JMSR
Journal of Medical and Scientific Research

ORIGINAL RESEARCH

Device associated and surgical site infections, quality indicators in a tertiary care hospital: A 5 year study

Anil Kumar Bilolikar[1,*], Jaya Banerjee[1], and Marriyamma K Thomas[1]

[1]Department of Hospital Infection Control & Microbiology, Krishna Institute of Medical Sciences, Minister Road, Secunderabad-500003, Telangana, India

Abstract

Purpose: In the present study, an attempt is made to understand the pattern of HAIs (Healthcare Associated Infections) [device associated infections such as Catheter Associated Urinary Tract Infection (CAUTI), Ventilator Associated Event (VAE), Central Line-Associated Bloodstream Infection (CLABSI) & Surgical Site Infection (SSI) by analyzing statistical tool of quality indicators] and to establish a bench mark for HAIs in a single hospital for a period of 5 years.

Methods: The Microbiologist & ICN's conduct rounds in ICU's & wards and collect data for active surveillance. The details of culture positive samples are collected by Microbiologist from the laboratory for passive surveillance. The surveillance forms (active & passive) capture details of individual patients. The data collection forms are prepared and updated as per Centers for Disease Control and Prevention (CDC), National Healthcare Safety Network (NHSN) guidelines. The data is analyzed and presented in the meeting of Hospital Infection Control Committee meeting & discussed with clinicians.

Results: The cumulative (5 years) CAUTI rate is 0.45, VAE is 2.42, CLABSI is 1.35 & SSI is 0.21. HAI rates were highest for VAE (2.42/1000 ventilator days), the next was CLABSI (1.35/1000 central line days), followed by CAUTI (0.45/1000 urinary catheter days). SSI rate was 0.21/ 100 surgeries.

Conclusions: Before the study was started, the benchmark were 2 for CAUTI, 5.5 for VAE, 3 for CLABSI and 2 for SSI. We could able to reduce the baseline benchmark and established our new benchmark as 1 for CAUTI, 3 for VAE, 2 for CLABSI and 1 for SSI that can be used in developing HAI prevention policies by the institution.

Keywords: quality indicator; bench mark; CAUTI; VAE; CLABSI; SSI; tertiary care hospital

***Corresponding author:** Dr. Anil Kumar Bilolikar, Department of Hospital Infection Control & Microbiology, Krishna Institute of Medical Sciences, Minister Road, Secunderabad-500003, Telangana, India. Email: dranilbilolikar@yahoo.com

Received 3 May 2021; *Revised* 16 June 2021; *Accepted* 26 June 2021; *Published* 1 July 2021

Citation: Bilolikar AK, Banerjee J, Thomas KM. Device associated and surgical site infections, quality indicators in a tertiary care hospital: A 5 year study. J Med Sci Res. 2021; 9(3):132-146. DOI: http://dx.doi.org/10.17727/JMSR.2021/9-20

Introduction

Healthcare Associated Infections (HAIs) are one of the most common adverse events during healthcare delivery. These are major public health issue affecting morbidity, mortality and quality of life. It is a problem worldwide. At any time, up to 7 % of patients in developed and 10% in developing countries will acquire atleast one HAI [1].

It is evident that HAIs result in prolonged hospital stay, long term disability increased resistance of microorganisms to antimicrobials, additional cost on health care system, increases financial burden, for patients and their family and preventable death.

Major HAIs include, device associated infections such as Catheter Associated Urinary Tract Infection (CAUTI), Ventilator Associated Event (VAE), Central Line-Associated Bloodstream Infection (CLABSI) & Surgical Site Infection (SSI). Catheter Associated Urinary Tract Infection (CAUTI) is the most common Hospital Acquired Infection (HAI) worldwide, account for 35- 45% of all HAI's [2, 3].

Approximately 12-16% of adult inpatients are on indwelling urinary catheter at some point of time during their hospitalization. The risk of CAUTI increases by 3-7% with each day of urinary catheterization [4]. CAUTI can lead to complications as prostatitis, epididymitis, orchitis in males and cystitis, pyelonephritis, gram negative bacteremia, endocarditis, vertebral osteomyelitis, septic arthritis, endophthalmitis and meningitis in patients. Hence, surveillance of catheterized patients for CAUTI is of importance.

Ventilator-Association Pneumonia/Event (VAP/VAE): Healthcare associated Pneumonia (HAP) is the second most common nosocomial infection and accounts for 15-20% of total HAI's. It is the most common cause of death among HAIs with a mortality rate up to 40% and is the primary cause of death in ICU. Ventilator associated pneumonia (VAP) for patient under mechanical ventilation, is the single most important cause of HAP. Hence, surveillance for VAP is of great importance [5].

Surveillance for VAP has been a challenge due to lack of objective and reliable definitions. To overcome it, in 2013, National Healthcare Safety Network (NHSN) introduced more objective surveillance criteria known as Ventilator Association Event (VAE) in adult location & 2019 in pediatric location [5, 6].

Mechanical ventilation is an essential, life-saving therapy for patients with critical illness and respiratory failure. These patients are at high risk for complication and poor outcomes, including death. The complications include VAP, sepsis, acute respiratory distress syndrome (ARDS), pulmonary embolism, barotrauma and pulmonary oedema. Mortality in patients with acute lung injury on mechanical ventilation is high [7].

Central Line-Associated Bloodstream Infection (CLABSI) is a major cause of mortality and morbidity. Patients in ICU settings are at higher risk of developing CLABSI as majority of them require long term central line. It can be prevented through proper insertion techniques and management of central line. Surveillance is done in any inpatient location where denominator data can be collected which can include critical care units. CLABSI surveillance after patient discharge from facility in not required [8].

Surgical Site Infection (SSI) is the costliest HAI type [9]. It is associated with an increase in hospital stay by 7-11 days and has 2-11 times higher risk of death as compared to operated patients without SSI [10]. Hence SSI surveillance is of chief importance. Surveillance of SSI with feedback of appropriate data to surgeon has been shown to be an important component of strategies to reduce SSI risk. Surveillance of surgical patients will occur in inpatient facility and outpatient department.

Quality Indicators are standardized, evidence-based measures of health care quality that can be used with readily available hospital inpatient administrative data to measure and track clinical performance and outcomes. They are the backbone on which quality assurance program of hospital relies. Calculation of several quality indicators can be used for monitoring the quality of care provided by healthcare system [11].

Quality Indicators are monitored by making use of surveillance tool (active & passive surveillance following latest Centers for Disease Control and Prevention (CDC), National Healthcare Safety Network (NHSN) guidelines). In the present study, quality indicators for device associated (CAUTI,

VAE & CLABSI) & SSI infections are monitored for a period of 5 years.

The healthcare facilities are collecting standardized data on HAIs, which are used to track internal performance as well as to compare local data to national & international benchmark.

However, bench mark for quality indicators of HAIs from a single hospital in Indian setting is not available.

In the present study, an attempt is made to understand the pattern of HAIs by analyzing statistical tool of quality indicators (5 years) and to establish a bench mark for HAIs in a single hospital. This information may further help to formulate policies to prevent and control HAIs at institutional levels in India. The available International benchmarks CDC & the International Nosocomial Infection Control Consortium (INICC) and two multi -centric pooled HAI data [12] from India are used as guidance.

Material and methods

A prospective observational study was conducted for 5 years from January 2016 to December 2020 at Krishna Institute of Medical Sciences, Secunderabad. It is a multi, super-specialty hospital having solid organ transplant & bone marrow transplant facilities with bed strength of 850. There are 11 ICUs with 163 beds, 22 operation theater with HEPA filters & 2 dialysis units with 71 beds. This hospital is accredited by National Accreditation Board for Hospitals and Healthcare Providers (NABH) and National Accreditation Board for Testing and Calibration Laboratories (NABL). It has Green Operation Theatre Certification.

The primary objective of this study was to analyze 5 years quality indicators of HAIs in order to find out the trends of HAI and to establish the benchmark for our institution. Hospitalized patients of all age groups, who have devices or undergone surgeries are included in the study. Hospitalized patients who do not have devices or undergone surgeries are excluded from the study.

The hospital has a multi-disciplinary infection control committee. The committee prepares policies which aims at preventing and reducing risk of HAIs in patients. The Infection Control Team (ICT) helps the committee for smooth implementation of HIC policies. The ICT comprising of Infection Control Officer (ICO), Microbiologist, designated and qualified infection control nurses (ICNs) and unit in charges of medical & surgical ICUs, pediatric & neonatal ICUs, medical & surgical wards, transplant units, emergency department, dialysis unit, OT, CSSD and housekeeping,

The Microbiologist & ICN's conduct laboratory-based ward liaison surveillance. The ICN's prospectively monitor cases while conducting rounds in ICU's & wards and collect data for active surveillance (Supplemental Figure 1). The details of culture positive samples are collected by Microbiologist from the laboratory for passive surveillance. Data collection is done on a daily basis. The surveillance forms (active & passive) capture details of individual patients. The data collection forms are prepared and updated as per CDC, NHSN guidelines (Supplemental Figure 2-CAUTI, Supplemental Figure 3-VAE, Supplemental Figure 4-CLABSI, & Supplemental Figure 5-SSI).

Active and Passive surveillance forms are verified and analyzed by the ICO or Microbiologist routinely. The infection risks, rates & trends of device associated HAI's (CAUTI, VAE, CLABSI) & surgical site infections (SSI) are analyzed. Appropriate feedback regarding HAI rates is provided on a regular basis to clinical consultants & incharge nursing staff in a monthly HIC meeting. The committee takes decision to implement policies which can reduce the risk of HAIs in patients.

The details of surveillance CAUTI, VAE, CLABSI & SSI are given as follows.

CAUTI

Definition: Cather -associated UTI (CAUTI) is a UTI where an indwelling urinary catheter was in place for >2 calendar days on the date of event, with day of device placement being Day 1, AND An indwelling urinary catheter was in place on the date of event or the day before. According to Centers for Disease Control and Prevention (NHSN) Surveillance Criteria for CAUTI includes [13].

(1) *Catheter criteria:* Patient had an indwelling urinary catheter that had been in place for more than two consecutive days in an inpatient location on the

date of event AND was either present for any portion of the calendar days on the date of event or removed the day before the date of event. (2) *Symptom criteria:* Patient has atleast on of the following signs or symptoms. Fever (>38°C), suprapubic tenderness, costovertebral angle pain or tenderness, urinary urgency, urinary frequency, dysuria, (3) *Urine culture criteria:* 1 or 2 organisms isolated from urine with atleast one organism of $>10^5$ CFU/ml.

The CAUTI rate can be calculated as per the formula mentioned in Table 1. Formulae of calculation of various HAI infection rates.

Table 1: Formulae for calculation of various HAI infection rates.

Measures	*Formula*
CAUTI rate	Number of CAUTI cases/ Number of urinary catheter days x 1000
CLABSI rate	Number of CLABSI cases/ Number of central line days x 1000
VAE rate	Number of VAE cases/ Number of mechanical ventilation days x 1000
SSI rate	Number of SSI cases/ Number of surgeries done x 100

Ventilator -Association Event (VAE)

Mechanical ventilation is an essential, life-saving therapy for patients with critical illness and respiratory failure. Surveillance of patients under ventilation was limited to ventilator-associated Pneumonia (VAP) prior to 2013.

The VAE surveillance definition algorithm developed by the Working Group and implemented in the NHSN in January 2013 is based on objective, streamlined, and potentially automatable criteria that identity a broad range of conditions and complications occurring in mechanically ventilated adult patients.

There are three tiers definition within the VAE algorithm (Table 2). This algorithm is for use in surveillance, it is not a clinical definition algorithm and is not intended for use in clinical management of patients.

Definition: VAE's are identified by using a combination of objective criteria: deterioration in respiratory status after a period of stability or improvement on the ventilator, evidence of infection or inflammation, and laboratory evidence of respiratory infection [7].

Table 2: VAE algorithm.

Mechanical ventilation (MV) criteria	Patient has mechanical ventilator in place for 2 calendar days or more. If it is removed, then DOE must be on the day of removal or on next day.
↓	
Baseline period	Patient should have an initial period of stability or improvement of respiratory status; defined as ≥ 2 days of stable or decreasing daily minimum FiO_2 or PEEP
↓	
Ventilator associated condition (VAC)	After a baseline period, the patient should have atleast on of the following criteria of worsening of oxygenation: * Increase daily minimum FiO_2 of ≥ 0.20 sustained for ≥ 2 days * Increase daily minimum PEEP values of ≥ 3 cms of H_2O sustained for ≥ 2 days
↓	
Infection related ventilator associated condition (IVAC)	If VAC criteria is fulfilled, the IVAC can be met if the patient has both of the following criteria during the VAE window period, which is an indicator of associated infection or inflammation: * Clinical criteria: Any one of the following: Temperature>100°F, Temperature <96.8°F, WBC count ≥ 12,000 cells/mm^3 WBC count ≤4,000 cells/mm^3 * Antimicrobial agent criteria: A new antimicrobial agent is started, and continued for ≥ 4 days
↓	
Possible ventilator associated pneumonia (PVAP)	Laboratory criteria: If IVAC criteria are fulfilled, the PVAP can be met if the patient fulfills on of the following criteria during the VAE window period, which indicates laboratory confirmation of the infection: *Culture positive by quantitative or semiquantitative method *Gram stain finding of purulent respiratory secretion with culture positive by quantitative method * Non culture methods (histopathology, immunofluorescence test for respiratory viruses, Legionella).

VAE rates to be calculated as per the formula mentioned in Table 1, Formulae of calculation of various HAI infection rates.

Central Line-Associated Bloodstream Infection (CLABSI)

It is a major cause of mortality and morbidity. Patients in ICU settings are at higher risk of developing CLABSI as majority of them require long term central line.

Central line (CL)

An intravascular catheter that terminate at or close to the heart, or in one of the great vessels that is used for infusion, withdrawal of blood, or hemodynamic monitoring. Aorta, pulmonary artery, superior vena cava, inferior vena cava, brachiocephalic veins, internal jugular veins, subclavian veins, external iliac veins, common iliac veins, femoral veins and in neonates' umbilical artery/vein.

Surveillance for Central Line-Associated Bloodstream Infection (CLABSI) is carried out from the day of insertion of central line till the next day of central line removal. To establish CLABSI the following criteria to be fulfilled [8]. (1) Central line criteria: Central line is in place for >2 calendar days (day of device placement = day 1). If it is removed, then DOE must be on the day of removal or on the next day, and (2) Laboratory confirmed bloodstream infection: Any one of three laboratory confirmed bloodstream infections (LCBIs).

Laboratory Confirmed Bloodstream Infection (LCBI)

Laboratory confirmed bloodstream infection (LCBI) is a primary blood stream infection that is confirmed by a positive blood culture, and the organism isolated is not attributed to any other body site. Depending up on the organism isolated (pathogen or commensal) and presence or absence of associated symptoms, LCBI can be classified into three types (Table 3).

Table 3: Types of Laboratory Confirmed Bloodstream Infection (LCBI).

Category	*Age of the patient*	*Blood culture criteria*		*Symptom criteria (any 1 must be present)*
		Organism isolated	*Number of samples*	
LCB-1	Any age	Pathogen	1 or more	Regardless of symptoms
LCB-2	Any age	Commensal	2 or more	Fever (>38°C), chills, hypotension
LCB-3	≤ 1 year	Commensal	2 or more	Fever (>38°C), hypothermia (<36°C), apnea, bradycardia

In immunocompromised and neutropenic patients, mucosal barrier injury laboratory- confirmed blood stream infection (MBI-LCBI) surveillance criteria is followed (Table 4).

When an LCBI criterion is met, MBI-LCBI is considered if:

- Organism isolated in blood is intestinal organism (for MBI-LCBI-1) or viridians streptococci or Rothia species (for MBI-LCBI-2 and MBI-LCBI-3)
- Patient must have one of the following- (1) Allogeneic hematopoietic stem cell transplant recipient having gastrointestinal graft versus host disease or diarrhea, (2) Neutropenia.

Table 4: Types of mucosal barrier injury laboratory- confirmed blood stream infection (MBI-LCBI).

MBI-LCBI 1	*MBI-LCBI 2*	*MBI-LCBI 3*
Patient of any age fully meets LCBI 1 criteria	Patient of any age fully meets LCBI 2 criteria	Patient <1 year of age fully meets LCBI 3 criteria
With atleast one blood specimen	With atleast two matching blood specimens	
Identified by culture or non-culture based microbiology testing method		
With only intestinal organisms	With only viridans group Streptococci and / or Rothia spp & but no other organisms	

CLABSI rates to be calculated as per the formula mentioned in Table 1, Formulae of calculation of various HAI infection rates.

Surgical Site Infection (SSI)

It is one of the most common HAI and accounts for significant morbidity and mortality, accounting for

longer stay in hospital and a higher risk of death as compared to operated patients without SSI. Hence SSI surveillance is of chief importance.

Definition: Surgical site infections are defined as infections that develop at the surgical site within 30 days of surgery (or within 90 days for some surgeries such as breast, cardiac, and joint surgeries including implants) [14].

Advances made in infection control practices, improved operating room ventilation, sterilization methods, barriers, surgical technique and antimicrobial prophylaxis.

Surveillance of SSI with feedback of appropriate data to surgeons has been shown to be an important component of strategies to reduce SSI rate. Surveillance of surgical patients will occur in any inpatient facility and/ or hospital outpatient procedure department where the selected NHSN operative procedures are performed. Surveillance method include active, patient based, prospective surveillance. Both ante-discharge and post-discharge surveillance should be conducted.

SSI rate to be calculated as per the formula mentioned in table 1, Formulae of calculation of various HAI infection rates

Results

We conducted a detailed analysis of Quality indicators (QI) of HAIs in our hospital between January 2016 and December 2020. The details of total number of HAI cases and total number of device days were analyzed (Tables 5, 6, 7&8).

The table 5 shows details of number of CAUTI cases, number of urinary catheter days and CAUTI rate which was calculated as per the formula mentioned in table 1 as per the CDC/NHSN guidelines, CAUTI rate was found to be 1.03 in 2016, 0.24 in 2017, 0.25 in 2018, 0.27 in 2019 and 0.47 in 2020.

The table 6 shows details of number of VAE cases, number of mechanical ventilation days and VAE rate which was calculated as per the formula mentioned in table 1 as per the CDC/NHSN guidelines, VAE rate was found to be 5.33 in 2016, 2.10 in 2017, 2.13 in 2018, 1.18 in 2019 & 1.10 in 2020.

The table 7 shows details of number of CLABSI cases, number of central line days and CLABSI rate which was calculated as per the formula mentioned in table 1 as per the CDC/NHSN guidelines, CLABSI rate was found to be 1.58 in 2016, 0.97 in 2017, 1.22 in 2018, 1.12 in 2019 & 1.88 in 2020.

The table 8 shows details of number of SSI cases, number of surgeries done and SSI rate which was calculated as per the formula mentioned in table 1 as per the CDC/NHSN guidelines, it was found to be 0.29 in 2016, 0.18 in 2017, 0.18 in 2018, 0.12 in 2019 and 0.32 in 2020.

Table 5: Details of number of CAUTI cases, urinary catheter days and CAUTI rate- 2016-2020.

MONTH	*CAUTI*	*2016*	*2017*	*2018*	*2019*	*2020*
January	Number of CAUTI cases	3	2	1	0	3
	No. of urinary catheter days	3431	3956	4257	5079	4137
	CAUTI rate	0.8	0.5	0.23	0	0.72
February	Number of CAUTI cases	7	0	0	0	1
	No. of urinary catheter days	3878	3795	4082	3812	4061
	CAUTI rate	1.80	0	0	0	0.24
March	Number of CAUTI cases	11	3	0	2	3
	No. of urinary catheter days	3839	4018	4076	3914	4376
	CAUTI rate	2.86	0.74	0	0.51	0.68
April	Number of CAUTI cases	3	0	1	0	0
	No. of urinary catheter days	4097	4186	3754	3612	1808
	CAUTI rate	0.73	0	0.26	0	0

May	Number of CAUTI cases	3	1	1	1	1
	No. of urinary catheter days	4154	4482	4117	4326	2306
	CAUTI rate	0.72	0.22	0.24	0.23	0.43
June	Number of CAUTI cases	6	1	3	2	0
	No. of urinary catheter days	4422	3785	5918	4309	279
	CAUTI rate	1.35	0.26	0.5	0.46	0
July	Number of CAUTI cases	9	0	2	1	1
	No. of urinary catheter days	4468	3634	3694	3939	1576
	CAUTI rate	2.01	0	0.54	0.25	0.63
August	Number of CAUTI cases	2	0	3	2	0
	No. of urinary catheter days	4754	3881	4338	4379	2121
	CAUTI rate	0.42	0	0.69	0.45	0
September	Number of CAUTI cases	2	0	0	4	2
	No. of urinary catheter days	4352	4526	4232	4042	2930
	CAUTI rate	0.45	0	0	0.98	0.68
October	Number of CAUTI cases	2	1	1	1	1
	No. of urinary catheter days	4193	4255	4238	4454	2887
	CAUTI rate	0.47	0.23	0.23	0.22	0.34
November	Number of CAUTI cases	3	2	0	1	2
	No. of urinary catheter days	4108	4214	4766	4343	3295
	CAUTI rate	0.73	0.47	0	0.23	0.6
December	Number of CAUTI cases	0	2	1	0	2
	No. of urinary catheter days	3692	4416	4246	4561	3829
	CAUTI rate	0	0.45	0.23	0	0.52
Total	Number of CAUTI cases	51	12	13	14	16
	No. of urinary catheter days	49,388	49,148	51,718	50,770	33,605
	CAUTI rate	1.03	0.24	0.25	0.27	0.47

Table 6: Details of number of VAE cases, mechanical ventilation days and VAE rate-2016-2020.

MONTH	*VAE*	*2016*	*2017*	*2018*	*2019*	*2020*
January	Number of VAE Cases	4	2	1	0	2
	No. of mech ventilation days	700	968	911	885	912
	VAE rate	5.71	2.06	1.09	0	2.19
February	Number of VAE Cases	5	3	3	0	3
	No. of mech ventilation days	791	823	981	825	772
	VAE rate	6.32	3.64	3.05	0	3.88
March	Number of VAE Cases	4	2	2	1	1
	No. of mech ventilation days	696	877	775	777	573
	VAE rate	5.74	2.28	2.58	1.28	1.74

April	Number of VAE Cases	5	3	3	1	0
	No. of mech ventilation days	788	888	722	825	431
	VAE rate	6.34	3.37	4.15	1.21	0
May	Number of VAE Cases	2	5	3	0	1
	No. of mech ventilation days	625	1109	866	797	596
	VAE rate	3.20	4.50	3.4	0	1.67
June	Number of VAE Cases	2	4	3	0	0
	No. of mech ventilation days	758	734	759	828	915
	VAE rate	2.63	5.44	3.95	0	0
July	Number of VAE Cases	6	0	2	1	1
	No. of mech ventilation days	817	716	624	664	558
	VAE rate	7.34	0	3.20	1.5	1.79
August	Number of VAE Cases	12	2	3	1	0
	No. of mech ventilation days	989	905	749	863	1510
	VAE rate	12.1	2.20	4.0	1.15	0
September	Number of VAE Cases	5	0	1	1	0
	No. of mech ventilation days	886	1155	808	932	924
	VAE rate	5.64	0	1.23	1.07	0
October	Number of VAE Cases	3	1	1	2	0
	No. of mech ventilation days	949	1072	1140	892	764
	VAE rate	3.16	0.93	0.87	2.24	0
November	Number of VAE Cases	3	3	0	3	1
	No. of mech ventilation days	1062	1218	995	947	893
	VAE rate	2.82	2.46	0	3.16	1.11
December	Number of VAE Cases	4	0	0	2	2
	No. of mech ventilation days	868	1062	987	906	781
	VAE rate	4.60	0	0	2.20	2.56
Total	Number of VAE Cases	55	25	22	12	11
	No. of mech ventilation days	9,929	11,527	10,317	10,141	9,629
	VAE rate	5.53	2.1	2.13	1.18	1.1

Table 7: Details of number of CLABSI cases, central line days & CLABSI rate -2016-2020.

MONTH	*CLABSI*	*2016*	*2017*	*2018*	*2019*	*2020*
January	Number of CLABSI cases	3	2	1	2	0
	Number of central line days	1323	1047	933	953	949
	CLABSI rate	2.26	1.91	1.07	2.09	0

February	Number of CLABSI cases	3	0	2	1	2
	Number of central line days	1306	1095	901	950	867
	CLABSI rate	2.29	0	2.21	1.05	2.30
March	Number of CLABSI cases	4	0	1	0	4
	Number of central line days	1237	1328	1065	987	887
	CLABSI rate	3.23	0	0.93	0	4.5
April	Number of CLABSI cases	2	2	1	4	0
	Number of central line days	1314	1146	911	872	275
	CLABSI rate	1.52	1.74	1.09	4.58	0
May	Number of CLABSI cases	1	2	1	1	0
	Number of central line days	1066	1210	872	772	679
	CLABSI rate	0.93	1.65	1.14	1.29	0
June	Number of CLABSI cases	3	1	3	0	0
	Number of central line days	1093	883	872	819	875
	CLABSI rate	2.74	1.13	3.44	0	0
July	Number of CLABSI cases	2	2	0	1	1
	Number of central line days	1295	1100	717	818	519
	CLABSI rate	1.54	1.81	0	1.2	1.92
August	Number of CLABSI cases	2	0	2	1	1
	Number of central line days	1117	1116	843	927	603
	CLABSI rate	1.79	0	2.37	1.07	1.65
September	Number of CLABSI cases	1	1	1	0	1
	Number of central line days	1175	1189	822	820	820
	CLABSI rate	0.85%	0.84	1.21	0	1.21
October	Number of CLABSI cases	2	1	0	1	3
	Number of central line days	1120	1040	933	822	1064
	CLABSI rate	1.78	0.96	0	1.21	2.81
November	Number of CLABSI cases	0	1	1	1	3
	Number of central line days	1348	1058	933	964	1163
	CLABSI rate	0	0.94	1.07	1.03	2.57
December	Number of CLABSI cases	0	1	0	0	4
	Number of central line days	1142	1110	852	916	1359
	CLABSI rate	0	0.90	0	0	2.94
Total	Number of CLABSI cases	23	13	13	12	19
	Number of central line days	14,536	13,327	10,654	10,620	10,060
	CLABSI rate	1.58	0.97	1.22	1.12	1.88

Table 8: Details of number of SSI cases, number of surgeries done & SSI rate- 2016-2020.

Month	*Surgical site infections*	*2016*	*2017*	*2018*	*2019*	*2020*
January	Number of SSI cases	4	1	1	0	4
	Number of surgeries done	1126	1107	1134	1206	1303
	SSI rate	0.35%	0.09%	0.08%	0	0.30%
February	Number of SSI cases	5	1	1	0	5
	Number of surgeries done	1126	1158	1161	1190	1220
	SSI rate	0.44%	0.08%	0.08%	0	0.40%
March	Number of SSI cases	4	1	1	2	3
	Number of surgeries done	1390	1319	1305	1240	928
	SSI rate	0.28%	0.07%	0.07%	0.16%	0.32%
April	Number of SSI cases	2	4	3	3	2
	Number of surgeries done	1391	1299	1145	1260	322
	SSI rate	0.14%	0.30%	0.26%	0.23%	0.62%
May	Number of SSI cases	4	5	2	1	0
	Number of surgeries done	1403	1402	1425	1435	667
	SSI rate	0.28%	0.35%	0.14%	0.06%	0
June	Number of SSI cases	4	3	3	2	1
	Number of surgeries done	342	1282	1320	1392	736
	SSI rate	1.16%	0.23%	0.22%	0.14%	0.13%
July	Number of SSI cases	4	3	3	1	2
	Number of surgeries done	1372	1196	1374	1538	487
	SSI rate	0.29%	0.25%	0.21%	0.06%	0.41%
August	Number of SSI cases	6	2	3	2	2
	Number of surgeries done	1263	1217	1310	1323	455
	SSI rate	0.47%	0.16%	0.22%	0.15%	0.43%
September	Number of SSI cases	6	3	3	1	0
	Number of surgeries done	1163	1250	1221	1267	796
	SSI rate	0.51%	0.24%	0.24%	0.07%	0
October	Number of SSI cases	1	1	1	0	6
	Number of surgeries doe	1184	1148	1276	1263	922
	SSI rate	0.08%	0.08%	0.07%	0	0.65%
November	Number of SSI cases	1	2	3	2	3
	Number of surgeries done	1196	1304	1295	1263	1015
	SSI rate	0.08%	0.15%	0.23%	0.15%	0.29%
December	Number of SSI cases	1	2	4	5	4
	Number of surgeries done	1168	1245	1037	1255	1145
	SSI rate	0.08%	0.16%	0.38%	0.39%	0.34%
Total	Number of SSI cases	42	28	28	19	32
	Number of surgeries done	14,124	14,927	15,003	15,632	9,996
	SSI rate	0.29	0.18	0.18	0.12	0.32

We further analyzed the cumulative data of 5 years for each HAI following the formulae proposed by CDC/NHSN guidelines. Data revealed, HAI rates were highest for VAE (2.42/ 1000 ventilator days), the next was CLABSI (1.35/ 1000 central line days), followed by CAUTI (0.45/1000 urinary catheter days). SSI rate was (0.21/ 100 surgeries) as shown in Table 9.

Prior to this study in 2016, we standardized our institutional benchmarks as 2 for CAUTI, 5.5 for VAE and 3 for CLABSI by considering CDC/ NHSN, INICC and multicentric pooled Indian benchmarks figure as the standard [12]. For SSI rate, we established 2 as baseline benchmark on the basis of previous SSI rates of our own institutional record. There is no bench mark figure for SSI available from any national or international organization.

Table 10 shows cumulative data (5 years) of QI for HAI revealed that HAI rate of our institution was almost always maintained below the benchmark. Eventually, we were able to reduce the baseline benchmark and establish our new benchmark as 1 for CAUTI, 3 for VAE, 2 for CLABSI and 1 for SSI that can be used in developing HAI prevention policies by other institutions.

Table 9: Cumulative data of 5 years (2016 to 2020).

Type of HAI	*Number of Infections*	*Number of device days/ number of surgeries*	*Rate*
CAUTI	106	2,34,629	0.45
VAE	125	51,543	2.42
CLABSI	80	59,197	1.35
SSI	149	69,682	0.21

Table 10: Mapping of HAI rates of KIMS hospitals with CDC/NHSN, INICC and 2 Multicentric pooled Indian data.

Type of HAI	*CDC/NHSN Benchmark*	*INICC Bench mark*	*Multicentric Pooled Indian data from 4 Hospitals (NABH) Bench mark.*	*Multicentric Pooled Indian data from 40 hospitals by Dr Rosenthal VD*	*KIMS benchmark*	*Observed HAI rates*	*New Benchmark (After 5-year study)*
CAUTI	2.09	6.5	1.63	2.1	2	0.45	1
VAE	1.43	19.5	6.74	9.4	5.5	2.42	3
CLABSI	1.02	6.12	2.42	5.1	3	1.35	2
SSI	--	--	--	--	2	0.21	1

Note: In the studies of CDC-/NHSN, INICC, multicentric pooled data from 4 Indian Hospitals (NABH) & 40 hospitals from 20 cities by Rosenthal VD, the term Ventilator Associated Pneumonia (VAP) was used. However, in the present study the term Ventilator Associated Event (VAE) is used.

Discussion

Centre for Disease Control/National Healthcare Safety Network (CDC/NHSN) HAI rates are globally considered bench mark of health care associated infection [15].

The International Nosocomial Infection Control Consortium (INICC) data for HAI rates are used for comparison by developing and underdeveloped countries. It is an international, nonprofit, multicentric health care–associated infection (HAI) cohort surveillance network with a methodology based on the U.S. Centers for Disease Control and Prevention's National Healthcare Safety Network (CDC-NHSN). The INICC was founded in 1998 to promote evidence-based infection control in limited-resource countries for better health care delivery [16].

A study was conducted by Rosenthal VD on device associated infection rates, among 20 cities of India from 2004 to 2013. Our organization was a part of the study. In the study, it was observed that device associated HAI rate as 5.1 CLABSI/1,000 central line days, 9.4 VAP/1,000 mechanical ventilator days and 2.1 CAUTI/1,000 urinary catheter days.

Although National guidelines on HAI prevention and control are available, there is no definite benchmark from Indian hospital is available in published journals [17].

The trend of various HAI's in the present study are shown in Figures 1. Hence the present study aimed to find out HAI trends and to establish the benchmark figure for our institution.

It is evident from our study, the VAE rate is the highest among all HAIs, therefore, a matter of prime concern. In comparison to INICC data and both multicentric pooled Indian data, present study showed significantly better performance but lower performance than CDC/NHSN data (Table 10). There could be a possibility that prevalent hospital care delivery system, better infection control policies and their implementation measures in developed countries (US) are advanced than those of developing countries such as India. CLABSI rate was significantly better in our study than INICC & pooled Indian study and almost comparable with CDC/NHSN data.

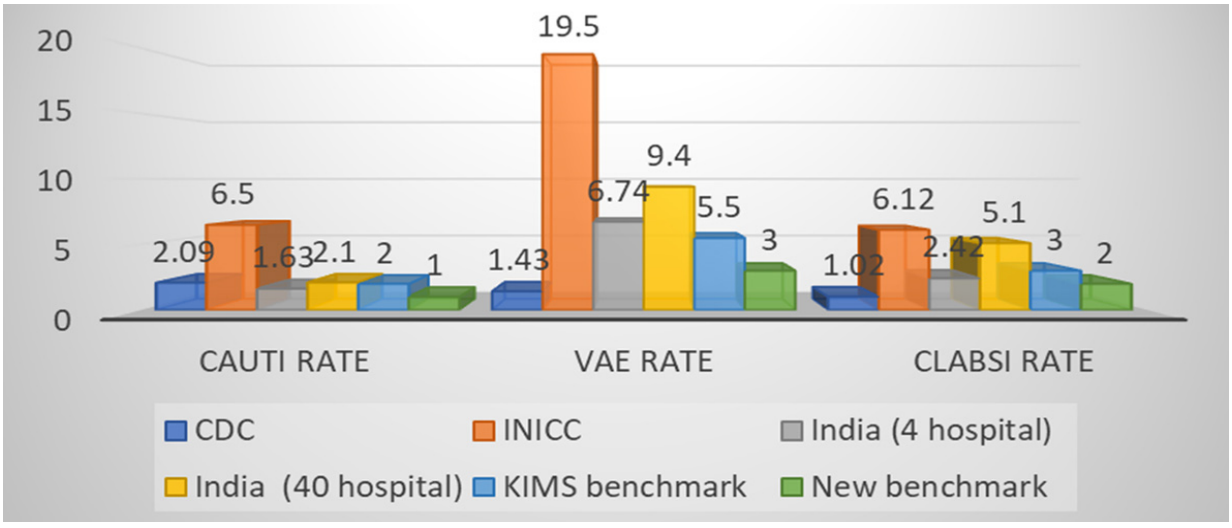


Figure 1: Comparison of various HAI rates of present study with CDC-NHSN, INICC, Indian pooled data & Observed rate.

The CAUTI rate was found to be much lower than VAE and CLABSI rate. Surprisingly, CAUTI rate was significantly lower in our study findings as compared to Indian hospital benchmarks, INICC benchmark and even CDC/NHSN benchmark. SSI rate was found lower than our institutional standard benchmark although SSI surveillance was the most challenging to conduct among all HAI types.

Conclusion

Findings of our study revealed, gradual reduction in major HAI rates in the institution, which further suggest that the existence of evidence-based guidelines results in better infection control in the hospital. This information (HAI trends and benchmark) may further help to formulate the infection control policies for implementation of effective hospital infection prevention & control practices and antimicrobial stewardship at the institutional level in India.

Acknowledgement

We thank Ms. Lavanya Sirikonda, Jr. Computer Operator for Hospital Infection Control (HIC), KIMS hospital, Secunderabad for maintaining the Quality Indicator data.

Conflicts of interest

Authors declare no conflicts of interest.

References

[1] Ministry of Health and Family Welfare Government of India. National Guidelines for Infection Prevention and Control in Healthcare Facilities. National Centre for Disease Control, Directorate General of Health Services Ministry of Health and Family Welfare, Government of India, January 2020. Available from: https://cdn.who.int/media/docs/default-source/searo/india/antimicrobial-resistance/ipcguidelines-web-sep2020.pdf?sfvrsn=9e77fcb0_2

[2] Foxman B. Epidemiology of urinary tract infections: incidence, morbidity and economic costs. Am J Med. 2002; 113(Suppl 1A):5S–13S.

[3] Kamat US, Fereirra A, Amonkar D, Motghare DD, Kulkarni MS. Epidemiology of hospital acquired urinary tract infections in a medical college hospital in Goa. Indian J Urol. 2009; 25(1):76–80.

[4] Centres for Disaese Control and Prevention 2019. National Healthcare Safety Network (online). Available from: https://www.cdc.gov/nhsn/index.html/.

[5] Sastry SA, Deepashri R. Text Book. Essential of hospital infection control. Haryana: Jaypee Brothers Medical Publishers (P) Ltd, 2019. Chapter 4, Surveillance of Healthcare-associated Infections; Page 90.

[6] Centres for Disaese Control and Prevention 2017. National Healthcare Safety Network. Pneumonia (Ventilator-associated (VAP) and non-ventilator-associated Pneumonia (PNEU) Event. Available from: https://www.cdc.gov/nhsn/pdfs/pscmanual/6pscvapcurrent.pdf

[7] Centres for Disaese Control and Prevention 2018. National Healthcare Safety Network. Ventilator Associated Event (VAE). Available from: https://www.cdc.gov/nhsn/pdfs/pscmanual/10-vae_final.pdf

[8] Centres for Disaese Control and Prevention 2018. National Healthcare Safety Network. Bloodstream Infection Event (Central Line-Associated Bloodstream Infection and Non-central Line Associated Bloodstream Infection). Available from: https://www.cdc.gov/nhsn/pdfs/pscmanual/4psc_clabscurrent.pdf

[9] Zimlichman E. Health Care Associated Infections. A Meta -analysis of Costs and Financial Impact on the US Health Care System. JAMA Intern Med. 2013; 173(22):2039–2046.

[10] Sastry SA, Deepashri R. Text Book. Essential of Hospital Infection Control. 1st ed. Haryana: Jaypee Brothers Medical Publishers (P) Ltd, 2019. Chapter 4, Surveillance of Healthcare-associated Infections; Page 103.

[11] National Accreditation Board for Hospitals and Healthcare Providers (NABH). Accreditation Standards for Hospitals. 4th Edition guidebook. Chapter 5, Hospital Infection Control (HIC) Page 54–62.

[12] Singh S, Chakravarthy M, Sengupta S, Munshi N, Jose T, et al. Analysis of a multi-centric pooled healthcare associated infection data from India: New insights. The Journal of National Accreditation Board for Hospitals & Healthcare Providers. 2014; 1(2):39.

[13] Centres for Disaese Control and Prevention 2016. National Healthcare Safety Network. Urinary Tract Infection (Catheter-Associated Urinary Tract Infection (CAUTI) and Non Catheter-Associated Urinary Tract Infection (UTI) and other Urinary System Infection (USI) events.

[14] Centres for Disaese Control and Prevention 2016. National Healthcare Safety Network. Surgical Site Infection (SSI) events. Procedure-associated Module.

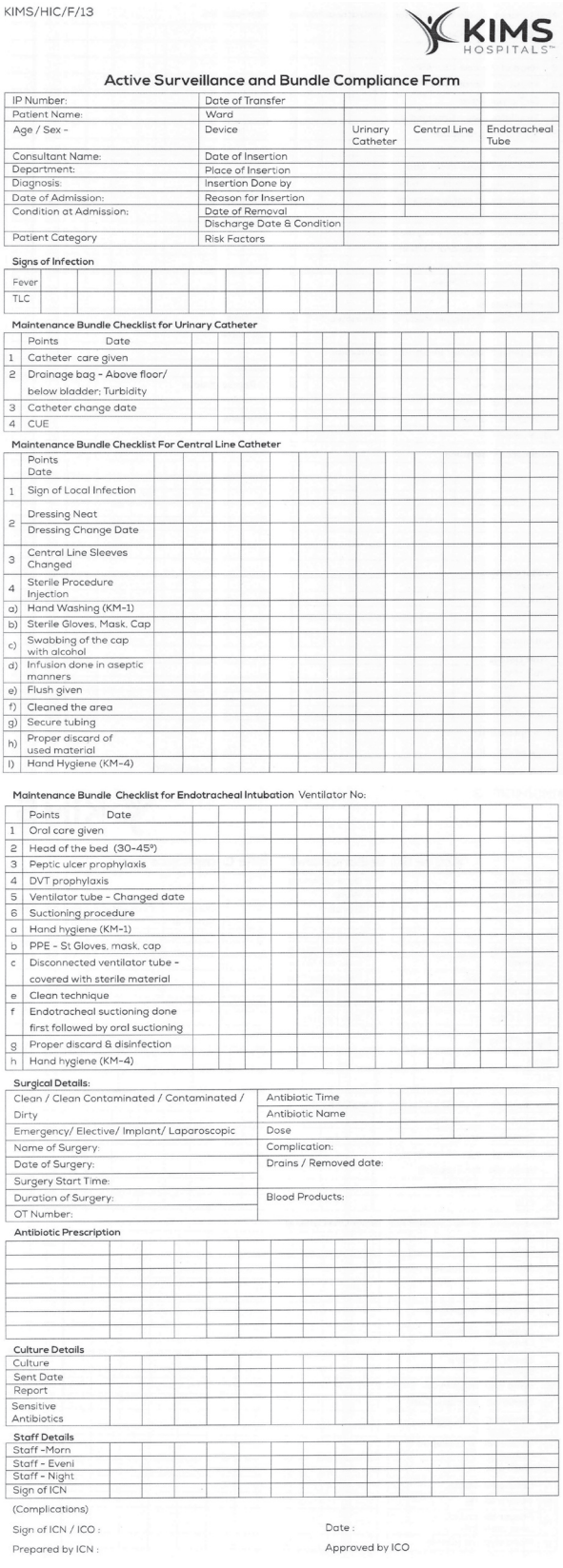
[15] Emori TG, Culver DH, Horan TC, Jarvis WR, White JW, et al. National Nosocomial Infection Surveillance System (NNIS): Description of surveillance methods. Am J Infect Control. 1991; 19(1):19–35.

[16] Rosenthal VD, Maki DG, Mehta A, Alvarez-Moreno C, Leblebicioglu H, et al. International nosocomial infection control consortium report, data summary for 2002-2007, issued January 2008. Am J Infect Control. 2008; 36(9):627–637.

[17] Mehta Y, Jaggi N, Rosenthal VD, Kavathekar M, Sakle A, et al. Device-associated infection rates in 20 cities of India, data summary for 2004–2013: findings of the international nosocomial infection control consortium. infection control & hospital epidemiology. 2016; 37(2):172–181.

Supplemental Figures

http://dx.doi.org/10.17727/JMSR.2021/9-20



KIMS/HIC/F/13

KIMS HOSPITALS

Active Surveillance and Bundle Compliance Form

IP Number:	Date of Transfer			
Patient Name:	Ward			
Age / Sex -	Device	Urinary Catheter	Central Line	Endotracheal Tube
Consultant Name:	Date of Insertion			
Department:	Place of Insertion			
Diagnosis:	Insertion Done by			
Date of Admission:	Reason for Insertion			
Condition at Admission:	Date of Removal			
	Discharge Date & Condition			
Patient Category	Risk Factors			

Signs of Infection

Fever														
TLC														

Maintenance Bundle Checklist for Urinary Catheter

	Points Date													
1	Catheter care given													
2	Drainage bag - Above floor/ below bladder; Turbidity													
3	Catheter change date													
4	CUE													

Maintenance Bundle Checklist For Central Line Catheter

	Points Date													
1	Sign of Local Infection													
2	Dressing Neat													
	Dressing Change Date													
3	Central Line Sleeves Changed													
4	Sterile Procedure Injection													
a)	Hand Washing (KM-1)													
b)	Sterile Gloves, Mask, Cap													
c)	Swabbing of the cap with alcohol													
d)	Infusion done in aseptic manners													
e)	Flush given													
f)	Cleaned the area													
g)	Secure tubing													
h)	Proper discard of used material													
i)	Hand Hygiene (KM-4)													

Maintenance Bundle Checklist for Endotracheal Intubation Ventilator No:

	Points Date													
1	Oral care given													
2	Head of the bed (30-45°)													
3	Peptic ulcer prophylaxis													
4	DVT prophylaxis													
5	Ventilator tube - Changed date													
6	Suctioning procedure													
a	Hand hygiene (KM-1)													
b	PPE - St Gloves, mask, cap													
c	Disconnected ventilator tube - covered with sterile material													
e	Clean technique													
f	Endotracheal suctioning done first followed by oral suctioning													
g	Proper discard & disinfection													
h	Hand hygiene (KM-4)													

Surgical Details:

Clean / Clean Contaminated / Contaminated / Dirty	Antibiotic Time			
	Antibiotic Name			
Emergency/ Elective/ Implant/ Laparoscopic	Dose			
Name of Surgery:	Complication:			
Date of Surgery:	Drains / Removed date:			
Surgery Start Time:				
Duration of Surgery:	Blood Products:			
OT Number:				

Antibiotic Prescription

Culture Details

Culture														
Sent Date														
Report														
Sensitive Antibiotics														

Staff Details

Staff -Morn														
Staff - Eveni														
Staff - Night														
Sign of ICN														

(Complications)

Sign of ICN / ICO :

Date :

Prepared by ICN :

Approved by ICO

Supplemental Figure 1: Active surveillance form.

KIMS/HIC/F/05

KIMS HOSPITALS

Catheter Associated Urinary Tract Infection (CAUTI) Passive Surveillance Form

Name -
Doctor -
Date of Admission
Presence of indwelling Urinary Catheter - Yes / No
If Yes, - Catheter in place for >48hrs / 2 days - Yes / No
-Present on Date of Event - Yes / No
Date of Catheter Insertion -
Ward on Date of Event -
Ward of Catheter Removal -

Age/Sex -
Diagnosis -
Date of Event -
Type of Catheter :
I.P.No. -
Ward of Catheter Insertion -
Type of catheter used -

Signs / Symptoms during window period & with no other obvious recognised cause (Urgency, Frequency, Dysuria are not recorded if patient is catheterised)

Costovertebal Angle Pain or tenderness	-3 D before	-2 D before	-1 D before	DOE	1 D r	1 D r	2 D r	3 D
Fever (>38°C/ 100.4°F)								
Costovertebal Angle Pain or tenderness								
Suprapubic tenderness								
In <1yr Hypothermia (<36°C);								
Apnea / Bradycardia								
Lethargy / Vomiting								

CUE Report -
Culture Report of Urine Clean Catch / Catheter Catch -

Date of sample collection -
Organism Isolated -
Colony Count -
Drug Susceptibility -

Secondary Blood Stream Infection (Positive Blood Culture) - Yes/No If Yes, mention details -
Date of Patient Discharge -
Condition of Patient at Discharge -
To be reported when Catheter is not in place.

HIC Workup:-
Patient Category: MDR Infection: Yes / No. Risk Factors:

- ☐ Meets UTI Criteria
- ☐ Meets Criteria for Catheter Associated Symptomatic Urinary Tract Infection (CAUTI)
- ☐ Meets Criteria for Catheter Associated Asymptomatic Bacteremic UTI (CAUTI)
- ☐ Meets Criteria for Non-Catheter Associated Symptomatic Bacteremic UTI
- ☐ Meets Urinary System Infection Criteria

Treating Doctor / In Charge Sign :
ICN Sign :
Date :
ICO Sign :
Date :

Note: As Per CDC 2021 Criteria

Supplemental Figure 2: Passive surveillance form of CAUTI.

KIMS/HIC/F/04

KIMS HOSPITALS

Ventilator Associated Event and Possible Ventilator Associated Pneumonia Passive Surveillance Form

Patient Name -
Age / Sex -
IP No -
Doctor Name -
Diagnosis -
Date of Event -
Ward -
Date of Intubation -
Ward of Intubation -
Date of Extubation -
Ward of Extubation -
Nature of Event -

Date	Minimum PEEP (Stable over 1 hour)	Minimum Fi O2 (Stable over 1 hour)	Temp Min / Max	WBC Count	Antibiotic Used
DOE -					

Patient has mechanical ventilator (MV) in place for 2 days or more	Yes / No
If removed: MV was in place on the day of sample collection or the day before	Yes / No
Patient has a baseline period of stability or improvement on the ventilator, defined by ≥ 2 calendar days of stable or decreasing daily minimum* FiO2 or PEEP values. The baseline period is defined as the 2 calendar days immediately preceding the first day of increased daily minimum PEEP or FiO2. *Daily minimum defined by lowest value of FiO2 or PEEP during a calendar day that is maintained for > 1 hour.	Yes / No
After a period of stability or improvement on the ventilator, the patient has at least one of the following indicators of worsening oxygenation: 1) Increase in daily minimum* FiO2 of ≥ 0.20 (20 points) over the daily minimum FiO2 of the first day in the baseline period, sustained for ≥ 2calendar days. 2) Increase in daily minimum* PEEP values of ≥ 3 cmH2O over the daily minimum PEEP of the first day in the baseline period†, sustained for ≥ 2calendar days. Note: For Pediatric VAE (Ped VAE)- 1. ↑ Dialy minimum FiO2 of ≥0.25 is considered significant in contrast to ≥ 0.20 in adult-VAE 2. ↑Daily minimum MAP values of ≥ 4cm H2O is considered significant in contrast ≥ 3 cm H2O of PEEP in adult-VAE	Yes / No Yes / No Yes / No Yes / No
On or after calendar day 3 of mechanical ventilation and within 2 calendar days before or after the onset of worsening oxygenation, the patient meets both of the following criteria: 1) Temperature > 38 °C or < 36°C, 2) White blood cell count ≥12,000 cells/mm3 or ≤4,000 cells/mm3AND 3) A new antimicrobial agent(s) (see Appendix for eligible antimicrobial agents) is started, and is continued for ≥4 calendar days.	Yes / No Yes / No Yes / No
1. Positive Quantitative/ semi quantitative culture (ET aspirate ≥ 10^5 CFU/ml ; BAL ≥ 10^4 CFU/ml; Lung tissue ≥ 10^4 CFU/g 2. Qualitative culture plus Gram stain	

Note: As per CDC 2021 Criteria

3. One of the following positive tests : Lung histopathology abscess formation or foci of consolidation with intense neutrophil accumulation in bronchioles and alveoli, evidence of lung parenchyma invasion by fungi (hyphae, pseudohyphae or yeast forms)	Yes / No
Viral Pathogens - Evidenceof infection with the viral pathogens listed below based on results of immunohistochemical assays, cytology, or microscopyperformed on lung tissue	Yes / No
Diagnostic test on respiratory secretions for influenza virus, respiratory syncytial virus, adenovirus, parainfluenzavirus,rhinovirus, human metapneumovirus, coronavirus	Yes / No
Diagnostic test for Legionella species	Yes / No

Ventilator-Associated Events (VAE) Surveillance Algorithm

Mechanical ventilation criteria
2 days of Baseline period- Stable or decreasing oxygenation (dm FiO2 or dm PEEP)

↓

2 days: Worsening oxygenation (↑ dm FiO2 or ↑ dm PEEP)
Ventilator Associated Condition (VAC)

↓

VAC + (Fever or hypothermia in < 1yr age or High/ low WBC count) + New antimicrobial for 4 days
Infection related Ventilator associated Complication (IVAC)

↓

IVAC + Positive Quantitative or semi quantitative culture
Possible Ventilator Associated Pneumonia (PVAP)

Type of Sample - Sample sent on-
Sputum / Endotracheal aspirate / Broncho-alveolar lavage / Lung tissue /Protected specimen brush / Pleural Fluid

Nature of Secretion - Purulent / Non purulent
Culture Sent - Yes / No Culture
Positive - Yes/ /No
If Yes, Colony Count - 103 /104 / 105
Name of Organism -
Antibiotic Sensitivity -
Date of Patient Discharge - Condition of Patient at Discharge -

HIC Work Up
Patient Category: MDR Infection: Yes / No Risk Factors:

Ventilator-Associated Condition (VAC) /Infection-related Ventilator-Associated Complication (IVAC)
Possible Ventilator-Associated Pneumonia (PVAP)/ PNEU 1 / PNEU 2 / PNEU 3

ICN Sign:
ICO Sign:

Supplemental Figure 3: Passive surveillance form of VAE.

KIMS/HIC/F/06

KIMS HOSPITALS

Central Line Associated Blood Stream Infection Passive Surveillance Form

Patient Name -	Ward -
Age / Sex -	Date of Central Line Insertion -
IP No -	Ward of Insertion -
Doctor Name -	Date of Insertion -
Diagnosis -	Ward of Removal -
Date of Event -	Type of Catheter - Temporary / Permanent
	Site of Catheter -

Any hemodialysis catheter present : Yes / No
Extracorporeal life support present (e.g. ECMO) : Yes / No
Ventricular assist device (VAD) present : Yes / No

Signs & Symptoms (check all that apply)
Any Patient

- ☐ Fever > 38°C
- ☐ Chills
- ☐ Hypotension
- ☐ Bradycardia, Apnea, Hypothermia < 36°C - < 1 year

Laboratory (check one)

- ☐ Recognized pathogen from one or more blood cultures
- ☐ Common commensal from ≥2 blood cultures from 2 different sites as separate occassions

Date	-3D before	- 2Dbefore	-1 D before	Date of Event	1 D	2D	3D
Signs / Symptoms							

Date of Blood Culture Sent -
Blood Culture Sent - Yes / No
Culture Positive - Yes / No
Organism Isolated -
Antibiotic Sensitivity -

Secondary Blood Stream Infection - Yes / No If Yes, mention Details -

Date of Patient Discharge -
Condition of Patient at Discharge -

HIC Workup:-

Patient Category: MDR Infection: Yes / No Risk Factors:

Note: As per CDC 2021 Criteria

- ☐ **Primary CLABSI**
- ☐ **Secondary BSI**
- ☐ **LCBI 1** - A Laboratory Confirmed Bloodstream Infection (LCBI) that is not secondary to an infection at another body site
- ☐ **LCBI 2** - Patient of any age has at least one of the following signs or symptoms:
  fever (>38.0oC), chills, or hypotension AND
  Organism(s) identified in blood is not related to an infection at another site
  and The same common commensal is identified by a culture or (non-culture based microbiologic testing method), from two or more blood specimens collected on separate occasions
- ☐ **LCBI 3** - Patient ≤ 1 year of age has at least one of the following signs or symptoms:
  fever (>38.0oC), hypothermia (<36.0oC), apnea, or bradycardia AND
  Organism(s) identified in blood is not related to an infection at another site
  and The same common commensal is identified by a culture or (non-culture based microbiological testing method), from two or more blood specimens collected on separate occasions (see Blood Specimen Collection).

Culture should be present ≥2 Calendar days - Yes / No

Patient meets at least one of the following: Yes / No

1. Is an allogeneic hematopoietic stem cell transplant recipient within the past year with one of the following documented during same hospitalization as positive blood specimen:
   a. Grade III or IV gastrointestinal graft versus host disease [GI GVHD]
   b. ≥1-liter diarrhea in a 24-hour period (or ≥20 mL/kg in a 24-hour period for patients <18 years of age) with onset on or within the 7 calendar days before the date the positive blood specimen was collected.
2. Is neutropenic, defined as at least two separate days with ANC† and/or WBC values <500 cells/mm3 collected within a 7-day time period which includes the collection date of the positive blood specimen, the 3 calendar days before and the 3 calendar days after

MBI-LCBI 1 ☐	MBI-LCBI 2 ☐	MBI-LCBI 3 ☐
Patient of any age fully meets LCBI 1 criteria	Patient of any age fully meets LCBI 2 criteria	Patient <1 year of age fully meets LCBI 3 criteria
with at least one blood specimen	with at least two matching blood specimens	
identified by culture or non-culture based microbiologic testing method		
with only intestinal organisms	with only viridans group Streptococci and / or Rolhiospp & but no other organisms	

Treating Doctor / InCharge Sign: Date :
ICN Sign: ICO Sign:
Date

Supplemental Figure 4: Passive surveillance form of CLABSI.

KIMS/HIC/F/07

KIMS HOSPITALS

Surgical Site Infection Passive Surveillance Form

Name : Age/Sex : I.P.No :
Doctor : Diagnosis : Ward :
DOA : DOS : DOD :
Name of Procedure : Out-patient procedure : Yes/No
Type of Procedure : Emergency / Elective Duration of Surgery :
Infection present at the time of surgery : Yes/No
Types of Surgery : Clean / Clean Contaminated / Contaminated / Dirty
Types of Closure : Primary Closure / Secondary Closure
Prophylactic Antibiotic and Timing :
Number of Surgical Site : Primary - Secondary - Primary Closure / Secondary Closure
Number of Drains : Site -
Date of Event:

Signs & Symptoms

- ☐ Fever
- ☐ Pain or tenderness
- ☐ Vomiting
- ☐ Hypothermia
- ☐ Apnea
- ☐ Bradycardia
- ☐ Cough
- ☐ Nausea
- ☐ Dysuria
- ☐ Lethargy
- ☐ Other positive laboratory tests†
- ☐ Imaging test evidence of infection
- ☐ Swelling or inflammation
- ☐ Other signs & symptoms†
- ☐ Sinus tract
- ☐ Drainage of pus - Site
- ☐ Incision deliberately opened/drained
- ☐ Wound spontaneously dehisces
- ☐ Abscess
- ☐ Other evidence of infection found on invasive procedure, gross anatomic exam, or histopathology exam, imaging

Laboratory

- ☐ Organism(s) identified – Yes / No

If Yes, Culture Report: - Sample Sent on (DOE) –
Organisms Identified –
Drug Susceptibility Pattern –

- ☐ Culture or non-culture based testing not performed
- ☐ Organism(s) identified from blood specimen
- ☐ Organism(s) identified from ≥ 2 per prosthetic specimens

Diagnosis of SSI by treating Doctors :

- ☐ **Superficial Incisional SSI**
- ☐ **Deep Incisional SSI**
- ☐ **Organ / Space SSI** (any part of the body deeper than the fascial/muscle layers) - Yes / No

Patient has at least one of the following:
1. Purulent drainage from a drain that is placed into the organ/space (for example, closed suction drainage system, open drain, T-tubedrain, CT guided drainage) - Yes / No
2. Organisms are identified from fluid or tissue in the organ/space by a culture or non-culture based microbiologic testing method which is performed for purposes of clinical diagnosis or treatment - Yes / No
3. An abscess or other evidence of infection involving theorgan/space that is detected on gross anatomical or histopathologic exam, or imaging test evidence suggestive of infection. - Yes / No

AND meets at least one criterion for a specific organ/space infection site

Secondary Blood Stream Infection (Positive Blood Culture) : Yes/No ; If Yes, mention details -
Date of Patient Discharge -
Condition of Patient at Discharge -

HIC Workup:-
Patient Category: MDR Infection – Yes/No Risk Factors:

- ☐ Superficial Incisional SSI

Deep SSI

Organ Space SSI

30-day SurveillanceCode

Operative Procedure	Operative Procedure
Abdominal aortic aneurysm repair	Laminectomy
Limb amputation	Liver transplant
Appendix surgery	Neck surgery
Shunt for dialysis	Kidney surgery
Bile duct, liver or pancreatic surgery	Ovarian surgery
Carotid endarterectomy	Prostate surgery
Gallbladder surgery	Rectal surgery
Colon surgery	Small bowel surgery
Cesarean section	Spleen surgery
Gastric surgery	Thoracic surgery
Heart transplant	Thyroid and/or parathyroid surgery
Abdominal hysterectomy	Vaginal hysterectomy
Kidney transplant	Exploratory Laparotomy

90-day SurveillanceCode

Operative Procedure
Breast surgery
Cardiac surgery
Coronary artery bypass graft with both chest and donor site incisions
Coronary artery bypass graft with chest incision only
Craniotomy
Spinal fusion
Open reduction of fracture
Herniorrhaphy
Hip prosthesis
Knee prosthesis
Pacemaker surgery
Peripheral vascular bypass surgery
Ventricular shunt

Specific Sites of an Organ/Space SSI.

Osteomyelitis	Mediastinitis
Breast abscess or mastitis	Meningitis or ventriculitis
Myocarditis or pericarditis	Oral cavity (mouth, tongue, or gums)
Disc space	Other infections of the male or female reproductive tract
Ear, mastoid	Per prosthetic Joint Infection
Endometritis	Spinal abscess without meningitis
Endocarditis	Sinusitis
GI tract	Upper respiratory tract
Intraabdominal, not specified	Urinary System Infection
Intracranial, brain abscess or dura	Arterial or venous infection
Joint or Bursa	Vaginal cuff
Other infections of the lower respiratory tract	

Treating Doctor Sign :
ICN Sign: ICO Sign:
Date: Date:

Note: As per CDC 2021 Criteria

Supplemental Figure 5: Passive surveillance form of SSI.