Application of Bundle Care in Critical Care Settings

Dr Saurabh Saigal

Patient care-Complex

One of the cardinal principles of hospital care is that it should cause no harm to the patient

- Invasive procedures are being undertaken in greater numbers and with a higher degree of aggressiveness
- Patients with immuno-compromised status is increasing.
- Conditions for which patients require hospitalization weakens their resistance
- The hospital environment acts as a source of infection
- Micro-organisms endemic in hospitals are resistant to most antibiotics

Major HAIs

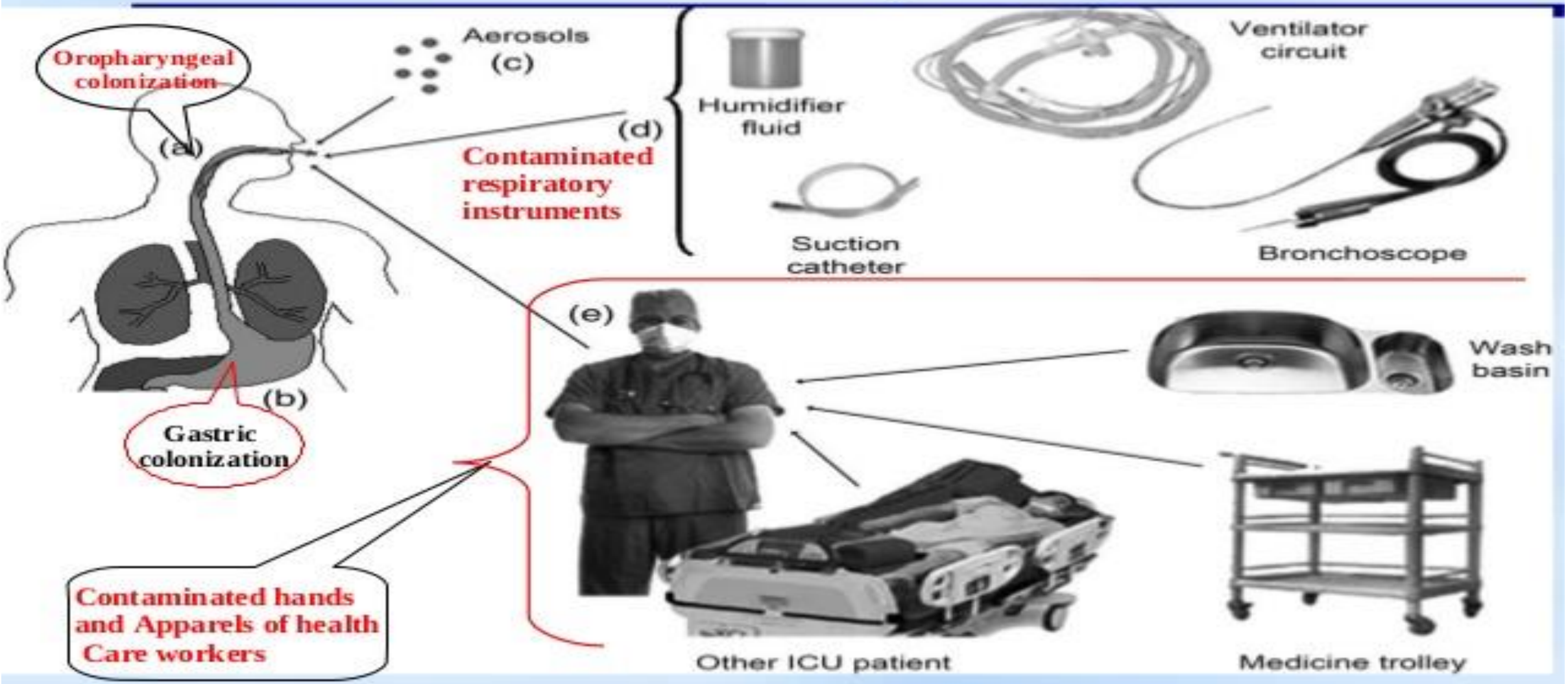
- Catheter-associated urinary tract infection (CAUTI)
- Ventilator-associated pneumonia (VAP)
- Central line-related bloodstream infection (CRBSI)

What is a bundle ?

- Grouping of best practices that have been individually proven to improve quality in an area of clinical practice
  - **Simple**
  - **Basic**
  - **Tested and proven interventions that will improve patient outcomes**
- They are generally so basic that they have been abandoned or lost in the intensity of high-tech devices.

VAP Bundle
CRBSI Bundle
UTI Bundle

Sources of VAP pathogens



European Journal of Internal Medicine 21 (2010) 360–368

Definitions

Form Approved
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www.cdc.gov/nhsn

Ventilator-Associated Event (VAE)

*required for saving **required for completion

Facility ID:	Event #:
*Patient ID:	Social Security #:
Secondary ID:	Medicare #:
Patient Name, Last:	First: Middle:
*Gender: F M Other	*Date of Birth:
Ethnicity (Specify):	Race (Specify):
*Event Type: VAE	*Date of Event:
Post-procedure VAE: Yes No	Date of Procedure:
NHSN Procedure Code:	ICD-10-PCS or CPT Procedure Code:
*MDRO Infection Surveillance:	
☐ [illegible] -plan for Infection Surveillance in the MDRO/CDI Module	
☐ [illegible] **not** in-plan for Infection Surveillance in the MDRO/CDI Module	
*Date Admitted to Facility:	*Location:
* Location of Mechanical Ventilation Initiation: _____	*Date Initiated: __ /__ /_____ APRV: Yes No

Event Details

*Specific Event: ☐ VAC ☐ IVAC ☐ PVAP

*Specify Criteria Used:

STEP 1: VAC (☐1 REQUIRED)

☐ Daily min FiO_2 [illegible] 2 days[6] **OR** ☐ [illegible] 3 cm H_2O [illegible] 2 days[6]

[6]*after 2+ days of stable or decreasing daily minimum values.*

STEP 2: IVAC

☐ Temperature > 38°C or < 36° **OR** ☐ White blood cell [illegible] $/mm^3$

AND

☐ A new antimicrobial agent(s) is started [illegible]

STEP 3: PVAP

☐ Criterion #1: Positive culture of one of the following specimens, meeting quantitative or semi-quantitative thresholds as outlined in protocol,[7] without requirement for purulent respiratory secretions:

- ☐ Endotracheal aspirate
- ☐ Bronchoalveolar lavage
- ☐ Lung tissue
- ☐ Protected specimen brush

OR

☐ Criterion #2: Purulent respiratory secretions[7] (defined in the protocol) plus organism(s) identified from one of the following specimens:[7]

- ☐ Sputum
- ☐ Endotracheal aspirate
- ☐ Bronchoalveolar lavage
- ☐ Lung tissue
- ☐ Protected specimen brush

OR

☐ Criterion #3: One of the following positive tests (as outlined in the protocol):[7]

- ☐ Organism(s) identified from pleural fluid
- ☐ Lung histopathology
- ☐ Diagnostic test for *Legionella* species
- ☐ Diagnostic test for selected viral pathogens

[7]*collected after 2 days of mechanical ventilation and within +/- 2 days of onset of increase in FiO_2 or PEEP.*

*Secondary Bloodstream Infection: Yes No	
**Died: Yes No	VAE Contributed to Death: Yes No
Discharge Date:	*Pathogens Identified: Yes No *If Yes, specify on pages 2-3

How do we do it

Parameters	Day of Diagnosis	Day 3
Temperature (°C): • 36.1-38.4 • 38.5-38.9 • ≥39 or ≤36	• 0 points • 1 point • 2 points	• 0 points • 1 point • 2 points
WBC (cells/mL^3 x 1000): • 4-11 • 4-11 plus bands >5% or ≤4 or ≥11 • ≤4 or ≥11 plus bands >5%	• 0 points • 1 point • 2 points	• 0 points • 1 point • 2 points
Tracheal secretions or sputum: • Absent • Nonpurulent (no WBCs or <10 WBC in sputum) • Purulent (10-50 WBC in sputum)	• 0 points • 1 point • 2 points	• 0 points • 1 point • 2 points
Oxygenation (PaO_2/FiO_2): • >240 • ARDS • ≤240 (with no ARDS)	• 0 points • 1 point • 2 points	• 0 points • 1 point • 2 points
CXR: • No new oroprogressive infiltrate • Diffuse (or patchy) infiltrate • Localized infiltrate	• 0 points • 1 point • 2 points	• 0 points • 1 point • 2 points
Progression of CXR (after 3 days): • Infiltrate clear at day 3 • No radiographic progression • Radiographic progression (without CHF or ARDS)	Do not calculate on day of diagnosis	• 0 points • 1 point • 2 points
Culture of sputum or tracheal aspirate: • No growth or culture between 1+and 2+ or <10^4 • Growth 3+ to 4+ or ≥10^4 or Growth 1+ to 2+ or <10^4 and same bacteria on GS • Growth 3+ to 4+ or ≥10^4 and same bacteria on GS	Do not calculate on day of diagnosis	• 0 points • 1 point • 2 points
Total CPIS		

CPIS>6 goes in favor of VAP or delta rise in CPIS score by 3

- We send samples
- We change antibiotics
- Wait for cultures and don't change over next 72 hours.
- Oxygenation worsening is most sensitive indicator

VAP Bundle

F1000Research 2017, 6(F1000 Faculty Rev):2061 Last updated: 15 DEC 2017

TABLE 2. Summary of Recommendations for Preventing Ventilator-Associated Pneumonia (VAP) in Adult Patients

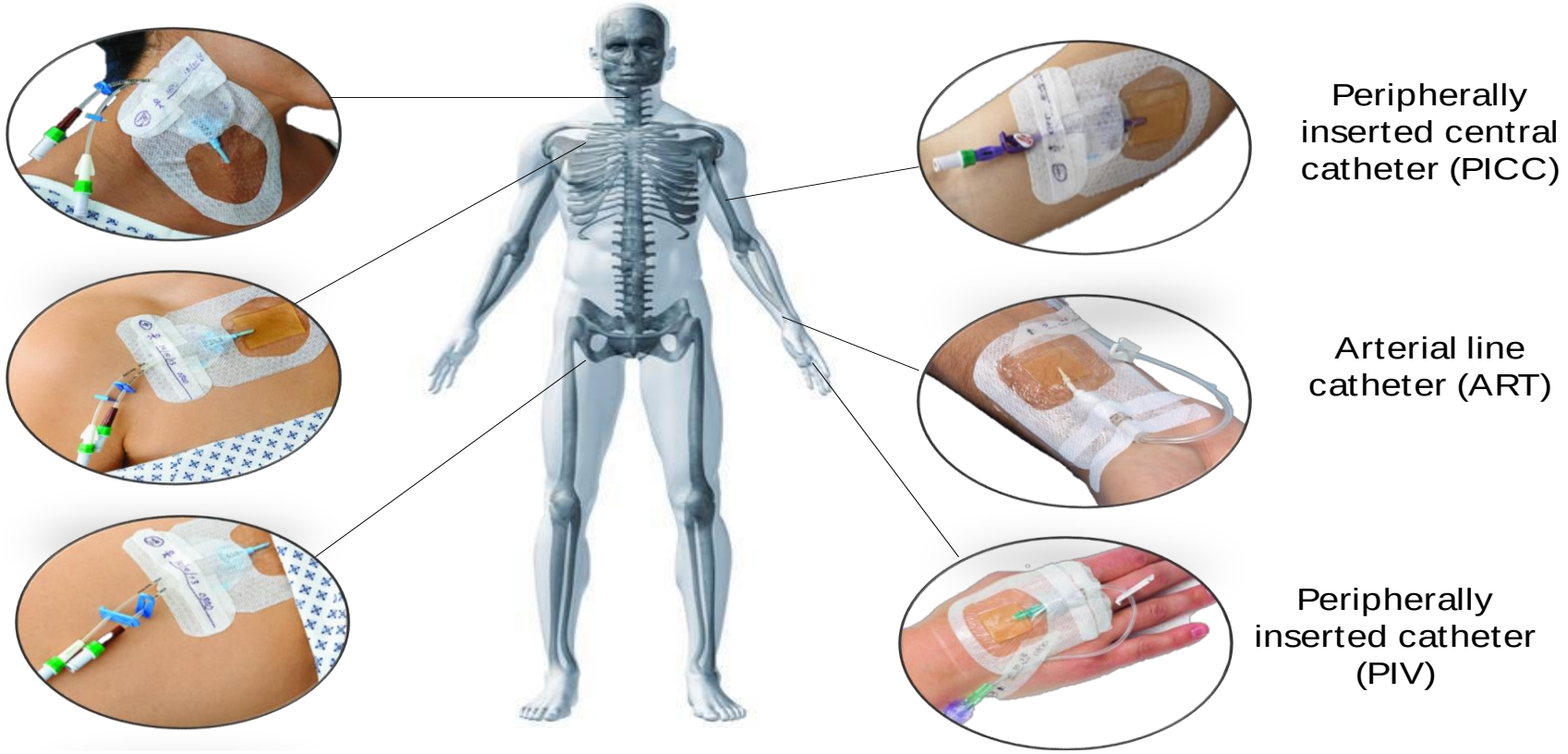
Recommendation	Rationale	Intervention	Quality of evidence
Basic practices	Good evidence that the intervention decreases the average duration of mechanical ventilation, length of stay, mortality, and/or costs; benefits likely outweigh risks	Use noninvasive positive pressure ventilation in selected populations[57,58]	High
		Manage patients without sedation whenever possible[46,61]	Moderate
		Interrupt sedation daily[62]	High
		Assess readiness to extubate daily[47,66-68]	High
		Perform spontaneous breathing trials with sedatives turned off[48]	High
		Facilitate early mobility[49,70-75,78]	Moderate
		Utilize endotracheal tubes with subglottic secretion drainage ports for patients expected to require greater than 48 or 72 hours of mechanical ventilation[50]	Moderate
		Change the ventilator circuit only if visibly soiled or malfunctioning[88-91]	High
		Elevate the head of the bed to 30°–45°[84-86]	Low[a]
Special approaches	Good evidence that the intervention improves outcomes but insufficient data available on possible risks	Selective oral or digestive decontamination[93-96]	High[b]
	May lower VAP rates but insufficient data to determine impact on duration of mechanical ventilation, length of stay, or mortality	Regular oral care with chlorhexidine[98,101-104]	Moderate
		Prophylactic probiotics[111-114]	Moderate
		Ultrathin polyurethane endotracheal tube cuffs[120,121]	Low
		Automated control of endotracheal tube cuff pressure[122,123]	Low
		Saline instillation before tracheal suctioning[124]	Low
		Mechanical tooth brushing[125,126]	Low
Generally not recommended	Lowers VAP rates but ample data suggest no impact on duration of mechanical ventilation, length of stay, or mortality	Silver-coated endotracheal tubes[127]	Moderate
		Kinetic beds[128]	Moderate
		Prone positioning[87,129-134,c]	Moderate
	No impact on VAP rates, average duration of mechanical ventilation, length of stay, or mortality[c]	Stress ulcer prophylaxis[135,136]	Moderate
		Early tracheotomy[137]	High
		Monitoring residual gastric volumes[138]	Moderate
		Early parenteral nutrition[139]	Moderate
No recommendation	No impact on VAP rates or other patient outcomes, unclear impact on costs	Closed/in-line endotracheal suctioning[141-143]	Moderate

[a] There are very little data on head-of-bed elevation, but it is classified as a basic practice because of its simplicity, ubiquity, low cost, and potential benefit.
[b] There are abundant data on the benefits of digestive decontamination but insufficient data on the long-term impact of this strategy on antimicrobial resistance rates.
[c] May be indicated for reasons other than VAP prevention.

Strategies to Prevent Ventilator-Associated Pneumonia in Acute Care Hospitals: 2014 Update

CRBSI – Central Line Bundle

ALL vascular access devices = BSI risk



Strategies to Prevent Central Line–Associated Bloodstream Infections in Acute Care Hospitals: 2014 Update

Patient Impact

HAIs account for a large proportion of the harm to patients caused by health care[9]

- Incidence rate estimated for hospitalized adult populations at risk for CLABSI.
- CRBSIs are significant contributors to preventable hospital deaths.[2]
- Real world evidence has demonstrated an increase in hospital resources - and associated cost - required to treat morbidities due to CRBSIs[11-15]

1 in 4

Patients who contract CLABSI die[7]

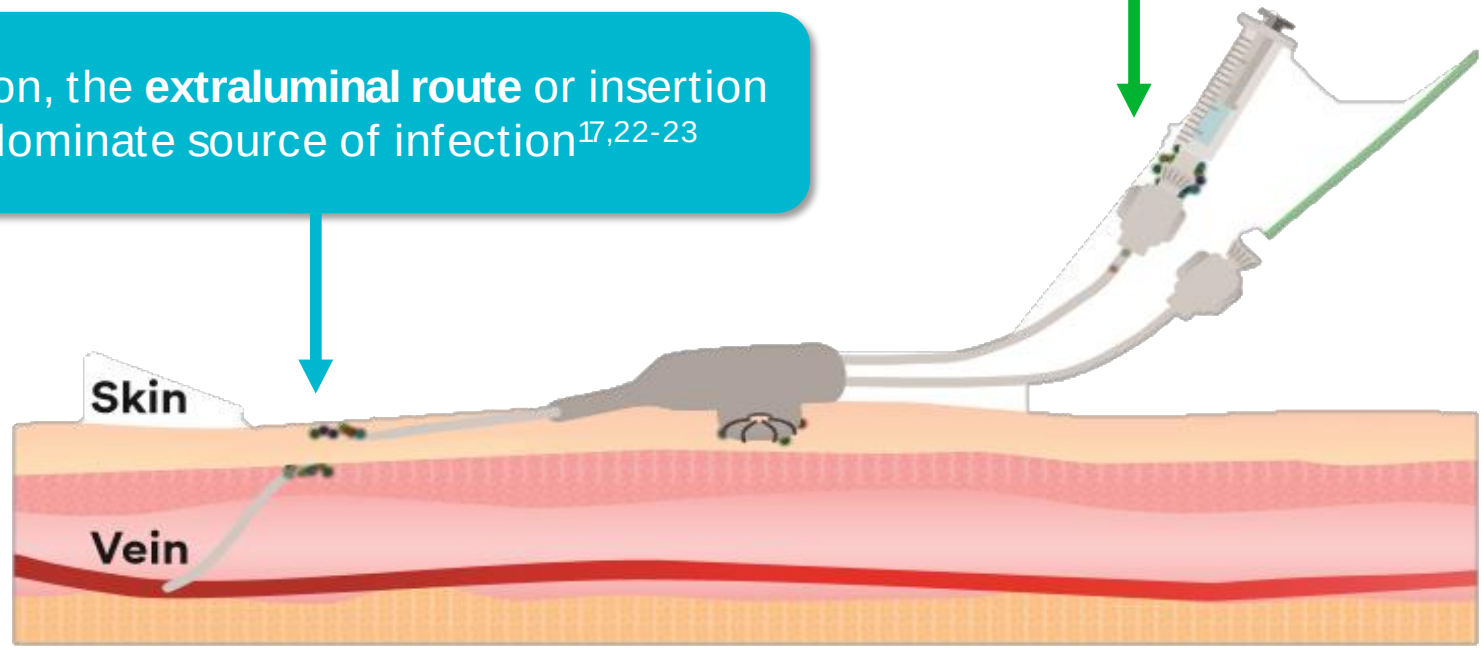
Strategies to Prevent Central Line–Associated Bloodstream Infections in Acute Care Hospitals: 2014 Update

The majority of CR-BSIs emanate from either the insertion site or the hub[16-19]

Organisms on the skin gain access to the bloodstream via migration along the external surface of the catheter or catheter hub; both important routes of catheter-related bloodstream infections[17-21]

Whereas the **intraluminal route** (primarily the hub) predominates after a more extended dwell time[24-25]

Soon after insertion, the **extraluminal route** or insertion site is the predominate source of infection[17,22-23]

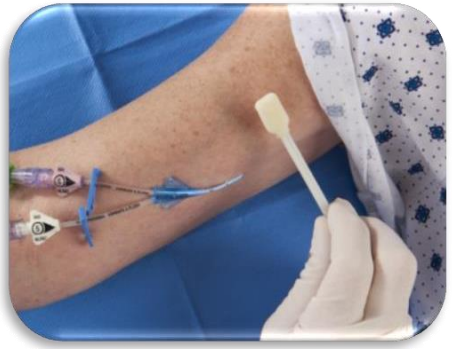


Strategies to Prevent Central Line–Associated Bloodstream Infections in Acute Care Hospitals: 2014 Update

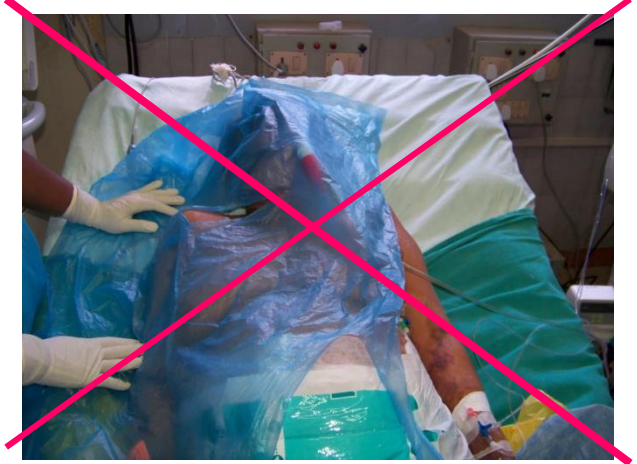
The use of bundles

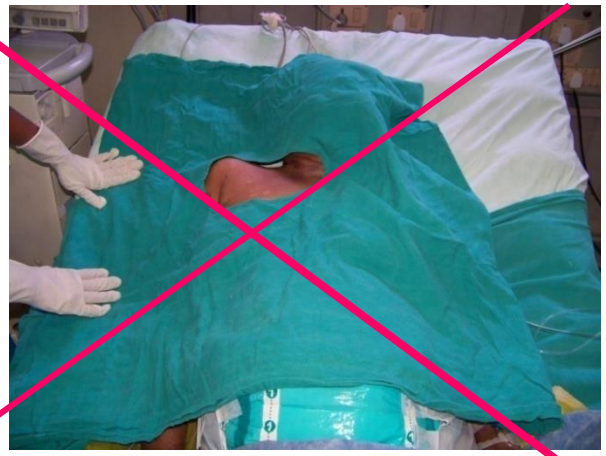
Evidence-based recommendations and performance improvement initiatives or strategies are bundled together to improve compliance[26]

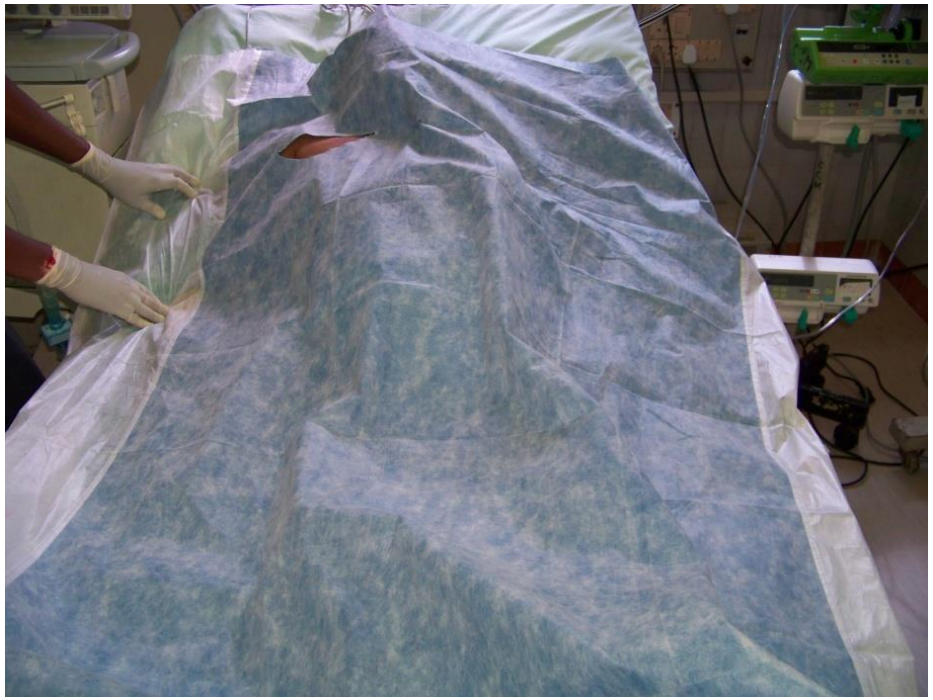
Central Line Insertion Bundles[26-29]
Hand Hygiene
Skin antisepsis using >0.5% chlorhexidine in alcohol solution
Maximal sterile barrier precautions (Mask, cap, sterile gown, large sterile drape and sterile gloves)
Avoid the femoral vein for CVC placement



Barrier Precautions







Full body sheet

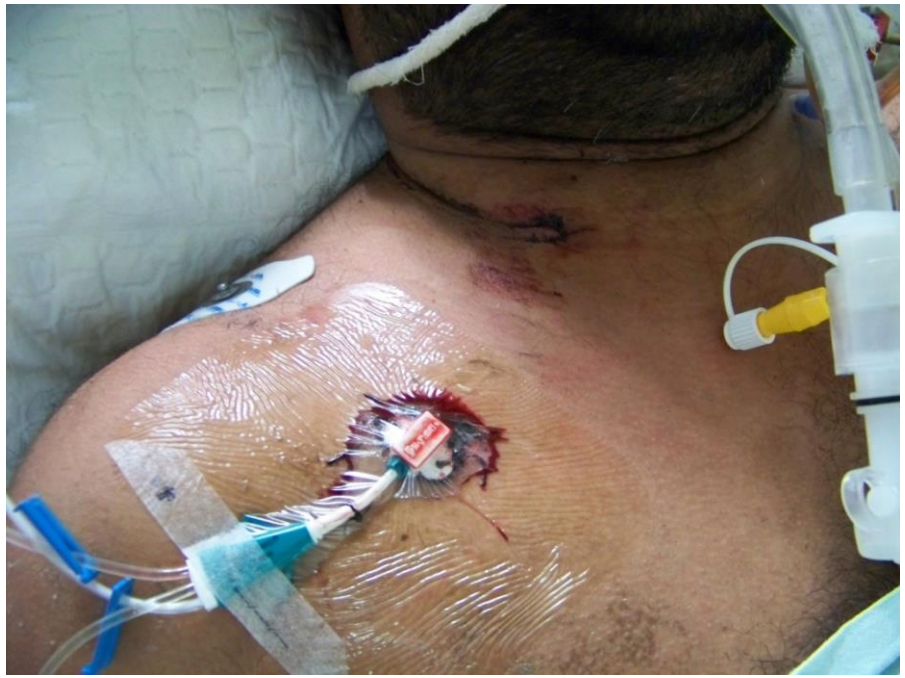
Maintenance includes many interventions

After catheter insertion, maintenance bundles have been proposed to ensure optimal catheter care[29]

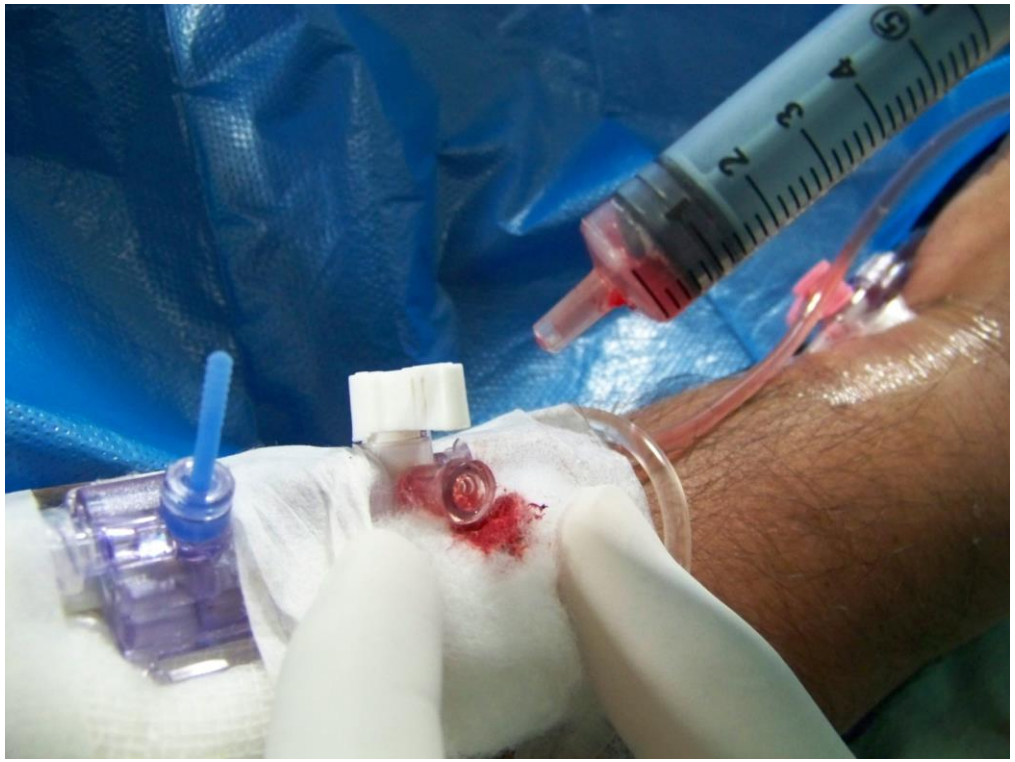
Maintenance Bundles[26-29]
Assess need for catheter daily
Perform hand hygiene before manipulation of IV system
Dressing change recommendations and guidelines based on dressing type
IV tubing administration set, secondary set and add-on device change guidelines based on medication or product infused
Disinfect IV access ports with appropriate disinfectant for a period of time

Catheter Care

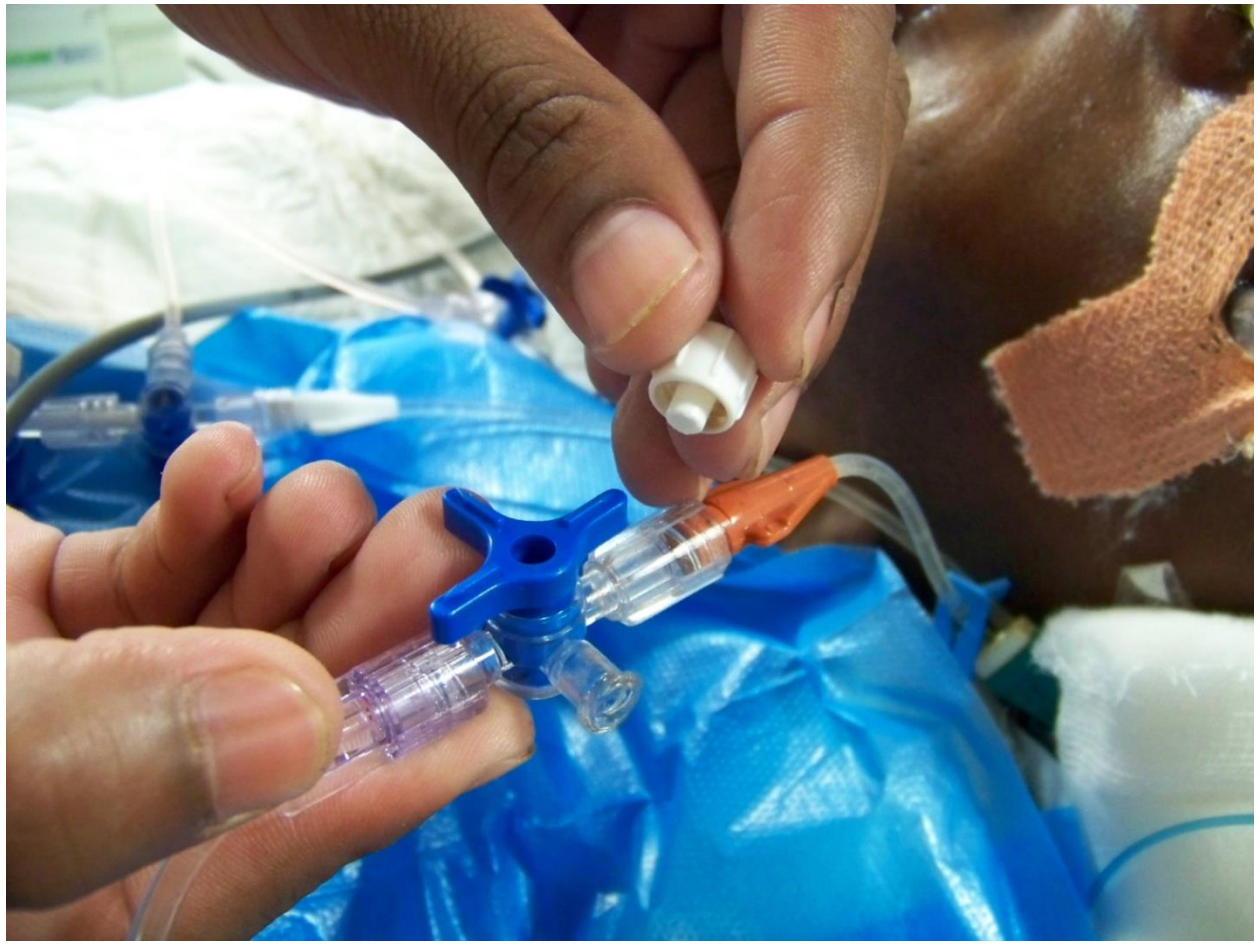
Factors Predisposing to CRBSI



Factors Predisposing to CRBSI



Catheter care: is it correct ?



Skin preparation

- Prepare **clean skin with a >0.5% chlorhexidine preparation with alcohol IA**

- If there is a contraindication to chlorhexidine, tincture of iodine, an iodophor, or 70% alcohol can be used as alternatives ***IA***

- No comparison has been made between using chlorhexidine preparations with alcohol and povidone-iodine in alcohol to prepare clean skin. ***Unresolved issue***

- No recommendation can be made for the safety or efficacy of chlorhexidine in infants aged <2 months. ***Unresolved issue***

Strategies to Prevent Central Line–Associated Bloodstream Infections in Acute Care Hospitals: 2014 Update

- **Recommendation Update [July 2017] *Category I A***

Chlorhexidine-impregnated dressings (with an FDA-cleared label) are recommended to protect the insertion site of short-term, non-tunnelled CVC

[Superseded 2011 Recommendation]

- **Antimicrobial/Antiseptic Impregnated Catheters and Cuffs**

Use a chlorhexidine/silver sulfadiazine or minocycline/ rifampin -impregnated CVC in patients whose catheter is expected to remain **in place >5 days** if, after successful implementation of a comprehensive strategy to reduce rates of CLABSI, the CLABSI rate is not decreasing

Category IA

- **Antiseptic ointment**

Use povidone iodine antiseptic ointment or bacitracin/ gramicidin/polymyxin B ointment at the haemodialysis catheter exit site after catheter insertion and at the end of each dialysis session only if this ointment does not interact with the material of the haemodialysis catheter per manufacturer's recommendation

Category IB

Preventing Catheter-Associated Urinary Tract Infections
CAUTI

Why CA-UTI?

- Most common hospital-acquired infection
- 40% of all HAIs
- 12-25% of all hospitalized patients receive a urinary catheter
- Half of these found to not have valid indication
- Increased length of stay 0.5 – 1 day

Preventing CA-UTI

1. Avoid unnecessary urinary catheters
2. Insert using aseptic technique
3. Maintain catheters based on recommended guidelines (daily care)
4. Review catheter necessity daily and remove promptly

1. Avoidance Strategies

- External condom catheters for appropriate male patients
- Intermittent catheterization multiple times per day
- Assessing urinary retention with bladder ultrasound

2. Insert urinary catheters using aseptic technique

- Utilize appropriate hand hygiene practice.

- Insert catheters using aseptic technique and sterile equipment, specifically using:
  - gloves, a drape, and sponges;
  - sterile or antiseptic solution for cleaning the urethral meatus; and
  - single-use packet of sterile lubricant jelly for insertion.

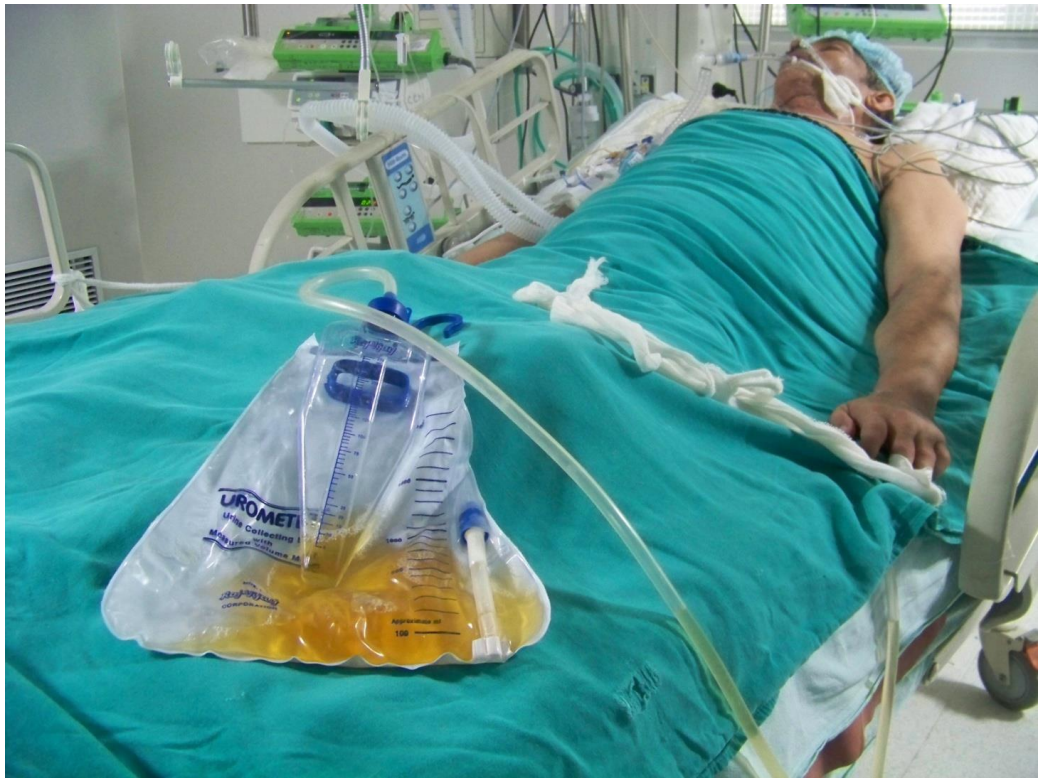
- Use as small a catheter as possible that is consistent with proper drainage, to minimize urethral trauma.

3. Maintain catheters based on recommended guidelines

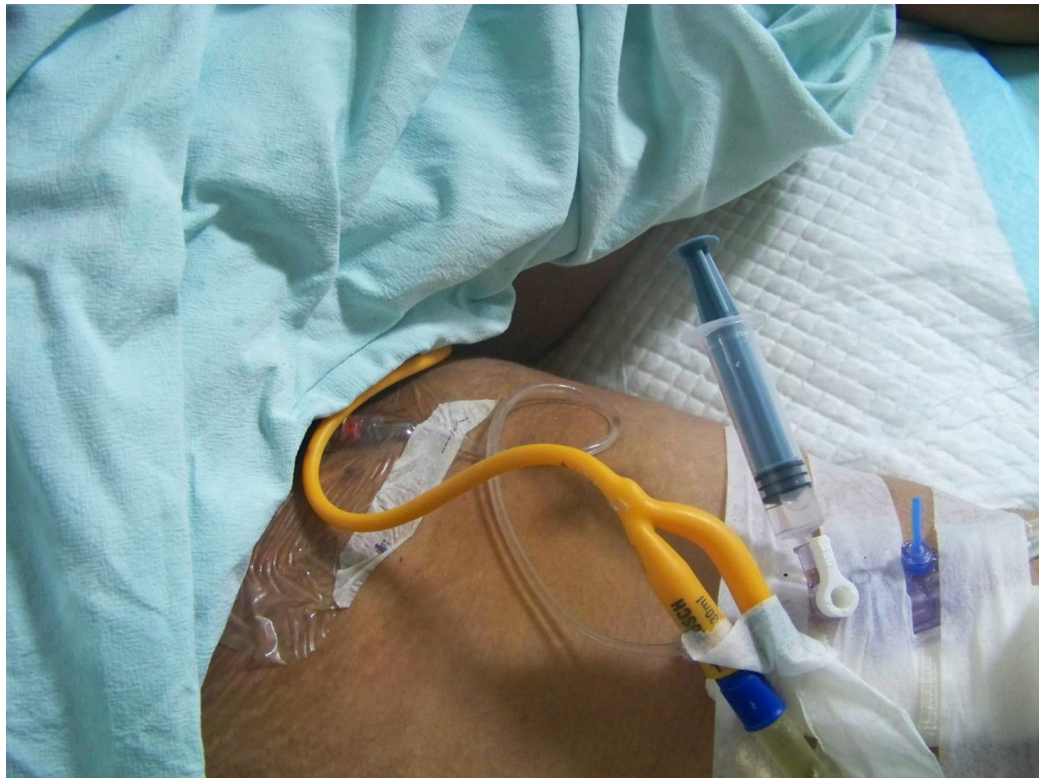
- Maintain a sterile, continuously closed drainage system.
- Keep catheter properly secured to prevent movement and urethral traction.
- Keep collection bag below the level of the bladder at all times.
- Maintain unobstructed urine flow.
- Empty collection bag regularly .

Errors

Wrongly placed urinary bag



Catheter -fixation



4. Daily review of necessity with prompt removal

"The duration of catheterization is the most important risk factor for development of infection." *SHEA-IDSA Compendium, October 2008*

- 74% of hospitals surveyed did not monitor catheter duration.

- 47% of patient days had no justification for continued catheterization.
- 41% of the time, physicians were unaware of patients inappropriately catheterized.

AIIMS ICU 2018 data
HAI

No. of patient days 2586	Degree of utilisation
CVC days 1390	CVC utilisation rate-53.7%
Ventilator days 1088	Ventilator utilisation rate-42%
Urinary catheter days 2034	Urinary catheter utilisation rate-78.65%

HAI types	Rates
VAP	67 per 1000 ventilator days Acceptable 10-30 very High
CLABSI	16.56 per 1000 catheter days Acceptable <10; High
UTI	7.3 per 1000 catheter days Acceptable ;ok

BED TURNOVER INTERVAL (25 days for a 10 bedded ICU)

- **BTI= $\frac{\text{available staffed bed days – occupied bed days}}{\text{Total discharges/ deaths}}$**

- **BTI = $\frac{250-244}{43}$ = 0.13**

***Negative: over utilization**
Short positive: optimum utilization
long positive : Under utilization

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INFECTION CONTROL MEASURES

S. No.		24 (D1)	48 (D2)	72 (D3)	96 (D4)	120 (D5)	144 (D6)	168 (D7)	192 (D8)
1.	Bain's circuit to be plasma sterilized every 48 hours								
2.	Bain's circuit to be discarded after 7 days								
3.	Nebulizer- Prior to nebulizing ;dip in cidex for 30 minutes and then wash with water and then nebulize the patient								
4.	Disposable Nebulizer set to be discarded after 3 days								
5.	IV drip sets to be changed every 24 hours								
6.	Blood administration set to be discarded after use								
7.	Three ways, extension tubing's and syringes to be changed every 24 hours Note if three ways contaminated with blood to be discarded immediately								
8.	Whenever using lipid emulsion i.e. Propofol, Dexmetomidine change tubing, syringes and three ways immediately after use.								
9.	The suction bottle to be plasma sterilized every 48 hours.								
10.	Yonkers suction to be replaced within 72 hours								
11.	Bed railings, all surface contact surroundings to be cleaned with Micro-clean-H three times daily.								
12.	Central line dressing to be inspected daily, the transparent dressing to be changed every 48 hours								
13.	Catheter mount &HME to be changed every 48 hours								
14.	Bed sheet to be changed if contaminated with blood urine & faeces.								
15.	Laryngoscopes to be plasma sterilized-- Saturday								

ICU

CENTRAL LINE INSERTION PRACTICES ADHERENCE MONITORING FORM

Section A. General information

Facility ID _____ Surveillance ID _____

Patient ID _____ Patient Name _____

Date of insertion _____/____/_____ (DD/MM/YY) Event# _____

Name of observer: _____

Occupation of inserter: _____
Medical student Intern/resident Consultant physician Other medical staff

Reason for insertion:
- ☐ New indication for central line (e.g., hemodynamic monitoring, fluid/medication administration, etc.)
- ☐ Replace malfunctioning central line Other (specify): _____
- ☐ Suspected central line-associated infection

Section B. Summary of insertion practices

Inserter performed hand hygiene prior to central line insertion? Yes No

Which of the following sterile barriers were used:

Mask	Sterile gown	Sterile gloves	Cap	Full body sterile drape
Yes	Yes	Yes	Yes	Yes
No	No	No	No	No

Skin preparation (check all that apply) Chlorhexidine1 gluconate Povidone iodine Alcohol

Was skin prep agent completely dry at time of first skin puncture Yes No

Insertion site: Femoral Jugular Subclavian Umbilical Other

DAILY CENTRAL LINE MAINTENANCE CHECK LIST

Section A: General Information

Patient id 20190170947.		Patient name Vamam Rambhal.
Facility name	Surveillance Unit	Date of admission to surveillance Unit (dd/mm/yr)

Section B:Daily checks

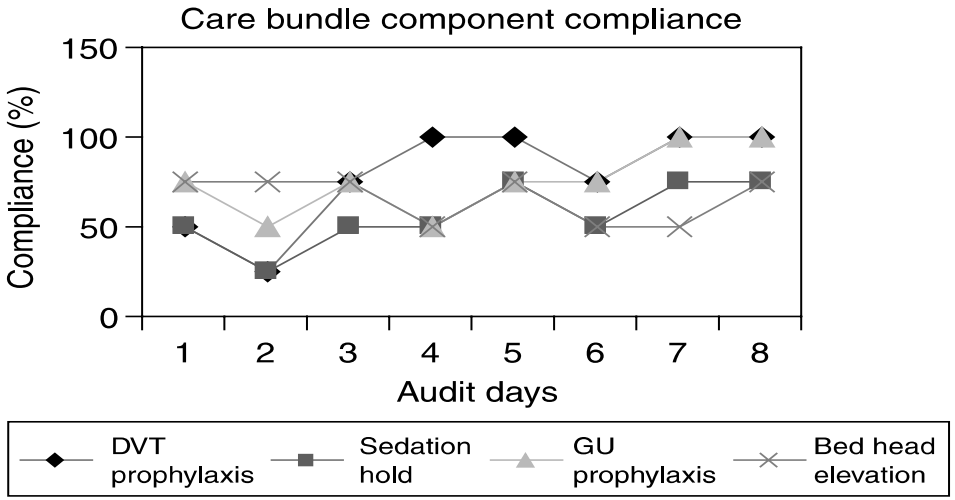
Date (dd/mm/yr)	Central line day	Was central line reviewed for necessity today		Signature of day shift nurse	Was the dressing for soiling, dampening and loosening today?		Signature of day shift nurse	Was the access port scrubbed with an antiseptic each time before use?					
								During the day shift?		Sign of day shift nurse	During the night shift?		Sign of night shift nurse
20/8/1	D1	✓ Yes	No	[illegible]	✓ Yes	No	[illegible]	✓ Yes	No	[illegible]	✓ Yes	No	[illegible]
21/8	D2	✓ Yes	No	[illegible]	✓ Yes	No	[illegible]	✓ Yes	No	[illegible]	✓ Yes	No	[illegible]
		Yes	No		Yes	No		Yes	No		Yes	No	
9/10/19		✓ Yes	No	[illegible]	Yes	No		Yes	No		Yes	No	
		Yes	No		Yes	No		Yes	No		Yes	No	
		Yes	No		Yes	No		Yes	No		Yes	No	
		Yes	No		Yes	No		Yes	No		Yes	No	
		Yes	No		Yes	No		Yes	No		Yes	No	
		Yes	No		Yes	No		Yes	No		Yes	No	
		Yes	No		Yes	No		Yes	No		Yes	No	
		Yes	No		Yes	No		Yes	No		Yes	No	
		Yes	No		Yes	No		Yes	No		Yes	No	
		Yes	No		Yes	No		Yes	No		Yes	No	
		Yes	No		Yes	No		Yes	No		Yes	No	
		Yes	No		Yes	No		Yes	No		Yes	No	
		Yes	No		Yes	No		Yes	No		Yes	No	

Future what we can do

Table 2 Care bundle compliance

	Component															
	1. e.g. DVT prophylaxis				2. e.g. sedation hold				3. e.g. GU prophylaxis				4. e.g. head of bed			
Patient	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Day 1	Y	Y	Y	Y	N	N	N	N	N	N	Y	Y	Y	N	Y	Y
Day 2	Y	Y	Y	Y	N	N	N	N	N	N	Y	Y	Y	N	Y	Y
Day 3	Y	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y	Y	Y	Y
Day 4	Y	Y	Y	Y	Y	Y	N	N	Y	N	Y	Y	Y	Y	N	N
Day 5	Y	N	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	Y	Y	Y
Day 6	Y	Y	Y	N	Y	N	N	N	N	N	Y	Y	Y	Y	Y	Y
Day 7	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	N
Day 8	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y

DVT, deep vein thrombosis; GU, gastric ulceration; Y, compliance; N, non-compliance.

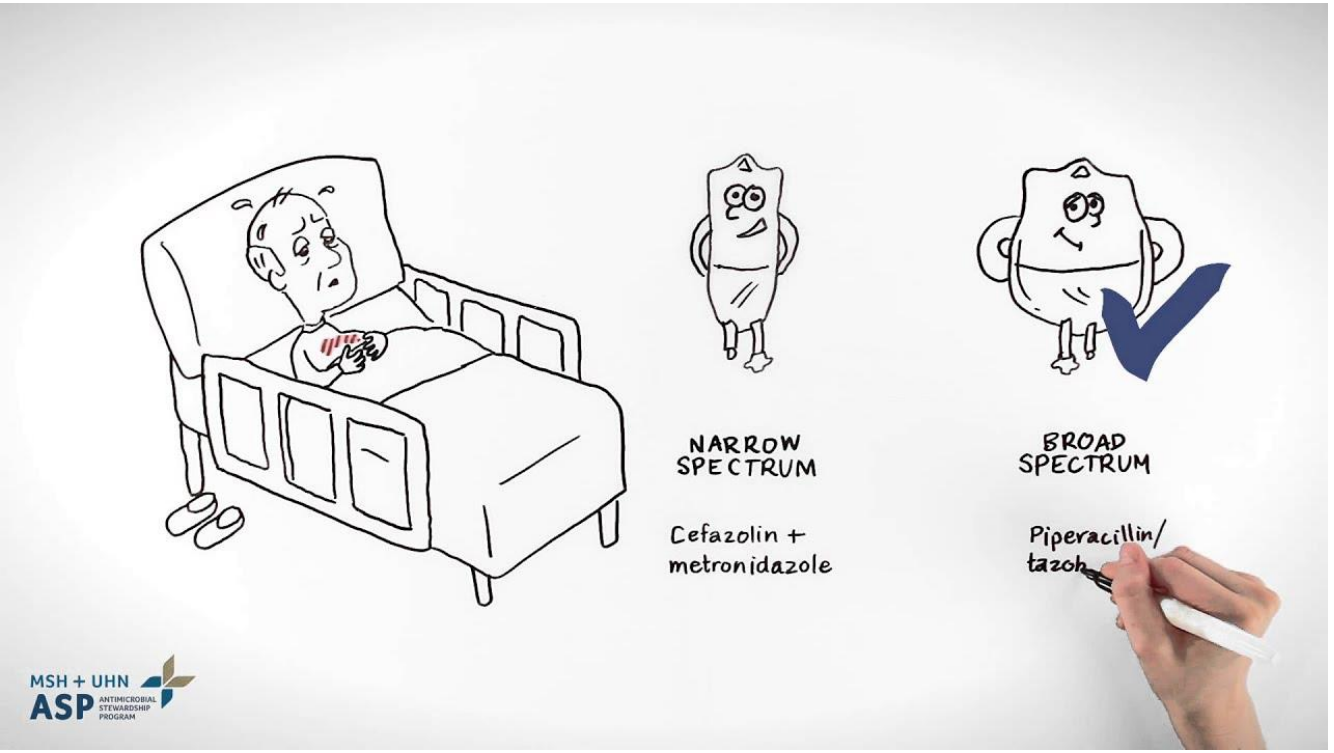


Infection rates of various wards can be displayed

SUMMARY

- Instead of jumping on antibiotics we should focus more attention on following these bundles
- **An educational session alone, without an associated behavioural strategy, is unlikely to induce profound behavioural changes**.
- **It should be kept in mind that, to engage an individual in a particular behaviour and improve compliance, we need to act on predisposing factors (knowledge, perceptions, and beliefs)** to favour the access to new processes or technologies and to continually reinforce the behaviour by feedback

TEAM work


NARROW SPECTRUM
Cefazolin + metronidazole
BROAD SPECTRUM
Piperacillin/
MSH + UHN
ASP
ANTIMICROBIAL STEWARDSHIP PROGRAM


Swachh
Bharat
Abhiyan

AVERAGE LENGTH OF STAY IN ICU

$$ALS = \frac{\text{Inpatient days}}{\text{Discharges /transfer/ DEATH}}$$

- $ALS = \frac{244}{43} = 5.6$
- Indicates Efficiency of health care services and depends upon the

1. **Characteristics of the patient**
2. **Disease characteristics**
3. **Habits of doctors and staff**
4. **Hospital infections**

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BED TURNOVER RATIO

- No of patients cured/ treated for a bed during the period.

$$BTR = \frac{\text{No of discharges / transfers / deaths}}{\text{Avg bed count}}$$

- $BTR = \frac{43}{10} = 4.3$

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