers, pharmacy, lab, discharge planners and consultants

Managing Cultural Dimensions in MDT stewardship interactions
CROSS-SPECIALTY ENGAGEMENT WITH ANTIMICROBIAL STEWARDSHIP

Conclusions: Despite current AMS-AMR strategies being advocated by infection specialists and discussed by national and international policy makers, AMS-AMR coverage remained limited across clinical specialty scientific conferences in 2014. We call for further intervention to ensure specialty engagement with AMS programmes and promote the AMR agenda across clinical practice.
Implementation of an intensified antibiotic stewardship programme targeting third-generation cephalosporin and fluoroquinolone use in an emergency medicine department


Problem

Antibiotic policy and stewardship programme
Locally consented guidelines for the most frequent indications and acute infections were first available in written formats in 2006. In the following years, the overall hospital-wide antibiotic use density remained stable. However, the use of third-generation cephalosporins and fluoroquinolones increased.

Action

Goal: reduce FQ/CP antibiotics  Guideline revision
Alternative treatment options
Information/education
Standards protocols
Internet/pocket size
Briefings by ID + consults
Feedback of data
Agreed action, metrics and outcomes

An intensive antibiotic stewardship programme targeting third-generation cephalosporin and fluoroquinolone prescription, using persuasive rather than restrictive tools, was implemented in a large academic German emergency department. Interrupted time series (TS) analysis in this quasi-experimental research setting demonstrated reduced cephalosporin and fluoroquinolone drug use densities by >20% with sustained performance. Interrupted Time S analysis is the statistic tool of choice to investigate intervention-related effects of ABS programmes in a quasi-experimental research-setting.
CHANGING BEHAVIOUR?

Antibiotic prescribing in hospitals: a social and behavioural scientific approach

Panel: Examples of potentially effective strategies to improve antibiotic use in hospitals

Improvement strategies at the organisational level

* Antibiotic policies
  - Provide an antibiotic formulary
  - Provide an antibiotic order form
  - Provide an antibiotic order form including restriction requiring prior authorisation of prescriptions by infectious disease physicians, microbiologists, pharmacists
  - Provide automatic stop orders
  - Install an infection prevention committee
  - Provide written antibiotic guidelines
  - Provide an antibiotic booklet

* Strategies to improve coordination, collaboration, communication, teamwork, and care logistics
  - Introduce pharmacists to review orders and to contact physicians to reinforce appropriate use
  - Introduce ward rounds to stimulate collaboration between doctor and pharmacist or microbiologist
  - Introduce telephone advice for doctors to discuss prescriptions with the pharmacist or microbiologist
  - Introduce flow sheets regarding the coordination of care
  - Improve the logistics of care, for example, to reduce the time between requesting laboratory diagnostics and prescribing antibiotics

Improvement strategies at the individual level

* Distribute educational materials (eg, guidelines)
* Provide group education including conferences, seminars, and skills training programmes
* Provide small group education
* Stimulate local consensus processes
* Use local opinion leaders
* Provide individual instruction at the physician’s office (outreach visits or academic detailing)
* Provide feedback (provision of summary of clinical performance, based on, for example, medical records)
* Provide reminders (prompts to perform specific actions), including decision support by computer

But – remember, not all prescribers are equal or equivalent

“Improvement Science” …
THE SPREAD AND SUSTAINABILITY OF QUALITY IMPROVEMENT IN HEALTHCARE

A resource to increase understanding of the 10 key factors underpinning successful spread and sustainability of quality improvement

Sustainability is ‘when new ways of working and improved outcomes become the norm.’ In other words, it is when an improvement has become an integrated and the mainstream way of working. It should withstand challenge and variation over time, through a process of continuous improvement³.
**PRINCIPLES OF OPTIMAL PRESCRIBING**

**Start Smart**
- Do not start antibiotics in the absence of evidence of bacterial infection
  - Take history of relevant allergies
  - Initiate prompt effective antibiotic treatment within one hour of diagnosis

**Then Focus**
- Clinical review check microbiology, make and document decision

**Focus = Clinical review and antimicrobial decision making at 48 hrs**

- Shift to principles...
- Keep simple...
- Opportunities to share principles across professions...

---

**DoH Advisory Committee on Antimicrobial Resistance and Healthcare Associated Infection (ARHAI) Antimicrobial Stewardship: "START SMART - THEN FOCUS"**


Pulcini C, Defres S, Aggarwal I, Nathwani D, Davey P. Design of a 'day 3 bundle' to improve the reassessment of inpatient empirical antibiotic prescriptions. JAC. 2008
The New Antibiotic Mantra—“Shorter Is Better”

Brad Spellberg, MD

JAMA Internal Medicine  Published online July 25, 2016

### Table. Infections for Which Short-Course Therapy Has Been Shown to Be Equivalent in Efficacy to Longer Therapy

<table>
<thead>
<tr>
<th>Disease</th>
<th>Short, Days</th>
<th>Long, Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Community-acquired pneumonia&lt;sup&gt;1-3&lt;/sup&gt;</td>
<td>3-5</td>
<td>7-10</td>
</tr>
<tr>
<td>Nosocomial pneumonia&lt;sup&gt;5,7&lt;/sup&gt;</td>
<td>≤8</td>
<td>10-15</td>
</tr>
<tr>
<td>Pyelonephritis&lt;sup&gt;10&lt;/sup&gt;</td>
<td>5-7</td>
<td>10-14</td>
</tr>
<tr>
<td>Intraabdominal infection&lt;sup&gt;11&lt;/sup&gt;</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>Acute exacerbation of chronic bronchitis and COPD&lt;sup&gt;12&lt;/sup&gt;</td>
<td>≤5</td>
<td>≥7</td>
</tr>
<tr>
<td>Acute bacterial sinusitis&lt;sup&gt;13&lt;/sup&gt;</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>Cellulitis&lt;sup&gt;14&lt;/sup&gt;</td>
<td>5-6</td>
<td>10</td>
</tr>
<tr>
<td>Chronic osteomyelitis&lt;sup&gt;15&lt;/sup&gt;</td>
<td>42</td>
<td>84</td>
</tr>
</tbody>
</table>

Abbreviation: COPD, chronic obstructive pulmonary disease.
Novel Future strategies to reduce- improve antibiotic use
QUALITY IMPROVEMENT

How to Improve

IH uses the Model for Improvement as the framework to guide improvement work. The Model for Improvement,* developed by Associates in Process Improvement, is a simple, yet powerful tool for accelerating improvement. This model is not meant to replace change models that organizations may already be using, but rather to accelerate improvement.

Learn about the fundamentals of the Model for Improvement and testing changes on a small scale using Plan-Do-Study-Act (PDSA) Cycles:

- Introduction
- Forming the Team
- Setting Aims
- Establishing Measures
- Selecting Changes
- Testing Changes
- Implementing Changes

* What are we trying to accomplish?
* How will we know that a change is an improvement?
* What changes can we make that will result in improvement?

Act
Plan
Study
Do
The missing care bundle: antibiotic prescribing in hospitals

Table 1
Proposed antibiotic care bundle for prescribing antibiotics as treatment in acute care

We recommend the following points are included:

At initiation:
- Document clinical rationale for antibiotic initiation
- Appropriate specimens sent to diagnostic microbiology laboratory (according to local policy)
- Antibiotic selected according to local policy and risk group (exclude allergy)
- Consider removal of foreign body/drainage of pus/surgical intervention

Continuation:
- Daily consideration of de-escalation, intravenous–oral switch or stopping antibiotics (based on review of clinical picture and laboratory results)
- Antibiotic drug levels monitored as required by local policy

The 3 Day Antibiotic Bundle

### Figure 2: Dimensions needed to achieve clinical quality improvement

| Strategic × Cultural × Technical × Structural = Result |
|-----------|-------------------|-------------------|-------------------|-------------------|
| 0 × 1 × 1 × 1 = No significant results on anything really important |
| 1 × 0 × 1 × 1 = Small, temporary effects; no lasting impact |
| 1 × 1 × 0 × 1 = Frustration and false starts |
| 1 × 1 × 1 × 0 = Inability to capture the learning and spread it throughout the organisation |
| 1 × 1 × 1 × 1 = Lasting organisation-wide impact |

0 = absent; 1 = fully present
Change in prescribing
Review

Time for action—Improving the design and reporting of behaviour change interventions for antimicrobial stewardship in hospitals: Early findings from a systematic review

Peter Davey\textsuperscript{a,\textdagger}, Claire Peden\textsuperscript{a}, Esmita Charani\textsuperscript{b}, Charis Marwick\textsuperscript{a}, Susan Michie\textsuperscript{c}

\textsuperscript{a} Division of Population Health Sciences, Medical Research Institute, University of Dundee, Dundee DD1 4BE, Scotland, UK
\textsuperscript{b} Centre for Infection Prevention and Management, Imperial College, Hammersmith Campus, London W12 0NN, UK
\textsuperscript{c} Centre for Behaviour Change, University College London, 1-19 Torrington Place, London WC1E 7HJ, UK

\begin{figure}
\centering
\includegraphics[width=\textwidth]{metrics_bar_chart.png}
\end{figure}

- Participants aware of goal: 69%
- Awareness of higher order goal: 56%
- Stakeholders involved in setting targets: 15%
- Goal threshold specified: 9%
- Goal timed: 4%

\textbf{Metrics}
The three faces of performance measurement should not be seen as mutually exclusive silos. This is not an either/or situation.

All three areas must be understood as a system. Individuals need to build skills in all three areas.

Organizations need translators who and be able to speak the language of each approach.

The problem is that individuals identify with one of the approaches and dismiss the value of the other two.
TARGETS FOR SCRUTINITY

f) Major targets for the campaign;
   i. Antibacterial agents being stocked less than 50 or 35 in tertiary or secondary hospitals, respectively;
   ii. Prescriptions with antibiotics for outpatients being < 20%;
   iii. Prescriptions with antibiotics for emergency patients being < 40%;
   iv. Antibiotic-use rate for inpatients being < 60%;
   v. Antibiotic prophylaxis use for surgical procedures being < 30%, and regimen rationality > 80%;
   vi. Antibiotic utilizing intensity for inpatients being < 40DDD/100 patient days;
   vii. Microbiological testing rate before antibacterial therapy being > 35% (in 2011) or > 50% (in 2012).

What is the national goal for reducing inappropriate antibiotic prescribing?

In 2015, the White House set a goal of reducing inappropriate antibiotic use in outpatient settings by 50 percent within the next five years. Based on the current amount of unnecessary antibiotic prescribing, this equates to 15 percent fewer antibiotic prescriptions per year by 2020—eliminating more than 23 million unwarranted prescriptions of antibiotics annually.
A CONCISE SET OF STRUCTURE AND PROCESS INDICATORS TO ACCESS AND COMPARE ANTIMICROBIAL STEWARDSHIP PROGRAMS AMONG EU AND US HOSPITALS: RESULTS FROM A MULTINATIONAL EXPERT PANEL

Lori A. Pollock, Diamantis Plachouras, Ronda Sinkowitz-Cochran, Heidi Gruhler, Dominique L. Monnet, Todd Weber, Transatlantic Taskforce on Antimicrobial Resistance (TARFAR) expert panel on Stewardship structure and process indicators
STRUCTURE AND PROCESS TARGETS?

Measurable goals of the road map

First year
1. Formulation of a national policy to combat antimicrobial resistance.
2. Initiation of efforts to implement major components of the policy.
3. Sixty percent compliance rate to major recommendations by all stakeholders.

Second year
1. Compliance rate to reach 70%.
2. Initiation of efforts to implement minor components of the policy.
3. India achieving the status of a country with a functioning antibiotic policy despite limitations.

Next five years
1. More than 90% compliance rate to major and minor components of the policy.
2. India achieving the status of a country with a functioning antibiotic policy comparable to those countries with high quality infection control and antibiotic policy compliance rates.

Who is doing this?
Who is measuring?
What is the incentive to do it?
## STRUCTURES & PROCESSES

Six years of a national antimicrobial stewardship in Scotland: where are we now?

### Performance of 14 Scottish AMTs against 10 European Validated Indicators

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Formal mandate for hospital multi-disciplinary antimicrobial management team (AMT)</td>
<td>13</td>
</tr>
<tr>
<td>2. AMT member is a member of Drug and Therapeutics Committee</td>
<td>13</td>
</tr>
<tr>
<td>3. Bedside expert consultant advice regarding antibiotics on request available the same day</td>
<td>13</td>
</tr>
<tr>
<td>4. Regular ward rounds by members of AMT performed at least weekly</td>
<td>11</td>
</tr>
<tr>
<td>5. Clinical audit of prescribers’ compliance with local clinical guidelines by AMT</td>
<td>14</td>
</tr>
<tr>
<td>6. Antibiotic formulary list updated biannually</td>
<td>14</td>
</tr>
<tr>
<td>7. Local clinical practice guidelines for microbiologically documented therapy updated biannually</td>
<td>14</td>
</tr>
<tr>
<td>8. Local clinical practice guidelines for empiric/therapy updated biannually</td>
<td>14</td>
</tr>
<tr>
<td>9. Local clinical practice guidelines for surgical prophylaxis available</td>
<td>14</td>
</tr>
<tr>
<td>10. Prescriber education by personalised interactive methods (e.g. daily ward rounds, face-to-face training sessions)</td>
<td>9</td>
</tr>
</tbody>
</table>

* Not applicable to Scottish Practice

Source: SFPG Survey, Maturity of Antimicrobial Stewardship in Scotland, May 2014

### Performance of 14 Scottish AMTs against 13 Other Stewardship Initiatives and Practices

<table>
<thead>
<tr>
<th>Practice</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Links with Drug and Therapeutics Committee</td>
<td>12</td>
</tr>
<tr>
<td>2. Links with Infection Prevention/Control Committees</td>
<td>16</td>
</tr>
<tr>
<td>3. Links with Primary Care/Medicine Management Teams*</td>
<td>10</td>
</tr>
<tr>
<td>4. Links with Patient Safety Teams</td>
<td>1</td>
</tr>
<tr>
<td>5. CDI HEAT target supporting indicator</td>
<td>16</td>
</tr>
<tr>
<td>6. Programme of Point Prevalence Studies</td>
<td>9</td>
</tr>
<tr>
<td>7. Hospital level surveillance of antimicrobial use</td>
<td>13</td>
</tr>
<tr>
<td>8. Surveillance recommended agents vs restricted agents</td>
<td>8</td>
</tr>
<tr>
<td>9. Surveillance of antimicrobial use in selected wards</td>
<td>6</td>
</tr>
<tr>
<td>10. IV to oral switch policy</td>
<td>13</td>
</tr>
<tr>
<td>11. Assays for vancomycin and gentamicin available with rapid reporting</td>
<td>14</td>
</tr>
<tr>
<td>12. On-line calculators available for gentamicin and vancomycin</td>
<td>14</td>
</tr>
<tr>
<td>13. Standardised prescription &amp; monitoring chart for gentamicin</td>
<td>10</td>
</tr>
<tr>
<td>14. Alert policy for restricted use of specific antimicrobials</td>
<td>10</td>
</tr>
<tr>
<td>15. Authorisation required for supply for specific antimicrobials</td>
<td></td>
</tr>
<tr>
<td>16. Education programme for all staff groups</td>
<td>12</td>
</tr>
<tr>
<td>17. Mandatory training for certain staff groups</td>
<td>7</td>
</tr>
<tr>
<td>18. Delivery of SCRAP Initiative in primary care planned*</td>
<td>7</td>
</tr>
</tbody>
</table>

* Out of 13 AMTs because one Health Board has no Primary Care Services

Colligan C et al ARIC 2015: 4:28
ANTIBIOTIC PRESCRIBING INDICATORS/METRICS

Process measures
- Amount of antibiotic in DDD/100 bed days
  - Promoted antibiotic
  - Restricted antibiotics
- Days or length of therapy
- Compliance with acute empiric guidance
  - documentation in notes and compliance with policy
- Compliance with surgical prophylaxis
  - < 60 min from incision, < 24 hours and compliance with local policy
- Compliance with “other bundles”

Outcome measures
- [we use trends and time series analysis]
  - CDI rates
  - SSI rates
  - Surveillance of resistant pathogens
  - Mortality [SMR’s]
  - Cost of pharmaceuticals
  - LOS

Balancing measures
- Mortality
- SSI’s
- Readmissions to hospital within 30 days of discharge
- Admissions to ICU
- Rate of complications
- Treatment related toxicity e.g. aminoglycoside related toxicity
FROM INTERMITTENT ANTIBIOTIC POINT PREVALENCE SURVEYS TO QUALITY IMPROVEMENT: EXPERIENCE IN SCOTTISH HOSPITALS

Malcolm et al. Antimicrobial Resistance and Infection Control 2013, 2:3

Make data collection easy and routine
Effect of a national 4C antibiotic stewardship intervention on the clinical and molecular epidemiology of *Clostridium difficile* infections in a region of Scotland: a non-linear time-series analysis

Timothy Lawes, José-María Lopez-Lozano, Cesar A Nebot, Gillian Macartney, Rashmi Subbarao-Sharma, Karen D Wares, Carolyn Sinclair, Ian M Gould

**Outcomes**

Effects of control interventions on *Clostridium difficile* infection in England: an observational study

Kate E Dingle, Xavier Didelot, T Phuong Quan, David W Eyre, Nicole Stoesser, Tanya Golubchik, Rosalind M Harding, Daniel J Wilson, David Griffiths, Alison Vaughan, John M Finney, David H Wyllie, Sarah J Oakley, Warren N Fawley, Jane Freeman, Kirsti Morris, Jessica Martin, Philip Howard, Sherwood Gorbach, Ellie J C Goldstein, Diane M Citron, Susan Hopkins, Russell Hope, Alan P Johnson, Mark H Wilcox, Timothy E A Peto, A Sarah Walker, Derrick W Crook, the Modernising Medical Microbiology Informatics Group*

**Interpretation** Restricting fluoroquinolone prescribing appears to explain the decline in incidence of *C difficile* infections, above other measures, in Oxfordshire and Leeds, England. Antimicrobial stewardship should be a central component of *C difficile* infection control programmes.

BSAC
BRITISH SOCIETY FOR ANTIMICROBIAL CHEMOTHERAPY
Cochrane 2017
Only 6 studies with microbial outcome data, and these were too heterogeneous for data synthesis

Impact of an antimicrobial stewardship intervention on resistance rates in community-associated Gram-negative bacteraemia: segmented regression analysis of interrupted time series data.

Virginia Hernandez Santiago, Charis Marwick, Peter Davey, Dilip Nathwani, Bruce Guthrie

Background & Objective
A system-wide antimicrobial stewardship intervention was implemented across the Tayside region of Scotland in 2009 to reduce prescribing of broad spectrum antimicrobials related to Clostridium difficile infection (co-amoxiclav, cephalosporins, fluoroquinolones (mainly ciprofloxacin), and clindamycin – "4C" antimicrobials). We have previously shown that this led to large and sustained reductions in primary care prescribing of the targeted antimicrobials of more than 50% at 2 years post-intervention. (V Hernandez)

Our aim now is to assess the impact of this real-world hospital with community-associated (CA) gram neg Outcomes

Methods
Interrupted time series with segmented regression
Primary outcome measure: proportion (rate per 1000) of the three relevant antimicrobials whose use were prescribed prior to intervention for community use (co-amoxiclav), from 2005 to 2015.

We define community-associated gram negative bacteraemia or Klebsiella, taken within days 0, 1 and 2 of hospital admission and no hospital stay in the preceding 30 days.

Results
2143 eligible Gram-negative bacteraemias from 2004 patients, 81% E coli, 12% Klebsiella spp and 6.2% Proteus spp. Steady increase from 186 eligible samples in 2005 to 188 in 2009 and 234 in 2015 (Figure 1).

There was a significant change in trend in gram negative resistance to fluoroquinolones and cephalosporins, decreasing by 94.7% (22.3 to 10.0) and 40.3% (62.7 to 52.3) respectively at 3 years post-intervention. Co-amoxiclav resistance didn’t have a significant change. Similarly, the two promoted antimicrobials have experienced a change in resistance in the opposite direction, with the greater effect seen in amoxicillin resistance, related to increased antimicrobial use. (Figure 2 and Table)

Conclusion
We have shown a significant decrease in resistance to targeted antimicrobials in gram negative bacteraemia as a result of lower antimicrobial use, and demonstrated that real world antimicrobial stewardship interventions can lead to significant reductions in resistance in important infections at population level.

We have also shown increased resistance related to increased antimicrobial use, which highlights the need for future interventions aiming to decrease overall antimicrobial use, rather than substitution.
Major article

Influence of antimicrobial consumption on gram-negative bacteria in inpatients receiving antimicrobial resistance therapy from 2008-2013 at a tertiary hospital in Shanghai, China

Background: Irrational use of antimicrobial agents is a major cause of increased antimicrobial resistance. Effective antibiotic stewardship strategies nationwide or in local health care settings are necessary to reduce antibiotic use and bacteria resistance.

Methods: We evaluated the effectiveness of China's antimicrobial stewardship policy on antimicrobial use and applied time-series analysis methodology to determine the temporal relationship between antibiotic use and gram-negative bacteria resistance at Shanghai Hospital from 2008-2013. Isolates investigated included Escherichia coli, Klebsiella pneumoniae, Acinetobacter baumannii, and Pseudomonas aeruginosa.

Results: Consumption of 7 restricted-use antibiotics was dramatically reduced. Resistance to cefazidime in P. aeruginosa and A. baumannii and resistance to ciprofloxacin in P. aeruginosa significantly decreased. By using cross-correlation analysis, associations between ciprofloxacin resistance in P. aeruginosa and fluoroquinolones consumption (r = 0.48; lag = 0; P = .02), cefazidime resistance in P. aeruginosa and third-generation cephalosporins consumption (r = 0.54; lag = -1; P = .01) were identified. No substantial association between other pairs was found.

Conclusions: Enhanced nationwide antimicrobial stewardship campaigns launched in 2011 have made great achievements in regard to antibiotic use but have had limited effects on the reversal of gram-negative bacteria resistance in health care settings. Sound infection prevention and control programs to reduce the transmission of resistant pathogens for hospitals in China are urgently needed.
HOW DO WE REDUCE RESISTANCE CONSISTENTLY AND ENSURE SUSTAINABILITY?

"IF YOU ALWAYS DO WHAT YOU’VE ALWAYS DONE YOU’LL ALWAYS GET WHAT YOU’VE ALWAYS GOT"

- Henry Ford
The rise of antibiotic resistance is a major concern for public health. In hospitals, frequent usage of antibiotics leads to high resistance levels; at the same time the patients are especially vulnerable. We therefore urgently need treatment strategies that limit resistance without compromising patient care. Here, we investigate two strategies that coordinate the usage of different antibiotics in a hospital ward: “cycling”, i.e. scheduled changes in antibiotic treatment for all patients, and “mixing”, i.e. random assignment of patients to antibiotics. Previously, theoretical and clinical studies came to different conclusions regarding the usefulness of these strategies. We combine meta-analyses of clinical studies and epidemiological modeling to address this question. Our meta-analyses suggest that cycling is beneficial in reducing the total incidence rate of hospital acquired infections as well as the incidence rate of resistant infections, and that this is most pronounced at low baseline levels of resistance. We corroborate our findings with theoretical epidemiological models. When incorporating treatment adjustment upon deterioration of a patient’s condition (“adjustable cycling”), we find that our theoretical model is in excellent accordance with the clinical data. With this combined approach we present substantial evidence that adjustable cycling can be beneficial for suppressing the emergence of multiple resistance.
In this study, we aimed to evaluate the relationship between the rates of resistance of *Pseudomonas aeruginosa* to carbapenems and the levels and diversity of antibiotic consumption. Data were retrospectively collected from 20 acute care hospitals across 3 regions of Switzerland between 2006 and 2010. The main outcome of the present study was the rate of resistance to carbapenems among *P. aeruginosa*. Putative predictors included the total antibiotic consumption and carbapenem consumption in defined daily doses per 100 bed days, the proportion of very broad-spectrum antibiotics used, and the Peterson index. The present study confirmed a correlation between carbapenem use and carbapenem resistance rates at the hospital and regional levels. The impact of diversifying the range of antibiotics used against *P. aeruginosa* resistance was suggested by (i) a positive correlation in multivariate analysis between the above-mentioned resistance and the proportion of consumed antibiotics having a very broad spectrum of activity (coefficient = 1.77; 95% confidence interval, 0.58 to 2.96; *P* < 0.01) and (ii) a negative correlation between the resistance and diversity of antibiotic use as measured by the Peterson homogeneity index (coefficient = −0.52; *P* < 0.05). We conclude that promoting heterogeneity plus parsimony in the use of antibiotics appears to be a valuable strategy for minimizing the spread of carbapenem resistance in *P. aeruginosa* in hospitals.
Impact of national carbapenem sparing strategy

Increased use of Aztreonam, Aminoglycosides Temocillin fosfomycin

P=0.01
P=0.25

Figure 1 NHS Scotland: Carabapenem and Piperacillin tazobactam use (defined daily doses) – Jan 2012 to October 2016

GOD PRACTICE RECOMMENDATIONS TO OPTIMISE ANTIMICROBIAL PRESCRIBING IN POSSIBLE OR SUSPECTED MULT-DRUG RESISTANT GRAM NEGATIVE INFECTIONS
"Live as if you were to die tomorrow. Learn as if you were to live forever."

Mahatma Gandhi

Moving from principles into practice
GOOD ANTIBIOTIC PRESCRIBING

1. Prescribe antibiotics only with clear clinical justification
2. Document decision-making in antimicrobial prescribing
3. Intervene surgically when required to control infection
4. Collect specimens for culture prior to starting therapy
5. Prescribe antimicrobials according to local guidelines
6. Prescribe antimicrobials at the correct dose
7. Choose narrow spectrum agents
8. Consider broad spectrum therapy in certain circumstances
9. De-escalate broad spectrum therapy promptly
10. Prescribe ALERT antimicrobials only with authorisation from microbiology
11. Limit surgical prophylaxis to 24 hours
12. Prescribe oral rather than iv antimicrobials
13. Consider intravenous therapy under certain circumstances
14. Switch intravenous to oral therapy promptly
15. Review antimicrobial therapy regularly and stop when infection has resolved
16. Seek expert advice
## Table 2. Antimicrobial stewardship principles included in undergraduate education programmes, by discipline.

<table>
<thead>
<tr>
<th>Antimicrobial stewardship principle</th>
<th>Dentistry n/N (%)</th>
<th>Medicine n/N (%)</th>
<th>Nursing n/N (%)</th>
<th>Pharmacy n/N (%)</th>
<th>Veterinary Medicine n/N (%)</th>
<th>Total n/N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimisation of unnecessary prescribing of antimicrobials</td>
<td>13/13 (100)</td>
<td>21/22 (95.4)</td>
<td>19/33 (57.5)</td>
<td>14/14 (100)</td>
<td>5/6 (83.3)</td>
<td>72/88 (81.8)</td>
</tr>
<tr>
<td>Timing of antimicrobial administration</td>
<td>13/13 (100)</td>
<td>21/22 (95.4)</td>
<td>19/33 (57.5)</td>
<td>14/14 (100)</td>
<td>5/6 (83.3)</td>
<td>72/88 (81.8)</td>
</tr>
<tr>
<td>Therapeutic drug monitoring</td>
<td>2/12 (16.6)</td>
<td>20/22 (90.9)</td>
<td>13/32 (40.6)</td>
<td>11/14 (78.5)</td>
<td>4/6 (66.6)</td>
<td>50/86 (58.1)</td>
</tr>
<tr>
<td>Need for standard infection prevention and control precautions</td>
<td>13/13 (100)</td>
<td>22/22 (100)</td>
<td>32/33 (96.9)</td>
<td>12/14 (85.7)</td>
<td>5/6 (83.3)</td>
<td>83/88 (94.3)</td>
</tr>
<tr>
<td>Collection of appropriate specimens for microscopy, culture and sensitivity</td>
<td>9/13 (69.2)</td>
<td>21/22 (95.4)</td>
<td>26/33 (78.7)</td>
<td>12/14 (85.7)</td>
<td>5/6 (83.3)</td>
<td>73/88 (82.9)</td>
</tr>
<tr>
<td>Intravenous use only in severely ill patients, unable to tolerate oral treatment, or where oral treatment would not guarantee coverage or tissue penetration</td>
<td>7/13 (53.8)</td>
<td>18/22 (81.8)</td>
<td>14/32 (43.7)</td>
<td>10/13 (76.9)</td>
<td>4/6 (66.6)</td>
<td>53/86 (61.6)</td>
</tr>
<tr>
<td>Review microbiology results daily and de-escalate to pathogen-directed narrow-spectrum treatment promptly</td>
<td>4/13 (30.7)</td>
<td>18/22 (81.8)</td>
<td>10/32 (31.2)</td>
<td>11/14 (78.5)</td>
<td>4/6 (66.6)</td>
<td>47/87 (54.0)</td>
</tr>
<tr>
<td>Review need for intravenous treatment daily and switch to oral route promptly</td>
<td>3/13 (23.0)</td>
<td>18/22 (81.8)</td>
<td>9/32 (28.1)</td>
<td>10/14 (71.4)</td>
<td>4/6 (66.6)</td>
<td>44/87 (50.5)</td>
</tr>
<tr>
<td>Require single dose surgical prophylaxis regimens as appropriate</td>
<td>5/13 (38.4)</td>
<td>16/22 (72.7)</td>
<td>9/32 (28.1)</td>
<td>9/14 (64.2)</td>
<td>4/6 (66.6)</td>
<td>43/87 (49.4)</td>
</tr>
</tbody>
</table>

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DEVELOPING THE FIRST NATIONAL ANTIMICROBIAL PRESCRIBING AND STEWARDSHIP COMPETENCES

D. Ashiru-Oredope, B. Cookson and C. Fry on Behalf of the Advisory Committee on Antimicrobial Resistance and Healthcare Associated Infection Professional Education Subgroup

The Competency framework
This consists of five dimensions, each of which includes statements that describe the activity and outcomes that prescribers should be able to demonstrate. The Five dimensions comprise:

(i) Infection prevention and control - Understand the principles and demonstrate competence in preventing and controlling infections (five statements)
(ii) Antimicrobial resistance and antimicrobials – Understand the modes of action and spectrum of action of antimicrobials and the mechanisms of resistance (six statements)
(iii) The prescribing of antibiotics – Understand the key elements in prescribing appropriate antimicrobial agents for prophylaxis and treatment (eight statements)
(iv) Antimicrobial stewardship – Demonstrate an understanding of antimicrobial stewardship in day-to-day practice (eight statements)
(v) Monitoring and learning – Demonstrate continuing professional development in antimicrobial prescribing and stewardship (four statements)

J Antimicrob Chemother
doi:10.1093/jac/dku350

Generic Principles, curriculum, competency being developed by
IMPLEMENTING AN ANTIBIOTIC STEWARDSHIP PROGRAM: GUIDELINES BY THE INFECTION DISEASES SOCIETY OF AMERICA AND THE SOCIETY FOR HEALTHCARE EPIDEMIOLOGY OF AMERICA

Interventions

I. Does the Use of Preauthorization and/or Prospective Audit and Feedback Interventions by ASPs Improve Antibiotic Utilization and Patient Outcomes?

Recommendation

1. We recommend preauthorization and/or prospective audit and feedback over no such interventions (strong recommendation, moderate-quality evidence).

II. Is Didactic Education a Useful Antibiotic Stewardship Intervention for Reducing Inappropriate Antibiotic Use?

Recommendation

2. We suggest against relying solely on didactic educational materials for stewardship (weak recommendation, low-quality evidence).

XI. Should ASPs Implement Interventions to Increase Use of Oral Antibiotics as a Strategy to Improve Outcomes or Decrease Costs?

Recommendation

12. We recommend ASPs implement programs to increase both appropriate use of oral antibiotics for initial therapy and the timely transition of patients from IV to oral antibiotics (strong recommendation, moderate-quality evidence).

CID ADVANCED ACCESS APRIL 13 2016
Blended learning- added value

Blended learning appears to have a consistent positive effect in comparison with no intervention, and to be more effective than or at least as effective as nonblended instruction for knowledge acquisition in health professions. Due to the large heterogeneity, the conclusion should be treated with caution.

10 DRIVERS OF BLENDED LEARNING

1. Improve ability to personalize learning
2. Potential for individual progress
3. Improve student engagement and motivation
4. Shift to online state tests starting in 2015
5. Need to extend time and stretch resources
6. Potential to extend the reach of effective teachers
7. Ability to improve working conditions
8. Decrease device costs
9. Student and parent adoption of learning apps
10. Interest in narrowing the digital divide
Free global online course.

The course is based around a fictitious outbreak of a resistant organism in a hospital.

- >37,000 registered
- >14,000 active learners
- Large number of health professionals

Chinese and Spanish translations in 2017
IMPROVING ANTIBIOTIC USE.
AN OVERVIEW OF EVIDENCE ON PRESCRIBING DETERMINANTS OF PRESCRIBING

Fig. 3. Prescribing determinants of antibiotics. Sources: Ref. 56.

Fig. 4. Dispensing determinants of antibiotics.
### Requirements to support Clinical decision making

<table>
<thead>
<tr>
<th>Patient presentation</th>
<th>Care setting</th>
<th>Decision needed</th>
<th>Key decision-makers</th>
<th>Dx info needed</th>
<th>Dx minimum profile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suspected HCAP / HAP / VAP, critically ill patient</td>
<td>Community</td>
<td>Treatment needed?</td>
<td>PCP</td>
<td>bacterial / viral / (fungi)</td>
<td>Reliability (sensitivity and specificity): [X% / Y%]</td>
</tr>
<tr>
<td>Suspected upper respiratory infection - sinusitis</td>
<td>Long-term care</td>
<td>Order diagnostic!</td>
<td>ER Doctor</td>
<td>Species / type (can be multiple)</td>
<td>Speed of end-to-end diagnosis: [X minutes / hours]</td>
</tr>
<tr>
<td>Suspected pediatric otitis media (middle ear infection)</td>
<td>Specialty care</td>
<td>First dose?</td>
<td>ID specialist</td>
<td>Susceptibility</td>
<td>Implementation cost (install, train, maintain): [X]$</td>
</tr>
<tr>
<td>Suspected severe sepsis infection</td>
<td>Community clinic</td>
<td>2nd+ dose?</td>
<td>Critical care physician</td>
<td>Pathogen load / quantitation</td>
<td>Use cost: [cost per test and staff time]: [X]$ / test</td>
</tr>
<tr>
<td></td>
<td>PCP</td>
<td>Admission to hospital?</td>
<td>Other attending physician</td>
<td>Resistance profile</td>
<td>Test complexity: [measure needed]</td>
</tr>
<tr>
<td></td>
<td>ER</td>
<td>Isolate / infection control?</td>
<td>Clinical microbiologist</td>
<td>Pathogen vs. colonizer</td>
<td>Scope of detection: [number and types of pathogens]</td>
</tr>
<tr>
<td></td>
<td>Critical care</td>
<td>Enroll in clinical trial?</td>
<td>Nurse or NP</td>
<td>Patient and family</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Isolation Ward</td>
<td>Inform public health officials?</td>
<td>Public health official</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Acute care</td>
<td></td>
<td>Ambulatory care physician</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>In-patient ward</td>
<td></td>
<td>Pathogen vs. colonizer</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Biodefense</td>
<td></td>
<td>Resistance profile</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Emerging pathogen</td>
<td></td>
<td>Test complexity: [measure needed]</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mass casualty</td>
<td></td>
<td>Scope of detection: [number and types of pathogens]</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Figure 5:** Diagnostic use can be considered in the context of patient journeys, focusing attention on who needs diagnostic information, of what kind, for what purpose and in which clinical setting.
AN INTEGRATED STEWARDSHIP MODEL: ANTIMICROBIAL, INFECTION PREVENTION AND DIAGNOSTIC (AID)

Jan-Willem H Dik, Randy Poelman, Alexander W Friedrich, Prashant Nannan Panday, Jerome R Lo-Ten-Foe, Sander van Assen, Julia EWC van Gemert-Pijnen, Hubert GM Niesters, Ron Hendrix & Bhanu Sinha

# Point-of-Care C-Reactive Protein Testing to Reduce Inappropriate Use of Antibiotics for Non-Severe Acute Respiratory Infections in Vietnamese Primary Health Care: A Randomised Controlled Trial

Nga TT Do, Ngan TDTa, Ninh TH Tran, Hung M Than, Bich TN Vu, Long B Hoang, H Rogier van Doorn, Dung TV Vu, Jochen WL Cals, Ariun Chandna, Yoel Lubell, Behzad Nadim, Guv Thwaites, Marcel Wolbers, Kinh V Nauven, Heiman F L Wertheim

<table>
<thead>
<tr>
<th>Site</th>
<th>Control</th>
<th>CRP</th>
<th>OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ba Trieu</td>
<td>49/107</td>
<td>60/110</td>
<td>1.42 (0.83-2.42)</td>
</tr>
<tr>
<td>Ba Vi</td>
<td>82/97</td>
<td>40/86</td>
<td>0.16 (0.08-0.32)</td>
</tr>
<tr>
<td>Dong Da</td>
<td>77/83</td>
<td>71/80</td>
<td>0.61 (0.21-1.81)</td>
</tr>
<tr>
<td>Ha Dong</td>
<td>108/135</td>
<td>94/129</td>
<td>0.67 (0.38-1.19)</td>
</tr>
<tr>
<td>Hoan Kiem</td>
<td>65/81</td>
<td>62/81</td>
<td>0.80 (0.38-1.70)</td>
</tr>
<tr>
<td>Linh Nam</td>
<td>62/75</td>
<td>51/72</td>
<td>0.51 (0.23-1.12)</td>
</tr>
<tr>
<td>Long Bien</td>
<td>71/91</td>
<td>49/83</td>
<td>0.41 (0.21-0.79)</td>
</tr>
<tr>
<td>Mai Huong</td>
<td>62/92</td>
<td>29/91</td>
<td>0.23 (0.12-0.42)</td>
</tr>
<tr>
<td>Sai Dong</td>
<td>93/97</td>
<td>50/80</td>
<td>0.07 (0.02-0.22)</td>
</tr>
<tr>
<td>Thanh Xuan</td>
<td>69/89</td>
<td>75/90</td>
<td>1.45 (0.69-3.05)</td>
</tr>
</tbody>
</table>

**Random treatment effects model**

Heterogeneity: P = 84.3% (95% CI 66.1-95.6)

OR = 0.47 (0.26-0.83)

**Figure 2:** Effect of C-reactive protein testing on evidence of antibiotic use during 14 days of follow-up, by centre
INTEGRATING RAPID DIAGNOSTICS AND ANTIMICROBIAL STEWARDSHIP IMPROVES OUTCOMES IN PATIENTS WITH ANTIBIOTIC RESISTANT GRAM-NEGATIVE BACTEREMIA

Katherine K. Perez a,b, Randall J. Olsen a, William L. Musick l, Patricia L. Cernoch a, James R. Davis a, Leif E. Peterson c, James M. Musser a,*

Stewardship improves patient outcomes

Figure 2  Timeline comparison of pre-intervention (PI) and intervention (Int) study periods. Adjusted therapy included, when clinically indicated, de-escalation/escalation of antibiotic therapy, dosing/route modifications, and/or discontinuation of unnecessary Gram-positive coverage. White boxes denote the average times (h) until the corresponding information was obtained or action implemented in the PI and Int groups. The bottom horizontal line represents the global study/subject timeline (h). The dotted line to “Adjust therapy” for the intervention cohort indicates that, due to the rapid species identification via MALDI-TOF MS and the real-time antimicrobial stewardship notifications, therapy was often adjusted before susceptibility data were available.
Need to develop/enhance laboratory services in LMIC’s
Need to promote better use of existing facilities across all countries
Need to support diagnostics with stewardship follow up – requires expertise
Healthcare systems need to be appropriate and adequately resourced to adopt new rapid diagnostics and POCT’s
Need to be cost effective
Need to work in all resource settings
Need continuing real world evaluation to identify value
CONCLUSIONS
Creating, supporting and Implementing Global stewardship

Stewardship: Structure + Process = Outcomes

S + P = O

Kotter’s 8 Step Change Management Model

1. Increase urgency
2. Build the guiding team
3. Get the right vision
4. Communicate for buy-in
5. Empower action
6. Create short-term wins
7. Don’t let up
8. Make it stick

Implementing and sustaining change

Creating a climate for change

Creating, supporting and Implementing Global stewardship

In the long history of humankind, those who learned to collaborate and improvise most effectively have prevailed.” Charles Darwin