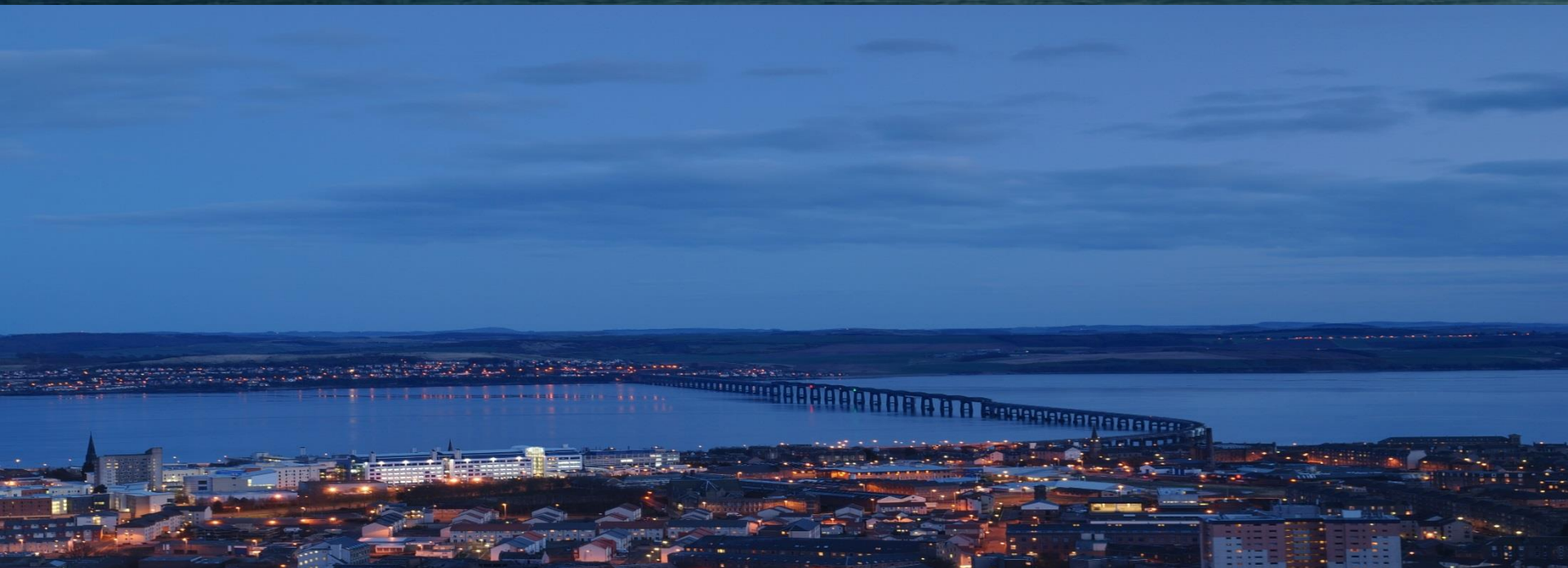
Solutions for HAI and AMR : The Role of Antimicrobial Stewardship

Lisbon 2016

Dilip Nathwani
Ninewells Hospital and Medical School
Dundee, UK



Active Conflict of interest

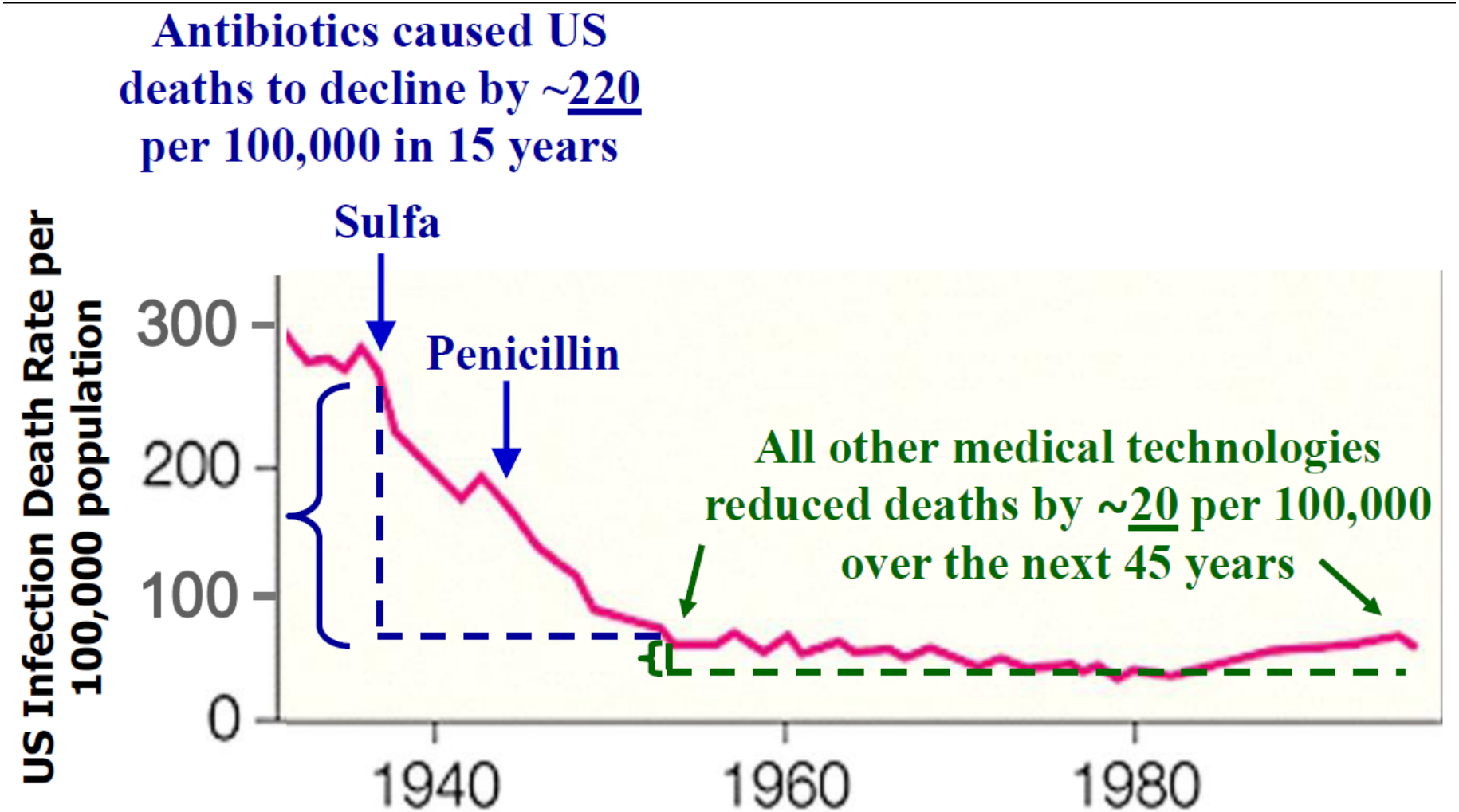
- Has participated in commercial advisory boards for: – Astellas, Pfizer, The Medicines Company, Bayer
- Has received lecture funds from: – Astellas, Pfizer,
- Has received research/education funds from: – Bayer, Pfizer, Biomerieux

- Has non-commercial positions as:
- Chair of Scottish Antimicrobial Prescribing Group [SAPG] since 2008 – Scottish Government Stewardship Programme
- Chair ESGAP till 4/2015
- President BSAC -3/2015
- Director – The Academic Health Sciences Partnership [AHSP] in Tayside, Scotland

‘The War of Worlds', bacteria and antibiotic resistance (film, 2005)

This film in which aliens that had no immunity to the bacteria on Earth were killed trough the spreading of an infection.

Science on Screen Outreach Project



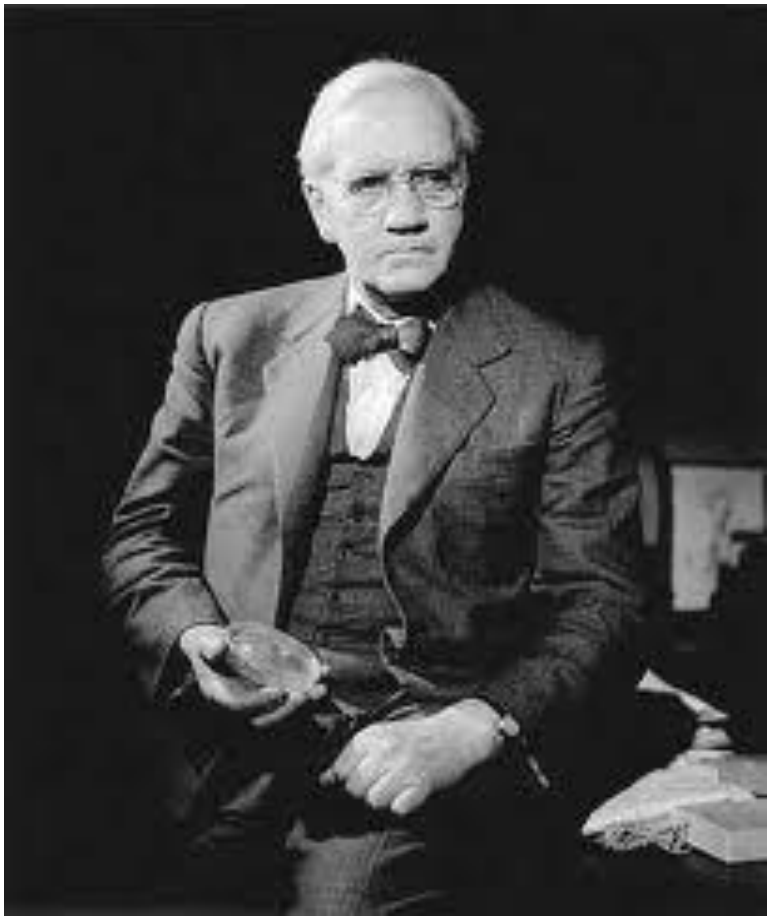
Armstrong, G. L. et al. JAMA 1999;281:61-66.

From IDSA Capitol Hill talk by Brad Spellberg May 11 2010.
www.idsociety.org/Content.aspx?id=4810

Drug resistance follows the drug like a Faithful shadow

- Paul Erhlich 1854-1915

Sir Alexander Fleming



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

Nobel lecture, 1945

Lancet, April 2011

Society's failure to protect a precious resource: antibiotics

Jean Carlet, Peter Collignon, Don Goldmann, Herman Goossens, Inge C Gyssens, Stephan Harbarth, Vincent Jarlier, Stuart B Levy, Babacar N'Doye, Didier Pittet, Rosana Richtmann, Wing H Seto, Jos W M van der Meer, Andreas Voss

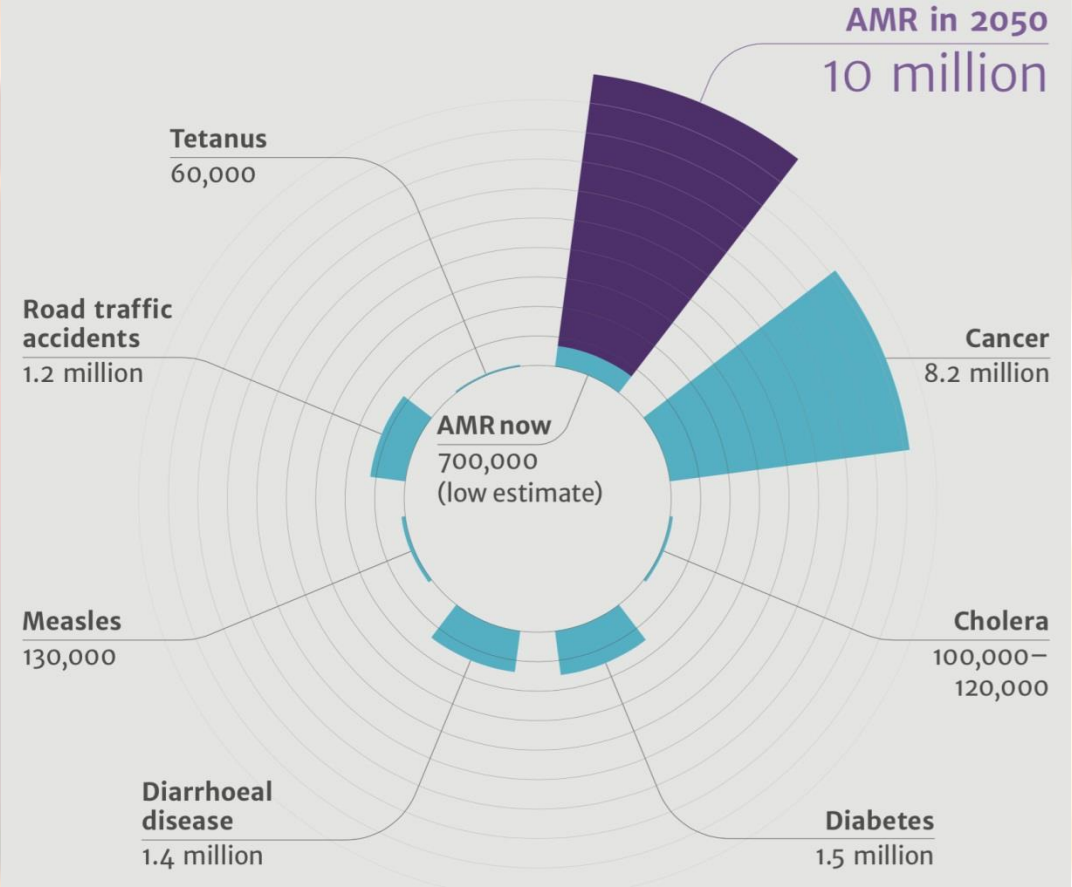
Since their discovery last century, antibiotics have served society well by saving tens of millions of lives.

recently introduced agents, such as daptomycin and oxazolidinones.[2] Community-acquired MRSA strains have

We have watched too passively as the treasury of drugs that has served us well has been stripped of its value. We urge our collegues worldwide to take responsibility for the protection of this precious resource. There is no longer time for silence and complacency.

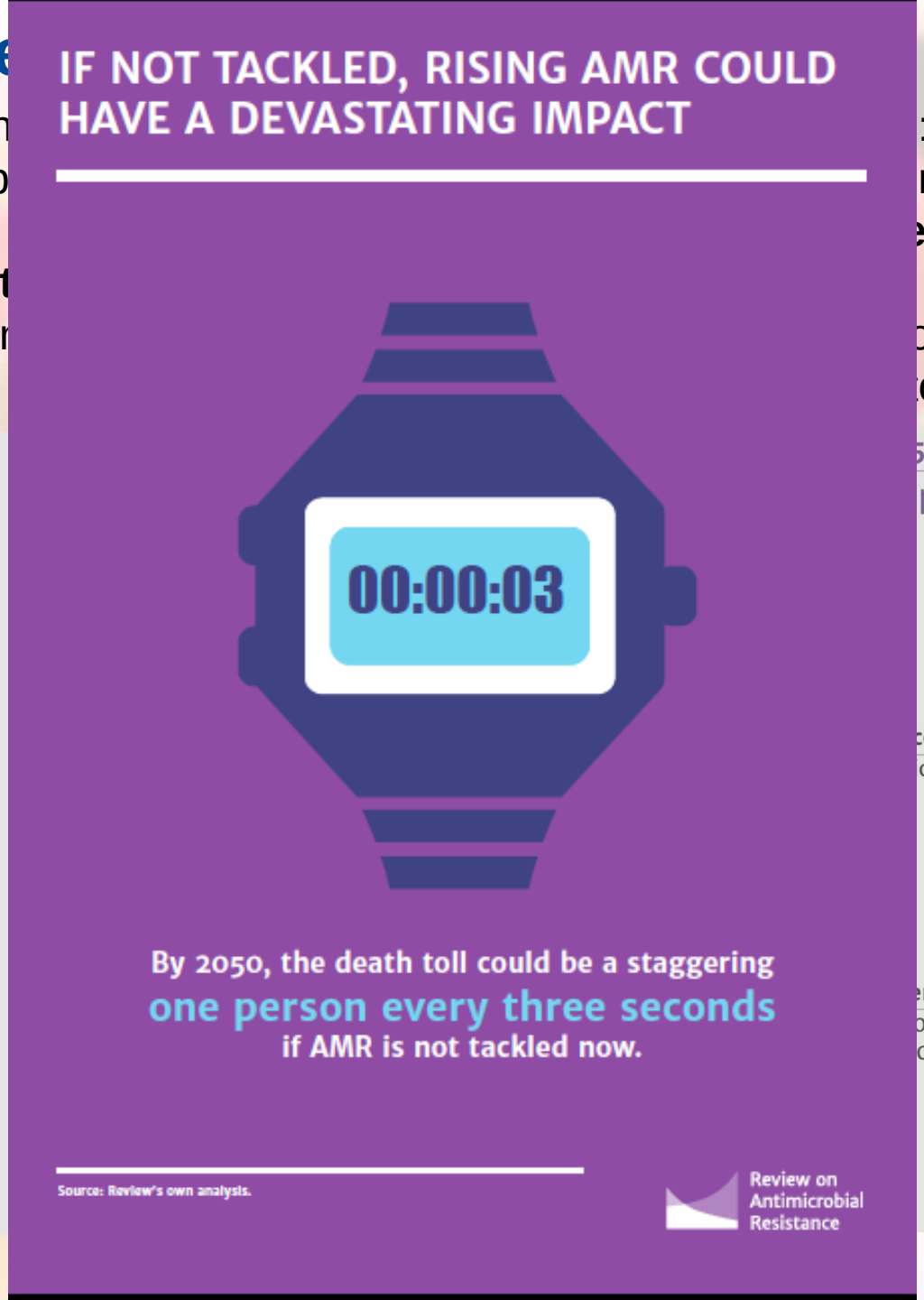
Antibiotic Resistance

Antibiotic resistance poses a grave and growing global problem: a **World Health Organization** report released April 2014 stated, "**this serious threat is no longer a prediction for the future, it is happening right now in every region of the world and has the potential to affect anyone, of any age, in any country.** Antibiotic resistance—when bacteria change so antibiotics no longer work in people who need them to treat infections—is now a major threat to public health."

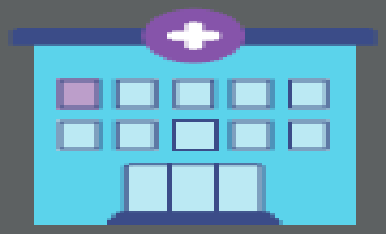


Antibiotic Re

Antibiotic resistan : a **World Health Organization** rep **reat is no longer a prediction for ery region of the world and has t in any country.** Antibiotic resistar o longer work in people who need o public health."



HEALTHCARE-ASSOCIATED INFECTIONS ARE A CONCERN IN ALL COUNTRIES

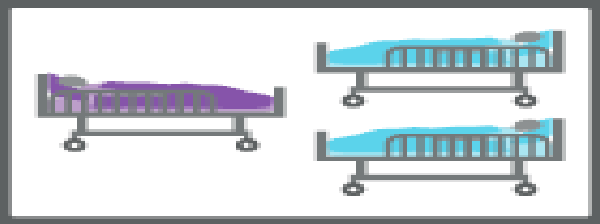


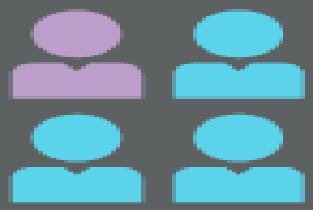
7 to 10%

Of every 100 hospitalised patients, 7 in high-income and 10 in low and middle-income countries, will acquire at least one healthcare-associated infection.

1 in 3

A third of patients in intensive care units (ICUs) in high-income countries are affected by at least 1 healthcare-associated infection.





1 in 4

A quarter of healthcare-associated infections in long-term acute care settings are caused by antibiotic-resistant bacteria.

Sources: WHO Healthcare-Associated Infections, Fact Sheet, 2014, WHO, The Burden of Health Care-Associated Infection Worldwide: A Summary, 2010, and CDC, Vital Signs Report, March 2016.

Review on Antimicrobial Resistance

Impact of Antimicrobial resistance on Stakeholders related to health

Patient, Hospital and Clinician all adversely affected

Patient pays more. Hospital loses on revenue from new patient

Patient / Payer pays more. Hospital spends more on antibiotics

Table 1 Impact of antibiotic resistance on patient mortality, length of hospital stay, and healthcare costs

Infection and causative organism	Increased risk of death (OR)	Attributable length of stay (days)	Attributable cost[a] (US$)
MRSA bacteremia	1.9	2.2	6916
MRSA surgical infection	3.4	2.6	13 901
VRE infection	2.1	6.2	12 766
Resistant *Pseudomonas aeruginosa* infection	1.8–5.4	5.7–6.5	11 981–32 949
Resistant *Enterobacter* infection	5.0	9.0	29 379
Resistant *Acinetobacter* infection	2.4–6.2	5–13	3758
ESBL-producing or KPC-producing *Escherichia coli* or *Klebsiella* infection	3.6	1.6-fold increase	1.7-fold increase

ESBL, extended-spectrum β-lactamase; KPC, *Klebsiella pneumoniae* carbapenemase; MRSA, methicillin-resistant *Staphylococcus* aureus; OR, odds ratio; VRE, vancomycin-resistant enterococci.

[a] As reported in the original studies reviewed, without adjusting for present-day value. Reprinted with permission from [19].

Ref: Goff DA. Current Opinion in Infectious Diseases 2011, 24 (suppl 1):S11–S20

TACKLING ANTIMICROBIAL RESISTANCE ON TEN FRONTS

Public awareness

Sanitation and hygiene

Antibiotics in agriculture and the environment

Vaccines and alternatives

Surveillance

Rapid diagnostics

Human capital

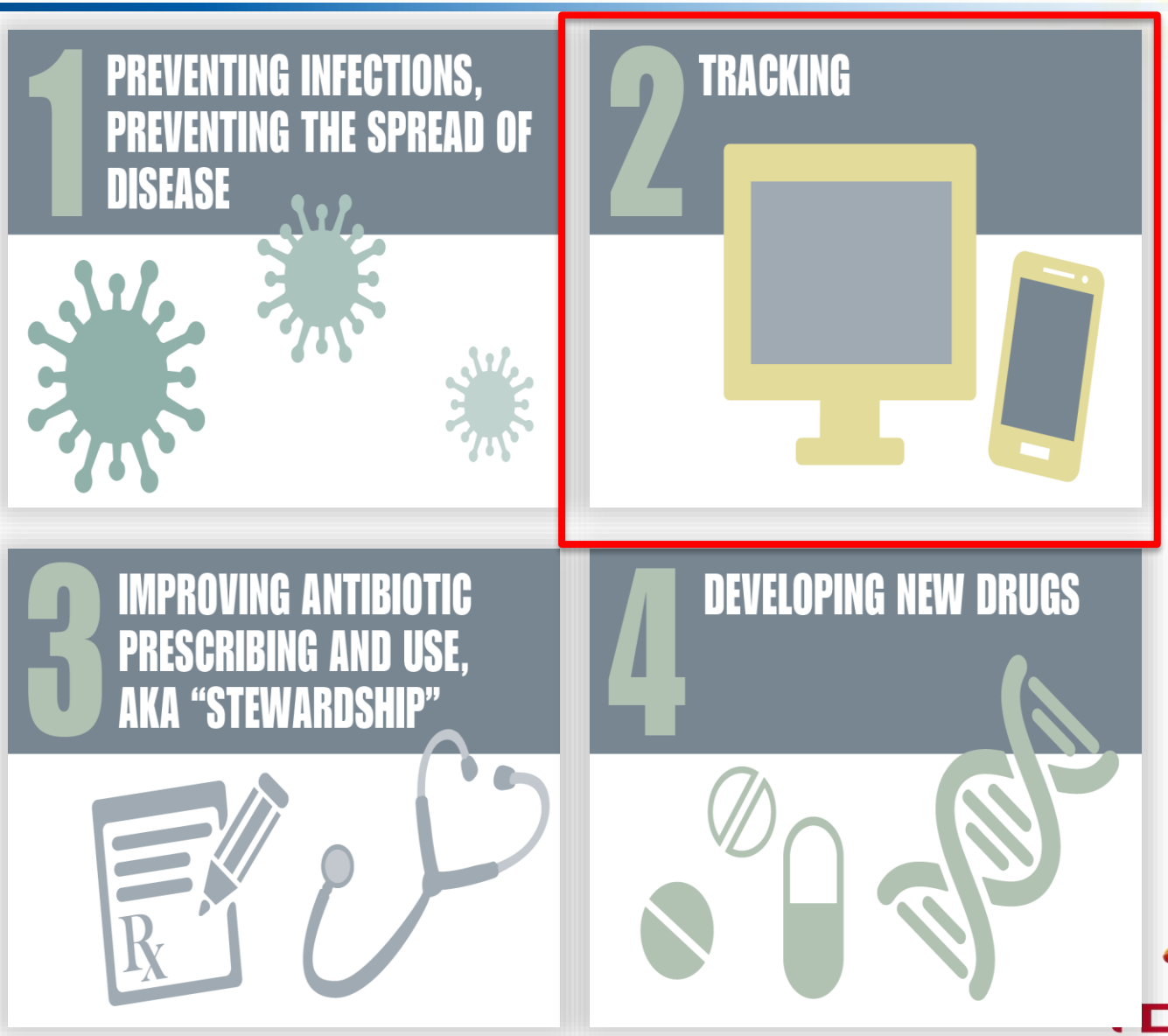
Drugs

Global Innovation Fund

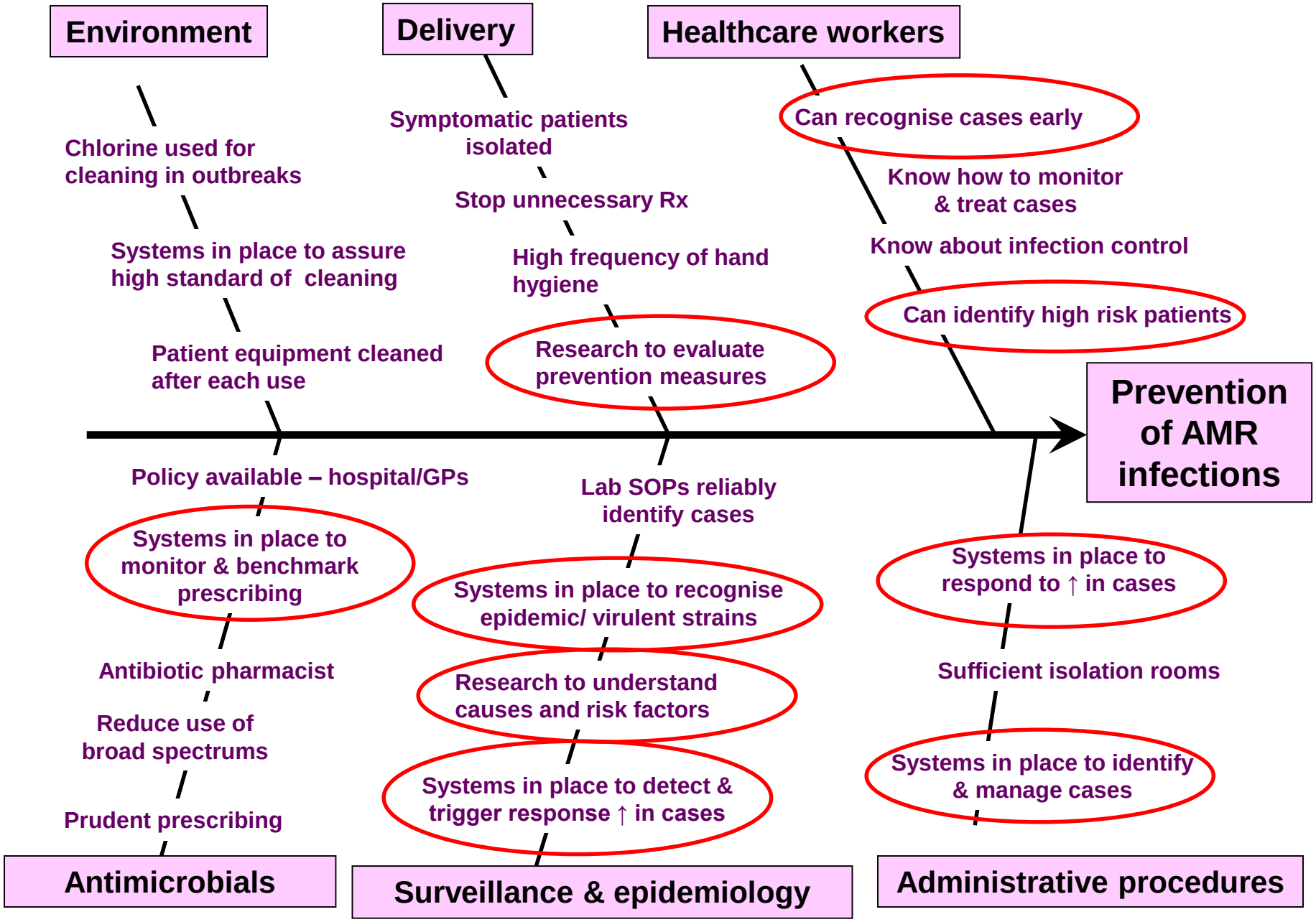
International coalition for action

Review on Antimicrobial Resistance

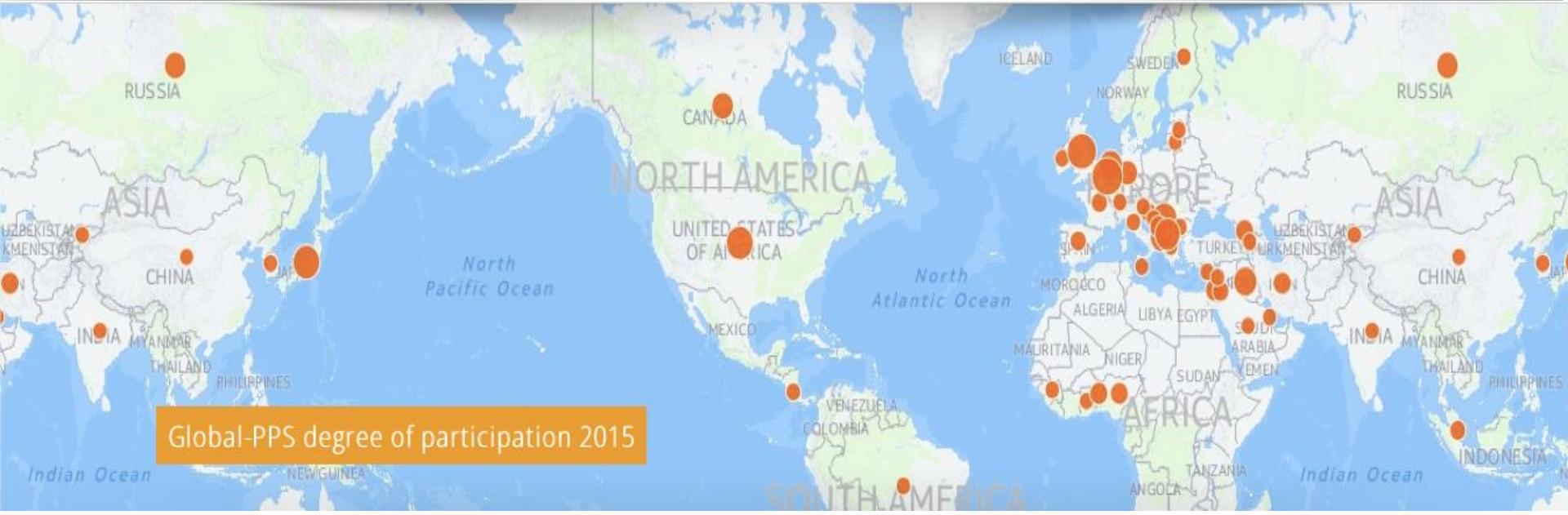
Fighting Back Against Antibiotic Resistance



AMR: role of surveillance & epidemiology



www.global-pps.com



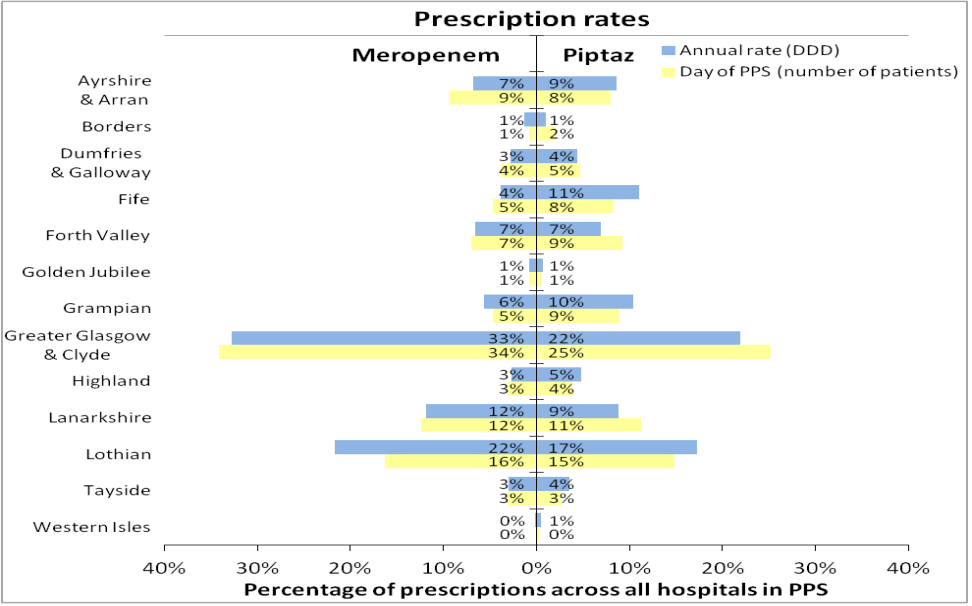
National Antimicrobial Stewardship Point Prevalence Survey System

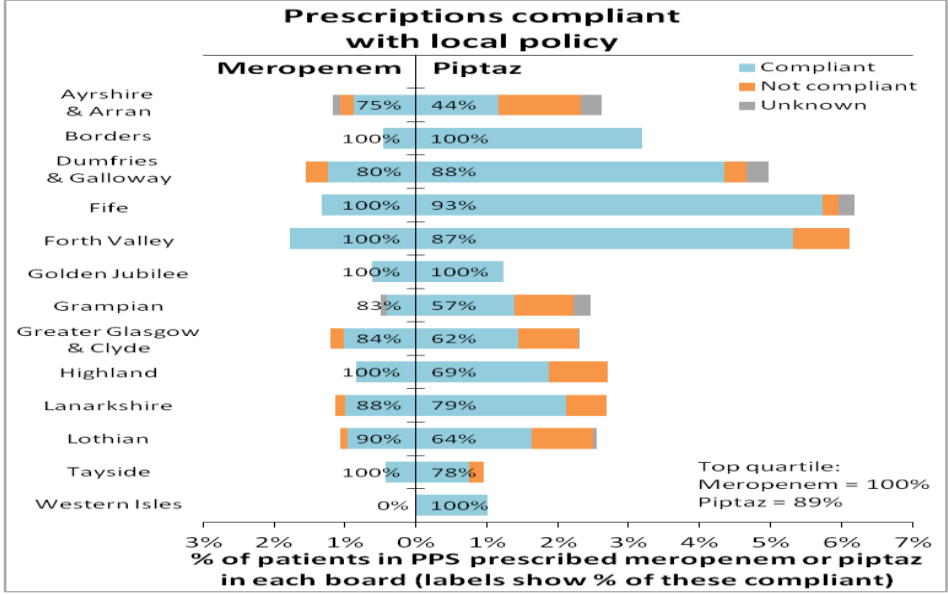
Providing reference data on antimicrobial consumption in hospital settings

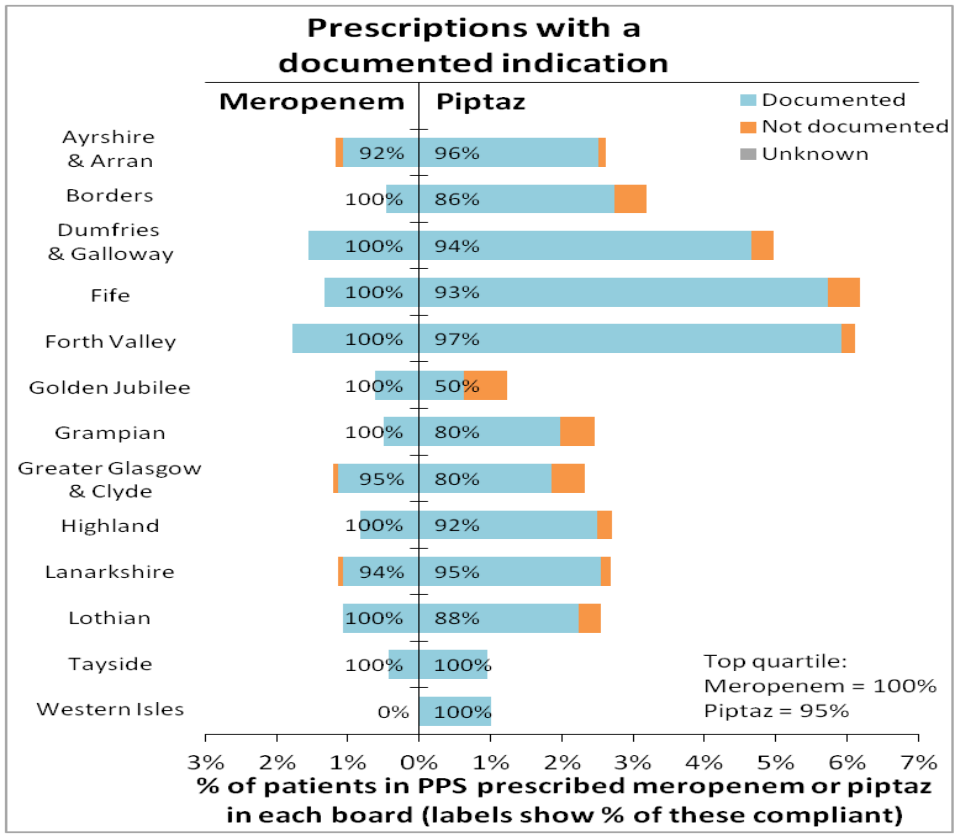
The system will:

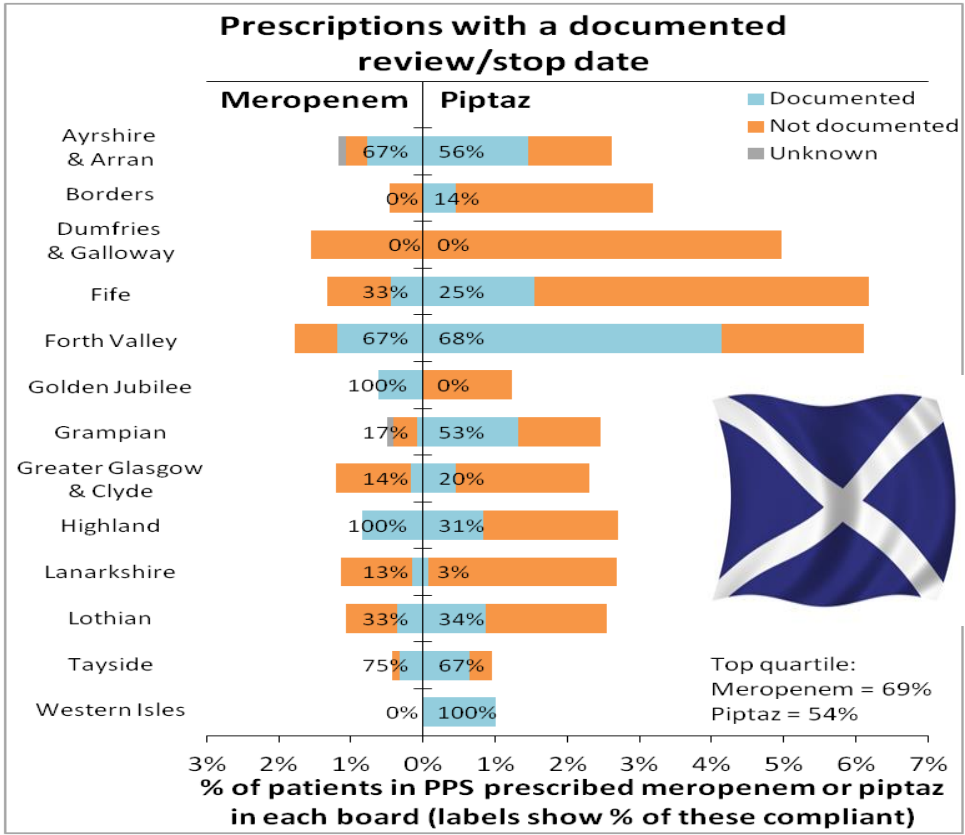
- Provide a national benchmarking and training tool
- Available free of charge to Trusts and Boards in the UK
- All data available real time via national dashboard
- Aggregated data can be shared and compared
- Will be used by Public Health England as tool by which to collect and submit to ECDC PPS
- Have international applicability

NAS·PPS
National Antimicrobial Stewardship Point Prevalence System

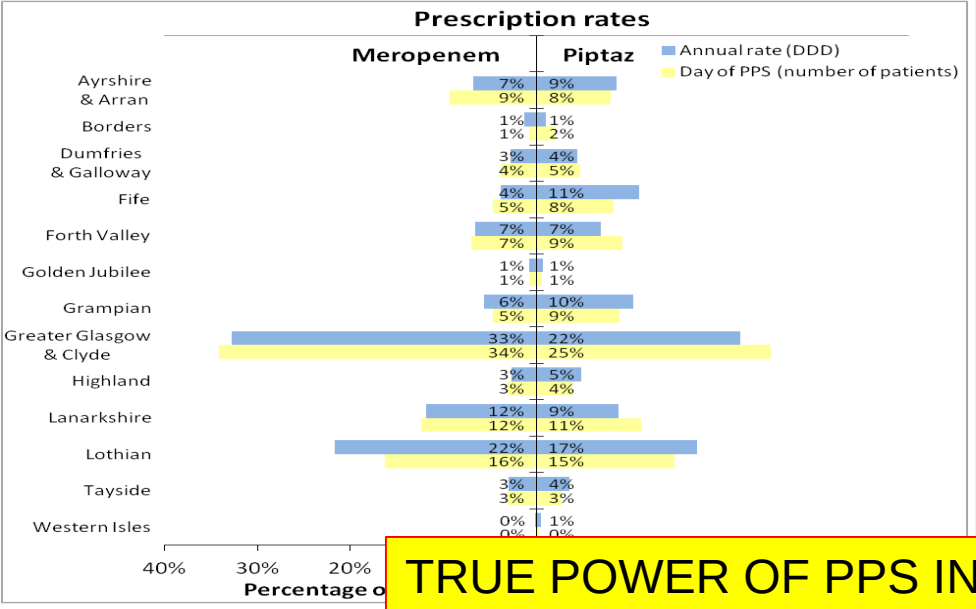

Prescription rates
Meropenem
Piptaz
Annual rate (DDD)
Day of PPS (number of patients)
Ayrshire & Arran
Borders
Dumfries & Galloway
Fife
Forth Valley
Golden Jubilee
Grampian
Greater Glasgow & Clyde
Highland
Lanarkshire
Lothian
Tayside
Western Isles
7% 9%
9% 8%
1% 1%
1% 2%
3% 4%
4% 5%
4% 11%
5% 8%
7% 7%
7% 9%
1% 1%
1% 1%
6% 10%
5% 9%
33% 22%
34% 25%
3% 5%
3% 4%
12% 9%
12% 11%
22% 17%
16% 15%
3% 4%
3% 3%
0% 1%
0% 0%
40% 30% 20% 10% 0% 10% 20% 30% 40%
Percentage of prescriptions across all hospitals in PPS

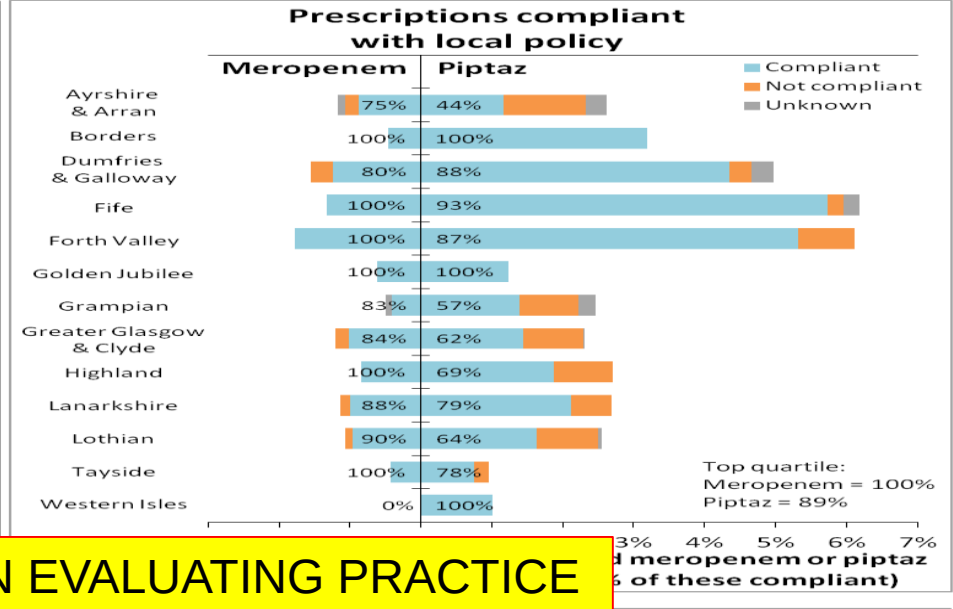

Prescriptions compliant with local policy
Meropenem
Piptaz
Compliant
Not compliant
Unknown
Ayrshire & Arran 75% 44%
Borders 100% 100%
Dumfries & Galloway 80% 88%
Fife 100% 93%
Forth Valley 100% 87%
Golden Jubilee 100% 100%
Grampian 83% 57%
Greater Glasgow & Clyde 84% 62%
Highland 100% 69%
Lanarkshire 88% 79%
Lothian 90% 64%
Tayside 100% 78%
Western Isles 0% 100%
Top quartile:
Meropenem = 100%
Piptaz = 89%
3% 2% 1% 0% 1% 2% 3% 4% 5% 6% 7%
% of patients in PPS prescribed meropenem or piptaz in each board (labels show % of these compliant)

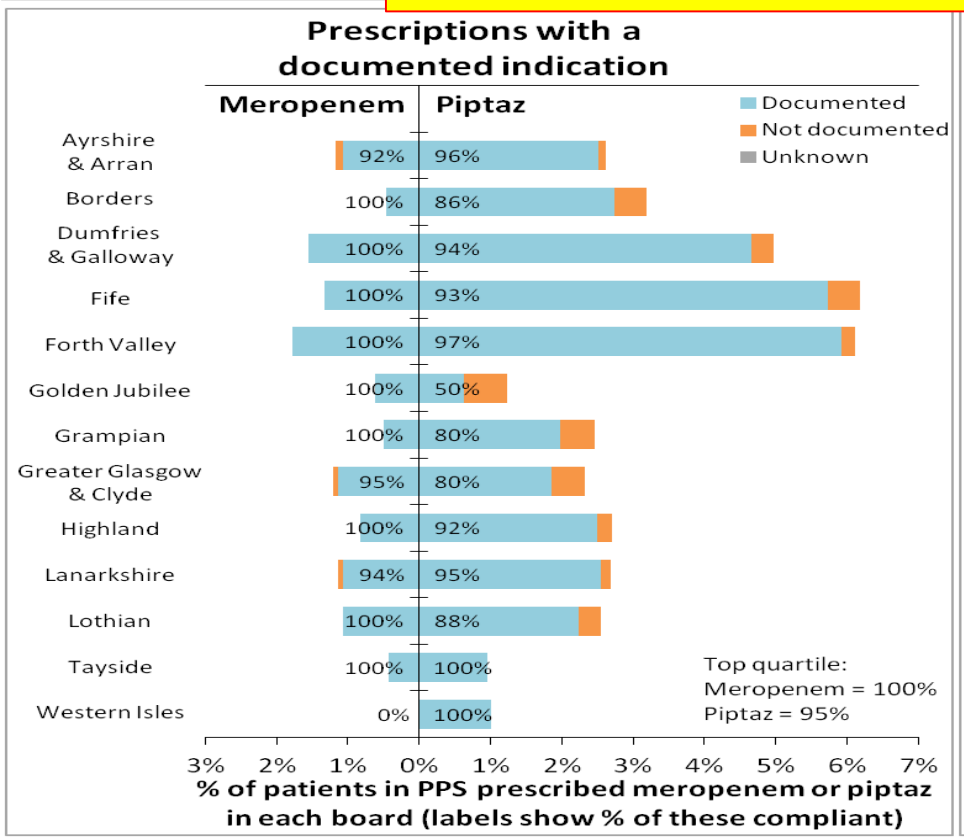

Prescriptions with a documented indication
Meropenem
Piptaz
Documented
Not documented
Unknown
Ayrshire & Arran 92% 96%
Borders 100% 86%
Dumfries & Galloway 100% 94%
Fife 100% 93%
Forth Valley 100% 97%
Golden Jubilee 100% 50%
Grampian 100% 80%
Greater Glasgow & Clyde 95% 80%
Highland 100% 92%
Lanarkshire 94% 95%
Lothian 100% 88%
Tayside 100% 100%
Western Isles 0% 100%
Top quartile:
Meropenem = 100%
Piptaz = 95%
3% 2% 1% 0% 1% 2% 3% 4% 5% 6% 7%
% of patients in PPS prescribed meropenem or piptaz in each board (labels show % of these compliant)

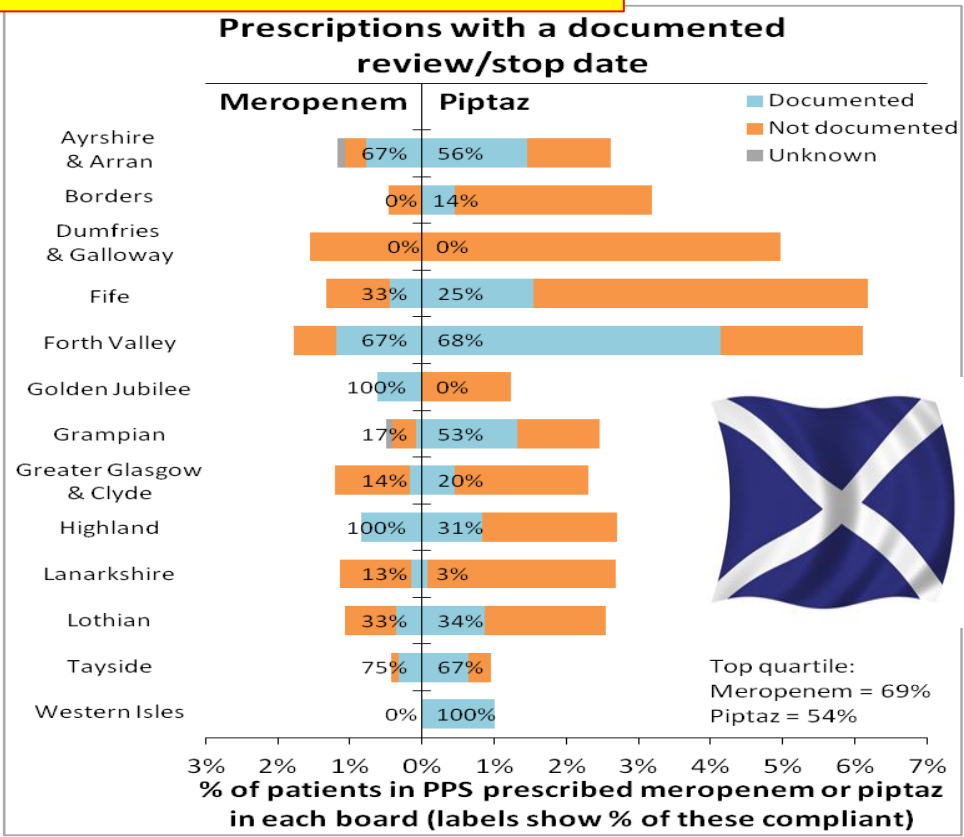

Prescriptions with a documented review/stop date
Meropenem
Piptaz
Documented
Not documented
Unknown
Ayrshire & Arran 67% 56%
Borders 0% 14%
Dumfries & Galloway 0% 0%
Fife 33% 25%
Forth Valley 67% 68%
Golden Jubilee 100% 0%
Grampian 17% 53%
Greater Glasgow & Clyde 14% 20%
Highland 100% 31%
Lanarkshire 13% 3%
Lothian 33% 34%
Tayside 75% 67%
Western Isles 0% 100%
Top quartile:
Meropenem = 69%
Piptaz = 54%
3% 2% 1% 0% 1% 2% 3% 4% 5% 6% 7%
% of patients in PPS prescribed meropenem or piptaz in each board (labels show % of these compliant)

TRUE POWER OF PPS IN EVALUATING PRACTICE

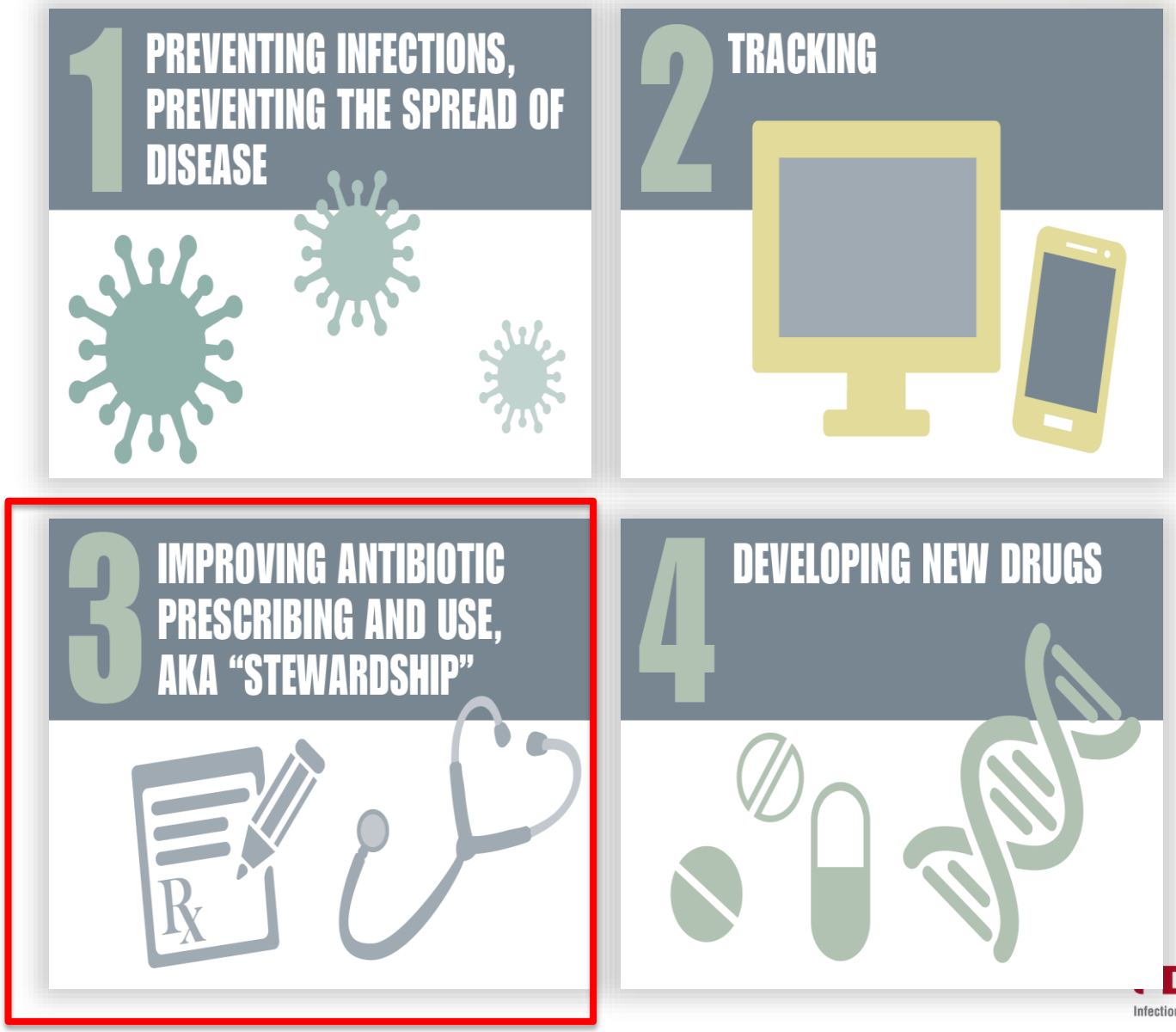








Fighting Back Against Antibiotic Resistance



We need new antimicrobials!!!

“The development of new antibiotics without having mechanisms to ensure their appropriate use is much like supplying your alcoholic patients with a finer brandy”

Dennis Maki, 1998

APUA
ALLIANCE FOR THE PRUDENT USE OF ANTIBIOTICS

UK Five Year Antimicrobial Resistance Strategy 2013 to 2018

Programa de Prevenção e Controlo de Infeções e Resistências aos Antimicrobianos

Orientações Programáticas

i. **improve the knowledge and understanding of AMR** through better information, intelligence, supporting data and developing more effective early warning systems to improve health security,

ii. **conserve and steward the effectiveness of existing treatments** through improving infection prevention and control and development of resources to facilitate optimal use of antibiotics in both humans and animals,

iii. **stimulate the development of new antibiotics, diagnostics and novel therapies** by promoting innovation and investment in the development of new drugs and ensuring that new therapeutics reach the market quickly.

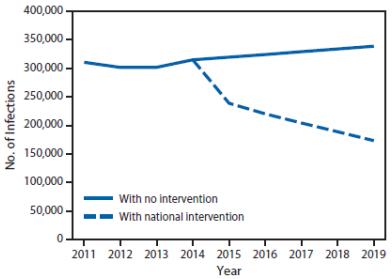
Morbidity and Mortality Weekly Report

Vital Signs: Estimated Effects of a Coordinated Approach for Action to Reduce Antibiotic-Resistant Infections in Health Care Facilities — United States

Rachel B. Slayton, PhD[1]; Damon Toth, PhD[2]; Bruce Y. Lee, MD[3]; Windy Tanner, PhD[2]; Sarah M. Bartsch, MPH[3]; Karim Khader, PhD[2]; Kim Wong, PhD[4]; Kevin Brown, PhD[2]; James A. McKinnell, MD[5]; William Ray[2]; Loren G. Miller, MD[6]; Michael Rubin, MD, PhD[2]; Diane S. Kim[7]; Fred Adler, PhD[8]; Chenghua Cao, MPH[7]; Lacey Avery, MA[1]; Nathan T.B. Stone, PhD[9]; Alexander Kallen, MD[1]; Matthew Samore, MD[2]; Susan S. Huang, MD[7]; Scott Fridkin, MD[1]; John A. Jernigan, MD[1]

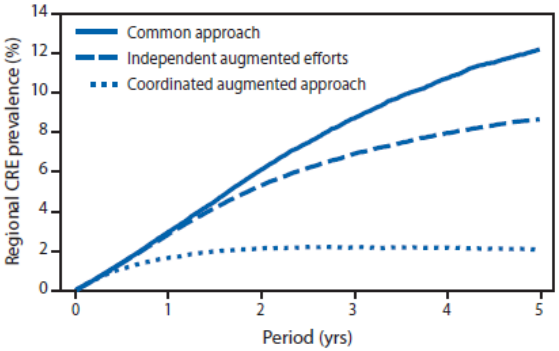
- If best infection control practices and antibiotic stewardship were nationally adopted, more than 600,000 infections and 37,000 deaths could be prevented over 5 years.

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†



* Methicillin-resistant *Staphlococcus aureus*, carbapenem-resistant *Enterobacteriaceae*, and multidrug-resistant *Pseudomonas aeruginosa*.
† Additional information available at http://www.cdc.gov/drugresistance/resources/publications.html.

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*



MMWR August 7, 2015

Modern stewardship alligned to infection prevention, decontamination etc

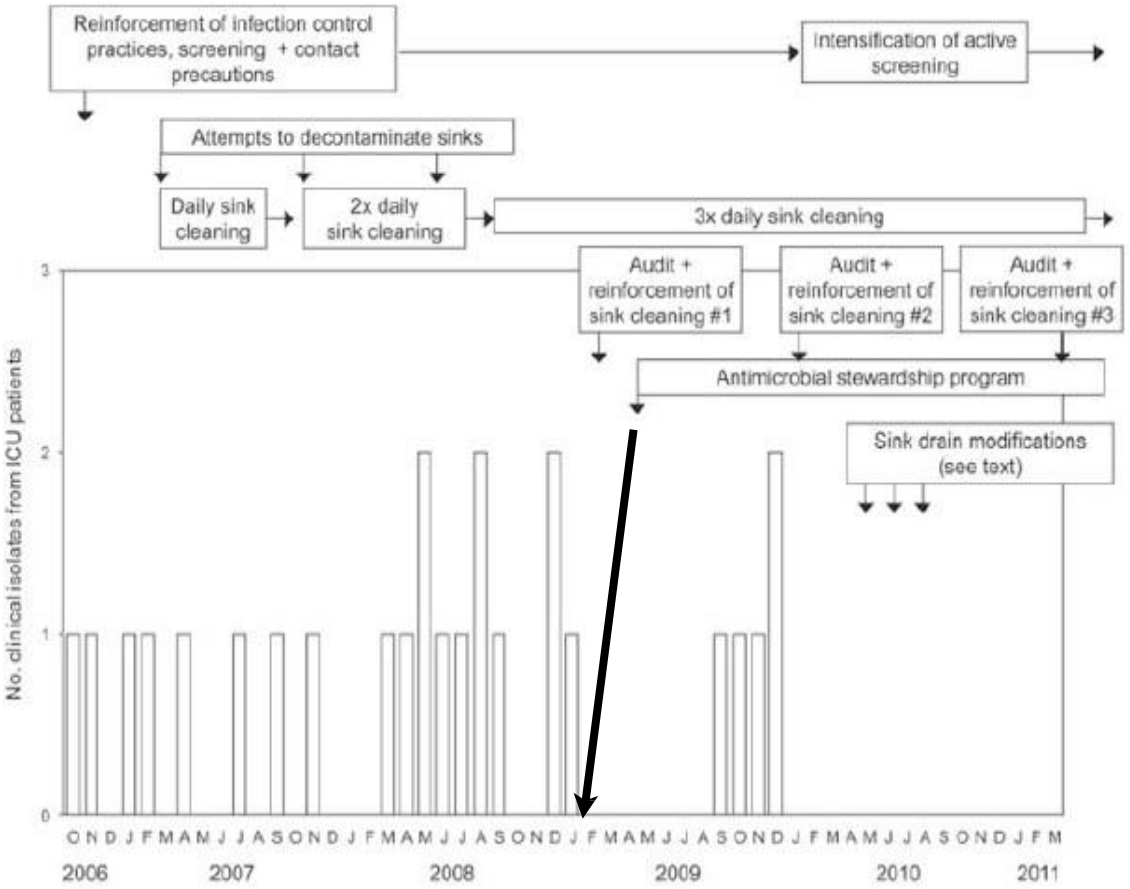


Figure 2. Nosocomial extended-spectrum β-lactamase–producing *Klebsiella oxytoca* clinical isolates from patients in the intensive care unit of a hospital in Toronto, Ontario, Canada, and the associated interventions implemented to contain the spread of the outbreak, October 2006–March 2011. ICU, intensive care unit.

Lowe C et al. *Emerg Infect Dis*. 2012;**18**(8):1242-7

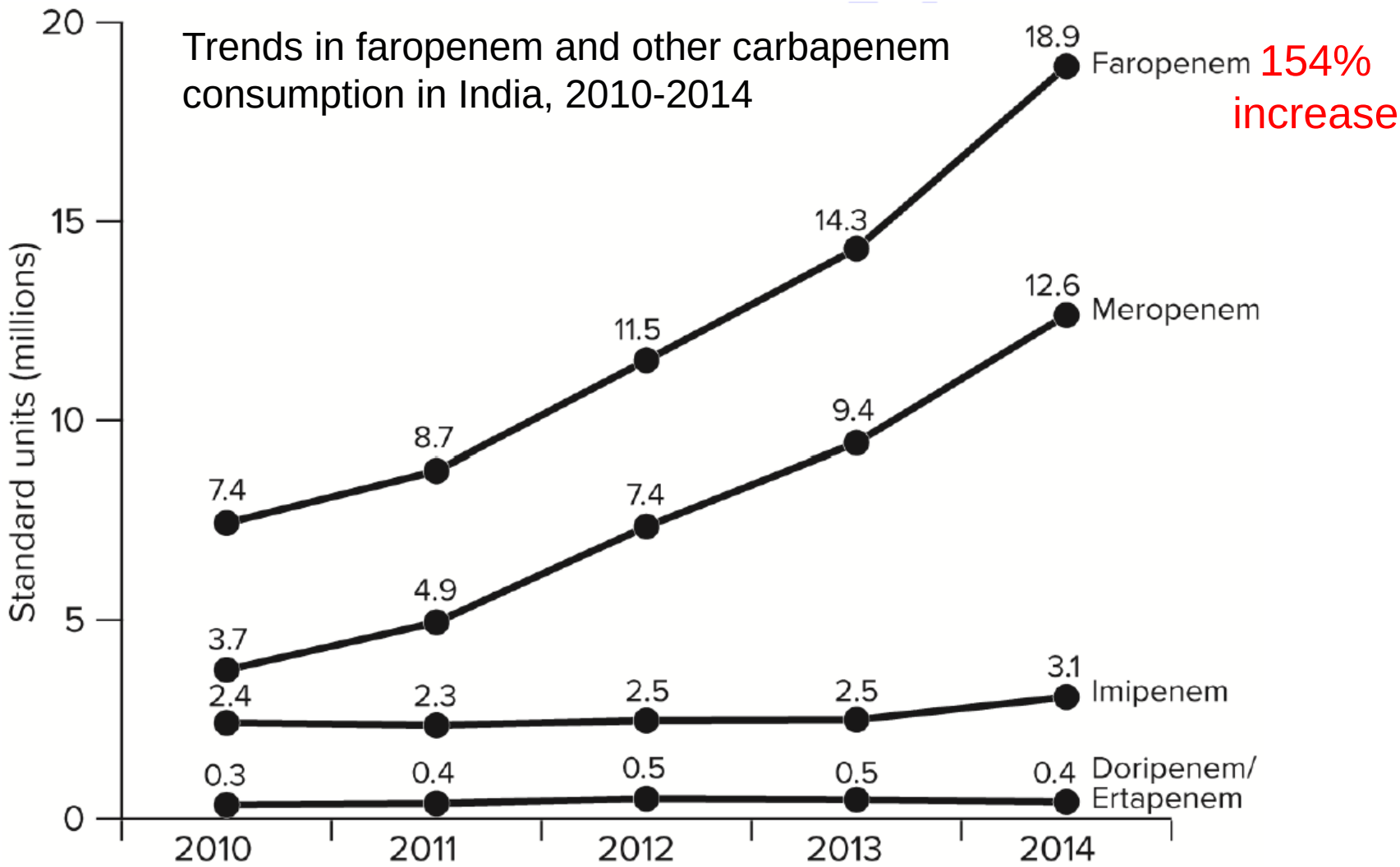
An integrated stewardship model: antimicrobial, infection prevention and diagnostic (AID)

Future Microbiol. (2015) 11(1)

Jan-Willem H Dik[1], Randy Poelman[2], Alexander W Friedrich*[,3], Prashant Nannan Panday[4], Jerome R Lo-Ten-Foe[1], Sander van Assen[5], Julia EWC van Gemert-Pijnen[6], Hubert GM Niesters[2], Ron Hendrix[1,7] & Bhanu Sinha[1]

- Antibiotic consumption in humans is increasing globally. The greatest increase between 2000 and 2010 was in low- and middle-income countries (LMICs), but in general, high-income countries still use more antibiotics per capita.
- An estimated 80 percent of all antibiotics are used in the community, where prescribing and purchasing of antibiotics without prescription are common, especially in LMICs. In many countries at all economic levels, clinicians have incentives to overuse antibiotics.
- The confluence of patients with serious medical conditions, interconnectedness of hospitals through mobile patient populations, and high density of antibiotic use make hospital antibiotic use disproportionately important.

Implementation challenges remain



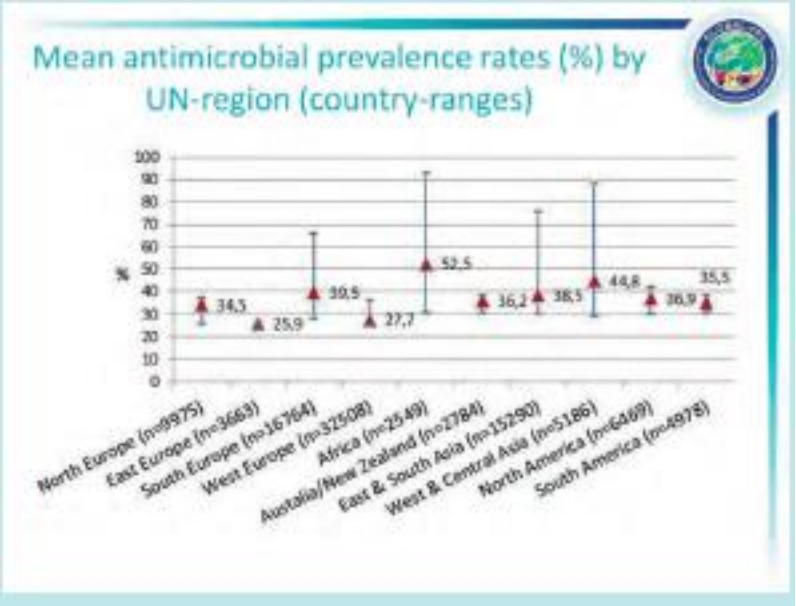
Gandra S. Clin Infect Dis. (2016)doi: 10.1093/cid/ciw055

A Sense of Perspective

Where used	Types of Use	Questionable use
Human (50%)	20% Hospital	20-50% unnecessary
	80% Community	
Animal (50%)	20% Therapeutic	40-80% highly questionable
	80% Prophylaxis/growth promotion	

Wise *et al.* BMJ 1999; 317: 609-610

THE GLOBAL POINT PREVALENCE SURVEY
on Antimicrobial Consumption and Resistance



Antibiotic (ATC J01) quality indicators for therapeutic use

Antibiotic quality indicators (N antibiotics for CAI and HAI)	No guidelines %	guideline compliant %	Reason in notes %	Stop review date documented %	Parenteral RoA %	Targeted treatment %
North Europe (n=3441)	7.1	83.9	89.5	52.7	68.0	65.9
East Europe (n=651)	1.1	90.0	77.0	38.6	85.1	15.7
South Europe (n=4909)	25.1	77.3	75.9	30.2	82.3	25.8
West Europe (n=8074)	10.3	80.4	86.4	37.2	67.0	32.1
Africa (n=1366)	22.0	71.3	74.2	30.2	78.5	16.8
Australia & New Zealand (n=1021)	19.0	74.5	94.5	26.9	65.9	27.0
East & South Asia (n=4785)	18.2	84.9	89.8	49.3	80.2	25.9
West & Central Asia (n=2088)	43.3	69.2	79.3	19.7	83.8	17.7
North America (n=2392)	17.2	87.2	93.2	34.2	79.3	25.0
South America (n=1964)	22.2	70.4	91.2	42.4	87.8	31.0
All Regions (n=30693)	17.7	80.3	85.5	38.0	75.9	25.5

Overview of quality indicators of antibiotic prescribing for prophylactic use are provided in poster n° P1222

POOR QUALITY

Braykov NP, Lancet ID 2014

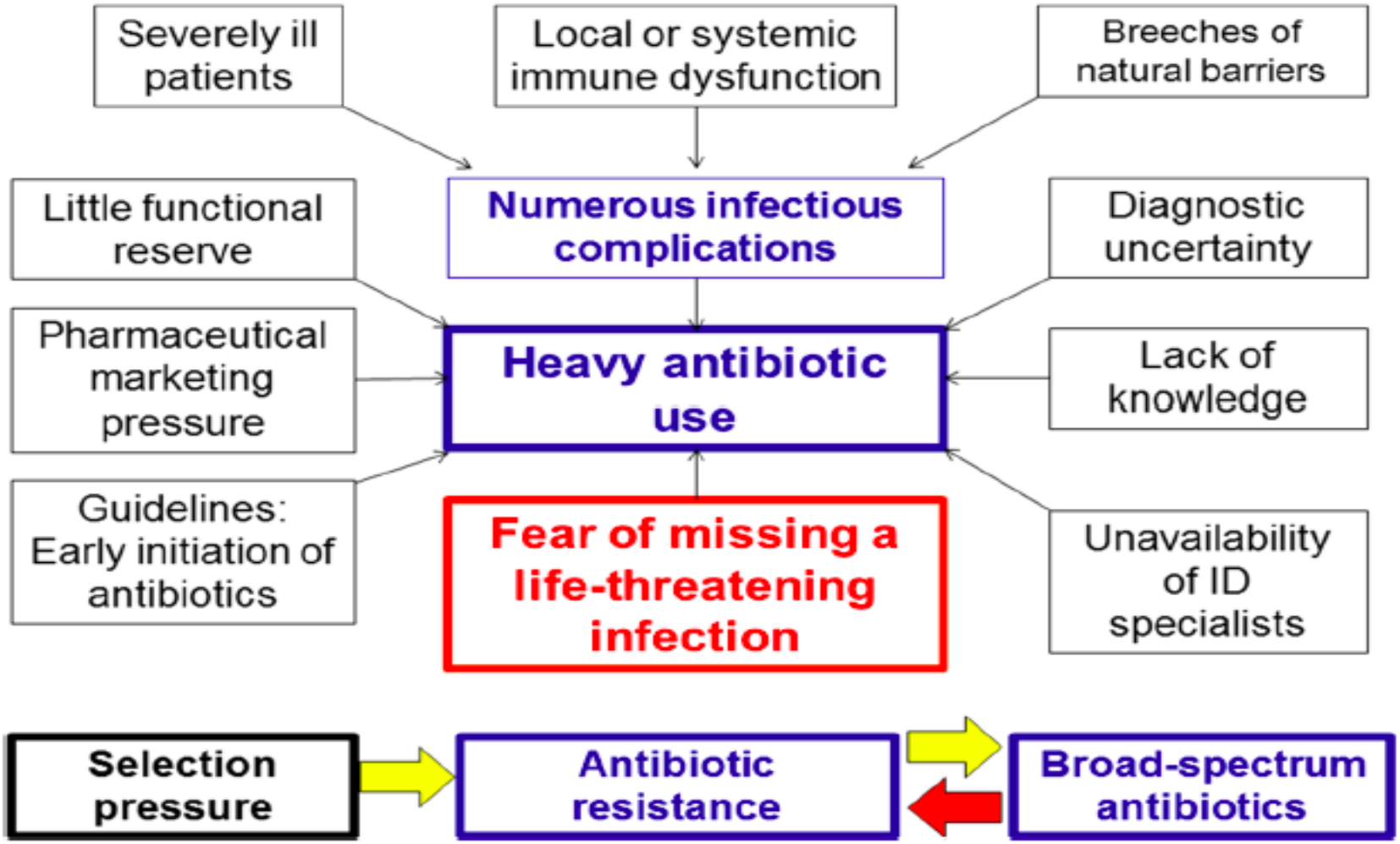
- 6 US HOSPITALS
- Antibiotic use was prevalent in 60.4% of patients
- 2/3 of patients started on empirical antibiotics
  did not have a fever
  one third did not have a fever or increased white cell count
- By the fifth day of therapy 66.4% of therapy was unchanged
- Cultures and imaging were frequently not obtained

Pros and cons of using biomarkers versus clinical decisions in start and stop decisions for antibiotics in the critical care setting

Intensive Care Med
DOI 10.1007/s00134-015-3978-8

Fig. 1 Causes and consequences of heavy antibiotic use in the intensive care unit. *ID* infectious diseases

Why is stewardship so challenging ?



MAJOR ARTICLE

Behavior Change Strategies to Influence Antimicrobial Prescribing in Acute Care: A Systematic Review

Esmita Charani,[1] Rachel Edwards,[1] Nick Sevdalis,[2] Banos Alexandrou,[3] Eleanor Sibley,[4] David Mullett,[4] Bryony Dean Franklin,[5,6] and Alison Holmes[1]

[1]The National Centre for Infection Prevention and Management, [2]Department of Surgery and Cancer and Centre for Patient Safety and Service Quality, Imperial College London, [3]Independent Consultant, [4]Dr Foster Intelligence, [5]Centre for Medication Safety and Service Quality, Imperial College Healthcare National Health Service Trust, and [6]The School of Pharmacy, University of London, Pharmacy Department, Charing Cross Hospital, London, United Kingdom

Background. Antimicrobial use in acute care is widely reported to be suboptimal. Inappropriate use of antimicrobials is a major contributing factor to the emergence of multidrug resistance and health care–associated infection. Addressing prescribing behavior is a key component of antimicrobial stewardship.

Methods. We performed a novel systematic review of both qualitative and quantitativ antimicrobial prescribing behavior in acute care. We assessed the extent to which behavioral scie marketing were used and whether this could be related to the effectiveness of reported outcom Excerpta Medica Database (EMBASE), Applied Social Sciences Index and Abstracts (ASSIA), E Complete, The Cochrane Library, PsychInfo, Database of Abstracts of Reviews of Effectiveness (DA Management Information Consortium (HMIC) were searched for studies undertaken during the 1999–April 2011 and published in English.

Results. Five qualitative and 5 quantitative studies met the quality criteria. Qualitative studi predominant influence of social norms, attitudes, and beliefs on antimicrobial prescribing behavic studies reporting interventions to optimize antimicrobial prescribing behavior do not use theore primary research to inform the design and choice of the interventions deployed.

Conclusions. Despite qualitative evidence demonstrating the impact of behavioral determin norms on prescribing, these influences are not given due consideration in the design and interventions. To ensure a better understanding of prescribing behaviors and to improve the quality and research in this area, the incorporation and application of behavioral sciences supported multidisciplinary collaboration is recommended.

Intensive Care Med
DOI 10.1007/s00134-015-3978-8

Why is stewardship so challenging ?

MAJOR ARTICLE

Understanding the Determinants of Antimicrobial Prescribing Within Hospitals: The Role of "Prescribing Etiquette"

E. Charani,[1] E. Castro-Sanchez,[1] N. Sevdalis,[2,3] Y. Kyratsis,[1] L. Drumright,[1] N. Shah,[1] and A. Holmes[1]

[1]The National Centre for Infection Prevention and Management, Hammersmith Hospital; and [2]Department of Surgery and Cancer, and [3]Imperial Centre for Patient Safety and Service Quality, St Mary's Hospital, Imperial College London, United Kingdom

Background. There is limited knowledge of the key determinants of antimicrobial prescribing behavior (APB) in hospitals. An understanding of these determinants is required for the successful design, adoption, and implementation of quality improvement interventions in antimicrobial stewardship programs.

Methods. Qualitative semistructured interviews were conducted with doctors (n = 10), pharmacists (n = 10), and nurses and midwives (n = 19) in 4 hospitals in London. Interviews were conducted until thematic saturation was reached. Thematic analysis was applied to the data to identify the key determinants of antimicrobial prescribing behaviors.

Results. The APB of healthcare professionals is governed by a set of cultural rules. Antimicrobial prescribing is performed in an environment where the behavior of clinical leaders or seniors influences practice of junior doctors. Senior doctors consider themselves exempt from following policy and practice within a culture of perceived autonomous decision making that relies more on personal knowledge and experience than formal policy. Prescribers identify with the clinical groups in which they work and adjust their APB according to the prevailing practice within these groups. A culture of "noninterference" in the antimicrobial prescribing practice of peers prevents intervention into prescribing of colleagues. These sets of cultural rules demonstrate the existence of a "prescribing etiquette," which dominates the APB of healthcare professionals. Prescribing etiquette creates an environment in which professional hierarchy and clinical groups act as key determinants of APB.

Conclusions. To influence the antimicrobial prescribing of individual healthcare professionals, interventions need to address prescribing etiquette and use clinical leadership within existing clinical groups to influence practice.

Keywords. prescribing etiquette; antimicrobial prescribing; prescribing behavior.

Little functional reserve

Pharmaceutical

J Antimicrob Chemother 2012; **67** Suppl 1: i29–i36
doi:10.1093/jac/dks200

Journal of Antimicrobial Chemotherapy

Addressing healthcare-associated infections and antimicrobial resistance from an organizational perspective: progress and challenges

Eleanor Murray[1]* and Alison Holmes[2]

[1]*Imperial College Centre for Patient Safety and Service Quality, Faculty of Medicine, Imperial College London, 5th floor Medical School Building, St Mary's Campus, Norfolk Place, London W2 1PG, UK;* [2]*National Centre for Infection Prevention and Management, Faculty of Medicine, Imperial College London, Level 2 Infection Control, Hammersmith House, Hammersmith Hospital Campus, Du Cane Road, London W12 0HS, UK*

*Corresponding author. Tel: +44-20-3313-3248; Fax: +44-20-3313-3235; E-mail: e.murray@imperial.ac.uk

This paper explores the progress and challenges associated with the application of organizational factors and approaches to infection prevention and control (IPC) and antibiotic stewardship (AS) in England, many of which have been considered and supported by the Advisory Committee on Antimicrobial Resistance and Healthcare-associated Infections (ARHAI). An organizational perspective is described and the wider macro context and socio-political forces that shape an organizational approach are considered. Factors that drive organizational change in IPC and AS are discussed. The tensions, constraints and dilemmas that can occur are identified and outstanding challenges are debated. Some recommendations for the future direction of IPC and AS organizationally focused strategies and research are proposed.

Keywords: organizations, infection control, antibiotic stewardship

Old style stewardship !

Restriction of antibiotics

brief; cases 10 and 11 in this series had sensory disturbance or hemiparesis lasting only two and fifteen minutes respectively yet showed focal abnormalities sixty-four and ninety days after their last attack. It is clear that, despite apparently complete clinical recovery, some degree of vascular disturbance persisted. It is, however, unlikely that this was solely vascular for the following reasons: the R.C.B.F. in 9 of the 10 patients in which it was tested showed a normal response to hypocapnia; both low and high flow areas were found and there were areas showing abnormal proportions of tissue clearing at fast and slow rates. These findings suggest that tissue damage had occurred.

The recording of areas of decreased flow indicates ischæmia and, when combined with reduction in the proportion of tissue clearing at the fast or slow rates, suggests infarction. The finding of areas of increased flow is more difficult to explain. Areas of increased flow in acute stroke cases have usually been associated with unresponsiveness to changes in arterial P_{CO_2} indicating some degree of vasoparalysis.[6-8] This was not so in the present series in which all but 1 case

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.

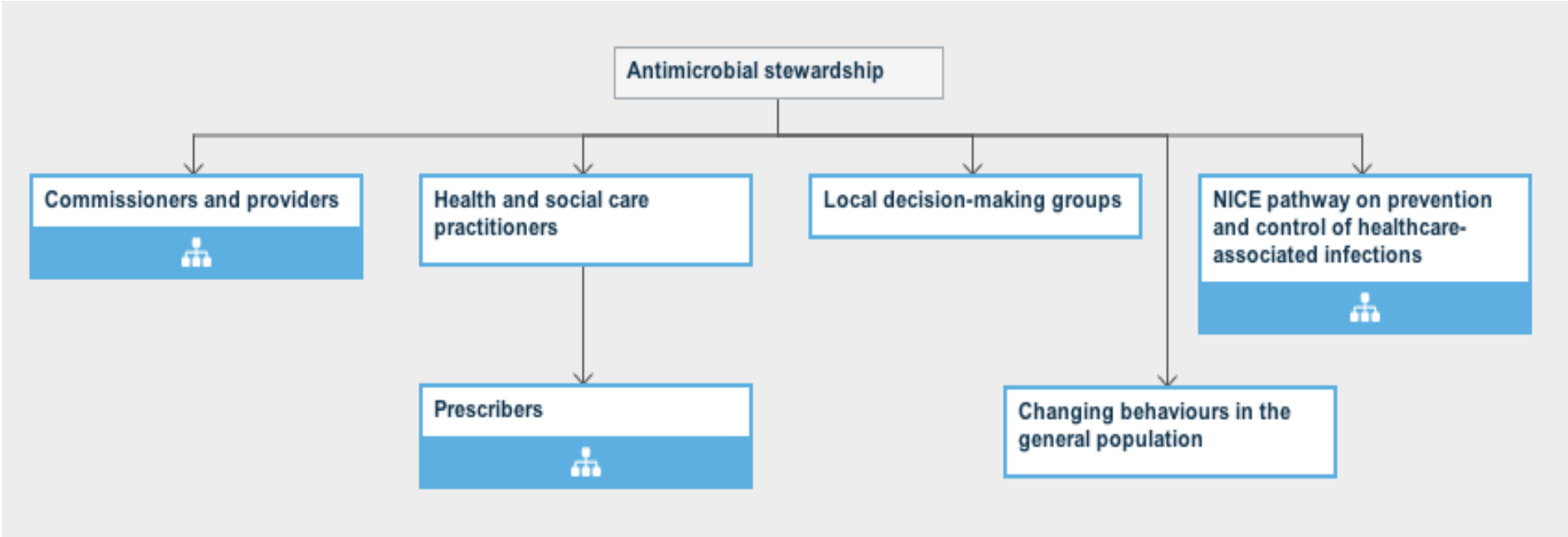
Antimicrobial stewardship: systems and processes for effective antimicrobial medicine use

NICE guideline
Published: 18 August 2015
nice.org.uk/guidance/ng15

NICE guideline

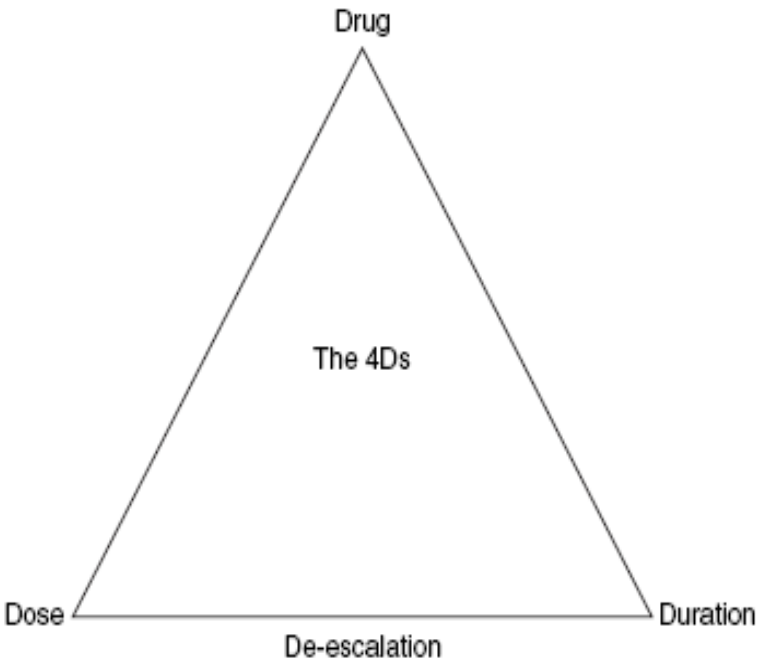
Antimicrobial stewardship

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'.



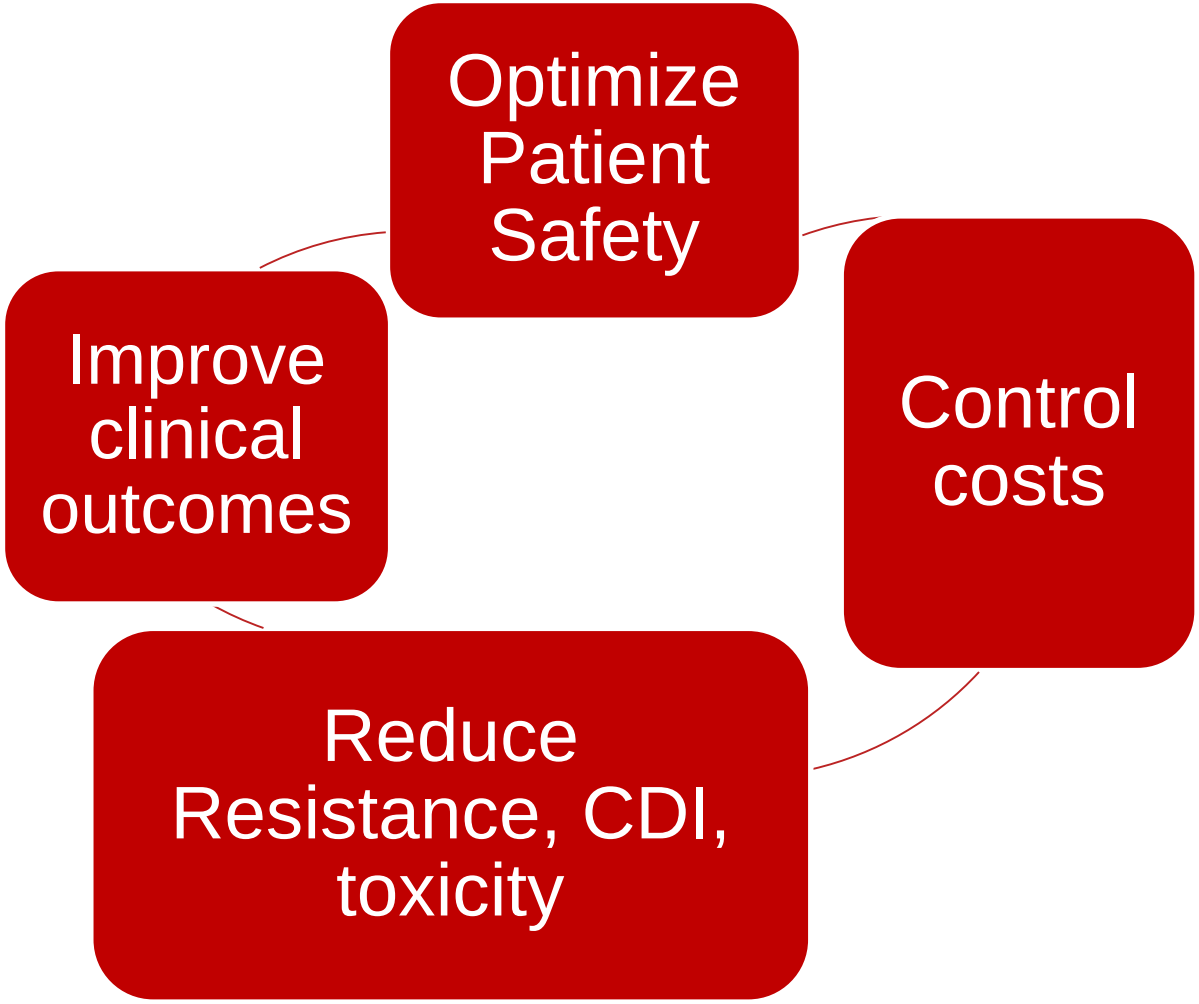
What is Antimicrobial Stewardship (AMS) ?

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."



4 Ds of AMS

Goals of Antimicrobial Stewardship Programs



Antimicrobial Stewardship: Importance for Patient and Public Health

Thomas M. File Jr,[1] Arjun Srinivasan,[2] and John G. Bartlett[3]
[1]Summa Health System, Akron, Ohio; [2]Division of Healthcare Quality Promotion, Centers for Disease Control and Prevention, Atlanta, Georgia; and [3]Johns Hopkins University School of Medicine, Baltimore, Maryland

Keywords. antimicrobial stewardship programs; public health.

Impact of Stewardship on SAFETY?

The reductions in antimicrobial utilization associated with stewardship interventions have not been associated with any worsening in nosocomial infection rates, length of stay or mortality among intensive care patients."

- **"Stewardship interventions were associated with … fewer antibiotic adverse events."**

Kaki R, et al. Impact of antimicrobial stewardship in critical care: a systematic review. J Antimicrob Chemother
2011 (June); 66: 1223-1230

J Antimicrob Chemother 2015; **70**: 1219–1225
doi:10.1093/jac/dku479 Advance Access publication 3 December 2014

Journal of Antimicrobial Chemotherapy

Safety and clinical outcomes of carbapenem de-escalation as part of an antimicrobial stewardship programme in an ESBL-endemic setting

Kaung Yuan Lew[1], Tat Ming Ng[2], Michelle Tan[2], Sock Hoon Tan[2], Ee Ling Lew[2], Li Min Ling[3], Brenda Ang[3], David Lye[3,4] and Christine B. Teng[1,2]*

Results: The de-escalation recommendations for 300 patients were evaluated; 204 (68.0%) were accepted. The patient demographics and disease severity were similar. The clinical success rates were similar [de-escalated versus not de-escalated, 183/204 (89.7%) versus 85/96 (88.5%), $P=0.84$], as was the survival at hospital discharge [173/204 (84.8%) versus 79/96 (82.3%), $P=0.58$]. In the de-escalated group, the duration of carbapenem therapy was shorter (6 versus 8 days, $P<0.001$), the rate of adverse drug reactions was lower [11/204 (5.4%) versus 12/96 (12.5%), $P=0.037$], there was less diarrhoea [9/204 (4.4%) versus 12/96 (12.5%), $P=0.015$], there was a lower incidence of carbapenem-resistant *Acinetobacter baumannii* acquisition [4/204 (2.0%) versus 7/96 (7.3%), $P=0.042$] and there was a lower incidence of CDAD [2/204 (1.0%) versus 4/96 (4.2%), $P=0.081$].

Conclusions: This study suggests that the ASP-guided de-escalation of carbapenems led to comparable clinical success, fewer adverse effects and a lower incidence of the development of resistance. This approach is safe and practicable, and should be a key component of an ASP.

INTERVENTIONS TO IMPROVE ANTIBIOTIC PRESCRIBING IN HOSPITALS

- 89 STUDIES
- 55 FROM N. AME
  37 EUROPE, 3 FA
  3 SOUTH AMERICA& 2 AUSTRALIA
- PERSUASIVE AND RESTRICTIVE INTERVENTIONS

- Davey P et al Cochrane systematic review Update April 30th 2013

- Evidence to support beneficial impact on :
  - *1, Decrease in antibiotic use does not increase mortality and can improve clinical outcomes*
  - *2, Better use of antibiotics will reduce SSI's*
  - *3. Decrease and better use of antibiotics reduces resistance and C. difficile*
  - *4. Emerging data on cost-reduction*

LIMITATIONS: VERY FEW DATA FROM NON WESTERN COUNTRIES

frontiers in Microbiology

Financial evaluations of antibiotic stewardship programs—a systematic review

April 2015 | Volume 6 | Article 317

GEOGRAPHY		
North America	51	52%
South America	3	3%
Europe	28	28%
Asia	14	14%
Africa	2	2%
Australia	1	1%

TABLE 3 | Types of economic evaluation of the reviewed papers.

Type of analysis	Number	Percentage
CA	2	2%
CMA	2	2%
CBA	32	32%
CCA	3	3%
CEA	3	3%
CUA	0	0%
ACA	57	57%

CA, Cost-Analysis; CMA, Cost-Minimization Analysis; CBA, Cost-Benefit Analysis; CCA, Cost-Consequence Analysis; CEA, Cost-Effectiveness Analysis; CUA, Cost-Utility Analysis; ACA, Antimicrobial Cost Analysis.

TABLE 2 | Types of interventions of the reviewed papers.

Block	Interventions	Number	Percentage	Patients
1	Altered therapy guidelines	16	16%	32,103
	Antibiotic restriction lists or pre-authorization	12	12%	70,446
	Giving education	10	10%	21,913
	Antibiotic cycling	1	1%	–
	Pre-analytic consultations	1	1%	100
	New therapy	1	1%	2888
2	Therapy evaluation, review and/or feedback	62	63%	51,506
	Rapid diagnostic tools	9	9%	701
	New biomarkers	2	2%	–
3	Producing local use and resistance data	5	5%	19,390

Outcome measures	Number	Percentage
Implementation costs	11	11%
Antimicrobial costs	97	98%
Operational costs	23	23%
LOS costs	18	18%
Morbidity/mortality costs	14	14%
Other hospital costs	19	19%
Societal costs	0	0%

LOS, length of stay.

Antimicrobial Stewardship Toolkit:

Quality of Evidence to support interventions

- Prospective audit with intervention and feedback AI
- Education BIII [Education with an active intervention AIII]
- Formulary restriction and pre-authorisation
  - AII for rapid decrease in antibiotic in use
  - BII for control of outbreak
  - BII/III may lead to unintended increase in resistance
- Guidelines and clinical pathways AII
  - With education and feedback on outcomes AIII
- Antimicrobial cycling CII
- Antimicrobial order forms BII
- Combination therapies CII
  - In critically unwell patient with high rIsk of MDRO AII
- De-escalation-review AII
- Dose optimisation AII
- Parenteral to oral conversion AIII
- Computerised decision support, surveillance BII
- Laboratory surveillance and feedback BII

Update 2016
No major changes

Adapted from Dellit et al. Clinical Infectious Diseases 2007; 44:159-77

J Antimicrob Chemother
doi:10.1093/jac/dku497 JAC

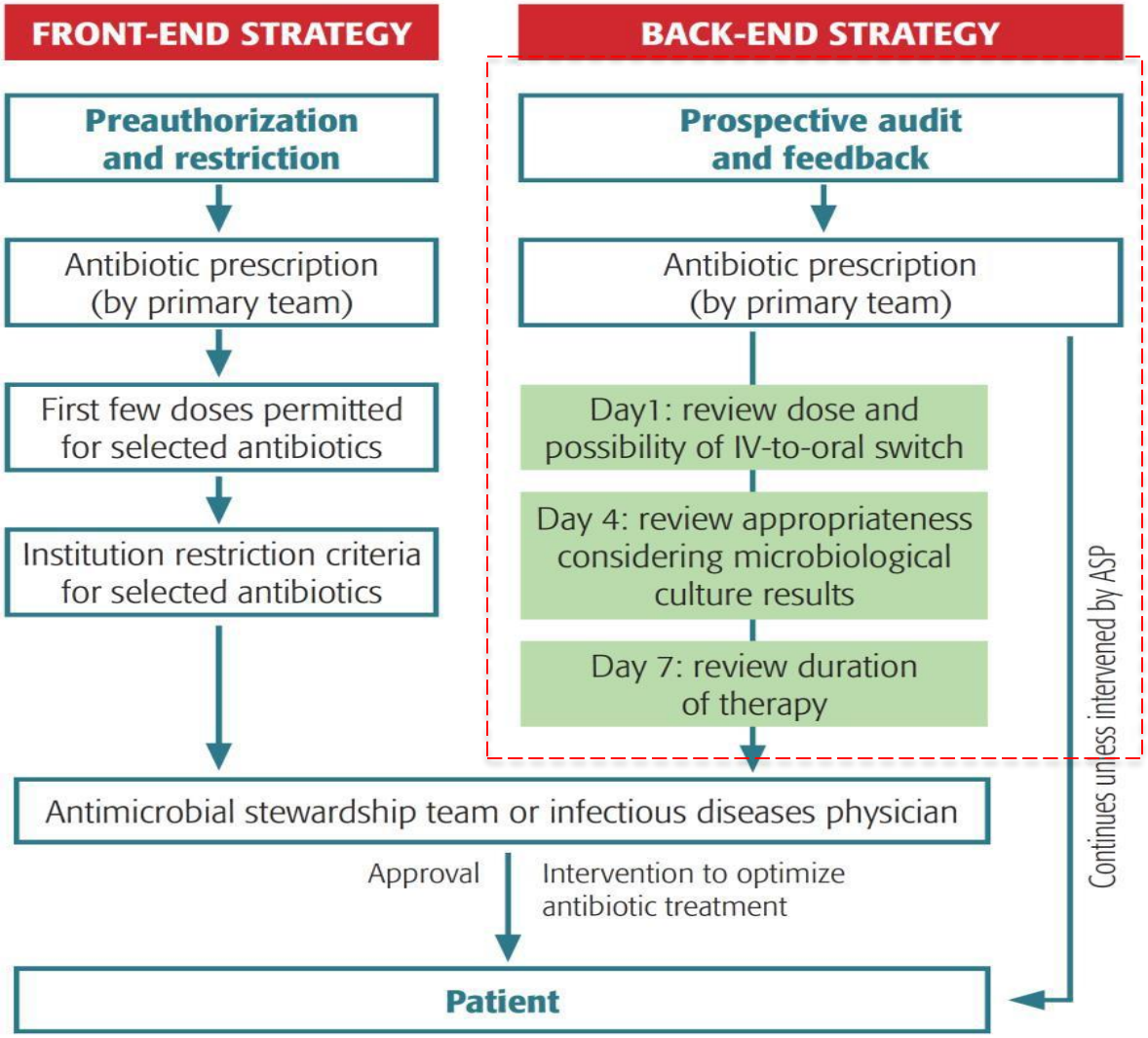
Table 4. AMS strategies—all or some wards (actual or planned AMS programme), $n=422$

	Asia (13) (%)	Africa (31) (%)	Europe (258) (%)	North America (54) (%)	Oceania (23) (%)	South America (43) (%)	Total (422) (%)
Treatment guidelines	85	84	98	89	96	84	94
Surgical prophylaxis guidelines	77	94	95	87	96	88	93
Approved antibiotics (formulary)	69	84	95	87	91	77	90
Reserve antibiotics needing authorization by indication	38	84	88	87	87	77	84
Infectious diseases/microbiology advice by telephone	85	84	92	81	96	84	89
Infectious diseases/microbiology advice on ward rounds	69	87	84	63	74	81	81
Systematic advice for bacteraemia by infectious diseases/microbiology	46	74	78	52	83	74	73
Dose optimization on request	92	71	80	87	96	67	80
Intravenous-to-oral switch guidance	62	65	82	91	78	67	80
Review of intravenous therapy at Day 3	62	61	78	89	61	70	76
Care bundles (e.g. ventilator)	85	90	59	76	30	72	64
Automatic stop/review policy	23	58	42	69	43	40	46
Pre-authorized pharmacy-driven dose optimization (e.g. automatic renal dose adjustments, intravenous-to-oral conversions etc.)	31	48	36	69	35	47	42
Separate antimicrobial chart or section	62	55	40	33	0	47	39
Inflammatory markers to prevent initiation of antibiotics, e.g. procalcitonin	69	65	37	22	13	51	39
Inflammatory markers to stop antibiotics early, e.g. procalcitonin	46	58	35	24	13	51	36
Restrictions on access by pharmaceutical representatives	31	45	26	56	43	40	33
Antibiotic cycling programme	23	19	14	11	4	42	17

An international cross-sectional survey of antimicrobial stewardship programmes in hospitals

‘Front-end’ versus ‘Back-end’ AMS strategies

Figure 9. Front- and Back-end Antimicrobial Stewardship Strategy.



Adapted from Chung GW et al. Virulence 2013; 4:1-7.

Eur J Clin Microbiol Infect Dis (2013) 32:1599–1604
DOI 10.1007/s10096-013-1918-5

ARTICLE

Impact of a program combining pre-authorization requirement and post-prescription review of carbapenems: an interrupted time-series analysis

T. Delory · A. De Pontfarcy · A. Emirian · F. About · B. Berdougo · C. Brun-Buisson · P. Lesprit

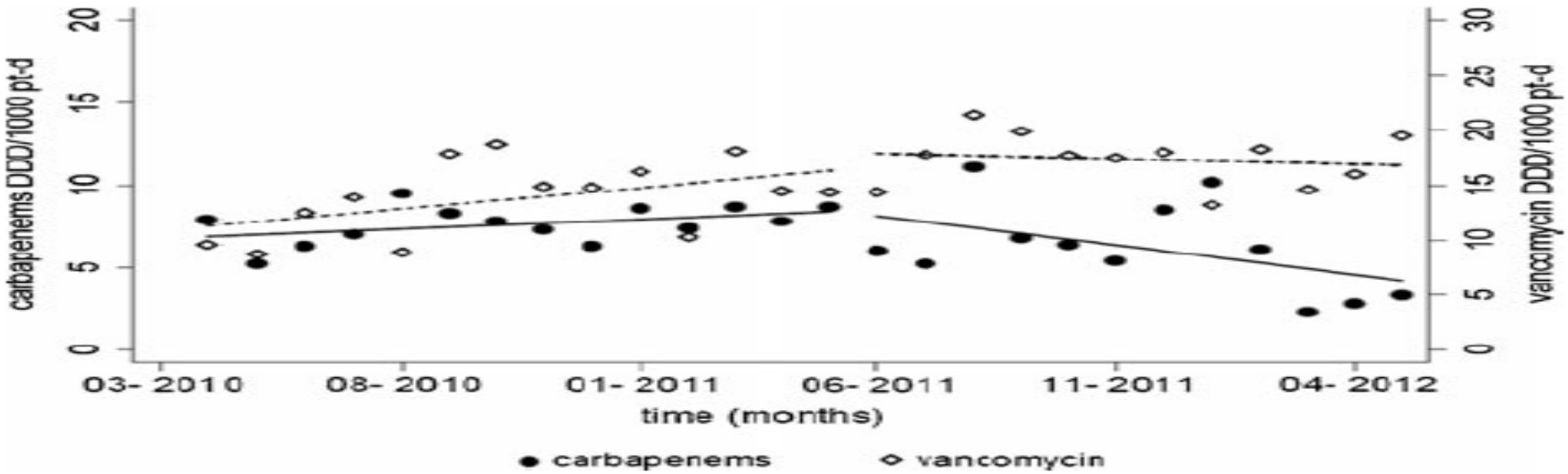


Fig. 1 Intervention effect on carbapenems and vancomycin consumptions. Carbapenems consumption is represented by *filled symbols* and vancomycin consumption is represented by *open symbols*. Consumption trends are represented by *lines*. The diffusion period was from May to July 2011. Only carbapenems consumption was affected by the intervention with a direct and sustained decreasing effect: (1) change in mean (−1.66 DDD/1,000 pt-d, $p=0.048$) corresponding to the global consumption change between the pre- and intervention periods; (2) change in level (−5.34 DDD/1,000 pt-d, $p=0.049$) corresponding to the consumption change at the start of the intervention; (3) change in slope (−2.66 DDD/1,000 pt-d, $p=0.02$) corresponding to the consumption change during the intervention period

Current evidence on hospital antimicrobial stewardship objectives: a systematic review and meta-analysis

Traditional stewardship systematic review: the effectiveness of a range of stewardship Strategies on a range of outcomes e.g Cochrane

New review : Effect of meeting the objectives of a range of strategies on different outcomes ; e.g mortality, LOS, cost, toxicity etc

Key Strategies identified through Delphi

1. **Adherence to local guidelines**
2. **De-escalation of therapy according to culture**
3. IVOST
4. Adjustment of therapy according to renal function
5. TDM
6. Use of restricted antibiotics
7. 7. bed side consultations

Lancet Infect Dis 2016
Published Online
March 2, 2016
http://dx.doi.org/10.1016/S1473-3099(16)00065-7

Systematic review and meta-analysis : impact of key 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 0.25-075; 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

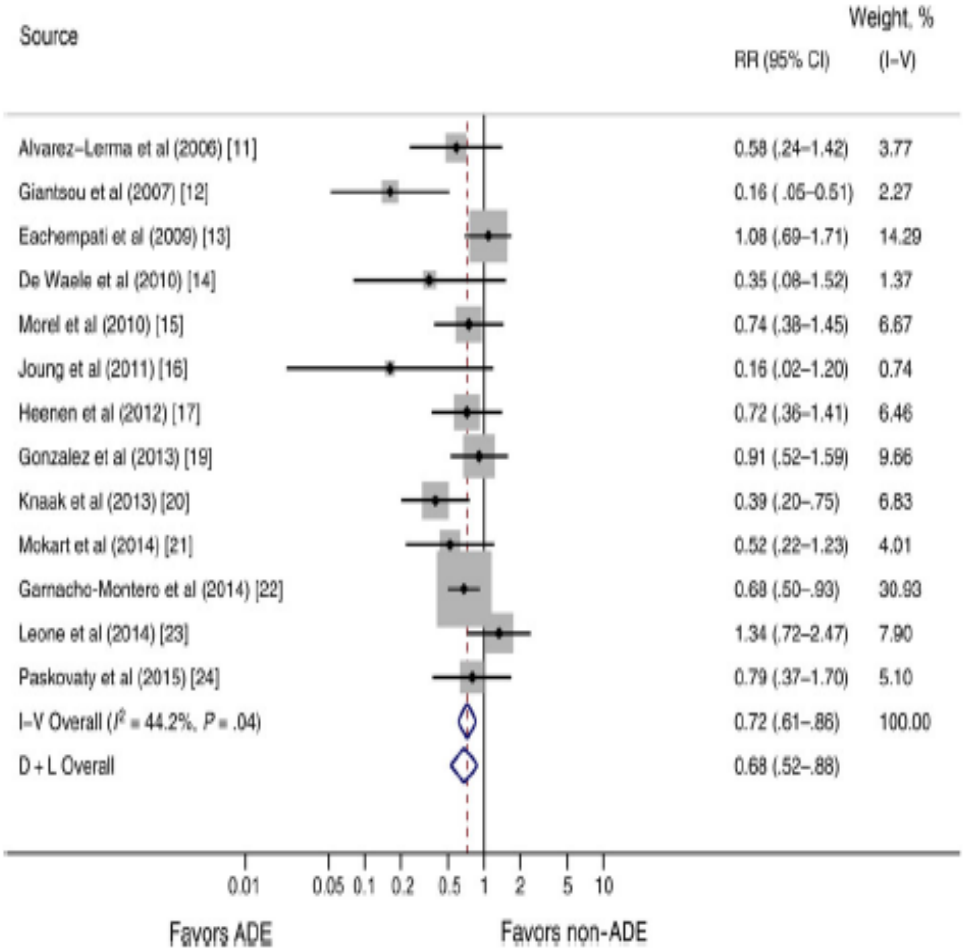
Schuts EC et al. Lancet ID March 2nd 2016

A Systematic Review of the Definitions, Determinants, and Clinical Outcomes of Antimicrobial De-escalation in the Intensive Care Unit

Table 3. Factors Associated With Antimicrobial De-escalation

Factors Associated With ADE
Positively associated
Initially appropriate empiric antimicrobial therapy
Broad-spectrum empiric therapy
Compliance with national prescribing guidelines
Treatment with multiple and "companion" antimicrobials
Positive microbiological cultures
Lower severity of illness scores at
Baseline
Time of ADE
Day 5 of therapy
Negatively associated
Isolation of a multiresistant pathogen
Polymicrobial infections
Intra-abdominal infections

Abbreviation: ADE, antimicrobial de-escalation.



Clinical Infectious Diseases Advance Access published February 9, 2016

Core Elements of Hospital Antibiotic Stewardship Programs From the Centers for Disease Control and Prevention

Loria A. Pollack and Arjun Srinivasan

Division of Healthcare Quality Promotion, Centers for Disease Control and Prevention, Atlanta, Georgia

Table 1. Core Elements of Hospital Antibiotic Stewardship Programs

Leadership commitment	Dedicating necessary human, financial, and information technology resources
Accountability	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
Drug expertise	Appointing a single pharmacist leader responsible for working to improve antibiotic use
Action	Implementing at least 1 recommended action, such as systemic evaluation of ongoing treatment need after a set period of initial treatment (ie, antibiotic "time-out" after 48 h)
Tracking	Monitoring process measures (eg, adherence to facility-specific guidelines, time to initiation or de-escalation), impact on patients (eg, *Clostridium difficile* infections, antibiotic-related adverse effects and toxicity), antibiotic use and resistance
Reporting	Regular reporting of the above information to doctors, nurses, and relevant staff
Education	Educating clinicians about disease state management, resistance, and optimal prescribing

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

Antimicrobial Stewardship Toolkit:

Quality of Evidence to support interventions

- Prospective audit with intervention and feedback AI
- Education BIII [Education with an active intervention AIII]
- Formulary restriction and pre-authorisation

  AII for rapid decrease in antibiotic in use

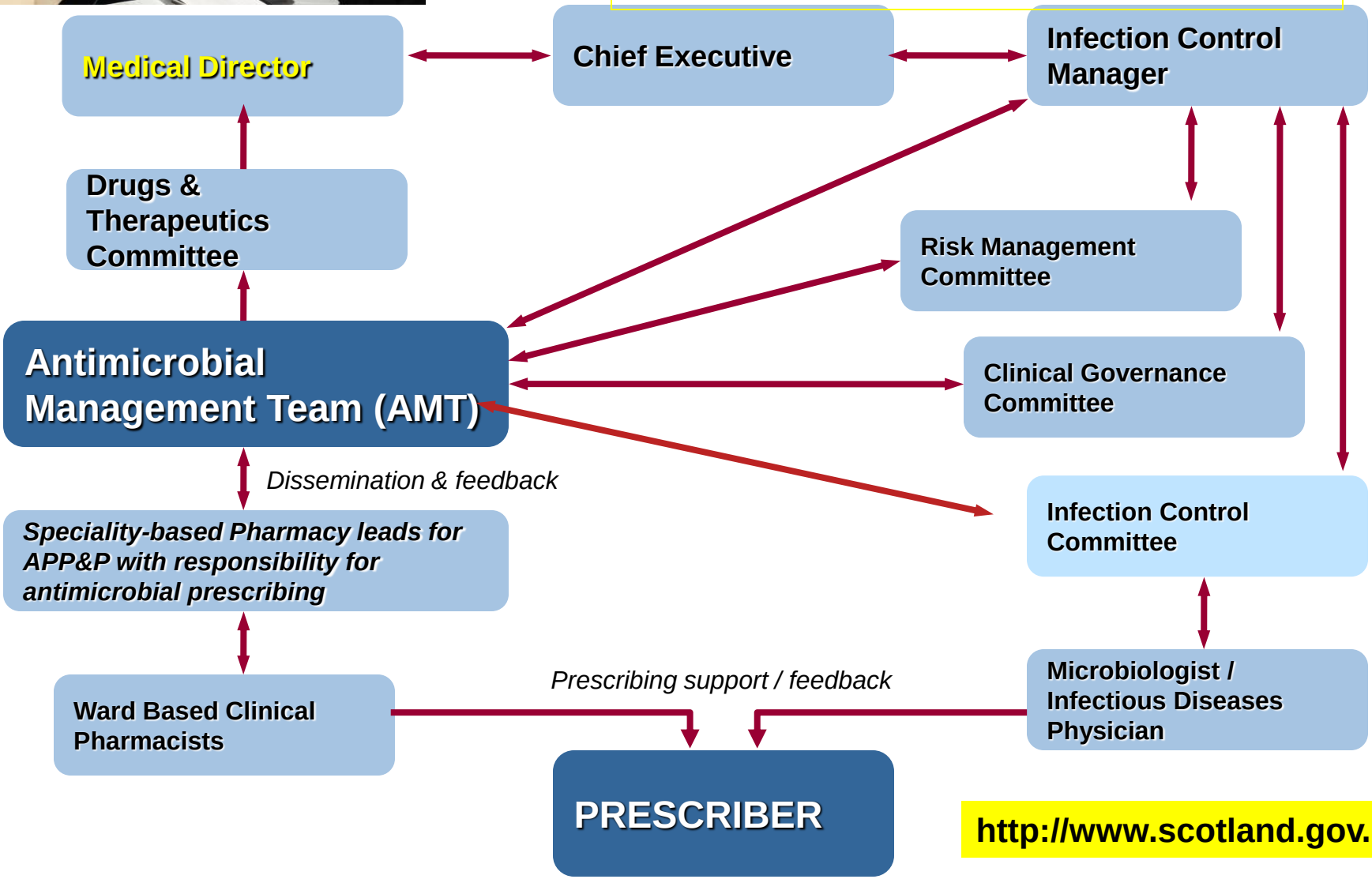
  BII for control of outbreak

  BII/III may lead to unintended increase in resistance
- Guidelines and clinical pathways AII
  - With education and feedback on outcomes AIII
- Antimicrobial cycling CII
- Antimicrobial order forms BII
- Combination therapies CII
  - In critically unwell patient with high rIsk of MDRO AII
- De-escalation-review AII
- Dose optimisation AII
- Parenteral to oral conversion AIII
- Computerised decision support, surveillance BII
- Laboratory surveillance and feedback BII

Antimicrobial Management Teams

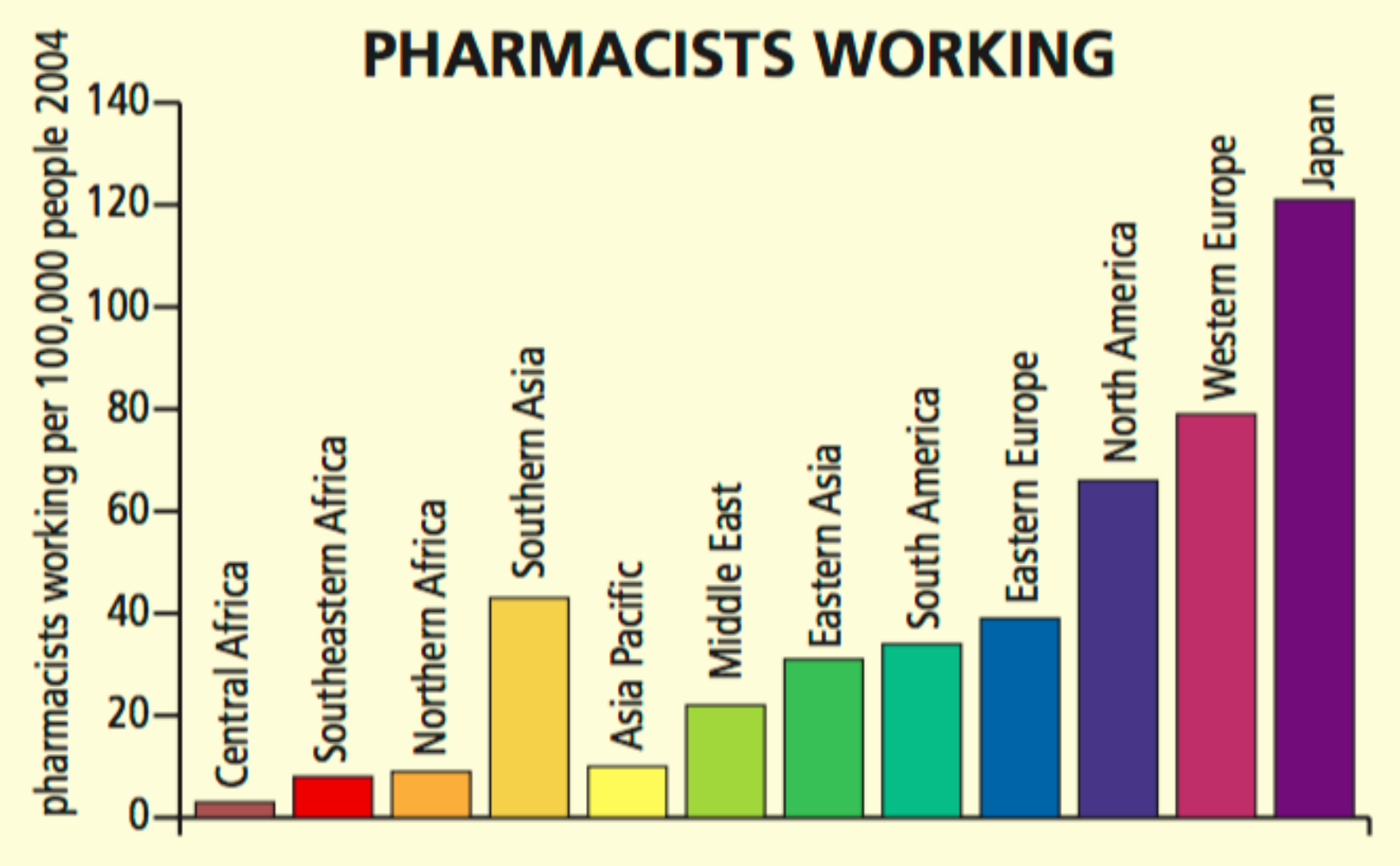
Adapted from Dellit et al. Clinical Infectious Diseases 2007; 44:159-77

THE Antimicrobial Management team and its relationships within the organisation



http://www.scotland.gov.uk

Lack of Human Resources



http://www.worldmapper.org/display.php?selected=219#

Antimicrobial stewardship across 47 South African hospitals: an implementation study

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

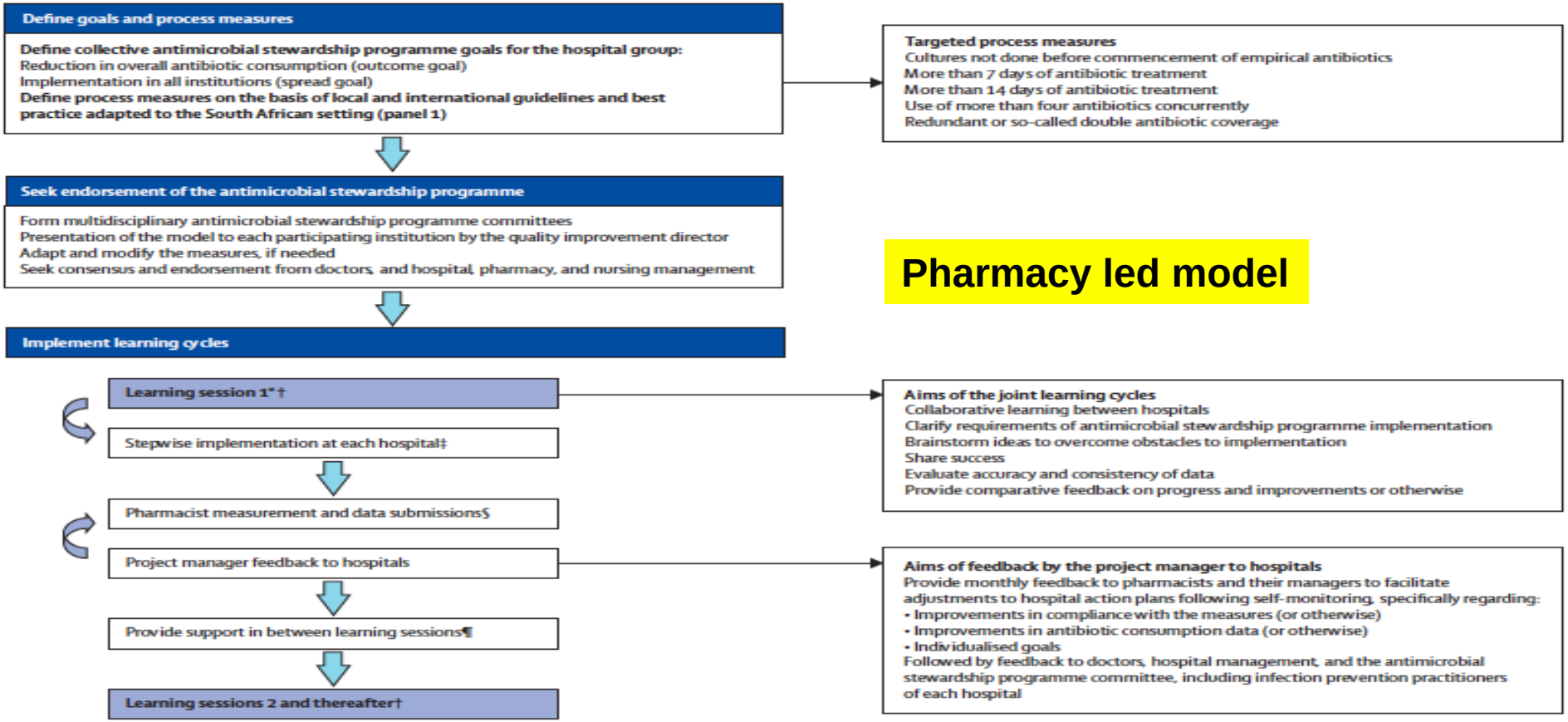


Figure 1: Netcare antimicrobial stewardship Breakthrough Series Collaborative model for group-wide implementation and monitoring process (47 hospitals)

Lancet Infect Dis 2016

Published Online
June 13, 2016
http://dx.doi.org/10.1016/S1473-3099(16)30012-3

Antimicrobial stewardship across 47 South African hospitals: an implementation study

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

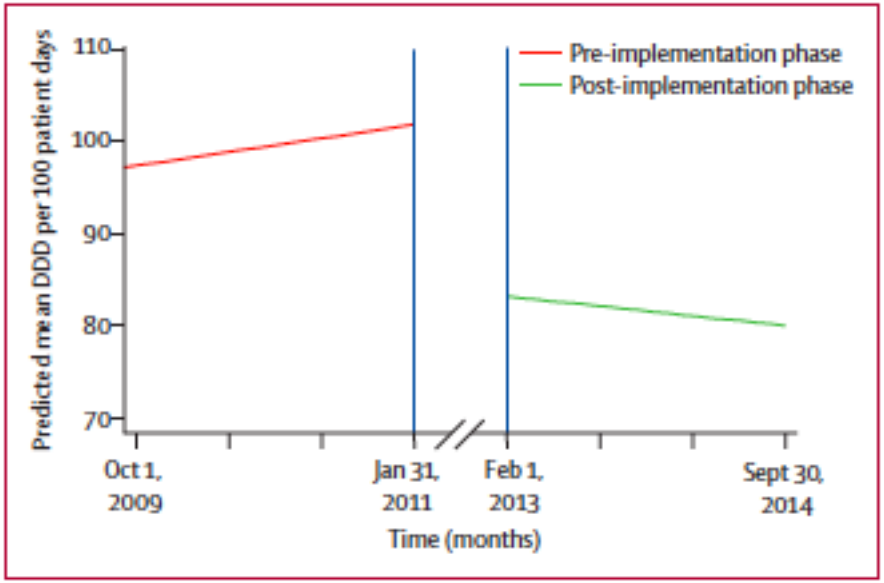


***Figure 3*: Predicted mean antibiotic consumption for the pre-implementation and post-implementation phases**
Mean antibiotic consumption is measured in defined daily doses (DDDs) per 100 patient–days. More detail is available in the appendix.

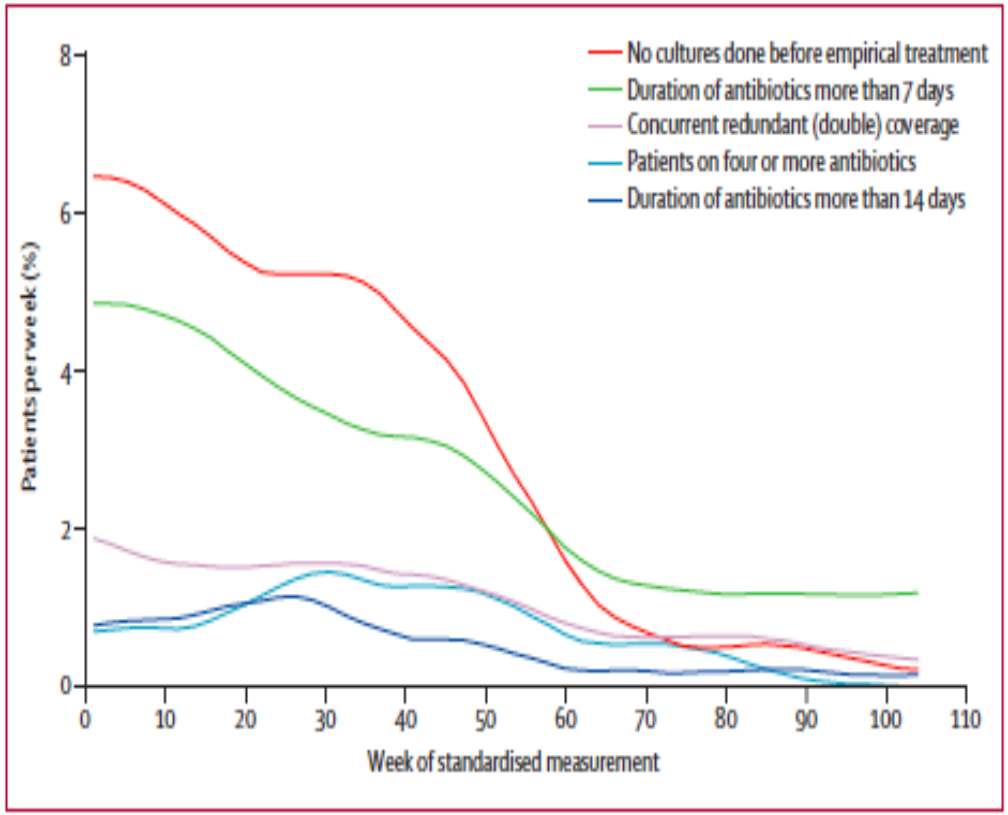


***Figure 4*: Local polynomial smoothed curves for the five parameters targeted for improvement (weeks 1-104)**

Lancet Infect Dis 2016
Published Online
June 13, 2016
http://dx.doi.org/10.1016/S1473-3099(16)30012-3

Antimicrobial stewardship programmes: the need for wider engagement

Esmita Charani, Alison H Holmes
Charani E, *et al*. *BMJ Qual Saf* 2013;**0**:1–3. doi:10.1136/bmjqs-2013-002444

Professional, social, patient and organisational interventions

EMBEDDING PRACTICE WITHIN EXISTING SYSTEMS AND RESOURCES

Wider engagement of clinical staff

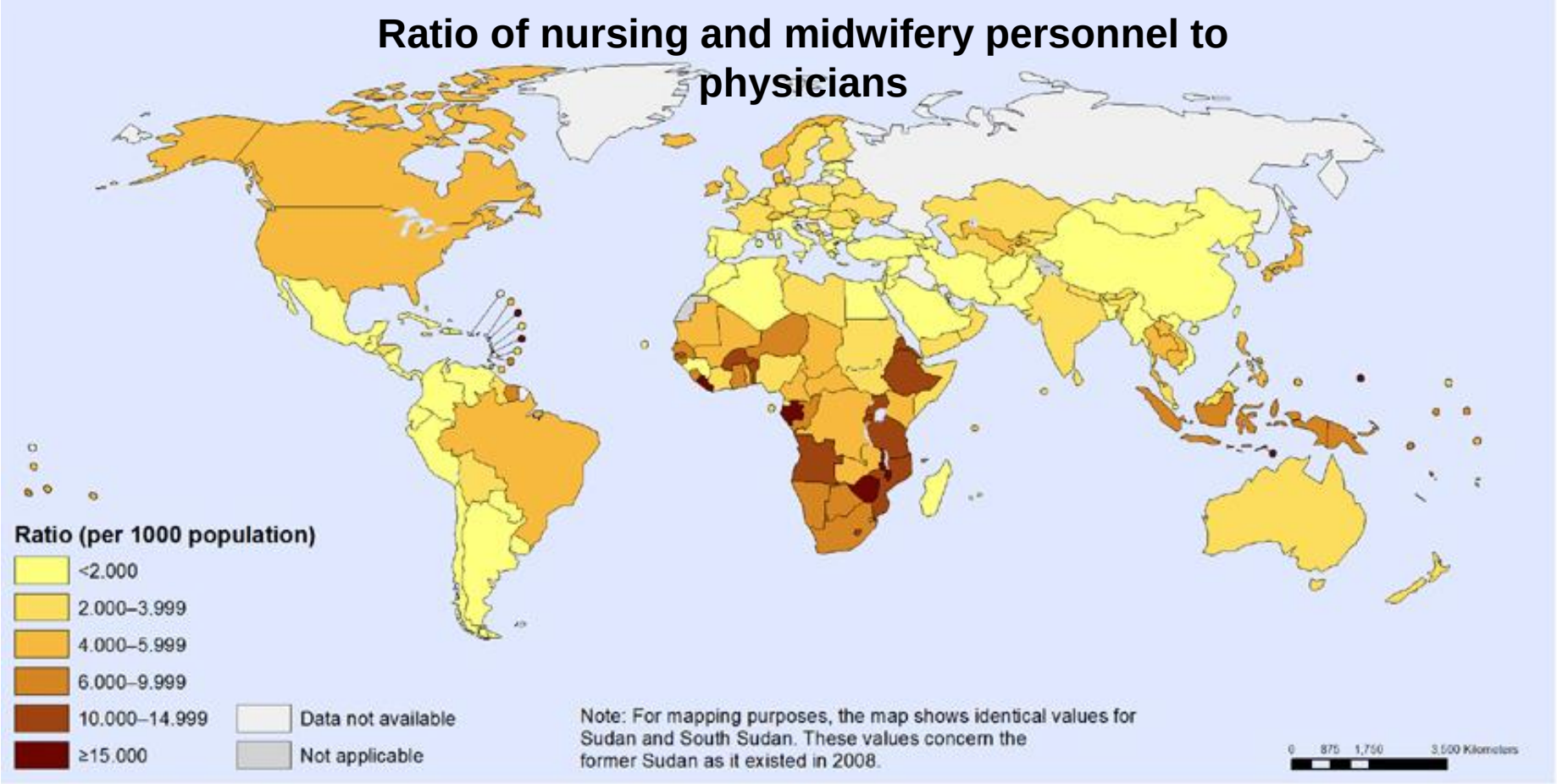
1. Partnering with a larger hospital with an established stewardship programme
2. Developing targeted quality improvement intervention for a common and recurring problem related to the overuse of antimicrobials.

BMJ Qual Saf 2013 [bmjqs-2012-001791]

Task-shifting - developing pharmacist- & nurse-based stewardship interventions in LMICs

Nurses are the largest healthcare workforc

NHS
National Institute for Health Research



The boundaries and names shown and the designations used on this map do not imply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted and dashed lines on maps represent approximate border lines for which there may not yet be full agreement.

Data Source: World Health Organization
Map Production: Health Statistics and Information Systems (HSI)
World Health Organization

World Health Organization

© WHO 2015. All rights reserved.

Nurse steward/stewardess?

…but only clinical roles and tasks?

Clinical Infectious Diseases

INVITED ARTICLE

CLINICAL PRACTICE: Ellie J. C. Goldstein, Section Ed

The Critical Role of the
Stewardship—Unrecogni

Richard N. Olans,[1] Rita D. Olans,[2] and Alfred DeMaria Jr[3]

[1]Hallmark Health System, Inc., Melrose-Wakefield Hospital, [2]MGH Institute of Hea
William A. Hinton State Laboratory Institute, Jamaica Plain, Massachusetts

An essential participant in antimicrobial stewardship w
role of staff nurses has not formally been recognized i
grams (ASPs) or defined in the medical literature, the
antimicrobial stewardship. Nurses are antibiotic first r
monitors of patient status, safety, and response to antib
nursing stewardship activities and analyzes the potent

Keywords. antimicrobial stewardship; antimicrobi

The emergence and worldwide spread of antimicrob
tance presents a global health crisis that both the US
for Disease Control and Prevention (CDC) and th
Health Organization (WHO) have labeled a grave t
human health [1]. The "perfect storm" of widespread a
use, pharmaceutical industry retreat from new antibiot
opment [2], and spread of antibiotic resistant organi
combined with rapid, accessible international trave
captured the attention of healthcare professionals,
governments, the media, and the public at large. The r
mediately available strategy to address this problem is
zation of currently available antibiotics and resourc
most judicious manner to achieve the best clinical
while limiting the development and propagation o
drug resistant microorganisms.

Antimicrobial stewardship is such a programmatic a
to the thoughtful use of antibiotics [5]. It is hoped that e
of all healthcare providers, as well as the general publ
the rationale for antimicrobial stewardship will lead
straint in the use of antibiotics that was felt to be unn
in an earlier time when antibiotics were regarded as a
and effective "miracle drugs." Although conceptual gu
for the ideal use of antibiotics were published in 1988
warnings regarding resistance to antibiotics were promu
far back as 1939 and 1945 [7], formal antimicrobial ste
programs (ASPs) have developed only in the last 15 y
The major currently recognized stakeholders in ASPs

Received 18 May 2015; accepted 4 August 2015; published online 11 August 2
Correspondence: R. N. Olans, Division of Infectious Diseases, Hallmark Health
Melrose-Wakefield Hospital, 585 Lebanon St, Melrose, MA 02176 (rolans@hallma
Clinical Infectious Diseases® 2016;62(1):84–9
© The Author 2015. Published by Oxford University Press for the Infectious Dise
of America. All rights reserved. For permissions, e-mail journals.permission
DOI: 10.1093/cid/civ697

IDSA hivma

Table 1. Overlap of Nursing Activities With Function Attribution in Current Antimicrobial Stewardship Models

	Nursing	Microbiology	Case Management	Pharmacy	Infectious Diseases	Infection Control	Inpatient Physician	Administration
Patient admission								
Triage and appropriate isolation	•					•		
Accurate allergy history	•			•	•		•	
Early and appropriate cultures	•				•		•	
Timely antibiotic initiation	•				•		•	•
Medication reconciliation	•			•			•	
Daily(24 h) clinical progress monitoring								
Progress monitor and report	•		•		•		•	
Preliminary micro results and antibiotic adjustment	•	•		•	•		•	
Antibiotic dosing and de-escalation	•			•	•		•	
Patient safety & quality monitoring								
Adverse events	•			•	•		•	
Change in patient condition	•				•		•	
Final culture report and antibiotic adjustment	•	•		•	•	•	•	
Antibiotic resistance identification	•	•			•	•	•	
Clinical progress/patient education/discharge								
IV to PO antibiotic, outpatient antibiotic therapy	•		•	•	•		•	
Patient education	•				•	•	•	
Length of stay	•		•		•		•	•
Outpatient management, long-term care, readmission	•		•		•	•		•

Abbreviations: IV, intravenous; PO, per os [oral].

INVITED ARTICLE CLINICAL PRACTICE

Ellie J. C. Goldstein, Section Editor

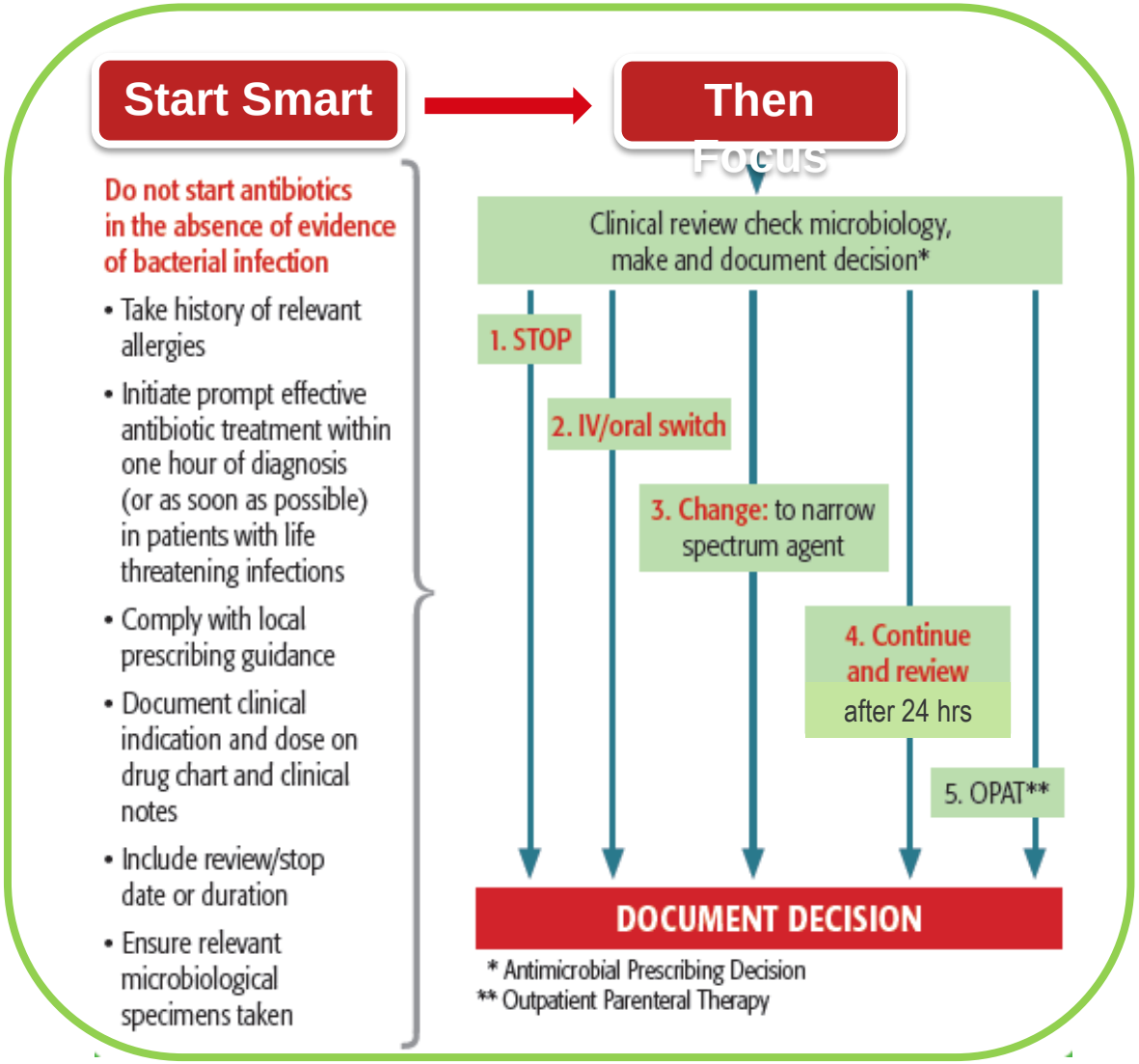
Is the "Low-Hanging Fruit" Worth Picking for Antimicrobial Stewardship Programs?

Debra A. Goff,[1] Karri A. Bauer,[1] Erica E. Reed,[1] Kurt B. Stevenson,[2,3] Jeremy J. Taylor,[1] and Jessica E. West[2]

[1]Department of Pharmacy, The Ohio State University Wexner Medical Center, [2]Division of Infectious Diseases, College of Medicine, and [3]Division of Epidemiology, College of Public Health, The Ohio State University, Columbus

A new antimicrobial stewardship program can be overwhelmed at the breadth of interventions and education required to conduct a successful program. The expression "low-hanging fruit," in reference to stewardship, refers to selecting the most obtainable targets rather than confronting more complicated management issues. These targets include intravenous-to-oral conversions, batching of intravenous antimicrobials, therapeutic substitutions, and formulary restriction. These strategies require fewer resources and less effort than other stewardship activities; however, they are applicable to a variety of healthcare settings, including limited-resource hospitals, and have demonstrated significant financial savings. Our stewardship program found that staged and systematic interventions that focus on obvious areas of need, that is, low hanging fruit, provided early successes in our expanded program with a substantial cumulative cost savings of $832 590.

Principles of optimal prescribing



Focus = Clinical review and antimicrobial decision making at 48 hrs

DoH Advisory Committee on Antimicrobial Resistance and Healthcare Associated Infection (ARHAI) Antimicrobial Stewardship: "START SMART - THEN FOCUS" Guidance for antimicrobial stewardship in hospitals (England) 2011.

Cooke FJ, Holmes AH. The missing care bundle: antibiotic prescribing in hospitals. Int J Antimicr Agents. 2007

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

Microbiological surveillance and antimicrobial stewardship minimise the need for ultrabroad-spectrum combination therapy for treatment of nosocomial infections in a trauma intensive care unit: An audit of an evidence-based empiric antimicrobial policy

stewardship and an antimicrobial policy based on surveillance. This study was undertaken with three aims: (*i*) to describe the spectrum and sensitivities of nosocomial pathogens in a level I TICU; (*ii*) to ascertain, based on surveillance data, how frequently initial empiric choice of antimicrobials was correct; and (*iii*) to determine how frequently ultrabroad-spectrum antimicrobials were prescribed and were actually necessary.

Table 1. Empirical policy for antimicrobial prophylaxis and therapy based on surveillance and co-existent organ dysfunction

	Prophylaxis	Therapy
Community-acquired		
Pneumonia		Amoxycillin/clavulanic acid
Peritonitis	Cefoxitin	Amoxycillin/clavulanic acid + gentamicin
Compound fracture	Cefazolin	Cloxacillin or moxycillin/ clavulanic acid*
Hospital-acquired		
Pneumonia		Piperacillin/tazobactam + amikacin Piperacillin/tazobactam + ciprofloxacin†
Tertiary peritonitis		Piperacillin/tazobactam + amikacin Piperacillin/tazobactam + ciprofloxacin† (Fluconazole is added for foregut injury)
Catheter-related insertion site infection		Cloxacillin
Ultrabroad therapy		Meropenem + vancomycin + fluconazole‡

*If severe contamination.
†If acute kidney injury present.
‡If risk factors for fungal sepsis are present, which include penetrating foregut injury, repeated laparotomies, and prior treatment for nosocomial bacterial infections on more than 2 occasions.

Q2

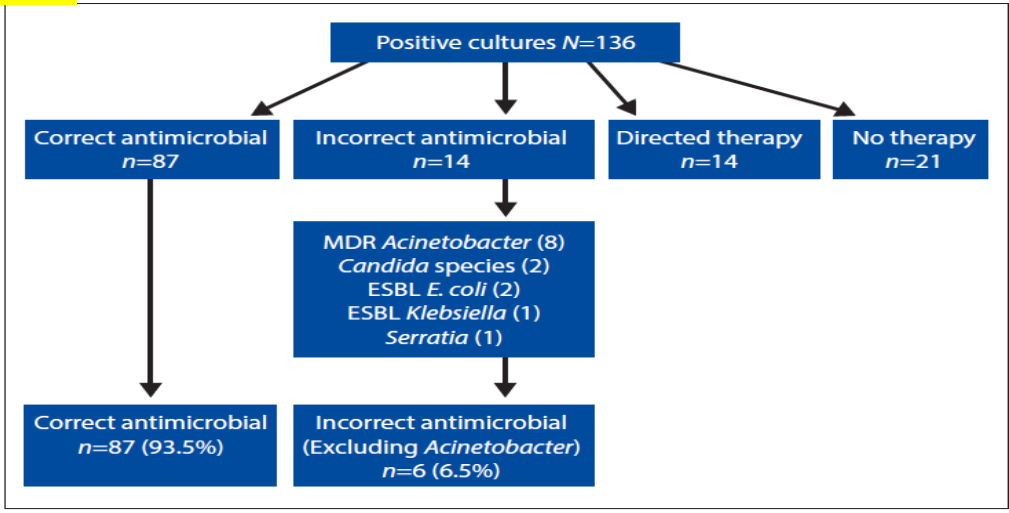


Fig. 3. Correct, incorrect and directed prescriptions for nosocomial sepsis.

S Afr Med J 2013;103(6):371-376. DOI:10.7196/SAMJ.6459

Microbiological surveillance and antimicrobial stewardship minimise the need for ultrabroad-spectrum combination therapy for treatment of nosocomial infections in a trauma intensive care unit: An audit of an evidence-based empiric antimicrobial policy

stewardship and an antimicrobial policy based on surveillance. This study was undertaken with three aims: (*i*) to describe the spectrum and sensitivities of nosocomial pathogens in a level I TICU; (*ii*) to ascertain, based on surveillance data, how frequently initial empiric choice of antimicrobials was correct; and (*iii*) to determine how frequently ultrabroad-spectrum antimicrobials were prescribed and were actually necessary.

Q3 + CONCLUSIONS

isolates were sensitive to fluconazole. One hundred and one empiric and 14 directed prescriptions were issued. Despite positive cultures, antimicrobials were not prescribed for 21 patients who had no evidence of sepsis. Excluding multidrug-resistant *Acinetobacter* isolates, there were 87 (93.5%) appropriate and 6 (6.5%) incorrect prescriptions. Ultrabroad-spectrum combination therapy (U-bSCT) was employed for 11 patients but was necessary in only 2.

Conclusions. When combined with regular bacterial surveillance, antimicrobial stewardship allows accurate empiric antimicrobial prescription with minimal need for ultrabroad-spectrum combination therapy. This policy can potentially reduce the emergence of multidrug-resistant pathogens, precluding the need for broad-spectrum antimicrobials and the attendant problems of overuse.

S Afr Med J 2013;103(6):371-376. DOI:10.7196/SAMJ.6459

ESCMID guidelines for the management of the infection control measures to reduce transmission of multidrug-resistant Gram-negative bacteria in hospitalized patients

Clin Microbiol Infect 2014; **20 (Suppl. 1)**: 1–55

The Role of Antimicrobial Stewardship to Prevent Spread

Recommendations

Epidemic setting

Strong recommendation: Implement an antimicrobial stewardship programme. Plan interventions of restriction of antibiotic usage to reduce the spread of extended-spectrum β-lactamase-producing Enterobacteriaceae (moderate level of evidence)

Recommendations

Endemic setting

Strong recommendation: Implement an antimicrobial stewardship programme to reduce the spread of extended-spectrum β-lactamase-producing Enterobacteriaceae (moderate level of evidence)

Cristina Vazquez Guillamet
Marin H. Kollef

Intensive Care Med
DOI 10.1007/s00134-015-4126-1

"Does this patient have…" "Is this patient at risk for infection with multidrug resistant bacteria?"

Table 1 Prediction criteria for pneumonia attributed to antibiotic-resistant bacteria

Prediction algorithm	Risk factors/prediction variables[a]	Referenc
HCAP criteria	Hospitalized in the previous 90 days	[6]
	Nursing home resident	
	Home infusion therapy	
	Chronic dialysis	
	Home wound care	
	Family member with resistant bacteria	
St. Louis, Missouri criteria	Hospitalized in the previous 90 days	
	Nursing home resident	
	Chronic dialysis	
	ICU admission	
Milan, Italy criteria	Comorbid conditions (cerebrovascular disease, diabetes, COPD)	
	Antibiotics in prior 90 days	
	Immunosuppression	
	Home wound care	
	Home infusion therapy	
	Nursing home resident	
	Hospitalized in prior 90 days	
	Chronic renal failure	
Joint Japanese–U.S. criteria	ICU admission	
	Immunosuppression	
	Hospitalized in prior 90 days	
	Antibiotics in prior 6 months	
	Poor functional status	
Nagoya, Japan criteria	Hospitalized in prior 90 days	
	Immunosuppression	
	Antibiotics in prior 90 days	
	Gastric acid suppression medication	
	Tube feeding	
	Nonambulatory status	
Rome, Italy criteria	One risk factor for HCAP	
	Bilateral infiltrates	
	Pleural effusion	
	paO_2/FiO_2 ratio <300	
Spanish criteria HCAP	Hospitalization in previous 90 days	[12]
	Residence in a nursing home or extended care facility	
	Home infusion of antibiotics	
	Chronic hemodialysis	
	Home wound care	
	Family member colonized with MDR isolate	
Spanish criteria ICP	HIV	[12]
	Organ transplant	
	Chemotherapy, corticosteroids, other immunosuppressive therapy for at least 4 weeks prior to the diagnosis of pneumonia	

algorithms in Table 1 have demonstrated limited accuracy in the precision of these models when applied to an independent population, indicating again that local ecology and case mix drive the rates of MDR infection in differing regions and countries [5, 13, 14]. Similarly, specific HCAP risk factors and the presence of multiple HCAP risk factors have been linked to increased risk of pneumonia attributed to *S.aureus* and *P. aeruginosa*, respectively [15]. However, the clinical utility of these specific risk factor profiles for improving the prescription of antibiotics to patients with pneumonia has not been demonstrated.

Meropenem
+Vanco
Pip-Tazo
+ Cipro
Imipenem+
linezolid
Cefepime
watch and wait a
bit
Ceftazidime
+Clindamycin
+ Gentamicin
+ Caspofungin
+linezolid

Determinants of antibiotic prescribing and dispensing

Soc Sci Med 2003; 57 : 733-44.

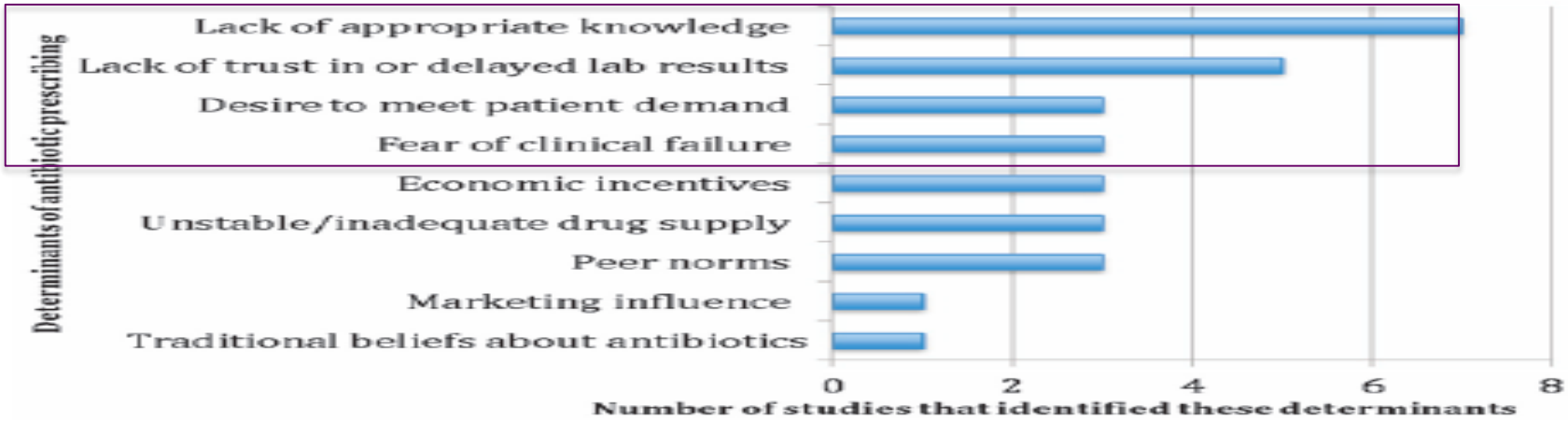


Fig. 3. Prescribing determinants of antibiotics.
Sources: Ref. 56.

Fig. 4. Dispensing determinants of antibiotics.

Internal Medicine Journal 2001; 31: 462–469

ORIGINAL ARTICLE

What do physicians think about evidence-based antibiotic use in critical care? A survey of Australian intensivists and infectious disease practitioners

Table 4 Information sources used in clinical practice (%)

	IDP (n = 73)	ICUP (n = 80)	P*
Hospital antibiotic formulary	69.9	50.0	0.01
Therapeutic guidelines	98.6	86.2	0.005
Australian medicines handbook	12.3	6.2	NS
Local microbiology laboratory database	68.5	38.7	<0.001
Local intranet resources	15.1	8.7	NS
Web-based resources (e.g. Medline, PubMed)	80.8	51.2	<0.001

*χ^2 test. IDP, infectious disease practitioners; ICUP, intensive care unit practitioners; NS, not significant.

Table 2 Value of some attributes for antibiotic choice decision (no. and % of positive answers)

Attribute	IDP (n = 73)			ICUP (n = 80)			P
	Very important	Somewhat important	Unsure or not important	Very important	Somewhat important	Unsure or not important	
Antibiotic propensity to promote resistance in the unit	36 (49.3)	36 (49.3)	1 (1.4)	38 (47.5)	39 (48.8)	3 (3.7)	NS
Antibiotic cost	12 (16.4)	51 (69.9)	10 (13.7)	6 (7.5)	53 (66.2)	21 (26.3)	0.05
Antibiotic potential for adverse effects	36 (49.3)	36 (49.3)	1 (1.4)	34 (42.5)	44 (55.0)	2 (2.5)	NS
Virulence of the pathogen	46 (63.0)	22 (30.1)	5 (6.8)	35 (43.7)	35 (43.7)	10 (12.5)	NS
Pathogen antibiotic susceptibility *in vitro*	65 (89.1)	8 (10.9)	0 (0)	31 (38.7)	45 (56.3)	4 (5.0)	0.001
Risk of serious superinfection	23 (31.5)	39 (53.4)	11 (15.1)	33 (41.2)	37 (46.3)	10 (12.5)	NS

To simplify the presentation of results, self-reported 5-point scale attitudes were grouped into three groups (very important and important; somewhat important; unsure and not important). Statistics were calculated by ANOVA. IDP, infectious disease practitioners; ICUP, intensive care unit practitioners; NS, not significant.

Empirical antimicrobial therapy for probable v. directed therapy for possible ventilator-associated pneumonia in critically injured patients

Objectives. To ascertain outcomes of directed v. empirical therapy in possible and probable VAP, respectively.

Methods. Endotracheal aspirates were obtained from patients with suspected VAP. Those considered to have possible VAP were given directed therapy following culture results, whereas patients with more convincing evidence of VAP were classed as having probable VAP and commenced on empirical antimicrobials based on microbiological surveillance.

Results. Pneumonia was suspected in 106 (36.8%) of 288 patients admitted during January - December 2014. Of these, 13 did not fulfil the criteria for VAP. Of the remaining 93 (32.2%), 31 (33.3%) were considered to have probable and 62 (66.7%) possible VAP. The former were commenced on empirical antimicrobials, with 28 (90.3%) receiving appropriate therapy. Of those with possible VAP, 34 (54.8%) were given directed therapy and in 28 (45.2%) no antimicrobials were prescribed. Of the latter, 24 recovered without antimicrobials and 4 died, 3 from severe traumatic brain injury and 1 due to overwhelming intra-abdominal sepsis. No death was directly attributable to failure to treat VAP. No significant difference in mortality was found between the 34 patients with possible VAP who were commenced on directed therapy and the 31 with probable VAP who were commenced on empirical antimicrobials (p=0.75).

Conclusions. Delaying antimicrobial therapy for VAP where clinical doubt exists does not adversely affect outcome. Furthermore, this policy limits the use of antimicrobials in patients with possible VAP following improvement in their clinical condition despite no therapy.

S Afr Med J 2016;106(2):196-200. DOI:10.7196/SAMJ.2016.v106i2.9870

Determinants of antibiotic prescribing and dispensing

Soc Sci Med 2003; 57 : 733-44.

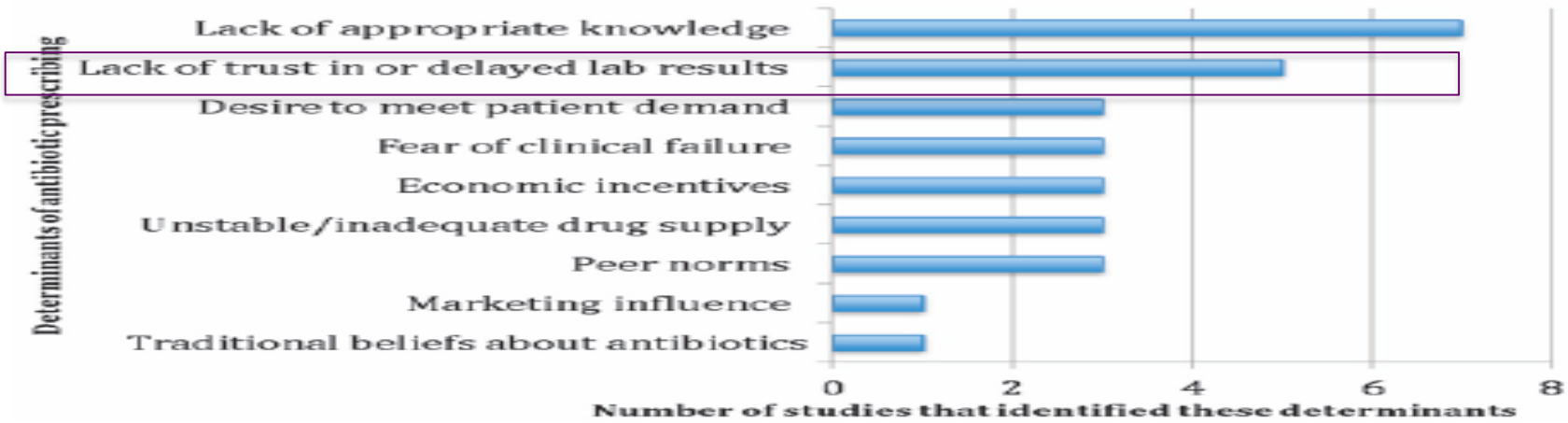


Fig. 3. Prescribing determinants of antibiotics.
Sources: Ref. 56.

Fig. 4. Dispensing determinants of antibiotics.

Improving use and confidence in existing laboratory support

Clinical-laboratory engagement

Diagnostics as essential tools for containing antibacterial resistance

I.N. Okeke et al. / Drug Resistance Updates 14 (2011) 95–106

Table 3
Diagnostics as tools for limiting antibacterial resistance: next steps.

Need for action	Next steps
Strengthening the case for diagnostics	In depth situation analysis to better understand the challenges for diagnostic development and use State a compelling case for diagnostics in resistance containment in multiple venues
Product profile and development	Develop target product profiles that incorporate the meet the Affordable, Sensitive, Specific, User-friendly, Robust and Rapid, Equipment-free and Deliverable to areas of need ("ASSURED") criteria concept and will promote maximal antibiotic resistance containment Ensure susceptibility is included in diagnostic product profiles for bacterial infections Research suites of tests for given localities Develop local surveillance systems to ensure appropriate product development
Increased research and development, collaborations and information exchange	New funding programs that promote longer cycles and public-private initiatives Create appropriate networking platforms and resources Apply modern technologies and evaluating diagnostics Joint academia – health care – industry initiatives that include researchers from developing countries Closer collaboration between the pharmaceutical and diagnostics industries
Uptake by health systems	Advocating routine use of existing diagnostics Harmonized regulation for diagnostics between different countries Research to identify behavioral determinants influencing diagnostics use and interventions to promote effective integration of testing into health practices
Making the cost-effectiveness of bacterial diagnostics more visible	Cost-benefit analyses Offering equivalent or greater subsidies and reimbursements for diagnostics, as compared to medicines

The Role of the Microbiology Laboratory in Antimicrobial Stewardship Programs

Box 1
The Clinical and Laboratory Standards Institute recommendations for antibiogram development

Data should be stratified by:

- Patient population (inpatients, outpatients)
- Location (ICU, wards)
- Specimen types (all, blood, urine)

Data should include:

- Only species with at least 30 isolates
- Diagnostic isolates only (not surveillance)
- First isolate per patient in the period analyzed
- Results only for drugs that are routinely tested

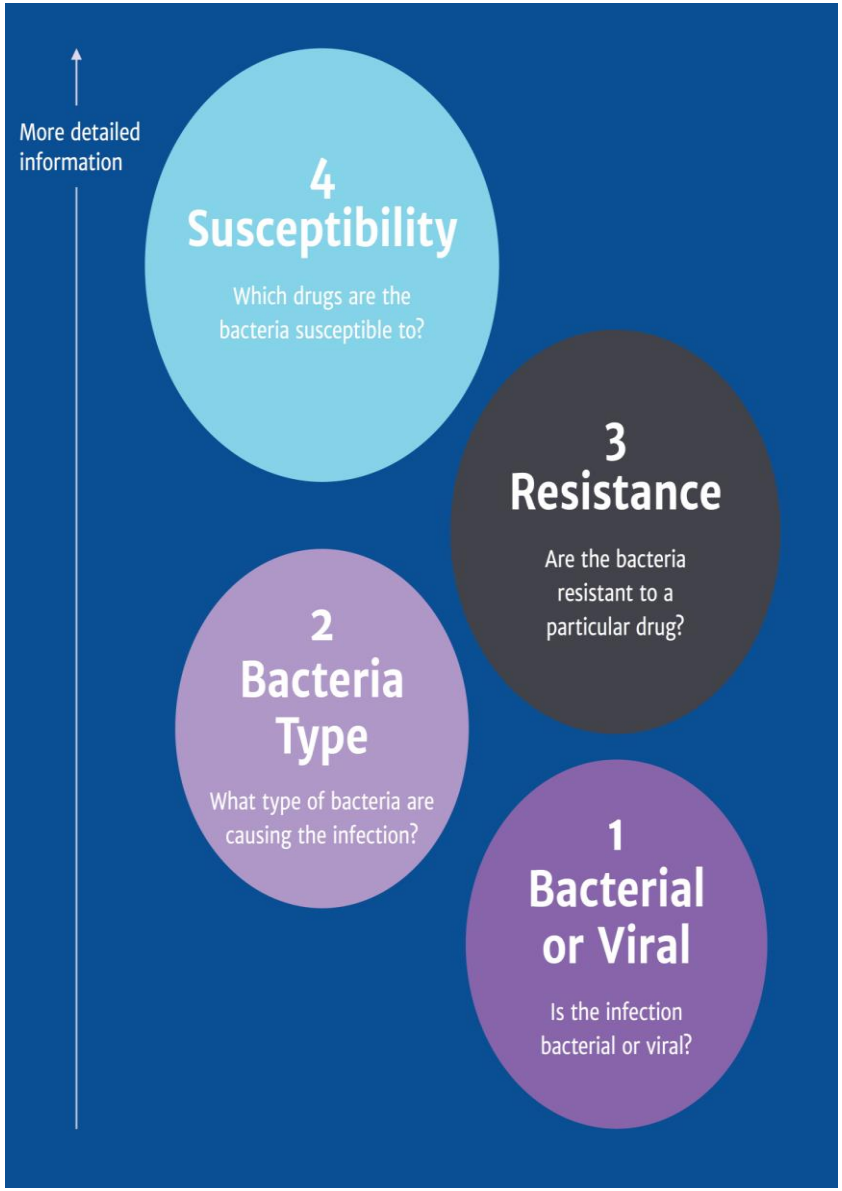
Antibiograms should be generated at least annually

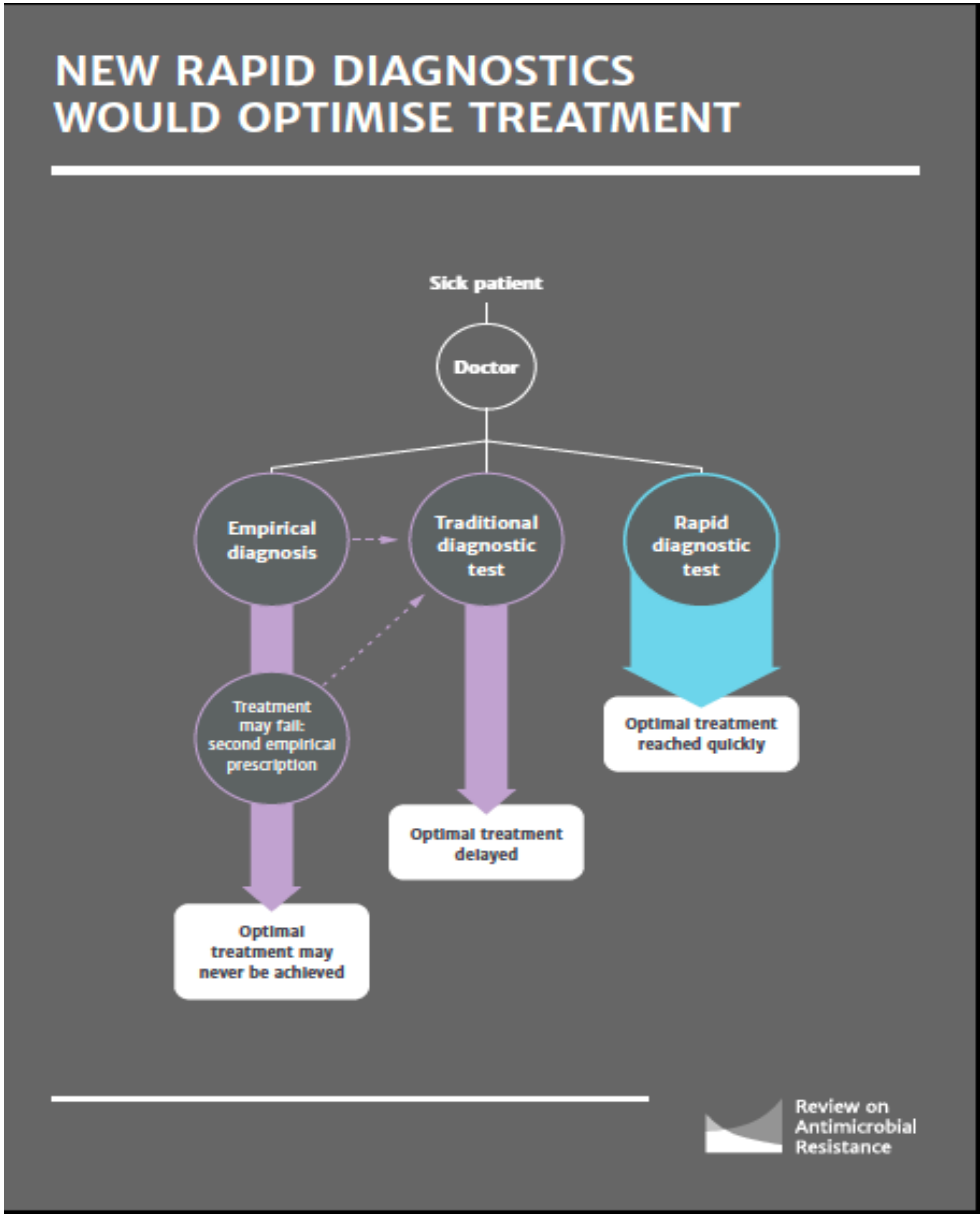
Data from Hindler JF, Stelling J. Analysis and presentation of cumulative antibiograms: a new consensus guideline from the Clinical and Laboratory Standards Institute. Clin Infect Dis 2007;44:867–73.

Infect Dis Clin N Am 28 (2014) 215–235

What a Rapid Test Should Tell

Review on Antimicrobial Resistance
Tackling drug-resistant infections globally

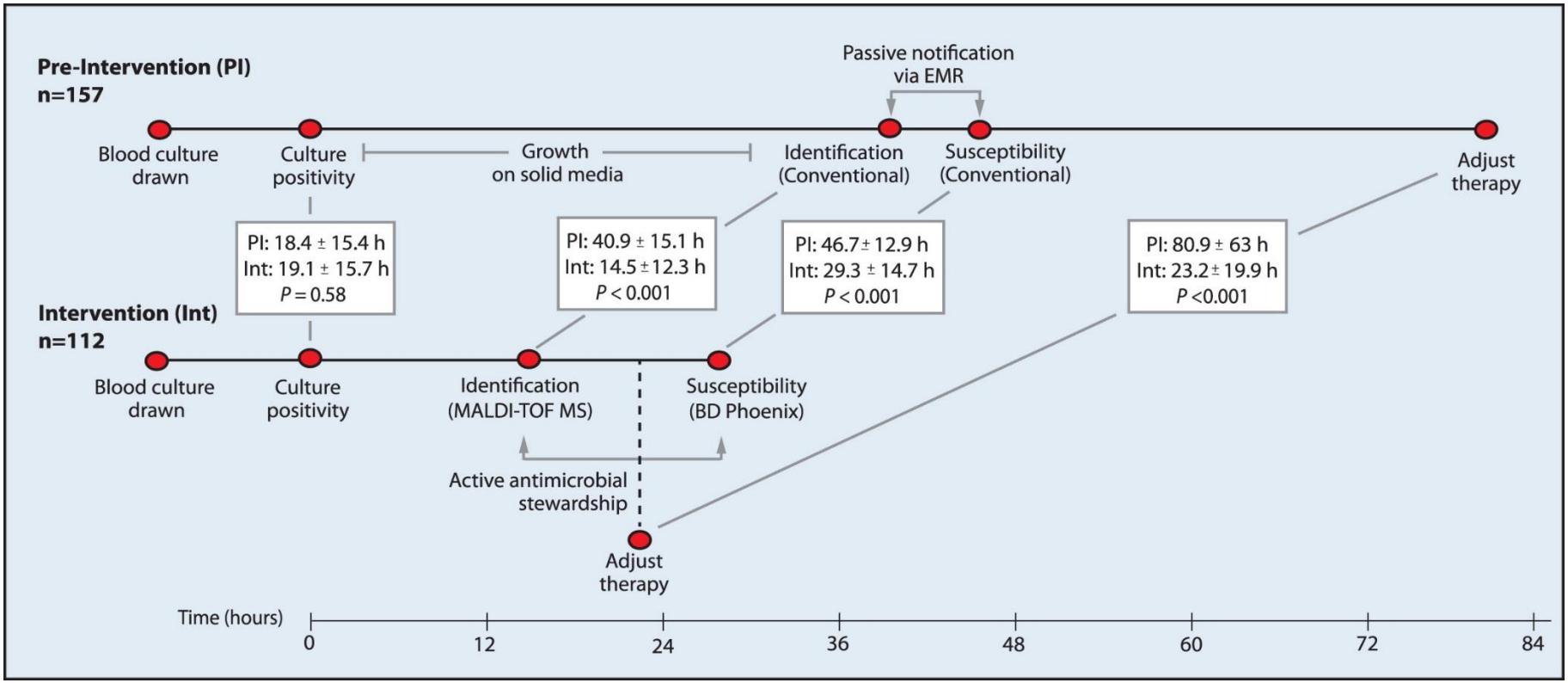




Rapid Diagnostics: Stopping unnecessary use of antibiotics, Report October 2015 The Review on Antimicrobial Resistance Chaired by Jim O'Neill http://amr-review.org/

Integrating rapid diagnostics and antimicrobial stewardship improves outcomes in patients with antibiotic-resistant Gram-negative bacteremia

Journal of Infection
Volume 69, Issue 3, Pages 216-225 (September 2014)
DOI: 10.1016/j.jinf.2014.05.005



Terms and Conditions

The Role of the Microbiology Laboratory in Antimicrobial Stewardship Programs

Box 1
The Clinical and Laboratory Standards Institute recommendations for antibiogram

- Rapid diagnostic technologies can decrease the time to identification of microrganisms and resistance genes, potentially leading to reduced time to optimal therapy and improved clinical outcomes. The benefits of rapid diagnostic techniques are enhanced when coupled with antimicrobial stewardship interventions.
- Procalcitonin-guided therapy can reduce antimicrobial consumption by decreasing the initiation of antimicrobial therapy and decreasing the duration of therapy.
- Clinical microbiology laboratories should work closely with antimicrobial stewardship programs to compile institution-specific antibiograms. Antibiograms are frequently used by stewardship programs to make formulary decisions, develop guidelines for empiric therapy, and monitor local resistance rates over time.

Data from Hindler JF, Stelling J. Analysis and presentation of cumulative antibiograms: a new consensus guideline from the Clinical and Laboratory Standards Institute. Clin Infect Dis 2007;44:867–73.

Infect Dis Clin N Am 28 (2014) 215–235

Be clinical and engage with clinicians

How to cite this URL:
Bhattacharya S. Clinical microbiology: Should microbiology be a clinical or a laboratory speciality?. Indian J Pathol Microbiol [serial online] 2010 [cited 2016 May 17];53:217-21. Available from: http://www.ijpmonline.org/text.asp?2010/53/2/217/64323

Procalcitonin in critically ill patients: time to change guidelines and antibiotic use in practice

- PRORATA [1] PCT based de-escalation
  - 25% reduction in antibiotic exposure
  - Non inferior 28d mortality, 3.6% non significant increase in 90 day mortality [95% CI -2.1 TO 9.7]

- PASS [2] PCT - diagnostic and all treatment based escalation
  - Less investigative and treatments including antibiotics , more treatment related harm in PCT arm

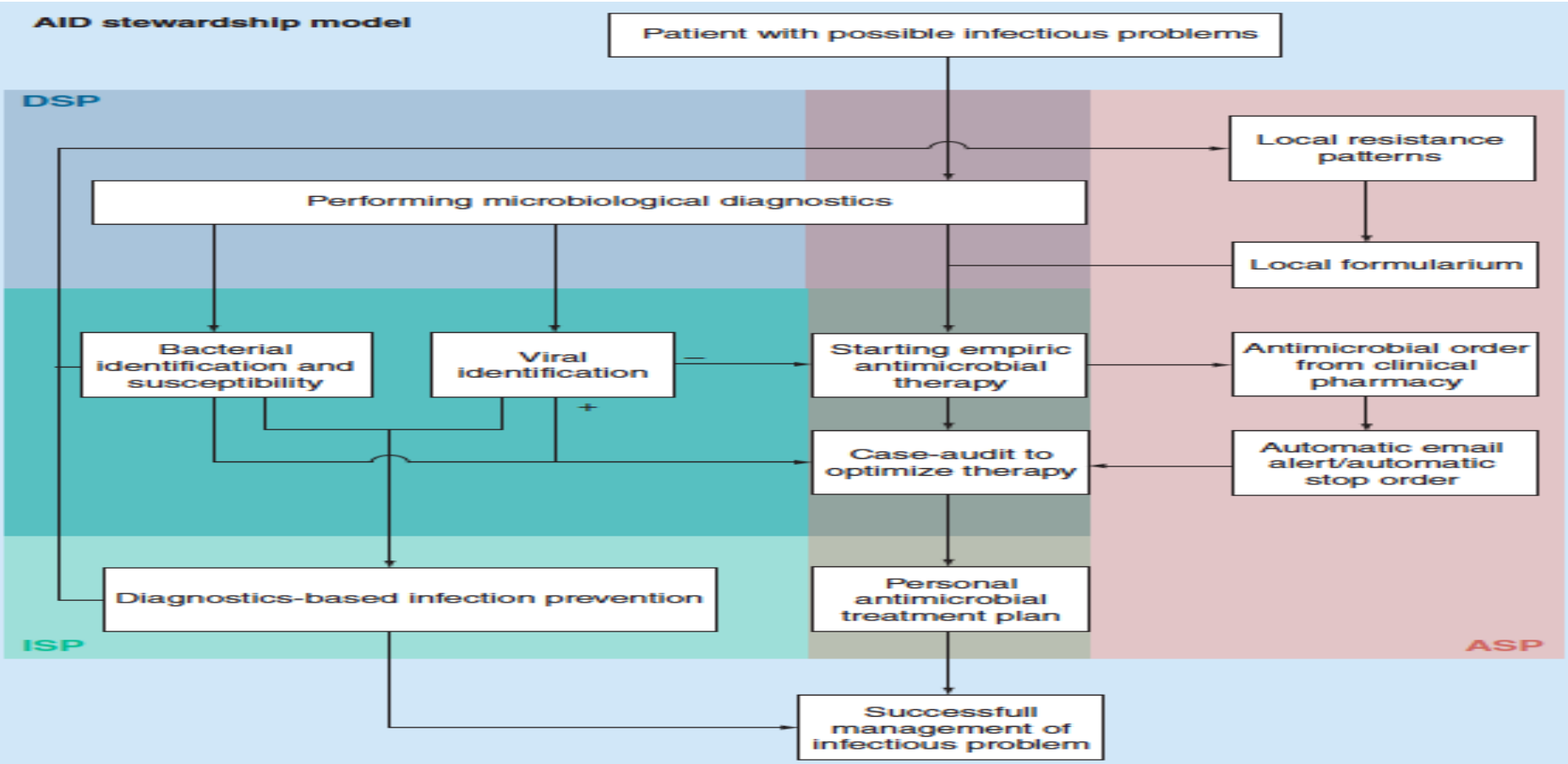
- **SAPS [3] PCT guided de-escalation {decrease of 80% or > from peak or 0.5ug/l or < = stop }**
  - **N=1546, 15 centres, Netherlands**
  - **25% reduction in antibiotIc duration [7 to 5d]**
  - **7% survival benefit at 28d in PCT ARM and 7.4% at 1y follow up**

1 Bouadma L et al. Lancet 2010; 375:463-74; 2. Jensen J-U et al BMC ID 2008; 8:91: 3. de Jong E et al Lancet Feb 29 2016 , on line

An integrated stewardship model: antimicrobial, infection prevention and diagnostic (AID)

Future Microbiol. (2015) 11(1)

Jan-Willem H Dik[1], Randy Poelman[2], Alexander W Friedrich[*,3], Prashant Nannan Panday[4], Jerome R Lo-Ten-Foe[1], Sander van Assen[5], Julia EWC van Gemert-Pijnen[6], Hubert GM Niesters[2], Ron Hendrix[1,7] & Bhanu Sinha[1]



Core Elements of Hospital Antibiotic Stewardship Programs From the Centers for Disease Control and Prevention

Loria A. Pollack and Arjun Srinivasan

Division of Healthcare Quality Promotion, Centers for Disease Control and Prevention, Atlanta, Georgia

Data, feedback and education

Table 1. Core Elements of Hospital Antibiotic Stewardship Programs

Leadership commitment	Dedicating necessary human, financial, and information technology resources
Accountability	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
Drug expertise	Appointing a single pharmacist leader responsible for working to improve antibiotic use
Action	Implementing at least 1 recommended action, such as systemic evaluation of ongoing treatment need after a set period of initial treatment (ie, antibiotic "time-out" after 48 h)
Tracking	Monitoring process measures (eg, adherence to facility-specific guidelines, time to initiation or de-escalation), impact on patients (eg, *Clostridium difficile* infections, antibiotic-related adverse effects and toxicity), antibiotic use and resistance
Reporting	Regular reporting of the above information to doctors, nurses, and relevant staff
Education	Educating clinicians about disease state management, resistance, and optimal prescribing

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

Implementing an Antibiotic Stewardship Program: Guidelines by the Infectious 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 Interventi 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?

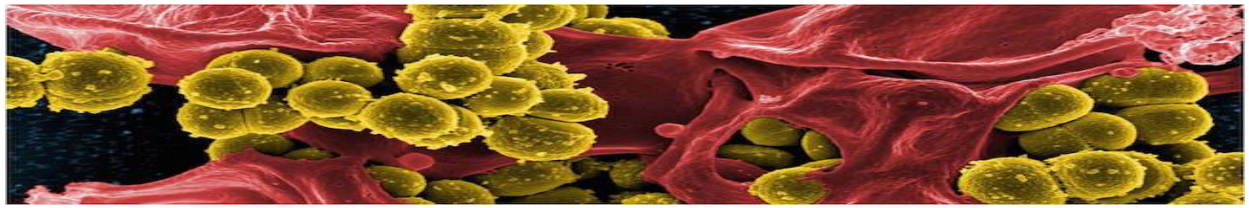
Recommendation

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

FREE ON LINE STEWARDSHIP COURSE

UNIVERSITY OF DUNDEE



BSAC

Free global on-line course.

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

- > 25000 registered
- > 8000 active learners
- Large number of health professionals
- > 400statements of participation sold

Course availability in 2016:

8th February, 23rd May

& 19th Sept

Esther Robinson Follow 26 NOV

I have found a lot of this course thought-provoking, particularly around behaviour change. I will be encouraging our trainees to participate in future. Thanks.

Jeanne Brooks Follow 02 NOV

I have learned a lot from this course and my Hospital the JR part of the University hospitals at Oxford has been intreagued by my feed back and suggested ideas. I have already recommended the course to my friends who are looking forward to start your next one. It has been s great learning curve and opportunity to advance my knowledge.

Like 1

Trish Morrow Follow 07 DEC

This was a wonderful course. In particular it allowed me to revise and update my knowledge of behaviour change strategies and that will be extremely helpful for my future work. Thanks so much, well done!

Translation in Chinese, Spanish coming soon

https://www.futurelearn.com/courses/antimicrobial-stewardship

Healthcare Improvement Scotland

Scottish Antimicrobial Prescribing Group

NHS Education for Scotland

Antimicrobial Stewardship

Educational Workbook

Contents **Page**

Target Audience 3
How To Use The Workbook 4
Ksf Mapping 5

Section 1:

Introduction To Antimicrobial Stewardship 6
Antimicrobial Prescribing And Stewardship Video 7
Role Of The Nurse In Antimicrobial Stewardship Video 7

Section 2:

Stewardship In Practice 8
Antimicrobial Stewardship In Scotland 8
Antimicrobial Management Teams 10
Scottish Patient Safety Programme 11
Responsibilities And Accountability 12
The Role Of The Nurse In Antimicrobial Management 13

Section 3:

Bacteria, Resistance And Antibiotics 14
Bacteria L Classification 14
Where Do We Find Microbes And Microbial Infection? 17
Antimicrobial Resistance 19
How Does Antimicrobial Resistance Develop? 20
Antibiotics And How They Work 22

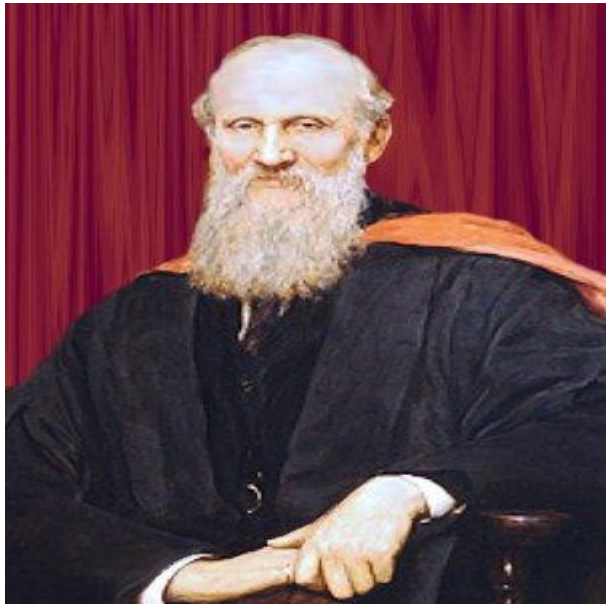
Section 4:

Diagnosis And Assessment Of Infection 26
Microbiology Investigations 26
Avoiding Contamination Of Blood Cultures 29
Testing For Antimicrobial Suseptibility 30
Antimicrobial Prescribing Practice 31
Local Antimicrobial Prescribing Policy 33
Patient Education, Awareness And Involvement 39
Review Of Antimicrobial Prescriptions 40

Section 5:

Considerations For Hospital Practice 41
Iv To Oral Switch 41
Surgical Prophylaxis –Sign 104 Guidelines 44
Surgical Site Infection 45
Gentamicin And Vancomycin 48
Sepsis Management 49

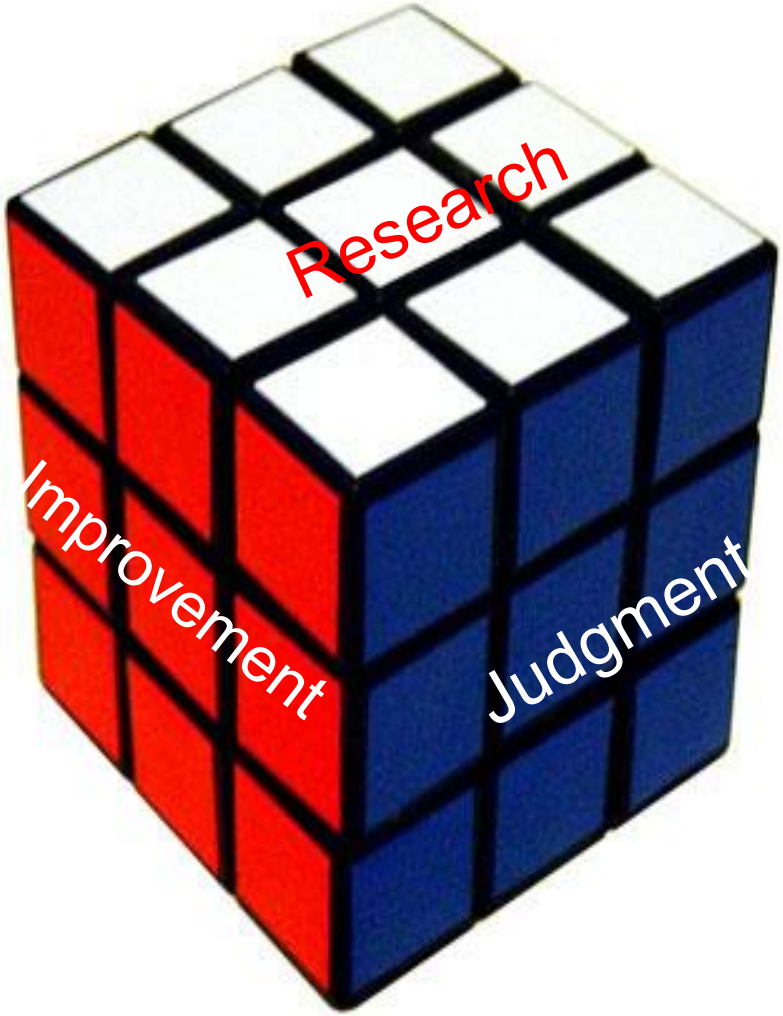
Useful Resources And Reading List 51
Acknowledgements 53
Certificate Of Achievement 54



"If you cannot measure it, you cannot improve it"

Lord Kelvin, 1824-1907

Integrating the Three Faces of Performance Measurement



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.

© 2011 Institute for Healthcare Improvement/R Lloyd

Measurement

- 3 types of measures for quality improvement
  - Outcome measures
  - Structural + Process measures
  - Balancing measures
  - (+/- Structure Measures)

  - What would you use for each ?

  - **STRUCTURE [S] + PROCESS [P] = OUTCOMES [O]**

METRICS STRUCTURE + PROCESS = OUTCOMES

Transatlantic Taskforce on Antimicrobial Resistance (TATFAR)

Report on the modified Delphi process for common structure and process indicators for hospital antimicrobial stewardship programmes

SUPPLEMENTAL Indicators for hospital antimicrobial stewardship programs

Policy and Practice	(Core 9) Does your facility have facility-specific treatment recommendations based on local antimicrobial susceptibility to assist with antimicrobial selection for common clinical conditions: **S8.** If YES, for **surgical prophylaxis**? **S9.** If YES, for **community acquired pneumonia**? **S10.** If YES, for **urinary tract infection**? **S11.** If YES to any of the clinical conditions above, are these **treatment recommendations easily accessible** to prescribers on all wards (printed 'pocket guide' or electronic summaries at workstations)? (Core 11,12) Are any of the following actions implemented in your facility to improve antibiotic prescribing? **S12.** Standardized criteria for changing from **intravenous to oral** antimicrobial therapy in appropriate situations? **S13.** **Dose optimization** (pharmacokinetics/pharmacodynamics) to optimize the treatment of organisms with reduced susceptibility? **S14.** Discontinuation of specified antimicrobial prescriptions after a **pre-defined duration**?

DRAFT

Antibiotic prescribing indicators/metrics

Process measures

- Amount of antibiotic in DDD/100 bed days
  - Promoted antibiotic
  - Restricted antibiotics

  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 resistance
- Mortality [SMR's]

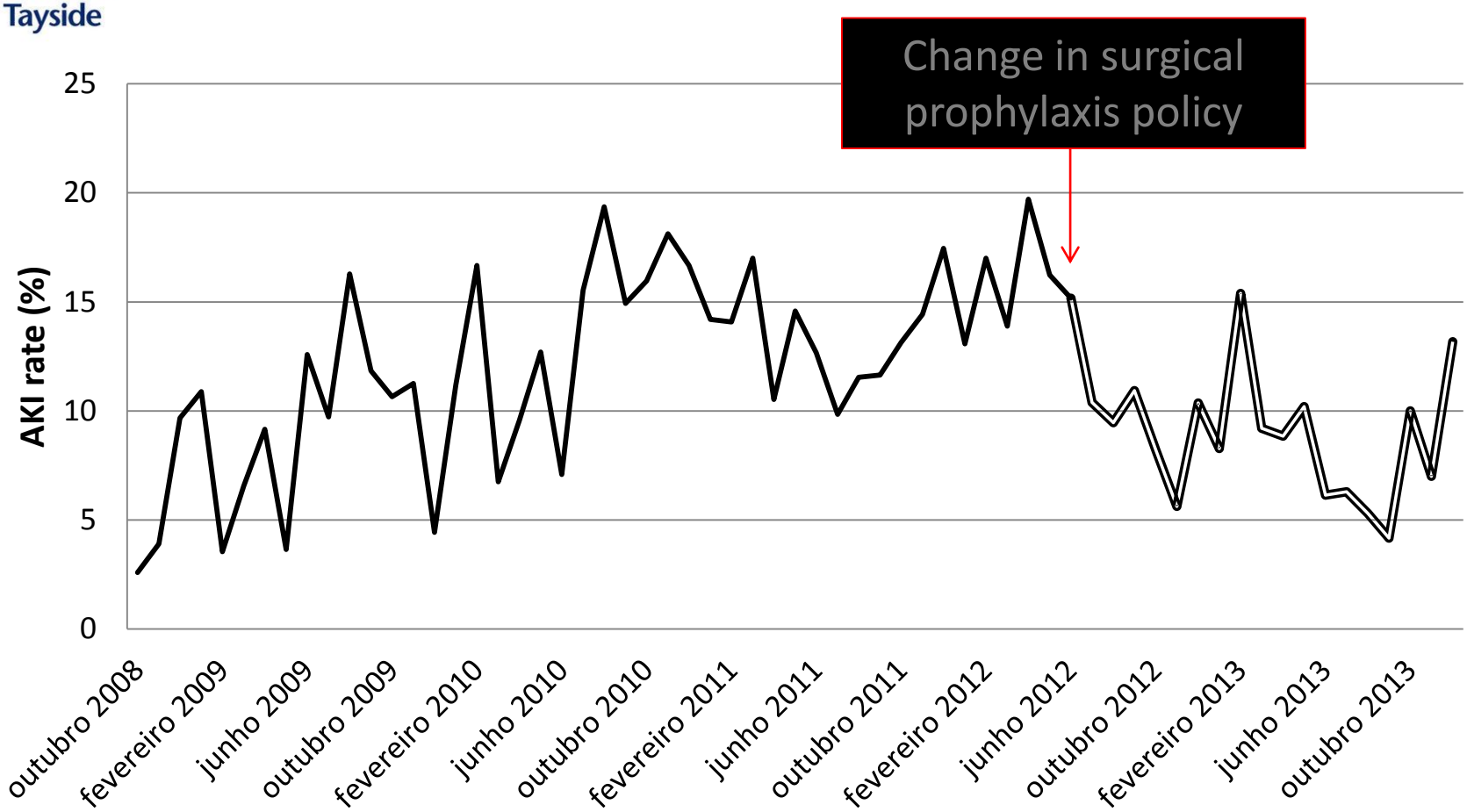
Balancing measures

- 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

CAP, community-acquired pneumonia; ICU, intensive care unit; VAP, ventilator-associated pneumonia

BALANCING MEASURES

NHS Tayside follow up study: Orthopaedic surgical prophylaxis and acute kidney injury



Walker H et al JAC May 2016

Is It Working? YES – and Sustainable

Strict Infection Control Leads to Low Incidence of Methicillin-Resistant *Staphylococcus aureus* Bloodstream Infection over 20 Years

Andreas F. Widmer, MD, MS;[1] Botond Lakatos, MD;[1] Reno Frei, MD[2]

Infect Control Hosp Epidemiol 2015; 36: 702-709

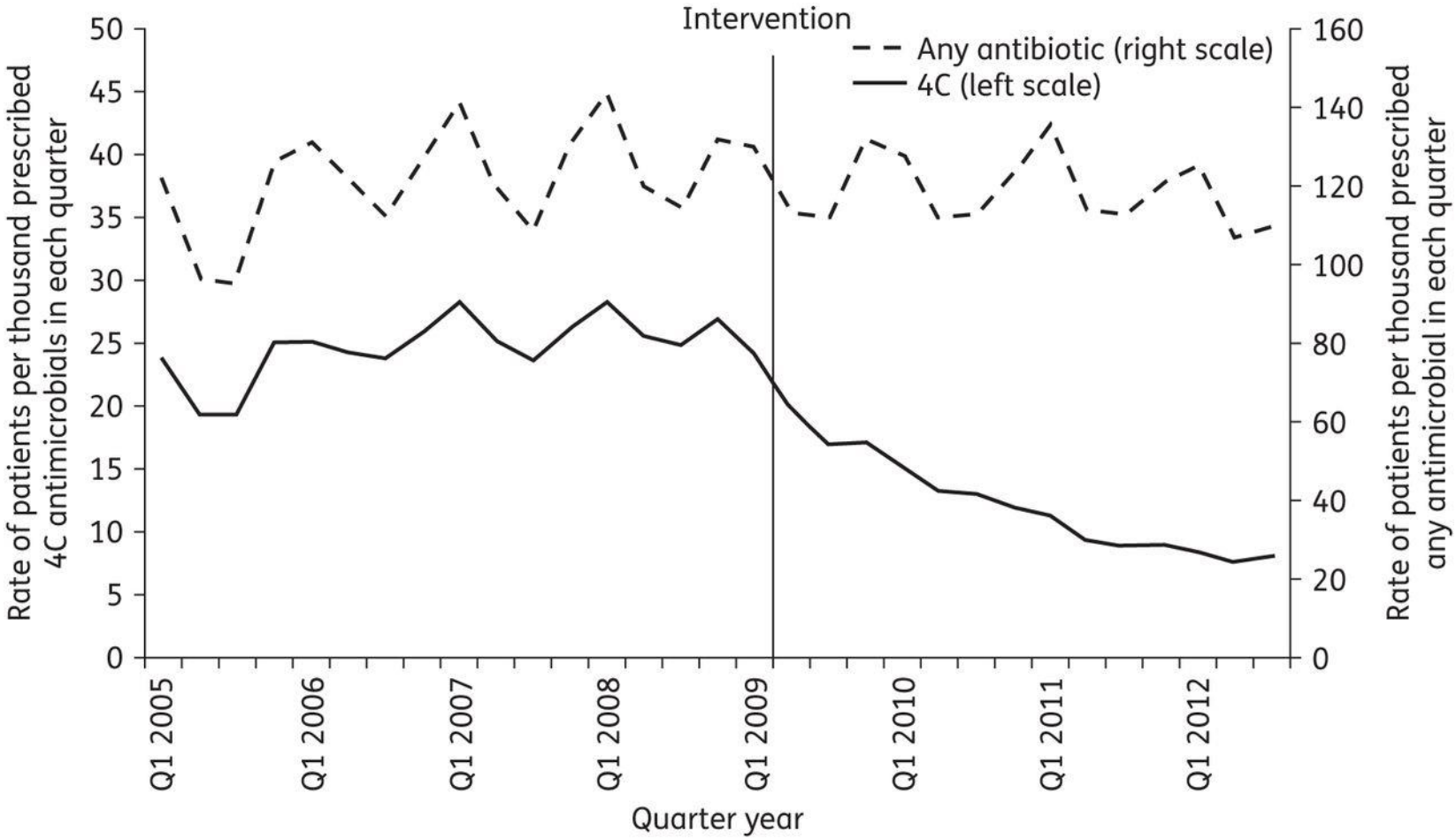
Time series analysis of the impact of an intervention in Tayside, Scotland to reduce primary care broad-spectrum antimicrobial use

Virginia Hernandez-Santiago*, Charis A. Marwick, Andrea Patton, Peter G. Davey, Peter T. Donnan and Bruce Guthrie

Conclusions: A real-world intervention to reduce primary care prescribing of antimicrobials associated with CDI led to large, sustained reductions in the targeted prescribing, largely due to substitution with guideline-recommended antimicrobials rather than by avoiding antimicrobial use altogether. Further research is needed to examine the impact on antimicrobial resistance.

J Antimicrob Chemother 2015; 70: 2397-2404

Prescribing of: (i) 4C antimicrobials (left-hand scale); and (ii) all antimicrobials (right-hand scale).



Virginia Hernandez-Santiago et al. J. Antimicrob. Chemother. 2015;70:2397-2404

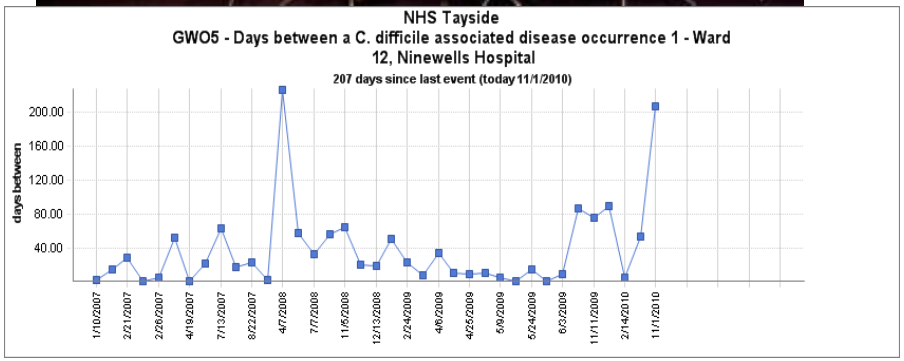
© The Author 2015. Published by Oxford University Press on behalf of the British Society for Antimicrobial Chemotherapy. All rights reserved. For Permissions, please e-mail: journals.permissions@oup.com

Journal of Antimicrobial Chemotherapy

2012 theory-based Cochrane review of Audit & Feedback *Ivers et al 2012 Courtesy of Susan Michie UCL*

- Median 4.3% increase in compliance (IQR 0.5% to 16%)
- A&F is more effective when combined with
  - Explicit targets and an action plan
- In addition,
  - the target was prescribing
  - the source was a supervisor or colleague
  - it was provided more than once
  - it was delivered in both verbal and written formats

LET DATA BE AT THE HEART OF YOUR LEARNING /COMMUNICATION/FEEDBACK



Overview | Compare indicators | Map | Trends | Compare areas | Area profiles | Definitions | Download

Area type: CCG | Areas grouped by: Sub-region | Benchmark: England

Area: NHS Southwark CCG | Sub-region: London

Search for an area

Compared with benchmark: Better | Similar | Worse | Lower | Similar | Higher | Low | High | Not compared

* a note is attached to the value, hover over to see more details

Export table as image

Indicator	Period	England	London NHS region	NHS Barking And Dagenham CCG	NHS Barnet CCG	NHS Bexley CCG	NHS Brent CCG	NHS Bromley CCG	NHS Camden CCG	NHS Central London (Westmins...	NHS City And Hackney CCG	NHS Croydon CCG	NHS Ealing CCG	NHS Enfield CCG	NHS Greenwich CCG	NHS Hammersmith And Fulham C...	NHS Haringey CCG	NHS Harrow CCG	NHS Havering CCG
Quarterly total number of prescribed antibiotic items per 1000 individuals, per day	2015 Q3	1.55	1.22	1.33	1.23	1.61	1.08	1.32	0.86	1.07	0.99	1.34	1.26	1.21	1.28	1.25	1.00	1.33	1.61
Percentage of all antibiotic prescription items in primary care from cephalosporin, quinolone and co-amoxiclav class	2015 Q3	10.81	13.76	11.46	15.27	11.89	12.05	12.97	11.63	11.74	13.89	9.62	14.24	12.15	10.40	12.85	11.54	14.72	13.62
Quarterly total number of prescribed antibiotic items per STAR-PU	2015 Q3	0.24	0.20	0.23	0.19	0.27	0.17	0.20	0.14	0.16	0.17	0.22	0.18	0.21	0.21	0.19	0.16	0.22	0.24

Some indicators display a coloured background on their values. This is to denote a comparison to the benchmark value.
A legend is provided by the system at the top.

Effectiveness of bundled behavioural interventions to control healthcare-associated infections: a systematic review of the literature

Journal of Hospital Infection (2007) 66, 101–108

The missing care bundle: antibiotic prescribing in hospitals

International Journal of Antimicrobial Agents 30 (2007) 25–29

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

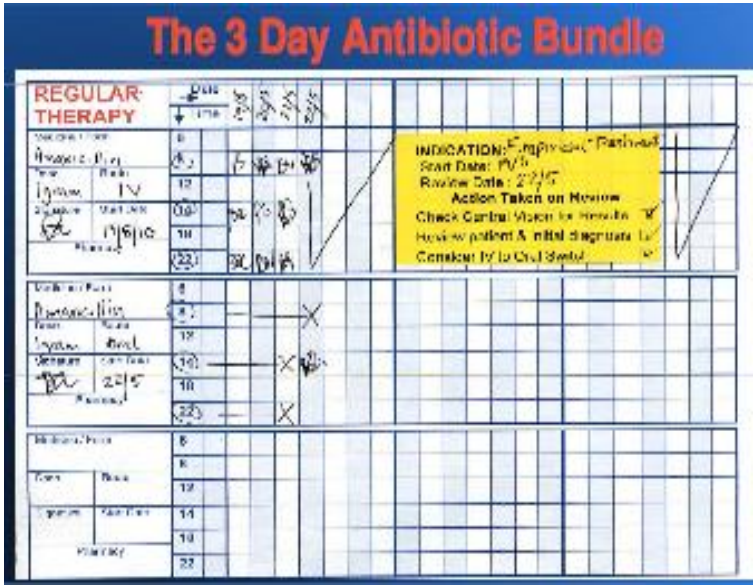
We recommend the following points are included:

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



Courtesy of Esmita Charani

In my hospital there is an army of generals!
An army of Napoleons...
Consultant Microbiologist

STEWARDSHIP CONCLUSIONS

- **Antimicrobial stewardship in a patient safety priority**

- **Antimicrobial stewardship programmes need to be integrated with infection prevention programmes and diagnostic/laboratory stewardship**
- **The structure & processes[interventions] for stewardship need to reflect local geography, resources, challenges and culture but ultimately the goal must always be better outcomes whilst ensuring no unintended harm**

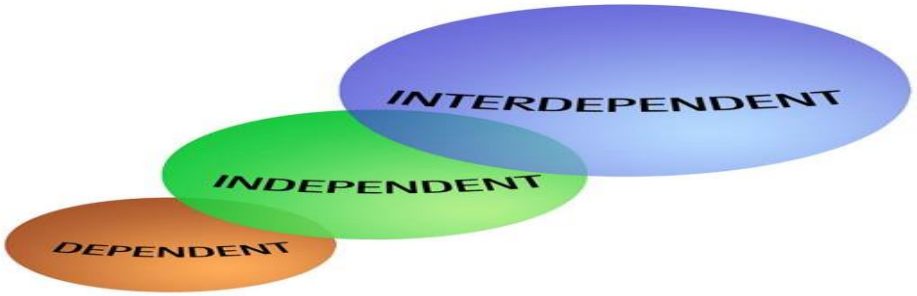
- **A focus on a multi-professional stewardship team, engaging and feedback to prescribers underpinned by accountability and educational support in fundamental to success**

UK 5-YEAR AMR STRATEGY AND THE BRITISH SOCIETY OF ANTIMICROBIAL CHEMOTHERAPY'S CONTRIBUTION

KEY AREA 1	KEY AREA 2	KEY AREA 3	KEY AREA 4	KEY AREA 5	KEY AREA 6	KEY AREA 7
IMPROVING INFECTION PREVENTION AND CONTROL PRACTICES	OPTIMISING PRESCRIBING PRACTICE	IMPROVING PROFESSIONAL EDUCATION, TRAINING AND PUBLIC ENGAGEMENT	DEVELOPING NEW DRUGS, TREATMENTS AND DIAGNOSTICS	BETTER ACCESS TO AND USE OF SURVEILLANCE DATA	BETTER IDENTIFICATION AND PRIORITISATION OF AMR RESEARCH NEEDS	STRENGTHENED INTERNATIONAL COLLABORATION
Align the Infection Control and Stewardship Agenda Measure Infection Rates and Antibiotic Consumption Implement Quality Improvement Agenda and Improvement Science	Collaborative Multi-disciplinary Working Expert Conferences, Workshops & Events Professional & Public Education Campaigns Funding Programme Preceptorship Support International Collaborations Data Collection Systems to Measure Antibiotic Use National Sentinel Surveillance Programme National Susceptibility Testing Methodology Advisory Role to Government Quality Improvement / Behavioural Science Supporting out of Hospital Treatment Programmes	Collaborative Multi-disciplinary Working Evidence-Based Guideline Development Expert Conferences, Workshops & Events Professional & Public Education Campaigns Preceptorship Support International Collaborations Advisory Role to Government Quality Improvement / Behavioural Science Development of an online resource for Antimicrobial Resistance arc.com	Collaborative Multi-disciplinary Working Expert conferences, Workshops & Events Professional & Public Education Campaigns Antibiotic Action Funding Programme International Collaborations Advisory Role to Government	Collaborative Multi-disciplinary Working Evidence-Based Guideline Development Expert Conferences, Workshops & Events Funding Programme Preceptorship Support International Collaborations Data Collection Systems to Measure Antibiotic Use National Sentinel Surveillance Programme National Susceptibility Testing Methodology Advisory Role to Government	Collaborative Multi-disciplinary Working Expert Conferences, Workshops & Events Professional & Public Education Campaigns Antibiotic Action International Collaborations National Sentinel Surveillance Programme National Susceptibility Testing Methodology Advisory Role to Government Provision of Research Grants Collaboration with Industry	Collaborative Multi-disciplinary Working Evidence-Based Guideline Development Expert Conferences, Workshops & Events Professional & Public Education Campaigns Antibiotic Action Preceptorship Support International Collaborations Data Collection Systems to Measure Antibiotic Use Advisory Role to Government

UK 5-YEAR AMR STRATEGY AND THE BRITISH SOCIETY OF ANTIMICROBIAL CHEMOTHERAPY'S CONTRIBUTION

KEY AREA 1	KEY AREA 2	KEY AREA 3	KEY AREA 4	KEY AREA 5	KEY AREA 6	KEY AREA 7
IMPROVING INFECTION PREVENTION AND CONTROL PRACTICES	OPTIMISING PRESCRIBING PRACTICE	IMPROVING PROFESSIONAL EDUCATION, TRAINING AND PUBLIC ENGAGEMENT	DEVELOPING NEW DRUGS, TREATMENTS AND DIAGNOSTICS	BETTER ACCESS TO AND USE OF SURVEILLANCE DATA	BETTER IDENTIFICATION AND PRIORITISATION OF AMR RESEARCH NEEDS	STRENGTHENED INTERNATIONAL COLLABORATION
Align the Infection Control and Stewardship Agenda Measure Infection Rates and Antibiotic	Collaborative Multi-disciplinary Working Expert Conferences, Workshops & Events	Collaborative Multi-disciplinary Working Evidence-Based Guideline	Collaborative Multi-disciplinary Working Expert conferences, Workshops & Events	Collaborative Multi-disciplinary Working Evidence-Based Guideline	Collaborative Multi-disciplinary Working Expert Conferences, Workshops & Events	Collaborative Multi-disciplinary Working Evidence-Based Guideline Development Expert Conferences, Workshops & Events Professional & Public Education Campaigns Antibiotic Action Preceptorship Support International Collaborations Data Collection Systems to Measure Antibiotic Use Advisory Role to Government
	Behavioural Science Supporting out of Hospital Treatment Programmes					



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