Establishing a Monitoring Process
For Inpatient Room Cleaning at Discharge

Final Report

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# Table of Contents

Executive Summary ........................................................................................................ 6

Key Issues ..................................................................................................................... 6

Project Goals .................................................................................................................. 6

Methodology ................................................................................................................... 6

Findings and Analysis .................................................................................................... 7

Recommendations .......................................................................................................... 8

Introduction .................................................................................................................... 9

Background .................................................................................................................... 9

Key Issues ...................................................................................................................... 10

Goals and Objectives ..................................................................................................... 10

Project Scope ................................................................................................................ 11

Hospital Units for Data Collection .............................................................................. 11

High-Touch Areas ......................................................................................................... 11

Expected Impact ........................................................................................................... 12

Data Collection ............................................................................................................. 12

Literature Search .......................................................................................................... 12

Observations ................................................................................................................ 13

Pilot Testing ................................................................................................................... 13

Active Review .............................................................................................................. 14

Interviews and Surveys ................................................................................................. 15

Findings ......................................................................................................................... 15

C. diff Impact ............................................................................................................... 16

Monitoring Process Development .............................................................................. 16

Product Costs ............................................................................................................... 17
List of Tables and Figures

Table 1: Swabbing receives a higher value overall .................................................................8
Table 2: Costs per unit of materials ......................................................................................17
Table 3: Average cost per room for processes ......................................................................17
Table 4: Time requirements for the spray process .................................................................18
Table 5: Time requirements for the swabbing process ..........................................................18
Table 6: Travel time requirements ........................................................................................19
Table 7: Adjusted average monitoring times ..........................................................................19
Table 8: Supervisors give higher rating overall to the swabbing process .........................21
Table 9: Quality criterion value scale ....................................................................................23
Table 10: Usability criterion value scale ...............................................................................23
Table 11: Time criterion value scale .....................................................................................24
Table 12: Cost criterion value scale ......................................................................................25
Table 13: Swabbing receives a higher value for usability and time .....................................26
Table 14: Swabbing is the better process even with increased review frequency .............26

Figure 1: Discharge Clean Process Flow Chart (updated from Winter 2010 project) .........13
Figure 2: Process Flow Chart for Spray ............................................................................16
Figure 3: Process Flow Chart for Swabs ............................................................................17
Figure 4: Monitoring processes have similar quality levels .............................................20
EXECUTIVE SUMMARY

The increased incidence of hospital-acquired infections, including *Clostridium difficile* (*C. diff*) has become a serious issue at the University of Michigan Health System (UMHS), according the Infection Control and Epidemiology (ICE) department. Many initiatives are currently being pursued throughout the hospital to reduce the rates of infection, including the development of a monitoring process for the cleaning of discharged patient rooms. In the winter of 2010, an Industrial and Operations Engineering (IOE) 481 team identified high-touch areas in patient rooms, and developed a monitoring process using a surrogate spray. The monitoring process used an active review method, where the results and feedback are shared immediately with the custodian. The next step for the Environmental Services (EVS) and ICE departments is to implement a monitoring process hospital-wide. However, since the previous project ended, a new monitoring method, which uses ATP swabs and a luminometer to measure the cleanliness of surfaces, has been introduced to ICE. Therefore EVS and ICE need evaluate the ATP swabs, and determine which product to use for monitoring.

Key Issues

The following key issues were driving this project:

- The rate of *C. diff* in UMHS is higher than desired, and EVS and ICE want to reduce the incidence of infection
- Patient satisfaction needs to be maintained, and clean rooms tend to lead to positive patient experiences
- ICE has introduced swabs as another possible monitoring method, but the product has not yet been tested or used in UMHS
- EVS wants to develop a monitoring process that can be used throughout UMHS

Project Goals

The goal of the project was to develop and analyze monitoring processes using the two products, swabs and spray, and then to recommend a final process for use throughout UMHS, based on four criteria: quality, usability, time requirements, and cost.

Methodology

To analyze the processes, the team used five methods for data collection:

- Literature search – The team reviewed 15 sources for information on *C. diff* and other hospital-acquired infections, monitoring products, and monitoring effectiveness in hospitals.
- Observations – The team performed a discharge cleaning with a custodian, and observed the discharge process in the hospital for approximately six hours per team member.
- **Pilot testing** – The team practiced using the products in discharged rooms, and then developed directions for monitoring, using both processes, and created data collection forms for active review.

- **Active review** – The team and three EVS supervisors performed 28 active reviews using the swabs, and 28 active review using the spray, for a total of 56 active reviews, collected over 4 weeks. The team recorded the time required to perform the monitoring process, and the high-touch areas missed in each room. The team also requested that the supervisors record the time it took them to travel to the discharged room (from their location when they were paged).

- **Interviews & surveys** – The team interviewed the three supervisors involved in the active review data collection and nine custodians that had been reviewed to gain insight into staff perception of monitoring and the two processes. The team also surveyed the three supervisors to get a quantitative understanding of how the supervisors perceived the usability and quality of the two processes.

### Findings & Analysis

Findings from the data collection include:

- **C. diff impact** – Patients who acquire *C. diff* while in the hospital have an increased length of stay of 1.9 days and increased cost to the hospital system of $3,070, on average.

- **Monitoring process development** – The team created flow charts for the two monitoring processes based on observations in the hospital

- **Product costs** – The team calculated the average cost per room to be $14.61 for the swabbing process, and $1.00 for the spray process

- **Active review time** – From the data collected from the active reviews, the team found the time needed to perform an active review (including travel time) to be 15.4 minutes for the swabbing process, and 18.3 minutes for the spray process.

- **Supervisor and custodian perceptions** – Interviews and surveys indicated that a majority of EVS staff (both supervisors and custodians) prefers the swabbing process. Also, none of the custodians found the monitoring process disruptive to their work routine and most found it to be a positive experience.

The team then used the findings to compare the two processes by rating each process based on the four criteria (quality, usability, time requirements, and costs), and assuming the supervisors perform five active reviews each week. Each criterion received a value from 1 to 5 (with 1 being bad and 5 being good), and then the values were weighted and summed to get a total value. The assigned values are shown in Table 1 below.
Table 1: Swabbing receives a higher value overall

<table>
<thead>
<tr>
<th></th>
<th>Quality (Q)</th>
<th>Usability (U)</th>
<th>Time (T)</th>
<th>Cost (C)</th>
<th>Total Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Swabbing</td>
<td>4</td>
<td>5</td>
<td>3</td>
<td>5</td>
<td>17</td>
</tr>
<tr>
<td>Spray</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>5</td>
<td>14</td>
</tr>
</tbody>
</table>

Table 1 indicates that the swabbing process is better, based on the four criteria. The team also rated the processes assuming the supervisors performed 10 and 15 active reviews each week, and swabbing received a higher value in all cases.

**Recommendations**

Based on the results from the data collection and the criteria analysis, the team recommends that EVS implement the following plan for monitoring inpatient discharge cleaning throughout UMHS:

- Use the swabbing process
- Require each supervisor to perform five active reviews per week
- Record the monitoring results to calculate changes over time
- Change the high-touch areas over time to ensure that the monitoring process is effective
- Use the spray process during training and for weekly or monthly cleaning process checks
INTRODUCTION

Eliminating the spread of the *Clostridium difficile* (*C. diff*) bacterial infection in the University of Michigan Hospital Systems (UMHS) is a top priority, and UMHS has started several initiatives to reduce the number of infections and control the spread of the bacteria. For example, any visitors, doctors and other staff members who enter the room of an infected patient are required to follow specified isolation precautions. Another method for controlling the spread of infection is to ensure proper patient room cleaning, which is performed by the Environmental Services (EVS) staff. EVS and the Infection Control and Epidemiology (ICE) department want to further decrease the rates of patient infection by ensuring that the rooms are clean before patient arrival.

In the winter of 2010, an Industrial and Operations Engineering (IOE) 481 team worked with EVS and ICE to establish a process to monitor the cleaning of patient rooms by identifying high-touch areas in the rooms, and creating a standard method for using a surrogate spray. The spray was applied to the identified high-touch areas before the cleaning, and then the areas were reviewed after cleaning with a black light to check for remaining spray (indicating an unclean area). The team employed active review, where the results of the monitoring were shared with the EVS staff member immediately the high-touch areas were examined. Since the completion of the last IOE 481 project, Hygenia ATP swabs were introduced to the ICE department by the Risk Management department as an alternative product option for monitoring the cleaning process.

The next step in the implementation of a monitoring process for discharge cleaning, according to EVS and ICE, is establish and execute a plan a for use throughout the hospital.

The EVS and ICE departments at the University of Michigan Hospital requested that an IOE 481 team develop options for monitoring processes that can be implemented throughout the hospital, using the surrogate spray or swabs. The team has recommended the best process for monitoring the quality of patient room cleaning at discharge based on four criteria: usability, quality, time requirements, and cost. This report presents the project methodology, findings, and final recommendations.

BACKGROUND

According to an Infection Control Practitioner in ICE, hospitals around the world have recently seen a significant increase in the incidence of infection caused by the bacteria *Clostridium difficile* (*C. diff*). *C. diff* causes an infection that can be spread throughout a hospital via contaminated surfaces. *C. diff* is especially dangerous because of its ability to live on dry surfaces for extremely long periods of time. However, hospitals can contain the rate of infection of *C. diff* and many other hospital-acquired infections, including Methicillin-resistant *Staphylococcus aureus* (MRSA) and Vancomycin-resistant *enterococcus* (VRE), by using standardized contact precautions and good hand hygiene, alerting staff of contaminated areas, and thoroughly cleaning rooms upon patient discharge from the hospital.
UMHS has long stood as an example to other health systems through innovative research, passionate employees, and high quality patient care. Nevertheless, UMHS has seen higher than desired rates of *C. diff* throughout the hospital system. According to data collected by ICE, the hospital-acquired rate of *C. diff* has been approximately 0.89 cases per 1,000 patient days from January 2009 to September 2010, which is significantly above the hospital goal of 0.6 hospital-acquired cases per 1,000 patient days (see Appendix A for graph of complete data).

The EVS and ICE Departments have determined that ensuring patient rooms are properly cleaned can help reduce the rate of *C. diff* and other infections. Additionally, clean rooms lead to higher patient satisfaction, which helps to maintain patient loyalty, according to past hospital studies. Therefore, the departments want to effectively monitor the work of the EVS staff when they clean patient rooms after patient discharge. Two products have been selected as options to monitor the process: Clue Spray and Hygenia ATP swabs. Detailed explanations of both products can be found in Appendix B. These products each require a standardized method of use to be effective for monitoring room cleanliness. Currently, only one EVS staff manager performs periodic, but unscheduled, monitoring using the Clue Spray.

The IOE 481 team from Winter 2010 focused on determining high-touch areas in the patient rooms, and developing a process for using the surrogate spray. This project continues the work of the previous IOE 481 team by using their established high-touch areas and procedures for applying the surrogate spray when comparing the two products, swabs and spray, and then recommends a plan for monitoring discharged room cleaning throughout the hospital.

**KEY ISSUES**

The following key issues were driving this project:

- The rate of *C. diff* in UMHS is higher than desired, and EVS and ICE want to reduce the prevalence of infection
- Patient satisfaction needs to be maintained, and clean rooms tend to lead to positive patient experiences
- ICE has introduced swabs as another possible monitoring method, but the product has not yet been tested or used in UMHS
- EVS wants to develop a monitoring process that can be used throughout UMHS

**GOALS AND OBJECTIVES**

The primary goal of the project was to recommend a product and corresponding process for monitoring inpatient room cleaning that can be used throughout UMHS. The development of the process includes evaluating different scenarios for implementation by varying the frequency of
monitoring, which will vary the costs and time requirements for implementing the monitoring process.

The selection of the recommended method and its process will be based on the following criteria:

- **Quality** – How effective is the monitoring? Does the monitoring accurately reflect how well the room was cleaned?
- **Usability** – How repeatable is the process? How reproducible is the process? Is the process cumbersome for the EVS supervisors or staff? Is the process intrusive for the clinical staff and/or patients?
- **Time requirements** – How long does the monitoring take to complete? How large is the variation in monitoring time?
- **Cost** – How much does each process cost?

**PROJECT SCOPE**

The project considered only two alternative methods for monitoring: surrogate spray and swabbing. Any other available method was not evaluated. Also, the team worked primarily with EVS staff, but did not analyze the cleaning process itself. Specifically, the team was not present in the room while cleaning was occurring during the active review process. Data collection occurred primarily between 12:00pm (noon) and 12:00am (midnight), and only in inpatient rooms.

**Hospital Units for Data Collection**

The units examined during the study, as defined by the EVS Staff Development Manager, were:

- University Hospital (UH) 7 – excluding Intensive Care Unit
- University Hospital (UH) 8 – excluding Intensive Care Unit
- Cardiovascular Center (CVC) 5

All other units were not used for data collection, but the final recommended process should be applicable on all floors, in all parts of UMHS.

**High-Touch Areas**

This project includes the examination of the following high-touch areas during the monitoring process:

- Television remote
- Drawer handle**
- Room light switch
- Door handle (inside and outside)
- Sink faucet handles
- Toilet handle**
- Toilet seat**
- Bathroom rail**
• Bathroom light switch
• Bathroom door handles (inside and outside)
• Telephone*
• Bed rail

* Monitored with swabbing only
** Monitored with spray only

However, not all areas were tested during each review. The specific areas are determined by the room type (double or single) and the method. Because another patient remains in a double room after a discharge, only areas around the discharged patient bed area are cleaned (not the bathroom). The areas used for the surrogate spray procedure are those defined for each room type during the previous project (Winter 2010). However, because the swabs are more expensive than the spray, only the most frequently missed high-touch areas, as identified by the EVS Staff Development Manager, were tested. (See Appendices D and E for specific areas.)

EXPECTED IMPACT

Implementing the recommended monitoring method will result in:

• A standardized monitoring procedure throughout UMHS
• Improved quality of room cleaning at patient discharge
• Reduced levels of *C. diff* and other hospital-acquired infections
  o Lower overall hospital costs from reduced patient stay time
  o Improved patient satisfaction

DATA COLLECTION

To develop processes for monitoring and compare the two alternatives – spray and swabbing – the team collected data using five methods. The primary parties involved in the data collection process were EVS custodians and supervisors.

Literature Search

The team conducted a literature search on hospital-acquired infections, focusing primarily on *C. diff*. The team has also performed a literature search on the two alternative methods, surrogate spray and swabbing, to gain a better understanding of how they work, how they are currently being used in hospitals, and how much each product costs. Key references consulted include:

• Hygenia Product Manual (for the swabs)
Observations

The team participated in one discharge room cleaning with an EVS staff member and observed the discharge cleaning process for 6 hours per team member, on the selected floors. These observations helped the team to understand the interactions between custodians, nurses, patients, and other staff members, before, during, and after the discharge cleaning. This understanding of the process flow is important to estimate the effect of adding a monitoring step to the discharge process to each group (i.e. nurses, custodians, patients) involved. The team also used the observations to create process flow charts, and to develop the pilot tests and the data collection processes. The process flow chart for the discharge cleaning process is shown in Figure 1.

Figure 1: Discharge Clean Process Flow Chart (updated from Winter 2010 project)

While the process generally follows the chart in Figure 1, the team observed occasional deviations. For example, some custodians will clean a room before they have been paged, if they know the patient has already been discharged.

Pilot Testing

Pilot testing involved three main components: developing flow charts for each method, creating data collection sheets, and developing directions for monitoring. The team developed processes for monitoring both the surrogate spray and swabbing methods using the information from the literature search, observations, and discussions with the EVS Staff Development Manager and an Infection Control Practitioner. Topics discussed at the meetings included:
- High-touch areas for swabbing
- Monitoring in batches vs. one room at a time
- Differences between single and double rooms
- Product costs

Then each team member spent 6 to 8 hours practicing the methods and the monitoring process in the hospital. The team created data collection forms for use by both the team members and the supervisors who collected data. The forms recorded the duration of the active review (and for the surrogate spray only, the duration of the application before cleaning) by recording start and stop times, and unclean (“missed”) high-touch areas. The two data collection forms, one for each process, are shown in Appendix D.

The team also developed directions for the monitoring process (for both the swabbing and surrogate spray methods), based primarily on practice, and the information from the literature search and the EVS Staff Development Manager. In developing the directions, the team used the application process from the product manual for the swabs, and used the application process taught by the EVS Staff Development Manager (from the previous project) for the spray. The directions were used by the supervisors during data collection and will be used after monitoring is implemented throughout the hospital, to ensure that the supervisors are all following the same monitoring process, including swabbing/spraying consistent areas and properly applying the products. The directions are shown in Appendix E.

**Active Review**

During the active review process, the monitor (either a team member or supervisor) used one of the monitoring methods, spray or swabs, to check the quality of the cleaning, and then gave immediate feedback to the custodian by sharing the results of the monitoring with him or her.

The team and the supervisors collected data on the time required for each active review, and the number of areas successfully cleaned, using the team-developed data collection forms (see Appendix D). To measure the required time, the monitors recorded the start and stop times of the following steps of the active review process:

- **Travel time** – The time needed for the supervisor to get from his or her current location to the room that has recently been discharged or cleaned (data collected by supervisors only)
- **Apply spray** – The time needed to spray the high-touch areas before the room is cleaned (not applicable for swabbing process)
- **Active Review** – The time needed to review the high-touch areas and discuss results with the custodian

To measure the cleanliness of the room, the monitor recorded on the data sheet any high-touch areas that were unclean.
Each method had a specific application procedure. For the spray process, the spray was applied to high-tough areas before cleaning, and then the monitor and custodian went through the room after cleaning with a black light to determine if each area was cleaned or missed. After the assessment, the monitor removed residue from the surrogate before the next patient entered. For the swabbing method, the swabs were wiped on the high-touch areas (in an area no larger than 4” x 4”) only after cleaning. The team member or supervisor then inserted the swabs into an ATP luminometer to determine if the area was cleaned. The supervisors had the directions for monitoring with them for reference while performing the reviews.

The team collected data for 4 weeks. The team members performed 34 active reviews during the first 2 weeks, and three supervisors performed a combined 22 active reviews during the second 2 weeks, for a total of 56 active reviews (28 active reviews for each method – spray and swabbing).

**Interviews and Surveys**

After completing the active reviews the team informally interviewed the 3 supervisors involved in the data collection (2 supervisors in UH and 1 supervisor in CVC) and 9 custodians who had participated in an active review during the data collection. The questions asked (and responses) are shown in Appendix F. The purpose of the interviews was to get a qualitative understanding of the processes and the staff perception of the monitoring.

The team also surveyed the three supervisors involved in data collection to get qualitative and quantitative data on the usability and the quality of the two methods and processes. The surveys (and results) are shown in Appendix F.

**FINDINGS**

Before comparing the processes based on the four criteria, the team analyzed the results of the data collection. The key findings from data collection include:

- The estimated cost of C. diff to UMHS is $767,500 per year
- The material and equipment costs are lower for the spray process
- The average time per active review is lower for the spray process, but spraying requires an additional visit to the patient room (before the room is cleaned)
- Supervisors found the swabbing process to have higher usability
- Supervisors indicated that five active reviews per week was feasible

The EVS and ICE departments decided the team should assume that the distribution of single and double rooms throughout the hospital is approximately the same as the distribution during data collection. Therefore the team did not need to analyze the differences between single and double rooms.
C. diff Impact

During the literature search, the team reviewed 15 sources. The primary goal was to learn about C. diff and its impact on hospitals and patients, but the team also researched the products used in the swabbing and spray processes, and how other hospitals are monitoring room cleaning. A complete list of the sources reviewed can be found in Appendix C.

The literature search revealed that C. diff has a significant impact on hospital systems with respect to patient stay time, patient costs and public perception. An article by Dubberke, et al. indicated that patient length of stay increases by 1.9 days on average if a patient acquires C. diff in the hospital, and C. diff infections increase the cost of inpatient treatment by $2,470-$3,669 per episode (2008). UMHS experiences about 250 hospital-acquired cases per year (see graph in Appendix A), resulting in costs attributable to C. diff at UMHS are approximately $767,500 per year.

The literature also indicated that observation and monitoring had a positive impact on cleaning quality. Hota, Blom, Lyle, Weinstein, and Hayden found that observing the work of custodians led to decreased contamination rates (2009). Further, this study showed that cleaning quality could be improved by educating custodians about hospital-acquired infections and the importance of cleaning in reducing infection spread.

Monitoring Process Development

Based on the observations and pilot testing, the team-developed high-level process flow charts for using the two products, shown in Figures 2 and 3.

Figure 2: Process Flow Chart for Spray
The primary difference between the two process flows is that the spray process involves an additional step, before the room is cleaned, to apply the surrogate spray. The monitor must be sure to apply the spray after the patient leaves, but before the custodian starts to clean.

**Product Costs**

Based on the product cost information from meetings with ICE and EVS, the team calculated the costs per room for the two processes. According to both the ICE practitioner and the EVS staff manager, the average spray bottle lasts for 20-30 reviews. For data analysis purposes, the team assumed that the spray lasts for 25 reviews. Each swab can be used once (for one high-touch area per room). The unit costs for the products and the costs per room are shown in Tables 2 and 3, respectively.

Table 2: Costs per unit of materials  
Source: EVS and ICE departments

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost (Per Unit)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spray Bottle</td>
<td>$25</td>
</tr>
<tr>
<td>Swab</td>
<td>$2</td>
</tr>
<tr>
<td>Black light</td>
<td>$30</td>
</tr>
<tr>
<td>Luminometer</td>
<td>$1,000</td>
</tr>
</tbody>
</table>

Table 3: Average cost per room for processes

<table>
<thead>
<tr>
<th>Process</th>
<th>Average Cost Per Room*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spray</td>
<td>$1.00</td>
</tr>
<tr>
<td>Swabbing</td>
<td>$14.61</td>
</tr>
</tbody>
</table>

*Cost of luminometer / blacklight not included
Tables 2 and 3 indicate that swabbing process is more expensive, as both cost per room for swabbing and the cost of equipment (luminometer) are greater compared to that of the spray process. The EVS department will have to purchase the equipment before the monitoring process is implemented (the equipment used for the data collection is property of the ICE department). It should be noted that the cost of batteries for the luminometers and black lights is not included in the cost analysis.

**Active Review: Time Statistics**

Using the data from the active reviews, the team calculated statistics for the time requirements for monitoring, for both processes. Because the travel time is unrelated to the monitoring method used, the team pooled the travel time data for the two processes to calculate travel time statistics. The results are shown in Tables 4, 5 and 6.

**Table 4: Time requirements for the spray process**

Source: IOE 481 Team #7 and EVS supervisors, Oct.-Nov. 2010

<table>
<thead>
<tr>
<th></th>
<th>Apply Spray (min)</th>
<th>Active Review (min)</th>
<th>Total Time: Apply + Review (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample Size (n)</td>
<td>28</td>
<td>28</td>
<td>28</td>
</tr>
<tr>
<td>Average</td>
<td>3.11</td>
<td>6.61</td>
<td>9.71</td>
</tr>
<tr>
<td>St. Dev.</td>
<td>0.994</td>
<td>2.780</td>
<td>2.980</td>
</tr>
<tr>
<td>Median</td>
<td>3</td>
<td>6.5</td>
<td>9</td>
</tr>
<tr>
<td>Max</td>
<td>6</td>
<td>17</td>
<td>19</td>
</tr>
<tr>
<td>Min</td>
<td>2</td>
<td>3</td>
<td>6</td>
</tr>
</tbody>
</table>

**Table 5: Time requirements for the swabbing process**

Source: IOE 481 Team #7 and EVS supervisors, Oct.-Nov. 2010

<table>
<thead>
<tr>
<th></th>
<th>Active Review (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample Size (n)</td>
<td>28</td>
</tr>
<tr>
<td>Average</td>
<td>10.11</td>
</tr>
<tr>
<td>St. Dev.</td>
<td>3.695</td>
</tr>
<tr>
<td>Median</td>
<td>9.5</td>
</tr>
<tr>
<td>Max</td>
<td>18</td>
</tr>
<tr>
<td>Min</td>
<td>4</td>
</tr>
</tbody>
</table>
Table 6: Travel time requirements  
Source: IOE 481 Team #7 and EVS supervisors, Oct.-Nov. 2010

<table>
<thead>
<tr>
<th>Travel Time (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample Size (n)</td>
</tr>
<tr>
<td>19</td>
</tr>
<tr>
<td>Average</td>
</tr>
<tr>
<td>4.32</td>
</tr>
<tr>
<td>St. Dev.</td>
</tr>
<tr>
<td>3.181</td>
</tr>
<tr>
<td>Median</td>
</tr>
<tr>
<td>3.0</td>
</tr>
<tr>
<td>Max</td>
</tr>
<tr>
<td>12</td>
</tr>
<tr>
<td>Min</td>
</tr>
<tr>
<td>1</td>
</tr>
</tbody>
</table>

The average time required for monitoring (excluding travel time) from the data collection is 0.4 minutes longer for spray than swabbing. However, after the data collection process concluded, EVS and ICE requested that an additional high-touch area (the bed rail) be added to the swabbing process. Therefore the team added an additional minute to the average swabbing time to account for the added area. Also, the spray process requires the supervisor to visit the discharged room twice, which doubles the total travel time. The team assumed the monitor will leave while the cleaning is occurring, as this was observed during data collection, and is a more efficient use of supervisor time overall. Table 7 shows the average monitoring times after accounting for the added high-touch area to swabbing, and the travel times for the two processes.

Table 7: Adjusted average monitoring times

<table>
<thead>
<tr>
<th>Application (min)</th>
<th>Active Review (min)</th>
<th>Total Time (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Swabbing</td>
<td>4.32</td>
<td>N/A</td>
</tr>
<tr>
<td>Spray</td>
<td>8.64</td>
<td>3.11</td>
</tr>
</tbody>
</table>

*Includes addition of time for swabbing the bed-rail

Table 7 indicates that, after adding in the required travel time, the spray process takes about three minutes longer to perform than the swabbing process.

**Active Review: High-Touch Area Analysis**

To compare the quality and usability of the swabs and spray, the team also analyzed the high-touch areas missed during the active review. Figure 4 below shows the percentage of the rooms monitored that were clean, for each area considered (based on the defined high touch areas). See Appendix G for further high-touch area analysis.
Figure 4 indicates that the qualities of monitoring using the two methods are comparable. For the seven high-touch areas where both methods are used, only the percentages for the sink faucet handle and the door handle differ by more than 15% (the last six high-touch areas in the graph are only examined in one of the monitoring processes).

Additionally, 25.0% of rooms monitored using swabs (n=28) were completely clean (no missed areas) and 21.4% of the rooms monitored using spray (n=28) were completely clean. Also, 86.8% of high-touch areas were found clean with swabs (n=164), and 77.4% of high-touch areas were found clean using spray (n=287). The similarity between the two processes with respect to the fraction of rooms completely clean and the number of high-touch areas clean also indicates that the quality of the monitoring is similar.

**Supervisor and Custodian Perceptions**

The feedback from the interviews with the custodians indicated how the monitoring processes were received within the hospital. Advantages and disadvantages listed by the supervisors for the swabbing process include:

- The supervisors only have to enter to room once
- The process is less time consuming overall
- The luminometer gives a value for the degree of cleanliness (objective)
- The swab can only wipe a small area

Advantages and disadvantages listed by the supervisors for the spray process include:
• The supervisors can physically see the areas that were missed
• The process is a better learning tool for employees (compared to swabs)
• The process is time consuming overall

The supervisors were also asked what method they preferred, and how they felt about being asked to perform five active reviews per week (as was requested during data collection). Two of the three supervisors preferred the swabs, and thought that five active reviews per week seemed reasonable, and one supervisor preferred the spray and thought that supervisors should perform ten active reviews per week. See Appendix F for complete supervisor survey and interview results.

Interviews with custodians indicated that most did not find either process to disrupt their cleaning, and found the reviews to helpful. However, some custodians expressed skepticism about being monitored; one custodian commented about the monitoring that he “noticed it, in a negative way.”

The survey results were primarily used to qualitatively measure the quality and usability of the two processes. Four of the survey statements were used as measurements of quality / usability:

• “It was easy to perform the process.” (Usability)
• “I (the supervisor) was able to perform the process consistently from room to room.” (Usability)
• “The process did not disrupt my work routine.” (Usability)
• “The process (swabbing or spray) accurately affects the quality of cleaning.” (Quality)

The average response values (among the three supervisors) for these questions shown in Table 8, where 5 is “strongly agree” and 0 is “strongly disagree.”

Table 8: Supervisors give higher rating overall to the swabbing process
Source: IOE 481 Team #7, n=3, Nov. 2010

<table>
<thead>
<tr>
<th>Survey Statement</th>
<th>Average Value for the Three Supervisors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Swab</td>
<td></td>
</tr>
<tr>
<td>1. It was easy to perform the swabbing process.</td>
<td>5.0</td>
</tr>
<tr>
<td>2. I was able to perform the swabbing process consistently from room to room.</td>
<td>4.7</td>
</tr>
<tr>
<td>3. The swabbing process did not disrupt my work routine.</td>
<td>4.3</td>
</tr>
<tr>
<td>4. The results from the swabbing process reflect the quality of the cleaning.</td>
<td>4.0</td>
</tr>
</tbody>
</table>
Spray
1. It was easy to perform the spray process. 3.7
2. I was able to perform the spray process consistently from room to room. 3.0
3. The spray process did not disrupt my work routine. 2.0
4. The results from the spray process reflect the quality of the cleaning. 4.0

Table 8 indicates that the supervisors found the swabbing process to have higher usability, however they found the processes to reflect the quality of the cleaning equally.

ANALYSIS
To quantitatively evaluate and compare the two processes, the team developed a rating formula that considers the four criteria: quality, usability, time, and cost. The results of the formula indicate that:

- Swabbing is a better process overall, based on the criteria
- Swabbing has higher ratings for usability and time
- The two processes have equal ratings for quality and cost
- Swabbing is the better process even if the number of reviews performed per week increases

Formula Overview
Each criterion (quality, usability, time, and cost) for a given process is assigned a value 1-5 based on the time, cost, and survey results from data collection (represented by the variables T, C, U and Q in Equation 1), and then the criteria are weighted based on their importance according to EVS and ICE (represented by the variables $W_T$, $W_C$, $W_U$ and $W_Q$ in Equation 1), and total to 100%. The rating formula is:

$$\text{Value} = W_T T + W_C C + W_U U + W_Q Q$$  \hspace{1cm} (1)

The two departments agreed that each criterion should have equal weight initially, but they want to be able to change the weights later if necessary. Therefore, the weighting for each criterion is 25%, and the equation simplifies to:

$$\text{Value} = T + C + U + Q$$  \hspace{1cm} (2)
The team created a Microsoft Excel worksheet that automatically calculates the value based on inputted cost and time requirements, and allows management to change the weighting if necessary in the future.

**Quality Criterion**

The quality criterion is based on the results from question #4 from the surveys (see Table 6), and the analysis of the high-touch areas from the active review. The quality criterion value scale is shown in Table 7.

Table 9: Quality criterion value scale

<table>
<thead>
<tr>
<th>Value</th>
<th>Quality Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Very Poor – Survey Rating = 0/1</td>
</tr>
<tr>
<td>2</td>
<td>Poor – Survey Rating = 2</td>
</tr>
<tr>
<td>3</td>
<td>Neutral – Survey Rating = 3</td>
</tr>
<tr>
<td>4</td>
<td>Good – Survey Rating = 4</td>
</tr>
<tr>
<td>5</td>
<td>Excellent – Survey Rating = 5</td>
</tr>
</tbody>
</table>

Both the swabbing and spray processes received average quality ratings of 4.0 from the surveys, and the high-touch area analysis also indicated that the two processes had comparable quality, so the team assigned both processes a quality criterion value of four:

- \( Q_{\text{Swabbing}} = 4 \)
- \( Q_{\text{Spray}} = 4 \)

**Usability Criterion**

The usability criterion is based on the results from questions #1, 2 and 3 from the surveys (see Table 8). The average supervisor responses for the three questions (the values shown in Table 8) were averaged, to get an overall usability rating. The usability criterion value scale is shown in Table 10.

Table 10: Usability criterion value scale

<table>
<thead>
<tr>
<th>Value</th>
<th>Usability Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Very Poor – Survey Rating* = 0/1</td>
</tr>
<tr>
<td>2</td>
<td>Poor – Survey Rating* = 2</td>
</tr>
<tr>
<td>3</td>
<td>Neutral – Survey Rating* = 3</td>
</tr>
<tr>
<td>4</td>
<td>Good – Survey Rating* = 4</td>
</tr>
<tr>
<td>5</td>
<td>Excellent – Survey Rating* = 5</td>
</tr>
</tbody>
</table>

*Average of the three questions

The average ratings for questions #1, 2 and 3 for the swabbing process were 5.0, 4.7 and 4.3, respectively, resulting in an average of 4.7. The average ratings for the questions #1, 2, and 3 for
the spray process were 3.7, 3.0 and 2.0, respectively, resulting in an average of 2.9. The team rounded the average to the nearest whole number, and therefore assigned a value of 5 to the swabbing process, and 3 to the spray process:

- $U_{\text{Swabbing}} = 5$
- $U_{\text{Spray}} = 3$

**Time Criterion**

The team used the time required per month, per supervisor, as the units for the time criterion, and the ranges were broken down into two-hour increments based on recommendations from the coordinator. The time criteria value scale is shown in Table 11.

**Table 11: Time criterion value scale**

<table>
<thead>
<tr>
<th>Value</th>
<th>Time Requirements Per Supervisor</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>481+ min/month</td>
</tr>
<tr>
<td>2</td>
<td>361-480 min/month</td>
</tr>
<tr>
<td>3</td>
<td>241-360 min/month</td>
</tr>
<tr>
<td>4</td>
<td>121-240 min/month</td>
</tr>
<tr>
<td>5</td>
<td>0-120 min/month</td>
</tr>
</tbody>
</table>

The team first calculated the weekly time requirements per supervisor, when performing five reviews per week (per supervisor), by adding the average monitoring process time (from Tables 3 and 4), and the average travel time (from Table 5). Since the spray process requires two visits to the patient room, the travel is two times the travel time for swabbing. Also, because an extra high-touch area was added to the swabbing process after data collection, an additional minute was added to the swabbing process average. The monthly time requirements assume that there are 4.3 weeks per month; therefore the average time requirements, assuming five active reviews per week, per supervisor, for the swabbing and spray processes are 331.1 minutes and 393.5 minutes, respectively. Thus from Table 6, the time criterion values for the swabbing and spray processes are 3 and 2, respectively:

- $T_{\text{Swabbing}} = 3$
- $T_{\text{Spray}} = 2$

**Cost Criterion**

The cost criterion was based on the cost to EVS of implementing each monitoring process for the first year, and therefore both initial (capital) costs and monthly costs were considered. Both processes require equipment that uses batteries; however, the cost of batteries was not included in this analysis.
It should be noted that implementing a monitoring process does not necessarily directly lead to a reduction in *C. diff* incidences. A monitoring process only aims to improve the quality of discharge cleaning, which is one of many factors that affect *C. diff* infection rates. Other factors that contribute to the spread of *C. diff* include hand-washing protocol, feces-handling, and contact precautions. UMHS is pursuing other interventions to reduce rates of *C. diff* and other hospital-acquired infections for these factors as well.

The cost value scale is based on the cost of *C. diff* to UMHS. Each *C. diff* episode costs a hospital system about $2,470-$3,669, according to the literature, so the team took the midpoint of this range ($3,070) to serve as the average cost per *C. diff* episode. UMHS also has a goal of 0.6 *C. diff* cases per 1,000 patient days, or approximately 150 cases per year. Currently, UMHS experiences approximately 250 *C. diff* cases per year (see graph in Appendix A). Based on these estimates, the hospital has an excess of 100 *C. diff* cases per year above the goal, indicating an overall “excess *C. diff* cost” of about $307,000. The team used this cost of $307,000 as a maximum in the cost value scale, as it would be financially inefficient to spend more than potential cost savings of reducing *C. diff* to the UMHS goal. The cost values scale was split into 5 equal cost ranges, shown in Table 12.

### Table 12: Cost criterion value scale

<table>
<thead>
<tr>
<th>Value</th>
<th>Cost Requirements (Per Year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$245,601 – $307,000</td>
</tr>
<tr>
<td>2</td>
<td>$184,201 – $245,600</td>
</tr>
<tr>
<td>3</td>
<td>$122,801 – $184,200</td>
</tr>
<tr>
<td>4</td>
<td>$61,401 – $122,800</td>
</tr>
<tr>
<td>5</td>
<td>$0 – $61,400</td>
</tr>
</tbody>
</table>

EVS indicates that 10 supervisors will be performing the monitoring process throughout UMHS. With 5 active reviews per week per supervisor, 50 reviews will be performed each week throughout UMHS (or about 215 reviews per month assuming 4.3 weeks per month).

For the swabbing process, the initial (capital) investment is the cost of luminometers, and EVS indicates that they will need five luminometers total (two for UH, one for CVC, and two for Mott Children’s Hospital). Multiplying the number of reviews per month (215 reviews) by the variable cost per review for swabbing ($14.61) gives a monthly cost of $3,140.54 for the swabbing process, which leads to an overall cost of $42,686.43 for the first year.

For the spray process, the initial (capital) investment is the cost of black lights, and similar to the swabbing process, EVS indicates that they will need 5 black lights total. Therefore, multiplying the number of reviews (215 reviews) by the variable cost per review for the spray ($1.00) gives a monthly cost of $215.00 for the spray process, which leads to an overall cost of $2,730 for the first year.
The first year costs for both processes are below $61,400, and therefore both receive a criterion value of five.

- \(C_{\text{Swabbing}} = 5\)
- \(C_{\text{Spray}} = 5\)

Although the cost of the swabbing process is over 14 times more expensive than the spray process, both are inexpensive relative to the overall cost of \(C. \text{diff}\) to UMHS. See Appendix H for a detailed breakdown of the cost analysis for each process.

**Formula Results**

Table 13 shows the criteria values and the total value for each process, assuming that each supervisor performs five active reviews per week.

Table 13: Swabbing receives a higher value for usability and time

<table>
<thead>
<tr>
<th></th>
<th>Quality (Q)</th>
<th>Usability (U)</th>
<th>Time (T)</th>
<th>Cost (C)</th>
<th>Total Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Swabbing</td>
<td>4</td>
<td>5</td>
<td>3</td>
<td>5</td>
<td>17</td>
</tr>
<tr>
<td>Spray</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>5</td>
<td>14</td>
</tr>
</tbody>
</table>

Table 13 suggests that the swabbing process is better than the spray process based on the four criteria, as swabbing received a higher total value.

If each supervisor performs 5 active reviews per week, and the supervisors manage 20 custodians, on average, then each custodian receives approximately 1.1 reviews per month. To increase the frequency of the reviews, the team evaluated the processes with 10 active reviews per week per supervisor, and 15 active reviews per week per supervisor. The quality and usability of the processes are assumed to remain constant, however the cost and time requirements increase with more reviews. The results of all three cases for both swabbing and spray are shown in Table 14.

Table 14: Swabbing is the better process even with increased review frequency

<table>
<thead>
<tr>
<th>SWABBING</th>
<th>Time/Month (min)</th>
<th>Reviews/Month per Custodian</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reviews/Week</td>
<td>Cost/Year</td>
<td>Value</td>
</tr>
<tr>
<td>5 (base case)</td>
<td>$42,693.15</td>
<td>331.1</td>
</tr>
<tr>
<td>10</td>
<td>$77,245.80</td>
<td>662.2</td>
</tr>
<tr>
<td>15</td>
<td>$111,798.40</td>
<td>993.3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SPRAY</th>
<th>Time/Month (min)</th>
<th>Reviews/Month per Custodian</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reviews/Week</td>
<td>Cost/Year</td>
<td>Value</td>
</tr>
<tr>
<td>5 (base case)</td>
<td>$42,693.15</td>
<td>331.1</td>
</tr>
<tr>
<td>10</td>
<td>$77,245.80</td>
<td>662.2</td>
</tr>
<tr>
<td>15</td>
<td>$111,798.40</td>
<td>993.3</td>
</tr>
</tbody>
</table>
Table 14 shows that for any given number of reviews (5, 10 or 15), the swabbing process receives a higher value. Also, EVS management can increase the number of reviews each custodian receives per month, on average, from 1.1 to 3.2 reviews by increasing from 5 reviews to 15 reviews each week (per supervisor). But doing so would also increase the time and cost requirements by a factor of three.

CONCLUSIONS

After evaluating the two processes based on the criteria formula, and assessing the interviews and surveys with staff, along with personal observations from the team members, the team summarized their conclusions.

Conclusions Based on Interviews and Team Observations

Feedback from the EVS staff members indicated that:

- The swabbing process is better accepted by custodians because of its objectivity
- The most difficult aspect of the spray process is that supervisors have to visit the discharged room twice (before and after the clean)
- The implementation of a monitoring process is an effective way to measure and improve the discharge cleaning process

The team also found that the swabbing process was much easier to perform. Other team observations include:

- Finding the custodian(s) after the monitoring was finished (to review results) was sometimes difficult if the custodian(s) were busy
- Getting into the room after discharge but before cleaning started (for the spray) was sometimes difficult if the custodian did not notify the monitor as the custodians did not always clean according to the bed-tracking system updates
- The method for judging if an area was clean or dirty for the spray process varied somewhat from supervisor to supervisor
- The swabbing process evaluates the contamination level of surfaces after the cleaning, whereas the spray process evaluates if the surfaces were wiped / washed during cleaning
Conclusions Based on the Active Reviews and Criteria Formula Results

The team and supervisors performed 56 active reviews over a 4-week period during the project. From the active reviews and the criteria formula results, the team determined that:

- The swabbing process is better overall based on the criteria (quality, usability, time and cost)
- The quality of the two processes is equivalent based analysis of the high touch areas and survey results
- Five active reviews per week is optimal according to supervisor feedback
- The costs of the two monitoring processes are minimal compared to the cost of *C. diff* to UMHS

RECOMMENDATIONS

Based on the conclusions from the findings and the criteria analysis, the team recommends that EVS implement the following plan for monitoring inpatient discharge cleaning throughout UMHS:

- Use the swabbing process
- Require each supervisor to perform 5 active reviews per week, which would result in 50 active reviews performed each week throughout the UMHS
- Record the monitoring results to calculate changes over time, which can help EVS to identify both high-touch areas needing improvement, and specific units needing improvement in cleaning quality
- Change the high-touch areas over time to ensure that the monitoring process is effective
- Use the spray process during training and for weekly or monthly cleaning process checks

To support these changes, the team developed three tools for EVS and ICE:

- *Monitoring Checklist* – The team has created for EVS a form for the supervisors to complete when performing an active review. The supervisor indicates his or her name, the name of the custodian who cleaned the room, the date of the review, and the room being reviewed. The high-touch areas are listed on the form with check boxes, and the supervisor checks the box if the corresponding high-touch area is found unclean (“missed”). The monitoring checklists are shown in Appendix I.
- *Monitoring Directions* – To supplement the checklist, the team also developed directions for each monitoring process (developed during pilot testing) for all supervisors to use when performing active reviews. The directions are shown in Appendix E.
- **Monitoring Records Excel Sheet** – The team has created a Microsoft Excel sheet for recording the high-touch areas found unclean on the monitoring checklist forms. The supervisor enters all the data on the checklist, and indicates that an area was unclean by entering in a ‘1’ in the appropriate column. If the room was 100% clean (no high-touch areas missed), then the supervisor puts a ‘1’ in the ‘100% Clean’ column. The spreadsheet automatically calculates the percentage of high-touch areas cleaned in the room. On a second worksheet the file also keeps a cumulative record of the percentage of rooms cleaned by each area, and a count of the number of rooms monitored. A screenshot of the worksheets are shown in Appendix J.

The team believes that EVS and ICE departments must to adhere to a standardized monitoring process, and to record and analyze the changes in room cleanliness in order to effectively fight the incidence of *C. diff* and other hospital-acquired infections within UMHS.
APPENDICES

Appendix A – Data on *C. diff* Occurrences in UMHS

The chart above was provided by the Infection Control and Epidemiology Department, and is confidential data.

**Switch to TechLab GHD antigen test**  
**Addition of toxin EIA test on all specimens**  
**Addition of confirmatory PCR**  

*Goal: 0.6 Cases per 1,000 Patient days*  

*excludes Holden*
Appendix B – Product Overviews

*Clue Spray*
Clue Spray is sprayed on surfaces prior to cleaning. After Clue Spray has been applied, surfaces are cleaned according to pre-determined cleaning processes. Once cleaning has been finished, a monitoring examiner reviews all surfaces using a black light. After all surfaces have been examined, any remaining Clue Spray must be wiped from the surfaces.

Clue Spray costs approximately $25 for a 6-ounce can.

*Source: Kathy Petersen, Infection Control Practitioner, UMHS Department of Infection Control and Epidemiology*

*Hygenia ATP Swabs and ATP Luminometer*
The swab system consists of two components: ATP Swabs and the ATP Luminometer. Our team will be specifically using the Hygenia Ultrasnap ATP Surface Test Swabs and the Hygenia SystemSURE Plus Luminometer. To determine cleanliness of a surface, the surface is first cleaned. Following cleaning, a monitoring examiner swabs a 4”x4” area on the surface. The snap valve is then broken, releasing a cationic agent that is stored in the top of the swab. After the agent is mixed with the sample, the swab is inserted into the reading chamber of the luminometer. When the examiner activates the luminometer, the sample is read and a number is displayed on the luminometer screen that reflects the cleanliness of the surface.

The chemical that reaction that drives the luminometer’s reading is powerful, yet straightforward. The luminometer measures the amount of adenosine triphosphate (ATP) on a surface. Once a surface has been cleaned, ATP should not be present in significant amounts. When a surface is wiped with the swab and the cationic reagent in the snap valve is released, the luminometer is able to determine the amount of ATP present by measuring the relative light emitted from the sample. This amount of light emission correlates to the contamination of the sample, providing the examiner with a measure of how clean a surface is.

*Source: http://www.hygienausa.com/systemsure_plus.html*
Appendix C – Literature Search Sources


Ellingson, K. and McDonald, C. (2010). Reexamining methods and messaging for hand hygiene in the era of increasing *Clostridium difficile* colonisation and infection. *Infection Control and Hospital Epidemiology, 31* (6), 571-573.


EVS Monitoring Processes Review Form - Surrogate

Name: ____________________________ Date: ____________________________
Unit/Room Number: ____________________________ Page Time: ____________________________
Circle one: Single Double

Check box for each activity.
If activity is interrupted, note in Comments box and record new entry when activity resumes.

<table>
<thead>
<tr>
<th>Travel</th>
<th>Apply Surrogate</th>
<th>Active Review Surrogate</th>
<th>Start Time</th>
<th>End Time</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td></td>
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</tr>
</tbody>
</table>

High Touch Areas
For single rooms, check areas in both columns. For double rooms, check areas in right column only.
Check box if area is not clean. Note in “General Comments” if all areas are clean.

<table>
<thead>
<tr>
<th>Single</th>
<th>Double</th>
</tr>
</thead>
<tbody>
<tr>
<td>Room Light Switch</td>
<td>☐</td>
</tr>
<tr>
<td>Sink Faucet Handles</td>
<td>☐</td>
</tr>
<tr>
<td>Toilet Handle</td>
<td>☐</td>
</tr>
<tr>
<td>Toilet Seat</td>
<td>☐</td>
</tr>
<tr>
<td>Bathroom Rail</td>
<td>☐</td>
</tr>
<tr>
<td>Bathroom Light Switch</td>
<td>☐</td>
</tr>
<tr>
<td>Bathroom Door Handles</td>
<td>☐</td>
</tr>
</tbody>
</table>

General Comments: __________________________________________________________
___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________

Card Received By: ____________________________
# EVS Monitoring Processes Review Form - Swab

Name: ___________________________  Date: ___________________________

Unit/Room Number: _______________  Page Time: __________________________

Circle one: Single  Double

*Check box for each activity.*

*If activity is interrupted, note in Comments box and record new entry when activity resumes.*

<table>
<thead>
<tr>
<th>Travel</th>
<th>Active Review</th>
<th>Start Time</th>
<th>End Time</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>□</td>
<td>□</td>
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<td></td>
</tr>
</tbody>
</table>

## High Touch Areas

*For single rooms, check areas in both columns. For double rooms, check areas in right column only.*

*Check box if luminometer reads above 10. Note in "General Comments" if all areas are clean (below 10).*

<table>
<thead>
<tr>
<th>Single</th>
<th>Double</th>
</tr>
</thead>
<tbody>
<tr>
<td>Room Light Switch</td>
<td>□</td>
</tr>
<tr>
<td>Bathroom Light Switch</td>
<td>□</td>
</tr>
<tr>
<td>Bathroom Door Handle</td>
<td>□</td>
</tr>
<tr>
<td>Sink Faucet Handle</td>
<td>□</td>
</tr>
<tr>
<td>Toilet Handle</td>
<td>□</td>
</tr>
</tbody>
</table>

General Comments: _______________________________________________________________

___________________________________________________________________________

___________________________________________________________________________

___________________________________________________________________________

Card Received By: ___________________________
Appendix E – Directions for Monitoring

DIRECTIONS FOR MONITORING WITH SPRAY PROCESS

Applying the Spray

- Put on gloves before entering room.
- Hold spray approximately 6-12 inches from surface (see photo below).
- One spray is usually sufficient. The surface only needs to be lightly sprayed (not coated).
- Spray the high-touch areas on the designated parts shown on the back of the directions.
- Spray all the necessary high-touch areas, depending on the room occupancy (see below).

Reviewing the Cleaning

- Turn out lights (if possible).
- Go over each high-touch area with the black light.
- Hold the black light approximately one (1) inch from the surface.
- Missed areas will show neon green spots.
- Record results of the black light test on the form.
- Review the results with the custodian.
- Remember to wipe the areas with a wet cloth to removed any remaining spray.

High-Touch Areas

For single and double rooms, spray the following areas:

- Television remote
- Drawer handles
- Door handles (both sides)
- Bed rails (both sides)
- Over-bed table

For single rooms ONLY, also spray the following areas:

- Room light switch
- Sink faucet handles
- Toilet handle
- Toilet seat
- Bathroom rail
- Bathroom light switch
- Bathroom door handles (both sides)
DIRECTIONS FOR MONITORING WITH SWABBING PROCESS

Before starting:

- Check to make sure you have enough unused swabs to monitor each room.
  - Single room: Nine (9) swabs
  - Double room: Four (4) swabs
- Check to make sure you have the luminometer.
- Put on gloves to ensure that germs are not transferred to the area after cleaning.
- Start the swabbing immediately after the cleaning is finished to ensure that no one has touched the areas.
- Surface areas must be dry before swabbing.
- Turn on the luminometer before swabbing first area. The luminometer takes 60 seconds to warm up.

Reminders:

- See the photos at the end of the directions for the specific area to swab on each high-touch area.
- Once the Snap Valve™ has been broken, read the sample in the luminometer within 60 seconds.
- If the luminometer reads 0-10, the area is considered clean; 11+ is considered unclean.
- Record results of each swab test on the form.
- Once all areas have been tested, review the results with the custodian.

High-Touch Areas:

For a double or single room, swab the following areas:

- Phone
- Television remote
- Room door handle
- Bed rail

For a single room ONLY, also swab the following areas:

- Room light switch
- Bathroom light switch
- Bathroom door handle
- Sink faucet handle
- Toilet handle
Steps for swabbing and reading results:

The directions for the swabbing come from the Hygiena™ product manual. Start the swabbing after the custodian has finished cleaning the room.

1. Remove swab from test tube and swab surface. Swabbing motion should be in a 4x4 inch square while rotating swab or a random motion that ensures a good sample collection.

2. Place swab back in test tube.

3. Break plastic Snap Valve™ at the top of swab by bending bulb. Squeeze bulb twice, pushing liquid reagent down swab shaft.

4. Shake test for 5 seconds.

5. Place test tube in SystemSURE Plus™ luminometer and close lid.

6. Press “OK” and reading will appear in 15 seconds.
### Survey Results

The supervisors responded to the statements with a number 0 to 5, with 0 being “strongly disagree” and 5 being “strongly agree.”

<table>
<thead>
<tr>
<th>Statement</th>
<th>Supervisor 1</th>
<th>Supervisor 2</th>
<th>Supervisor 3</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>It was easy to perform the swabbing process.</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5.0</td>
</tr>
<tr>
<td>I was able to perform the swabbing process consistently from room to room.</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>4.7</td>
</tr>
<tr>
<td>The swabbing process did not disrupt my work routine.</td>
<td>5</td>
<td>5</td>
<td>3</td>
<td>4.3</td>
</tr>
<tr>
<td>The results from the swabbing process reflect the quality of the cleaning.</td>
<td>4</td>
<td>5</td>
<td>3</td>
<td>4.0</td>
</tr>
<tr>
<td>I was easily able to perform 5 active reviews in one week using the swabbing process.</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>4.7</td>
</tr>
<tr>
<td>Please indicate an overall rating for the swabbing process.</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>4.7</td>
</tr>
<tr>
<td>It was easy to perform the spray process.</td>
<td>3</td>
<td>3</td>
<td>5</td>
<td>3.7</td>
</tr>
<tr>
<td>I was able to perform the spray process consistently from room to room.</td>
<td>2</td>
<td>2</td>
<td>5</td>
<td>3.0</td>
</tr>
<tr>
<td>The spray process did not disrupt my work routine.</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2.0</td>
</tr>
<tr>
<td>The results from the spray process reflect the quality of the cleaning.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>4.0</td>
</tr>
<tr>
<td>I was easily able to perform 5 active reviews in one week using the spray process.</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4.0</td>
</tr>
<tr>
<td>Please indicate an overall rating for the spray process.</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>3.3</td>
</tr>
<tr>
<td>I was easily able to perform 5 active reviews overall.</td>
<td>4</td>
<td>5</td>
<td>3</td>
<td>4.0</td>
</tr>
</tbody>
</table>

Please indicate which process you prefer.  
- Swabbing  
- Swabbing  
- Spray  
- Swabbing

### Supervisor Interview Questions & Responses

**Remember:** Review project with supervisors before beginning questions.

1. Based on your data collection experience, what are pros/cons of using the clue spray?
   - **Pros**
     - Time consuming. Shows crevices.
     - Cons – holds up process of cleaning room and getting next patient in; too long
     - Pros – can actually see what isn’t clean, i.e. crevices
     - Pros – best way to use as a learning tool for employees to see deficiencies
   - Cons – time

2. Based on your data collection experience, what are pros/cons of using the swabs?
   - **Pros**
     - Live
     - Pros – can check immediately; faster; tells degree of cleanliness (numbers); only have to go once
     - Cons – none
     - Pros – accurate, less time consuming
   - Cons – can only swab small areas
3. Based on your data collection experience, which product do you feel gave a better indication of how well a room was cleaned?
   - Spray (shows more) – just time consuming
   - Swabs
   - Swabs

4. What do you think is the appropriate number of active reviews to perform in one week?
   - 5 was good
   - 5
   - At least 10 times per week (2 each day)

5. How are you going to adapt your current routine to accommodate a monitoring process?
   - Swabs – none
     - Spray – may not get back on time (page when done)
   - Checks rooms everyday anyways, so would just do it then. Wouldn’t affect routine at all.
   - Normal routine – go after discharge cleaning. With spray, will know which rooms are done, then go back and inspect, then review. “Won’t interrupt anything really.” “Proactive approach.”

6. What support will you need to implement a monitoring process?
   - Custodians
   - Backpack/carrying case
   - The only way this will be efficiently utilized is if everyone on all 3 shifts use it. Training coordinators should get data and compile it. QH device.

7. How do you hope your staff members will use your feedback from monitoring to improve their work?
   - Pay attention to areas. How they clean.
   - Get encouraged to clean better. Work harder.
   - Every employee likes to be shown their deficiencies. Use as a learning tool. Improves consciousness and caution used with their work.

8. Do you have any suggestions or comments on the process?
   - No
   - Clue spray – hard to see in room when you need to turn the lights off
   - More supervisors should be involved

*Spray validates infection control process. Swabs seem to be more geared towards administrators (unethical). Spray holds employees accountable, better teaching tool.
Custodian Interview Questions and Responses

**Remember:** Thoroughly introduce project before beginning questions.

1. **How was the experience of being monitored?**
   - Very helpful, very good for us to be inspected
   - Easy
   - Noticeable – negative
   - Fine – good to see where I missed
   - Interesting. I don’t know. I like swabs. Gave an accurate reading of how clean room is. Black light is a good way to see missed spots, but was intimidating.
   - Good, excellent. Liked everything. “Rooms have to be clean.”
   - Good
   - No big deal, as long as you do your job. Great that we’re doing this – will make slackers do their job better.
   - Fine

2. **Did you find it easy to be involved in the monitoring process, especially the active review?**
   - It wasn’t too hard
   - Easy for the most part, but could be a hassle on busy days
   - Yes
   - Didn’t change any of the work I had to do. Just cleaned and waited to be inspected.
   - Yeah, all I had to do was be on my floor
   - Yes, very easy
   - Yes
   - Yes
   - Yes

3. **How are you going to use the feedback you received during the monitoring process?**
   - Make sure I hit spots that get checked
   - Didn’t change much – still did process the same
   - If it would help (no real active review)
   - Try to pay more attention to missed areas
   - Makes you aware of stuff you don’t think about
   - Go back and clean again
   - Use it to be more thorough. Use it to know most important areas.
   - Pay more attention to those spots. Be more aware of work.
   - Take it into consideration to know which areas to wipe

4. **Do you have any suggestions or comments on the process?**
   - Let us know ahead of time that we are being inspected
   - Swabs seemed better
   - No, it was fine
   - I don’t know. Seems like something that would work.
   - It’s good for me and good for patient. I hope it continues.
   - Glad that we’re doing this. Will help them be a better worker.
   - Keeps you on your toes. Makes you wonder if the bleach strength (1-10) is strong enough to meet test standards. Doubts about black light and spray – seems inaccurate – prefers swabs. Threatened by spray process, but not swabs.
   - Interesting that we’re doing this
Appendix G – High-Touch Area Results from Active Reviews

The data for the high-touch area analysis came from the active reviews performed by the team and the EVS supervisors (Oct. – Nov. 2010).

**SWABS**

<table>
<thead>
<tr>
<th>High-Touch Area</th>
<th>Total Rooms Reviewed</th>
<th>Rooms Missed</th>
<th>% Missed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Room Light Switch</td>
<td>16</td>
<td>4</td>
<td>25.0%</td>
</tr>
<tr>
<td>Bathroom Light Switch</td>
<td>16</td>
<td>2</td>
<td>12.5%</td>
</tr>
<tr>
<td>Bathroom Door Handle</td>
<td>16</td>
<td>2</td>
<td>12.5%</td>
</tr>
<tr>
<td>Sink Faucet Handle</td>
<td>16</td>
<td>6</td>
<td>37.5%</td>
</tr>
<tr>
<td>Toilet Handle</td>
<td>16</td>
<td>0</td>
<td>0.0%</td>
</tr>
<tr>
<td>Television Remote</td>
<td>28</td>
<td>11</td>
<td>39.3%</td>
</tr>
<tr>
<td>Door Handle</td>
<td>28</td>
<td>7</td>
<td>25.0%</td>
</tr>
<tr>
<td>Telephone</td>
<td>28</td>
<td>5</td>
<td>17.9%</td>
</tr>
</tbody>
</table>

**SPRAY**

<table>
<thead>
<tr>
<th>High-Touch Area</th>
<th>Total Rooms Reviewed</th>
<th>Rooms Missed</th>
<th>% Missed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Room Light Switch</td>
<td>21</td>
<td>7</td>
<td>33.3%</td>
</tr>
<tr>
<td>Bathroom Light Switch</td>
<td>21</td>
<td>4</td>
<td>19.0%</td>
</tr>
<tr>
<td>Bathroom Door Handle</td>
<td>21</td>
<td>0</td>
<td>0.0%</td>
</tr>
<tr>
<td>Sink Faucet Handle</td>
<td>21</td>
<td>2</td>
<td>9.5%</td>
</tr>
<tr>
<td>Toilet Handle</td>
<td>21</td>
<td>2</td>
<td>9.5%</td>
</tr>
<tr>
<td>Television Remote</td>
<td>28</td>
<td>7</td>
<td>25.0%</td>
</tr>
<tr>
<td>Door Handle</td>
<td>28</td>
<td>2</td>
<td>7.1%</td>
</tr>
<tr>
<td>Toilet Seat</td>
<td>21</td>
<td>3</td>
<td>14.3%</td>
</tr>
<tr>
<td>Bathroom Rail</td>
<td>21</td>
<td>5</td>
<td>23.8%</td>
</tr>
<tr>
<td>Drawer Handle</td>
<td>28</td>
<td>0</td>
<td>0.0%</td>
</tr>
<tr>
<td>Bed Rail</td>
<td>28</td>
<td>6</td>
<td>21.4%</td>
</tr>
<tr>
<td>Over-Bed Table</td>
<td>28</td>
<td>0</td>
<td>0.0%</td>
</tr>
<tr>
<td>Percent of Rooms Completely Clean</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------------------------------</td>
<td>---------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spray (n=28)</td>
<td>21.4%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Swabbing (n=28)</td>
<td>25.0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall</td>
<td>23.2%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Percent of High Touch Areas Cleaned (n=56)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Spray (n=164)</td>
<td>86.8%</td>
</tr>
<tr>
<td>Swabbing (n=287)</td>
<td>77.4%</td>
</tr>
<tr>
<td>Overall</td>
<td>83.4%</td>
</tr>
</tbody>
</table>
Appendix H – Yearly Product Cost Analysis

Swabbing

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Initial Cost (First Month)</th>
<th>Monthly Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Luminometers (5)</td>
<td>$5,000.00</td>
<td>$0.00</td>
</tr>
<tr>
<td>ATP Swabs</td>
<td>$3,140.54</td>
<td>$3,140.54</td>
</tr>
</tbody>
</table>

Cost of swabbing process for first year = Equipment cost + 12 x (Monthly testing materials cost)
Cost of swabbing process for first year = $5,000.00 + 12 x ($3140.54) = $42,686.48

Spray

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Initial Cost (First Month)</th>
<th>Monthly Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black Lights (5)</td>
<td>$150.00</td>
<td>$0.00</td>
</tr>
<tr>
<td>Clue Spray Bottles</td>
<td>$215.00</td>
<td>$215.00</td>
</tr>
</tbody>
</table>

Cost of spray process for first year = Equipment cost + 12 x (Monthly testing materials cost)
Cost of spray process for first year = $150.00 + 12 x ($215.00) = $2,730.00
Appendix I – Monitoring Checklists

**EVS Discharge Monitoring Form - Spray**

Supervisor Name:___________________________  
Custodian Name:___________________________  
Date:________________________  
Unit/Room Number: __________  
Circle one:    Single          Double

### High Touch Areas

*For single rooms, check areas in both columns. For double rooms, check areas in right column only.  
Check box if area is *not* clean. Note in "General Comments" if all areas are clean.*

<table>
<thead>
<tr>
<th></th>
<th>Single</th>
<th></th>
<th>Double</th>
</tr>
</thead>
<tbody>
<tr>
<td>Room Light Switch</td>
<td>□</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sink Faucet Handles</td>
<td>□</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Toilet Handle</td>
<td>□</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Toilet Seat</td>
<td>□</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bathroom Rail</td>
<td>□</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bathroom Light Switch</td>
<td>□</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bathroom Door Handles</td>
<td>□</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Television Remote</td>
<td></td>
<td></td>
<td>□</td>
</tr>
<tr>
<td>Drawer Handle</td>
<td></td>
<td></td>
<td>□</td>
</tr>
<tr>
<td>Door Handles</td>
<td></td>
<td></td>
<td>□</td>
</tr>
<tr>
<td>Bed Rail</td>
<td></td>
<td></td>
<td>□</td>
</tr>
<tr>
<td>Over-Bed Table</td>
<td></td>
<td></td>
<td>□</td>
</tr>
</tbody>
</table>

**General Comments:**

___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________
**EVS Discharge Monitoring Form - Swabbing**

Supervisor Name: ________________________________  Date: ____________________________
Custodian Name: ________________________________  Unit/Room Number: __________
Circle one:    Single          Double

### High Touch Areas

*For single rooms, check areas in both columns. For double rooms, check areas in right column only.*

*Check box if luminometer reads above 10. Note in "General Comments" if all areas are clean (below 10).*

<table>
<thead>
<tr>
<th>Single</th>
<th></th>
<th>Double</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Room Light Switch</td>
<td>□</td>
<td>Television Remote</td>
<td>□</td>
</tr>
<tr>
<td>Bathroom Light Switch</td>
<td>□</td>
<td>Door Handle</td>
<td>□</td>
</tr>
<tr>
<td>Bathroom Door Handle</td>
<td>□</td>
<td>Telephone</td>
<td>□</td>
</tr>
<tr>
<td>Sink Faucet Handle</td>
<td>□</td>
<td>Bed Rail</td>
<td>□</td>
</tr>
<tr>
<td>Toilet Handle</td>
<td>□</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

General Comments: __________________________________________________________
___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________

---

48
Appendix J – Screenshot of Monitoring Records Excel Sheet

The monitor enters in the data from the monitoring checklist.

Statistics are automatically calculated.

---

**Directions:** Please enter in the date of the service review, your name, the unit and room reviewed, and the room type in the appropriate column. If a high-touch area was unclean, enter a 'T' in the corresponding cell. If the room was 100% clean (no missed areas), enter a 'T' in the '100% Clean' cell.

<table>
<thead>
<tr>
<th>Date</th>
<th>Supervisor Name</th>
<th>Custodian Name</th>
<th>Unit / Room</th>
<th>Room Type</th>
<th>Room Light Switch</th>
<th>Bathroom Light Switch</th>
<th>Bathroom Door Handle</th>
<th>Sink Faucet Handle</th>
<th>Toilet Handle</th>
<th>Television Remote</th>
<th>Door Handle</th>
<th>Telephone</th>
<th>Bed Rail</th>
<th>% of High-Touch Areas Cleaned</th>
</tr>
</thead>
</table>

**Number of Rooms Reviewed:**
- Single Rooms Reviewed: 1
- Double Rooms Reviewed: 0

**% of Clean Rooms - By Area**
- Room Light Switch: 0.0%
- Bathroom Light Switch: 0.0%
- Bathroom Door Handle: 100.0%
- Sink Faucet Handle: 100.0%
- Toilet Handle: 0.0%
- Television Remote: 0.0%
- Door Handle: 100.0%
- Telephone: 100.0%
- Bed Rail: 100.0%

**% of Rooms 100% Clean:** 0.0%