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Mini Review

Antibiotic Use Bundle

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Abstract

Bacterial resistance is a worldwide phenomenon. Being partly man-made, it is probably the most dangerous pandemic affecting every country and all walks of life. The formulation of antibiotic policies has been one of many strategies tried, most of which have been unfortunately unsuccessful. To ensure control of this multifactorial problem, a number of steps need to be taken simultaneously. The concept of care bundle to tackle important healthcare problems have recently gained ground. It was originally developed by Institute of Healthcare Improvement, USA and Refined by Health Protection Agency, NHS, Scotland. As apparent by previous scientific evidence a bundle is a set of three to five practices which need to be carried out collectively, reliably, and continuously resulting in improved patient outcomes. The implementation of care bundle is monitored on all or none basis and regular feedback is provided to the team to help in continuous improvement in level of healthcare delivery.

Keywords: Bacterial Resistance; Healthcare; Antibiotic

Bacterial resistance is a worldwide concern. At least one third of antibiotic prescribed in hospitals are either unnecessary or inappropriate and such misuse is a main driver for development of resistance [1]. One obvious example is the prescription of antimicrobial agents for upper respiratory infections while it is well known that about 90% cases are of viral origin and self-limiting [2].

Although increasing bacterial resistance to antimicrobials has several causes, two key features include overuse and misuse of antibiotics. Antibiotics are prescribed for indications in which their use in not warranted or an incorrect or suboptimal antibiotic is prescribed. The council for appropriate and rational antibiotic therapy (CARAT) has developed five criteria to assist healthcare providers in selecting the most appropriate and accurate treatment regimen. This consists of 1. Evidence based results, 2. Therapeutic benefits, 3. Safety, 4. Cost effectiveness and 5. Optimal drug dose and duration [3].

However, there is now convincing evidence that timely selection and administration of appropriate antimicrobial therapy can significantly impact treatment outcomes, especially in patients with severe or life-threatening infections [4]. In an effort to optimize antimicrobial therapy while reducing treatment related costs, minimize adverse events and decrease risk of development of antimicrobial resistance, antimicrobial stewardship program has been proposed and implemented [5,6].

Antimicrobial stewardship guidelines identify two cores proactive activity-based strategies to promote prudent use of antibiotics:

- Formulation restriction and preauthorization and
- Prospective audit with intervention and feedback.

The efficiency of ASP has been measured by antimicrobial costs, resistant trends, days of therapy (DOTs) and defined daily doses (DDDs). All of these have their own limitations and no single measure provides a complete picture of the potential effect of ASP.

Clinicians have been carrying out sequential management steps for numerous conditions for years, some of these steps have been formerly collated together as protocols. Nevertheless, compliance has always been a challenge. The concept of a bundle has been developed to act as a cohesive unit to ensure all steps of care are reliably delivered and adequately documented. This approach reduces unwarranted clinical variation, prevents avoidable morbidity and results in reduced length of hospital stay and improved patient outcome.

Care bundles consist of a group of key evidence-based actions instituted over a specific timeframe. They are distilled from scientific evidence and ideally should consist of between 3 to 5 elements whose compliance can be monitored in a yes or no format. All elements of the care bundle need to be implemented for compliance and rapid feedback provided to caregiver. Care bundles are a practical method of taking policies and guidelines right to the bedside of the patients rather than confining them to the realm of committee and multidisciplinary teams.

All elements of the care bundle are crucial, if one element is left out, the process is likely to fail. They are a grouping of best practices with respect to disease process that individually improve care, yet when applied together result in substantial greater improvement. The science behind the care bundle should be established enough that it should be considered standard of care and bundle elements should be dichotomous so that compliance can be measured as yes or no at the same time and space. In addition, the care bundle would also avoid the piecemeal application of proven therapies in favor of an "all or none" approach.

The application of the care bundle relies upon a mixture of cognitive (education), administrative (recording), and behavioral (feedback of results) methods. These are then used to achieve quality improvement in healthcare delivery.

The care bundle approach has been well established as a method to optimize process delivery in healthcare, as endorsed by the Institute for Healthcare Improvement "100,000 Lives Campaign" in the USA and the Department of Health "Saving Lives" program in the UK. The following Care bundles already exist in critical care settings:

- Central vascular catheter maintenance bundle
- Catheter associated urinary tract infection care bundle
- Peripheral vascular catheter care bundle
- Surgical site infection prevention bundle
- *Clostridium difficile* infection care
- VAP bundle
- Severe sepsis resuscitation bundle (6 hours)
- Severe sepsis management bundle (24 hours)
- Maintenance bundle for use in the community.

It has been demonstrated that noncompliance with the 6-hour sepsis bundle was associated with a greater than two-fold increase in hospital morbidity. Noncompliance with 24-hour sepsis bundle resulted in 76% increase in risk for hospital death. There is also evidence that compliance with CARTI care bundle lead to zero infection in ICU and in VAP [7].

The following antimicrobial care bundle elements for antibiotic use in acute care hospitals have been proposed:

Initiation bundle [8]**:**

- Clinical rationale for antibiotic initiation is documented
- Collect and submit sample material for smears and cultures to the laboratory
- A suitable antibiotic selected in accordance with local policy and risk class
- Antibiotic ordered as per plan (name, dose, route, frequency and tentative duration)
- Removal of foreign body or ID, as appropriate, is considered.

Day 3 bundle [3]**:**

- Was an antibiotic plan documented (name, dose, route, frequency and planned duration?)
- Review of diagnosis after lab reports?
- If positive microbiology results, was there any adaptation: streamlining or discontinuation
- Was IV → oral switch considered and implemented
- Were all four above mentioned steps followed?

For surgical prophylaxis [8]:

- The chosen agent is in line with local guidelines for the operational and for the patient
- Timing of first dose in 30 min to 1 hour before incision
- Stop antibiotic by 24 hours after the pre operative dose.

Operationalization of antibiotic bundle

Templates need to be created and used to make entering the information easy for the prescriber figure 1, it is assumed that a hospital antibiotic policy has already been developed and available for use. To start with, the responsibility of monitoring and reviewing antimicrobial prescription needs to be delegated to either one person (pharmacologist/pharmacist) or a team consisting of a pharmacologist/pharmacist and microbiologist with active support from infection control (infection prevention) nurse, data needs to be entered daily figure 2,3,4,5. To detect 20% increase in compliance with care bundle using a beta of 0.2 and an alpha of 0.05, at least 85 antibiotic orders must be reviewed. The job description of the antimicrobial bundle team or officer must include daily review of all patients' culture and antimicrobial therapy. After in depth reviews and comparisons with existing local antimicrobial policy, changes should be suggested if required, directly to the medical team. Institutes should be required to organize and participate in at least a weekly in-service program focused on its own antibiogram.

Fortis Hospital
Antimicrobial Use Bundle Data Collection Form (Summary)

Audit Date	Adm Date	Consultant Team		Specialty Med / Surg / HDU / Paeds
Hospital No	Audit No	Age: Yr / Mth	Gender M / F	Ward

Antimicrobial	Dose	Freq	Route	Valid period	Diagnosis / Site of infection	Indication code*

*Indication codes A = Community Acquired C= Surgical Prophylaxis D = Medical Prophylaxis
B = Hospital Acquired (B1 = Post operative, B2 = Indwelling device related, B3 = *C.difficile*, B4 = Other infection, B5 = From Other Hospital)

Figure 1

Fortis Hospital
Antimicrobial Use Bundle Data Collection Form: Initiation

	Care Bundle Element	Evident Yes / No	Comments
1	Clinical signs of infection documented in medical notes		
2	Appropriate clinical specimens sent to microbiology / blood samples requested		
3	Antimicrobial prescription in accordance with local guidelines and appropriate for individual patient		
4	Antibiotic plan documented ?		
5	Foreign body removed or pus drained, as appropriate		
	Total no. care bundle elements evident		% Compliance

Figure 2

Fortis Hospital
Antimicrobial Use Plan

Antibiotic plan	Agent:	Route of administration:
Dosage:	Dosing interval:	Planned total duration: days
If the patient receives iv antibiotic, is an **oral switch** possible? □ Yes □ No □ Not applicable (not on iv)	Give the reason for that choice:	

Figure 3

Fortis Hospital
Antimicrobial Use Bundle Data Collection Form: Day 3

	Care Bundle Element	Evident Yes / No	Comments
1	Was an antibiotic plan documented (name, dose, route, frequency & planned duration ?)		
2	Review of diagnosis after lab reports ?		
3	If positive microbiology results, was there any adaptation : streamlining or discontinuation		
4	Was IV -> oral switch considered & implemented		
5	Were all four above mentioned steps followed ?		
	Total no. care bundle elements evident		% Compliance

Figure 4

Fortis Hospital
Antimicrobial Use Bundle Data Collection Form (Prophylaxis)

	Care Bundle Element	Evident Yes / No	Comments		
1	Antimicrobial prescription in accordance with local guidelines and appropriate for individual patient				
2	First dose administered 30- 60 mins prior to incision				
3	Duration in accordance with local guidelines (also tick one box in right-hand column)		Single Dose	24h	>24h
	Total no. care bundle elements evident		% Compliance		

Figure 5

The following information should be collected:

- Patient demographic
- Infection characteristics,
- Antimicrobial therapy
- Patient outcome: length of stay and eradication of pathogen.

Quality indicators to be monitored and shared with care givers: 1. documentation of treatment rationale, 2. collection and submission

of relevant samples for culture, 3. appropriate empirical selection of antimicrobial according to institutional guidelines, 4. Antibiotic plan (which should indicate name of antibiotic chosen, dose, route, frequency and planned duration) and 5. Appropriate de-escalation.

Toth [9] from Michigan, USA reported on implementation of this antimicrobial care bundle in a 903-bed tertiary care institute. During the retrospective control phase (September through November 2007) there was no ASP pharmacist involved subsequently during the intervention phase (February through April 2008) a pharmacist performed prospective audit and provided feedback. A total of 160 patients (80 in control and 80 in intervention groups) and 442 antibiotic orders were evaluated. In the intervention phase, 168 interventions were made with an acceptance rate of 91%. Following implementation of the ASP, compliance with the care bundle improved. Prescriber documentation of the indication for therapy improved from 95% to 100%, de-escalation improved from 72% to 90% and compliance with all quality indicators rose from 16% to 54%, with daily prospective audit and feedback provided by the ASP team. Between control and intervention groups, there was no statistically significant difference in the mortality rate or length of stay; pathogen eradication improved from 90% to 98%. As a result of the intervention, the median duration of therapy was reduced from eight to six days.

However, Fleet [10] from Lewisham Hospital, NHS Trust, reported that in their hospital the bundle was found to be complex and frequently attracted non-applicable as the response, they subsequently proposed two simpler bundles

The antimicrobial initiation bundle suggested by Fleet has the following components:

- Two relevant clinical signs of infections are documented in the medical notes
- working diagnosis including severity of infection is documented
- Appropriate clinical specimen sent for microscopy, culture and susceptibility before starting antimicrobial therapy.
- Antimicrobial is selected according to local guidelines and is appropriate for individual patient
- First dose of antimicrobial administered within 4 hours of prescription.

The 48-hour review care bundle has the following elements:

- Diagnosis confirmed by consultant and clinical indication for antimicrobial recorded
- Microbiology results checked and initial choice of antimicrobial reviewed regarding possible de-escalation or stopping therapy.
- Route of administration reviewed and possibility of IV to oral switch evaluated
- Dose and frequency reviewed in relation to clinical progress and laboratory findings including renal functions and therapeutic drug monitoring results.
- Duration and treatment or next review data recorded on drug chart and end point documented.

Fleet reports that clinicians found its application easy and compliance rose from previously 50% to over 80%. The proposed bundles thus provided a simple, reproducible measure of quality of antibiotic management and have been incorporated in the "Principles of antibiotic management" published by the hospital.

While interventions targeting the point of prescription may have a limited impact because of the usual empirical nature of this prescription, formal reassessment of antibiotic therapy after two to four days. When the clinical evolution and microbiological results are available, it may lead to modifications of the prescription and might contribute to more appropriate use of antibiotics.

Manuel., *et al*. (2010) [11] estimated the impact of a standardized review of intravenous antibiotic therapy three days after prescription in two internal medicine wards of a university hospital in Switzerland. In one ward, they assessed the charts of patients under intravenous antibiotic therapy using a standardized review process and provided feedback to the prescriber. There was no intervention in the other ward. The allocation was crossed after six months between the two wards. There were 204 courses of antibiotic therapy included in the intervention period and 226 in the control period. An antibiotic course review resulted in a recommendation for modification in 46% of cases. Time to treatment modification was 22% shorter in the intervention periods compared with the control periods (3.9 + 5.2 days vs 5.0 + 6.0 days, P = 0.007). Compared to the control group, patients in the intervention group consumed fewer antibiotics, but the intervention did not significantly change the overall antibiotic consumption of the two hospitals.

Antimicrobial care bundles are presently a work in progress and as more hospitals use it and provide inputs, there is bound to be revision and refinement, but it should be considered as a step in the right direction of taking policies from the realm of board room to bedside of the patients and addressing the question about appropriate use of antibiotics (as per Antibiotic Use Policy) and the emergence and spread of drug resistance.

Bibliography

1. Pulcini C., *et al*. "Design of a "day 3 bundle" to improve the reassessment of inpatient empirical antibiotic prescriptions". *Journal of Antimicrobial Chemotherapy* 61 (2008): 1384-1388.

2. Jing Li., *et al*. "A systemic review of antibiotic prescription associated with upper respiratory tract infections in China". *Medicine* (Baltimore) May 95.19 (2016): e3587-3598.

3. Slama TG., *et al*. "A clinician's guide to the appropriate and accurate use of antibiotics: the council for appropriate and rational antibiotic therapy (carat) criteria". *American Journal of Medicine* 118 (2005): 1S-6S.

4. Kollef KE., *et al*. "Predictors of 30 days mortality and hospital costs in patients with ventilator associated pneumonia attributed to potentially antibiotic resistant gram-negative bacteria". *Chest* 134.2 (2008): 281-287.

5. Owens RC. "Antimicrobial stewardship: concepts and strategies in the 21st century". *Diagnostic Microbiology and Infectious Disease* 61 (2008): 110-128.

6. Drew RH. "Antimicrobial stewardship programs: how to start and steer a successful program". *Journal of Managed Care and Specialty Pharmacy* 15 (2009): S18-S23.

7. Gao F., *et al*. "The impact of compliance with 6 hours and 24 hours sepsis bundles on hospital mortality in patients with severe sepsis: a prospective observational study". *Critical Care* 9 (2005): R 764-770.

8. Cooke FJ and Holmes AH. "The missing care bundle: antibiotic prescribing in hospitals". *International Journal of Antimicrobial Agents* 30 (2007): 25-29.

9. Toth NR., *et al*. "Implementation of a care bundle for antimicrobial stewardship". *American Journal of Health-System Pharmacy* 67 (2010): 746-749.

10. Fleet L. "Development of antimicrobial prescribing bundles to monitor quality of antimicrobial management". The Lewisham Hospital NHS Trust July (2010).

11. Manuel O., *et al*. "Impact of standardized review of intravenous antibiotic therapy 72 hours after prescription in two internal medicine wards". *Journal of Hospital Infection* 74 (2010): 326-331.