Survey of sanitation practices used on toys in general practitioners' waiting rooms in Vancouver, BC.

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Abstract

Children are a highly susceptible group for many infectious diseases due to their under-developed immune systems. Environments with close contact to infected individuals and contaminated items pose a threat of communicability of invasive pathogens. Doctors' offices often supply toys in their waiting areas for children to play with. Many of the children entering a general practitioner's (GP's) office are already ill and their immune systems further compromised, leaving them at a higher risk of being infected. Due to the frequent oral contact with toys, they are most likely to be a fomite for infections. This study surveyed 30 general practitioners' offices in Vancouver, BC to assess the frequency and level of disinfection of toys in comparison to the reception countertops, another waiting room surface of equal hazard level. No association was found between the level of disinfection used and surface type cleaned (P=0.432993), however, an association was found between surface type and the frequency of disinfection used (P= 0.000036). The participants were also asked if they had a sanitation plan that includes the sanitation of toys (13.33 %), and whether or not they provided soft toys (36.67 %), as it has been found that soft toys are difficult to disinfect and are unsuitable for waiting rooms. Results of this study were then combined with a parallel microbiological assay to find no association between disinfection levels or frequencies and bacterial levels on toys. High aerobic colony counts were still found on toys in relation to countertops in the microbiological assay. Findings of this study suggest that although the disinfection frequency for toys is not associated with bacterial levels, it should still be increased, and a more stringent sanitation plan should be implemented and enforced in general practitioners' offices, as a safety measure to reduce the survival of other potential pathogens. Further research is required to assess the association between sanitation of toys in waiting rooms and the survival of other microbial agents.

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Introduction

Many standard general practitioners' offices, not to mention paediatricians' offices, have waiting rooms with designated "play areas", scattered with various types of toys, to occupy children as they wait for their next appointment. Given the nature of that office, many children who play in those areas are sick; some are infected with communicable diseases, others with chronic conditions, and some are healthy and just waiting for a routine check-up (Canadian Paediatric Society, 2008a). For the purpose of this project, it is the children who are infected with communicable diseases that are of concern. As these children with infectious diseases play with the shared toys in the waiting rooms, they often put them into their mouths or otherwise contaminate them with their hands. As more children play with these toys, they are potentially being exposed to the pathogens from the last sick child to have contaminated that toy. Toys in waiting rooms are a potential vehicle for spreading communicable diseases, particularly infectious diseases causing diarrhoea. Disinfection of the toys with the appropriate level of disinfectant and at an adequate frequency is shown to reduce bacterial and total coliform levels on toys (Merriman, Corwin, and Ikram, 2002). The objective of this study was to determine, using survey methodology, the frequency at which physicians' offices in Vancouver sanitize their toys, using what procedures and whether or not they had soft toys in the office. The results of this study would be of great interest to any parent of a young child, as well as the College of Family Physicians of Canada, an organization dedicated to setting standards for general practitioners across the country.

Young children are already a highly susceptible demographic in terms of developing illness from invasive pathogens, since they are not protected from previous exposure or

vaccination as adults are. Their immune systems are still developing and when already infected, their immune systems are further compromised and they are susceptible to a secondary infection if exposed (Posfay-Barbe, Zerr, and Pittet, 2008). In a doctor's office, children are subject to higher transmissibility of communicable diseases due to a close environment of infected individuals and susceptible hosts (Canadian Paediatric Society, 2008b).

Many infectious diseases are monitored and reported by health professionals, then compiled by the British Columbia Centre for Disease Control (BCCDC) and published in an *Annual Summary of Reportable Diseases.* The reports for the last three years indicate that of the diseases considered to be reportable, children ages 1 to 4 years old have higher incidence rates than adults aged 20 to 24 years of cryptosporidiosis, verotoxigenic *E.coli*, giardiasis, salmonellosis and yersiniosis (See Table 1) (British Columbia Centre for Disease Control [BCCDC], 2007, 2008, 2009).

TABLE 1 - INFECTION RATES IN BC (RATES ARE PER 100,000 POPULATION)

	2006		2007		2008	
	Age 1-4	**Age 20-24**	**Age 1-4**	**Age 20-24**	**Age 1-4**	**Age 20-24**
Cryptosporidiosis	15.3	3.8	8.4	1.0	5.9	2.9
Verotoxigenic *E.coli*	8.2	5.1	15.0	7.8	6.5	2.3
Giardiasis	41.0	20.5	38.3	20.7	43.6	15.1
Salmonellosis	42.8	20.2	37.1	21.4	48.9	28.3
Yersiniosis	25.9	17.2	25.2	14.6	15.9	13.5

All of the aforementioned diseases are spread through the faecal-oral route. Transmission of pathogens among children during outbreaks of gastroenteritis is higher than with other age populations due to inadequate handwashing, touching each other often, placing

objects (fomites) into their mouths, and putting their fingers into mouths and noses (Canadian Paediatric Society, 2008a).

The British Columbia Centre for Disease Control published *Guidelines for Infection Prevention and Control in the Physician's Office* (2004) that states:

> Toys in the office should be washable and of appropriate sizes and shapes to avoid aspiration or other injuries. Toys contaminated with body fluids should be removed until cleaned. The value of antibacterial agents within the toys is unproven. Cleansing of toys in a dishwasher on a routine basis will decrease microbial contamination and keep the toys clean (p.16).

Although it is stated that cleansing of toys in a dishwater will reduce microbial contamination, it is not set as a standard for sanitation. Appendix 3 of the guideline also indicates that toys and other environmental surfaces are to receive low-level disinfection when they are soiled (BCCDC, 2004). Waiting for a visible indication of soiling is a subjective reference point and could vary the actual frequency of cleaning from very often, for a particularly tidy office worker, to never. This study will evaluate the frequency of cleaning and sanitation of the toys in the waiting room, and shed light on how variable that frequency actually is in the waiting rooms of Vancouver doctors' offices.

Low-level disinfectants, such as phenolic disinfectants (mouthwash, Lysol, etc.) and quaternary ammonium compounds, are defined to "kill most vegetative bacteria and some fungi as well as enveloped (lipid) viruses (e.g., hepatitis B, C, hantavirus, and HIV)" in BCCDC's *Guide to Selection and Use of Disenfectants* (p.3, 2003). They do not kill bacteria with spores,

protozoans with cysts (e.g. *Giardia lamblia* and *Cryptosporidium parvum*), mycobacteria (e.g. *Mycobacterium tuberculosis)*, non-enveloped viruses (e.g. Norwalk-like viruses and rotaviruses), and fungi (BCCDC, 2003). As noted in Table 1, cryptosporidiosis (caused by *C. parvum*) and giardiasis (caused by *G. lamblia*) are noted in high numbers in children aged 1 to 4 years old, with infection rates of 5.9/100,000 population and 43.6/100,000 population respectively in 2008 (BCCDC, 2009). A higher level of disinfection that would effectively eliminate protozoa could potentially help reduce the transmissibility of these pathogens via fomites in health care settings. Both frequency and level of disinfection were compared to microbiological assays taken alongside the survey, to determine if they have an effect on the bacterial and coliform counts on the toys. Tests for protozoa and viruses were not conducted alongside this survey, so the effect of low-level disinfection on those pathogens on toys remains unknown.

While these guidelines to distinguish which disinfectants should be used on which surfaces and the frequency of sanitation recommended, the enforcement of these standards could not be determined. Sections 27 and 28(1)(a) of the *Health Professions Act [RSBC 1996] CHAPTER 183* state that an inspector appointed by the College of Physicians or the registrar itself can inspect the premises of a registrant used to practice the health profession (Health Professions Act, 2008). Results of this study may indicated that more frequent inspection is not necessary, and that the current level of disinfection used by general practitioners in Vancouver is adequate to control the levels of coliform and fecal coliform counts on toys in the waiting rooms.

Even healthy children pose a risk of contamination of toys in general practitioners' offices. *Enterococci* bacteria are "commonly found in the gastrointestinal tract of 95% of

healthy individuals" (p.14, Provincial Infection Control Network [PIC Net], 2008). *Enterococci* is abundant in human faeces and easily transmissible through the faecal-oral route. They are opportunistic and can become invasive, causing disease in susceptible individuals with weakened immune systems, such as sick children (PIC Net, 2008). Vancomycin-Resistant *Enterococci* (VRE) are bacteria that have acquired resistance to the antibiotic vancomycin. For this reason, it is difficult to treat, much like Methicillin-Resistant *Staphylococcus aureus* (MRSA), due to limited options with medication. Newer drugs are being used, but VRE are starting to show resistance to those as well (PIC Net, 2008). It is noted in the *Antibiotic Resistant Organism Guidelines* that VRE is highly transmissible through environmental surfaces, such as table tops and toys, and can survive for prolonged periods of time on these surfaces (PIC Net, 2008). It can also be transmitted person-to-person. "[D]isinfectants and cleaning processes are a key part of institutional infection control policies. Thorough daily disinfection of environmental surfaces is necessary to reduce the potential bacterial load." (p.15, PIC Net, 2008) Areas that exhibit high rates of VRE infection should implement better sanitation procedures of inanimate surfaces such as toys. Instead of waiting until they are visibly soiled, more frequent disinfection for this reason could be proposed if results of the study find that sanitation occurs infrequently.

Literature Review

Hospital Acquired Infections (HAIs)

Also referred to as Health Care Associated Infections (HCAIs), Hospital acquire infections are defined by Horan *et al.* (2008) as "a localized or systemic condition resulting from an adverse reaction to the presence of an infectious agent(s) or its toxin(s)" that was acquired

during a visit to a health care setting, without infection present prior to admission (p.310). Gravel *et al.* (2007) investigated the prevalence of HAIs in paediatric care in children 18 years and younger and found that the overall prevalence of HAIs was 8% of the 997 children surveyed. The predominant types of infections found by this study were bloodstream infections, pneumonia, viral gastroenteritis, urinary tract infections, surgical site infections, Clostridium difficile-associated diarrhea, and viral respiratory infections (Gravel *et al.*, 2007). Pneumonia, gastroenteritis, and viral respiratory infections are diseases that are caused by agents potentially transmitted orally, such as from chewing on a contaminated toy. Proper sanitation of surfaces that children commonly come into contact with orally can help prevent a number of HAIs.

Causative agents of HAIs

Randle & Fleming (2006) analysed the prevalence of micro-organisms on childrens' toys in an intensive care unit and in the play area of a hospital. The predominant organisms found included *Staphylococcus epidermidis*, micrococci, and diphtheroids, all of which are commensals of skin. Commensals are organisms that are naturally found on human skin without affecting the host (Heymann, 2008). Opportunistic pathogens, organisms that act as commensals but attack the host when defenses are down, were also found. These included bacteria such as *Staphylococcus aureus, Methicillin-Resistant Staphylococcus aureus (MRSA), Escherichia coli, and Clostridium difficile.* Respiratory syncytial virus (RSV) was also found on childrens' toys (Randle & Fleming, 2006). RSV can lead to serious respiratory infections such as pneumonia, bronchitis and colds (Moore, 2001).

Transmission in the doctor's office

Children do not have the well-developed immune systems that adults have acquired through vaccinations and previous exposures to pathogens. Their immune systems are still developing, their handwashing hygiene is poor, they touch things and each other often, and they put things in their mouths and noses. All of these activities put them at higher risk of transmitting and acquiring disease (Canadian Paediatric Society, 2008a). Doctors' offices contain a higher proportion of sick people at a given time than most other venues. The close proximity of so many potentially infected people greatly increases the chance of transmitting an infectious disease. Children in doctors' offices are subject to both person-to-person transmission, as well as direct contact transmission from fomites such as toys (Canadian Paediatric Society, 2008b) . Children with infectious gastrointestinal or respiratory diseases and poor handwashing skills may touch the toys. Then, another child who is already ill can pick up that same toy and put it, and any pathogens it may be carrying, into his/her mouth.

Disinfection frequency

The Canadian Paediatric Society conducted a study of *Infection control in paediatric office settings*, assessing the different transmission routes of infectious pathogens in health care settings and the most effective means of controlling them (2008b). Contact transmission including direct contact and indirect contact (toys) was the primary route of transmission in these offices. A study was done on the microbial content of the toys after at least one week of cleaning. It was found that soft toys that had been cleaned regularly showed no difference in microbial levels than those that were not clean; they were always high in bacterial counts. Hard toys that were regularly cleaned, however, showed lower counts than those that were never cleaned. The study concluded that soft toys were unsuitable for doctors' offices as they are a

much more potent vehicle for cross-contamination than hard toys. It also makes some strong recommendations regarding cleaning toys. The study suggests that toys be cleaned between patients with a 1:100 bleach solution or dishwasher, and that toys soiled by older children be discarded completely (Canadian Paediatric Society, 2008b). Based on the findings of this study, the survey conducted in Vancouver assessed how many doctors' offices in Vancouver supplied their waiting rooms with soft toys to play with.

Disinfection level

Merriman, Corwin and Ikram (2002) observed toys as a potential source of cross-contamination in general practitioners' waiting rooms. They had sampled several toys from waiting rooms and tested them for total bacterial and coliform counts. Results indicated presence of coliforms on 90% of soft toys and 13.5% of hard toys. They had also questioned the six participating practices and found that two (33%) cleaned their toys fortnightly, and the other four (66%) cleaned their toys infrequently or not at all. Hard toys were cleaned effectively by soaking in a hypochlorite (2.5 g/L) solution, and coliform and bacterial levels were kept low with a regular cleaning schedule. Soft toys were inadequately cleaned using a dishwasher, but if soaked first for 30 minutes in a hypochlorite solution, then washed, coliforms and bacteria were eliminated. However, shortly after replacing soft toys, microbial counts returned to moderate levels (Merriman et al., 2002). Again, this difficulty observed in maintaining healthy bacterial counts on soft toys suggests that they are not suitable for health care settings.

Current regulations and guidelines

Sanitation of environmental surfaces in these settings is suggested to be regular in frequency or when objects are soiled (BCCDC, 2004). Disinfection is to be carried out with low-

level disinfectants and inspections of the premises carried out by an appointed inspector from the College of Physicians (BCCDC, 2003). Whether or not these steps to ensure safety are taken is difficult to determine without access to monitoring records or inspection reports. Inspections are to be carried out by an inspector from the College of Physicians, however frequency and depth of inspections were difficult to ascertain (Health Professions Act, 1996).

Purpose of study

The purpose of this research study was to determine how well physicians' offices in Vancouver followed sanitation frequency guidelines for toys, if at all, what kinds of disinfectants they used, if at all, and whether or not they provided soft toys for kids to play with in the waiting rooms. The following sets of hypotheses were tested:

H_O: There was no association between countertops and toys in level of disinfection used
H_A: There was an association between countertops and toys in level of disinfection used

H_O: There was no association between countertops and toys in frequency of disinfection used
H_A: There was an association between countertops and toys in frequency of disinfection used

To measure the quality of disinfection used on waiting room toys in comparison to countertop surfaces, an in-person interview was administered to the staff of randomly selected general practitioners' offices. Thirty doctors' offices were interviewed and the data was analyzed for association between types of surfaces, specifically toys and reception countertops, and frequency and levels of disinfection. The same offices were also be asked to take part in a second study, which assessed the microbial count on the toys and countertops to determine if

frequency and/or level of disinfection used on toys was effective in maintaining safe microbiological level on the toys.

Materials and Methods

Materials

To conduct this study, 90 sheets of 8.5 x 11 inch white paper were required, along with sufficient ink to print the surveys (Appendix C) and consent forms (Appendix A) on them. Pens were also required to write with. A promotional prize of toys were offered as an incentive to participate in the study and offices that wished to do so were entered into the random draw to win it. The collected data was compiled in Microsoft Excel, where descriptive analysis was done (Microsoft, 2007). Inferential statistics was conducted using Number Crunching Statistical System (NCSS), a statistical analysis software that is commonly used by educational institutions, researchers and businesses (Hintze, 2009). In order to use these programs, access to a computer was required. A car was used to transport investigators of both this study, and the parallel microbiological assay study to the sites.

Description of standard method

A list of general practitioners in the Vancouver region was obtained from the *Find a Physician's Contact Information* tool (CPSBC, n.d.). Each office was assigned a different number Random.org web tool to choose the participants of the study (Haahr, 2009). The selected participants were then presented with the cover letter for the survey (see Appendix A), as well as verbally informed of the purpose, risks, and benefits of participating in the study (see Appendix B). They were assured confidentiality, ethical approval, and given contact information

in the event that they would like to see the results within the cover letter. Participants were required to sign the consent form before participating in the study. Once given consent to participate, the offices' staff members that were responsible for cleaning the waiting areas were interviewed and asked questions related to their sanitation practices of toys and countertops, as indicated on the Survey Questions Sheet in Appendix C. Participants were not given the questions ahead of time. The researcher asked open-ended questions, so as to not lead the participants into a specific answer, and categorized the given answers according to the options on the Survey Questions Sheet for easy inferential analysis. The survey took approximately 1-2 minutes to complete.

Data collected was compiled in Microsoft Excel as shown in Appendix D. The percentage of offices that offered soft toys and the percentage of offices that had sanitation plans in place that address the disinfection of toys were calculated in Microsoft Excel. Data collected regarding the frequency and level of disinfection of both toys and countertops were analyzed in NCSS to determine correlation.

Alternate methods

Instead of the *Find a Physician's Contact Information tool*, the Yellow Pages online phone book could have been used to search for doctors in Vancouver, BC (www.yellowpages.ca). This method was not selected for use in this study because the Yellow Pages search results included many specialized medical practices, which are excluded from the study. Potential participants could have been drawn from a hat to select the random sample, however a random number generator ensured a higher degree of validity as subjectivity may

play a role when picking names out of a hat; a computerized generator offers maximal randomization.

Aside from an in-person interview, a telephone interview could also have been conducted, where the same questions would have been asked over the phone, without giving the participants questions ahead of time. The participants could have also filled out the survey in-person, through registered mail, or online using survey software applications such as Survey Monkey (2009). Administering the survey by means of an in-person interview as opposed to a self-administered questionnaire reduced the number of anticipated changes in answers that could be expected by giving the whole survey to the participant. In such a case, the office worker could read ahead and develop an idea of what he or she should be answering to portray a more positive image for his or her workplace. For example, instead of being asked to name the disinfectant used and having the investigator select the level of disinfectant that the named product is classified as (i.e. low-level, intermediate-level, or high-level), in a self-administered survery, the participant could have simply selected "high-level disinfectant" regardless of what they were actually using, simply because it sounded more effective. Though time-consuming, conducting the interviews in-person provided a more immediate response rate, so that they could not forget to answer or think ahead to anticipate what would have been the best answer, instead of the true answer.

Analysis of data could have been done using any other statistical analysis software or the calculations could have also been done manually if access to these applications was not available. Microsoft Excel was used to conduct the descriptive statistical analysis (i.e.

percentages) and NCSS to carry out the inferential statistical analysis (i.e. Chi-Square Test) because these programs were made available for free at the British Columbia Institute of Technology, where the majority of the analyses took place.

Reliability and validity

In-person interviews to assess the sanitation practices of general practitioners' offices had moderate test-retest reliability as participants could change their answers upon retesting. Because the interview required an immediate face-to-face response prior to moving on to the next question, it had higher reliability than a self-administered survey, where one could look ahead to other questions and change answers several times before submitting it. The reliability of this study was increased by ensuring that the interviews were conducted in the same manner each time that they were administered. The criterion validity of the interview was dependent on how truthful the participants were in answering the questions. If their answers accurately depicted the sanitation practices in the office, the criterion validity was high, but this cannot be measured without monitoring the office over an extended time period to observe their sanitation procedures. The validity could have been increased by increasing the sample size to get results that were more representative of the population being sampled (Heacock & Chiodo, 2008).

Inclusion and exclusion criteria

Any general practitioner's office within the Vancouver region that contained children's toys for public use in the waiting room was eligible to participate in this study. Exclusions from this study included pediatricians' and other medical and surgical specialists' offices, offices

outside of the Vancouver area, and offices that did not have toys available for public use in the waiting rooms.

Ethical Considerations

Ethical concerns were addressed in the cover letter for the survey, as shown in Appendix A. Participants of the research study were given a description of the nature of the study, the activities involved and the duration. They were ensured that their participation was voluntary and that they could withdraw from the study at any time without penalty, and that confidentiality was guaranteed (Heacock & Chiodo, 2008). The study was designed to do no harm and pose no risks or discomfort. All participants were provided with the researcher's contacts in the event that they would like to see the results of the study or if they had any questions or concerns. The cover letter stated that the research study had ethics approval from BCIT. Lastly, the participants were required to sign the consent form, attached to the cover letter, prior to participating in the study.

Pilot study

The questionnaire (Appendix C) was distributed to 4 subjects for analysis of language and available answers and no issues had been brought to attention. An interview was conducted on two staff members of a local general practitioner's office and it proved to be successful in obtaining honest and unbiased answers. With these findings, the project was moved forward.

Results and Statistical Analyses

In this study, observations were qualitative and nominal data was collected. Because the data collected was in the form of counts, the descriptive statistical analysis was summarized

using percentages to indicate what proportion of GPs' offices had a sanitation plan in place that included toys, as well as what proportion of GPs' offices offered soft toys for kids to play with. With respect to inferential statistics, two chi-square tests were conducted: one to compare the frequencies of disinfection applied on toys in comparison to reception countertops, and another to compare the use of different levels of disinfectants (i.e. low-level, intermediate-level, or high-level) on either of those surfaces. This indicated if there was a relationship between the type of surface noted (toys or countertops) and levels and/or frequencies of disinfection. According to British Columbia Centre for Disease Control's (BCCDC's) *Guide to Selection and Use of Disinfectants*, these surfaces are considered of equivalent hazard and should be disinfected at the same frequencies and using the same level of disinfectant (2003). If they are found to have no association, there is still a basis for further argument that toys should be considered a higher hazard and deserve increased frequencies of cleaning, similar to that of semi-critical items (Health Canada, 1998).

Note that chi-square tests are one-tailed tests and do not state the power of the study. It is a measure of association by calculating the relationship between a nominal set of data for one criterion with another. (Greenwood & Nikulin, 1996).

The findings of the study were gathered in Microsoft Excel (2007) for further analysis using both Excel and NCSS (Hintze, 2009)(See Appendix D).

Descriptive statistics:

Using Microsoft Excel (2007), the percentages of general practitioners' offices with toys supplied in the waiting rooms for public use that had a sanitation plan in place was determined

to be 13.33 % of the offices that had been questioned. The percentage of offices that supply soft toys to play with was 36.67 % of the 30 offices surveyed. Seventeen out of fourty-seven (36 %) offices visited did not have toys available at all.

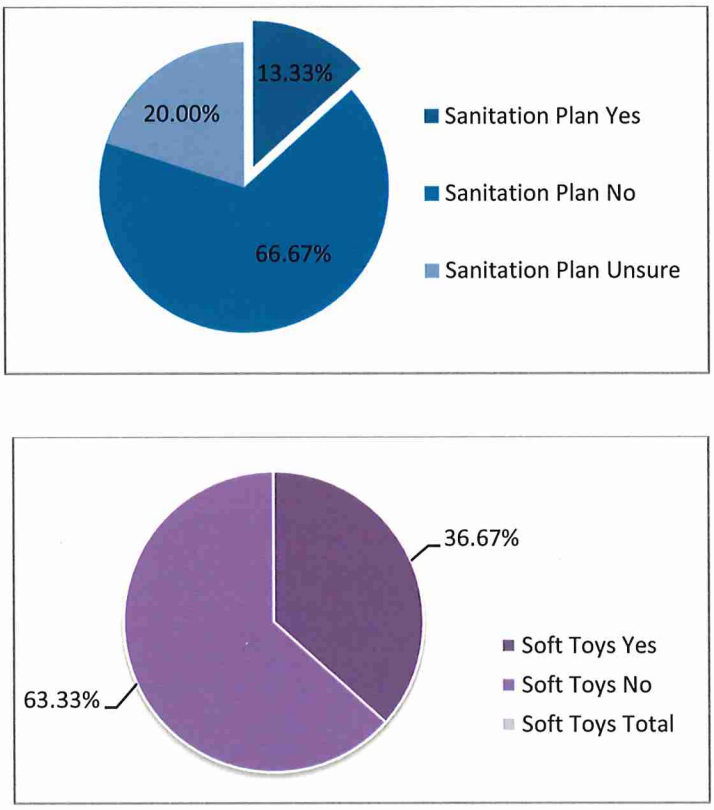

FIGURE 1 - DESCRIPTIVE STATISTICS OF SANITATION PLANS AND SOFT TOYS

A large proportion of offices (see 2X4 table in Appendix F) were disinfecting their reception countertops more frequently than they were disinfecting the toys in the waiting rooms (see Figure 2). Offices were found to be using mostly intermediate-level disinfectants, such as alcohol and bleach-based products, commonly in the form of Cavi-Wipes®, on both toys and reception countertops, as depicted in Figure 3 and tabulated in Appendix E.

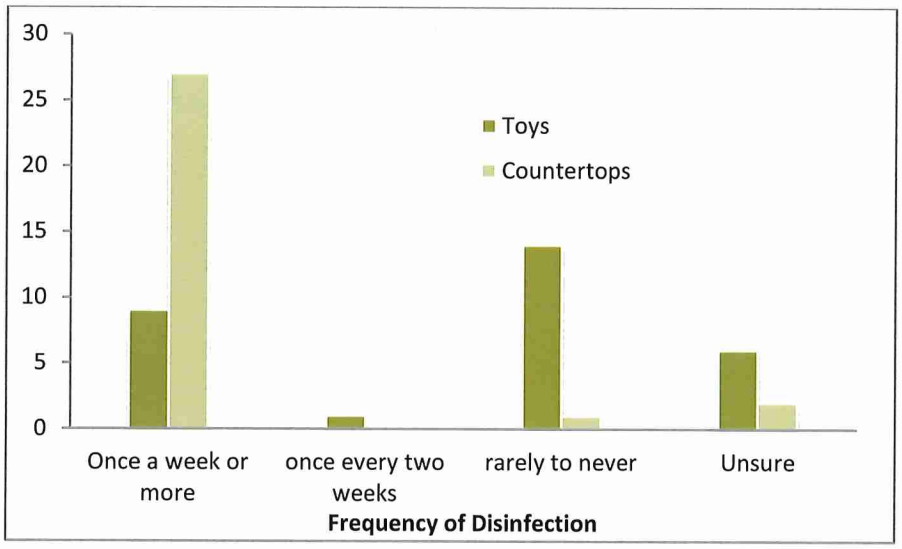

FIGURE 2 – BAR GRAPH OF FREQUENCY OF DISINFECTION OF TOYS AND COUNTERTOPS

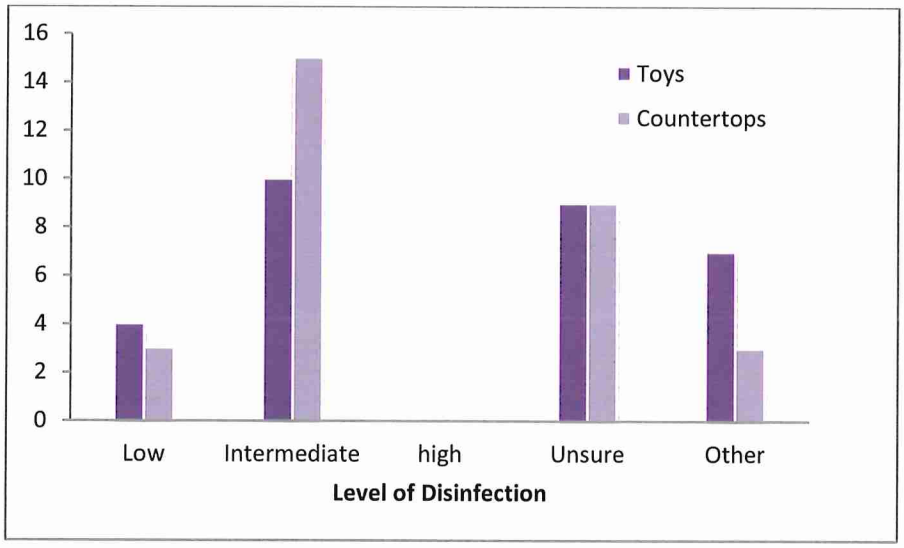

FIGURE 3 - BAR GRAPH OF LEVEL OF DISINFECTION USED ON TOYS AND COUNTERTOPS

Inferential statistics:

Chi-square tests were conducted using NCSS to evaluate the association between surface types, specifically toys and reception countertops, and the frequencies and levels of

disinfection (Hintze, 2009). The results of the first chi-square test (Appendix E) showed that there was not a significant relationship between the type of surface being cleaned and the level of disinfectant that was used to clean it. The test suggests that we accept the null hypothesis (H_0), which states that the level of disinfectant used and the surface type being cleaned were independent, and reject the alternative hypothesis (H_A) which states that the two were dependent (Heacock & Chiodo, 2008). This means that general practitioner's office workers are not likely to be selecting a specifically higher level of disinfectant to disinfect toys or the countertops. The probability level (P-value) of these statistics is 0.432993, which is greater than 0.05, the benchmark value to determine if a value is statistically significant (Heacock & Chiodo, 2008). In this case 0.432993 is not a significant P-value and suggests that the likelihood of this specific data distribution is high enough to accept H_0. Due to the high P-value, this analysis is unlikely to be prone to a type II or beta (β) error (Heacock & Chiodo, 2008).

The second chi-square test (Appendix F) analyzed the association between surface type and frequency of disinfection. The results indicated that the null hypothesis (H_0), stating that the surface type and frequency of disinfection were independent, should be rejected, and, in turn, that we accept the alternative hypothesis (H_A). The alternative hypothesis (H_A) states that the surface types being cleaned and the frequency of disinfection were dependent upon each other, and that the office workers were likely to be cleaning one surface (the countertops) more than the other (the toys). The P-value for this test was 0.000036, and thus H_0 should be rejected. In this case, a type I or alpha (α) and type II or beta (β) errors are not likely to have occurred as the P-value was extremely low (Heacock & Chiodo, 2008).

Both of the surfaces tested are categorized as non-critical items and are to be disinfected at equal frequencies. The chi-square test results show that countertops are cleaned at a higher frequency than the toys. Both items were also cleaned using an low-level disinfectant, and most offices exceeded the expectation by using an intermediate-level disinfectant (BCCDC, 2003). Proper sanitation of environmental surfaces is an important step in safeguarding the general public from the potential spread of infectious diseases and preventing unnecessary health implications (Byers et al., 1998).

The descriptive statistics show that 36.67 % of offices supply soft toys to play with while waiting to see the doctor. The Canadian Paediatric Society conducted a study on Infection control in paediatric office settings, resulting in a finding that soft toys are much more difficult to disinfect and are very effective carriers of disease causing organisms (2008b). According to that study, soft toys should be kept out of doctors' offices, where young and vulnerable hosts may be placing the toys directly into their mouths (Canadian Paediatric Society, 2008b).

Results from this study were also compared to the results of the microbiological assay, conducted alongside this survey study (Jang, 2010). Aerobic colony counts, coliform counts and fecal coliform counts on toys were compared to those on countertops according to their disinfection frequencies, and again by the level of disinfection used. For both surfaces, all samples showed zero counts of fecal coliforms and coliforms, which were the organisms of highest concern as they are indicators of other harmful organisms that can cause gastroenteritis. Offices that had used "other" means of disinfecting their toys (e.g. medicinal antiseptics, dishwashers, or drycleaners) all had aerobic colony counts (ACC) of 5.0 colony

forming units per cm^2 or greater, making them too numberous to count (TNTC) as shown in Appendix G. When analyzed using a Kruskal-Wallis one-way analysis of variance test (ANOVA) in NCSS with an alpha level of α=0.05, results showed no variance between ACC levels with different frequencies of disinfection (See Appendix H) and no variance between ACC levels with different levels of disinfection (See Appendix I) (Hintze, 2009). Findings of this secondary analysis would suggest that toys in GP offices do not play a large role in the transmission of fecal coliforms or coliforms, and that general sanitation levels are independent of both frequency and level of disinfection used.

Discussion

The results of this study, in collaboration with the parallel microbiological study (Jang, 2010), indicated that although there was a notable difference in frequency of disinfection of countertops and toys, it did not affect the levels of aerobic bacteria, coliforms, nor fecal coliforms present on the toys. These results suggest that the level and frequency of disinfection used on toys was sufficient to control gastroenteritis-causing bacteria and no alterations in these procedures is necessary. Further studies are required to determine the transmissibility of viruses through the handling of toys and whether current sanitation practices are sufficient to treat viruses. Jang's study (2010) on microbiological counts on the toys and countertops that were subject to this study found that there was a statistically significant difference (P= 0.0) between the number of aerobic bacterial colonies on toys versus countertops, with higher counts on the toys. Jang's (2010) results, in conjunction with the second alternate hypothesis of this study (H_A: There was an association between countertops and toys in the frequency of

disinfection), may suggest a relationship between the disinfection frequencies and aerobic colony counts, however, the results of the one-way ANOVA indicate otherwise. This suggests that a confounding factor may be involved in the increased colony counts found on the toys. While the focus of the combined study was to evaluate the efficacy of disinfection on inhibiting the transmission of faecal pathogens, and aerobic bacterial counts typically represent ubiquitous organisms, the increased aerobic counts could still be used as a crude representative count for other harmful agents that may be transmitted from child to child via surface contamination, such as viruses, allergens, mites and several species of pathogenic, aerobic bacteria.

It can still be argued that the health hazard that lies with improperly or insufficiently disinfected toys in doctors' offices should be ranked higher than it currently is (non-critical), as children often place items into their mouths, a mucous-membrane surface. Items that come into contact with mucous membranes are classified as semi-critical, according to the BCCDC Guideline for Infection Control in the Physician's Office (2004). Semi-critical items require disinfection more frequently than non-critical items (i.e. between each use) (BCCDC, 2004). Toys that are often placed into the mouths of immuno-compromised children, who are already more susceptible to contracting disease than adults, should be disinfected at a higher frequency than non-critical environmental surfaces with which they are classified, such as reception countertops that are mostly an exposure risk to adults. The results of this study found that the reception countertops were disinfected at a higher frequency than toys, a surface that may arguably require a higher degree of disinfection. The discrepancy in frequency of cleaning is something that may be addressed with the implementation of a sanitation plan that includes

protocols for the sanitation of toys. However, the descriptive statistical analysis show that very few (13.33 %) of general practitioners' offices actually use one.

Limitations

A lack of monetary funds limited the scope of the secondary study to assessing aerobic bacteria, coliforms and fecal coliforms, whereas viruses that cause respiratory diseases and noroviruses are also a large area of concern. A limited time frame also limited the sample size to thirty offices. A larger sample size could have resulted in higher validity and confirmed results.

As the survery in this study was dependent on the recollection of medical office staff, the results were prone to inaccuracy. If written procedures for environmental sanitation or log books that monitored the sanitation been available for reference, the criterion validity of this study could have been increased. Many offices were also located in commercial building that had contracted external janitorial companies to clean the medical offices. The communication between the cleaners and the medical office staff were often unclear.

Soft toys, books, and any other children's toy made of absorbent material were excluded from the study as the absorbancy of these items may have acted as a confounding factor in the study, compromising the internal validity of the results. Seventeen offices did not participate in the study. Four of those offices had toys available and refused to provide consent, and thirteen of those offices did not have toys. The practice of not carrying toys may also be a factor in assessing the sanitation practices in general of doctors' offices, as these offices may be more conscious of the potential for toys to act as vehicles for disease and their general

sanitation policies may be more stringent, but this factor would not be of a concern for confounding in this particular study.

Conclusions and Recommendations

Results of this research study suggest that toys are not a hazardous aspect in doctors' offices with respect to transmissibility of coliforms or faecal coliforms. However, elevated aerobic bacterial counts were still observed on toys (Jang, 2010). While transmission of disease among children via the faecal-oral route through toys in a general practitioner's office has been shown to be of minimal concern in this study, the threat of passing on disease through oral transmission or indirect contact, using the toys as a vehicle, is still at large. General sanitation of environmental surfaces could be improved by implementing requirements in legislation to include sanitation plans that address the cleaning of several items and surfaces in a physician's office, including toys in the waiting rooms. Findings of this study show that sanitation frequency differs among surface types, and even though results of this study do not show an association between bacterial levels and disinfection frequency, increased surface cleaning should be included in the sanitation plans as it may prevent the propagation of other causative agents. Even with a sanitation plan in place, further emphasis should be placed on inspection of practitioners' offices and ensuring that adequate disinfection is actually taking place on a consistent and regular basis and that staff are well-trained on the risks of communicable diseases and the role that adequate cleaning procedures play in infection control. Parents may also be advised to bring their own toys for their children to play with, or to practice diligent

handwashing and hygienic practices with their children before and after touching these toys, and any other shared, public object.

Further research suggestions

Based on the results of this study, further research may be conducted in the following areas:

1. The levels of viruses present on children's toys in the waiting room and their correlation or frequency of disinfection
2. The frequency of inspections conducted by the College of Physicians and Surgeons of doctors' offices and the focus areas of their inspections
3. The implementation of sanitation plans in doctors' offices and whether or not they are associated with lower microbial levels on surfaces
4. The frequency of disinfection of toys and associated microbial levels in paediatric offices or other specialized medical facilities

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Appendix A

(Heacock & Chiodo, 2008) **RESEARCH CONSENT FORM**

TITLE:	Surface Sanitation in General Practitioners' Waiting Rooms		
PRINCIPAL INVESTIGATORS:	Daliha Yousuf	(604) 649-9852	dyousuf@gmail.com
	Kira Jang	(604) 312-6818	kirajang15@yahoo.com
STUDY COORDINATOR:	Helen Heacock	(604) 451-6998	hheacock@bcit.ca

INVITATION

You are invited to take part in a research study. Before you agree to participate, it is important that you understand the purpose of the study and what it will involve. Please take the time to read the following information carefully and ask us questions if there is anything that is not clear or if you would like more information.

PURPOSE OF PROPOSED RESEARCH

Many doctors' offices have toys in the waiting areas for children to play with. The purpose of this study is to evaluate the sanitation of the toys in the waiting areas in comparison to other surfaces and to assess the kinds of toys made available for public use.

NATURE OF PROPOSED RESEARCH

General practitioners' offices in the Vancouver area with toys available for public use in the waiting room are invited to participate. You should **NOT** take part of this study if you are located outside of the Vancouver region, are a Paediatrician or other medical or surgical specialist's office, or you do not have toys available for public use in the waiting room.

Participants will be questioned in an in-person interview. Microbiological samples will also be taken of: 1) a hard toy surface and 2) the reception countertop surface. Samples will be taken with a swabbing technique and will be minimally disruptive to the nature of your business.

It is up to you to decide if you want to take part in this study. If you do decide to take part, you will be asked to sign this consent form. You are free to withdraw at any time, without giving any reason, and without receiving any penalty. You may be withdrawn from the study if you are not complying with the requirements of the study or for any other reason.

RISKS AND BENEFITS

There are no known harms associated with your participation in this research study. Other than the few moments of your time to complete the interview (approximately 1-2 minutes), our investigation will be minimally disruptive. You will not benefit directly from this research, however your participation in this study will benefit health care providers on a whole by helping improve sanitation in the offices to prevent the spread of disease to the public.

If you would like to know the microbiological results specific to your office, please contact us as noted in the CONTACT section.

CONFIDENTIALITY

All information collected in this study will be kept strictly confidential. No information that discloses your identity will be released or published without your specific consent to the disclosure. Documents will be kept in a locked filing cabinet and will be identified only by code numbers, which will be entered into computer with relevant data for processing.

CONTACT

If you have any questions regarding the study or would like to know your specific results, please feel free to contact any of the investigators by phone or email as indicated above. A written summary of the study will be available to all participants if you would like to know the results of the study.

ETHICAL CONCERNS

This study was designed to study the sanitation procedures and bacterial levels of toys in general practitioners' waiting rooms. The tasks required of participants were designed to do no harm. This study has received ethics approval by the British Columbia Institute of Technology's Ethical Review Board. If you have any questions, you may contact the Ethics Review Committee at research_ethics@bcit.ca.

CONSENT

I have read and understand the research consent form. I understand that my participation in this study is entirely voluntary, that I can ask questions now and in the future, and that I may refuse to participate or withdraw from the study at any time without penalty.

I have received a copy of this consent form for my own records.

I consent to participate in this study.

Subject Name: _____ Date: _____

Subject Signature: _____

Name of Practice: _____ Phone: _____
(if you want to be entered into the free draw)

Witness Name: _____ Date: _____

Witness Signature: _____

Appendix B

SCRIPT WHEN APPROACHING GENERAL PRACTICES

Hello,

My name is _____ and this is my colleague _____ and we are Environmental Health students at BCIT. We are conducting a study on the sanitation of toys in comparison to other surfaces in doctors' offices as well as the bacterial level found on those surfaces. One of the requirements for graduation is the completion of a public health research project. Upon graduation, we will be entitled to sit the Board of Certification examination to become Public Health Inspectors.

We would like to invite you to participate in our research study. It will only take a minute or two of your time and will cost you nothing. Your identity is guaranteed to be kept confidential, and your participation would be very helpful in evaluating practices to safeguard public health and preventing the spread of infectious disease among children at the doctor's office.

If you participate, you are also entered in our free draw to win new toy(s) for your waiting room.

All you have to do is answer 5 simple questions regarding the cleaning practices in your office, and allow _____ to take a couple of quick bacterial swabs of a couple of regular, everyday, non-medical surfaces.

Would you like to participate?

Great! Please read through and sign our Research Consent Form.

Appendix C

General Practitioner Survey Questions Sheet

1. How often do you disinfect the toys in the waiting room?
    a. Once a week or more
    b. Once every two weeks
    c. Rarely to never
    d. Unsure

2. What do you use to disinfect the toys in the waiting room?
    a. **Low-level:** Pinesol, Lysol, or Quaternary ammonium
    b. **Intermediate-level:** Ethyl alcohol, isopropyl alcohol, hypochlorite, dichloroisocianurate, bleach, iodine or iodophor
    c. **High-level:** Hydrogen peroxide, glutaraldehyde, formaldehyde, paracetic acid, or ortho-phthaloaldehyde (OPA)
    d. Other _____

3. How often do you disinfect the reception countertops?
    a. Once a week or more
    b. Once every two weeks
    c. Rarely to never
    d. Unsure

4. What do you use to disinfect the reception countertops?
    a. **Low-level:** Pinesol, Lysol, or Quaternary ammonium
    b. **Intermediate-level:** Ethyl alcohol, isopropyl alcohol, hypochlorite, dichloroisocianurate, bleach, iodine or iodophor
    c. **High-level:** Hydrogen peroxide, glutaraldehyde, formaldehyde, paracetic acid, or ortho-phthaloaldehyde (OPA)
    d. Other _____

5. Does your office have a sanitation plan in place that includes the disinfection of toys?
    a. Yes
    b. No
    c. Unsure
        - Explain_____

6. Does your office supply soft toys to play with? (Don't ask, just look for yourself)
    a. Yes
    b. No

Appendix D

TABLE 2 - SAMPLING DATAS

Surface	Level	Frequency
Toys	low	once a wk
Toys	low	once a wk
Toys	low	once a wk
Toys	low	once a wk
Toys	Intermediate	once a wk
Toys	Intermediate	once a wk
Toys	Intermediate	once a wk
Toys	Intermediate	once a wk
Toys	Intermediate	once a wk
Toys	Intermediate	once per 2 wks
Toys	Intermediate	rarely to never
Toys	Intermediate	rarely to never
Toys	Intermediate	rarely to never
Toys	Intermediate	rarely to never
Toys	Unsure	rarely to never
Toys	Unsure	rarely to never
Toys	Unsure	rarely to never
Toys	Unsure	rarely to never
Toys	Unsure	rarely to never
Toys	Unsure	rarely to never
Toys	Unsure	rarely to never
Toys	Unsure	rarely to never
Toys	Unsure	rarely to never
Toys	Unsure	rarely to never
Toys	Other	rarely to never
Toys	Other	unsure
Toys	Other	unsure
Toys	Other	unsure
Toys	Other	unsure
Toys	Other	unsure
Toys	Other	unsure
Countertops	Low	once a wk
Countertops	Low	once a wk
Countertops	Low	once a wk
Countertops	Intermediate	once a wk
Countertops	Intermediate	once a wk
Countertops	Intermediate	once a wk
Countertops	Intermediate	once a wk
Countertops	Intermediate	once a wk
Countertops	Intermediate	once a wk
Countertops	Intermediate	once a wk
Countertops	Intermediate	once a wk
Countertops	Intermediate	once a wk
Countertops	Intermediate	once a wk
Countertops	Intermediate	once a wk
Countertops	Intermediate	once a wk
Countertops	Intermediate	once a wk
Countertops	Intermediate	once a wk
Countertops	unsure	once a wk
Countertops	unsure	once a wk
Countertops	unsure	once a wk
Countertops	unsure	once a wk
Countertops	unsure	once a wk
Countertops	unsure	once a wk
Countertops	unsure	once a wk
Countertops	unsure	once a wk
Countertops	unsure	once a wk
Countertops	Other	rarely to never
Countertops	Other	unsure
Countertops	Other	unsure

Appendix E

Cross Tabulation Report

Page/Date/Time 1 08/03/2010 1:05:55 AM
Database

TABLE 3 - 2X4 TABLE OF SURFACE TYPE VS. LEVEL OF DISINFECTANT

Counts Section

	Surface		
Level	**Countertops**	**Toys**	**Total**
Intermediate	15	10	25
Low	3	4	7
Other	3	7	10
Unsure	9	9	18
Total	30	30	60

The number of rows with at least one missing value is 0

2 X4 Table

Expected Counts Assuming Independence Section

	Surface		
Level	**Countertops**	**Toys**	**Total**
Intermediate	12.5	12.5	25.0
Low	3.5	3.5	7.0
Other	5.0	5.0	10.0
Unsure	9.0	9.0	18.0
Total	30.0	30.0	60.0

The number of rows with at least one missing value is 0

Chi-Square Contribution Section

	Surface		
Level	**Countertops**	**Toys**	**Total**
Intermediate	0.50	0.50	1.00
Low	0.07	0.07	0.14
Other	0.80	0.80	1.60
Unsure	0.00	0.00	0.00
Total	1.37	1.37	2.74

The number of rows with at least one missing value is 0

Chi-Square Statistics Section

Chi-Square	2.742857
Degrees of Freedom	3
Probability Level	0.432993

WARNING: At least one cell had a value less than 5.

Accept H0

Appendix F

Cross Tabulation Report
Page/Date/Time 2 07/03/2010 9:40:31 PM
Database

TABLE 4 - 2X4 TABLE OF SURFACE TYPE VS. DISINFECTION FREQUENCY

Counts Section

	Surface		
Frequency	**Countertops**	**Toys**	**Total**
once a wk	27	9	36
once per 2 wks	0	1	1
rarely to never	1	14	15
unsure	2	6	8
Total	30	30	60

The number of rows with at least one missing value is 0

2 X4 Table

Expected Counts Assuming Independence Section

	Surface		
Frequency	**Countertops**	**Toys**	**Total**
once a wk	18.0	18.0	36.0
once per 2 wks	0.5	0.5	1.0
rarely to never	7.5	7.5	15.0
unsure	4.0	4.0	8.0
Total	30.0	30.0	60.0

The number of rows with at least one missing value is 0

Chi-Square Contribution Section

	Surface		
Frequency	**Countertops**	**Toys**	**Total**
once a wk	4.50	4.50	9.00
once per 2 wks	0.50	0.50	1.00
rarely to never	5.63	5.63	11.26
unsure	1.00	1.00	2.00
Total	11.63	11.63	23.26

The number of rows with at least one missing value is 0

Chi-Square Statistics Section

Chi-Square	23.266667
Degrees of Freedom	3
Probability Level	0.000036

Reject H0

WARNING: At least one cell had an expected value less than 5.

Appendix G

TABLE 5 - SITE SPECIFIC RESULTS WITH MICROBIOLOGY ASSAY

	TOYS				
Location	Freq. of disinfection of toys	Disinfectant used on toys	*E. coli* (cfu/cm^2)	Coliform (cfu/cm^2)	ACC (cfu/cm^2)
1	1x/wk	D. Other (water)	0	0	0.06
2	rare to never	D. Other (idk)	0	0	1.82
3	rare to never	D. Other (idk)	0	0	0.42
4	rare to never	B. Intermediate	0	0	3.56
5	rare to never	A. Low	0	0	3.52
6	rare to never	D. Other (idk)	0	0	2.70
7	rare to never	B. Intermediate	0	0	2.70
8	1x/wk	A. Low	0	0	TNTC
9	Unsure	D. Other (Drycleaner)	0	0	TNTC
10	Unsure	D. Other (idk)	0	0	1.94
11	rare to never	D. Other (dishwasher)	0	0	TNTC
12	Unsure	D. Other (idk)	0	0	2.82
13	rare to never	D. Other (none)	0	0	TNTC
14	rare to never	D. Other (none)	0	0	1.62
15	1x/wk	A. Low	0	0	TNTC
16	rare to never	B. Intermediate	0	0	3.92
17	Unsure	B. Intermediate	0	0	TNTC
18	Unsure	D. Other (idk)	0	0	TNTC
19	rare to never	D. Other (idk)	0	0	TNTC
20	1x/wk	D. Other (idk)	0	0	TNTC

21	1x/wk	B. Intermediate	0	0	3.46
22	1x/wk	B. Intermediate	0	0	TNTC
23	rare to never	A. Low	0	0	TNTC
24	1x/wk	B. Intermediate	0	0	4.54
25	1x/2wks	D. Other (VIRALEX)	0	0	TNTC
26	Unsure	D. Other (idk)	0	0	TNTC
27	1x/wk	B. Intermediate	0	0	TNTC
28	rare to never	D. Other (MEDZYME)	0	0	TNTC
29	rare to never	B. Intermediate	0	0	TNTC
30	1x/wk	B. Intermediate	0	0	4.08

COUNTERTOPS					
Location	**Freq. of disinfection of table**	**disinfectant used on table**	***E. coli* (cfu/cm^2)**	**Coliform (cfu/cm^2)**	**ACC (cfu/cm^2)**
1	1x/wk	D. Other (water)	0	0	TNTC
2	rare to never	B. Intermediate	0	0	1.30
3	1x/wk	D. Other (idk)	0	0	0.82
4	1x/wk	B. Intermediate	0	0	1.30
5	1x/wk	B. Intermediate	0	0	0.82
6	1x/wk	D. Other (water)	0	0	3.54
7	1x/wk	B. Intermediate	0	0	1.70
8	1x/wk	D. Other (idk)	0	0	1.40
9	1x/wk	B. Intermediate	0	0	0.64
10	1x/wk	B. Intermediate	0	0	TNTC

11	1x/wk	B. Intermediate	0	0	2.40
12	1x/wk	D. Other (idk)	0	0	3.48
13	1x/wk	D. Other (idk)	0	0	0.62
14	1x/wk	B. Intermediate	0	0	0.44
15	1x/wk	B. Intermediate	0	0	TNTC
16	1x/wk	A. low	0	0	0.46
17	1x/wk	B. Intermediate	0	0	0.38
18	Unsure	D. Other (idk)	0	0	TNTC
19	1x/wk	D. Other (idk)	0	0	1.98
20	1x/wk	D. Other (idk)	0	0	TNTC
21	1x/wk	B. Intermediate	0	0	TNTC
22	1x/wk	A. low	0	0	0.00
23	1x/wk	A. low	0	0	0.58
24	1x/wk	B. Intermediate	0	0	TNTC
25	Unsure	D. Other (idk)	0	0	0.46
26	1x/wk	D. Other (idk)	0	0	1.16
27	1x/wk	B. Intermediate	0	0	3.14
28	1x/wk	D. Other (MEDZYME)	0	0	3.20
29	1x/wk	B. Intermediate	0	0	3.34
30	1x/wk	B. Intermediate	0	0	TNTC

Appendix H

Analysis of Variance Report (FOR FREUENCY OF DISINFECTION)

Page/Date/Time	2 08/03/2010 2:29:33 AM
Database	
Response	once_per_2_wks,once_per_wk,rare_to_never,unsure

Kruskal-Wallis One-Way ANOVA on Ranks

Hypotheses

H0: All medians are equal.

Ha: At least two medians are different.

Test Results

Method	DF	Chi-Square (H)	Prob Level	Decision(0.05)
Not Corrected for Ties	3	1.094828	0.778323	Accept H0
Corrected for Ties	3	1.338024	0.720124	Accept H0

Number Sets of Ties	2
Multiplicity Factor	4902

Group Detail

Group	Count	Sum of Ranks	Mean Rank	Z-Value	Median
once_per_2_wks	1	22.00	22.00	0.7510	5
once_per_wk	9	145.00	16.11	0.2489	5
rare_to_never	14	197.00	14.07	-0.8314	4.28
unsure	6	101.00	16.83	0.4148	5

Means and Effects Section

Term	Count	Mean	Standard Error	Effect
All	30	3.941333		4.230119
A:				
once_per_2_wks	1	5	1.556557	0.769881
once_per_wk	9	4.126667	0.5188524	-0.1034524
rare_to_never	14	3.667143	0.4160074	-0.5629762
unsure	6	4.126667	0.6354617	-0.1034524

Appendix I

Analysis of Variance Report (FOR LEVEL OF DISINFECTION)
Page/Date/Time 2 08/03/2010 2:43:44 AM
Database
Response Intermediate_level,Low_level,Other

Kruskal-Wallis One-Way ANOVA on Ranks
Hypotheses
H0: All medians are equal.
Ha: At least two medians are different.

Test Results

Method	DF	Chi-Square (H)	Prob Level	Decision(0.05)
Not Corrected for Ties	2	0.5240086	0.769508	Accept H0
Corrected for Ties	2	0.6080237	0.737852	Accept H0
Number Sets of Ties	2			
Multiplicity Factor	3366			

Group Detail

Group	Count	Sum of Ranks	Mean Rank	Z-Value	Median
Intermediate_level	10	153.50	15.35	0.1606	4.31
Low_level	3	54.00	18.00	0.6445	5
Other	16	227.50	14.22	-0.5482	5

Means and Effects Section

Term	Count	Mean	Standard Error	Effect
All	29	3.867586		4.085472
A:				
Intermediate_level	10	4.226	0.4758914	0.1405278
Low_level	3	4.506667	0.8688548	0.4211944
Other	16	3.52375	0.3762252	-0.5617222