Antimicrobial Stewardship in Hospitals: A Patient Safety Emergency

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Conflicts of Interest

- Participated in commercial advisory boards for:
  - Astellas, Janssen, Novartis, Pfizer, Durata, Cubist
- Received lecture funds from:
  - Astellas, Bayer, Novartis, Pfizer, Wyeth, Biomerieux (production of stewardship booklet)
- Received research funds from:
  - Bayer, Pfizer, Basilea
- Non-commercial positions as:
  - Chair of Scottish Antimicrobial Prescribing Group (SAPG) – Scottish Government Stewardship Program, President ESGAP, President Elect British Society for Antimicrobial Chemotherapy (BSAC)

Conflicts of Interest

- *Any views or opinions expressed in this webinar are solely that of the presenter and do not necessarily represent those of the sponsor, Thermo Scientific, or Current Protocols.*

Antimicrobial Stewardship: What is it?

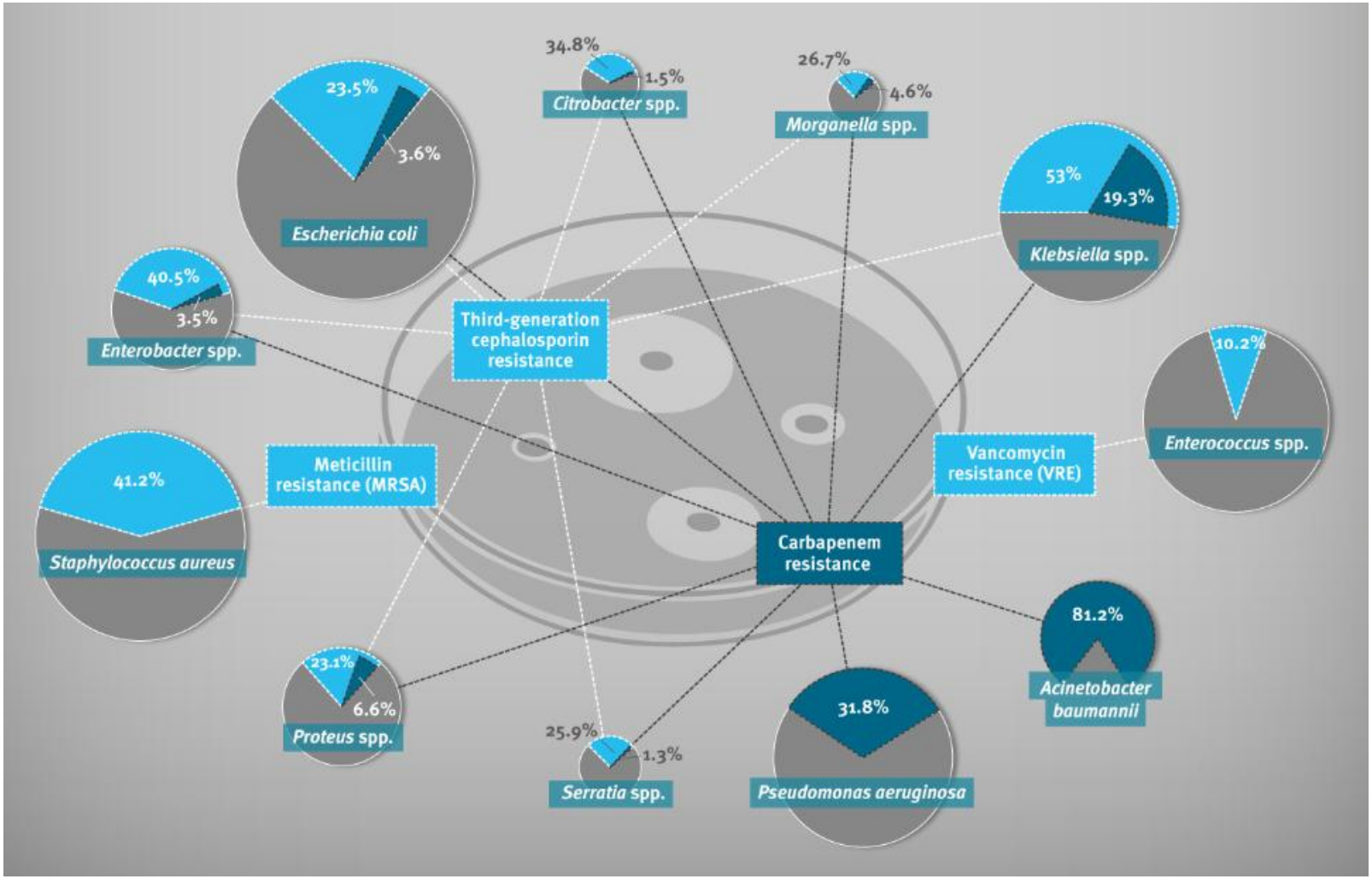
- Antimicrobial stewardship is a systematic approach to optimizing the use of antimicrobials
- It is used by healthcare institutions to:
  - Reduce inappropriate antimicrobial use
  - Improve patient outcomes
  - Reduce adverse consequences, including antimicrobial resistance, toxicity and unnecessary costs

MacDougall C. Clin Micro Rev 2005; 18:638-656

Objectives - “Hospital Focus”

- **Why stewardship? Evidence of antibiotic misuse and impact of misuse**
- Goals of stewardship with evidence base to support stewardship
- Implementing stewardship
- Measuring antibiotic use, indicators and feedback
- Diagnostics and biomarkers in stewardship

ECDC Point Prevalence Survey 2011-2012



Antimicrobial use on any given day in EU/EEA Hospitals 33% Patients [range: 21-55%]

Source: ECDC surveillance report (PPS), July 2013. Infographics: A. Haeger, ECDC.

Antibiotic Point Prevalence

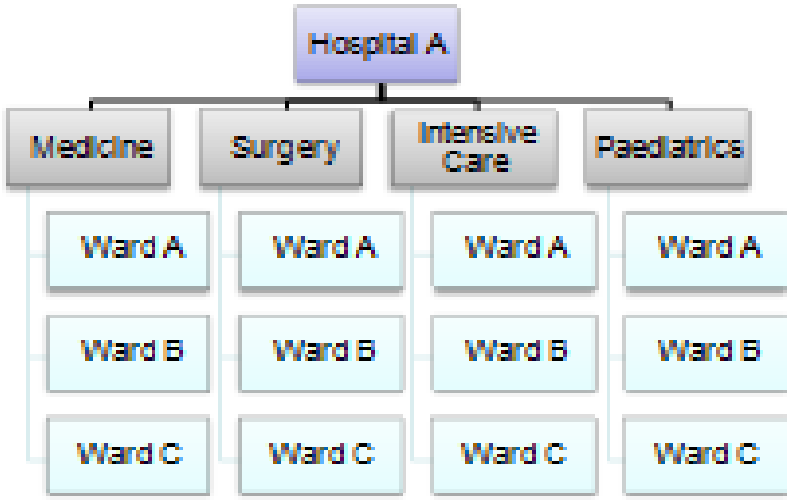
Key to qualitative measurement of antibiotic prescribing in your hospital

- Question 1 - What are you interested in measuring?

Identified any areas of concern? Is there political pressure?

Indication % Compliance to policy	Duration
IV-PO Switch	Surgical prophylaxis
Allergy Status	Combinations

What antibiotics are prescribed in your organisation?



Hospital Prescribing

- National Point Prevalence Study 2009 (ESAC-3) Scottish data
  - 31 hospitals (8732 patients)
  - 27.8% patients on antimicrobials
  - 50.5% given intravenously

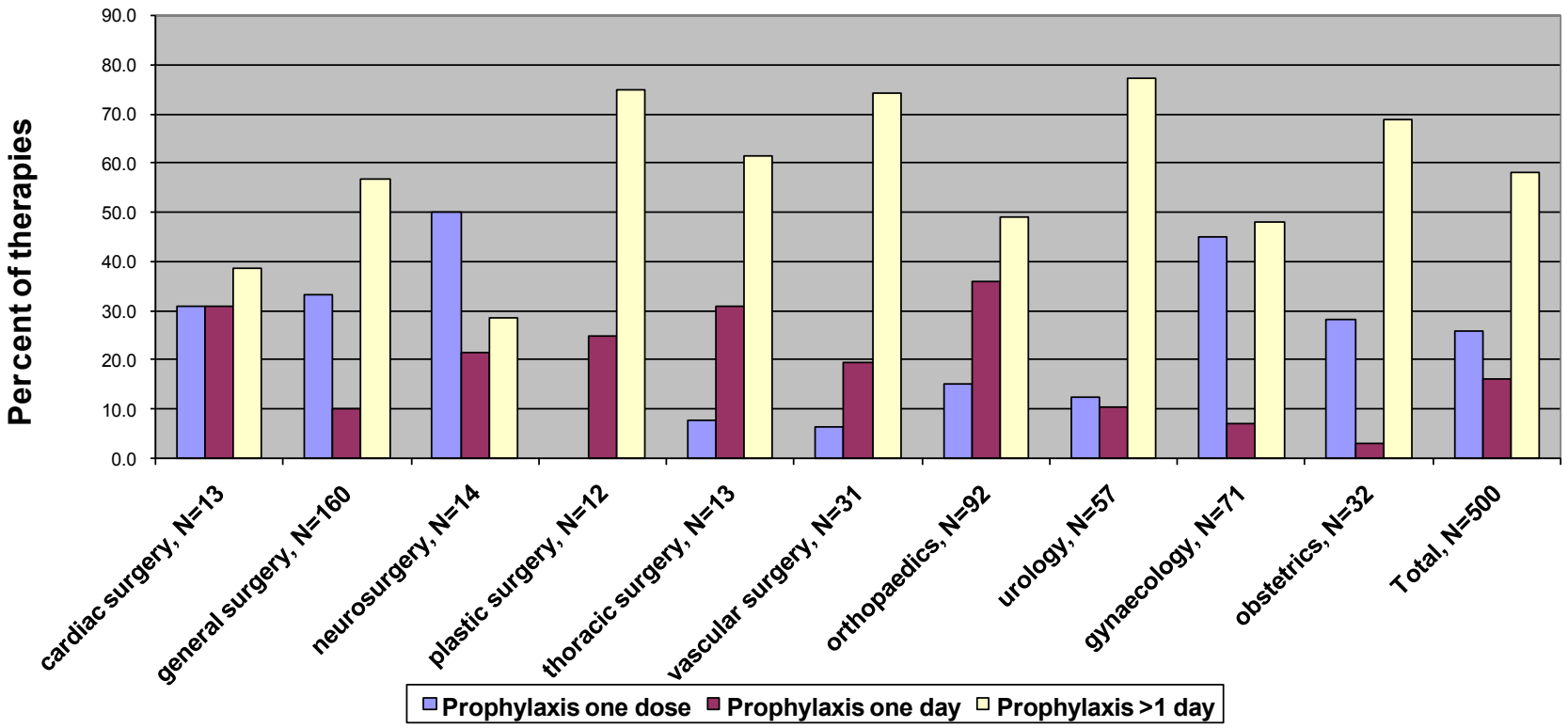
- 76.1% reason recorded in case notes
- 57.9% compliant with local guidelines

- 30.3% surgical prophylaxis more than one day

→ some room for improvement

Length of Pre-operative Prophylaxis in Surgery

European Hospitals: Variation



Source: ESAC European PPS 2012

The Increasing Scenario

- 45 year old patient with AML admitted for chemotherapy and has a new PICC line
- Prophylactic levofloxacin, acyclovir and fluconazole per protocol
- After a few days becomes neutropenic and febrile
- After 48 hours fevers continue up to 39° C with severe chills
- Blood cultures reveal a gram negative rod, PICC line is removed and antibiotics changed to a carbapenem
- On day 4 she is in septic shock, intubated and transferred to MICU
- Blood cultures: multidrug resistant *Pseudomonas*
- You call the lab and organism is resistant to all carbapenems; aminoglycosides

Is this unusual?

- **What are the consequences for this patient?**
- **Which antibiotic would you use next?**

Source: ESAC PPS

Harm from Resistance and HAI

Clinical consequences	Worsened patient morbidity and mortality
Economic consequences	Increased cost of managing individual patients, opportunity costs and costs of control programs >2-fold increase in cost per MDRO
Legislative mandates	Mandatory national surveillance and reporting, sometimes public
Reimbursement	Proposals to include some HAI's to decreased hospital reimbursement
Public image and reputation	Patient advocacy, media and political groups increasingly focused on MDRO preparedness; public anxiety
Medicolegal liability	Lawsuits linking certain HAI's with hospital/provider neglect

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% questionable
	80% Prophylaxis/growth	

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

PERSONAL VIEW

China's misuse of antibiotics should be curbed

Pressure from patients and perverse financial incentives are just two of many factors that conspire to encourage potentially dangerous overuse of antibiotics in China, writes **Yan Li**

Yan Li *lecturer, School of Arts and Humanities, Nottingham Trent University, Nottingham, United Kingdom*

China has a high rate of antibiotic use for inpatients and outpatients. On average, each Chinese person consumes 138 g of antibiotics a year—10 times that consumed in the United States. About 75% of patients with seasonal influenza are estimated to be prescribed antibiotics, and the rate of antibiotic prescription for inpatients is 80%.[1] The World Health Organization recommends a maximum of 30%.[2] About 97% of surgical patients in China are given antibiotics.[3]

In many primary healthcare centres in China, antibiotics are regarded as a panacea. However, they have no effect on viral infections such as the common cold. They are also ineffective against sore throats, which are usually viral and resolve they lack professional knowledge about rational use, because they want to prevent potential infections, or simply because they think this is what patients want.[8]

Financial motivations also play an important part. The Chinese government subsidises 8% of the running costs of hospitals, leaving the remaining 92% to be funded by charging for care. Drug sales currently account for more than 50% of all hospital revenues, and antibiotics account for 47% of all drug sales, on which hospitals are allowed to charge a 15% mark-up. In many hospitals, doctors' incomes are also closely linked to their prescription of specific drugs, and bonuses from their hospitals and kickbacks from companies augment their incomes.[6]

Source: *BMJ* 2014;348:g1083

Antibiotic Consumption Concerns

Global antibiotic consumption 2000 to 2010: an analysis of national pharmaceutical sales data

Thomas P Van Boeckel PhD [a], Sumanth Gandra MD [b], Ashvin Ashok MPP [b], Quentin Caudron PhD [a], Prof Bryan T Grenfell PhD [a c f], Prof Simon A Levin PhD [a c e], Prof Ramanan Laxminarayan [b c d]

Findings

- Between 2000 and 2010, consumption of antibiotic drugs increased by 36% (from 54 083 964 813 standard units to 73 620 748 816 standard units). Brazil, Russia, India, China and South Africa accounted for 76% of this increase. In most countries, antibiotic consumption varied significantly with season. There was increased consumption of carbapenems (45%) and polymixins (13%), two last-resort classes of antibiotic drugs.

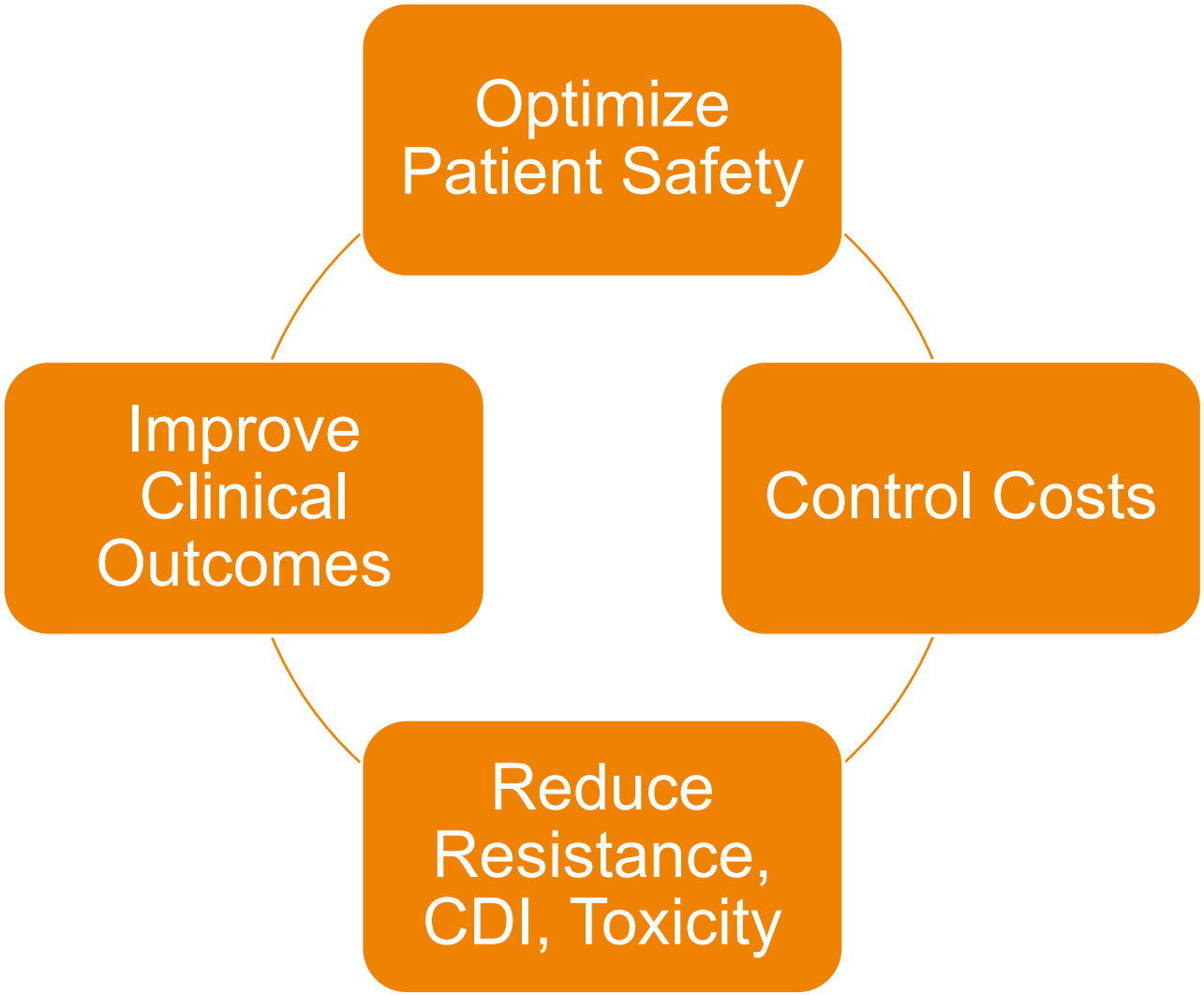
Interpretation

- The rise of antibiotic consumption and the increase in use of last-resort antibiotic drugs raises serious concerns for public health. Appropriate use of antibiotics in developing countries should be encouraged. However, to prevent a striking rise in resistance in low-income and middle-income countries with large populations and to preserve antibiotic efficacy worldwide, programs that promote rational use through coordinated efforts by the international community should be a priority.

Objectives - “Hospital Focus”

- Why stewardship? Evidence of antibiotic misuse
- **Goals of stewardship with evidence base to support stewardship**
- Implementing stewardship
- Measuring antibiotic use and feedback

Goals of Antimicrobial Stewardship Programs



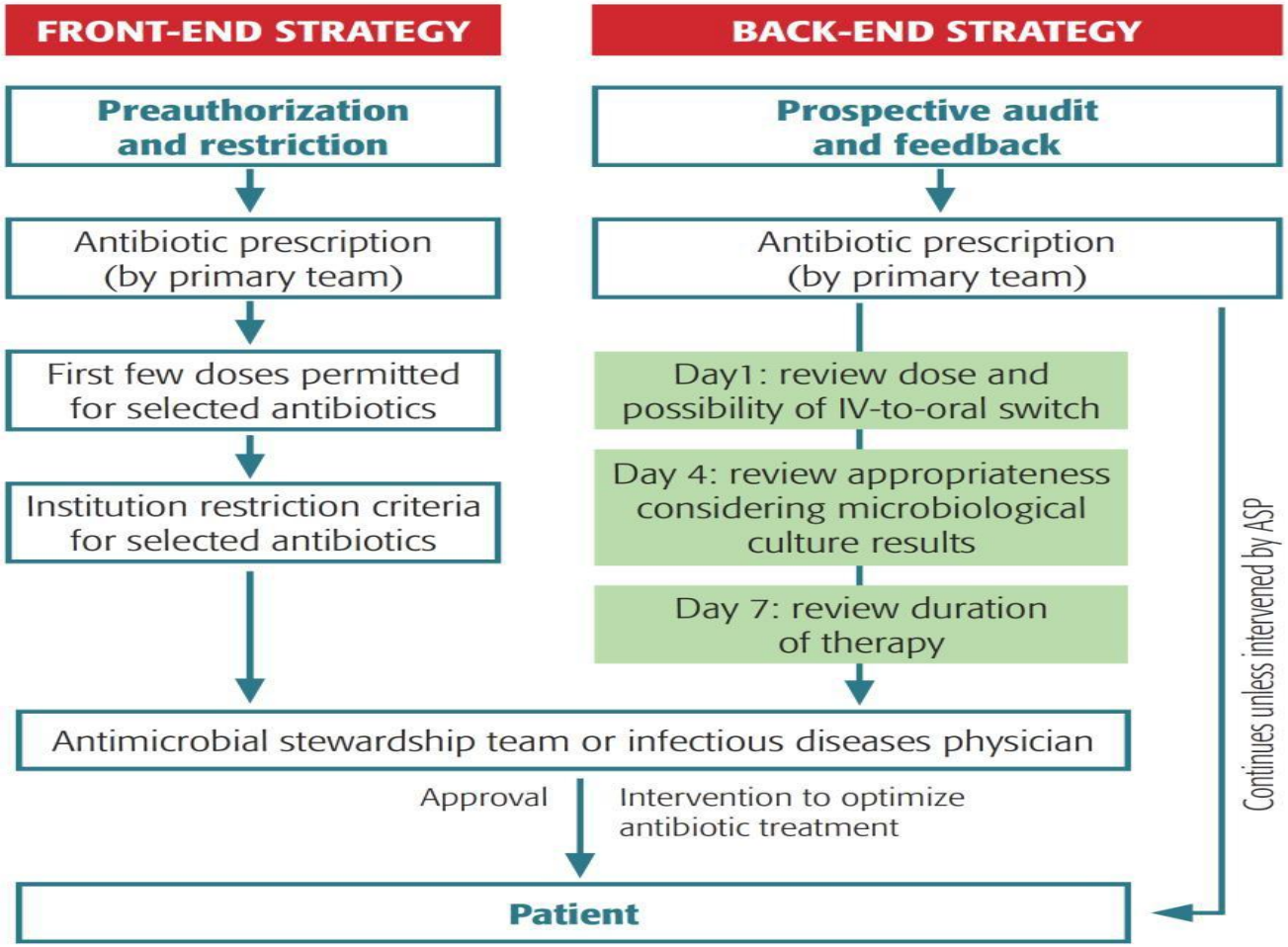
Antimicrobial Stewardship Toolkit: Quality of Evidence to Support Interventions

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

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

Workflow: Two-step Prospective Audit and Feedback Strategy: Formulary Restriction and Preauthorization Strategy

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



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

Intervention for a More Successful Outcome

- Interventions to improve antibiotic prescribing in hospitals:
  - 89 Studies until 2009
    - 55 from North America
    - 37 from Europe
    - 3 from Far East
    - 3 from South America
    - 2 from Australia
- Persuasive and restrictive interventions

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

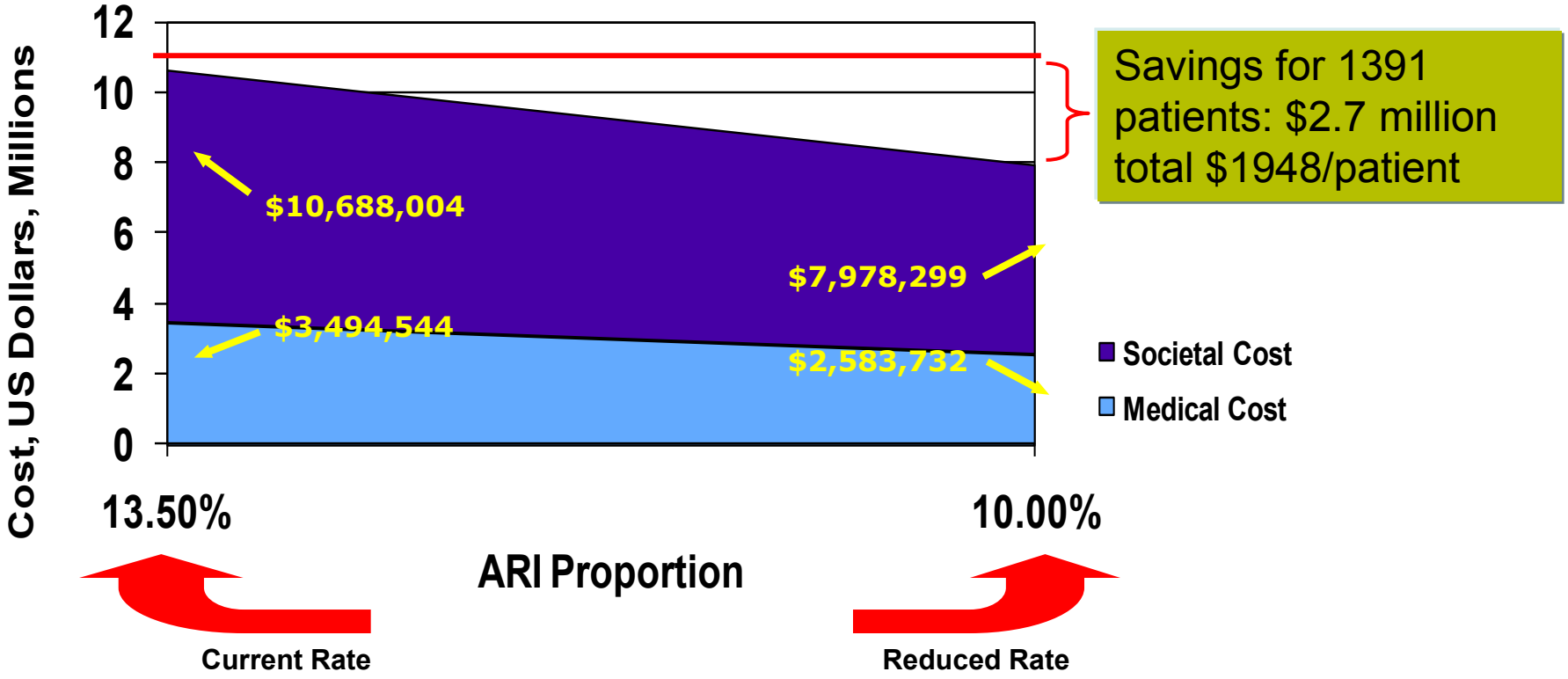
Source: Davey et al. Cochrane Database of Systematic Reviews. 2013

Impact of Stewardship on **Safety**? (critical care)

- "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."

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

Cost of Antibiotic Resistant Infection (ARI)



Had the Antibiotic Resistant Infection (ARI) rate been reduced to 10%, a reduction of 3.5%:

- Study hospital could have achieved savings of $910,812
- Societal savings of $1.8 million in reduced mortality and lost productivity

Source: Roberts RR, et al. *Clin Infect Dis.* 2009;49:1175-84.

“Show Me the Money”

Long term cost reduction with a stewardship program

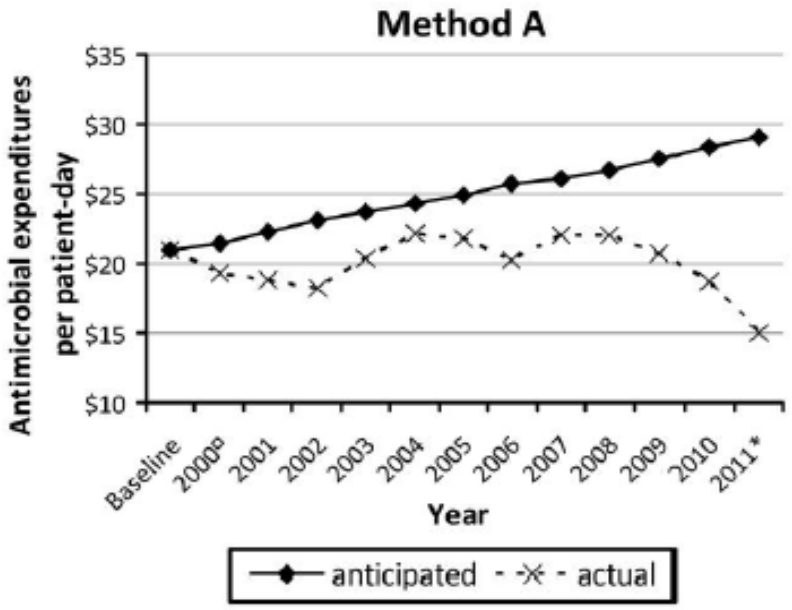


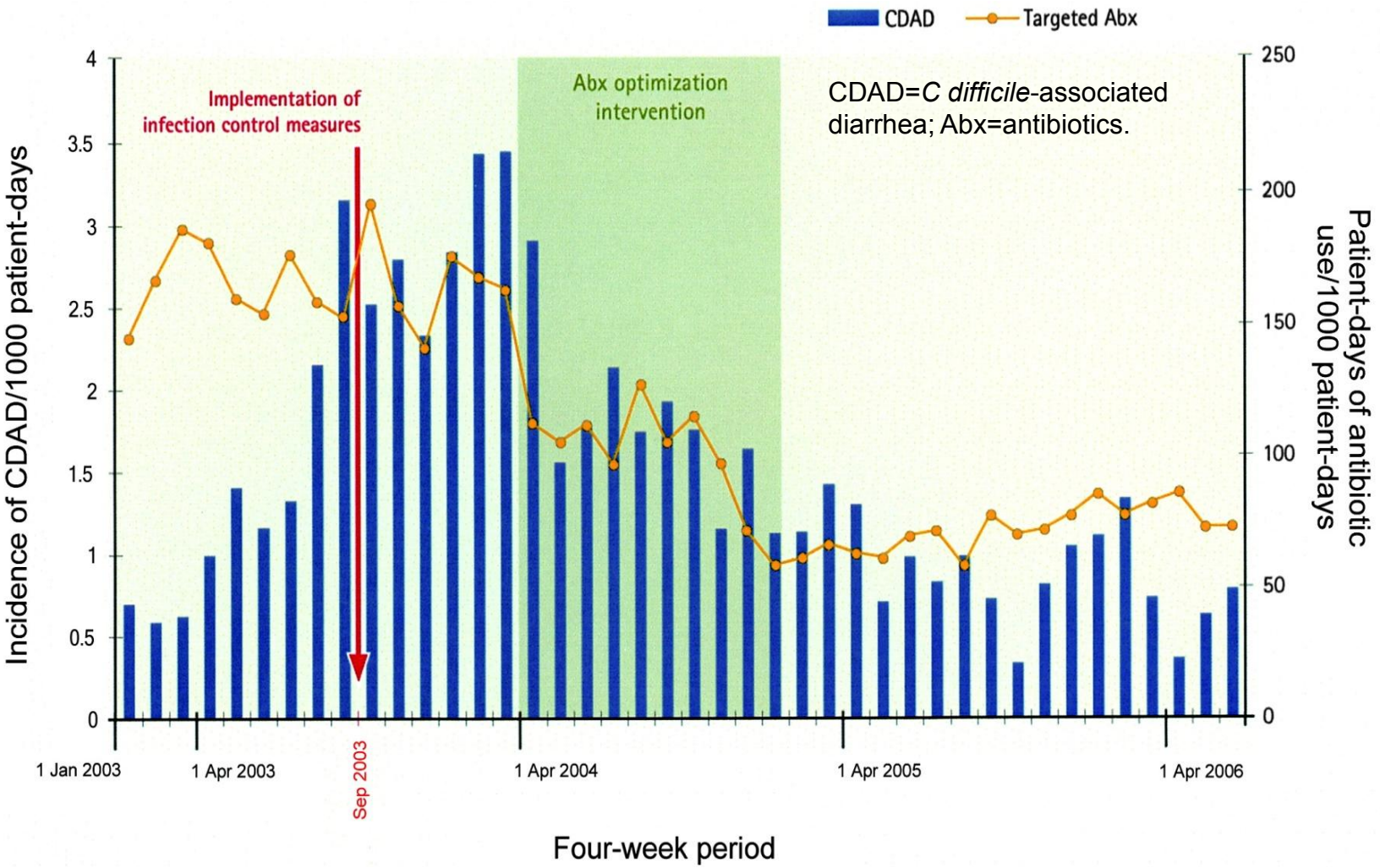
TABLE 1. Summary of Annual Savings Associated with the Implementation of the Center for Antimicrobial Utilization Stewardship and Epidemiology, Determined Using an Inflation Rate Based on the US Consumer Price Index for Medical Care Commodities (Method A) and an Anti-Infective-Specific Index (Method B)

Year	Method A	Method B
2000[a]	158,161	229,076
2001	548,002	1,267,638
2002	806,393	1,446,883
2003	473,174	1,354,129
2004	244,160	1,555,048
2005	419,613	2,005,202
2006	983,690	2,172,756
2007	675,036	1,990,967
2008	817,503	2,557,972
2009	1,278,301	2,782,519
2010	2,175,927	3,456,373
2011[b]	1,770,827	2,406,399
Yearly average	920,070	2,064,441
Total savings	10,350,787	23,224,961

NOTE. Data are US dollars.
[a] April–December 2000.
[b] January–June 2011.

Source *Infect Control Hosp Epidemiol* 2012;33(4):398-400

Reduction in CDI



Tertiary Care Hospital; Québec, Canada (2003-2006)

Source: Valiquette L et al. *CID* 2007; 45, S112-S121.

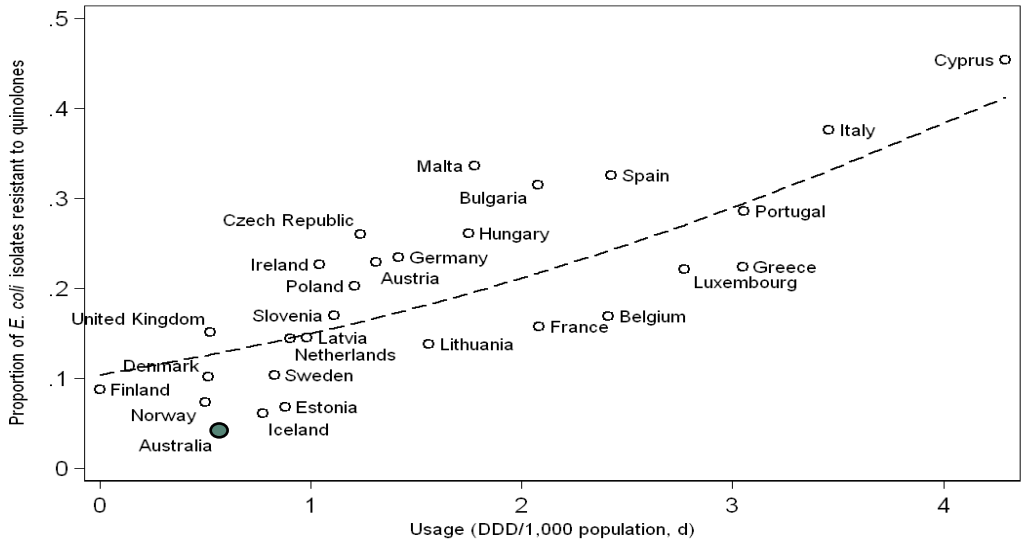
Managing Resistance

- Close links between volume of use in human and veterinary medicine and resistance (at community and hospital level)
- Regulations restrict quinolone availability in humans and in food-producing animals → low fluoroquinolone resistance rates
- Conscious decision to avoid quinolones in clinical guidelines

Control of Fluoroquinolone Resistance through Successful Regulation, Australia

Allen C. Cheng, John Turnidge, Peter Collignon, David Looke, Mary Barton, and Thomas Gottlieb

Emerging Infectious Diseases • www.cdc.gov/eid • Vol. 18, No. 9, September 2012



Source: Relationship of quinolone consumption and resistance in *E.coli* Durham K. Eur J Clin Microbiol Inf Dis 2010; 29, 353-356

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PLOS | MEDICINE

Health in Action

Changes in Chinese Policies to Promote the Rational Use of Antibiotics

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

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

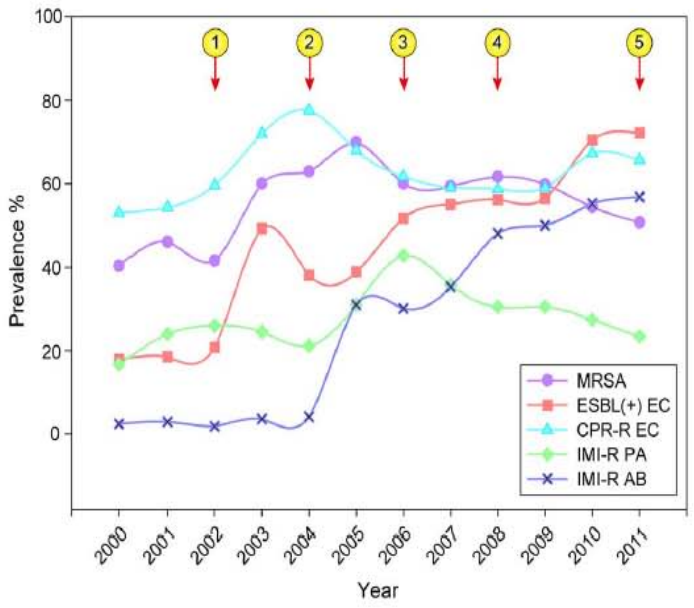


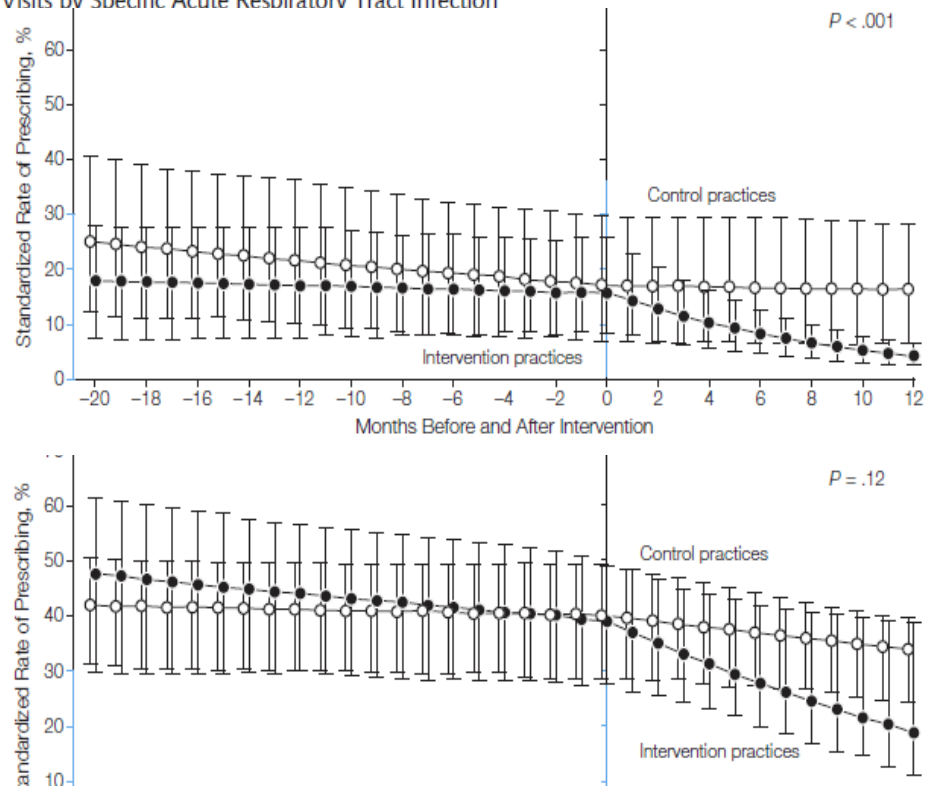
Figure 1. Overall trends in prevalence of major antimicrobial-resistant bacteria in Chinese tertiary hospitals in 2000–2011. The majority of the data were adapted from Mohnarin results, which mostly represent situations involving nosocomial infections in tertiary hospitals. The numbers in circles describe the chronology of major administrative interventions taken by the Chinese Ministry of Health. ① indicates the issue of "temporary rules for pharmaceutical affairs in healthcare institutions" (2002); ② indicates the issue of "guidance for the clinical use of antimicrobials" (2004); ③ indicates the issue of "regulations for management of nosocomial infections' (2006); ④ indicates the issue of recommendations for enhancing the prevention and control of multidrug resistant bacterial infections (2008); and ⑤ indicates the special campaign initiated in 2011. MRSA, methicillin-resistant *Staphylococcus aureus*; ESBL (+) EC, extended-spectrum β-lactamase-producing *Escherichia coli*; CPR-REC, ciprofloxacin-resistant *E. coli*; IMI-R PA, imipenem-resistant *Pseudomonas aeruginosa*; IMI-R AB, imipenem-resistant *Acinetobacter baumannii*.

doi:10.1371/journal.pmed.1001556.g001

Effects of Outpatient Antimicrobial Stewardship Intervention JAMA. 2013 Jun 12;309(22):2345-52.

Using broad spectrum antibiotic prescribing by primary care pediatricians – a randomized trial

Figure 3. Standardized Rates of Broad-Spectrum Antibiotic Prescribing at Acute Care Office Visits by Specific Acute Respiratory Tract Infection



Approach:

- One 1-hour on-site clinician education session followed by a 1-year quarterly audit and feedback of prescribing for bacterial and viral URTI's vs. usual practice

Objectives - “Hospital Focus”

- Why stewardship? Evidence of antibiotic misuse
- Goals of stewardship with evidence base to support stewardship
- **Implementing stewardship**
- Measuring antibiotic use and feedback

Implementation Elements

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

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].

Implementation and Change Strategies

- Social and behavioral scientific approach
- Organizational culture change model based on Hofstede's model
- Change models e.g. Kotter's managing change
- Implementation science

Changing Behavior?

Antibiotic prescribing in hospitals: a social and behavioural scientific approach

Marlies E J L Hulscher, Richard P T M Grol, Jos W M van der Meer

Lancet Infect Dis 2010; 10: 167–75

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

Improvement strategies at the organisational level

Antibiotic policies

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

Strategies to improve coordination, collaboration, communication, teamwork, and care logistics

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

Improvement strategies at the individual level

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

Kotter's Steps: Managing Change

- Step 1: Create a sense of urgency
- Step 2: Form a powerful guiding coalition
- Step 3: Create a compelling vision for change
- Step 4: Communicate the vision effectively
- Step 5: Empower others to act on the vision
- Step 6: Plan for and create short term wins
- Step 7: Consolidate improvements and create still more change
- Step 8: Institutionalize new approaches

Source: Kotter JP. Harvard Business Review. March-April 1995:59-67.

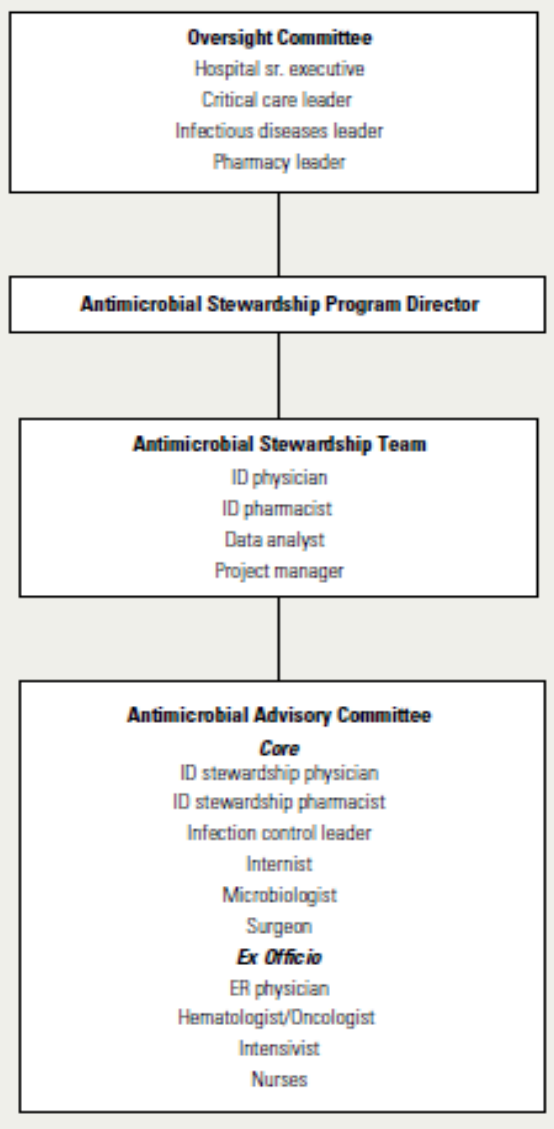
Kotter's Steps: Managing Change

Step 1: Create a sense of urgency

- Focus on patient safety and cost with hospital leaders
- "Our CDI rates are too high and we are hurting patients"
- "We are not compliant with the publically reported CAP measure and we are not going to win the good compliance award like our competitor"

Step 2: Form a powerful guiding coalition

- Team of leaders who represent key stakeholders
- Team member characteristics: position power, expertise, credibility, leadership



Source: Morris AM et al. Healthcare Quarterly. 2010;13:64-70.

Quick Wins

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.

Potential Quick Wins

- **Surgical prophylaxis**
- Empiric therapy policy
- Restricted use policy but with options
- IV to oral switch
- Generic substitution

- Post prescription review more resource consuming but potentially of long-term impact as educational and feedback opportunity

Potential Quick Wins: Example

Research Article

Adherence of Surgeons to Antimicrobial Prophylaxis Guidelines in a Tertiary General Hospital in a Rapidly Developing Country

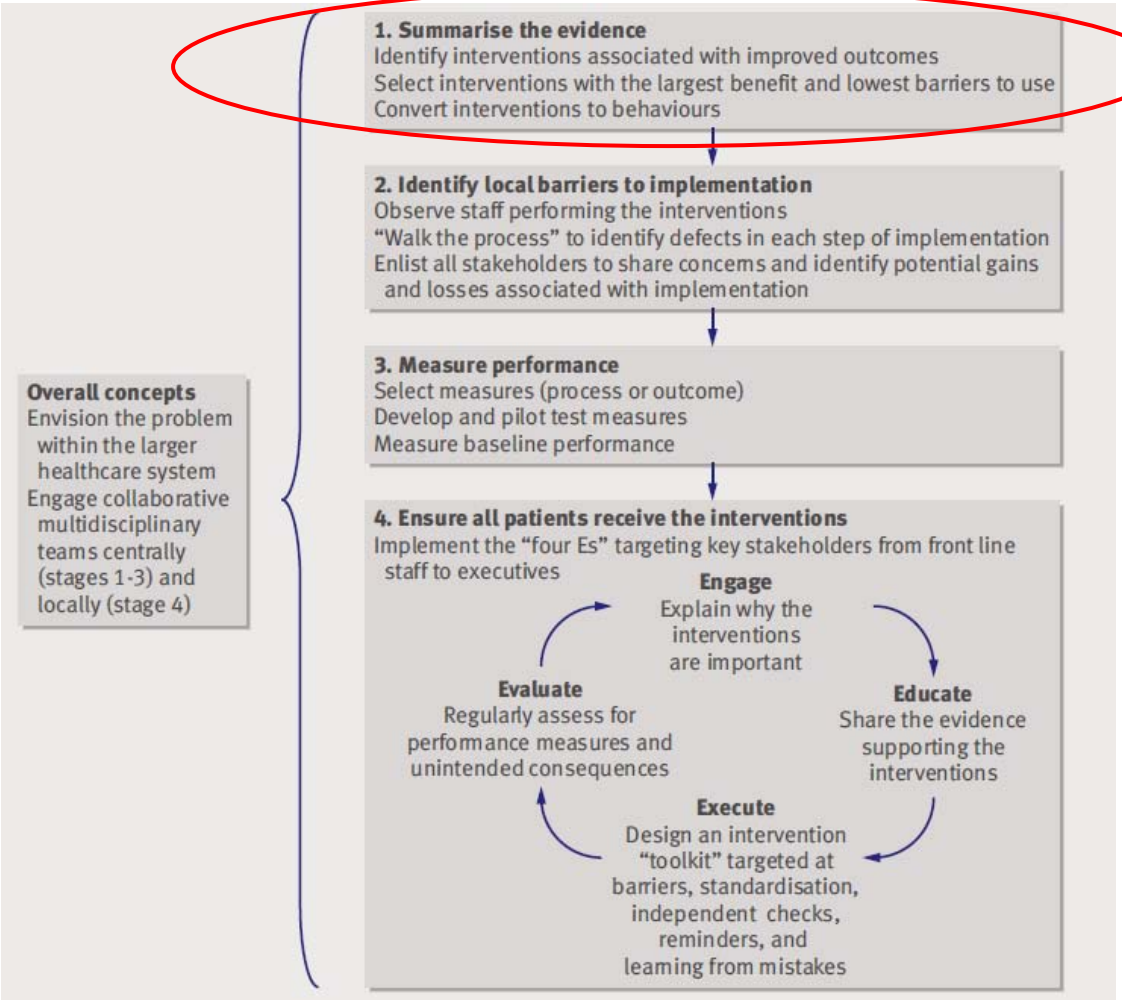
Ahmed Abdel-Aziz,[1] Ayman El-Menyar,[2,3,4] Hassan Al-Thani,[1] Ahmad Zarour,[1] Ashok Parchani,[1] Mohammad Asim,[2] Rasha El-Enany,[5] Haleema Al-Tamimi,[5] and Rifat Latifi[1,6]

TABLE 4

Country	Study duration (months)	Overall compliance rate (%) of SAP guidelines	Reason for noncompliance with SAP guidelines			
			Inappropriate antibiotic		Inappropriate antibiotic selection (%)	Inappropriate administration of indicated SAP (%)
			Duration (%)	Time of administration for 1st dose (%)		
Brazil [17]	5	4.9	95.2	15.3	19.1	98.1
Australia [18]	33	—	12.4	7.1	1.7%	—
Italy [19]	1	44.8	—	24.3	—	17.3
Greece [20]	10	—	63.7	0.0	30	19
Jordan [21]	3	—	60.6	0.9	98.3	0
India [22]	—	—		87	—	19
Eritrea [23]	3	—	—	—	—	34
Germany [24]	6	70.7	32.9	—	—	—
Present study	3	46.5	59.3	—	31.5	9.2

SAP: surgical antibiotic prophylaxis.

Program Implementation



Implementation Scientific Approach

Source: Pronovost P, Berenholtz S, Needham D. BMJ 2008;337:a1714

Program Implementation

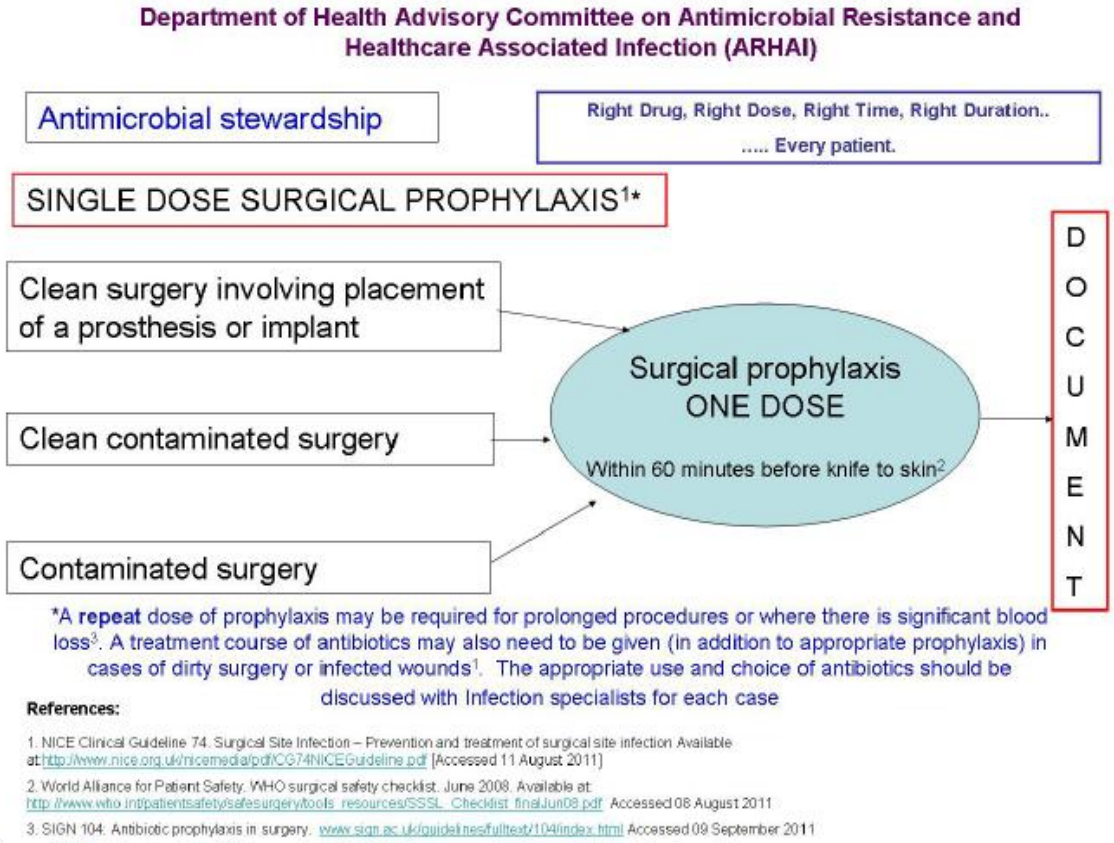
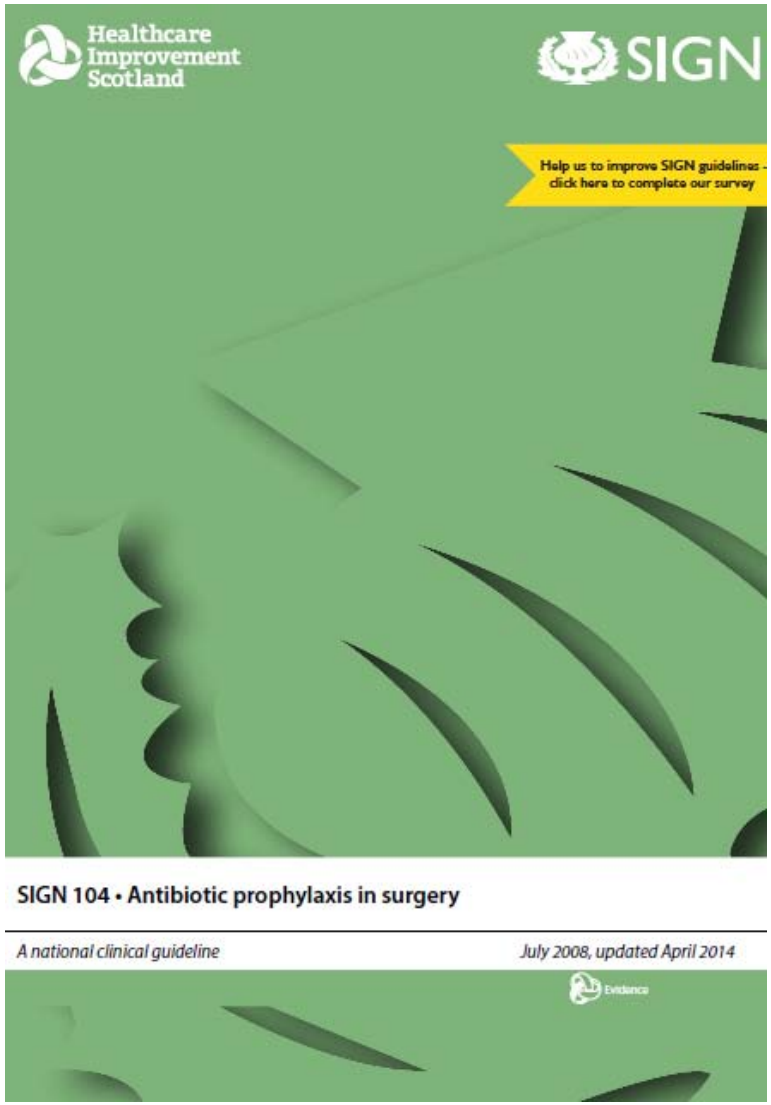


Figure 2: Antimicrobial Stewardship (AMS) – surgical prophylaxis algorithm

Advocating patient safety and auditing of antimicrobial stewardship in hospitals should be based around the principles stated in this AMS algorithm. Examples of audit tools are shared in Appendix 1

Program Implementation



2 Key recommendations

The following recommendations were highlighted by the guideline development group as being clinically very important. They are the key clinical recommendations that should be prioritised for implementation. The clinical importance of these recommendations is not dependent on the strength of the supporting evidence.

The key recommendations were identified using a web based Delphi Decision Aid (http://armstrong.wharton.upenn.edu/delphi2/). Guideline development group members scored recommendations and good practice points on the general principles of antibiotic prophylaxis from 0 to 10 (with 0 being least important and 10 most important). Recommendations for specific surgical interventions (*see section 5) were not included.*
The mean scores were calculated and recommendations achieving over 75% of the maximum score were identified as key. Eleven of the 35 guideline development group members responded covering the specialities of clinical effectiveness, clinical microbiology, hepatobiliary surgery, implementation, infection control, obstetrics, paediatric anaesthetics, pharmaceutical public health, and radiology.

2.1 Benefits and risks of antibiotic prophylaxis

C — Patients with a history of anaphylaxis, laryngeal oedema, bronchospasm, hypotension, local swelling, urticaria or pruritic rash, occurring immediately after a penicillin therapy are potentially at increased risk of immediate hypersensitivity to beta-lactams and should not receive prophylaxis with a beta-lactam antibiotic.

✓ Local policies for surgical prophylaxis that recommend beta-lactam antibiotics as first line agents should also recommend an alternative for patients with allergy to penicillins or cephalosporins.

These recommendations are important for patient safety. The risk of penicillin hypersensitivity is important and failure to implement these recommendations may have clinically-disastrous results. Another issue is over-diagnosis of an allergy, resulting in failure to use a beta-lactam when it would have been suitable.

D — The duration of prophylactic antibiotic therapy should be single dose except in special circumstances (for example, prolonged surgery, major blood loss or as indicated in sections 5.2, 5.3 and 6.4).
There is still a tendency to give prolonged courses of antibiotics. This recommendation is important to prevent over-prescribing, but if a second dose were administered there would be no major consequences for the patient.

2.2 Administration of prophylactic antibiotics

C — The antibiotics selected for prophylaxis must cover the expected pathogens for that operative site.

The choice of antibiotic should take into account local resistance patterns. Although it appears self evident that the antimicrobial agent chosen should be suitable for the organisms likely to be encountered, it is easily forgotten in routine prescribing.

✓ A single standard therapeutic dose of antibiotic is sufficient for prophylaxis under most circumstances.

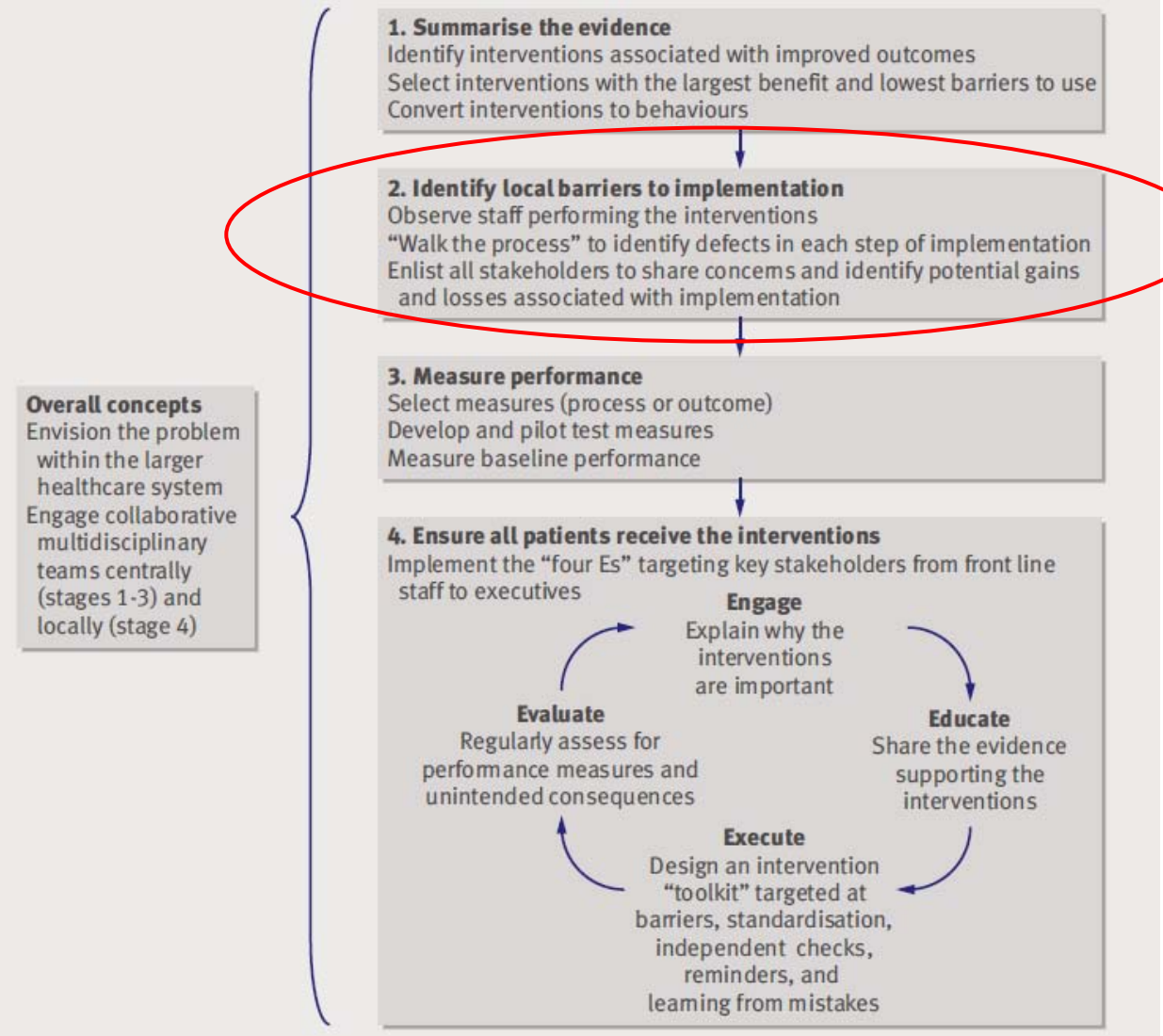
Evidence regarding the optimal timing of antibiotic phophylaxis is currently conflicting and based on studies including different types of surgical procedure. Shorter times between antibiotic administration and skin incision may result in lower rates of surgical site infection for some procedures.

B — For surgical procedures intravenous prophylatic antibiotics should be given within 60 minutes before the skin is incised and as close to the time of incision as possible.

✓ Vancomycin should be given by intraveneous infusion starting 90 minutes prior to skin incision

Source: SIGN 104 • Antibiotic prophylaxis in surgery. *July 2008, updated April 2014*

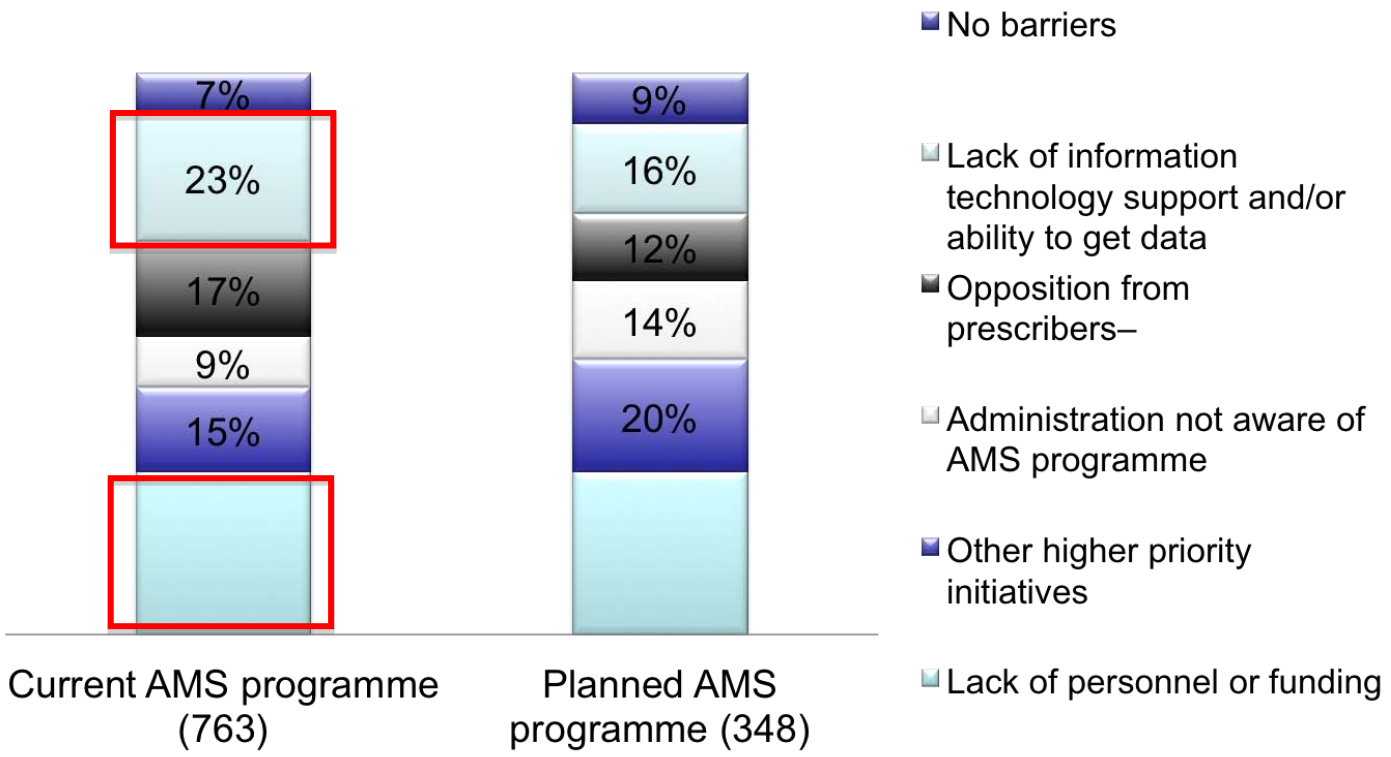
Program Implementation



Source: Pronovost P, Berenholtz S, Needham D. BMJ 2008;337:a1714

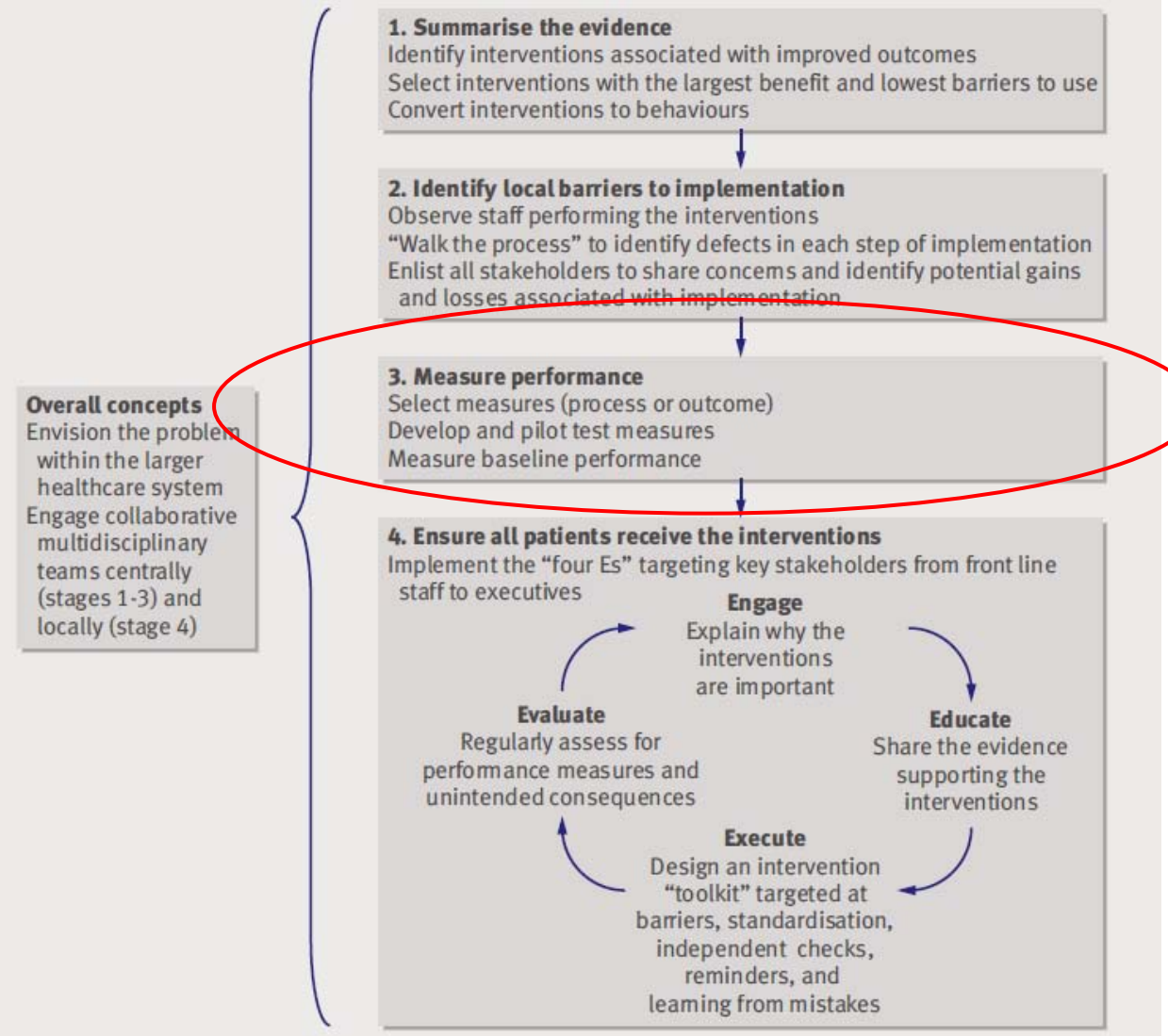
Barriers to Implementation

Hospitals top 3 barriers to providing a functional and effective AMS programme



Source: Global stewardship survey; Howard P et al JAC 2014, in press

Program Implementation



Source: Pronovost P, Berenholtz S, Needham D. BMJ 2008;337:a1714

Quality in Health Care and Medical Outcomes

- Measures or Indicators S+P=O

- S=Structure
  - The environment in which health care is provided
- P=Process
  - The method by which health care is provided
- O=Outcome
  - The consequence of the health care provided

Source: Avedis Donabedian, Physician

Performance Measurement Indicators

Final set of Core and Supplemental indicators for hospital antimicrobial stewardship programs

		CORE Indicators for hospital antimicrobial stewardship programs
Infrastructure	1.	Does your facility have a formal **antimicrobial stewardship programme** accountable for ensuring appropriate antimicrobial use?
	2.	Does your facility have a **formal organizational structure** responsible for antimicrobial stewardship (e.g., a multidisciplinary committee focused on appropriate antimicrobial use, pharmacy committee, patient safety committee or other relevant structure)?
	3.	Is an antimicrobial stewardship **team** available at your facility (e.g., greater than one staff member supporting clinical decisions to ensure appropriate antimicrobial use)?
	4.	Is there a physician identified as a **leader** for antimicrobial stewardship activities at your facility?
	5.	Is there a **pharmacist** responsible for ensuring antimicrobial use at your facility?
	6.	Does your facility provide any **salary support** for dedicated time for antimicrobial stewardship activities (e.g., percentage of full-time equivalent (FTE) for ensuring appropriate antimicrobial use)?
	7.	Does your facility have the **IT capability** to support the needs of the antimicrobial stewardship activities?
Policy and Practice	8.	Has your facility produced a **cumulative antimicrobial susceptibility report** in the past year?
	9.	Does your facility have **facility-specific treatment recommendations** based on local antimicrobial susceptibility to assist with antimicrobial selection for common clinical conditions?
	10.	Does your facility have a written policy that requires prescribers to **document** in the medical record or during order entry a dose, duration, and indication for all antimicrobial prescriptions?
	11.	Is it routine practice for specified antimicrobial agents to be approved by a physician or pharmacist in your facility (e.g., **pre-authorization**)?
	12.	Is there a formal procedure for a physician, pharmacist, or other staff member to review the appropriateness of an antimicrobial after 48 hours from the initial order (**post-prescription review**)?
Monitoring and Feedback	13.	Are results of antimicrobial audits or reviews **communicated directly** with prescribers?
	14.	Does your facility **monitor if the indication** is captured in the medical record for all antimicrobial prescriptions?
	15.	Does your facility audit or **review surgical antimicrobial prophylaxis** choice and duration?
	16.	Does your facility **monitor antimicrobial use** by grams [Defined Daily Dose (DDD)] or counts [Days of Therapy (DOT)] of antimicrobial(s) by patients per days?
	17.	Has an **annual report** focused on antimicrobial stewardship (summary antimicrobial use and/or practices improvement initiatives) been produced for your facility in the past year?

	SUPPLEMENTAL Indicators for hospital antimicrobial stewardship programs
Infrastructure	S1. Does your facility have a named **senior executive officer with accountability** for antimicrobial leadership? (Core 3) Is an antimicrobial stewardship team available at your facility (e.g., greater than one staff member supporting clinical decisions to ensure appropriate antimicrobial use)? S2. If YES, Is an **infection preventionist or hospital epidemiologist** involved in stewardship activities? S3. If YES, Is a **microbiologist (laboratory staff)** involved in stewardship activities? S4. Is clinical infectious disease **(ID) consultation** available at your facility? (Core 4) Is there a physician identified as a leader for antimicrobial stewardship activities at your facility? S5. If YES, are stewardship **duties included in the job description** and/or annual review? S6. If YES, has this **physician had specialized training** in infectious diseases, clinical microbiology and/or antimicrobial stewardship? (Core 5) Is there a pharmacist responsible for ensuring antimicrobial use at your facility? S7. If YES, has this **pharmacist had specialized training** in infectious disease management or stewardship?
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?**
Monitoring	S15. Does your facility measure the **percentage of antimicrobial prescriptions that are consistent with the local treatment recommendations** for either UTI or CAP? (Core 15) Does your facility audit or review surgical antimicrobial prophylaxis choice and duration? S16. If YES, are antimicrobial prescriptions for **surgical prophylaxis compliant with facility-specific guidelines** in >80% of sampled cases in your facility?

Source: Pollack L et al TATFAR 2014

Antibiotic Prescribing Indicators

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", all or nothing (3 Day antibiotic review bundle, VAP, CAP bundle's)

Outcome measures (trends and time series analysis)

- CDI rates
- SSI rates
- Surveillance of resistance
- Mortality [SMR's]

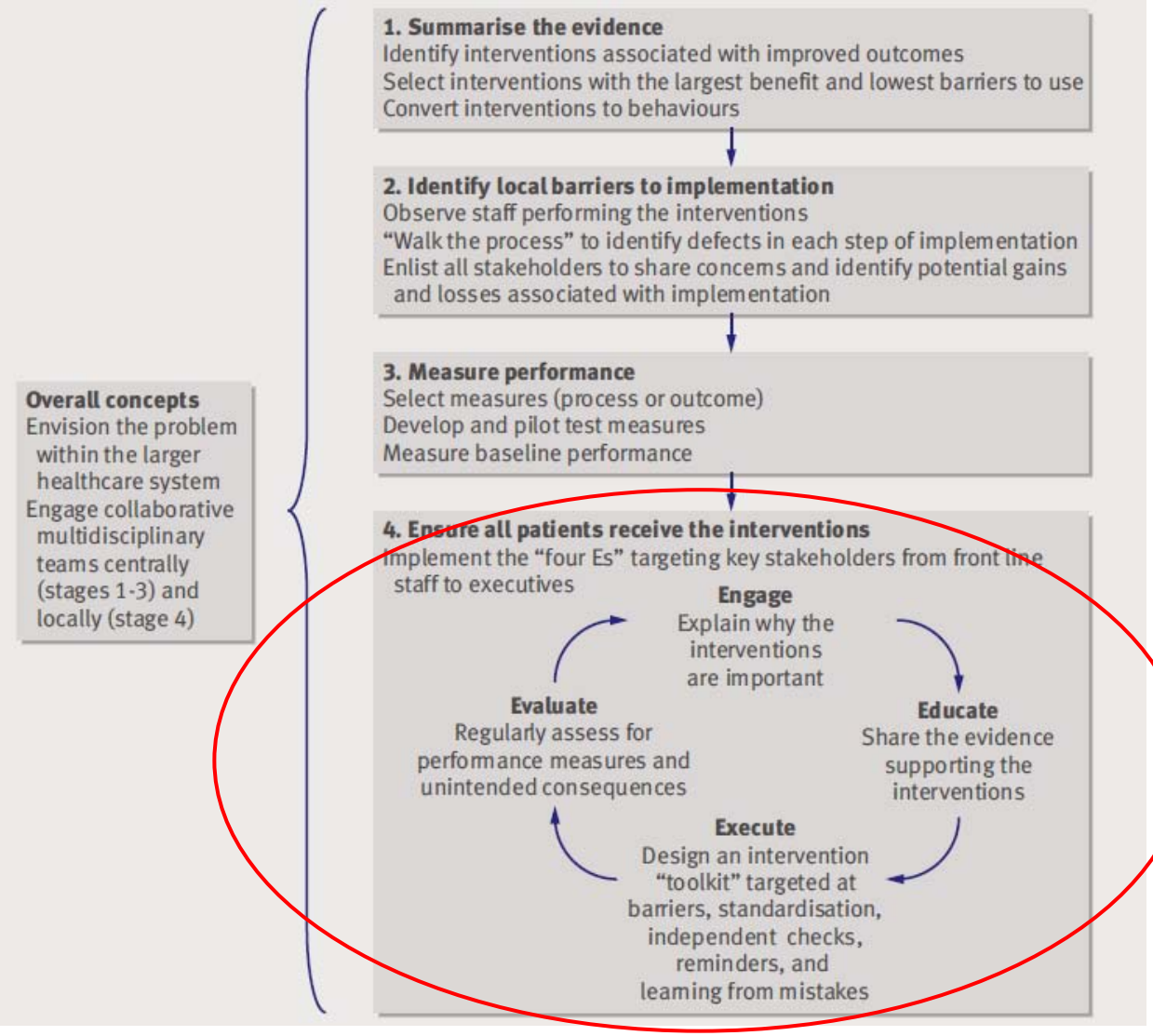
Balancing measures

- Mortality
- SSI's
- Re-admissions to hospital within 30 days of discharge
- Admissions to ICU
- Rate of complications
- Treatment related toxicity, e.g., aminoglycoside related toxicity

Performance Measures in Practice

- National CDI HEAT Target (Health, Efficiency and Access to Treatment)
- Now revised to: 0.39 cases or less per 1,000 total occupied bed days. SAPG prescribing indicators to support target.
- **Empirical prescribing**
  - **Compliant with the local antimicrobial policy and *indication recorded* in case note in ≥ 95% of sampled cases April 2011 revised to providing information and action about non-compliance**
- **Surgical antibiotic prophylaxis**
  - **Compliant with local antimicrobial prescribing policy and duration <24 hours in ≥ 95% of sampled cases**
- April 2011: Colorectal Surgery
  - ***Primary Care empirical prescribing:*** *Seasonal variation in quinolone use (winter months vs. summer months) is ≤ 5%: to remain*
  - *Potential additional "Stand Alone Target" of "best in class" reduction in items of antibiotic prescriptions*

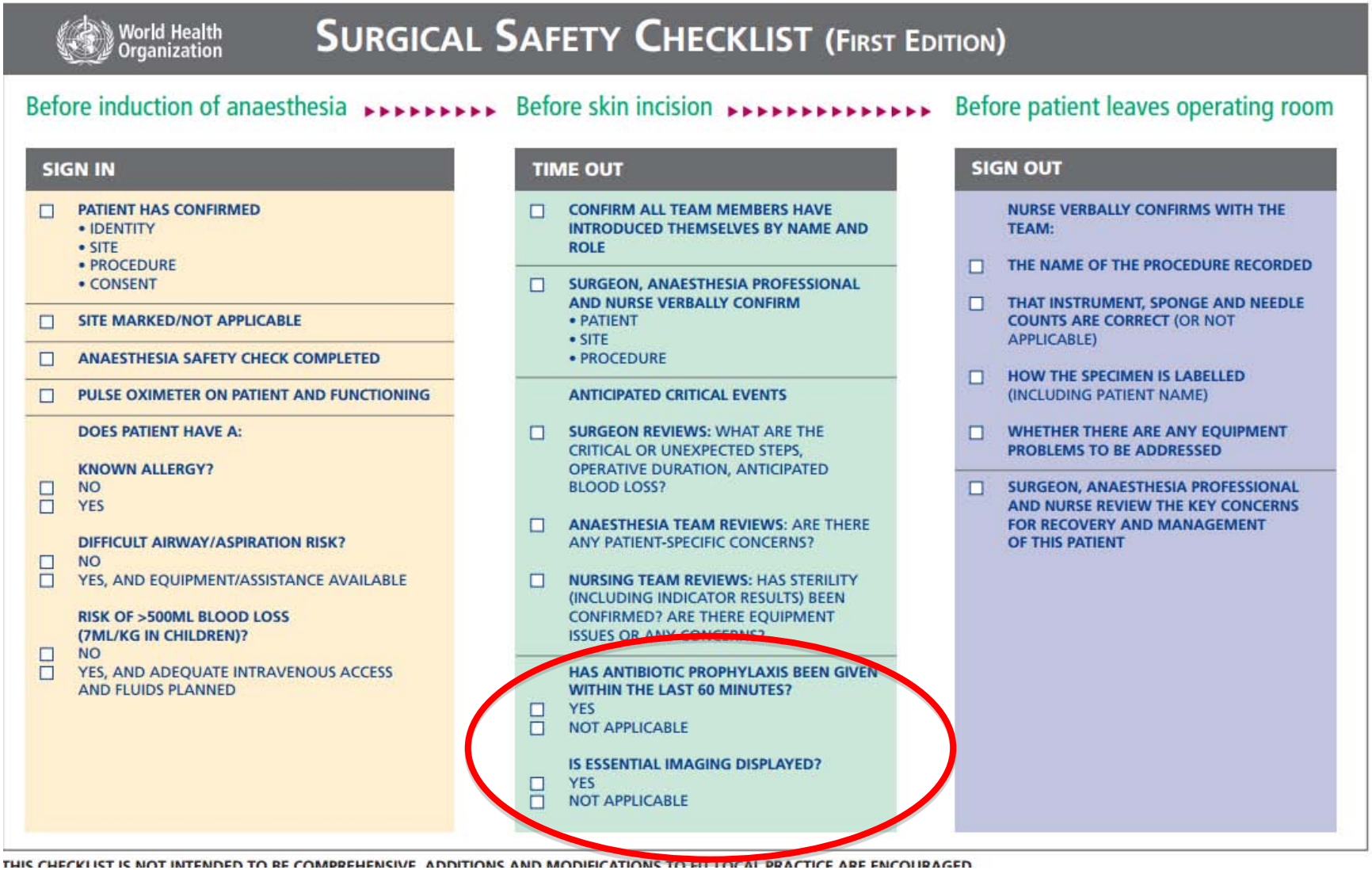
Program Implementation



Source: Pronovost P, Berenholtz S, Needham D. BMJ 2008;337:a1714

Education and Engagement

Execution: WHO Implementation Check List



World Health Organization

SURGICAL SAFETY CHECKLIST (FIRST EDITION)

Before induction of anaesthesia ▸▸▸▸▸▸▸▸▸ Before skin incision ▸▸▸▸▸▸▸▸▸▸▸▸▸ Before patient leaves operating room

SIGN IN

- ☐ PATIENT HAS CONFIRMED
  - IDENTITY
  - SITE
  - PROCEDURE
  - CONSENT
- ☐ SITE MARKED/NOT APPLICABLE
- ☐ ANAESTHESIA SAFETY CHECK COMPLETED
- ☐ PULSE OXIMETER ON PATIENT AND FUNCTIONING

DOES PATIENT HAVE A:

KNOWN ALLERGY?
- ☐ NO
- ☐ YES

DIFFICULT AIRWAY/ASPIRATION RISK?
- ☐ NO
- ☐ YES, AND EQUIPMENT/ASSISTANCE AVAILABLE

RISK OF >500ML BLOOD LOSS (7ML/KG IN CHILDREN)?
- ☐ NO
- ☐ YES, AND ADEQUATE INTRAVENOUS ACCESS AND FLUIDS PLANNED

TIME OUT

- ☐ CONFIRM ALL TEAM MEMBERS HAVE INTRODUCED THEMSELVES BY NAME AND ROLE
- ☐ SURGEON, ANAESTHESIA PROFESSIONAL AND NURSE VERBALLY CONFIRM
  - PATIENT
  - SITE
  - PROCEDURE

ANTICIPATED CRITICAL EVENTS

- ☐ SURGEON REVIEWS: WHAT ARE THE CRITICAL OR UNEXPECTED STEPS, OPERATIVE DURATION, ANTICIPATED BLOOD LOSS?
- ☐ ANAESTHESIA TEAM REVIEWS: ARE THERE ANY PATIENT-SPECIFIC CONCERNS?
- ☐ NURSING TEAM REVIEWS: HAS STERILITY (INCLUDING INDICATOR RESULTS) BEEN CONFIRMED? ARE THERE EQUIPMENT ISSUES OR ANY CONCERNS?

HAS ANTIBIOTIC PROPHYLAXIS BEEN GIVEN WITHIN THE LAST 60 MINUTES?
- ☐ YES
- ☐ NOT APPLICABLE

IS ESSENTIAL IMAGING DISPLAYED?
- ☐ YES
- ☐ NOT APPLICABLE

SIGN OUT

NURSE VERBALLY CONFIRMS WITH THE TEAM:

- ☐ THE NAME OF THE PROCEDURE RECORDED
- ☐ THAT INSTRUMENT, SPONGE AND NEEDLE COUNTS ARE CORRECT (OR NOT APPLICABLE)
- ☐ HOW THE SPECIMEN IS LABELLED (INCLUDING PATIENT NAME)
- ☐ WHETHER THERE ARE ANY EQUIPMENT PROBLEMS TO BE ADDRESSED
- ☐ SURGEON, ANAESTHESIA PROFESSIONAL AND NURSE REVIEW THE KEY CONCERNS FOR RECOVERY AND MANAGEMENT OF THIS PATIENT

THIS CHECKLIST IS NOT INTENDED TO BE COMPREHENSIVE. ADDITIONS AND MODIFICATIONS TO FIT LOCAL PRACTICE ARE ENCOURAGED

Objectives - “Hospital Focus”

- Why stewardship? Evidence of antibiotic misuse
- Goals of stewardship with evidence base to support stewardship
- Implementing stewardship
- **Measuring antibiotic use and feedback**

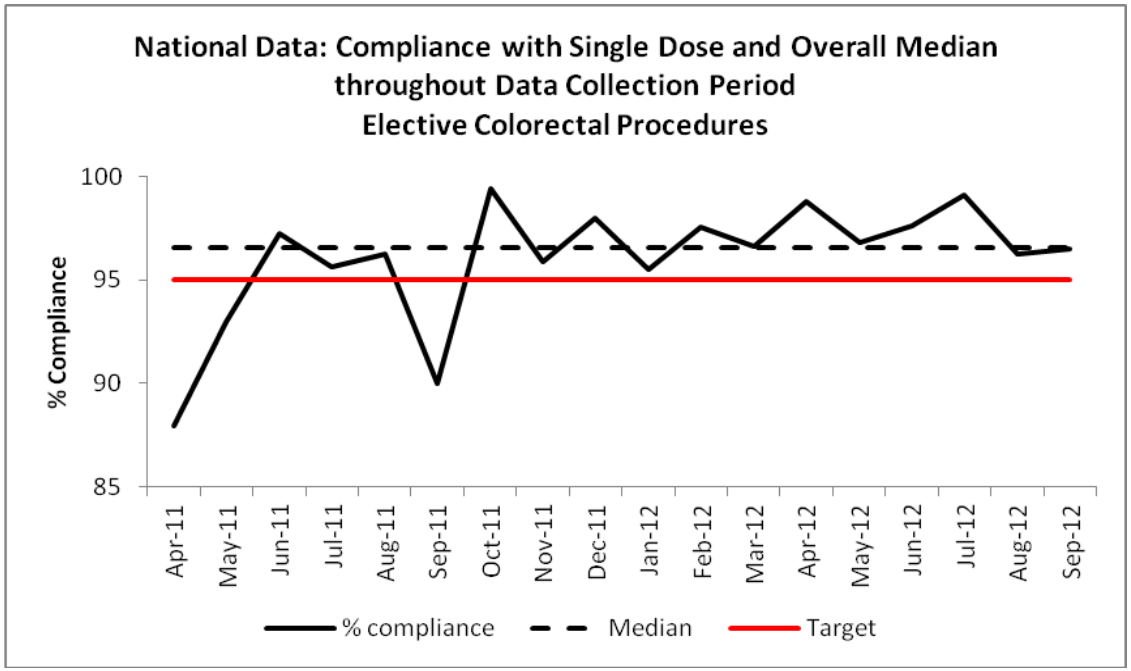
Results of Implementing Effective Surgical Prophylaxis Prescribing

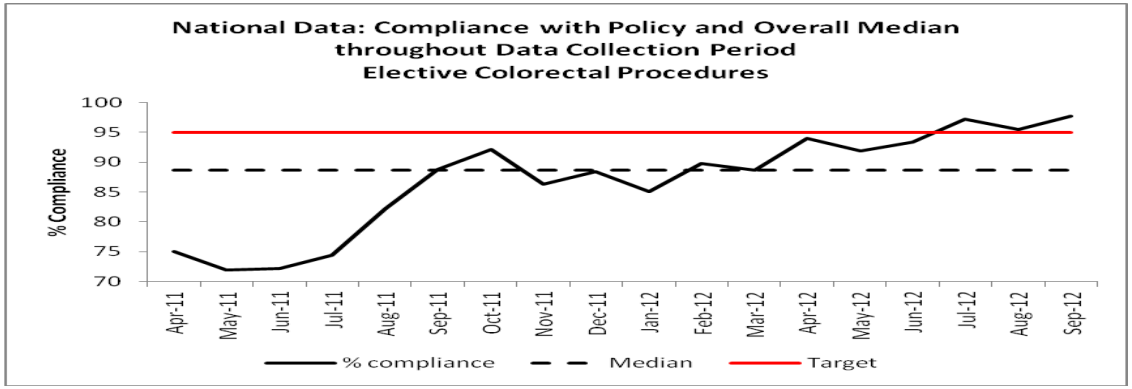
2012 Theory-based Cochrane review of Audit & Feedback

- Median 4.3% increase in compliance (IQR 0.5% to 16%)
- Audit and Feedback 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

Source: Ivers et al 2012 Courtesy of Susan Michie UCL

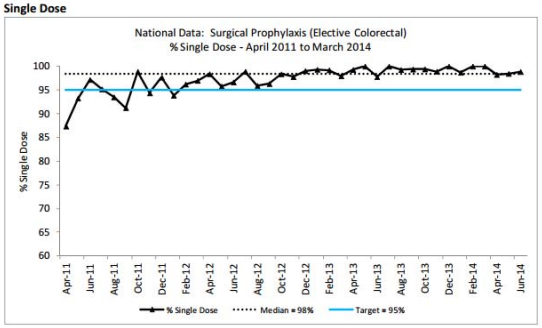
SAPG: National Hospital Surgical Prophylaxis Prescribing Indicator Target



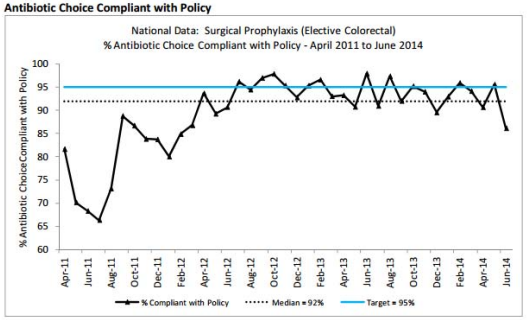


Surgical Prophylaxis Indicator
AMT National Level Report
April 2011 – June 2014

Single Dose



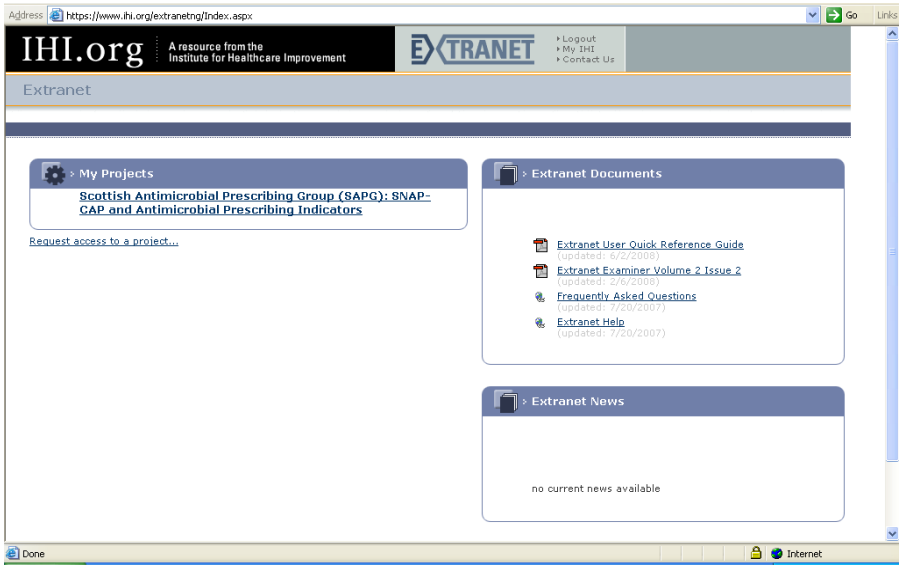
Antibiotic Choice Compliant with Policy

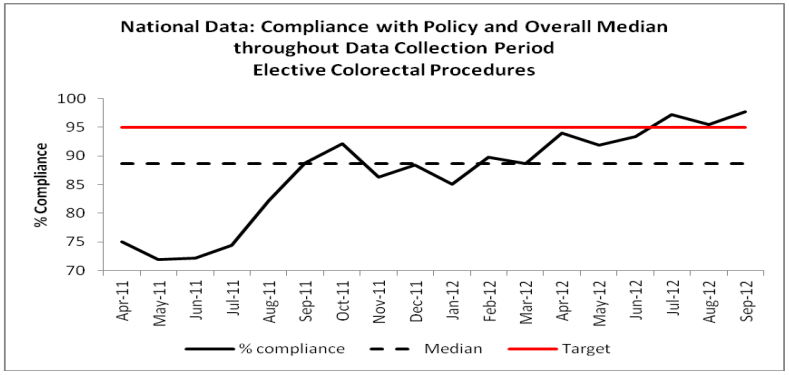


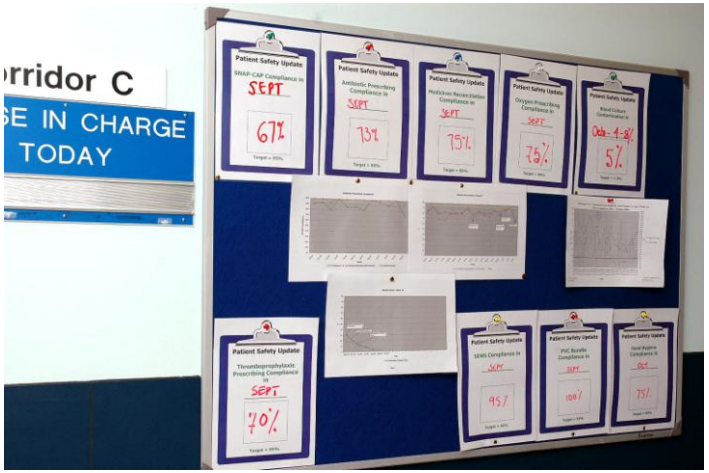
Note: non-zero y-axes

Source: Surgical Prophylaxis Indicator AMT National Level Report April 2011 – June 2014
Scottish Antimicrobial Prescribing Group (SAPG)

Feedback







ThermoFisher SCIENTIFIC

Outcome Indicators for Stewardship

Domain	Metric	Description*
Consumption	Expenditures	-Dollars spent from purchased, dispensed or administered data
	Grams	-Grams used from purchased, dispensed or administered data
	Defined Daily Doses (DDD)	-Grams used (as above) divided by WHO** approved DDD values
	Days Of Therapy (DOT)	-Number of days that patient receives at least one dose of an antibiotic summed for each antibiotic
	Length of Therapy (LOT) "treatment period"	-Number of days that patient receives therapy regardless of number of different drugs or doses
Patient Outcomes	Health care associated infections	-% of patients with infection -ASP intervention/acceptance rates
Resistance	Antibiotic resistant organisms	-% of patients with resistant organism(s) -Antibiogram

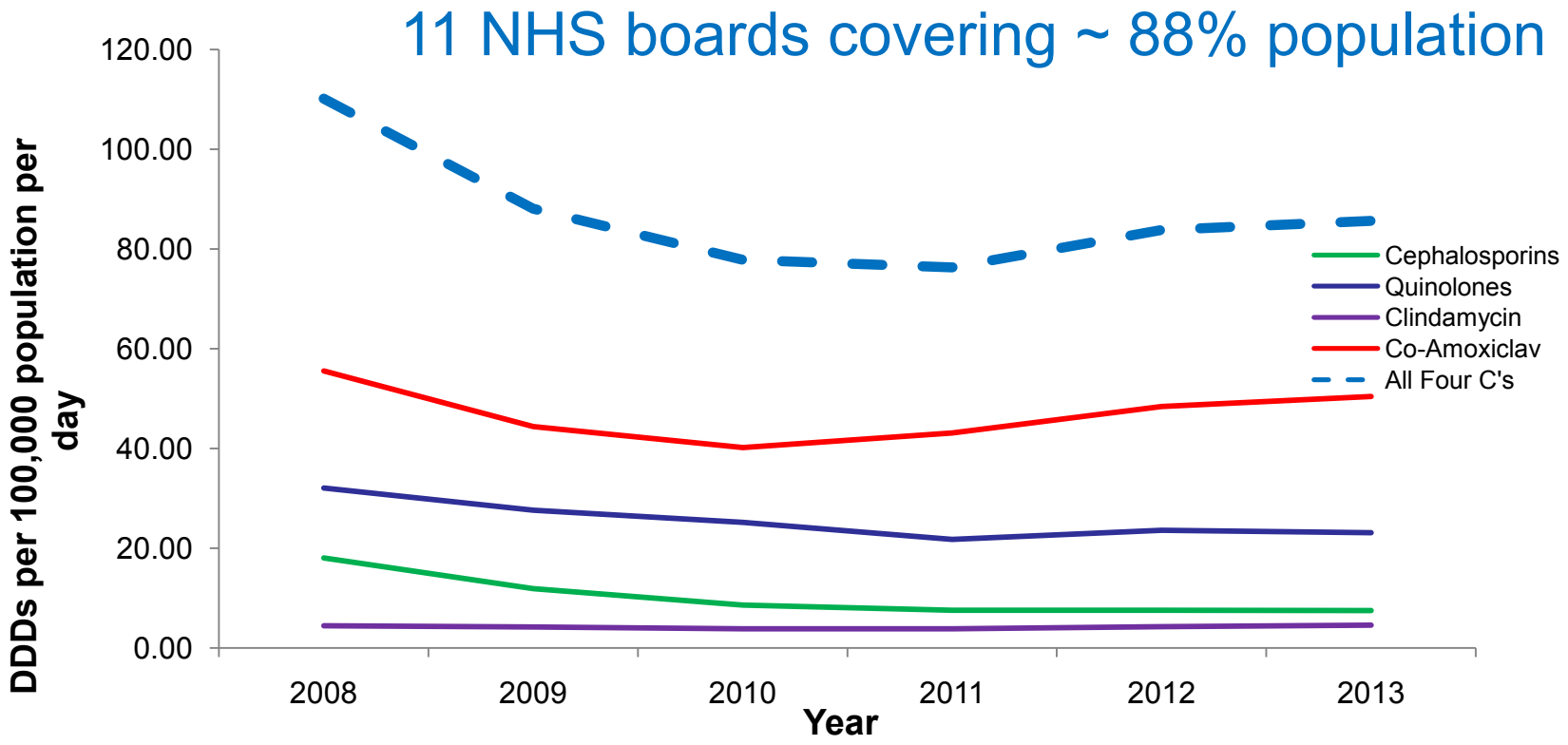
* Collected for defined population, over specified time, standardized to 100 or 1000 patient-days

** World Health Organization (see references)

Improving Process

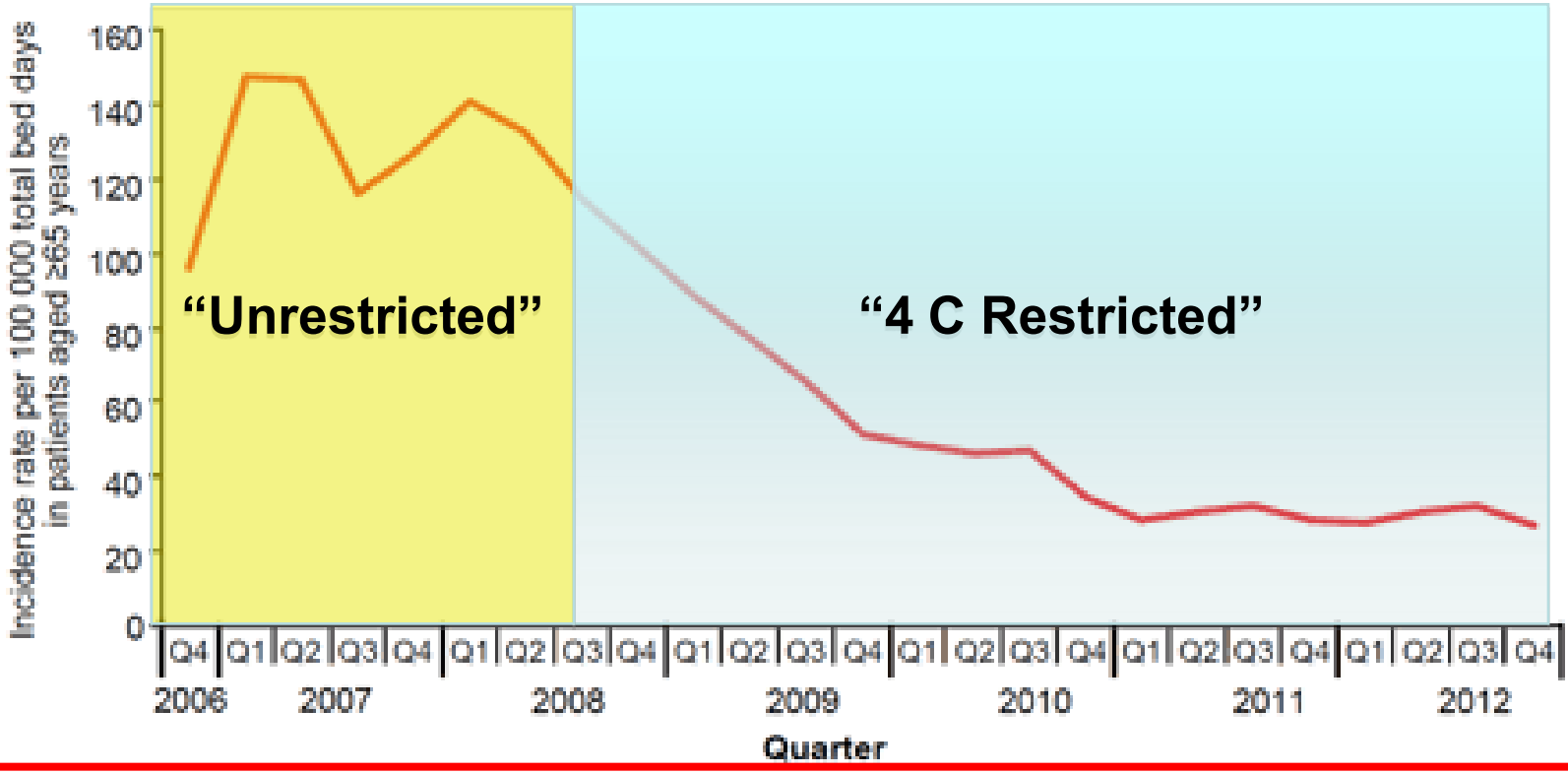
NHS Scotland: Use of 4C antibacterials in secondary care

DDD/100,000/day: 2008 - 2013



Outcomes: Antimicrobial Restriction and CDI

Changing Epidemiology: *Clostridium difficile*, Age ≥ 65 yrs



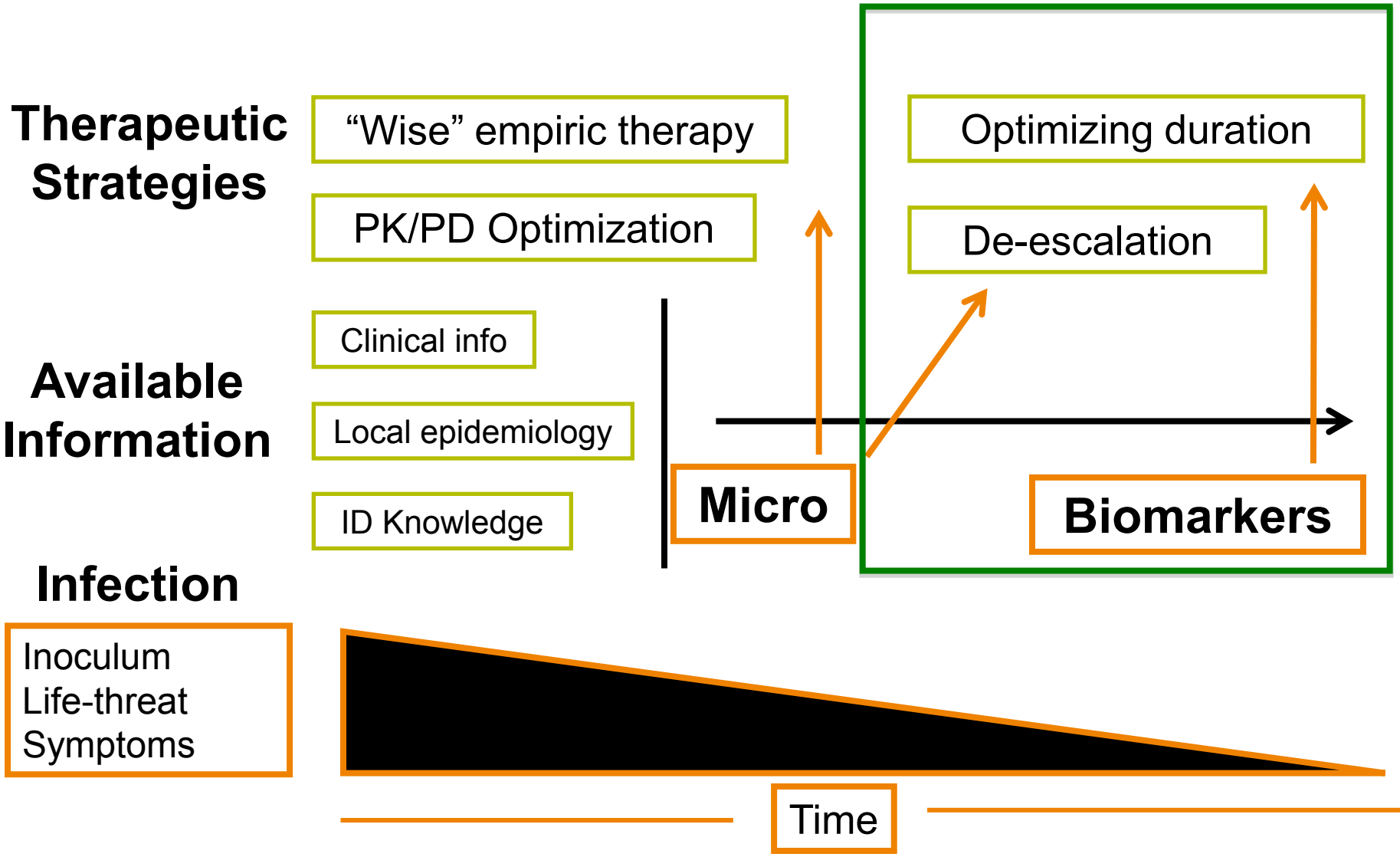
4 C = Cephalosporins, Co-amoxiclav, Ciprofloxacin (and other quinolones), Clindamycin

Source: Adapted from Health Protection Scotland, 2013

Objectives - “Hospital Focus”

- Why stewardship? Evidence of antibiotic misuse
- Goals of stewardship with evidence base to support stewardship
- Implementing stewardship
- Measuring antibiotic use and feedback
- **Diagnostics and biomarkers in stewardship**

Principles of Antimicrobial Use in Hospital



Source: Courtesy by Dr. Cobo

Impact of Optimization Strategies for Antibiotic Prescribing

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

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

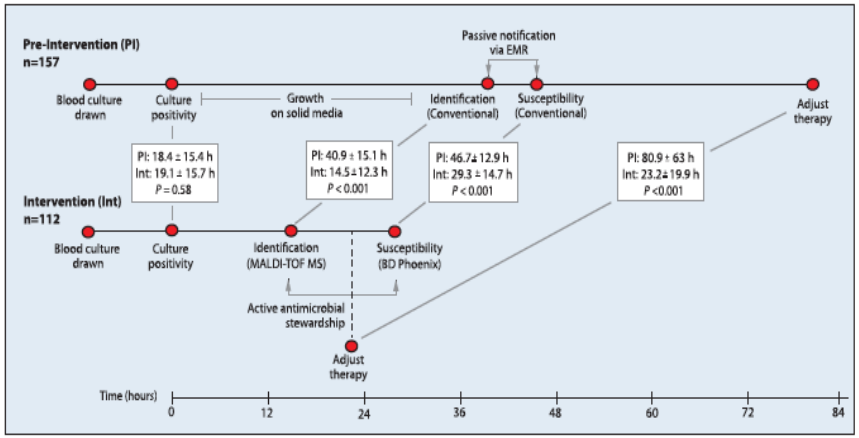


Figure 2 **Timeline comparison of pre-intervention (PI) and intervention (Int) study periods.** Adjusted therapy included, when clinically indicated, de-escalation/escalation of antibiotic therapy, dosing/route modifications, and/or discontinuation of unnecessary Gram-positive coverage. White boxes denote the average times (h) until the corresponding information was obtained or action implemented in the PI and Int groups. The bottom horizontal line represents the global study/subject timeline (h). The dotted line to "Adjust therapy" for the intervention cohort indicates that, due to the rapid species identification via MALDI-TOF MS and the real-time antimicrobial stewardship notifications, therapy was often adjusted before susceptibility data were available.

Optimization Strategies for Antibiotic Prescribing

Recommendations for starting/stopping antibiotics based on the PRORATA study.21 Adapted from Figure 1 in Bouadma et al.21.

Guidelines for starting antibiotics[a]			
If the blood sample taken for procalcitonin level was taken at the early stage of the episode, obtain a second procalcitonin level at 6–12 h			
[a]Excludes situations requiring immediate antibiotic treatment (e.g. septic shock, purulent meningitis)			
Concentration <0.25 μg/L	Concentration ≥0.25 to <0.5 μg/L	Concentration ≥0.5 to <1 μg/L	Concentration ≥1 μg/L
⇓	⇓	⇓	⇓
Antibiotics strongly discouraged	Antibiotics discouraged	Antibiotics encouraged	Antibiotics strongly encouraged
Guidelines for continuing or stopping of antibiotics			
Concentration <0.25 μg/L	Concentration decrease by ≥80% from peak OR ≥0.25 to <0.5 μg/L	Concentration decrease by <80% from peak AND ≥0.5 μg/L	Concentration increase compared with peak AND ≥0.5 μg/L
⇓	⇓	⇓	⇓
Stopping of antibiotics strongly encouraged	Stopping of antibiotics encouraged	Continuing antibiotics encouraged	Changing antibiotics strongly encouraged

Source: Kibe S et al. J. Antimicrob. Chemother. 2011;66:ii33-ii40

Antimicrobial Stewardship

Skin and Soft-Tissue Infections Requiring Hospitalization at an Academic Medical Center: Opportunities for Antimicrobial Stewardship

Timothy C. Jenkins,[1,4] Allison L. Sabel,[3,5] Ellen E. Sarcone,[2,4] Connie S. Price,[1,4] Philip S. Mehler,[2,3,4] and William J. Burman[1,4]

Results

- *S. aureus* or streptococci in 145/150 (97%) of patients with +ve culture in abscess, deep tissue or blood
- Broad spectrum Gram –ve antibiotics used in 61-80%
- Anti-anaerobic antibiotics in 73-83%

Source: Jenkins TC. Clin Infect Dis. 2010. 895-903

Intervention to Improve Therapy for Skin and Soft Tissue Infections

- Goals
  - Decrease use of broad spectrum Gram negative coverage for SSTI (particularly pip/tazo)
  - Decrease duration of therapy from baseline median of 13 days
- Approach
  - Data-driven guidelines about empiric therapy and duration of therapy
  - Dissemination of guideline via email, website, postings in nursing stations and work areas
  - Development of an admission order set
  - Educational campaign by designated key physician peer champions from ED, urgent care, medicine, surgery, orthopedic surgery
  - Audit and feedback to peer champions
  - Quarterly data regarding antibiotic use and compliance with guideline

Source: Jenkins TC. Clin Infect Dis. 2010. 895-903

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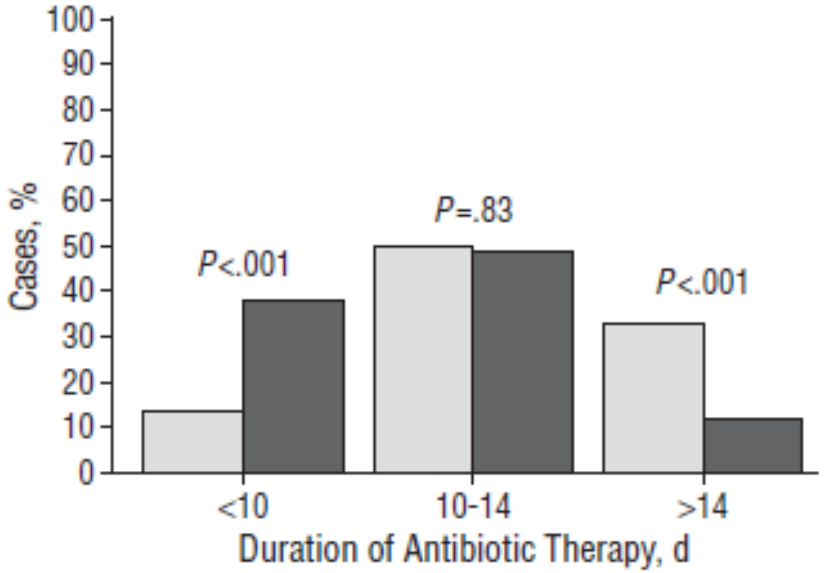

Outcome	All Cases: Baseline (n=169)	All Cases: Intervention (n=175)	P Value
Outpatient follow-up[b]	82 (49)	98 (56)	
Clinical failure	13 (7.7)	13 (7.4)	.93
Treatment failure	4 (2.4)	3 (1.7)	
Recurrence[b]	5 (3.0)	8 (4.6)	
Rehospitalization due to SSTI[b]	8 (4.7)	8 (4.6)	
Rehospitalization[b]	13 (7.7)	9 (5.1)	.33
In-hospital mortality	0	0	
Length of hospital stay, median (IQR), d	4 (3-5)	4 (3-5)	.43[d]

Source: Jenkins TC. Clin Infect Dis. 2010. 895-903

Antimicrobial Stewardship Resources

- The European Surveillance of Antimicrobial Consumption Network
- The Healthcare-Associated Infections Network
- The European Antimicrobial Resistance Surveillance Network
- Healthcare Associated Infections-Community Interface (HAIC)
- Surveillance for Healthcare-associated Infections using NHSN
- Healthcare Infection Control Practices Advisory Committee (HICPAC)
- National Institute for Health and Care Excellence (NICE)

- Learning Courses https://www.futurelearn.com/courses/antimicrobial-stewardship [in development]

Find Out More

- To learn more about Thermo Scientific™ Antimicrobial Susceptibility Testing Solutions or to request more information from one of our microbiology experts, please visit **www.thermoscientific.com/AST**

THANK YOU FOR ATTENDING!

Certificate of Attendance

Awarded to

For participation in the January 20, 2015 webinar entitled

Antimicrobial Stewardship in Hospitals:

A Patient Safety Emergency

Webinar Presenter:

Dr. Dilip Nathwani

Ninewells Hospital and Medical School, Dundee, UK

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