



INTERNATIONAL
SOCIETY
FOR INFECTIOUS
DISEASES

GUIDE TO INFECTION CONTROL IN THE HOSPITAL

CHAPTER 16:

Bundles in Infection Prevention and Safety

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KEY ISSUES

Care “bundles” are simple sets of evidence-based practices that, when implemented collectively, improve the reliability of their delivery and improve patient outcomes.¹ A number of specific bundles are available that can be implemented at healthcare facilities in resource-limited settings. These packages of care contribute to infection prevention, reduce unnecessary antibiotic prescribing, and may limit the development of antibiotic resistance in healthcare facilities.

KNOWN FACTS

General principles

- The implementation of care bundles can assist in enhancing compliance to evidence-based quality process measures to improve patient care.
- Care bundles include a set of evidence-based measures (where possible, level 1, randomized controlled trial evidence) that when implemented together have shown to produce better outcomes and have a greater impact than that of the isolated implementation of individual measures.²
- Bundles also help to create reliable and consistent care systems in hospital settings since they are simple (three to five elements), clear, and concise.²
- In addition to creating safer patient care environments, the implementation of bundles also promotes multi-disciplinary collaboration, since they should be developed collaboratively and consensus obtained with strong clinician engagement and endorsement.^{2,3}

- In order for bundle implementation to be successful, each element of the bundle must be implemented collectively with complete consistency to achieve the most favorable outcomes (“all or none” approach).²
- The effective implementation of a care bundle requires that the measures be adapted to the local setting; appropriately followed; entrenched in the patient care culture and; recorded and evaluated to ensure compliance by all members of the healthcare team involved.⁴
- Healthcare providers are advised to follow each bundle element for every patient, always. This aims to develop and promote a positive habit-forming behavior among providers and ultimately a reliable care processes.
- Bundled interventions are an effective way to implement change and improve the “culture” of patient safety by promoting teamwork, measuring compliance and providing feedback and accountability to frontline teams and hospital leadership to improve care.^{5,6}

Implementation and performance measures

- A multi-disciplinary approach, coupled with an institution-wide multi-modal strategy including: will-building, awareness, training, education, measurement, and feedback are required to optimally promote and sustain the implementation of care bundles in hospital settings.
- The development of “how-to guidelines,” and the provision of standardized data collection tools that calculate bundle compliance are advised to ensure healthcare team members are clear on the elements of each bundle, the actions required and, how compliance is measured and tracked for feedback.
- Should elements of a bundle require particular supplies or products, these should be appropriately procured prior to bundle roll-out and implementation.
- The elements of a bundle are measured in an “all or nothing” manner to simplify assessment of compliance for feedback to providers and to

emphasize the completion of every component.⁷ This measurement is different from an average compliance score.

- A bundle compliance percentage goal should be set for the healthcare team to work toward achieving (95% bundle compliance is the recommended best practice).²

Specific interventions

Bundles for the prevention of central line-associated bloodstream infections (CLABSI)

Central lines are used commonly in intensive care units (ICUs) and in non-ICU populations such as dialysis units, intraoperatively, and oncology patients. Most hospital-acquired bloodstream infections are associated with a central line (including peripherally-inserted central catheters, PICCs), and CLABSIs are responsible for excess mortality and morbidity, prolonged hospital stays, and increased costs. CLABSI incidence is higher in low-income countries. Implementation of central line insertion and maintenance bundles reduces the incidence of CLABSI in ICUs⁸ and non-ICU settings^{9,10}, including in low-income countries.⁸ CLABSI prevention bundles include the following components¹¹ (minimum requirements in bold):

1. Insertion Bundle:

- Maximal sterile barrier precautions (surgical mask, sterile gloves, cap, sterile gown, and large sterile drape).
- Skin cleaning with alcohol-based chlorhexidine (rather than iodine).¹²
- Avoidance of the femoral vein for central venous access in adult patients; use of subclavian rather than jugular veins.¹³
- Dedicated staff for central line insertion, and competency training/assessment.

- Standardized insertion packs.
- Availability of insertion guidelines (including indications for central line use) and use of checklists with trained observers.
- Use of ultrasound guidance for insertion of internal jugular lines.

2. Maintenance Bundle:

- Daily review of central line necessity.
- Prompt removal of unnecessary lines.
- Disinfection prior to manipulation of the line.
- Daily chlorhexidine washes (in ICU, patients > 2 months).
- Disinfect catheter hubs, ports, connectors, etc., before using the catheter.
- Change dressings and disinfect site with alcohol-based chlorhexidine every 5-7 days (change earlier if soiled).
- Replace administration sets within 96 hours (immediately if used for blood products or lipids).
- Ensure appropriate nurse-to-patient ratio in ICU (1:2 or 1:1).

These activities need to be integrated in a multi-modal approach including hand hygiene, clinician and nurse education, and performance of surveillance and feedback of CLABSI rates.

Bundle for the prevention of catheter-associated urinary tract infections (CAUTI)

CAUTI is defined as a urinary tract infection (significant bacteriuria plus symptoms and/or signs attributable to the urinary tract with no other identifiable source) in a patient with current urinary tract catheterization or who has been catheterized in the past 48 hours. It is the most common healthcare associated infection worldwide,¹⁴ resulting in increased costs, hospital stays, and substantial morbidity.¹⁵ The majority of cases are considered to be avoidable with the implementation of infection prevention

bundles of care.¹⁶ There are a number of strategies with varying levels of evidence to prevent CAUTI before and after placement of urinary catheters.^{15,17} These generally include appropriate use, aseptic insertion and maintenance, early removal, and hand hygiene. Recently, a large study in the United States demonstrated that a simple intervention comprising three components reduced catheter use and CAUTI rates in non-ICU acute care settings:¹⁸

1. Avoiding the use of urinary catheters by considering alternative methods for urine collection.
 - Methods include: condom catheters, intermittent catheterization, use of nappies.
2. Using an aseptic technique for insertion and proper maintenance after insertion.
 - Following evidence-based guidelines and implementing catheter insertion policies at the institution.
3. Daily assessment of the presence and need for indwelling urinary catheters.
 - Indications for urinary catheterization include:
 - Urinary retention (mechanical obstruction or neuropathic).
 - Need to closely monitor urine output in unstable patients.
 - To assist perineal wound care.

The bundle above is implementable in resource-poor settings, and should be accompanied by a multimodal approach of hand hygiene, healthcare worker education, and feedback of catheter use and CAUTI rates.

Bundle for the prevention of ventilator associated pneumonia (VAP)

VAP, defined as a new pneumonia occurring > 48 hours after endotracheal intubation, is a common and serious hospital-acquired infection. It occurs in up to 20% of patients receiving mechanical ventilation¹⁹, and is associated with increased antibiotic use, length of hospitalization, and

healthcare costs. The mortality associated with VAP ranges from 20% to 50%, and the attributable mortality is estimated at 13%.²⁰ It has been estimated that over half the cases of VAP may be preventable with evidence-based strategies, with an impact on mortality.¹⁶ The following bundle of ventilator care processes have been shown to substantially reduce VAP rates,³ and are recommended in international guidelines:²¹

- Elevate the head of the bed to between 30 and 45 degrees.
- Daily “sedation interruption” and daily assessment of readiness to extubate.
- Daily oral care with chlorhexidine.
- Prophylaxis for peptic ulcer disease.
- Prophylaxis for deep venous thrombosis.

These interventions should be implemented together with standard precautions (hand hygiene and use of gloves when handling respiratory secretions) as well as adequate disinfection and maintenance of equipment and devices.²¹ Other components of the VAP bundle may include:

- Utilization of endotracheal tubes with subglottic secretion drainage (only for patients ventilated for longer than 24 hours)
- Initiation of safe enteral nutrition within 24-48 hours of ICU admission

Bundle for the prevention of surgical site infection (SSI)

SSIs are infections of the incision or organ or space that occur after surgery. SSIs complicate ~1.9% of surgical procedures in the United States, and result in excessive healthcare costs.²² In contrast, infection is the most common postoperative complication in African countries, occurring in 10% of procedures; it is associated with a 9.7% case fatality rate.²³ It has been estimated that approximately half of SSIs are preventable.¹⁶ The following evidence based interventions should be provided as part of a bundle of care to prevent SSI:^{22,24}

1. Administration of parenteral antibiotic prophylaxis.
 - Antibiotic prophylaxis should be administered within 60 minutes prior to incision, including for Cesarean section²⁵
 - Re-dosing is recommended for prolonged procedures and in patients with major blood loss or excessive burns.²²
2. Patients should be washed with soap or an antiseptic agent within a night prior to surgery.
3. Avoid hair removal: use electric clippers if necessary.
4. Use alcohol-based disinfectant for skin preparation in the operating room.
5. Maintain intraoperative glycemic control with target blood glucose levels < 200 mg/dL (in patients with and without diabetes).
6. Maintain perioperative normothermia.
7. Administer increased fraction of inspired oxygen during surgery and after extubation in the immediate postoperative period in patients with normal pulmonary function.

The interventions above should be implemented with a multimodal package of infection prevention including hand hygiene, sterilization of surgical equipment, the use of appropriate surgical attire, and staff education and feedback.

SUGGESTED PRACTICE

- Depending on the local hospital setting these evidence-based infection prevention bundles can be implemented individually following identification of a gap in best practice, or increased prevalence of poor outcomes in a particular area or, multiple bundles can be adopted for implementation at once.
- Bundles are not 'silver bullet' solutions for all infection risks and should be implemented in a targeted group of patients, in a common hospital

location, so that the elements of the bundle can be delivered as part of a single process of care.

- Ensure the elements of the care bundle are concise, simple, and prescriptive since numerous, complex bundle elements may hinder the success and effectiveness of frontline adoption and implementation. Existing bundles promoted by the IHI (Institute for Healthcare Improvement) are a good place to begin (see above).²⁶
- Bundle elements should not be static, but must adapt to changing evidence and best practices as new evidence emerges.
- Obtain approval, commitment, and endorsement from hospital leadership, clinicians, nursing staff, and other members of the healthcare team. Be clear on the purpose and collective goal of the desired process and communicate this message.
- Identify members of the healthcare team to test the implementation of the proposed bundle elements. It is recommended that these team members are early adopters of change.
- Create awareness through the necessary training and education and provide the team with the applicable guidelines, evidence, toolkits and supplies (if any) to execute the implementation of a bundle.
- Once an appropriate methodology has been established, implement the interventions of each bundle element every time for every eligible patient.
- Track compliance to the care bundle as an “all or nothing” measure and feedback results to frontline teams. Measurement should be accurate, consistent and ongoing to authentically reflect hospital practice and, feedback should be delivered frequently (weekly or monthly if possible) to encourage improvement and sustainability.
- Adjust the delivery system and address logistical concerns to make it easy to deliver the bundle as part of the system of care and workflow.
- IHI improvement methods to re-design care processes and improve quality of care should be adopted when gaps or system breakdowns are identified in the process that hinder the achievement of the desired team

goal. An example of this is the Plan-Do-Study-Act (PDSA) methodology which can be used to render rapid process improvements or to test change ideas in order to improve bundle compliance.²⁷

- It is recommended that a bundle champion or leader be identified to enhance accountability of team members and to ensure oversight of the implementation process, track progress and, troubleshoot problems that may occur.

SUGGESTED PRACTICE IN UNDER-RESOURCED SETTINGS:

- Implementation of infection prevention care bundles, such as the CLABSI bundle, have been shown to be as effective in restricted resource, low- and middle-income countries when compared to their higher-income counterparts.⁸
- The most effective programs include those with robust leadership, stringent protocols, participation of all members of the available healthcare team, reliable measurement of compliance, subsequent feedback of results, and the enablement of nursing staff to stop practice if the required protocols are not appropriately followed by other team members.^{4,8}

SUMMARY

Care bundles include a set of evidence-based measures that, when implemented together, have shown to improve patient care and have a greater impact than that of the isolated implementation of individual measures. Specific care bundles include bundles for the prevention of central line-associated bloodstream infections (CLABSI), bundle for the prevention of catheter-associated urinary tract infections (CAUTI), bundle for the prevention of ventilator-associated pneumonia (VAP), and bundle

for the prevention of surgical site infection. Bundles help to create reliable and consistent care systems in hospital settings since they are simple, clear, and concise. The effective implementation of a care bundle requires that the measures are adapted to the local setting; appropriately followed; entrenched in the patient care culture and; recorded and evaluated to ensure compliance by all members of the healthcare team involved.

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