HALYARD

IMPACT OF ELECTRONIC HAND HYGIENE MONITORING SYSTEMS: A REVIEW OF CASE STUDIES

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INTRODUCTION

Hospital-acquired infections (HAIs) burden patients, complicate treatments, prolong hospital stays, increase costs, and can be life-threatening[1]. It is universally acknowledged that adequate hand hygiene is one of the most effective ways to prevent transmission of infections. However, despite tremendous effort, overall median compliance to hand hygiene protocols is 40%. Compliance rates are lower in intensive care units (30%-40%) than in other settings (50% - 60%), and are lower before (21%) than after patient contact (47%).[2]

There have been many strategies developed to help improve hand hygiene compliance. The most effective of such strategies include monitoring hand hygiene behaviors and implementing performance- based interventions.[3] In the last few years, a wide range of electronic or electronically assisted hand hygiene monitoring systems have been developed.[4]

This article reviews more than 40 peer-reviewed articles and case studies that utilize electronic monitoring systems to help influence hand hygiene behaviors. We review both the clinical and financial impact to the facility by improving hand hygiene compliance, including reduction in infections, direct cost savings, and reduction in patient length-of-stay. The results from these case studies demonstrate both clinical and financial evidence for adopting electronic hand hygiene monitoring solutions.

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ECONOMIC BURDEN OF NOSOCOMIAL INFECTIONS

Annually in the U.S., approximately 750,000[5] patients suffer from nosocomial or healthcare-associated infections (HAIs) and an estimated 80,000 of these patients die. This accounts for approximately 1 in 25 patients that are admitted to hospitals and ranks HAIs as the 5th leading cause of death in U.S. acute-care hospitals.[6] Five categories of infections account for more than three-quarters of all infections in acute-care hospitals, including –

1. Surgical Site Infection (SSI),

2. Blood Stream Infection (CLABSI),

3. Ventilator-Associated Pneumonia (VAP),

4. Urinary Tract Infection (CAUTI), and

5. Gastrointestinal infections, specifically Clostridium difficile (C. diff).

The substantial human suffering and financial burden of these infections is staggering. Table 1 presents recent estimates made by the US Department of Health and Human Services summarizing the burden of these infections. Estimated annual costs of HAIs in the U.S. are between $28 Billion and $45 Billion per year.[6] Beyond direct financial costs, HAIs also contribute significantly to increased patient length-of-stay (LOS) in the hospital resulting in both operational cost loss and patient dissatisfaction.

Infection Type	Estimated Annual Infections[6]	Mean Hospital Cost per Infection (US$)[6]	Mean Deaths per Year[6]	Average LOS[7, 8, 9, 10] (Length-of-Stay)
Surgical Site Infection	157,500	24,546	13,088	10.6
Pneumonia	157,500	9,966	35,967	8.7
Blood Stream Infection	71,900	36,441	30,655	10
Urinary Tract Infection	93,300	1,006	8,205	
Gastrointestinal Infection	123,100	12,607		14

Table 1: Economic Burden of Healthcare-Associated Infections

IMPACT OF HAND HYGIENE ON REDUCING INFECTIONS

Healthcare-associated infections (HAIs) are spread in a number of different ways, but contaminated hands of healthcare workers (HCW) are among the most common modes of transmission. Pitet and colleagues identified a five-step sequence leading to microbial transmission through hands during healthcare delivery[11]

1. Pathogens shed by infected patients can contaminate surrounding environments

2. The HCW's hands get contaminated by contact with patient skin or surrounding environment

3. The pathogen remains viable on the HCW's hands for at least several minutes

4. The HCW may omit hand decontamination or use inappropriate product or procedure

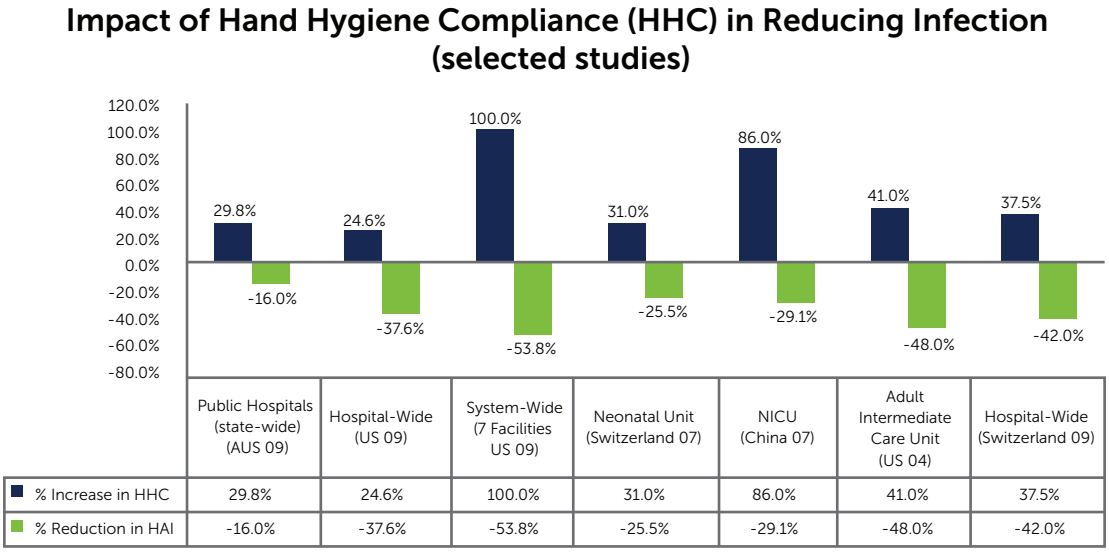
5. The HCW's contaminated hands can either transfer the pathogen directly to another patient or indirectly on a medical device or objects within the patient's immediate vicinity

To improve hand hygiene compliance, interventions need to be multimodal and should include key facets like availability of alcohol-based hand rub, education, surveillance and feedback along with consistent messaging and awareness among staff to encourage individual performance improvement. In a recent article[3], Huis et al conducted a systematic review of hand hygiene improvement strategies. They concluded that addressing a single determinant like "knowledge" or "education" to improve HH compliance is not enough. Addressing a combination of different determinants showed better results.

A recent literature review conducted by the World Health Organization (WHO)[12] identified 39 studies that demonstrated a significant reduction in infections resulting from improved hand hygiene compliance. Several high-quality studies are listed in Table 2 below demonstrating consistent association of improved hand hygiene compliance (HHC) with reduction in infection rates. Pitet et al published a landmark study in 2000 using a multidisciplinary hand hygiene promotional strategy and demonstrated a sustained improvement in compliance resulting in reduction in HAI prevalence[13]. Since then several hospital-wide and system-wide studies have been published that demonstrate similar results. For example, Lederer et al published a recent study conducted in seven acute care facilities that utilized a multimodal strategy including monitoring and reporting hand hygiene compliance for alcohol-based hand rub (ABHR) use across the facilities. They demonstrated a 49% to 98% improvement in compliance resulting in reduction of methicillin-resistant staphylococcus aureus (MRSA) rates from 0.52 to 0.24 HAIs per 1000 patient-days during the same time period.[14]

	Country/Year & Setting	Intervention	Follow-Up Duration	Improvement in HH Compliance	Resulting Reduction in Infection	Reference
1	Australia 2009, Hospital-Wide in 208 public hospitals (State-Wide)	HH Observation and performance feedback	18 months	47% to 61%	6% reduction in MRSA/ 10000 patient days. 16% reduction in ICU sites	Grayson ML et al[15]
2	US 2008, Hospital-Wide	Direct Observation (DO) and performance feedback	10 months	72.5% to 90.3%	MRSA reduction 0.85 to 0.53/1000 days	Cromer et al.[16]
3	US 2009, Hospital-Wide 7 acute care facilities	HH Observation and performance feedback	3 years	49% to 98%	MRSA reduction from 0.52/ 1000 episodes to 0.24 /1000 episodes	Lederer et al[14]
4	Switzerland 2007, Neonatal Unit	HH Observation, poster, education and performance feedback	27 months	42% to 55%	Overall HAI rates from 11 to 8.2 infections/ 1000 patient days	Pesso-silva et al[17]
5	China (Taiwan) 2004, NICU	HH Observation, performance feedback and rewards	24 months	43% to 80%	Reducation in HAI 15.1/ 1000 to 10.7/1000 patient days	Won et al[18]
6	US 2004, Adult Intermediate Care Unit	Phase I: electronic monitoring (EM) and DO, Phase II EM with voice prompts, PhaseIII EM	15 months	Phase II - 37%, Phase III - 41%	Phase I - 22% Phase III- 48%	Swoboda et al[19]
7	Switzerland 2000, Hospital-Wide	HH Observation, training and performance feedback	3 years	48% to 66%	Significant reduction of HAI - 42% and MRSA cross transmission rates down 87%	Pittet et al[13]

Table 2: Selected studies that demonstrate impact of HH on HAI Prevention



	Public Hospitals (state-wide) (AUS 09)	Hospital-Wide (US 09)	System-Wide (7 Facilities US 09)	Neonatal Unit (Switzerland 07)	NICU (China 07)	Adult Intermediate Care Unit (US 04)	Hospital-Wide (Switzerland 09)
% Increase in HHC	29.8%	24.6%	100.0%	31.0%	86.0%	41.0%	37.5%
% Reduction in HAI	-16.0%	-37.6%	-53.8%	-25.5%	-29.1%	-48.0%	-42.0%

Figure 1: Selected studies that demonstrate impact of HHC on HAI Prevention

ELECTRONIC HAND HYGIENE MONITORING SYSTEMS

There are many types of electronic or electronically assisted hand hygiene monitoring systems, including video-monitored direct observation, electronic dispensing counters, and individual hand hygiene monitoring networks.

Electronic monitoring can be a very effective method for improving hand hygiene compliance through data collection and individual feedback for performance improvement. Electronic monitoring is able to capture a high quantity of observations without the Hawthorne effect impact of having a human observer visible and present during the collection of data[30]. These systems are also capable of providing analytics and feedback to individuals either immediately at the point of use or later in reports on individual or team data.

We examined more than 40 peer-reviewed articles and case studies that utilized similar electronic monitoring systems and selected eleven studies that discuss both clinical and financial impacts on the facility, including reduction in infections, direct cost savings, and reduction in patient length-of-stay (LOS). Table 3 is a summary of data presented in these studies.

	Hospital Setting	Type of Intervention	Monitored Period	% Improved HH Compliance	% Reduction in Infection	LOS Avoided (In Days)	Reference Direct Cost Savings (USD)	Reference
1	Regional Hospital 2 Floors 28 Beds	EM of HH and Performance Feedback	12 months	160.6% in UNIT 1 and 89% in UNIT2	35% reduction in UNiT 1 and 22% decrease in Unit 2	52.4	$46,150	Meyer, et al[20]
2	Neuro ICU 10 Beds	EM of HH and Performance Feedback	14 months	162%	All HAI - 24%	268	$308,451	Richards, et al[21]
3	CPTU 12 Beds	EM of HH and Performance Feedback	20 months	113.6%	All HAI- 72.9% VAP - 73.9%, CAUTI -66.3%, C. diff -81.1%, CLABSI- 69.5%	236	$463,000	Cantrel et al, July 2014[22]
4	Cardiac ICU 22 Beds	EM of HH and Performance Feedback	16 month	125.5%	All HAI - 38.5%	105.6	$121,511	Sanders et al[23]
5	Med Surg and MICU 52 Beds	EM of HH and Performance Feedback	29 months	141%	All HAI - 35.7%		$476,697	Blumstein et al[24]
6	SICU 12 Beds	EM of HH and Performance Feedback	12 months	96.4%	All HAI - 16.2%	43.5	$32,216	Collins et al[25]
7	Med Surg 31 Beds	EM of HH and Performance Feedback	12 months	191.2%	All HAI - 25%	49.2	$53,376	Bailey et al APIC[26]
8	Med Surg 25 Beds	EM of HH and Performance Feedback	14 months	236.7%	All HAI - 18.8%	97.4	$112,164	Wofford et al[27]
9	Med Surg Unit 29 Beds	EM of HH and Performance Feedback	10 months	42.7%	All HAI - 59.1%	211.1	$243,022	Cape et al[28]
10	Hematology Unit 30 Beds	EM of HH w/ automated alerts	12 months	36% to 70.1%	No Significant			Venkatesh et al[29]
11	Adult Intermediate Care Unit 14 Beds	Phase 1: EM and Direct Observation, Phase II EM w/ Voice prompts, PhaseIII EM	15 months	Phase II - 37%, Phase III - 41%	Phase I - 22% Phase III- 48%			Swoboda et al[19]

Table 3: Selected studies demonstrate impact of Electronic Hand Hygiene Monitoring on HAI Prevention

Most of these studies are pre- and post-intervention and demonstrate significant clinical and financial impacts from improving hand hygiene compliance utilizing electronic systems, including consistent reduction in patient length-of-stay and direct cost savings. For example Meyer et al implemented an electronic hand hygiene monitoring solution in two floors of a regional hospital in 28 beds. Over the period of twelve months of performance monitoring and providing feedback to staff they demonstrated 160% improvement in compliance in Unit 1 and 89% in Unit 2. This resulted in 35% and 22% reduction in infections, respectively; $46,150 in direct savings, and 52.4 days length-of-stay avoided. Figures 2 and 3 below summarize results from several similar case studies.

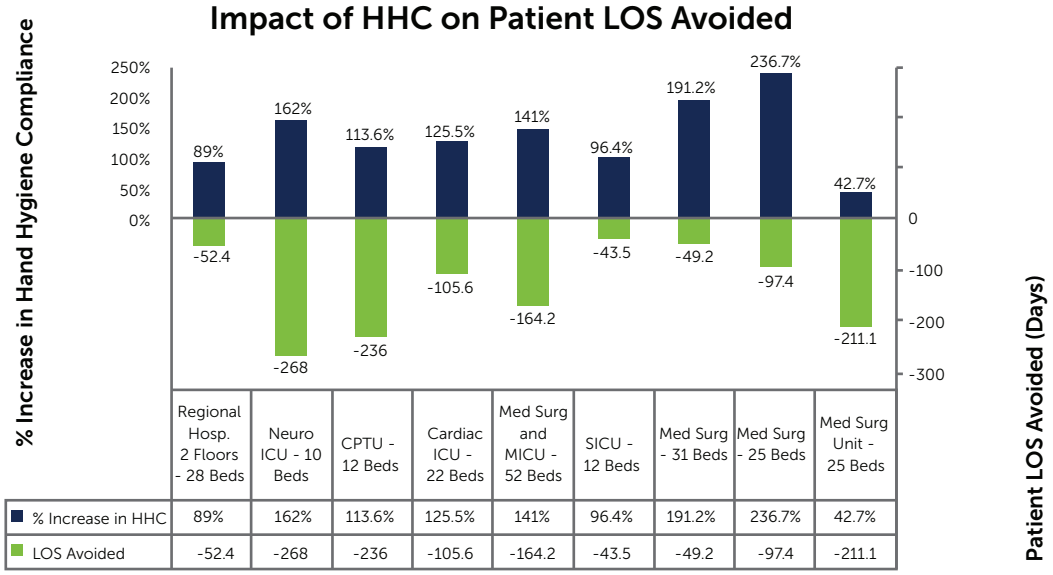


Figure 2: Selected studies with impact of Electronic Hand Hygiene Monitoring on LOS avoided

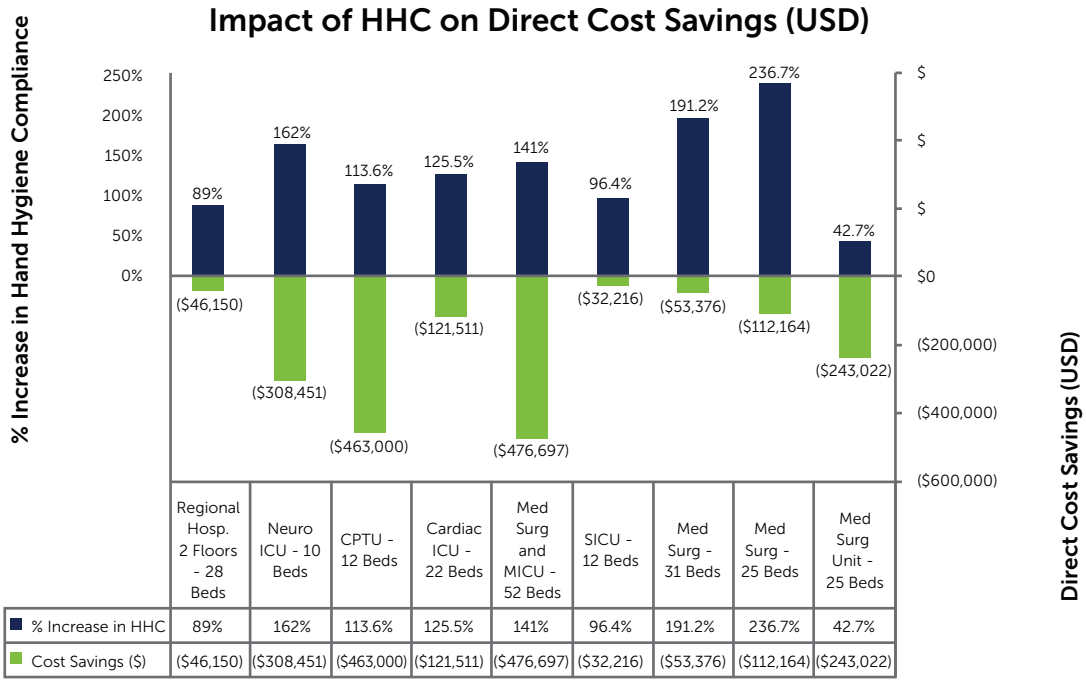


Figure 3: Selected studies with impact of Electronic Hand Hygiene Monitoring on direct cost savings

CONCLUSION

Performance monitoring, data collection of hand hygiene observations, and feedback to staff are often used as an effective strategy to help influence behaviors and improve hand hygiene compliance. Electronic compliance monitoring solutions often provide an unbiased and comprehensive measure of hand hygiene activity within a facility.

Studies where interventions resulted in significant improvement in compliance to hand hygiene guidelines also demonstrated a substantial decrease in infections[12]. Electronic hand hygiene compliance monitoring systems, in combination with staff education and availability of alcohol hand sanitizers, can be very effective in reducing infections and have demonstrated significant cost savings and reduction in patient length-of-stay across a number of case studies in a variety of acute care environments.

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