

## Cost Justification

The most immediate and obvious financial impact of The DiskCover System would be from the prevention of HAI.

While direct causative associations are not generally available for HAI impact with individual personal protective equipment (PPE), the stethoscope hygiene market has a very sharp contrast between standard of care alcohol based hand rubs (ABHRs) and The DiskCover System when it comes to the ability to reduce transmission of multidrug-resistant organisms (MDROs) and *Clostridioides difficile* (*C. diff*) within a hospital and the direct financial impact of this consequence.

*C. diff* is the leading cause of hospital-associated diarrhea in the United States and one of several HAIs targeted by the US Department of Health and Human Services in a 2013 action plan.<sup>26</sup> In 2017, it sickened more than 223,000 hospital patients, was associated with 12,800 deaths, and was responsible for more than \$1 billion in attributable healthcare costs.<sup>27</sup>

While ABHRs have merely a weak impact on removing patient exposure to *C. diff* from the stethoscope diaphragm,<sup>7, 14</sup> and in fact have the potential to even exacerbate spread,<sup>54</sup> the DiskCover System has been demonstrated to be 100% effective in blocking pathogens and contaminants found on the stethoscope diaphragm, including *C. diff* and MRSA.<sup>11, 22</sup>

Given that an intervention study, where patients are randomized to pathogen exposure, is unlikely to be completed for ethical reasons, value modeling is appropriate. From a value-analysis perspective, single-use, aseptic barriers may be effective, as the avoidance of a single hospital acquired *C. diff* infection, with an estimated cost of \$90,000,<sup>8, 24</sup> can underwrite over 250,000 auscultations with disk cover barriers.\*

\*Assumes list pricing for the Clean Cassette, your actual net price may be lower.



# Return on Investment Models

This section includes multiple models that reference cited literature to detail theoretical cost-savings attributable to adoption of The DiskCover System in the topics of cost and time-savings, HAI cost avoidance, and price comparison of previous standards of stethoscope hygiene. These models allow for variable inputs that can be tailored to the unique characteristics of a healthcare facilities and can be provided upon request to view how your facility might benefit financially through adoption of The DiskCover System. For this summary, a most-likely scenario using a 20-bed emergency department was used.

## **Acquisition Cost of The DiskCover System**

The combined initial implementation and annual cost of The DiskCover System in this scenario would equal only \$84,500.

## **Cost Avoidance from Time-savings**

Cleaning the stethoscope diaphragm with alcohol adequately takes a significant amount of time out of a clinician's day that they could instead be dedicating to patient care.<sup>8</sup>

A model that observes the following factors outlines the costs associated with clinicians solely spent on stethoscope cleaning:<sup>30</sup>

- **Number of auscultating clinicians (nurses & physicians) in a department**
- **Number of patients seen per clinician in each department**
- **Average hourly cost of each clinician**
- **Hospital compliance rate of stethoscope hygiene**

Using an example of a high-acuity area, such as an Emergency Department, with 20 clinicians that each see an average of 20 patients a day,<sup>31</sup> and an average annual cost of \$128,178.57 per clinician, this department if observing perfect stethoscope hygiene compliance would be spending **7300 hours on stethoscope hygiene a year**, with an **attributable cost of \$449,857.49 per year** dedicated entirely to clinicians in this single department cleaning their stethoscope.

Stethoscope hygiene compliance is often much lower than 100%. At a more commonly observed 11% rate of compliance,<sup>32</sup> the department would instead be spending 803 hours on stethoscope cleaning, or \$49,484.32 per year on clinician stethoscope cleaning.



While this model demonstrates that lower stethoscope hygiene compliance might be cost-saving in itself, the problem is that lower compliance will lead to much higher attributable costs, and potential mortality, from HAIs.

## HAI Cost-avoidance

MRSA and *C. diff* are two examples of pathogens that have commonly been found on stethoscope diaphragms<sup>33,34</sup>. Hospital's attributable costs of these to HAIs can be significant, at an average of \$14,792 per nosocomial non-pneumonia MRSA-related infection and \$11,285 per nosocomial *C. diff* infection.

### Theoretical pathogen transmission rate:

This model uses the following clinically referenced factors to outline the potential consequences of pathogen transmission occurrences via the stethoscope diaphragm and their associated attributable costs to the hospital:

- **Annual auscultations of the hospital / department being evaluated.**
- **Likelihood of *C. diff* (5%) or MRSA (7.4%) on a clinician's stethoscope diaphragm<sup>33,34</sup>**
- **Hospital compliance rate of stethoscope hygiene (data suggests 11%)<sup>28</sup>**
- **Occurrence of pathogen transmission from a contaminated to a non-contaminated surface (40% for uncleaned stethoscopes; 5% for cleaned stethoscopes)<sup>35</sup>**

The model uses the above referenced data to calculate what percentage of these interactions will result in a transmission event of *C. diff* or MRSA. Using the previous example of a high-acuity emergency department with 20 clinicians each seeing 20 patients a day, the annual number of auscultations would provide 146,000 patient contacts. According to the model and data, these auscultations will result in **2,639** transmission occurrences of *C. diff* to the patient, and **3,906** transmission occurrences of MRSA.

### Theoretical Infection Rate from Pathogen Transmission via Stethoscope Diaphragm

To convert *C. diff* transmission rate to *C. diff* infection rate, a variable factor must be used, as no clinical or scientific data exists on the transmission to disease conversion rates of pathogens for either the hands, fingertips, or the stethoscope diaphragm. Therefore, a sensitivity analysis was used to provide a theoretical infection range. The analysis uses a previously reported metric that 2.7% of United States adults are immunocompromised,<sup>36</sup> and these populations are at risk for a 100% sensitivity to infection from pathogen transmission.



**Sensitivity Factor:** An average patient will always have some sort of factor of sensitivity lower than that of a fully immunocompromised patient. In this case, the sensitivity factor is the % chance a patient becomes infected after being exposed to a pathogen, with 100% representing a completely immunocompromised patient.

- **Maximum sensitivity (100%):** An immunocompromised patient (2.7% of US adults) will most likely develop an infection if they experience a pathogen exposure. Theoretically, there is a 2.7% chance when auscultating a random patient that they are immunocompromised and, with a 100% sensitivity factor, will develop infection if they experience pathogen transmission from the stethoscope diaphragm. (For every 100 auscultation exposure = 2.7 infections)
- **Hospitalized sensitivity (10%):** An average hospitalized patient has a temporarily weakened immune system and is more vulnerable compared to their baseline health, but they may not be completely immunocompromised. They may experience a transmission to infection rate of 10% sensitivity factor compared to that of a fully immunocompromised patient, or 0.27% chance of infection per pathogen transmission. (For every 100 auscultation exposures = 0.27 infections)
- **Minimum sensitivity (1%):** A healthy patient, such as one simply being auscultated for a check-up, or one nearing full recovery, is much less likely to develop an infection from a pathogen transmission than either a hospitalized patient or a hospitalized immunocompromised patient. They may experience a transmission to infection rate of 1% (sensitivity factor) that of an immunocompromised patient, or a 0.027% chance of infection per pathogen transmission. (For every 100 auscultation exposure = 0.027 infections).

This same analysis was used for MRSA, except replacing one variable, that MRSA is a more common pathogen, and assumed there was a 7.4% likelihood of MRSA on a clinician stethoscope surface.<sup>30</sup>

Using the 2639 *C. diff* transmission and 3906 MRSA transmissions previously calculated, the theoretical rate of nosocomial infections per year due to transmission via stethoscope diaphragm are:

- **At 100% sensitivity factor: 71 *C. diff* infections and 105 MRSA infections**
  - o **Total attributable costs: \$2,365,554.78**
- **At 10% sensitivity factor: 7 *C. diff* infections and 11 MRSA infections**
  - o **Total attributable costs: \$236,555.48**
- **At 1% sensitivity factor: 1 *C. diff* infection and 1 MRSA infection**
  - o **Total attributable cost: \$23,655.55**



## **Price Comparison to Disposable Stethoscopes**

A simple model compares hospital costs dedicated to purchase and use of single-patient, or disposable, stethoscopes to the acquisition and annual cost of The DiskCover System can help further highlight cost-savings.

A 50-bed emergency department spending an average of \$6.00 per single-patient stethoscope on 4,000 patient admissions would be spending **\$24,000 on disposable stethoscopes** over the year.

## **Summary**

In conclusion, this model presents projected cost-avoidance from alleviation of time, HAIs, and current practices following integration of The DiskCover System into a facility. After considering the cost of acquisition of The DiskCover System, and the costs of maintaining alternate stethoscope hygiene methods, combining the highest probability scenario from each model yields an **annual cost saving of \$355,043.36**. In addition to cost avoidance – compliance, protocolization, and standardization is made easy with The DiskCover System. The speed and ease of use of the system removes variation, and protocolization is made simpler and easier to enforce.

\*Assumes list pricing for The DiskCover System, your actual net price may be lower

