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Research Article

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Bugs Can Be Busted: How to Prevent Hospital-Acquired Infections A Success Story of Norwegian American Hospital, Chicago, U.S.A, in Substantially Reducing Hospital-acquired Infection (HAI) Rates

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Abstract

Hospital-acquired infections (HAIs) including Central Line -Associated Bloodstream Infections (CLABSI), Catheter-Associated Urinary Tract Infections (CAUTI), Methicillin-Resistant Staphylococcus aureus (MRSA) infections, Clostridium difficle Infections (CDI), Surgical Site Infections (SSI), and Ventilator-Associated Pneumonia (VAP) are among the most common and serious patient safety threats in the health care settings, which contribute to significant morbidity, mortali-ty, length of patient stay, and healthcare cost.

To combat increasing number of HAI, Norwegian American Hospital (NAH), Chicago, Illinois, USA, strategically developed, and successfully implemented a HAI control and prevention initia-tive in 2013. As a result, NAH dramatically reduced its infection rates over the next several years and the trend continues to date.

Guided by Gap analysis, driven by data, gathered from both internal and external sources, and supported by hospital leadership, NAH initiated a process of gradual and transformational re-forms, by engaging, educating and empowering all clinical and administrative staff, patients, their families and community, promoting a culture of mutual responsibility, incorporating best practic-es, integrating technology into clinical practices, developing electronic standing order- sets and nurse-driven protocols, creating hand hygiene, sepsis and sexually transmitted infections task forces, and antimicrobial stewardship program, NAH successfully managed to achieve and maintain high-quality standards of patient care and lower then national benchmarks HAI rates for the last four consecutive years (January 2016 to December 2019).

Among the device-associated infections (CAUTI/CLABSI), we encountered only one CAUTI and no CLABSI in 2016, none in 2017, only one CAUTI and no CLABSIs in 2018 and only one CAU-TI and one CLABSI in 2019. Furthermore, our VAP rate remained zero, we had only one SSI in 2019 and the C. Difficle Infection rates have also been steadily declining since the implementation of new preventive measures. As a result, NAH received several recognition awards from the lo-Cal as well as national health organizations.

Keywords: Healthcare-Associated Infection, Hospital-Associated Infection, Healthcare-Acquired Infection, Catheter-Associated Urinary Tract Infection, Central Line-Associated Blood Stream Infection, Methicillin-Resistant Staphylococcus Aureus, Clostridium Difficile, Infection Rate.

Abbreviations

NAH: Norwegian American Hospital
HAI: Hospital-Acquired Infection
CAUTI: Cathe-ter-Associated Urinary Tract Infection
CLABSI: Central Line-Associated Blood Stream Infection
MRSA: Methicillin-Resistant Staphylococcus Aureus
CDI: Clostridium Difficile Infection
SSI: Surgical Site Infections
VAP: Ventilator- Associated Pneumonia

Introduction

Healthcare-associated infections are one of the most significant, often preventable, patient safety threats worldwide. According to the Centers for Disease Control and Prevention, device-related infections mainly, Catheter-Associated Urinary Tract Infections (CAUTI), Central Line-Associated Blood Stream Infections (CLABSI), as well as *Clostridium difficile* Infections, Surgical Site Infections (SSI), Ventilator- Associated Pneumonia (VAP), and Infections due to drug-resistant organisms like *Methicillin-Resistant Staphylococcus Aureus* (MRSA), are the major healthcare-associated infections that can have devastating effects on physical, mental, and emotional wellbeing as well as financial status of patients as they cost billions of dollars in added expenses to the healthcare system, often leads to prolong duration of hospital stays, and are associated with increased morbidity and mortality.

In the United States, an estimated 687,000 healthcare-acquired infections in acute care hospitals were reported to the Centers for Disease Control and Prevention in 2015. About 72,000 hospital patients with hospital-acquired infections died during their hospitalizations. On any given day, about 1 in 31 hospital patients has at least one healthcare-associated infection and 3% of hospitalized patients had one or more healthcare-associated infection. A growing number of healthcare-associated infections are caused by antibiotic-resistant organisms.

Norwegian American Hospital (NAH) is a 200-bed safety net community hospital located in the Greater Chicago area in Illinois, United States of America, dedicated to providing comprehensive healthcare services to the surrounding community, which comprises of 50% of Hispanics or Latinos, 40% as African Americans, and 10% as whites or unknown race. In order to address the growing challenge of hospital-associated infections (HAI), improve the healthcare outcomes, and ensure the patients safety and quality of care, NAH funded and implemented a healthcare-associated infections control and prevention initiative in 2013.

A multi-disciplinary team, comprised of Infectious Disease physician /Infection control preventions, hospital executive team, nursing leadership, patient's representatives, clinical pharmacists, laboratory personnel, and information technology (IT) experts, worked together in developing and implementing strategic plans, quality improvement measures, clinical protocols and pathways, focusing on promoting a culture of safety and a zero tolerance policy with regards to hospital-acquired infections (HAI). As a result, NAH has been able to significantly decrease the incidence rates of HAI for which the hospital has been nationally recognized and awarded.

Materials and Methods

Data Collection and Analysis

Gap analysis was performed to identify clinical practices and procedural shortfalls leading to hospital-acquired infections in the hospital. We collected baseline data for all hospital-acquired infections including their incidence and prevalence rates, devices utilization rates, patient hospital days, and outcomes and compared these measures on a quarterly and annual bases. Each case was analyzed to identify the deficiencies and opportunities to improve. From this data, we established realistic goals and clear objectives with timely benchmarks to measure the progress or failures of interventions.

Hospital Compare data refers to Hospital Inpatient Quality Reporting data, which was, developed in order to improve outcomes of healthcare provided by hospitals that accept Medicare, government funded health insurance in the United States, because of the Medicare Prescription Drug, Improvement, and Modernization Act of 2003, seeking to improve the quality of care among these hospitals. The intention is to provide consumers with information on the quality of care provided by these hospitals in order for them to make informed decisions about where they receive care. The Centers for Medicare and Medicaid Services (CMS) collaborate with Medi-care and Medicaid-accepting hospitals in the United States to report data on the quality of health care delivery in these primary short-term acute care hospitals. The motivation to participate for these hospitals draws from a reduction in Medicaid/Medicare fee-for-service payment rate for those who do not report their data. The goal of this reporting penalty is to ensure consistent unified data available to the public. Hospital Compare data was used to survey our peer or comparable hospitals to learn from their experiences, challenges, and strategies. Equipped with these strategies, we reviewed the literature on evidence-based best practices, incorporating local, national, and international guidelines for prevention of hospital-acquired infections from organizations including the CDC, Institute for Healthcare Improvement (IHI), Association for Professionals in Infection Control and Epidemiology (APIC), Infectious Diseases Society of America (IDSA), Society for Healthcare Epidemiology of America (SHEA), Hospital Engagement Network (HEN), and Joint Commission Accreditation of Healthcare Organizations (JCAHO).

Results

As a result of NAH Healthcare-Associated Infections Control and Prevention Initiative, our device-associated hospital infection rates have been dramatically decreased during the study period from January 2016 to December 2019. In 2016, we encountered only one CAUTI and no CLABSIs and in 2017, we had no CAUTI or CLABSI. Only one CAUTI and zero CLABSIs were found in 2018 and only 1 CAUTI and one CLABSI in 2019. These rates have consistently been below the national benchmarks for the last four consecutive years. The CAUTIs rate was 0% compared to 1.22% of non-teaching hospitals. , and below the State of Illinois standardized infection ratio (SIR) of 0.87. The CLABSI rate was 0% for three consecutive years. We have avoided 500 additional days of care and $213, 263/year in additional costs to the hospital. In 2018 from January to December, we had one CAUTI out of 5,697 hospital admissions, a total of 0.02%. The Standardized Infection Rate (SIR) for CAUTIs for the year 2018 was 0.327 infections per admission. Furthermore, there was also no Ventilator-Associated Pneumonia (VAP) observed during the same study period. We reported only one Surgical Site Infection (SSI) in 2019 and our C. Difficile Infection (CDI) rates have also been declining since the implementation of new preventive measures.

Infection Prevention Quality Dashboard

	TARGET															
	NHSN 2013 90%	NHSN 2013 Pooled Mean	SOURCE	NAH 2015	Jan-16	Feb-16	Mar-16	Apr-16	May-16	Jun-16	Jul-16	Aug-16	Sep-16	Oct-16	Nov-16	Dec-16
Device Associated Infections				Rate = number of infections/number of device days x 1000 Utilization Rate= number of device days/ number of patient days x 100												
ICU Patient Census *				3606	273	281	249	318	275	242	241	276	298	302	256	312
Rate of Catheter Associated Urinary Tract Infections (CAUTI)	0.0	1.3		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3	0.0	0.0
Number of infections				0	0	0	0	0	0	0	0	0	0	1	0	0
Device Days/ Patient Days					135/273	174/281	117/249	165/318	169/275	96/242	98/241	116/276	208/298	179/302	149/256	204/312
Urinary catheter utilization	32%	54%			49%	62%	47%	52%	61%	40%	41%	42%	70%	59%	58%	65%
Rate of Central Line Associated Bloodstream Infection (CLABSI)	0.0	0.8		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of infections				0	0	0	0	0	0	0	0	0	0	0	0	0
Device Days/ Patient Days					97/273	97/281	68/249	132/318	139/275	56/242	110/241	88/276	122/298	130/302	107/256	167/312
Central line utilization	10%	37%		38%	36%	35%	28%	42%	51%	23%	21%	32%	41%	43%	42%	54%
2A Medical-Surgical Patient Census *				6861	638	537	611	505	472	407	537	405	574	528	479	519
Rate of Catheter Associated Urinary Tract Infections (CAUTI)	0.0	1.3	National Healthcare Safety Network (NHSN) Comparable: Acute, Non Teaching, 51-200 beds, (N=1647) Data for this Unit Reported to NHSN *	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.4	0.0	0.0	0.0	0.0
Number of infections				1	0	0	0	0	0	0	0	1	0	0	0	0
Device Days/ Patient Days					43/638	48/537	27/611	66/505	48/472	72/407	32/537	43/405	51/574	76/528	42/479	38/519
Urinary catheter utilization	9%	17%			7%	9%	44%	13%	10%	18%	6%	11%	9%	14%	9%	7%
Rate of Central Line Associated Bloodstream Infection (CLABSI)	0.0	0.8			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of infections					0	0	0	0	0	0	0	0	0	0	0	0
Device Days/ Patient Days					50/638	73/537	90/611	44/505	60/472	36/407	33/537	50/405	70/574	48/528	50/479	19/519
Central line utilization	5%	15%			8%	14%	16%	9%	13%	9%	6%	12%	14%	9%	10%	4%
3C Medical-Surgical Census					177	154	126	171	120	77	closed	closed	NM	NM	NM	NM
Rate of Catheter Associated Urinary Tract Infections (CAUTI)	0.0	1.3			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of infections					0	0	0	0	0	0	0	0	0	0	0	0
Device Days/ Patient Days					25/177	19/154	19/126	30/171	38/120	20/77	0	0	0	0	0	0
Urinary catheter utilization	9%	17%			14%	12%	15%	18%	32%	26%	0%	0%	0%	0%	0%	0%
Rate of Central Line Associated Bloodstream Infection (CLABSI)	0.0	0.8			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of infections					0	0	0	0	0	0	0	0	0	0	0	0
Device Days/ Patient Days					34/177	18/154	15/126	29/171	29/120	18/77	0	0	0	0	0	0
Central line utilization	5%	15%			19.00%	12.00%	12.00%	17.00%	24.00%	2%	0%	0%	0%	0%	0%	0%
Pediatrics *																
Rate of Catheter Associated Urinary Tract Infections (CAUTI)	0.0	1.4			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rate of Central Line Associated Bloodstream Infection (CLABSI)	0.0	0.9			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
based on random sample size***																
	TARGET															
based on 20 days of data **	NHSN 2013 90%	NHSN 2013 Pooled Mean	SOURCE	NAH 2015	Jan-16	Feb-16	Mar-16	Apr-16	May-16	Jun-16	Jul-16	Aug-16	Sep-16	Oct-16	Nov-16	Dec-16
ICU Ventilators																
Rate of Ventilator Associated Event (VAE)	0.0	1.1		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

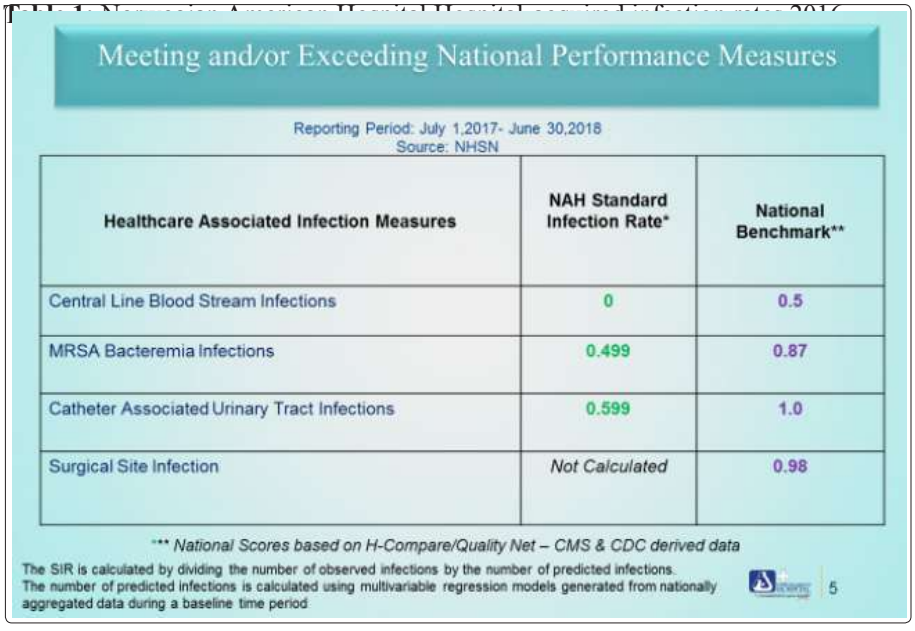


Table 2: HAI data from July 1, 2017 to June 30, 2018

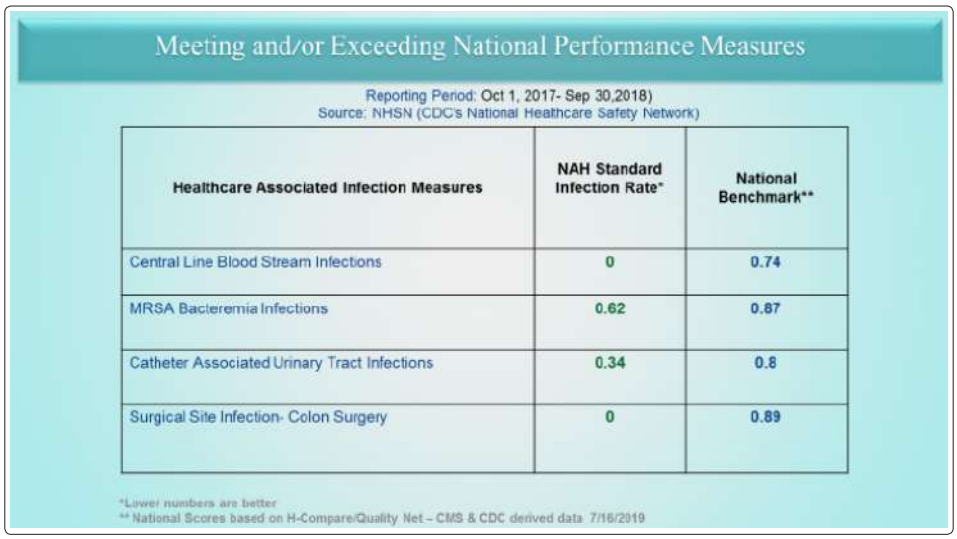


Table 3: HAI data from Oct 1, 2017 to Sept 30, 2018

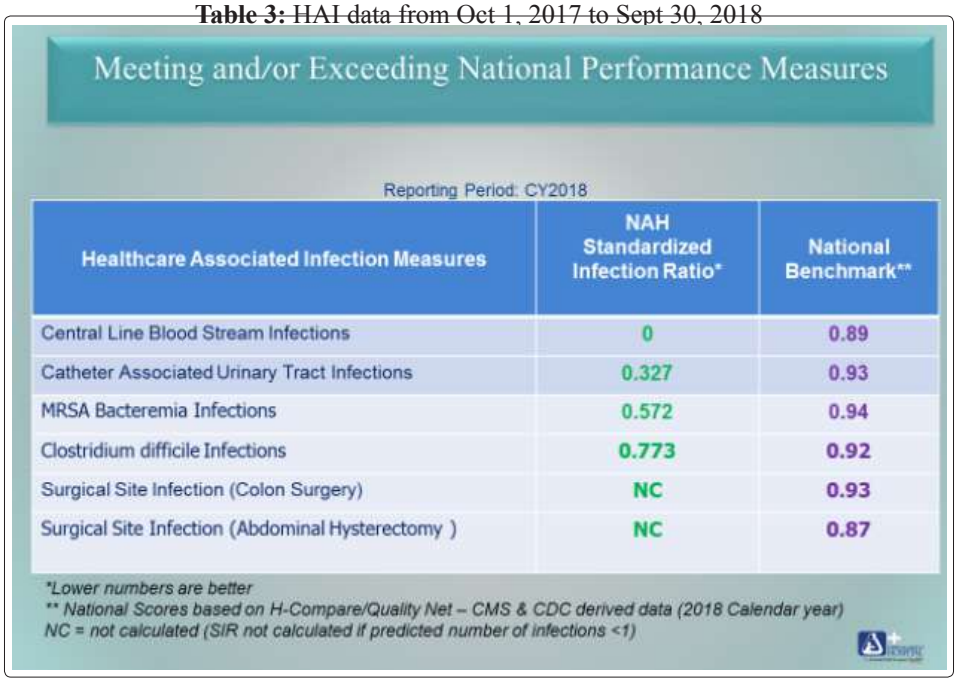


Table 4: HAI data from Calendar year 2018

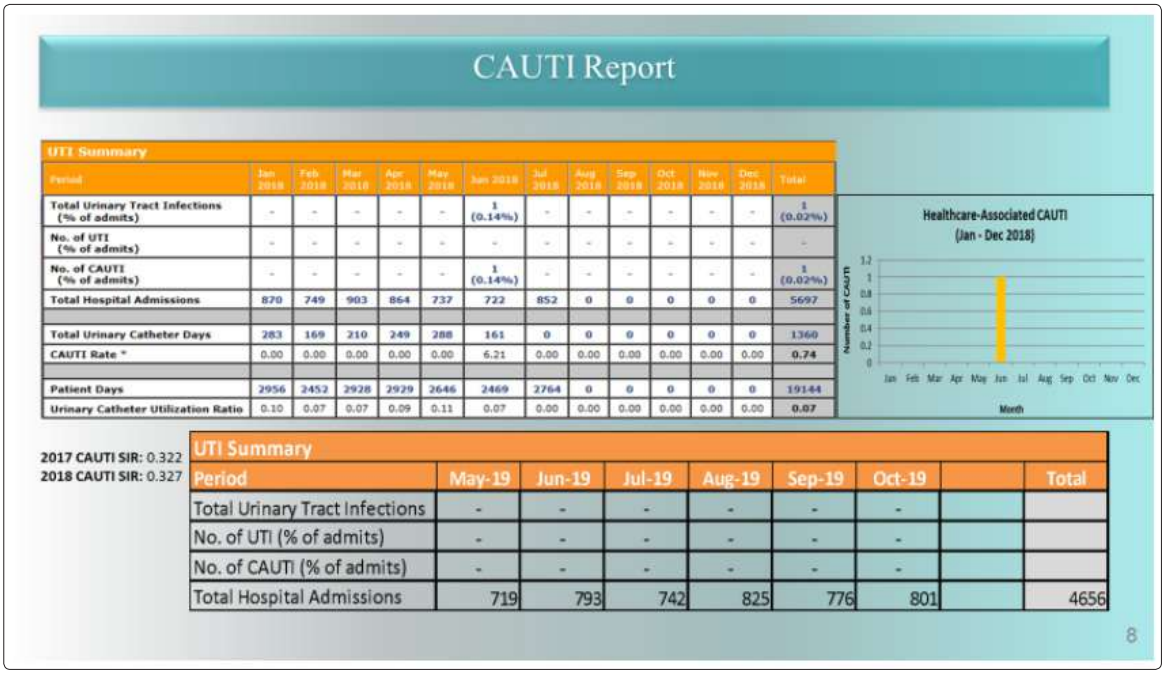


Table 5: CAUTI data from Jan 2018 to Oct 2019

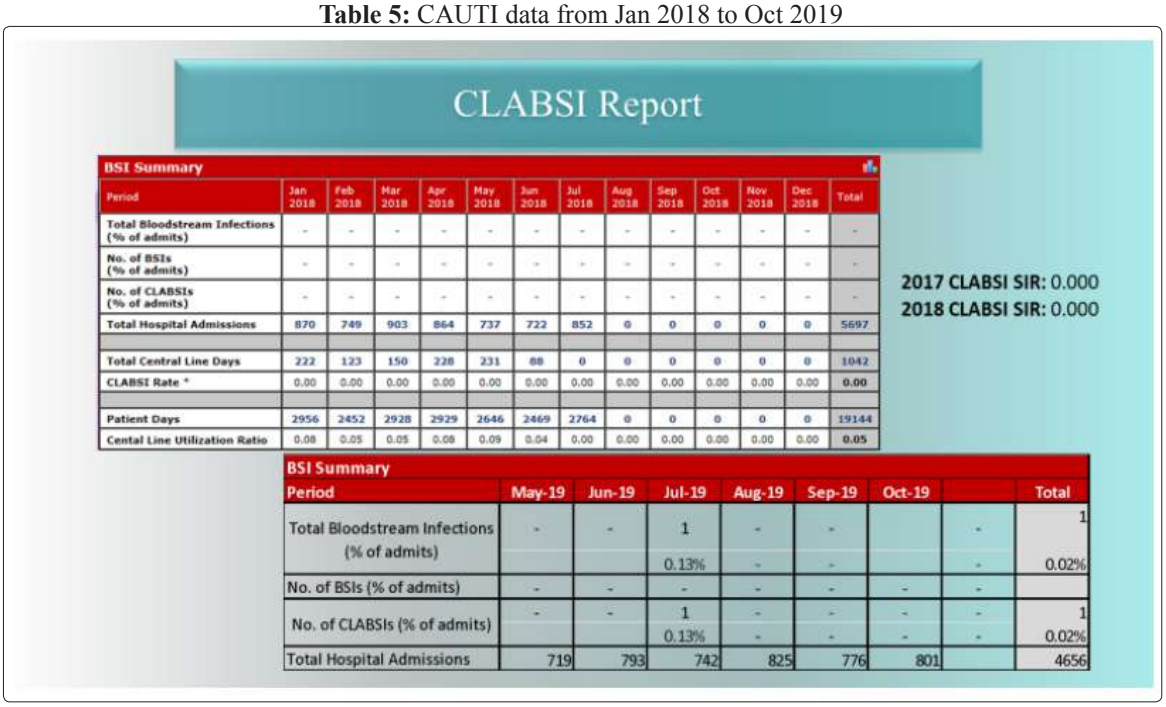


Table 6: CLABSI data from Jan 2018 to Oct 2019

VAP Report

PNEU Summary								
Period	May-19	Jun-19	Jul-19	Aug-19	Sep-19	Oct-19		Total
total pneumonia infections (% of admits)	-	-	-	-	-	-		
No. of PNEU (% of admits)	-	-	-	-	-	-		
No. of VAP (% of admits)	-	-	-	-	-	-		
Total Hospital Admissions	719	793	742	825	776	801		4656

PNEU Summary													
Period	Jan 2018	Feb 2018	Mar 2018	Apr 2018	May 2018	Jun 2018	Jul 2018	Aug 2018	Sep 2018	Oct 2018	Nov 2018	Dec 2018	Total
Total pneumonia infections (% of admits)	-	-	-	-	-	-	-	-	-	-	-	-	-
No. of PNEU (% of admits)	-	-	-	-	-	-	-	-	-	-	-	-	-
No. of VAP (% of admits)	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Hospital Admissions	870	749	903	864	737	722	852	0	0	0	0	0	5697
Total Ventilator Days	183	56	85	150	175	93	0	0	0	0	0	0	742
VAP Rate *	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Patient Days	2956	2452	2928	2929	2646	2469	2764	0	0	0	0	0	19144
Ventilator utilization ratio	0.06	0.02	0.03	0.05	0.07	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.04

Table 7: VAP data from Jan 2018 to Oct 2019

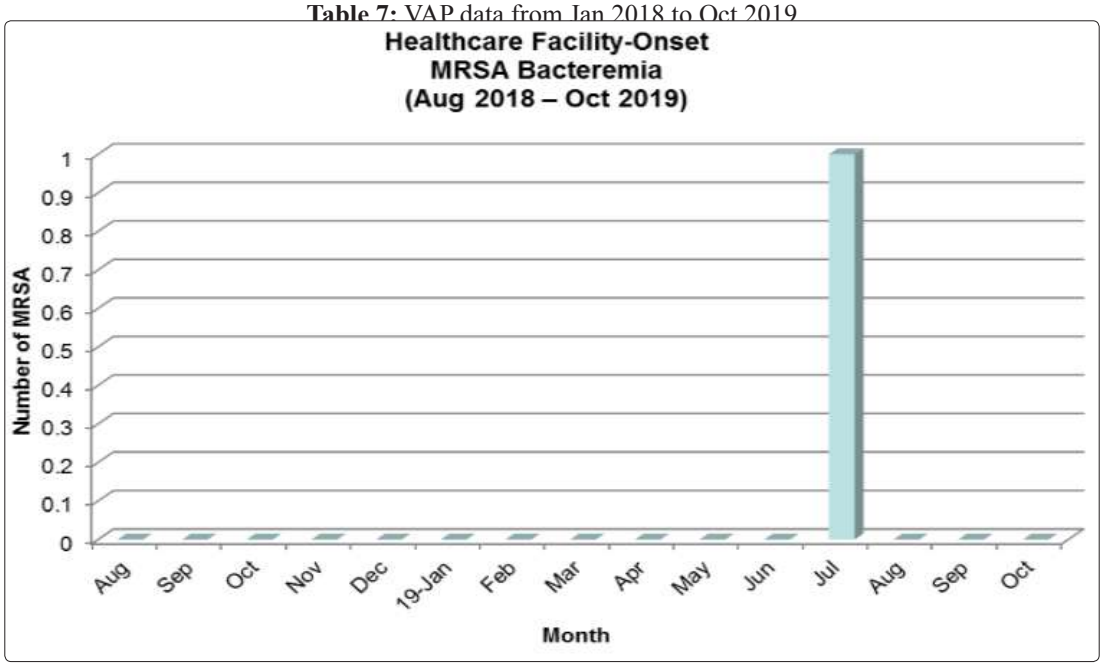


Table 8: MRSA bacteremia data from Aug 2018 to Oct 2019

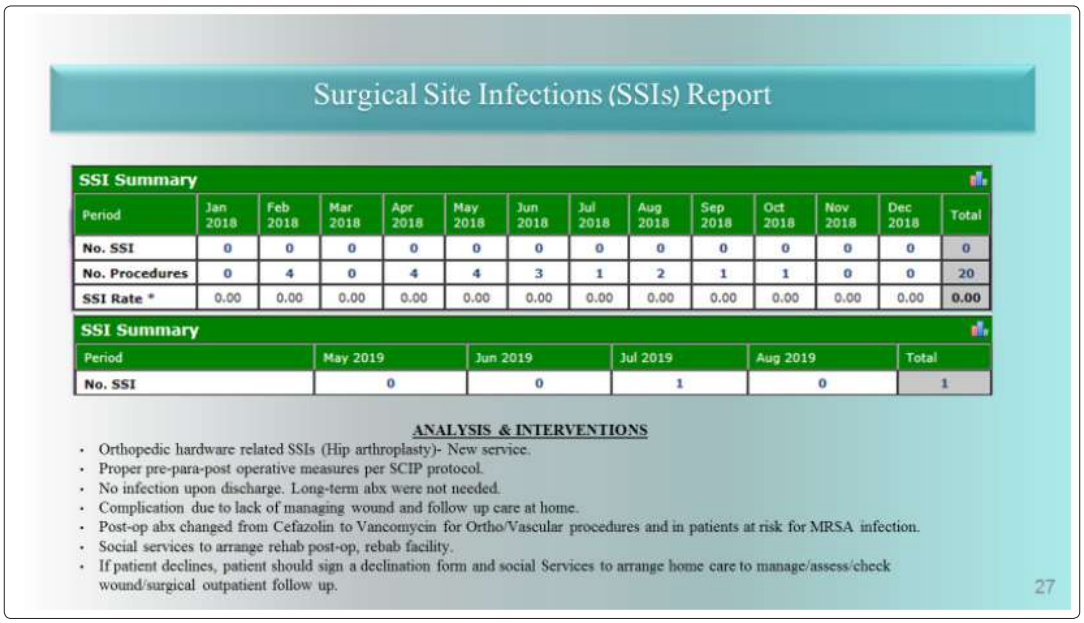


Table 9: Surgical Site Infections (SSI) data from Jan 2018 to Aug 2019

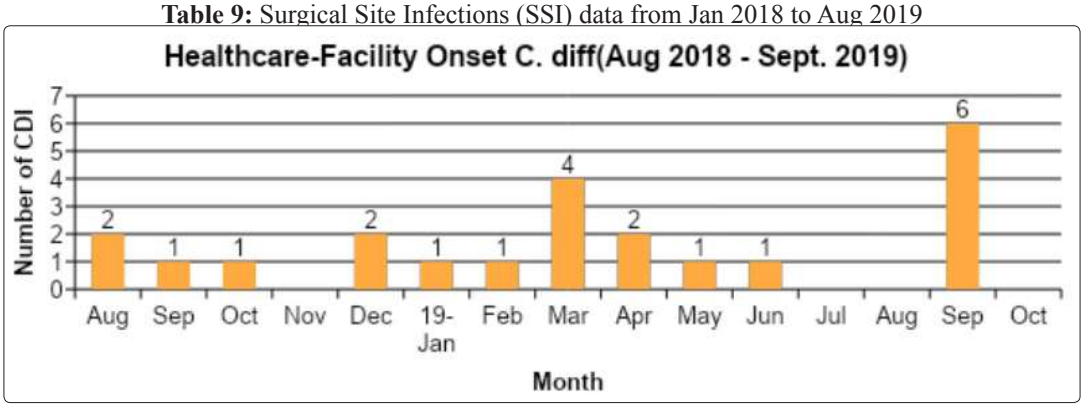


Table 10: Healthcare Facility Onset C. Diff date from Aug 2018 to Sept 2019)

Awards and Recognitions

In 2014, the hospital was recognized for having the lowest rate of hospital-acquired infections of the 67 hospitals in the greater Chicago area, based on hospital data from the Illinois Department of Public Health (IDPH). NAH ranked first in Chicago and fifth best in Illinois for significantly reduced hospital-acquired infection rates in 2014. Received the 2015 'Patient Safety Excellence Award' from Health grades, putting NAH within the top 10% of all hospitals evaluated nationwide for its excellent performance in safeguarding patients from serious, potentially preventable infections and complications. Exceeded the Quality of Care and Patient Experience expectations by protecting them from the acquisition of a health care acquired infection because of a Foley catheter and Central line (The Chicago Tribune/CMS Recognition 2016). Received the 2017 Honorary 'Gage Remarkable Project Award' from America's Essential Hospitals in recognition of its progress in protecting patients from HAIs by reducing or sustaining them at zero.

Discussion

Leadership, Staff, and Patient Engagement

Hospital-wide engagement was instrumental in improving patient safety and quality care by reducing HAIs. A team approach engaged every single player and at every level throughout the initiative, from the hospital's top leadership including all the executive employees and the board of trustees, to general medical staff such as physicians, medical students and residents, and nurses, as well as all other employees such as housekeeping, security, IT, administrative, and hospitality. Feedback and recommendations were used to identify deficiencies and improve processes and outcomes. Infection Control interacted closely and directly with hospital staff in daily huddles, hospital rounds, educational workshops, CME lectures, memo emails, Infection Control orientation in-service, recreational activities, and lunch-and-learn sessions. The infection control team created simple to understand policies, computerized order sets, attractive posters and brochures, and computer screensavers for constant reminding, reinforcing, while implementing and adopting the policies and procedures to ensure staff competence and compliance. Staff posted colorful presentation boards on every unit with an infographic from the Association for Professionals in Infection Control and Epidemiology (APIC) and CDC that explained what HAIs are. Patients and their families were educated, encouraged,

and empowered to question their providers about hand hygiene and need for invasive devices like Foley catheters and central lines, and the role that patients can play in infection prevention. Patients were encouraged to communicate freely with their providers about their care and safety practices and were provided relevant info on their in-room boards. In addition to hospital-wide participation, we recruited the surrounding community in a culturally sensitive way with public events, media coverage, and newsletters. The "Goal of Zero" HAIs concept promoted culture of safety within the hospital. The change process cultivated widespread engagement by adapting to a shared sense of ownership and responsibility.

Prevention of CAUTIs

We found that a majority of Foley catheters at our hospital were either inserted without a Physician order or maintained without a documented clinical indication. Catheters were sometimes left in place post-operatively beyond 48 hours without an appropriate justification. To prevent CAUTIs, the EMR-based "nurse-driven protocol for urinary catheter insertion and management" enables the nurse to insert Foley catheter only after receiving Physician order and satisfying a defined clinical indication [Figure 1]. Implementation of hard stops on orders in the EMR software prompt nurses to complete key components of the Foley catheter insertion and maintenance bundle at the time of insertion and every eight-hour shift thereafter. Foley catheters are assessed daily during safety huddles and surveillance rounds by unit managers and infection control personnel, and promptly removed when no longer indicated. All Foley catheters placed pre-operatively must be removed before leaving the recovery area or within 48 hours post-operatively. When the use of a urinary catheter could not be avoided, bedside bladder scans were performed by nurses to assess urinary retention and the use of alternate catheters, such a condom catheter, were encouraged when appropriate. Additionally, we track Foley catheter utilization rates daily as well as continuing to monitor those that are currently

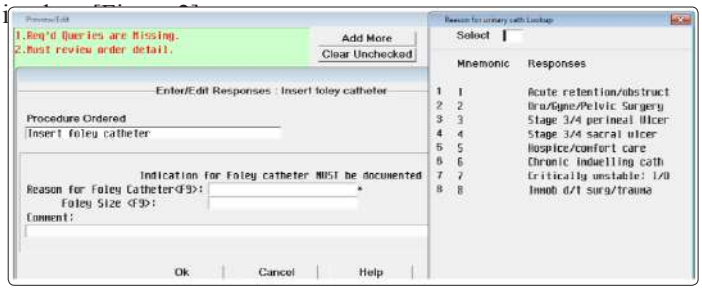


Figure 1: EMR Foley Catheter Insertion/Maintenance Criteria

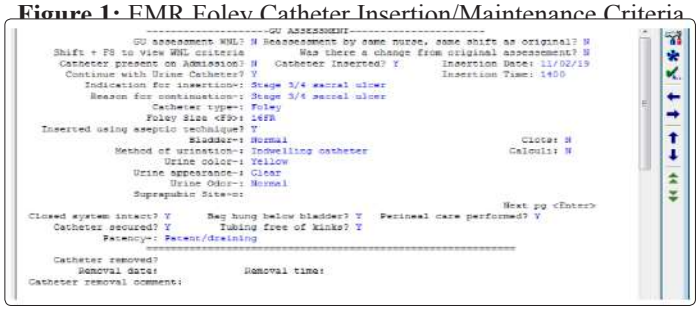


Figure 2: EMR Foley Catheter utilization daily assessment

Preventing Central Line Associated Blood Stream Infections (CLABSIs)

We created a dedicated intravenous (IV) line team comprised of specially trained nurses that work under the guidance and supervision of Infection Control and Interventional Radiology. We designated a chain of command to assist with the placement of all central lines when they are required. We also implemented a central line bundle, which ensures best practices related to selection of catheter insertion site, catheter type, and the exercise of insertion site care with appropriate dressings. Daily bathing with chlorohexidine gluconate (CHG) wipes for all patients in the intensive care unit (ICU). Daily surveillance of IV lines on Infection Control's hospital rounds. We restricted femoral lines use by reserving them only in emergency use as a last resort and removing them within 24 hours of insertion. All the while, we used strict hand hygiene practices following World Health Organization's WHO 5 Moments. Documentation in Meditech of central line assessment and management was required i

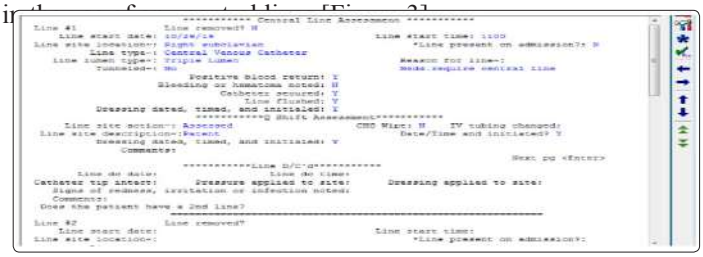


Figure 3: EMR-based (Meditech) central line assessment/ management tool

Screening for MRSA Colonization

MRSA screening is performed on all ICU patients using a MRSA order set in the EMR software and proactive isolation precautions are placed until the results are received. [Figure 4] Prior to placing a patient in an ICU bed, environment cleaning and surface disinfection are performed by hospital environmental services with CaviWipes which are single use moistened towelettes that contain Isopropanol 17.2% and ammonium chloride. Skin decontamination of all ICU patients with daily bathing with CHG wipes containing 2% chlorhexidine gluconate. Prophylaxis for peptic ulcer disease and d

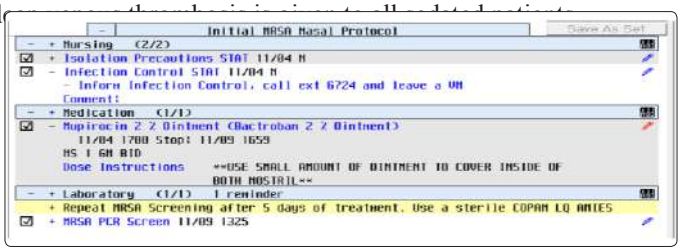


Figure 4: MRSA screening order set for all ICU and High-Risk Patients

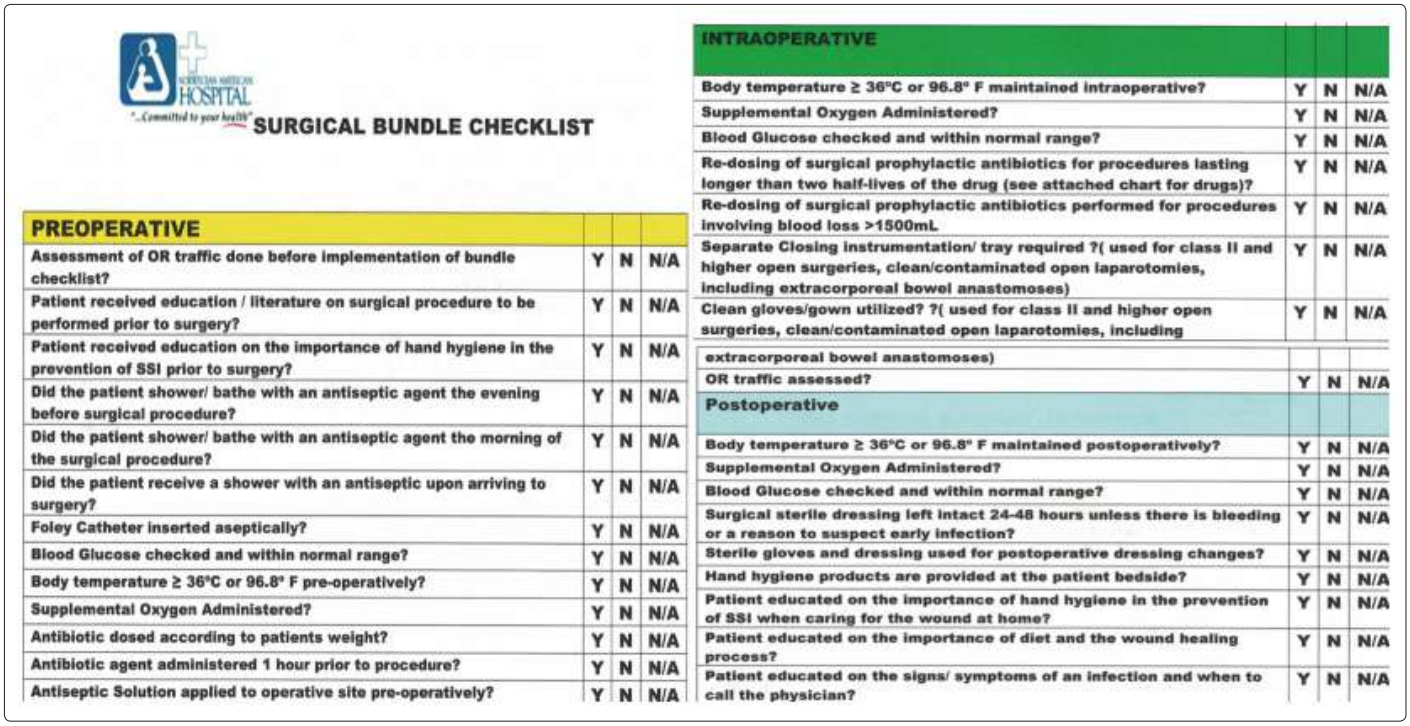
Preventing Ventilator-Associated Events (VAE) and Pneumonia (VAP)

Patients receiving invasive mechanical ventilation are at risk for numerous complications, including pneumonia. Out of 157,000 healthcare-associated, pneumonias occurred in acute care hospitals in U.S in 2011, 39% of which were VAPs. Shorter duration of ventilator use and length of ICU stay are major contributors in the prevention of VAP. Effective early weaning pro-tocol and practice was installed which includes daily arterial blood gas (ABG) draws promote real time monitoring of patients and early weaning trials.

We implemented a "VAP Bundle" which in-cluded oral care, aspiration precautions, suctioning, and a closed-circuit system. All intubated patients receive oral care every 2 hours. Oral care products contain 0.12 % chlorohexidine glu-conate and 11.6% alcohol rinse. Endotracheal suctioning is performed on patients with thick or copious secretions, a sputum culture is collected, and Mucomyst is given. We maintained a "closed-circuit system" ventilator setup. Patient's airways are never exposed to room-air when being suctioned and with nebulizer therapy. Aspiration precautions are placed with the head of the bed elevated to 30-45 degrees on all intubated patients.

Preventing Surgical Site Infections (SSIs)

We had one orthopedic hardware-related SSI after a hip arthroplasty, a new service at NAH. There were proper pre-operative, peri-operative, and post-operative measures per SCIP (Surgical Care Improvement Project) protocol. [Figure 5] The patient had no infection upon discharge. Long-term antibiotics were not needed in this patient, so they were discharged without antibiotics post-operatively. There was a complication due to lack of home wound management and follow-up care. Peri-operative antibiotics were changed from cefazolin to vancomycin for orthopedic or vascular procedures and in other patients with increased or perceived risk for MRSA infection. [Figure 6] Social services arrange post-operative rehabilitation for all post-surgery patients at rehabilitation facilities. If a patient decline, they must sign a declination form and social services in that case will arrange home care to manage the wound as well as post-surgical outpatient follow-up.

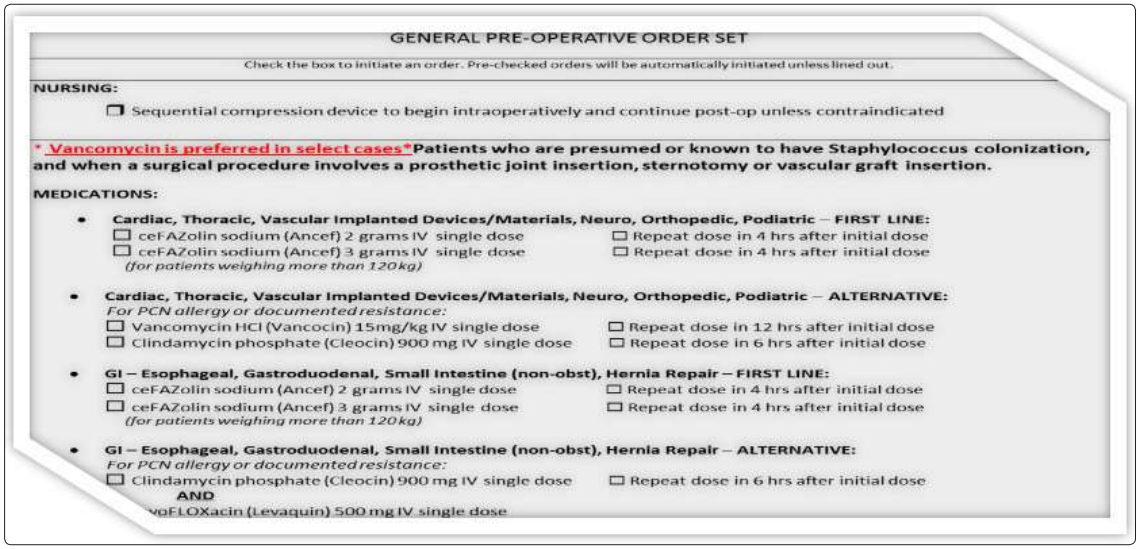


SURGICAL BUNDLE CHECKLIST

PREOPERATIVE			
Assessment of OR traffic done before implementation of bundle checklist?	Y	N	N/A
Patient received education / literature on surgical procedure to be performed prior to surgery?	Y	N	N/A
Patient received education on the importance of hand hygiene in the prevention of SSI prior to surgery?	Y	N	N/A
Did the patient shower/ bathe with an antiseptic agent the evening before surgical procedure?	Y	N	N/A
Did the patient shower/ bathe with an antiseptic agent the morning of the surgical procedure?	Y	N	N/A
Did the patient receive a shower with an antiseptic upon arriving to surgery?	Y	N	N/A
Foley Catheter inserted aseptically?	Y	N	N/A
Blood Glucose checked and within normal range?	Y	N	N/A
Body temperature ≥ 36°C or 96.8° F pre-operatively?	Y	N	N/A
Supplemental Oxygen Administered?	Y	N	N/A
Antibiotic dosed according to patients weight?	Y	N	N/A
Antibiotic agent administered 1 hour prior to procedure?	Y	N	N/A
Antiseptic Solution applied to operative site pre-operatively?	Y	N	N/A

INTRAOPERATIVE			
Body temperature ≥ 36°C or 96.8° F maintained intraoperative?	Y	N	N/A
Supplemental Oxygen Administered?	Y	N	N/A
Blood Glucose checked and within normal range?	Y	N	N/A
Re-dosing of surgical prophylactic antibiotics for procedures lasting longer than two half-lives of the drug (see attached chart for drugs)?	Y	N	N/A
Re-dosing of surgical prophylactic antibiotics performed for procedures involving blood loss >1500mL	Y	N	N/A
Separate Closing instrumentation/ tray required ?(used for class II and higher open surgeries, clean/contaminated open laparotomies, including extracorporeal bowel anastomoses)	Y	N	N/A
Clean gloves/gown utilized? ?(used for class II and higher open surgeries, clean/contaminated open laparotomies, including extracorporeal bowel anastomoses)	Y	N	N/A
OR traffic assessed?	Y	N	N/A
Postoperative			
Body temperature ≥ 36°C or 96.8° F maintained postoperatively?	Y	N	N/A
Supplemental Oxygen Administered?	Y	N	N/A
Blood Glucose checked and within normal range?	Y	N	N/A
Surgical sterile dressing left intact 24-48 hours unless there is bleeding or a reason to suspect early infection?	Y	N	N/A
Sterile gloves and dressing used for postoperative dressing changes?	Y	N	N/A
Hand hygiene products are provided at the patient bedside?	Y	N	N/A
Patient educated on the importance of hand hygiene in the prevention of SSI when caring for the wound at home?	Y	N	N/A
Patient educated on the importance of diet and the wound healing process?	Y	N	N/A
Patient educated on the signs/ symptoms of an infection and when to call the physician?	Y	N	N/A

Figure 5: Surgical Bundle Check List



GENERAL PRE-OPERATIVE ORDER SET

Check the box to initiate an order. Pre-checked orders will be automatically initiated unless lined out.

NURSING:

☐ Sequential compression device to begin intraoperatively and continue post-op unless contraindicated

* Vancomycin is preferred in select cases***Patients who are presumed or known to have Staphylococcus colonization, and when a surgical procedure involves a prosthetic joint insertion, sternotomy or vascular graft insertion.**

MEDICATIONS:

- **Cardiac, Thoracic, Vascular Implanted Devices/Materials, Neuro, Orthopedic, Podiatric – FIRST LINE:**
  - ☐ ceFAZolin sodium (Ancef) 2 grams IV single dose — ☐ Repeat dose in 4 hrs after initial dose
  - ☐ ceFAZolin sodium (Ancef) 3 grams IV single dose — ☐ Repeat dose in 4 hrs after initial dose
  (for patients weighing more than 120 kg)
- **Cardiac, Thoracic, Vascular Implanted Devices/Materials, Neuro, Orthopedic, Podiatric – ALTERNATIVE:**
  For PCN allergy or documented resistance:
  - ☐ Vancomycin HCl (Vancocin) 15mg/kg IV single dose — ☐ Repeat dose in 12 hrs after initial dose
  - ☐ Clindamycin phosphate (Cleocin) 900 mg IV single dose — ☐ Repeat dose in 6 hrs after initial dose
- **GI – Esophageal, Gastroduodenal, Small Intestine (non-obst), Hernia Repair – FIRST LINE:**
  - ☐ ceFAZolin sodium (Ancef) 2 grams IV single dose — ☐ Repeat dose in 4 hrs after initial dose
  - ☐ ceFAZolin sodium (Ancef) 3 grams IV single dose — ☐ Repeat dose in 4 hrs after initial dose
  (for patients weighing more than 120 kg)
- **GI – Esophageal, Gastroduodenal, Small Intestine (non-obst), Hernia Repair – ALTERNATIVE:**
  For PCN allergy or documented resistance:
  - ☐ Clindamycin phosphate (Cleocin) 900 mg IV single dose — ☐ Repeat dose in 6 hrs after initial dose
  AND
  - ☐ voFLOXacin (Levaquin) 500 mg IV single dose

Figure 6: Peri-operative Antibiotic Prophylaxis.

Preventing C. Difficile Infections

Clostridium difficile Infection (CDI) is the most common cause HAI in the United States. Clostrid-ium difficile has recently become an important community pathogen with increasing incidence and severity attributed to the emergence of new hyperactive virulent strains. CDI is a recognized urgent threat, causing approximately 453,000 infections and 29,000 deaths every year, with an annual economic burden ranging from $436 million to $3 billion dollars in the United States. According to the most recent Leapfrog report, CDI has been the most challenging Infection Control-related issue at NAH.8 our analysis revealed that most reportable CDI cases at NAH are attributed to the failure to diagnose infection at the time of admission or within the first three days of hospitali-zation, which accounts for overestimation of lab-confirmed, healthcare facility-onset cases of CDI. New, updated policies and protocols were implemented to address this issue. Emergency department triage assessment is completed for all ED admissions to screen for CDI. If a patient meets the assessment's criteria, a prompt appears on the EMR screen, which warns," Patient at risk for C.Diff, Notify ED provider" [Figure 7]. The emergency department provider assesses pa-tient and determines if the test, treatment, and contact isolation are necessary. We implemented daily nursing gastrointestinal assessments to screen all hospitalized patients for CDI every shift. Based on stool consistency and frequency, more than three loose or watery bowel movements in one day, and any one of the CDI risk factors, an automatic CDI order set is generated by the EMR software which states, "Notify the provider to order a C. diff toxin assay and immediately place patient in contact precautions." On or after day 3 of admission, all C.Diff test orders need pre-approval or authorization from Infection Control. Test of cure or repeat testing is not recom-mended. We also have changed the C. Difficile diagnostic test to NAAT-based test to improve the sensitivity and specificity as well as turnaround time of the results.

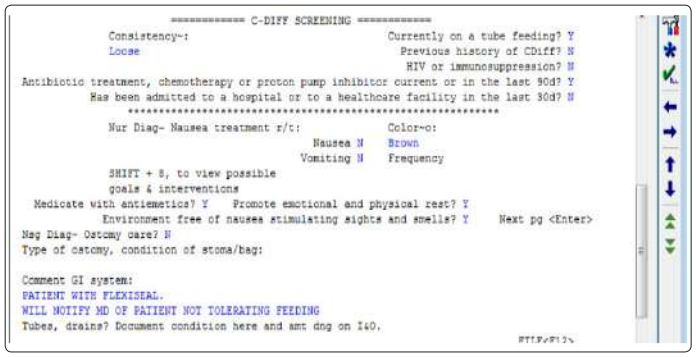


Figure 7: EMR-based C. Diff Screening Tool

Hand Hygiene

Hand Hygiene is the single most important step/initiative in preventing Health Care Associated Infections (HAIs) in Patients, Health Care Workers and Visitors. We follow the WHO HH guidelines. Hand Hygiene Dispensers and Cough Etiquette Stations are strategically placed around the facility, as well wall mounted in many and most areas. "Secret Shoppers" perform real-time sur-veil lance and monitor compliance.

Antimicrobial Stewardship Program

Antibiotic resistance is a significant and progressively worsening problem at healthcare facilities around the world. According to the CDC, 20-50% of antibiotics prescribed in United States acute care hospitals are unnecessary or inappropriate.9 Consistent management of antimicrobials in all healthcare settings is a fundamental step in slowing resistance and improving patient health. Antimicrobial stewardship programs can help prevent the development of multi drug-resistant organisms and reduce unnecessary drug use as well as costs associated with expensive, broad-spectrum therapies used to treat HAIs. Antimicrobial stewardship refers to coordinated interventions designed to improve and measure the appropriate use of antimicrobials by promoting optimal antimicrobial drug regimens, monitoring the doses, duration of therapy, and route of administration to minimize toxicity and other adverse events and to achieve optimal outcomes for patients in cost-efficient ways by limiting the selection for antimicrobial resistant strains. CMS and TJC developed and mandated the antimicrobial stewardship standards for the U.S hospitals.

Pharmacist's role in antimicrobial stewardship: Pharmacists perform daily monitoring for appropriateness by evaluating and documenting appropriate clinical indications for every antimicrobial prescribed. Review microbiology data to assess for de-escalation, changing antibiotics from broad to narrower-spectrum, and discontinuation opportunities and recommend an effective/appropriate alternate to the physician. ("Bug-drug mismatch"). We placed an automatic 7-day soft stop in the EMR software on all antibiotic orders to control or limit the duration of antibiotic therapy. Physicians converted IV antibiotics to oral formulation when appropriate. Pharmacists adjust antibiotic doses based on drug levels and end-organ function. With access to all the medi-cations ordered, the pharmacy is able to monitor and report hospital antimicrobial utilization rates. The pharmacy also placed antibiotic formulary restrictions and preauthorization requirements for specific antimicrobials, giving that ability to infectious disease physicians only.

Infection Control's role in antibiotic stewardship: In collaboration with the pharmacy and the Therapeutic Committee, the Infection Control Department has been actively involved in the An-timicrobial Stewardship Program, incorporating stewardship activities by supporting and super-vising clinical pharmacists. Infection Control tracks for newly emerging antimicrobial resistance patterns and review the annual antibiogram for necessary changes [Figure 10]. We perform periodic drug use evaluations (DUEs) to analyze and report HAIs related to antimicrobial over-use. Another responsibility of Infection Control is facilitating guidelines for antibiotic prophylaxis in surgical patients. In order to prevent antimicrobial misuse, we develop and pro-mote antimicrobial prescription guidelines for all end-users. From July to August 2019, we achieved our goal of 100% following the restricted antibiotics policy.

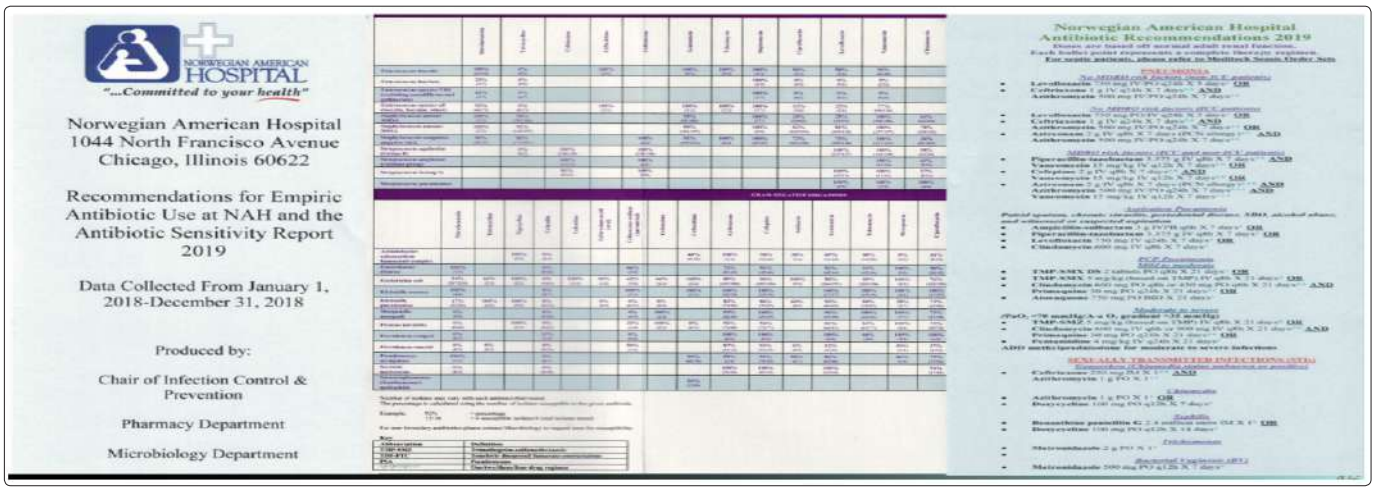


Figure 8: NAH Antibiogram 2019

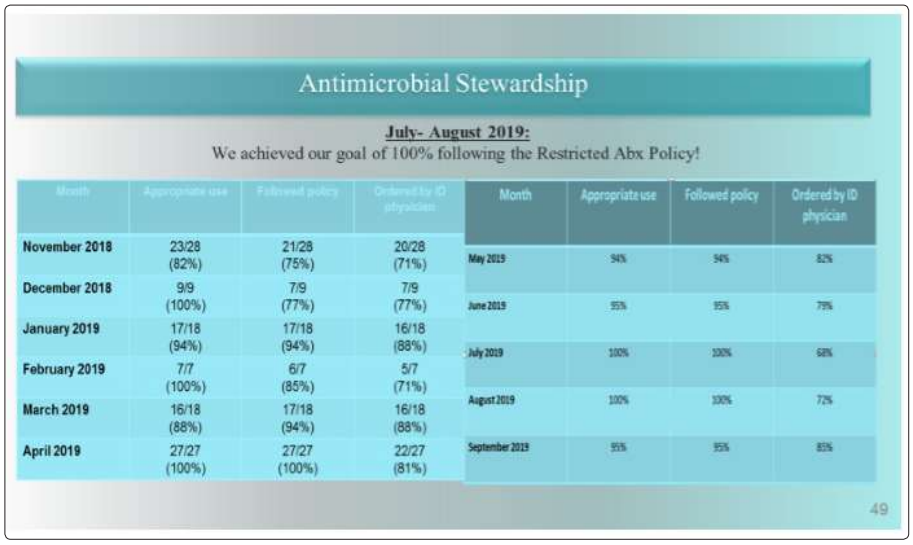


Figure 9: Restricted Antibiotic Policy Compliance

Acknowledgements

Mr. Jose Sanchez, President and CEO Norwegian American Hospital Chicago, IL 60622, U.S.A, Dr. Aleem Aziz, PharmD, Chair, Pharmacy & Therapeutic Committee Norwegian American Hospital, Chicago, IL Kathleen O'Connor, RN, BS,CIC Manager, Infection Prevention and Control Norwegian American Hospital, Chicago, IL

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