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ATP Testing in Hotel Industry Deliverable Approach

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Abstract

Currently evaluation of cleanliness of hotel rooms is done by visual observation rather than empirically based microbiological testing. The purpose of this review is to create awareness about the exposure of the microbial contaminates present on high touch surfaces in hotel industry which could cause a potential threat to the travellers and guest. To prevent such out breaks we have recommended new protocol for cleaning the luxury rooms and setting up a new platform for evaluating the cleanliness and hygiene level using ATP bioluminescence assay.

Keywords: Microbialtesting; High touch surfaces; ATP testing

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Background

Hotel industry is a public environment for travellers and hotel staff. There are around 700,000 hotels and resorts which count for 16.2million rooms across the world. India being the 7th Largest country in the world accounts 2.56 million rooms across the country. India being a developing country attracts tourists by its picturesque landscapes, spectacular waterfalls. Due to increase in rate of tourism we need to focus on providing the best services and hospitality [1-2]. Practically there is no universal standard operating procedures exist to guide and maintain cleaning practices in hotel rooms. Most of the times cleanliness check is performed by visual observation which is an aesthetic evaluation but it does not address the presence of microbial contamination which could be a possible thread to spreading nosocomial infection.

High Touch Surfaces

High touch surfaces are those that people **frequently touch with their hands,** which could therefore become easily contaminated with microorganisms and picked up by others on their hands. Infections primarily spread via respiratory spill and being in close contact with infected individuals, but another common way is **via ourhands.** When an individual is ill they touch so many things throughout the day which leads to contaminating the surface which could then infect another individual when then come in contact with the contaminated surface. Frequent cleaning is required to prevent the spread of nosocomial infections. COVID-19 being a global pandemic made us aware of importance of maintaining hygiene in public sector and paved way for developing better standard cleaning practices [3-5]. The most common high touch surfaces in hotel management are categorized into 3 sections namely guest room section, front office section & staff quarters section which could be the route of spread of infection within the community. (Figures 1&2) will give a clear picture of high touch surfaces which demands frequent cleaning and hygiene to be maintained.

To effectively clean and disinfect high touch surfaces, we should be aware of the current recommendations given by the Government and NHS which includes understanding how the guidance differs between general cleaning and cleaning after a suspected or confirmed COVID-19 case.

Prominent Pathogen on High Touch surfaces

Human disperse microbes into the environment by direct contact with the surfaces or by airborne release. According to few research it is observed that humans emit 10^6 biological particles per hour leading to spread of nosocomial infection. Micro biome shed by human into the environment is mostly non-pathogenic (coliforms), but the concern raises when an infected individual sheds the pathogen through airborne or by touching common surfaces. Among such pathogens, MRSA, VRE, C. difficile, P. aeruginosa, Enterobacteriaceae, Norovirus, Corona

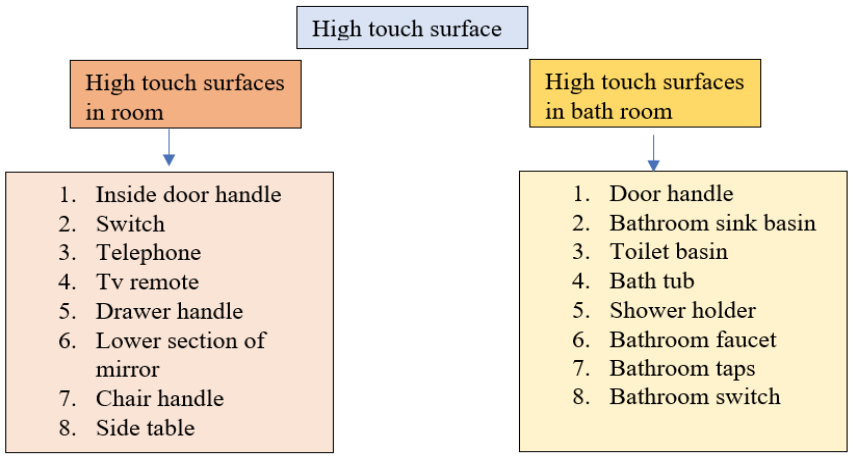

Figure 1 High touch surfaces in hotel system.

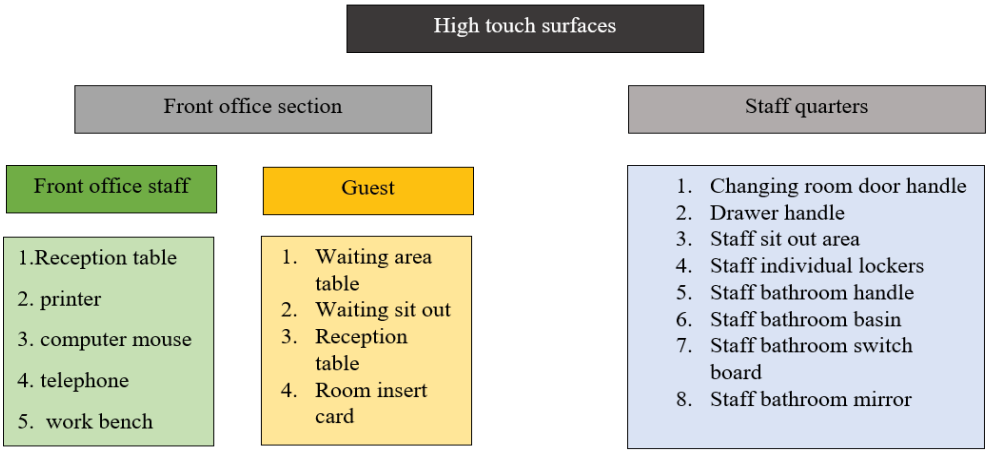

Figure 2 High touch surfaces in front office section and staff quarters section.

virus and Candida spp. may persist and contribute to the spread of nosocomial infections. Hence to prevent such out breaks within the community we need to follow frequent cleaning and standard protocols.

Age old cleaning procedure: Hotel Industry

Cleaning is mandatory to reduce the spread of nosocomial infections. There are different protocols followed by the organization in cleaning depending on their requirement and feasibility.

Stages of cleaning in hotel industry

Precleaning: The process of removal of disposables items which are visible to eyes is called as precleaning. Example removing the used water bottles, tissues roll, bed covers, pillow covers, leftover food in the guest room.

Main cleaning: The process which involves using disinfectant to remove the contamination on the high touch surfaces. Example cleaning the room with vacuum cleaners, wiping the surfaces with disinfectant.

Final rinse: The process of removal of debris of disinfectant using hot water or any cleansing to ensure the debris do not cause discomfort for the guest during their arrival.

Setting up: The process of setting up the room which can be immediately occupied by the guest during arrival. Examples: rooms with new bed covers, pillow covers, well cleaned bathrooms and consumables refilled.

Types of cleaning

Automated cleaning: The process of using high end technology such as UV Light, Hydrogen peroxide, steam vapours, ozone and HIPL (High intensity spectrum of light) is called as automated cleaning. This is usually followed in hospitals and in clean rooms to maintain very minimum or no contamination zone [29-31].

Manual cleaning: The process manual cleaning and wiping using different grades of chemicals is called as manual cleaning. This is the most common approach followed in hotel industry.

Periodic cleaning: The process which involves wiping of high touch surfaces minimum thrice a day is called periodic cleaning.

Apart from normal cleaning due to the outbreak of pandemic multiple times cleaning the HTS will help in maintaining an hygienic environment.

Deep cleaning: The process of cleaning the other surfaces which does not come under the category of HTS have to undergo cleaning at least once a day to ensure there is no accumulation of the contaminant.

To prevent outbreaks of nosocomial infections in hotels, Identifying and frequently cleaning the high touch surfaces play a crucial role. The process of manual cleaning is done by different ways based on the general practices followed by their respective organisation as shown in (Figure 1&3).

Most commonly the housekeeping department generally prefer taking less volume of disinfectant to avoid the smell to overtake the vicinity or to avoid prolonged drying. Such practices of disinfecting the high touch surface with weak disinfectant will lead to ineffective cleaning practices and also spread localized contamination over wide area. To avoid such ineffectiveness, we need to focus on selecting the appropriate disinfectant and use the minimum concentration required to remove the contamination. There are few factors which play a major role in manual cleaningexplained briefly in (Table 1&2).

Recommended approach for mainlining hygiene in hotel Industry

Hotel cleanliness is the most important aspect for every hotel. Achieving perfection must always be the aim of the house

Figure 3 Different approach of manual cleaning of high touch surface in hotel industry.

Table 1: Most commonly found pathogens on high touch surfaces.

Pathogen	Type of strain	Disease	References
Bacterial infection			
Methicillin-resistant *Staphylococcus aureus* (MRSA)	Gram positive	It causes skin infection It causes respiratory infection	[6-9]
Clostridium difficile	Gram positive	Common illness	[10-11]
Pseudomonas aeruginosa	Gram negative	Causes infections in blood stream and pneumonia	[12-13]
Enterobacteriaceae	Gram negative	Causes urinary tract infection, respiratory tract infection and soft tissue infection	[14-15]
Acinetobacter baumannii	Gram negative	Pneumonia and meningitis	[16-17]
Staphylococcus epidermidis	Gram positive	Common skin infections	[18-19]
Staphylococcus warneri	Gram positive	Urinary tract infections, meningitis & orthopaedic infections	[20-22]
Streptococcus pyrogenes	Gram positive	Sore throat & skin infection	[23-24]
Streptococcus mitis	Gram positive	Infective endocarditis	[25]
Corynebacterium spp.	Gram positive	Throat infections	[26]
Fungal infection			
Candida	Fungal strain	Common illness & UTI	[27-28]

Table 2: Different paraments need to be considered for disinfection by wiping.

Parameter	Property effecting the cleaning practice
Towelette	Size, thickness, material, compatibility with disinfectant
Wiping technique	Pressure exerted on wiping, direction of wiping
Type of surface to be wiped	Glass, brass, metals, ceramics, wood, plastic, fibre
Time duration of wiping	The disinfectant needs to be exposed to the surface for minimum time required to remove the contaminant

keeping staff. This includes not only looking tidy but also being clean and hygienic. To achieve this they Follow 5S cleaning system &4colour cloth- cleaning system.

5S cleaning system

1. Survey: check the area and inspect the things which need to be cleaned.
2. Service: clear waste and dust.
3. Shine: clean all the surfaces which is used by the guest using disinfectant.
4. Stage: set a clean platform for the guest to arrive.
5. Self-inspect: perform a self-check to ensure the room is clean (Figure 4).

Colour System

It is recommended for the staff to use colour coded clothes for cleaning different areas of the room to ensure there is no spread of infection from one point to another point. This approach will help in preventing the spread of nosocomial infections.

1. Green: Green cloth used for cleaning mirrors and glass.
2. Yellow: yellow cloth used for cleaning furniture's.
3. Red: Red cloth used for cleaning toilet.
4. Blue: blue cloth used for cleaning bathroom and washbasin (Figure 5).

Disinfectants

In today's world there is a wide array of chemicals which is used as disinfectants. People tend to use these disinfectants based on history without knowing the effectiveness of chemical in removing the contaminants, (Figure 4) gives a detailed description of the percentage of chemical used in preparing the disinfectants out of which quaternary ammonium salts is the most commonly used chemical in preparation of cleansings agents followed by hypochlorite chemical. (Table 3) explains about the mode of action of each chemical on killing the pathogen [32] (Figure 6).

Effectiveness of Cleaning

Routine monitoring of cleaning protocols and monitoring the effectiveness of cleaning will help in preventing the nosocomial infections and maintain hygienic environment. Usually, the effectiveness of cleaning is evaluated according to the standard protocols set by the organization. As per the FDA "Validation of cleaning processes" states that the organization is recommended to generate their own written procedures, sampling methods and evaluations methods which suits them better. Organization is recommended to have a separate team working on planning and execution of cleaning practices to ensure the space if safe for work. The most commonly used technique for evaluation of cleaning practices is by performing Aerobic plate count (Microbiological technique) (Table 4) (Figure 7).

Aerobic Plate Counting Technique (APC)

The test is used as an indicator for the presence of bacterial contamination assuming each cell will form visible colony when appropriate nutrients are provided. It is a generic test for microbes to grow at specific given conditions. APC are mostly used to evaluate the cleaning practices, adherence to cleaning practices and as a indicator of safety. We cannot rely completely

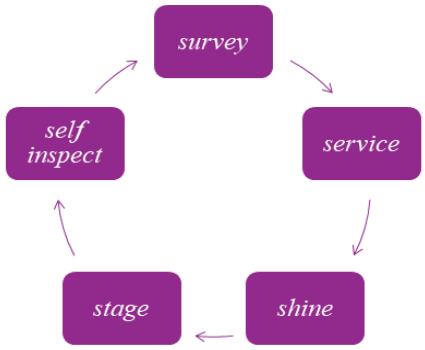

Figure 4 5S cleaning approach.

Figure 5 4C colour code for cleaning practices.

Table 3: Chemicals used as disinfectant and its mode of action on killing the pathogen.

Chemicals	Mode of action
aldehydes based disinfectant	Disrupt the cell membrane, denature enzyme and proteins
ionic based disinfectant	
peroxygens	It oxidises the enzymes and destroy the proteins
acids	Denatures the proteins
alcohol	Denature the cell wall proteins and create pores on cell membrane
hypochlorite	It oxidises the enzymes and destroy the proteins
pine oil	Denature the cell wall proteins and create pores on cell membrane
Phenolics	Denatures the proteins
quaternary ammonium salts	It increases the cell permeability and causes cell components to coagulate

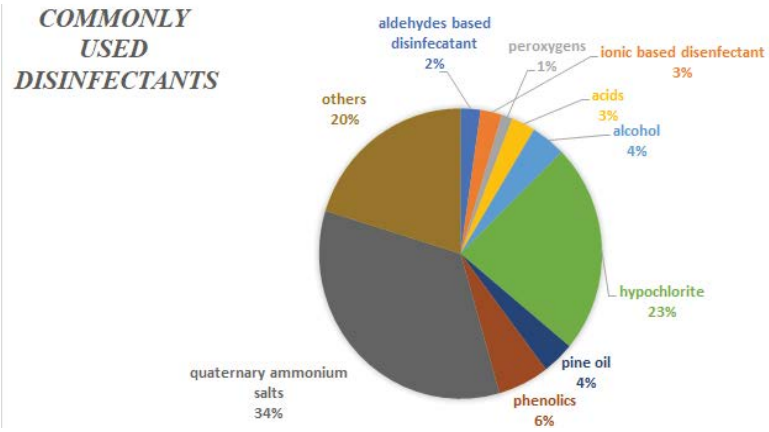

Figure 6 Commonly used chemicals in commercially available disinfectants.

Figure 4: Pathogens and growth media.

Pathogen	Growth media	References
Methicillin-resistant *Staphylococcus aureus* (MRSA)	Blood agar /mannitol salt agar	[34]
Clostridium difficile	Cycloserine-cefoxitin fructose agar	[35]
Pseudomonas aeruginosa	MOPS Medium, M9, M63	[36]
Enterobacteriaceae	Chromo select agar	[37]
Acinetobacter baumannii	*Acinetobacter* minimal agar	[38]
Staphylococcus epidermidis	mannitol salt agar	[39]
Staphylococcus warneri	Brain heart infusion agar	[40]
Streptococcus pyrogenes	agar media that contains phenylethyl alcohol, or Columbia agar with colistin and nalidixic acid	[41]
Streptococcus mitis	Trypticase soya agar	[42]
Corynebacterium spp.	Brain heart infusion agar	[43]
Fungal infection		
Candida	Potato dextrose agar	[44]

Figure 7 Aerobic plate count.

Figure 8 luminometer used to detect bioluminescence.

on APC because most instances they don't correlate with the presence of toxins and pathogens. When APC values are high then it is assumed that the surface is highly contaminated and could lead to spread of nosocomial infection. This microbiological test is performed using universal growth media and could give the level of contaminant present on the surface but they could not identify the type of bacteria, hence for further differentiation we need to perform APC performed on specific selective media. Even though these results look promising in identification of strain it requires skilled manpower, high end lab facility and resource to perform the experimental analysis, apart from that it's also time consuming [33].

ATP -Bioluminescence Assay: Modern Approach

ATP assay is a technique based on measurement of level of ATP present on High touch surfaces. This assay exploits the property of bioluminescence properties of luciferase-luciferin reaction which is ATP dependent that result in emission of light. ATP Bioluminescence assay is used to evaluate the cleaning practices by taking the level of ATP/organic matter present on the suspected high touch surface. ATP assay is user friendly and provide rapid real time detection and most commonly used to check cleanliness in high-risk areas. Although studies have shown that there is a lack of correlation between ATP & APC, People prefer ATP testing over APC due to ease of execution of assay. But focusing on evaluation of cleaning practices in hotel management ATP assay could be the best choice because the test can be performed by an hotel staff responsible for hygiene monitoring When it comes to evaluation of effectiveness of cleaning in hotel management requires multiple swabbing which makes APC technique more complicated and laborious apart from that APC are obtained only for 48 hrs which makes the test ineffective for real time Analysis in hotel industry and throws light on ATP testing for real time detection. ATP test are cost effective compared to APC and hence multiple sample collection on frequent time interval will help in determining the effectiveness on cleaning [45-48] (Figure 8).

Conclusion

Providing safe and hygienic accommodation is important for hotel industry. Hotel cleaning practice plays an important role in reducing microbial contamination in high touch surfaces and contributes to prevent spread of community Associated Infections. Adenosine Triphosphate (ATP) bioluminescence assaycan help the hotel managers more objectively to evaluate the cleaning practices. This kind of approach will help in guiding the staff to get maximum hygiene and prevent outbreaks of nosocomial infection. There is no testing standards available in market hence getting up started and setting up a bench mark will revolutionize the hotel industry and improve their standard.

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