How Clean Are Hotel Rooms? Part II: Examining the Concept of Cleanliness Standards

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Abstract **Hotel room cleanliness is based on observation and not on microbial assessment even though recent reports suggest that infections may be acquired while staying in hotel rooms. Exploratory research in the first part of the authors' study was conducted to determine if contamination of hotel rooms occurs and whether visual assessments are accurate indicators of hotel room cleanliness. Data suggested the presence of microbial contamination that was not reflective of visual assessments. Unfortunately, no standards exist for interpreting microbiological data and other indicators of cleanliness in hotel rooms. The purpose of the second half of the authors' study was to examine cleanliness standards in other industries to see if they might suggest standards in hotels. Results of the authors' study indicate that standards from other related industries do not provide analogous criteria, but do provide suggestions for further research.**

Introduction

Environmental surfaces have been demonstrated to be reservoirs for infection (Hota, 2004; Kim et al., 1981; Lueck, 2010; Talon, 1999). The presence of specific pathogenic (disease-causing) microorganisms on surfaces has also been demonstrated (Dancer, 2009; Dyskra, 1990; Evans et al., 2002; Gallimore et al., 2006; Wu et al., 2005) and these microorganisms are known to survive for extended periods of time (Cheesbrough, Barkess-Jones, & Brown, 1997). One study on environmental cleaning demonstrated that methicillin-resistant *Staphylococcus aureus* (MRSA) survived in dust for as long as one year (Wagenvoort, Sluijmans, & Penders, 2000).

Disease outbreaks in hotels have been reported widely in news stories. Legionnaires' disease, an uncommon pneumonia with serious consequences especially for older age groups (Centers for Disease Control and Prevention [CDC], 2012), was identified as early as 1976 at a hotel in Philadelphia (Freije, 2006). Recent Legionnaires' disease outbreaks have been reported in a 4,000-room hotel on the Las Vegas Strip in July 2011 (Ritter, 2011) and a Marriott Hotel in Chicago in summer 2012 (Smith, 2012). Another prominent disease linked to hotels was caused by the severe acute respiratory syndrome (SARS) virus. The origin of the spread of SARS was a single guest and a doctor who spent the night in a Hong Kong hotel in February 2003 (Bell, 2004; World Health Organization, 2004). This resulted in the spread of a global flu epidemic that devastated the Asian tourism industry.

More recently, norovirus has been linked to the cruise ship industry as well as hotels. It is considered highly contagious and resilient (Associated Press, 2004; CDC, 2013). Moreover, norovirus can survive in a dried state at room temperature for up to 28 days (MacCannell et al., 2011). Last but not least, bed bugs (*Cimex lectularius*), parasites of warm-blooded animals traveling around the world in luggage and on clothing (Shoemaker, 2011), are now considered to possibly harbor diseases such as hepatitis (James, 2003) and have been found to be vectors for MRSA (Lowe & Romney, 2013).

Part of the challenge in defining appropriate cleaning is that cleaning of hotel rooms presents some unique management issues. In addition to staffing challenges such as the limited amount of time available for hotel room cleaning, the surfaces to be cleaned are different than in other industries. For example, environmental surfaces in hotels include electronics and textiles as well as hard non-porous surfaces. These surfaces may require special handling because they may be uneven (e.g., a touchpad or keypad on telephone or television remotes), damaged by liquids, or susceptible to discoloration or bleaching from certain detergents or sanitizers.

At the same time, little academic research has been done to assist managers in the hotel industry with these challenges. If hotels knew the areas presenting the highest risk of contamination, cleaning protocols could be targeted for these areas. In addition, the rooms division manager or executive housekeeper needs more information about how to set standards for acceptable (or unacceptable) levels of contamination, rather than reliance on visual inspection. The purpose of our study was to examine cleaning standards from other industries to see if analogous criteria might be used in the hotel industry. This information is needed for interpreting research assessing hotel room cleanliness. In particular, part one of our study conducted exploratory research to determine if contamination of hotel rooms occurs and whether observation levels are accurate indicators of hotel room cleanliness. Data suggested that contamination occurred and that it was not reflective of observational assessments. Examination of standards in part II is needed to interpret data from part I as well as other future studies. Part II will also suggest recommendations for hotel managers based on interpretation of cleanliness data.

Methods

Literature Review

Current Cleaning Procedures in Hotel Rooms

Cleaning of hotel rooms occurs thousands of times per day. Based on the American Hotel and Lodging Association's (AH&LA's) number of guestrooms and average occupancy for 2011, this would translate to over 1.06 million guest rooms cleaned in the U.S. that year (AH&LA, 2013). In the U.S., room attendants or housekeepers clean between 12 (Casado, 2000) and 20 (Jones, 1986) rooms per eight-hour shift with an average of 14–16 rooms (Casado, 2000; Jones, 1986). Ironically, even though management expends incredible time, effort, and money cleaning hotel rooms, current practices for cleaning hotel rooms remain unstandardized and vary among properties and brands. In fact, differences in cleaning procedures (including rinsing the cloths between wipes or choice of chemicals such as detergent-based or hypochlorite/detergent-based solutions) can affect the efficacy of surface disinfection (Cogan, Slader, Bloomfield, & Humphrey, 2002). Currently, the most common method of evaluating hotel room cleanliness is a visual assessment.

Assessment of Cleanliness in Other Industries

General agreement exists in several research studies on the ineffectiveness of visual or personal assessments of cleanliness (Al-Hamad & Maxwell, 2008; Griffith, Cooper, Gilmore, Davies, & Lewis, 2000; Malik, Cooper, & Griffith, 2003; Sherlock, O'Connell, Creamer, & Humphreys, 2009). Ineffectiveness of visual observations has been cited in butchers' shops (Worsfold & Griffith, 2001), private homes (Worsfold & Griffith, 1996), hospitals (Griffith et al., 2000; Mulvey et al., 2011), and retail food service establishments (Cunningham, Rajagopal, Lauer, & Allwood, 2011).

It would seem intuitive that cleanliness (or lack of cleanliness), microbial contamination, and rates of infection would be correlated and some research has therefore suggested that infection rates should be used to assess appropriate cleaning. Results, however, are mixed (Dancer, 2009). One systematic review of the literature (Dettenkofer et al., 2004) found no difference in infection rate when disinfectants (vs. cleaning without the use of disinfectants) were used in the four cohort studies that they evaluated. Additionally, a study by Dettenkofer and co-authors (2004) suggested that microbial contamination in a patient's hospital room may be only a minor causative factor in acquired infections, although they admit that this effect has not been well studied.

Other methods to better assess cleanliness have also been suggested. At least one study has suggested the use of "best practices" in cleaning to determine appropriate levels (Worsfold & Griffith, 2001). In that research study of butchers' shops, microbial levels were compared before and after "best practices" cleaning was performed. Post-cleaning levels using "best practices" were suggested to set the standards for cleanliness, in contrast to periodic cleaning. The implication is that the highest standards of cleaning should be used when establishing appropriate microbial standards.

A related study using an assessment of cleanliness based on "normal clean" vs. "rigorous clean" standards was conducted in kitchens in private homes (Worsfold & Griffith, 1996). In this study "normal clean" was established by asking subjects to clean their kitchen according to their normal practices. "Rigorous clean" levels were defined when the surfaces were recleaned and disinfected by the researcher using a sanitizer (which may be perceived as similar to the "best practices" described in the previous research study). Significantly improved differences in cleaning were achieved with the "rigorous clean" methods and were thought to represent more appropriate cleaning. At the same time, that study suggested that acceptable levels of hygiene in domestic kitchens should take into account the nature of the (food) soil, the construction materials (environmental surfaces), the inter-cycle cleaning conditions (what happens in that environment when food is not being prepared), the variety of domestic cleaning products used, and the training of those who clean.

In summary, many industries no longer consider visual assessment adequate for assessment of cleaning and other more objective standards are being researched. Although the correlation between microbial contamination and infection rates would appear to provide the strongest evidence for where to set the objective standards for cleaning levels, research results on the relationship is mixed. The concept of looking at microbial levels after "best practices" or "rigorous" cleaning, however, may be useful. Research in at least two areas where cleaning is essential to prevent the spread of disease (butcher shops and home kitchens) found this approach to be a good method.

Types of Microbiological Assessment and Examples of Criteria Used

Different types of microbial assessment have been suggested and offer the potential for standard testing methodologies for cleanliness if appropriate standards can be set for hotel rooms (Aycicek, Oguz, & Karci, 2006; Cunningham et al., 2011; Griffith et al., 2000; Lueck, 2010; Moore & Griffith, 2002a; Worsfold & Griffith, 1996). They include the evaluation of general microbial contamination, specific types of microbial contamination relevant to that environment, or the use of adenosine triphosphate (ATP) bioluminescence. General microbial contamination has been quantified through aerobic plate counts (APC). Results are reported as CFU/cm^2. These tests give specific information relative to bacterial contamination, but are more expensive and time consuming than ATP tests. ATP tests are also thought to give a good indication of cleanliness (Griffith et al., 2000). They measure ATP (an energy-containing substance present in cells) from microorganisms, food residues (or other organic material), and humans (Worsfold &

Griffith, 1996). Results are reported as relative light units (RLU). They offer rapid results (within minutes), but do lack specificity for bacterial contamination as they also measure organic soil contamination. For example, one study found that microorganisms represented 33% of the ATP readings as compared to nonmicrobial sources (Griffith et al., 2000). It has also been suggested that although ATP readings lack specificity, they provide a better assessment of cleaning because organic residues provide a food source to bacteria (Worsfold & Griffith, 1996). Finally, some studies have suggested an integrated method incorporating visual assessments, ATP testing, and periodic microbial assessments (Aycicek et al., 2006; Cunningham et al., 2011; Moore & Griffith, 2002a). Occasionally, specific types of microbial contamination are further evaluated, such as generic *E. coli* and coliform counts (which may indicate sewage or fecal contamination) (Moore & Griffith, 2002b), *Campylobacter jejuni* on cutting boards (Cools et al., 2005), and *Staphylococcus aureus* (Scott, Duty, & McCue, 2009), among others.

Cleanliness standards for interpretation of APC or ATP results vary among research studies. Worsfold and Griffith (1996) used the following ATP standards in their study on home kitchens: <128 RLU for work surfaces, <114 for (cutting) boards, <27 for the tap, <154 for the drainer, and <58 for the refrigerator door handle. Manufacturer's recommendations for acceptable ATP levels were used by Cunningham and co-authors (2011). In this restaurant kitchen study, ATP levels exceeding 199 RLU were considered unacceptable for all surfaces except for cutting boards and bathroom door handles. The pass/fail level was set at 1,000 RLU for these two areas. When APC were assessed, surfaces with more than 125 CFU/50 cm^2 or those that tested positive for enteric (intestinal) bacteria were considered unclean.

Scott and co-authors (2009) sampled 32 surfaces for bacterial contamination in 35 homes. Highest counts were associated with potentially wet sites including kitchen drains, sponges, tubs, floor around the toilet, and kitchen faucet handles. Lowest counts were found on toilet seats and the toilet bowls. Because the purpose of that study was to determine areas of greatest contamination for specific microorganisms in relation to household demographics, they did not attempt to set acceptable levels, but drew comparisons at the 25th and 75th percentiles based on median levels of contamination. Their conclusions were that many surfaces were highly contaminated, bacterial counts varied extremely, moisture had an impact on microbial counts, and most importantly, a potential existed for spread of fecal pathogens via hand-contact surfaces.

An in-depth hospital cleaning study by Mulvey and co-authors (2011) looked at ATP levels and their relationship to microbial growth as assessed by APC. Correlation of ATP levels with a recently suggested APC hospital standard of 2.5 CFU/cm^2 (reduced from 5 CFU/cm^2) was assessed using samples taken from patient rooms including the floor underneath the patient's bed, bedside table, bed frame, and locker. An ATP benchmark value of 100 RLU offered the closest correlation with microbial growth levels <2.5 CFU/cm^2, although the researchers noted that this level was based on the use of the Hygiena brand ATP meter. Their overall conclusion was that more research is needed to determine appropriate cleanliness, particularly for high-risk (hand-touch) areas.

Another hospital study by Griffith and co-authors (2000) evaluated 29 ward locations and suggested realistic benchmark values after best practice cleaning and disinfection. These were 500 RLU for ATP assessment and 2.5 CFU/cm^2 for APC testing. The researchers noted that most sites that were assessed as visually clean would have failed using these benchmark values. More specifically, ATP tests would have failed an average of 76% of the sites that would have visually passed and APC would have failed an average of 70% of the sites. This disparity was striking as visually clean surfaces had more than 40 CFU/cm^2 in some sampling areas. These results offer useful information for the hotel industry because many cleaning sites would be considered "wet" hand-contact surfaces.

Significant differences in microbial contamination were also found in a study done in hotel food services in Spain based on the type of surfaces and the time parameters used (Domenech-Sanchez, Laso, Perez, & Berrocal, 2001). The standard used in that study was <1.3 log CFU/cm^{-2} for food contact surfaces as suggested by Henroid and co-authors (2004).

Results and Discussion

If the APC level of <2.5 CFU/cm^2 from other cleaning studies (Griffith et al., 2000; Mulvey et al., 2011) is used as a hotel cleaning benchmark, almost all tested surfaces (headboard, bathroom and room door handles, bathroom and shower floors, bathroom sink and faucet, mug, toilet paper holder, entry carpet, telephone and TV remote keypad, bedside and main light switches, toilet basin, and three items from the maid cart including a glove, mop, and sponge) from part I of our study would have failed for at least one sample. The one exception was the curtain rod that was only sampled in three rooms (Table 4, part I).

The meaning of coliform counts is even more difficult to assess. Dancer (2004) suggested that coliform count levels less than 2 CFU/cm^2 should be used as the standard in hospitals. Using this standard, most of the surfaces tested in part I of our study would have passed with the exception of some samples taken from the main light switch, telephone key pad, bathroom sink, glove, mop, and sponge. It is surprising, however, that any level of coliform contamination was found on a mug (1.8 CFU/cm^2). As in other studies, results varied widely with the samples. When mean coliform counts were calculated, four surfaces again exceeded the 2 CFU/cm^2 standard. They were the main light switch, the bathroom sink, the mop, and the sponge (Table 5, part I).

While the results might suggest potential concerns, the application of these standards may not be appropriate. Worsfold and Griffith's (1996) research states that situational variables need to be considered that are unique to the environment being cleaned. In the case of hotels, this might include the nature of the soil, type of materials being cleaned, cleaning frequency, room cleaning process, types of cleaning products used, and room attendants' training.

In addition, while the food industry has heavily researched acceptable levels, environmental surfaces in food establishments are regulated to be smooth, easily cleanable, durable, and most importantly, nonporous. In addition, access to kitchens in food establishments is limited to employees. Similarly, hospitals are also actively seeking to set standards; however, conditions may differ as to the pathogens present, stringent need for antiseptic conditions (e.g., surgery), and the immune-compromised condition of patients (which may require higher levels of "cleanliness").

Conclusion

Almost all hotel room surfaces failed when microbiological standards set in other industries were used for the hotel rooms. Use of these other industry standards may not be suitable, however. Hotel rooms differ from food establishments, hospitals, and other areas in their types of surfaces, presence of hotel guests living in these spaces (as compared to employees working in an environment), pathogens, need for antiseptic or sterile conditions, and immune status of people in their environment. Although comparing the standards from other industries is a starting point to establishing standards for the hotel industry, it appears that cleaning standards from other industries may not be appropriate.

Our study also reviewed relevant literature to determine how standards were set for cleaning in other industries. Previous research has focused on acceptable levels after thorough cleaning has been performed. By analogy, guest room cleaning standards should be based on evaluations after best cleaning practices have been conducted. Recommendations for future hotel room studies include "before and after" testing using best cleaning practices. The type of assessment (APC or ATP testing) that is most appropriate, operationally feasible, and cost-effective should also be considered.

Hotel managers might use these to develop cleaning policies that assure satisfactory cleaning of guest rooms. Housekeepers clean an average of 14–16 rooms per eight-hour shift (Casado, 2000; Jones, 1986). Because of this time limitation it is essential that areas with the greatest contamination be addressed. Rooms division managers or executive housekeepers may wish to emphasize cleaning the dirtiest areas when developing cleaning protocols or policies to ensure that rooms are cleaned in the most efficient and most effective manner. Additionally, it would be useful to determine the value of disinfectants in room cleaning. As compared to restaurants where the use of disinfectants is common, hotel managers have to consider the damaging effect of these products on textiles and other surfaces specific to hotel rooms.

Clearly, visual assessment of hotel room cleaning does not represent the level of microbial contamination that may be present. Visual cleanliness is aesthetically important, but doesn't necessarily reduce the risk of infection. Additional research will help hotel owners and managers assure that people staying in hotels are provided a safe and clean environment, just as people are in restaurants, hospitals, or anywhere else where services are provided for eating or sleeping.

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