

REDUCING PATIENT HARM WITH A NOVEL ENVIRONMENTAL INFECTION CONTROL PROGRAM

HEALTHCARE

sodexo

QUALITY OF LIFE SERVICES

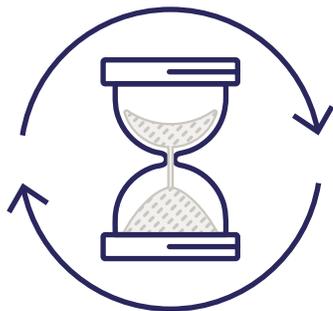
THE THREAT AND COST OF INFECTIONS IN HEALTHCARE

Every year hundreds of thousands of people around the world die from healthcare-associated infections (HAIs) caused by pathogens such as methicillin resistant *Staphylococcus aureus* (MRSA), *Clostridium difficile* (*C. diff*) or gram-negative rod bacteria (GNRs)¹. In the United States alone, 750,000 people are infected during their hospital stay annually and approximately one in 25 patients will acquire a preventable infection².

HAIs Increase Clinical Complications

In addition to patient morbidity and mortality, healthcare-associated infections can significantly increase the length of a patient's hospital stay and severely delay recovery. Patients that contract an HAI during their initial hospital stay are more likely to be readmitted.

An Agency for Healthcare Research and Quality-funded study showed that patients with HAIs are more likely to be **readmitted** after discharge – and readmitted sooner³. 35% of study patients who tested positive for MRSA, vancomycin-resistant enterococci (VRE), or *C. diff* were readmitted to the hospital within one year. Median time to readmission for HAI patients was 27 days, compared to 59 days for those patients without HAIs.

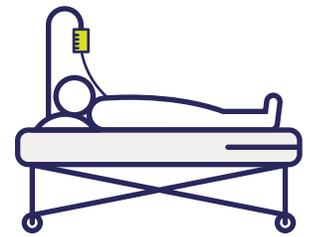


HAIs make a patient more likely to stay in the hospital longer or be readmitted.

The 30-day readmission rate was also higher for HAI patients compared to those without HAIs: 25% vs. 15%.

HAI patients are also at risk for an increased **length of stay**, with estimates showing that 9.3% of their total bed days and 11.4% of their total health costs can be attributed to the

infection⁴. Another study ran a Monte Carlo simulation on previously found estimates and found that *C. diff* is associated with a 3.3 day increase in length of stay and MRSA with 23 days⁵.



HAIs can lead to higher mortality risk.

Every year, HAIs cause many **preventable deaths**

in United States hospitals - some 75,000 deaths annually, or more than 200 deaths a day⁶. Trauma patients with a healthcare-associated infection have between 1.5 and 1.9 times higher odds of mortality⁷. Specifically, *C. diff* infections have been associated with a 9.3% mortality rate⁸ and MRSA bacteremia infections with a 31.5% mortality rate⁹.

HAIs Incur Cost

While the primary reason to control infections is to protect life and avoid harm, there is a significant economic impact too. According to the World Health Organization, 15% of total hospital activity and expenditure in OECD countries is a direct result of adverse events including infections¹⁰.

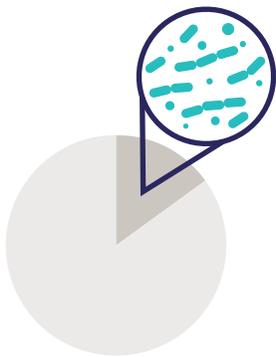
It is difficult to estimate the precise costs of healthcare-associated infections, and there is significant heterogeneity in the estimation methodologies used by peer-reviewed journal articles. In a study referenced by the Centers for Disease Control and Prevention (CDC), the direct medical cost of HAIs to US hospitals is estimated at \$36 billion to \$45 billion annually¹¹. Extending this to include total societal burden of illness (including not only direct medical but also non-medical and indirect costs), the economic impact increases to between \$96 and \$147 billion annually¹².

Centers for Medicare and Medicaid Services (CMS) has included infection prevention in its pay-for-performance initiatives, making the reduction of HAIs not just a patient safety initiative anymore, but an important element of a facility's reimbursement. Under the Hospital-Acquired Conditions Reduction Program (HACRP), hospitals are evaluated based on

their rates of avoidable complications including infections, and CMS penalizes the 25% worst performing hospitals, reducing their Medicare reimbursement by 1%. In 2017, this led to payment cuts for 769 hospitals due to poor hospital-acquired condition (HAC) performance¹³, and these providers together lost about \$440 million as a result¹⁴. In 2018, the total number of facilities

penalized under the HACRP fell slightly to 751, but there was stability in the cohort of penalized hospitals: 425 hospitals penalized in FY 2018 were also penalized in FY 2017¹⁵. Total penalties are estimated at \$303 million¹⁶. In addition, key infection rates including *C. diff* and MRSA are doubly penalized, due to inclusion in both the HACRP and Value-Based Purchasing (VBP) incentive programs.

About 15% of healthcare spending worldwide is a result of adverse events, including HAIs.



HAIs Threaten Hospital Reputations

There are also several less quantifiable costs associated with HAIs. Infections can be linked not only to more problematic clinical outcomes, but they can also taint patient perception of care and be a reputational risk for healthcare providers.

In recent years, regulators have placed significant emphasis on creating transparency around clinical and experiential outcomes, in consumer-facing ways; this includes publication of HAI rates at provider level.

Rating organizations have made use of this data and created a variety of dashboards and annual ranking lists of the best and worst performing hospitals: poor performance on these quality measures can become a real threat to hospital reputation.

The Emerson Clinical Resource Institute (ECRI) has identified device cleaning, disinfection and sterilization – all HAI-related topics – to be among the top 10 patient safety concerns in 2018¹⁷. There is a plethora of news stories with horror stories about infections, and vocal public condemnation has been finding a platform by way of social media. Research has shown that for health-related social media usage, 27% of users ask for recommendations, 20% rate the quality of care they've received, and 27% share their stories about their healthcare experience¹⁸. Social media and online quality ratings websites have become trusted sources of information for consumers, and infectious diseases have been shown to spark significant interest and social media comment, especially when there is news of an outbreak¹⁹. This trend will continue and accelerate.



The medical cost of HAIs in the US is estimated to be between \$36 and \$45 billion a year.



HAIs are a very real threat - to health outcomes, to healthcare costs, and to hospital reputation.

that patients don't know how to read and interpret published information: study participants incorrectly assessed hospital quality on infection data in more than 40% of responses²³. Overall, social media appears to be much more representative of patient perception than the clinical side of care. This further highlights the need for hospitals to not only drive good clinical outcomes, but also to properly manage patient perception of care, which has been clearly linked to hospitals' social reputation²⁴. As a result, both actual and perceived HAI incidence in hospitals can put hospital reputation at risk and therefore jeopardize patient loyalty. With an average lifetime hospital expenditure per person of \$184,000 and an average lifetime value of a typical household to a hospital of \$405,000²⁵, lack of patient loyalty has long-term financial consequence for providers.

What Makes HAIs So Threatening?

Pathogens are dangerous because they cause infections in many ways - the chain of infection has multiple ways of completing in a facility: pathogenic organisms can multiply in people, in the water supply, and on hospital surfaces and equipment. This is particularly problematic because studies show that in many hospitals only 40-50% of the surfaces that should be disinfected by environmental services workers actually are²⁶. When these surfaces are left alone, the impact of pathogen growth can be devastating. Pathogens can live on the surface for an ever-increasing amount of time. Their ability to learn, adapt, and enhance themselves with the resistant qualities of neighboring pathogens means that germs that could once live for a few days on a surface are now living for weeks, months, or more (Table 1).

There is mixed evidence as to whether or not social media reported outcomes are representative of true clinical outcomes²⁰⁻²².

What is talked about on social media may or may not be reflective of clinical quality. Specifically, for something as complex as HAIs, a study has shown

Table 1: Lifespan of Common HAI Pathogens on Surfaces²⁷

| Type of Bacteria | Length of Life on a Surface |
|--|-----------------------------|
| Acinetobacter spp. | >4 months |
| Clostridium difficile | 5 months |
| Escherichia coli | 16 months |
| Klebsiella spp. | >30 months |
| Mycobacterium tuberculosis | 4 months |
| Pseudomonas aeruginosa | 16 months |
| Staphylococcus aureus (including MRSA) | 7 months |

In addition to the relatively low level of compliance with disinfection regimes, there are issues around the materials and chemicals used to disinfect. Incorrect usage of hospital-grade disinfectants, retention of pathogenic materials within mops and cleaning cloths, and degradation of materials over time, all lead to significant impacts on efficacy even if regimes are tightly adhered to.

Disinfectants Don't Always Work As Expected

Many hospitals struggle with compliance with a disinfectant's required contact time. Contact time (also known as kill or dwell time) is the amount of time a product needs to stay wet on a surface to be effective in killing the organisms the Environmental Protection Agency (EPA) has certified it against. In its approvals, the EPA will certify any given chemical with a prescribed contact time that must be achieved for the disinfectant to be



Infection-related topics are in the top 10 patient safety concerns according to the Emerson Clinical Research

effective in the field. It sounds easy enough, but some chemicals have a contact time of up to 10 minutes. This cannot practically be achieved in a single application, so unless environmental services staff are routinely applying the chemical more than once to keep surfaces wet, disinfectants cannot work properly.



Dry surface biofilms form on all, but especially high-touch, surfaces in hospitals.

disinfectants (most hospital grade disinfectants contain quaternary ammonia), but only now are studies looking to determine how they perform during routine cleaning and disinfection of a facility. Efficacy of the disinfectant depends on multiple variables including the volume and dilution of the disinfectant, the fiber type, and the application method. According to a recent study, re-usable microfiber wipes, cotton towels, and half of the disposable wipes tested showed significant binding of quat disinfectants, substantially reducing efficacy²⁸.

Cleaning Materials Create As Many Issues As They Solve

Another complication to surface disinfection is directly related to the textiles used to wipe the hospital surfaces. Repeated laundering can cause damage to reusable microfiber mops, altering the structure of their fibers and rendering them less effective²⁹. When this happens, the reusable mops and towels are more likely to retain and spread contaminants. Because of this, reusable cloths don't just increase the risk of transmission of pathogens but can add pathogens as well³⁰. If the correct combination of material and chemicals is not used, it would be just as effective to leave a surface unattended to.

Biofilms Create Protected Spaces For Pathogens

Pathogens don't just survive on unattended surfaces—they thrive: grouping together and forming (dry) biofilms, a protective environment in which bacteria work together to multiply. As biofilms grow, they become stronger and more immune to traditional hospital disinfectants – even bleach. Many bacterial

In addition to the contact time issue, some widely used hospital cleaning products – specifically quaternary ammonium chloride (so-called “quat”) disinfectants – can become ineffective rapidly once dispensed. There have been many lab studies showing the efficacy of quat

species can form a biofilm together. The hallmark of a biofilm is its extracellular polymeric substances “house” – polymers secreted by the bacteria that protect it and allow it to grow as a community, protected from the elements³¹. Other pathogens are attracted to these organisms and can alter their DNA once exposed to environmental threats (such as cleaning materials), communicating within the new biosphere to share what they've learned, helping all the organisms in the biofilm to adapt and create stronger resistance for future cleaning. A clinical study found that biofilm was discovered on an average of 93% of all hospital cleaning towels, with 52% of samples containing multidrug-resistant bacteria³². Biofilms don't just form on hospital surfaces like bed rails and IV pumps. Bacteria from these communities can be transferred to the patient on healthcare workers' hands or directly from environmental surfaces. Once bacteria contact the patient, they can form new biofilms – inside the patient's bloodstream or on a medical device such as a central line or a urinary catheter. There is increasing evidence that biofilms are more responsible than previously believed for the failure of medical devices and the infections associated with these failures³³. Biofilms can also grow in patient wounds – chronic wounds can be persistent due to these biofilms and are a growing problem that is costing millions of dollars annually in the United States³⁴.



Biofilms can stay on a surface for months, and organisms within them can be transferred by cleaning towels and by healthcare workers' hands.

Increasing Prevalence Of Multi-Drug Resistant Organisms

The emergence of understanding around biofilms is concerning, but perhaps even more concerning is that pathogens are, in general, becoming increasingly resistant to antimicrobials, our only real way to treat them. More than 70% of the pathogens that cause the most common HAIs are multi-drug resistant organisms (MDROs)³⁵. MDROs are by definition resistant to many of the drugs that would normally be used to treat them, making them more expensive and dangerous. For example, a MRSA infection costs on average about \$4000 more per infection than the same infection with a susceptible strain of *S. aureus*³⁶.

In addition to bacterial DNA sharing and their adaptivity in general, antibiotic over-prescription is contributing to a worldwide MDRO crisis. Antibiotics are life-saving drugs, but more than half of the time they are prescribed, they are unnecessary. Antibiotics are also given prophylactically to livestock and end up in fertilizer or water supplies – and when bacteria are exposed to antibiotics that don't kill them, they learn about the drug and can become resistant to it³⁷. According to the World Health Organization (WHO), antibiotic resistance is reaching dangerously high levels in many areas of the world, and we are quickly running out of drugs that allow us to treat common infectious diseases. We are now in danger of entering a post-antibiotic era³⁸. When bacteria are multiplying out of control and there is no way of clinically treating them in people that develop infections, the environmental piece of infection control becomes increasingly important. It becomes our last line of defense, the safety net — and infection preventionists realize this.

Regulators Are Responding

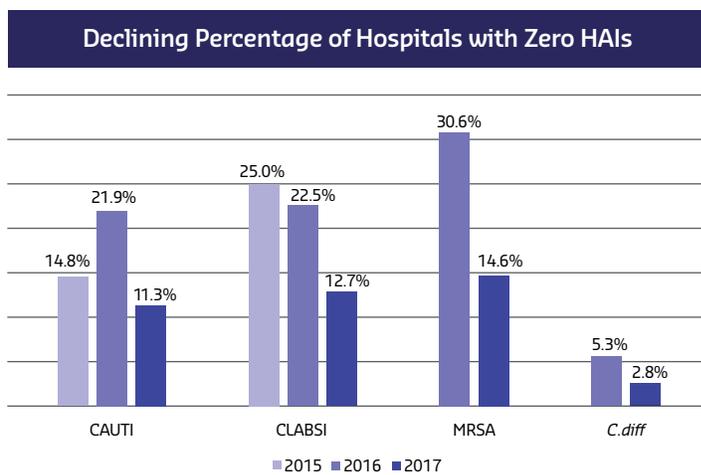
Infection prevention and control has been a priority in the healthcare system for many years. This is reflected in The Joint Commission (TJC)'s national patient safety goals (half of which pertain directly to preventing infection³⁹), and in the growing body of regulatory guidelines and mandates set forth by the many organizations that dictate quality in healthcare, most notably CMS. In response to this, the field of infection prevention has seen significant evolution. Infection preventionists are healthcare professionals—they can be nurses, physicians, public health professionals, or medical technologists—who coordinate departments throughout an entire healthcare facility with the

singular vision of providing healthcare without infection. The Association for Professionals in Infection Control and Epidemiology (APIC), has a strategic plan that outlines activity foci for achieving this vision through supporting infection prevention as a key component of patient safety, furthering scientific research that prevents infections, and influencing the legislation and regulatory agendas concerning infection prevention across the continuum of care⁴⁰.

Hospitals Are Losing The Battle

According to the CDC's National and State Healthcare-Associated Infections Progress Reports, progress was made between 2008-2014. There was a 50% reduction in central line-associated bloodstream infections (CLABSIs), a 17% decrease in surgical site infections (SSIs) in the ten tracked procedures, an 8% reduction in *C. difficile*, and a 13% decrease in hospital-onset MRSA⁴¹. However, even with the emergence of the field of infection prevention and the initial progress made in the field, according to a 2018 report, many hospitals are now losing ground in their infection prevention efforts. Between 2015 and 2018, the percentage of hospitals that reported zero infections declined significantly (Figure 1). Just between 2016 and 2017, the number of hospitals reporting zero *C. diff* and the number of hospitals reporting zero MRSA infections were both cut in half⁴².

Figure 1: Hospitals with Zero HAIs, according to a 2018 Leapfrog Group Report



Even with more resources than ever dedicated to preventing infections, it doesn't seem to be enough. Healthcare professionals know that traditional cleaning methods no longer suffice, and something needs to change.

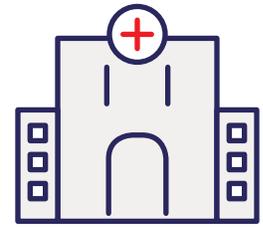
Can We Solve the Problem?

Sodexo has been actively piloting a new approach to environmental infection prevention at 31 hospitals in the US. Looking at the outcomes data from all the hospitals combined, there has been a marked reduction in the incidence of both healthcare-associated *C. diff* and healthcare-associated MRSA infections. There are 12 facilities with full data available comparing the 12 months prior to the 12 months post implementation. Data was collected monthly at hospital level, in collaboration with the hospital infection prevention teams. Summary statistics can be found in Table 2.

Table 2: Summary Infection Statistics for 12 United States Pilot Sites with 12 Months Pre and Post Data.

| | Mean | Standard Deviation | Minimum | Maximum |
|--|--------------|--------------------|---------|---------|
| 12 Months Before Protecta | | | | |
| Adjusted # of Patient Days | 83,810 | 51,060 | 11,962 | 159,710 |
| # of MRSA Infections | 7.92 | 11.88 | 0 | 43 |
| MRSA Infection Rate per 1,000 Patient Days | 0.12 | 0.14 | 0 | 0.48 |
| # of <i>C. diff</i> Infections | 48.42 | 47.77 | 0 | 147 |
| <i>C. diff</i> Infection Rate per 1,000 Patient Days | 0.69 | 0.52 | 0 | 1.44 |
| 12 Months After Protecta | | | | |
| Adjusted # of Patient Days | 84,454 | 53,541 | 11,944 | 170,541 |
| # of MRSA Infections | 2.75 | 3.79 | 0 | 14 |
| MRSA Infection Rate per 1,000 Patient Days | 0.04 | 0.04 | 0 | 0.12 |
| # of <i>C. diff</i> Infections | 22.17 | 20.23 | 0 | 64 |
| <i>C. diff</i> Infection Rate per 1,000 Patient Days | 0.33 | 0.28 | 0 | 0.90 |
| Reduction in Infection Rates | | | | |
| <i>C. diff</i> | 53% (p<0.01) | | | |
| MRSA | 70% (p<0.05) | | | |

In the 12 months before implementation, the average *C. diff* rate per 1,000 patient days across the twelve sites was 0.69 (standard deviation 0.52). Post deployment, the average rate fell to 0.33 (standard deviation 0.28) - a 53% reduction, statistically significant at the 1% level. For MRSA, the pre-deployment average infection rate per 1,000 patient days was 0.12 (standard deviation 0.14). After implementation, the average dropped to 0.04 (standard deviation 0.04). This was a statistically significant reduction of 70% (p<0.05).



The simple fact of the matter is that hospitals are doing more and gaining less.

A subset of the pilot facilities has had their infection data published by CMS on Hospital Compare for the full study period (12 months before and after program deployment). Data stems from CMS data releases in Q2 and Q3 in 2016 and 2017. The average reduction in these four hospitals' standardized infection ratio (SIR) was 23% for MRSA and 32% for *C. diff*. Before Protecta, the pooled SIR across the four sites was 0.99 for *C. diff* and 1.10 for MRSA. After 12 months of Protecta, pooled *C. diff* SIR dropped to 0.55 and pooled MRSA SIR dropped to 0.93. This pooled SIR takes the total number of infections across all hospitals and divides it by the total number of infections predicted across those hospitals, thereby proposing a weighted average that adjusts infection ratios to account for the increased impact of larger facilities or those with more predicted infections. CMS data, therefore, although it uses a slightly different success measure (standardized infection ratios), supports the impact of the program on reducing infections.

Taking into consideration the adjusted total number of patient days across the sites post deployment, this amounts to an avoidance of 319 *C. diff* infections and 63 MRSA infections across 12 facilities (Table 2).

Table 3: Infections Avoided

| | <i>C.diff</i> | MRSA |
|--|---------------|------|
| Number of Infections in 12 Months Before | 581 | 95 |
| Expected Number of Infections in 12 Months After (no Protecta) | 585 | 96 |
| Actual Number of Infections in 12 Months After (with Protecta) | 266 | 33 |
| # Infections Avoided | 319 | 63 |

Note: Expected infections are calculated based on pre-deployment infection rate per 1,000 patient days, applied to the total number of adjusted patient days in 12 months post-deployment.

The pilot program included a diverse set of sites, including hospitals with large and small patient populations (as seen by the adjusted number of patient days statistics) as well as hospitals with severe and less severe infection problems. Furthermore, due to the nature of the pilot programs across the sites, it is reasonable to assume that there were few systematic additional factors that influenced infection prevention efforts outside of the Protecta program. The data analysis has not explicitly controlled for whether hospitals simultaneously put in place additional infection prevention measures, such as their own hand hygiene or surgical infection prevention protocols, but anecdotally it can be shown that this was not the case. Nor had the hospitals under study experienced any systematic influx of patients with community-acquired *C. diff* that increased the bioburden at a single facility. The reduction in infection rates at the pilot sites can therefore be reasonably attributed to the new infection prevention program.

How Has This Been Achieved ?

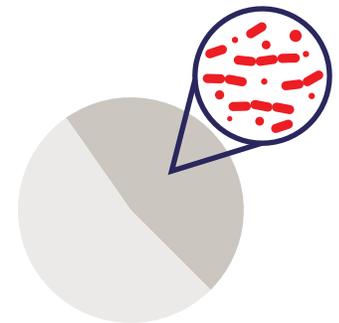
The solution is for environmental services teams to adopt a multi-disciplinary, multi-pronged, multi-tiered approach, working closely with hospital infection prevention teams. While hospitals do the things they must to reduce HAIs – hand hygiene programs, antibiotic stewardship and patient isolation we can demonstrate that the introduction of a radically different approach to environmental decontamination has a statistically significant impact on the level of healthcare-associated infections in hospitals.

Sodexo has effectively created a safety net, a last line of defense, for provider organizations when other means of reducing and controlling infections are ineffective: a foundational program focusing on the patient environment which is very practical, and which pays demonstrable dividends. By using experience from cleaning over 1,000 hospitals around the world, by working closely with clinicians, by undertaking lengthy pilot studies, and by understanding the literature, Sodexo has created a practical, evidence-based solution which demonstrably reduces patient harm.

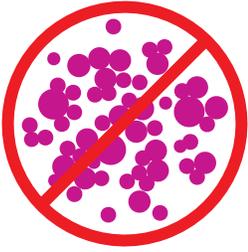
'Protecta' From Sodexo

The solution is built around an appreciation of risk – the risk of infection, and the understanding that different things need to be done in different ways at different times. Infection risk varies depending not only on a particular environment, but also on what is being done in that environment, what type of patients are present, and what equipment or assets there are. This requires a careful, multi-layered approach, incorporating standard operating procedures, materials and chemicals specific to the task in hand, and a governance regime which means hospitals are assured that the right things are being done, in the right way, in the right places, and at the right time.

Protecta is a unique combination of cleaning and disinfecting chemicals, materials, tools, processes, training, and IT applications focused on reducing infections built around a risk framework and governance processes. Evidence-based, it focuses on hiring and training the right people in what can be a challenging role, ensuring the right processes are put in place and adhered to, and providing the right technology solutions – solutions that are efficacious and can be practically used by environmental services staff.



***C. diff* infections at the sites were reduced by 53% after the Protecta program was implemented.**



MRSA infections at the sites were reduced by 70% after the Protecta program was implemented.

On reviewing the growing body of scientific literature, there is good evidence that pathogenic contamination on hospital surfaces contributes to the transmission of HAIs. Studies have shown that contact with the environment is just as likely to contribute to HAI transmission as direct

contact with a patient infected with a pathogen⁴³. Furthermore, it has been shown that cleaning interventions alone do not reduce pathogenic load on surfaces—but they are reduced with an intensive effort to improve environmental disinfection⁴⁴.

Sodexo has developed an operational and risk framework for cleaning and infection prevention in hospitals. At the core are scoring methodologies for microbiological risk. Environmental services teams work with the hospital infection prevention team to develop a specific risk profile for individual areas within the hospital (and all the assets within them) and use this profile to designate a set of frequencies, methods, materials and chemicals unique to that location.

Attached to the operational risk framework are governance processes: ensuring that a cleanliness and infection prevention policy is agreed with the healthcare provider, creating clarity on areas of responsibility, how often reporting systems and processes are to be employed, what audit and quality protocols are to be established, and, most importantly, how Sodexo adds value to the day-to-day operations of complex organizations.

Standard Operating Procedures (SOPs) support the risk framework: they cover every type of internal location and asset, as well as current infection status. This means that the environmental services labor model is designed around the SOPs for a given level of activity and risk, giving predictable outcomes and the flexibility to adjust things quickly (and in a controlled way) when the need arises. As you would expect from a company

present in over 3,000 hospitals globally, Sodexo has established a comprehensive knowledge base geared to the effective management of hospital environments.

Published audit and inspection methodologies and frequencies ensure hospitals have confidence that the right thing is being performed in the appropriate way to the correct standard: from daily through to monthly scheduling, each area of a hospital and every asset within it is inspected for cleaning effectiveness. To ensure day-to-day management of risk, activity and outcomes, Sodexo uses proprietary IT solutions: these not only manage assignment of tasks and activities, they also capture hospital reporting on both visual and microbiological standards, with links to track the level, type and location of any healthcare-associated infections. Labor management systems and processes are linked to this and assist with the efficient deployment and utilization of monitoring solutions.

The Opportunity – Save Lives, Reduce Costs

HAIs are a problem that are impacting patients (both morbidity and mortality) harming and killing patients and costing hospitals money. These infections are killing 75,000 people annually in the US alone, are increasingly resistant to the antibiotics we use to treat them, and are learning from each other to defeat established environmental strategies used to remove them from the patient environment. Infection prevention has risen to the forefront of modern hospitals' concerns, but even with the increased spending and effort to combat these pathogens, the pathogens are gaining more ground than the hospitals.

With Protecta, Sodexo presents a combination of tools, chemicals, processes, and education that will effectively reduce HAIs in facilities: proven effective across the sites where it is in place at reducing both healthcare-associated *C. diff* and MRSA.



In sites where the Protecta program was implemented, in a year, 400+ *C. diff* and MRSA infections were avoided.

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