

# Hospital Associated Infection Surveillance in a Tertiary Care Hospital

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**Abstract:** ***Introduction:** Surveillance for endemic HAIs is important to measure their burden, identify high risk populations and procedures and guide efforts to reduce HAI incidence. Health care workers are critical in implementation of infection prevention and control measures. Appropriate use of disinfectants and cleaning agents helps to prevent cross contamination. **Methods:** A prospective study was carried out for a period of one and a half year in which the activities of infection control program at SKIMS were studied by observational and record study. The infection control practices were studied for a period of six months by observational study. **Results:** On reviewing records, it was noted that infection control committee meets every two to three months or as per the need. The minutes of these meetings were perused. It was noted that a schedule for fogging of all patient care areas including OT's, wards, CSSD etc was being circulated every six months. On the day of fogging the patients would be taken out of wards, thorough cleaning of wards including beds, bedside lockers etc would be carried out by surface disinfectant. This would be followed by fogging with fogging solution. In Intensive care areas thorough cleaning of patient care area would be carried out by detergent which would be followed by surface disinfection of beds, bedside lockers etc by disinfectants. **Discussion:** Hospitals need to adopt infection control practices to reduce adverse impact on hospitals. The importance of Disinfection practices under supervision of Infection Control Committee has proved effective by improvement in clinical symptoms of patients and sterility of swabs taken post disinfection. Growth of Burkholderia Cepacia complex from fresh ECG gel is alarming. Hospitals need to invest more in infection control processes. Three infection control nurses for 1015 beds is too low whereas the recommendation is one infection control nurse for 100 beds. In this study we can see that more instances of nosocomial infection outbreaks have been reported from intensive care areas rather than wards. **Conclusion:** There is a robust infection control program at SKIMS, however more infection control nurses need to be there to improve surveillance and post surveillance control measures. Poor nursing ratio in patient care areas needs to be addressed as it negatively effects practices of infection control.*

**Keywords:** health care associated infections, infection control, surveillance, antibiotic resistance, hospital outbreaks

## 1. Introduction

### Hospital Associated infection surveillance in a tertiary care Hospital

Surveillance for endemic HAIs is important to measure their burden, identify high risk populations and procedures and guide efforts to reduce HAI incidence. HAI surveillance is a core component of infection and control programmes worldwide. The risk of acquiring HAI varies between countries and is up to 20 times higher in low- and middle-income countries. In a global survey, the prevalence of resistance to antibiotics including third generation cephalosporins and carbapenems among Enterobacteriaceae was significantly higher in LMICs. High levels of resistance, including against carbapenems among Acinebacter Spp, Pseudomonas and Klebsiella spp have been reported from India.<sup>1</sup> Health care workers are critical in implementation of infection prevention and control measures. Infection control programs that include strategies such as hand hygiene, personal protective equipment (PPE), environmental cleaning and surveillance have become standard. Lapses in proper sterilization techniques, overcrowding and insufficient implementation of standardized infection control protocols collectively contribute to the proliferation of HAIs. To stop the transmission of diseases, hospital rooms, equipment and surfaces need to be cleaned and disinfected regularly.

Appropriate use of disinfectants and cleaning agents helps to prevent cross contamination. Infectious disease outbreaks should be detected and reported and relevant control measures should be put in place in hospitals.<sup>2</sup> Surveillance of health care associated infections is limited and even in U.S hospitals focus is on just few health care associated infections: hospital onset Clostridioides difficile, central venous associated blood stream infections, catheter associated urinary tract infections, methicillin resistant Staphylococcus aureus (MRSA) bacteremia, surgical site infections. This approach results in many serious infections going unmonitored, which undermines efforts to understand and prevent the full breadth of nosocomial infections.<sup>3</sup> Therefore surveillance of infections needs to be done both for device associated infections and in other areas where there is less use of these devices ie in areas outside intensive care areas. The vital link between infection control programs and reduced rates of infections is already established.<sup>3</sup>

The surveillance has been recognized as the major component of infection control since late 1970s. It has been observed that there was a decrease in HAI rates on average 32% in hospitals with well-documented surveillance program in place over a 5-year period as compared with an increase of 18% in other hospitals without any such program. Epidemiological intervention following surveillance, control at the

administrative level for medical devices used for critical patients as well as for the HCWs working in hospital setups, and also, control of biomedical engineering parameters are among others, the major distinct surveillance components in controlling HAIs.<sup>4</sup>

SKIMS is a 1015 bedded superspeciality hospital in north India where Infection Control Programme has been in place since a decade with Infection Control Committee being chaired by Medical Superintendent, Hod Microbiology vice chairman, representation from Infection Unit of General Medicine, General Medicine, surgery, Pediatrics, Gynaecology, Anaesthesiology, Nursing Supdt and three infection control nurses. Infection control nurses do surveillance for infections and is being supported by Department of Microbiology. Regular disinfection of patient care areas is being carried out. It was thought appropriate to study the activities of infection control program at SKIMS and also the infection control practices being followed.

## 2. Methods

A prospective study was carried out for a period of one and a half year ie from 1/5/2024 to 1/12/2025 in which the activities of infection control program at SKIMS were studied by observational and record study. The record of infection control committee would be checked twice a week ie on Monday and Thursday. The infection control practices were studied for a period of six months by observational study ie 1/5/2024 to 30/11/2024. The observations were made for three days in a week in General Medicine, plastic surgery ward, neonatal and pediatric ICU; each of the above specialities were observed for two months each. Observations were made between 10 am to 4 pm.

## 3. Results

On reviewing records it was noted that infection control committee meets every two to three months or as per the need. The minutes of these meetings were perused. It was noted that a schedule for fogging of all patient care areas including OT's, wards, CSSD etc was being circulated every six months. On the day of fogging the patients would be taken out of wards, thorough cleaning of wards including beds, bedside lockers etc would be carried out by surface disinfectant. This would be followed by fogging with fogging solution. Polymeric Biguanide Hydrochloride and Quaternary Ammonium Compounds were used for fogging and surface disinfectant. In Intensive care areas thorough cleaning of patient care area would be carried out by detergent which would be followed by surface disinfection of beds, bedside lockers etc by disinfectants. In addition to the routine

schedule which was circulated need based thorough disinfection would be carried out, based on surveillance reports. SKIMS has three infection control nurses for 1015 beds. The hospital has been divided in three areas among these infection control nurses; who visit the hospital and submit their reports to infection control committee convener, who would forward these reports to HOD microbiology, concerned HOD and officer Incharge nursing administration and also put them for discussion before infection control committee. Necessary measures would be taken where in department of microbiology would take samples from these areas which would be followed by fogging and disinfection.

During the period of study seventeen instances of infection outbreaks were reported by infection control nurses based on tell- tale signs of infection like clustering of fever, non-response to treatment, wound infections, clustering of symptoms like diarrhea, respiratory symptoms etc, unexpected deterioration, multiple positive cultures showing same organism. The distribution of these outbreaks reported in different areas is as under as shown in Table 1.

**Table 1:** Outbreaks in different patient care areas during study period

S no	Patient care Area	Number of outbreaks on different dates
1	Neonatal Intensive care Unit	03
2	Neuro ICU	05
3	Critical Care Unit	03
4	Urology OT	01
5	Theatre Sterile Services Unit	01
6	CVTS ICU	01
7	Clinical Hematology	02
8	USG lab (ascitic and pleural tap)	01
9	ECG lab (ECG gel)	01

Most of these outbreaks have been in intensive care areas, one in ward, few related to operation theatre and theatre sterile services unit. One episode was reported from usg lab where ascitic and pleural tab was being done. Fresh ECG gel bottles surprisingly grew *Burkholderia Cepacia* complex.

Once these outbreaks were reported, microbiology department took swabs from different areas of these patient care units and were sent for surveillance. Immediately after swabs were taken, the infection control nurses on directions of infection control committee undertook disinfection drive in these areas by thorough cleaning by water and detergents followed by surface disinfection and fogging in areas other than ICU's. Fogging could not be done in ICU's because they would always be occupied by patients. The organisms which were grown from different surfaces on different instances in these areas is as follows.

**Table 2:** Microbiological reports of swabs taken from different surfaces of patient care areas

Patient care area	Date	Surface from which sample taken	Organism
Nicu (Neonatal)	11.5.24	Bed Crib Oxygen Probe Normal Saline Medicine Preparation trolley	CONS & Klebsiella Pneumonia CONS Sterile Enterococcus sps.
	24.7.24	Change room	Klebsiella Pneumonia, Acinetobacter Baumannii.
	27.8.24	From patients hands including cultures	Klebsiella Pneumonia
Neuro ICU	26.7.24	Medicine Trolley	Acinebacter Baumannii

	3.8.24	Patient bed  Patient Tracheostomy tube Ward Sink Attendant Hands Patients body Surface Attendant hand Door handle Oxygen mask	Acinebacter Baumannii & Methicillin resistant Baumannii  Sterile Acinobacter baumannii Acinobacter baumannii Klebsiella Puumonia Sterile Acinobacter baumannii Sterile.
	7.10.25	Medicine Trolley Patient bed  Hands and gown on nurse Angiocath hub Patient Tracheostomy tube Patient attendant hand patient Oxygen mask Patient tracheostomy tube Patient attendant hand Ward sink Door handle  Ecg gel Ventilator tubing Chlorhexidine sol from various beds Hands of attendants Handwash near patient beds Linen from patient bed Medicine tray Normal saline Tap near sink	Acinebacter baumannii Acinobacter baumannii, Methicillin resistan Staphylococcus aureus. Sterile Sterile Sterile Sterile Sterile Acinobacter baumannii Acinobacter baumannii Acinobacter baumannii Acinobacter baumannii  Burkholderia cepacia Acinebacter baumannii complex Sterile Sterile Sterile Sterile Sterile Acinebacter Lwoffii Sterile Pseudomonas aeruginosa.
	27.10.25	Hand Sanitizer Infusion pump Ventilator tubing from patient Suction catheter Nebulizer Normal saline near patient Central line from patient Tracheostomy tube from patient Bed side railing Infusion pump Ecg gel Staff hands Betadine	Sterile Sterile Pseudomonas aeruginosa Pseudomonas aeruginosa Pseudomonas aeruginosa Acinebacter baumannii Pseudomonas aeruginosa Pseudomonas aeruginosa Sterile Sterile Burkholderia complex Sterile Sterile
	11.11.25	Blood culture CSF cultures Fresh ECG gel	Burkholderia Cepacia Burkholderia Cepacia Burkholderia Cepacia.
Critical care unit	7.10.25	Blood culture Patient Tracheostomy tube Patient Attendants hand Mouth wash Hand wash Normal Saline by bed side Ventilator tubing	Burkholderia cepacia Acinetobacter baumannii Sterile Sterile Sterile Escherichia coli Acinebacter baumannii
	26.10.25	Ventilator tubing Nebulizer Normal saline by bedside Patient central line Stoma tracheostomy Hand sanitizer Infusion pump Attendant hand ECG gel Midazolam vial	Acinebacter baumannii Sterile Sterile Sterile Escherichia coli Acinebacter baumannii Pseudomonas aeruginosa Sterile Sterile Sterile
	11.11.25	ECG gel	Burkholderia cepacia

Urology OT	14.05.25	Scrub area Operating room Hands of health care workers Instruments (Anesthesia machine, endoscopes, X-ray)	Pseudomonas aeruginosa Pseudomonas aeruginosa Sterile CONS
Theatre Sterile Services Unit (TSSU)	14.5.25	Sterile room Autoclave room  Trolley Hands of staff AC vents	CoNS Escherchia coli, Pseudomonas aeruginosa, Acinebacte baumannii Sterile CoNS CoNS
CVTS icu	14.6.24	Health care worker hands Patient bed Infusion port site Ventilator tubing Ambu bag O <sub>2</sub> Outlet Wall suction unit inlet Oxygen mask	Sterile Sterile Acinebacter Lwoffii Sterile Sterile Sterile Klebsiella Pneumonia (MDR) sterile
Clinical haematology (ward 4p)	13.7.24	Bed surface Oxygen vent Door handles Patient hands Attendant hand Normal saline used for flushing iv lines Hand sanitizer Drug trolley Doctors sthethoscope Oxygen mask	Sterile Sterile Sterile Sterile Sterile Sterile Sterile Sterile Sterile Sterile
	27.8.24	Blood culture	Klebsiella Pneumonia
USG Room	15.11.24	USG probe 1 Nozzle of USG gel Trolley linen Instrument trolley used for tap Resident hands USG Probe 2 USG probe 3	Sterile Burkholderia cepacia Burkholderia cepacia Sterile Sterile Sterile Sterile
ECG gel from store	11.11.25	gel	Burkholderia cepacia

Whenever there was any outbreak reported and after taking samples, disinfection drive would be taken by infection control nurses. This would show marked improvement in clinical outcomes and samples from various surfaces would come sterile in most of the instances.

Critical care icu is a 12 bedded icu with 24 nurses and 7 nursing aides and neuro icu is also a 12 bedded icu with 14 nurses and 5 nursing aides. More outbreaks took place in neuro icu as compared to critical care icu. Three outbreaks took place in neonatal icu. The nursing ratio in wards was much below the recommended norms as per Indian nursing council.

**Table 3: Infection Control Practices in different patient care areas**

	Item	NICU/PICU No of positive observations	% where Adhered to	General Medicine No of positive observations	% where Adhered to	Plastic surgery ward No of positive observations	% where to
Hand Hygiene	Is antimicrobial soap used	26	78.80%	21	65.60%	24	75%
	Are alcohol hand rubs readily available	24	72.70%	23	71.90%	22	68.80%
	Are steps of hand hygiene displayed	32	97%	24	75%	19	59.40%
Barrier protection	Are gloves worn for appropriate task	32	97%	24	75%	19	59.40%
	Are gloves worn between patients	27	81.80%	16	50%	22	68.80%
	Are gloves changed as appropriate if they become soiled during a procedure	27	81.80%	16	50%	22	68.80%
	Are gowns available	31	93.90%	18	56.30%	18	56.30%
	Is facial barrier protection available	20	95.30%	21	85.90%	21	85.60%
	Is facial barrier protection observed to be used when there is risk of aerolization of body fluids	21	63.60%	15	46.90%	17	53.10%
	Are particulate resp masks available.	29	87.90%	20	62.50%	17	53.10%

Routine precautions	Is a sharps exposure protocol posted in patient care area	27	81.80%	18	56.30%	14	43.80%
	Are provisions in place for immediate reporting and assessment of sharps injury	23	69.70%	22	68.80%	18	56.30%
	Are sharps containers sealed for disposal when approximately 3/4th full	24	72.70%	23	71.90%	18	56.30%
	Are needles used on patients recapped	17	51.50%	19	59.40%	14	43.80%
	Is waste segregated appropriately	23	69.70%	19	59.40%	18	56.30%
Specimen Handling	Are specimens properly wrapped prior to sending to laboratory	24	72.70%	15	46.90%	21	65.60%
	Are specimens appropriately labelled	21	63.60%	20	62.50%	21	65.60%
	Is there a written policy for specimen collection and transport available	21	63.60%	20	62.50%	18	56.30%
Dressing changes	Was aseptic technique used throughout equipment setup	25	78.80%	25	70.10%	30	75.40%
	Was clean to dirty technique maintained through out the procedure	26	78.80%	17	53.10%	25	70%
Medication room	Does the area have a clean orderly appearance	24	72.70%	23	71.90%	22	68.80%
	Is there evidence of inappropriate activities such as food preparation/storage	27	81.80%	24	75%	23	71.90%
	Are open containers of sterile solutions dated	33	100%	31	96.90%	32	100%
	Are multidose vials used	23	69.70%	19	59.40%	18	56.30%
	Is a sharps disposal container readily available.	30	90.90%	25	78.10%	20	62.50%
	Is the refrigerator clean and free of frost build up	30	90.90%	24	75%	22	68.80%
Dress code	Are staff members in uniform	23	69.70%	24	75%	17	53.10%
Patient rooms	Do rooms have a clean orderly appearance	23	69.70%	25	78.10%	29	90.60%
	Are isolation and private rooms available	26	78.80%	29	90.60%	30	93.80%
	Are positive pressure and negative pressure rooms available	0	0%	0	0%	0	0%
	Are washbasins available	28	84.80%	24	75%	23	71.90%
	Are hand sanitizers available	28	84.80%	24	75%	24	75%
	Are patients beds adequately spaced	30	90.90%	25	100%	30	100%
MRSA /VRE	Is there an antibiotic resistant microorganisms precautions protocol	25	75.80%	24	75%	23	71.90%
	Are HCWs observed to comply with ARO precautions	29	87.90%	25	78.10%	21	65.6%
	Is a different mop head used for mrsa/vre rooms	24	72.70%	25	78.10%	20	62.50%

Although department of microbiology comes out every year with antibiogram, but adherence to this was observed to be very poor. First Edition of Hospital Antibiotic policy has been released in 2024, however its implementation is far from reality.

#### 4. Discussion

The World Health Organization (WHO) introduced an infection prevention and control (IPC) framework to mitigate the impact of Hospital associated Infections crucial for ensuring patient safety in hospitals. HAIs pose significant challenges due to factors such as compromised immunity, invasive medical procedures and antibiotic-resistant pathogens, which have dire consequences including higher mortality rates and increased health care costs. HAI is usually acquired after hospitalization and manifests 48 hrs after admission to the hospital. HAIs can be transmitted from patients to health care workers, from health care workers to patients and from patients to patients. Hospitals need to adopt infection control practices to reduce adverse impact on hospitals. The use of personal protective equipment (PPE) and good hand hygiene are essential elements for the prevention and control of HAI. A crucial step in creating an effective infection control program is determining the knowledge, attitudes and practices that healthcare personnel currently have about infection control.<sup>2</sup> Seventeen instances

of outbreaks were reported by infection control nurses during the study period. Blood cultures came positive for microbial organisms at number of instances and did not grow any organism at number of instances. As can be seen number of organisms were grown from different surfaces which include: *Acinetobacter Baumannii*, *Klebsiella Pneumonia*, *Methicillin Resistant Staphylococcus aureus*, *Pseudomonas Aeruginosa*, *Burkholderia Cepacia*, *Acinetobacter lwoffii*, *Escherichia coli*, *CoNS*. The importance of Disinfection practices under supervision of Infection Control Committee has proved effective by improvement in clinical symptoms of patients and sterility of swabs taken post disinfection. Growth of *Burkholderia Cepacia* complex from fresh ECG gel is alarming and high lights the gaps in quality control in manufacturing and regulatory processes. Regulatory processes for manufacturing of drugs need to be more stringent. Hospitals need to invest more in infection control processes. Three infection control nurses for 1015 beds is too low whereas the recommendation is one infection control nurse for 100 beds.<sup>5</sup> In this study we can see that more instances of nosocomial infection outbreaks have been reported from intensive care areas rather than wards. It is estimated that more than one-third of HAIs are acquired in various ICUs, which roughly accounts for a crude incidence of 15%-40% of all hospital admissions. Infections acquired in the hospitals, especially in the intensive care unit (ICU) settings, ranging between 15% and 20%, may further lead to



complications in >40% in critically ill patients.<sup>6</sup> As microbiology and pathophysiology of infections are common, there is a continuous shift toward more resistant strains over years, which includes MRSA, vancomycin-resistant enterococci (VRE), extended-spectrum beta-lactamases (ESBLs), carbapenems-resistant *Enterobacteriaceae* (CRE), colistin-resistant acinetobacter, and fluconazole-resistant *Candida* spp.<sup>6</sup>

The surveillance has been recognized as the major component of infection control since late 1970s. It has been observed that there was a decrease in HAI rates on average 32% in hospitals with well-documented surveillance program in place over a 5-year period as compared with an increase of 18% in other hospitals without any such program. Prevention plays a major role in the control of infections in ICUs, which can be implemented through various guidelines. However, the main approaches are schematized as follows: First, the potential sources of pathogens which may be responsible for transmitting infection from one patient to another, or to HCWs need to be identified and controlled, and the techniques to prevent cross-contamination such as proper cleaning, disinfection, and maintenance of various equipment or devices need to be documented and practiced; second, for selected group of patients, who need surgical antibiotic prophylaxis or empirical therapy guidelines need to be in place and strictly in use; third, appropriate strategies to restrict the use of higher antibiotics and prevent the emergence of MDROs need to be implemented and followed up at regular interval to check the effectiveness.<sup>6</sup> It can be observed that instances of infection outbreaks were less in intensive care areas where staffing was relatively better ie critical care unit compared to neuro icu. Understaffing and overcrowding in ICUs and ratio of nurse to patient ratio are major independent contributors for HAIs. Cross-transmission is facilitated by understaffing and overcrowding, along with carriage of Gram-negative fecal flora, leading to outbreak.<sup>6</sup> By understaffing staff tends to cut around corners in terms of Hand Hygiene not followed, catheter care and central line care compromised.

In our study lot of gaps were found in terms of availability of soaps, hand sanitizers and hand hygiene practices though they were a little better in neonatal icu. Barrier protection was observed more frequently in neonatal and paediatric icu than General Medicine and plastic surgery ward. Gaps were identified in handling of sharps and segregation of waste in all the three areas. Use of multidose vials can increase vulnerability to infections. Gaps in equipment set up for aseptic dressing and technique of dressing needs to be addressed.

Hospitals work uniform and attire replaces use of private clothes. Use of Jewellery is not permitted on work in hospitals as it increases the bacterial load. The work uniform is particularly exposed to organic matter and microbes. This makes wearing of uniform even more important as otherwise infection can reach homes of health care workers. For this reason hospital attire should not be taken home for washing. An additional certainty is that the outfit is changed daily or more often when needed.<sup>7</sup> Although private rooms are available in private ward, this may not necessarily available for some patients because their medical condition demands

more stringent observation. Similarly although isolation rooms are available but lack positive and negative pressure facility which is required in certain cases.

It is estimated that more than one-third of HAIs are acquired in various ICUs, which roughly accounts for a crude incidence of 15%-40% of all hospital admissions.<sup>6</sup> In developing countries, where rapid turnover of workforce, lack of structured ICUs, and inadequate awareness of infection control practices are predominant, prevention of HAIs in the ICUs to provide better health care is always a challenge. Infection control in an ICU or in a hospital can never be stand-alone actions; rather it should be a part of everyday flow of work, where HCWs must be focused on it as part of their essential duty, for the patients and for themselves as well.<sup>6</sup>

## 5. Conclusion

There is a robust infection control program at SKIMS, however more infection control nurses need to be there to improve surveillance and post surveillance control measures.

Poor nursing ratio in patient care areas needs to be addressed as it negatively effects practices of infection control. Growth of organisms from various patient care areas highlights need for more stringent disinfection practices and improvement in infection control practices.

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