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A survey of common habits of computer users as indicators of possible environmental contamination and cross infection source

Ubani, E. K[1], Oluduro, A. O, E. K.[2]* and Ofoezie, I. E.[1]

[1]Institute of Ecology and Environmental Studies, Obafemi Awolowo University, Ile-Ife, Osun State, Nigeria.
[2]Department of Microbiology, Obafemi Awolowo University, Ile-Ife, Osun State, Nigeria.

Hygiene has been recognized as an infection control strategy and the extent of the problems of environmental contamination largely depends on personal hygiene. With the development of several computer applications in recent times, the uses of computer systems have greatly expanded. And with the previous history of cross contamination of environmental objects, suggests that computer system may be another vehicle for transmission of infectious agents if not used in strict hygienic condition. This study assessed the level and rate of hygiene practice among computer users. It employed the use of questionnaires, interviews and personal observations. Stratified random sampling method was employed. The rate of computer usage and sharing among respondents were over 80 and 97%, respectively. Contrarily, hygienic practices were uncommon practices among users. Hand-washing was observed by only 13.5% of computer users examined. Other unhealthy practices found among computer users included eating (52.1), drinking (56), coughing, sneezing and scratching of head (48.2%). Since microorganisms can be transferred through contact, droplets or airborne routes, it follows that these habits exhibited by users may act as sources of bacteria on keyboards and mice, and equally provides a conducive environment for their survival and proliferation.

Key words: Computer users, environmental contamination, infection.

INTRODUCTION

Microorganisms that cause infections can be found in any environment including soil, air, water, food, and on other organisms as well as on environmental surfaces or objects. The infections that these microorganisms cause can spread to humans in different ways; directly or indirectly via inanimate objects called fomites and/or living organisms called vectors (Neely and Sittig, 2002). A search of literature has revealed that in human environment, microorganisms colonize and contaminate environmental objects in the home (Lori et al., 2002), hospital (Brady et al., 2007), schools and day-care environment (Itah and Ben, 2004), and in offices (Bouillard et al., 2005).

In recent times, keyboards and mice are environmental objects in constant use with the growing need for computer system applications. Keyboards and mice are components of a computer system that are used on daily basis in accomplishing various computer tasks in almost every aspect of our society. Their uses have greatly expanded and can be found in schools, banks, cybercafés, offices and hospitals. Also, contamination of keyboards and mice by bacteria with the potential to initiate an infection has been documented by some investigators (Eltablawy and Elhifnawi, 2009; Hartmann et al., 2004; Neely and Sittig, 2002). Bacterial contamination of keyboards and mice pose as a threat to public health as bacteria can be transferred from person to person or from other source to a person by direct contact or indirect contact via an inanimate object and back again. The latter process is known as cross-contamination. Furthermore, contaminants from the

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*Corresponding author. E-mail: aoluduro2003@yahoo.co.uk.
Tel: +2348069379885.

environment or objects that contaminate the human hands during daily activities can be transferred to other persons or reservoirs. Similarly, hands are also the most common means through which infectious agents are transferred into the environment and surfaces from the skin, nose and bowels. Therefore, hands play a major role in bacterial transfers and cross-contamination of surfaces. Unclean hands imply lack of personal hygiene which when coupled with poor sanitation favours person to person. This suggested that hygiene is a determinant when assessing level of contamination that can be obtained from any environmental surface (Yuhuan et al., 2001). Hygiene is the use of sanitary principles for the maintenance of health. Therefore, it is important to continually look for ways of improving and maintaining the high levels of hygiene. Since we are constantly been exposed to infectious agents, hygiene practices have been assessed as a potential means of reducing infectious disease transmission. Appropriate hygiene measures are required to protect a patient's health while lack of proper hygiene will increase the risk of acquiring an infection. Unhealthy behavior or habits usually pre-cede the onset of illness symptoms. Monitoring unhealthy or unhygienic habits/practices is an important mechanism in infectious disease prevention, health protection and promotion (Aiello et al., 2008). In medicine, homes (domestic) and everyday life settings, hygiene practices are employed as preventative measures to reduce the incidence and spreading of infectious diseases and consequently breaking the chain of infection transmission (Neely and Sittig, 2002).

The main sources of infections are people (who are either carriers or infected), foods and fluid. Infectious agents are usually shed from these sources via secre-tions, mucous, faeces, vomits, skin scales and aerosols. Environmental objects such as keyboards and mice can become secondary reservoirs of infection when they get contaminated through these means. Thus, people become exposed either directly or indirectly and can develop an infection.

MATERIALS AND METHODS

The survey was conducted in Ile-Ife, a city that hosts one of Nigeria's biggest universities. The university has drawn a lot of developments (educational, commercial, medical) that have greatly expanded the use of computer systems in the town. The study was a cross-sectional study that surveyed different organizations where computer systems are in active use. A preliminary survey of these organizations was undertaken to obtain a list of places where computer systems were in regular use and to determine the number of personal computers (PC) actively in use in each. The study population comprised employees and customers in these organizations that use keyboards and mice. Respondents were randomly selected from these organizations after stratification by organizational types (educational, banking, healthcare and commercial). Stratified random sampling was used to identify a representative sample of members with different backgrounds, ages, economic classes and occupations. A stratum in this study was represented by organizations with similar outfit or business.

Organizations were stratified into four organizational types (educational, commercial, banking and health-care).

Two instruments were used in this study; semi-structured questionnaires and interviews. The questionnaire contained fourteen set of structured questions for active interface users and another ten sets of structured questions for owners and chief executives of selected offices. A hundred questionnaires were administered to randomly selected respondents for each stratum. A total of 400 questionnaires were distributed and 326 were retrieved which represented 81.5% response rate. The questionnaire was divided into 3 sections. Section A consisted of closed-ended questions covering the demographic characteristics of the respondent. Section B aimed at gathering data on the frequency of computer usage and sharing. Section C aimed at finding out the level of hygiene and different habits that users indulge in while using keyboards and mice. The results of the survey were collected and analyzed using tables, frequency and percentages. The data were subjected to statistical analysis using Chi square test and analysis of variance test.
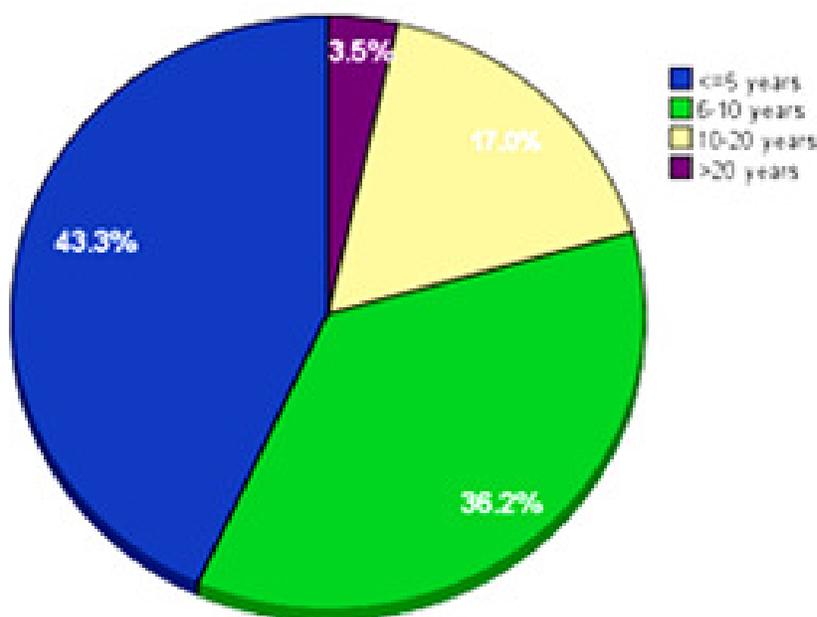
RESULTS

Gender distribution of users of the 326 respondents examined was 173 (53.1%) males and 153 (46.9%) females. Age distribution of respondents ranged from 17 to 71 years; a high percentage (66.9%) of interface users fell into the age group of 20 to 39 years. Keyboards and mice users cut across diverse occupational groups; teaching (15.6), civil service (32.6), schooling (34.8), lawyer (9.2), business (7.8) and bank cashier/personnel (7.8%). With reference to educational background; 21 (6.4%) of interface users examined were secondary school students while 305 (93.6%) were either undergraduate students or graduates. With regards to ownership of interface in use as at the time of sample collection, 127 (39.0%) were using their personal computer (keyboards and mice), while 199 (61.0%) were using shared systems. In addition, extensive computer use was evidenced by 90.2% of this study population using computers (with 80.1% owing a personal computer) (Table 1).

Only 5 participants have had twenty years of computer use experience, whereas 43.3% have had at least five. This suggested that computer usage is greatly expanding and is on the increase (Figure 1). 57.4% had less than five years of experience and of those 57.4% were between 20 and 29 years. This may be attributed to participants taking up computer use for schooling or new employment. The period of using computers among users in different organizations and occupational groups are comparable at $p < 0.05$.

In addition, the number of minutes spent on computer on daily basis by users was found to range from 5 (in educational and commercial establishments) to 900 min (observed in cybercafé) with a mean of 218.31 ± 15.939. The survey revealed that the most common time range spent on daily basis on computer by users was 0-200 minutes (56.0%), while 800 to 900 min ranked lowest (0.7%) (Figure 2). The number of minutes spent on the computers by users of different age group, educational

Table 1. Rate of computer usage and sharing, and hygiene practices among computer users.

| N = 326	Daily/Alway	Occasionally	Rarely	N/A
Computer usage	245 (75.2%)	60 (18.4%)	21 (6.4%)	0 (0%)
Sharing of computer among users	120 (36.8%)	148 (45.4%)	49 (15.0%)	9 (2.8%)
Cleaning of computer	104 (31.9%)	132 (40.5%)	44 (13.5%)	46 (14.1%)
Washing hands before/after contact with a computer	44 (13.5%)	72 (22.1%)	37 (11.3%)	173 (53.1%)
	Yes	No	Total	
Possession of a personal computer	261(80.1%)	65(19.9%)	326(100%)	
	Personal	Shared	Total	
Possession of computer in use at the time of sampling	127 (39.0%)	199 (61.0%)	326 (100%)	

Figure 1. Duration of time of computer use.

background and of both gender (male and female) was found to be comparable (P > 0.05). However, the time spent on the computer was found to be significantly different among the different organizational types (F = 8.601; P < 0.001) surveyed and consequently among the different occupational groups (F = 5.798; P < 0.001).

A total of 82.2% of interface users used both keyboards and mice on daily basis when compared to those that use either only keyboard (10.7) or mice (7.1%). With respect to sharing of keyboards and mice among users, 317 (97.2%) of users share keyboards and mice with other users, while only 4 (2.8%) users do not share computer at all (Table 2).

Of the number of users that share keyboards and mice, 75.8% frequently share both keyboards and mice while only 13.2 and 11.0% share only keyboard or mouse,

respectively. Usage and sharing of keyboards and mice were comparable among users with different occupation, educational background and between male and female users surveyed (P > 0.05).

With the younger age group of 10 to 29, usage of keyboards and mice was found to be higher among females, while men constituted most of the users at older age group of above 30 years. With respect to organization, active usage was observed in educational institutions and cybercafés to cut across all age groups, while active usage in banks was observed among users of 20 to 39 years. Interface sharing was found among all the age groups examined. The number of users that use shared interfaces was comparable to those that use personal keyboards and mice; though usage of shared keyboards and mice was to be higher at the time of
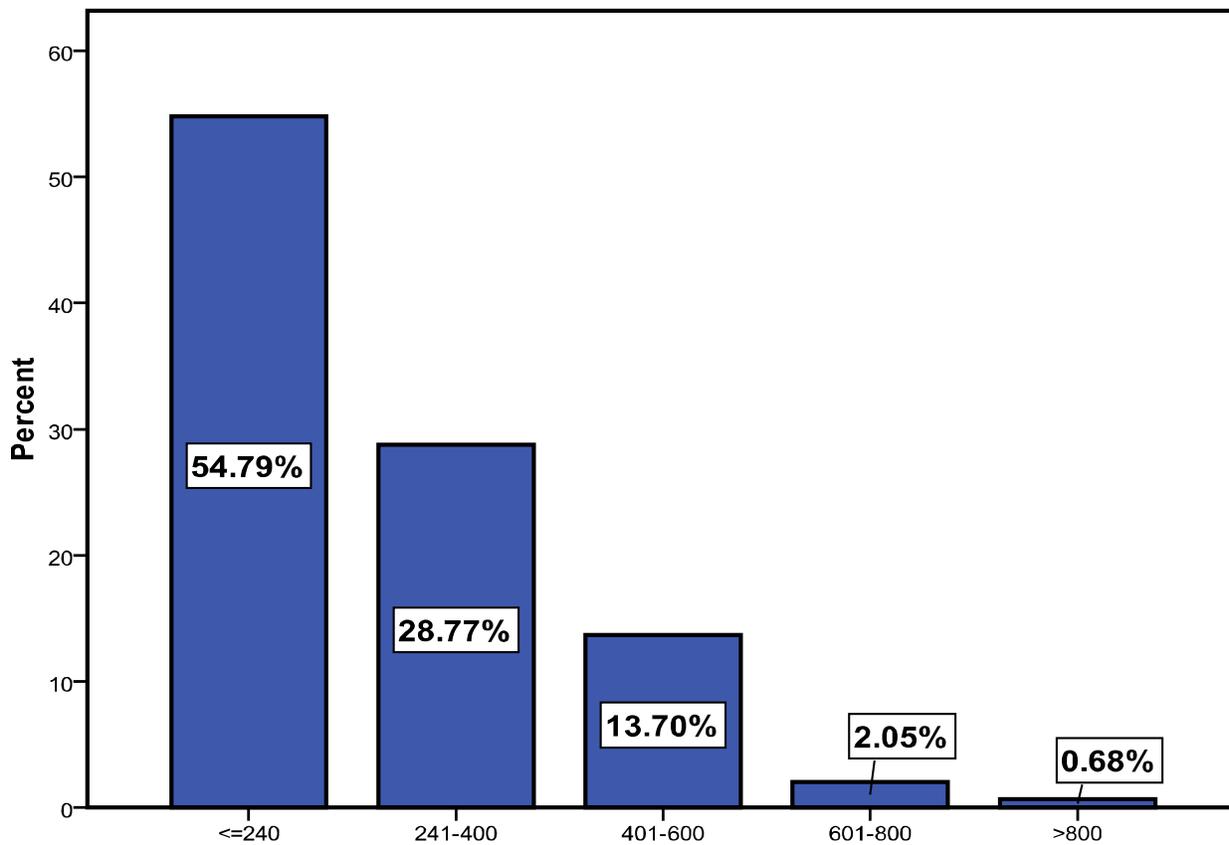
Figure 2. Number of minutes computer users spend on computer daily.

sampling. Irrespective of the high usage and sharing frequency, the numbers of users that strictly observe proper hygiene such as daily cleaning (31.9%) of their systems and regular hand-washing (13.5%) after contact with their systems were few.   Another disturbing discovering revealed that 53.1% do not wash their hands whether before and after contact with the computer (Table 1).

The majority of users practically display some common unhygienic practices that can introduce germs to their systems while using an interface; however the rate of display of some habits were higher in some than in others. Table 2 presents the list of unhygienic habits common among users during computer usage. Such habits among users were related to some user charac-teristics; age and gender. Lack of hygiene was higher among users within the age group of 10-39. Involvement in these practices ranged from 11.3 for biting of fingers to 56.0% for drinking. Drinking (56.0) and eating (52.1%) during computer usage were the most predominant habits among users. Also, the number of users that wash their hands after using the rest room (11.3%) during computer usage were insignificant to those that do not observe such hygiene (88.7%). Scratching of head

(48.2%) was also common among computer users while using the computer.

Female computer users appeared to be more hygienic than male users. The number of males that displayed most of these habits during usage was found to be higher than female users. Eating, drinking and scratching of head were common among male users. With respect to occupation, eating on the interface was common among academic, students and business men. The habits exhibited by both sexes were similar and comparable with the exception of picking of nose which was found to vary ($X^2 = 10.003$; P < 0.01) and much higher in males (79.3) than in females (20.7%) (Table 2). The prevalence of unhygienic practices was higher among students and office staff than bank cashiers (Table 3).

Generally, unhygienic practices were exhibited more by users in the educational institutions and were lesser among users in the bank (Table 4). Washing of hands after using the rest room during computer usage was observed as an irregular practice among office staff and students, males and among users within the age group of 20 to 39 years, however regular hand washing after contact with keyboard or mouse was a common practice among bankers. As a whole, unhygienic practices were

Table 2. Unhealthy habits common among computer users by sex and age.

Unhealthy habits among user	Sex			Age					
	Male N = 173	Female N = 153	Total N = 326	≤ 19 N = 16	20-29 N = 143	30-39 N = 92	40-49 N = 49	≥ 50 N = 26	Total N = 326
Eating	90 (52%)	60 (39%)	150 (46%)	9 (57%)	72 (50%)	44 (48%)	14 (29%)	11 (42%)	150 (46%)
Drinking	106 (61%)	77 (50%)	183 (56%)	9 (57%)	92 (64%)	53 (58%)	20 (41%)	9 (35%)	183 (56%)
Sneezing	85 (49%)	53 (35%)	138 (43%)	9 (57%)	62 (43%)	39 (42%)	21 (43%)	7 (27%)	138 (43%)
Coughing	69 (40%)	42 (27%)	111 (34%)	7 (44%)	51 (36%)	25 (27%)	23 (47%)	5 (19%)	111 (34%)
Scratching of head	90 (52%)	67 (44%)	157 (48%)	2 (13%)	76 (53%)	41 (45%)	26 (53%)	12 (46%)	157 (48%)
Biting of finger nails	30 (17%)	7 (5%)	37 (11%)	2 (13%)	25 (17%)	5 (5%)	5 (10%)	0 (0%)	37 (11%)
Nose picking	53 (31%)	14 (9%)	67 (21%)	2 (13%)	35 (24%)	23 (25%)	5 (10%)	2 (7.7%)	67 (21%)
Poking of eyes	64 (37%)	39 (25%)	103(32%)	9(57%)	48(34%)	21(23%)	16(33%)	9(35%)	103(32%)
Scratching of ears	32 (18%)	19 (12%)	51 (16%)	5(31%)	25(17%)	11(12%)	5(10%)	5(19%)	51(16%)

Table 3. Unhealthy habits common among computer users by occupation.

Unhealthy habits among user	Teaching N = 52	Office staff N = 106	Student N = 113	Bank cashier N = 25	Business N = 25	Lawyer N = 5	Total N = 326
Eating	28 (54%)	41 (39%)	62 (55%)	0 (0%)	16 (64%)	3 (60%)	150 (46%)
Drinking	28 (54%)	44 (42%)	76 (67%)	11 (44%)	20 (80%)	3 (60%)	182 (56%)
Sneezing	21 (40%)	51 (48%)	48 (42%)	7 (28%)	11 (44%)	0 (0%)	138 (42%)
Coughing	14 (27%)	41 (39%)	32 (28%)	9 (36%)	14 (56%)	0 (0%)	110 (34%)
Scratching of head	28 (54%)	48 (45%)	55 (49%)	11 (44%)	11 (44%)	3 (60%)	157 (48%)
Biting of Finger nails	0 (0%)	9 (8%)	21 (19%)	2 (8%)	5 (20%)	0 (0%)	37 (11%)
Nose picking	7 (13%)	25 (24%)	25 (22%)	5 (20%)	2 (8%)	3 (60%)	67 (21%)
Poking of eyes	19 (37%)	37 (35%)	37 (33%)	7 (28%)	5 (20%)	0 (0%)	105 (32%)
Scratching of Ears	12 (23%)	14 (13%)	21 (19%)	5 (20%)	0 (0%)	0 (0%)	52 (16%)

found to be more prevalent among users within educational institutions and in cybercafés. These habits that are commonly exhibited by users during computer usage were found to be similar and comparable (P > 0.05) among users irrespective of their occupation.

DISCUSSION

This study has clearly shown that active computer usage cuts across different age groups, occupational groups, organizations and used widely by both males and females in Ile-Ife town.

The number of people that uses keyboards and mice on a daily basis was over 80%, in addition regular sharing of keyboards and mice in Ile-Ife is a common practice with people that use interfaces. Computer sharing was common among 97.2% of users examined. The rate of usage and

Table 4. Unhealthy habits common among computer users by organization.

Unhealthy habits among users	Educational N = 155	Bank N = 72	Cyber café N = 76	Commercial N = 23	Total N = 326
Eating	87 (56%)	0 (0%)	25 (33%)	12 (52%)	124 (38%)
Drinking	78 (50%)	12 (17%)	55 (72%)	14 (61%)	159 (49%)
Sneezing	75 (48%)	7 (10%)	25 (33%)	9 (39%)	116 (36%)
Coughing	53 (34%)	9 (13%)	23 (30%)	9 (39%)	94 (29%)
Scratching of head	80 (52%)	12 (17%)	37 (49%)	5 (22%)	134 (41%)
Biting of finger nails	12 (8%)	2 (3%)	14 (18%)	5 (22%)	33 (10%)
Nose picking	39 (25%)	5 (7%)	9 (12%)	2 (9%)	55 (17%)
Poking of eyes	59 (38%)	7 (10%)	18 (24%)	2 (9%)	86 (26%)
Scratching of ears	27 (17%)	5 (7%)	12 (16%)	0 (0%)	44 (13%)

sharing of keyboards and mice is the same in all organizational types surveyed; educational institutions, banks, cybercafés and commercial centers. This result confirms similar reports of easy access to computers and increased computer use in different locations; home, office, schools, hospitals and cybercafés/internet centers by earlier investigators, who have demonstrated that computer use in schools aids effective teaching and improves students' learning capabilities, enhances competent treatment of patients in hospitals, and generally improves staff performance in offices (Afshari et al., 2010; Anderson et al., 2009; Anunobi, 2006; Gil-Flores, 2009). According to these investigators, the number of persons that frequently use computers in each of these locations in accomplishing their various tasks was over 55%.In spite of this widespread and frequent use of computer observed in this study, users do not observe strict personal hygiene such as hand-washing and cleaning of their computers. Cleaning of computers on regular basis is not a common habit among users, likewise only a few people (13.5%) wash their hands regularly before and after contact with keyboard or mouse; thus, hand washing is equally not habitual among many users. Hand-washing

and disinfection of surfaces are regarded as infection control (IC) protocols and have been demonstrated as effective means in breaking the chain of infection. Non-compliance with IC will result in increasing numbers of microorganisms on interfaces. The level of contamination of interfaces is an indicator of compliance with certain IC protocols. According to Henry et al. (2003), level of contamination was found to significantly decrease on most surfaces with improved IC design and protocols. They recorded reduction in the level of contamination on all surfaces in 1998 as against a similar study that was earlier carried out in that same hospital in 1976 with the exception of contamination on floors which increased significantly and was linked to reductions in the frequency of floor cleanings and maintenance as a cost-saving attempt. Contamination level of clinic jackets cuffs which were one of the mostly contaminated objects in 1976 was reduced in 1998 because they are now washed and changed on daily basis unlike in 1976 where they are not changed on a standard schedule. As a consequence, Henry et al. (2003) asserted that improvement in IC design, protocols, practices and education can result in a safer environment. Another study by Silvano et al. (2000) carried out

in a dental clinic where many IC protocols, knowledge of disinfection procedures are lacking or incomplete and where dental personnel did not follow the principal procedure for infection control recorded high contamination of air samples, water and surfaces. The result of their study was comparable to the counts observed in 1976 and higher than counts observed in 1998; thus suggesting that proper IC protocol is an effective way of controlling contamination levels on surfaces.

In addition to violation to observance of personal hygiene observed in this study, some other unhygienic practices such as eating, drinking, sneezing, coughing, picking of nose and ears were common among computer users; with eating and drinking occurring as the commonest habits. Users display varying unhealthy practices that can introduce bacteria to the keyboard or mouse in use. Unhygienic practices among users were higher with users within the age group of 10 to 39 years. These habits were found among different occupational groups but were recorded higher in some occupations than others. Academics, office staff and students seem to care less about hygiene while using the interface than other occupational group. Similarly, these habits and non-

compliance to IC protocols were higher in educational institutions and cybercafés than in banks. Bank personnel observed hygiene regimen during computer usage better than other occupational groups. Infrequent hand washing was higher among users between the age group of 20 to 39 years, which is dangerous for a group that so actively use and share computer on daily basis. With respect to sex of users, both male and female users display these unhygienic practice, however, scratching of head and picking of nose are found higher in males than in females. Also, majority of users use computers at cybercafés where sharing is predominant, a high percentage of people spend longer hours at cybercafés, this raises cause for concern because a large number of persons that share computers at cybercafés exhibit diverse unhygienic habits and have varying health conditions. With the high usage and sharing custom among users, non-compliance to personal hygiene and unhealthy practices during computer usage, it follows that users might be unknowingly exposed to agents of bacterial infection. According to Neely and Sittig (2002), for an infection to occur, a microbe must come in contact with the host which can happen in a number of different ways; through direct contact or indirect contact involving inanimate objects (fomites), which may become contaminated with droplets or body fluids, dusts, food particles that provide a conducive environment for their survival and growth and then serve as a reservoir for transmitting the microorganism to a host by some form of contact. According to Kwok and Kwok (2004), under-standing the means of transmission of infectious pathogens is important in preventing the transmission of infections.

Conclusion

Since microorganisms can be transferred through con-tact, droplets or airborne routes, it follows that these habits exhibited by users may act as sources of bacteria on keyboards and mice and equally provides a conducive environment for their survival and proliferation.

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