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Procalcitonin (PCT)

Antibiotic Stewardship implementation Guide

Part 2: Implementation

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Content

This guide is the second of a three-part series on Antibiotic Stewardship and focuses on implementation. To learn more about getting started and optimizing an Antibiotic Stewardship program in your hospital be sure to check out part one and part three in the series.

Part 1: The Importance of ABS

Part 2: Implementation

Part 3: Optimization with Biomarkers

Purpose of this booklet

Evidence from around the world shows a global decline in the effectiveness of antibiotics. Inappropriate use of antibiotics has driven the dramatic increase in resistance seen to all first-line and last-resort antibiotics. Antimicrobial resistance (AMR) has been identified by the WHO as a global healthcare threat as it limits our capacity to fight life-threatening diseases.

Antibiotic stewardship (ABS) is a key strategy used to preserve the effectiveness of antibiotics by promoting and monitoring their responsible use. If used effectively, it can help reduce and optimize the prescription of antibiotics in several healthcare settings.

This booklet serves as a practical guide to support the implementation of an ABS program within a hospital, outlining the key steps needed for successful implementation. Most of the information on ABS implementation have been adopted from recommendations and guidelines from IDSA[1], CDC[2], WHO[3], BSAC[4], and CDDEP.[5] The role of in-vitro diagnostics in an ABS program is discussed, and in particular the role of the biomarker procalcitonin (PCT) is highlighted, as the WHO recognizes the value of PCT for tertiary care facilities and above “to guide antibiotic therapy or its discontinuation in sepsis and lower respiratory tract infection”.[6]

We gratefully acknowledge the help of Dr. Broyles, Prof. Kwa and Prof. Giamarellos-Bourboulis for providing the examples for practical implementations of procalcitonin into an antibiotic stewardship program.

How to implement an antibiotic stewardship program in the hospital

2

2.1 Core elements of antibiotic stewardship programs

There is no single template for an antibiotic stewardship (ABS) program that leads to optimal antibiotic prescribing. The complex medical decision-making surrounding antibiotic use and the differences in hospital size and care means programs are expected to differ. However, effective programs can still be implemented in different types of hospitals provided there is sustained commitment to the program. Strong support and leadership and a multidisciplinary approach are pivotal to success. The Centre for Disease Control and Prevention (CDC) has listed seven core elements that provide the framework for a successful ABS program (Figure 1).

Hospital leadership commitment

Dedicate necessary human, financial, and information technology resources.

Accountability

Appoint a leader or co-leaders, such as physician and pharmacist, responsible for program management and outcomes.

Pharmacy expertise

Appoint a pharmacist, ideally as the co-leader of the stewardship program, to help lead implementation efforts to improve antibiotic use.

Action

Implement interventions, such as prospective audit and feedback or preauthorization, to improve antibiotic use.

Tracking

Monitor antibiotic prescribing, impact of interventions, and other important outcomes, like *C. difficile* infections and resistance patterns.

Reporting

Regularly report information on antibiotic use and resistance to prescribers, pharmacists, nurses, and hospital leadership.

Education

Educate prescribers, pharmacists, nurses, and patients about adverse reactions from antibiotics, antibiotic resistance, and optimal prescribing.

Figure 1. Core elements of a hospital antibiotic stewardship program (adapted from CDC. Core Elements of Hospital Antibiotic Stewardship Programs. 2019)[2]

2.2 The antibiotic stewardship toolkit

2.2.1 Elements of the antibiotic stewardship toolkit

Within the framework of an ABS program, there are multiple interventions that could improve antibiotic decision making (Figure 2). When launching an ABS program, it is recommended that the core ABS interventions are implemented initially. Once the ABS program has been successfully established, additional strategies can be added as appropriate.

Core	Additional
• **Multidisciplinary ABS team** › page 9	• **De-escalation of therapy based on culture results**
• **Guideline development** › page 10	• **Dose optimization**
• **Formulary restriction with preauthorization of named anti-infectives** › page 12	• **Intravenous (IV) to oral (PO) switch**
	• **Education** › page 11
AND/OR	• **Antimicrobial order forms**
• **Prospective audit and feedback** › page 12	• **Antimicrobial cycling**
	• **Combination antimicrobial therapy**
	• **IT to provide decision support and enhanced surveillance**
	• **Antibiograms at patient and organizational level**

Figure 2. Implementation framework of an antibiotic stewardship program (adapted from: BSAC. Antimicrobial Stewardship: From Principles to Practice – eBook 2018)[4]

2.2.2 Multidisciplinary ABS team

Although it is vital that the ABS program is rolled out hospital-wide, there needs to be a core team that is responsible and accountable for the program management and outcome. The composition of this team will depend on the resources available in an individual hospital as not every role will be available in all hospitals. Ideally, the team should comprise at least one infectious disease physician, a clinical microbiologist, and a clinical pharmacist (Figure 3).

Team members should have clearly defined roles and responsibilities and receive adequate training and resources to allow them to fulfil their duties. **The multi-disciplinary team is responsible for the development of local guidelines, implementation of core interventions, and education of all hospital staff.**

On a day-to-day basis, the ABS team will:[4]

- **Consult** on individual patient management at the request of clinicians
- **Review prescriptions** for antimicrobial therapy
- **Advice on the optimization** of antimicrobial therapy
- **Promote conversion** from intravenous (IV) medication to oral (PO) options
- **Educate** through formal teaching sessions or ad hoc education on ward rounds

Core team	Optional members
• Infectious disease physician	• Epidemiologist
• Clinical microbiologist	• Infection control specialist
• Clinical pharmacist	• IT resources

Figure 3. Members of an ABS team (adapted from BSAC. Antimicrobial Stewardship: From Principles to Practice – eBook 2018)[4]

2.2.3 Local guideline development

The development of local treatment guidelines is a good way for the ABS program to engage prescriber stakeholders and encourage them to develop consensus on antibiotic use. Local guidelines provide instructions on the application and minimum duration of antibiotic therapy, and should:

- **Provide clear recommendations for optimal antibiotic use** that are hospital-specific and based on national guidelines
- **Reflect hospital treatment preferences** based on local susceptibility, formulary options, and patient population
- **Optimize antibiotic selection and duration for common indications** like CAP, UTI, IAI, skin and soft-tissue infection and surgical prophylaxis
- **Include diagnostic approaches (if possible)** such as when to send diagnostic samples and what tests to perform, including indications for rapid-diagnostics and non-microbiologic tests (e.g. imaging, procalcitonin)

Figure 4. Local guidelines (adapted from: CDC. Core Elements of Hospital Antibiotic Stewardship Programs 2019)[2]

CAP Community-acquired pneumonia **UTI** Urinary tract infection **IAI** Intra-abdominal infection

2.2.4 Education

As part of a successful ABS program, the general public, patients, as well as healthcare staff should be educated on antibiotic resistance, potential adverse reactions from antibiotics, and optimal prescribing. In addition, all healthcare staff should be educated to demonstrate competency in the following:

- **Infection prevention and control**
- **Antimicrobial resistance and antimicrobials**
- **Prescribing of antimicrobials and antibiotic stewardship**
- **Monitoring and learning: continued professional development in antibiotic prescribing and stewardship**

Figure 5. ABS program education for healthcare staff (adapted from Public Health England, Antimicrobial prescribing and stewardship competencies, Online October 2013)[18]

2.2.5 Preauthorization and restriction or prospective audit and feedback

The two most effective ABS strategies are preauthorization of restricted antimicrobial agents and prospective audit and feedback (Figures 6 and 7). It is recommended that organizations choose to implement either one or a combination of both strategies depending on the hospital setting.

The primary advantage of prospective audit and feedback is that doctors do not lose prescribing autonomy due to the voluntary nature of the strategy, however, it can be very labor-intensive and expensive. An example of the prospective audit and feedback algorithm is shown in Figure 8.

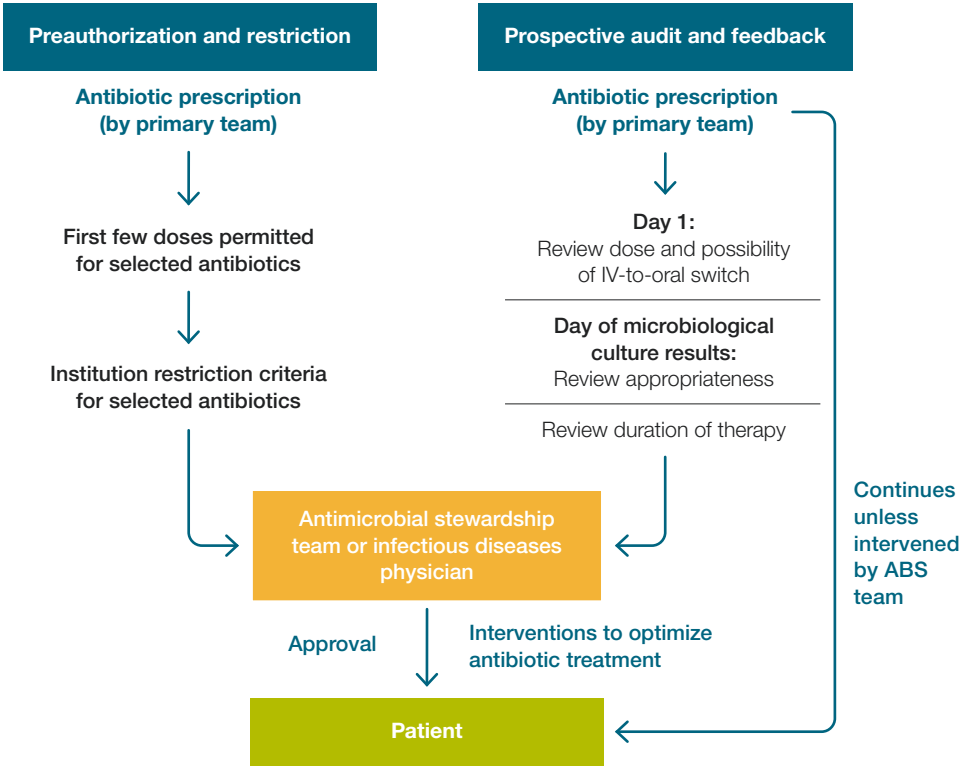

Figure 6. The two most effective antibiotic stewardship strategies: preauthorization and restriction vs. prospective audit and feedback (adapted from Chung GW et al., Virulence 2013)[19]

List of interventions considered as part of antimicrobial stewardship

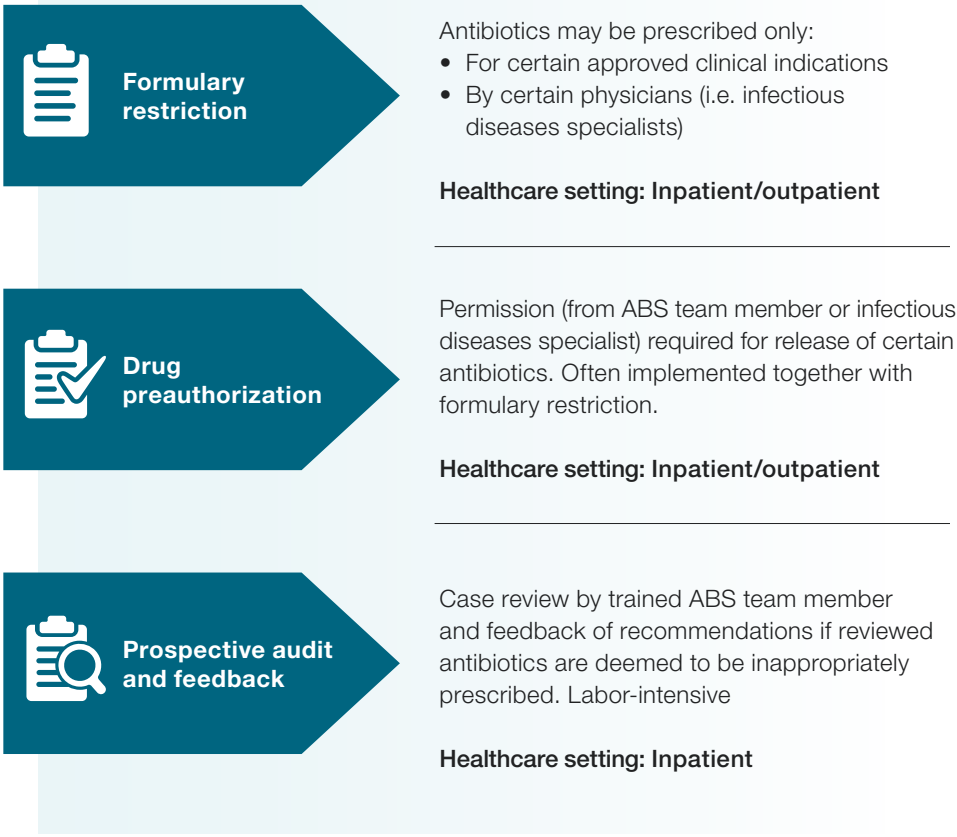

Figure 7. Description of interventions considered as part of antimicrobial stewardship (adapted from Chung GW et al., Virulence 2013)[19]

Audit-intervention-concurrent feedback

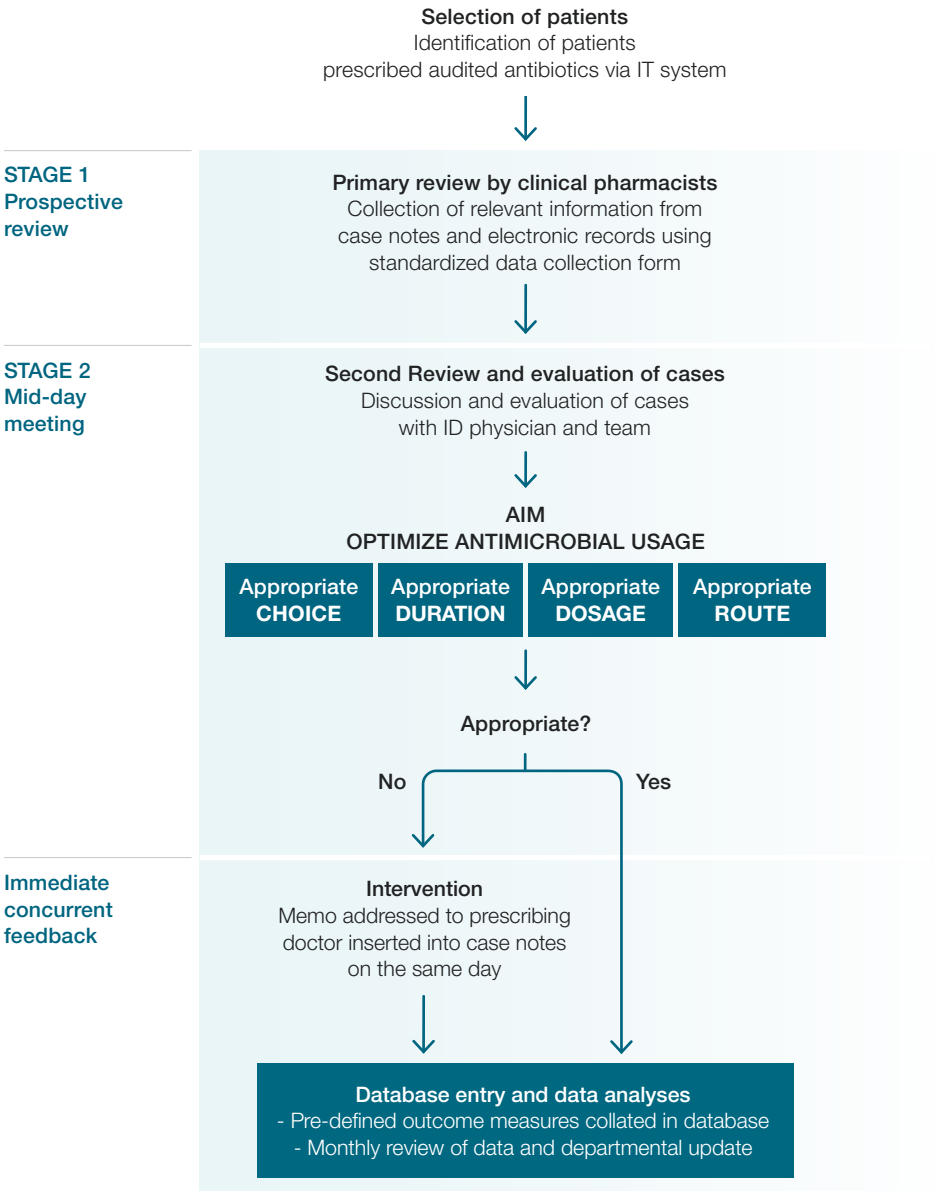

Figure 8. An example of a prospective audit and feedback algorithm (adapted from Loo LW et al., International Journal of Antimicrobial Agents 2019)[20]

2.3 Key measures of improvement

It is important to assess the impact of the stewardship intervention on clinical practice and outcomes. The ABS team must set clearly defined aims and objectives for their chosen areas of improvement and establish a clear plan of action how these goals will be achieved. Only by measuring the improvement indicators will the ABS team know whether the implemented measures have been effective.

- **Antibiotic use measures:** monitor and benchmark antibiotic use through standardized output, e.g. days of therapy (DOT), standardized antimicrobial administration ratio (SAAR) or defined daily doses (DDD)
- **Outcome measures** like *C. difficile* infections, antibiotic resistance or financial impact
- **Process measures** like tracking type and acceptance of recommended interventions, monitoring adherence to facility specific guidelines or the intravenous (IV) to oral (PO) ratio (IV/PO ratio)

Figure 9. Tracking key measures of improvement (adapted from: CDC. Core Elements of Hospital Antibiotic Stewardship Programs 2019)[2]

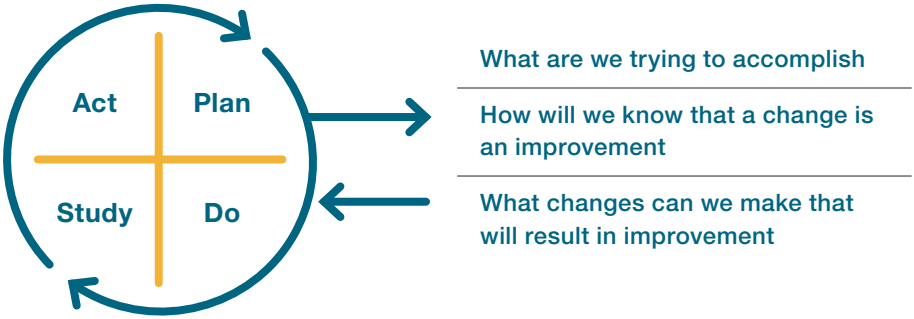

Figure 10. Using the Plan, Do, Study, Act framework for effective implementation (adapted from https://improvement.nhs.uk/documents/2142/plan-do-study-act.pdf)[21]

2.4 Key messages

An ABS program can be successfully implemented in any hospital as long as there is a **determined multidisciplinary core team** available that is empowered by the hospital leadership, with dedicated human, financial and IT resources.

Core tasks of the multidisciplinary team include the development of local guidelines, implementation of an antimicrobial prescribing method, e.g. preauthorization of restricted antimicrobial agents and/or prospective audit and feedback, and education of all hospital staff.

The impact of the ABS interventions on clinical practice should demonstrate benefits for patients (Figure 11).

Top Tips
for a Successful ABS Program

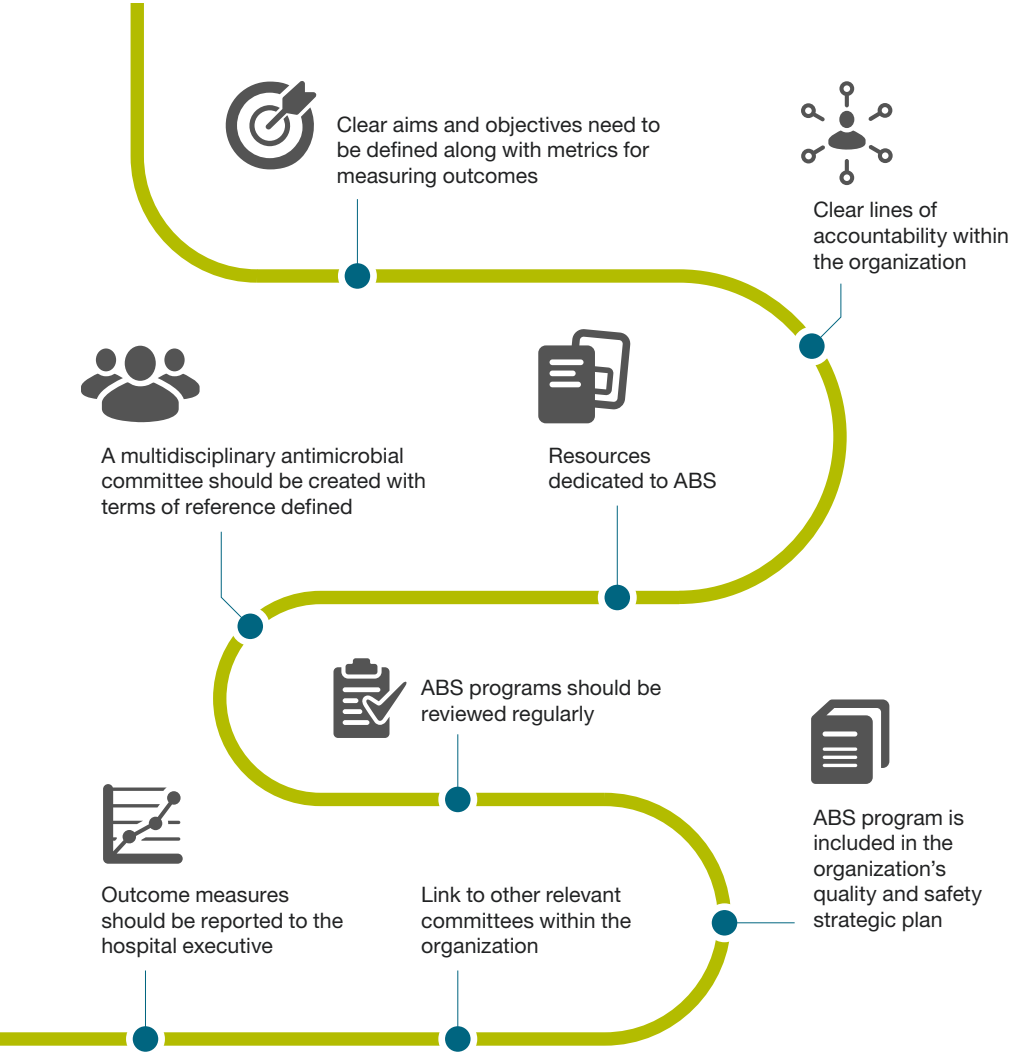

Figure 11. Top tips for a successful ABS program (adapted from: BSAC. Antibiotic stewardship from principles to practice – eBook 2018)[4]

References

Please note, this guide is part two in a three-part series. The references below are a culmination of the references for all three guides in the series.

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Want to learn more?

Find out more on ABS

BSAC https://bsac.org.uk/education/
CDC https://www.cdc.gov/antibiotic-use/healthcare/evidence.html
IDSA https://academy.idsociety.org/course-catalog-table?f%255B0%255D=field_course_format%3A19&f%5B0%5D=field_course_format%3A19
WHO https://www.who.int/activities/raising-awareness-and-educating-on-antimicrobial-resistance

Find out more on hospital ABS programs

CDC https://www.cdc.gov/antibiotic-use/training

Find out more on local resistance

CDDEP https://resistancemap.cddep.org/

Find out more on antimicrobial prescribing guidelines

NICE https://www.nice.org.uk/guidance/health-protection/communicable-diseases/antimicrobial-stewardship

Find out more on infection prevention and control

ECDC https://www.ecdc.europa.eu/en/publications-data/directory-guidance-prevention-and-control/training/training-courses-infection

Find out more on the use of procalcitonin in ABS

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