

CHAPTER TWO

2. LITERATURE REVIEW

2.1. Definition of computer

The computer is an electronic data processing machine which accepts data from the out-side world inform of an input and manipulates, calculates, computers on the basis of set of instructions supplied and stored in the memory and give the required or desired results in the form of an output to the user (Chimezie *et al.*, 2013)

2.2. History of computer

Rudimentary calculating devices first appeared in antiquity and mechanical calculating aids were invented in the 17th century. The first recorded use of the word computer. The first computer devices were conceived of in the 19th century, and only emerged in their modern form in 1940. During the first half of the 20th century, many scientific computing needs were met by increasingly sophisticated analog computers. Then evolve until it reached a precision small device (Cohen and Bernard, 2000).

2.3. Uses of computers in university setting

Computer in universities consider as assisted learning application generally require the student to follow the content without immediate or direct supervision from the tutor but the computer can be a temperamental and unforgiving beast (Greenhalgh, 2001). Computer keyboards could spread significant numbers of

pathogens between students at university setting (Enemuor *et al.*, 2012). In the university, students have indicated that 100% have access to computers, 92.1% regularly use the internet, and 37.3% regularly use-mail.to accommodate the extensive use of computer technology, universities have developed multiple-user on campus for general centre. As the popularity of such facilities increases, there is need to recognize that computer keyboard may act as a reservoir for the transmission of potentially hazardous or pathogenic microorganisms (Chairman *et al.*, 2011).

2.4. Previous studies on contamination of computer keyboards

Computer continue to have an increasing presence in almost every aspect of our occupational, recreational, and residential environments, whilst the contribution of hands contaminated with pathogenic and nonpathogenic microorganism to spread of infectious disease has been recognized for many years. Result from the study showed high levels of contamination of these level surfaces with at least mean bacterial count of 5.66×10 CFU. This confirms work by who found between 99 % - 100% contamination on computer keyboards in research centre. A five-year study of surfaces in the office environment which are usually cleaned found 11% to be positive for biochemical markers (such as those for blood, mucus, saliva, sweat, and urine) Thus for surfaces of keyboards which are frequently ignored yet receive a lot of traffic, one will expect greater levels of contamination. Pathogenic isolates (80.14%) were 4x greater than non-pathogenic isolates (19.86%)

confirming research undertaken in a city college that found 70.8% of used computer keyboards to be contaminated with pathogenic bacteria. This is a cause for concern since these pathogenic isolates are capable of causing diseases in anyone who gets contaminated when using the keyboard. Research has shown that 80% of infections are transmitted through the environment. The high isolation of confirms the ubiquitous nature of this organisms giving it greater colonization. The presence of *E. coli* and suggests faecal contamination of these surfaces which can result in community-acquired infections and disease outbreaks (Tagoe and Kumi-Ansah, 2010).

The presence of viable pathogenic bacteria that colonized and contaminated computer keyboard has been reported by earlier investigators in several studies (Oludure *et al.*, 2011). A research that was conducted in main internet center of Al-Mustansiriya, University, Baghdad, reported that computer keyboard contaminated with pathogenic bacteria (Ali *et al.*, 2013).

Percentage of different isolates recorded from computer keyboards of internet cafes was significantly higher ($p < 0.000$) than those from houses and offices. However, Domestic and public computer keyboards were swabbed and cultured. The swabbed areas were the keys mostly pressed like the space bar, the Enter and Backspace buttons. 100% of Internet café's computers were found to be contaminated comparing these results with the home computer keyboards there is a reduction in the percentage of contamination to 88 and 91% .This reduction is expected due to the limited number of users and assumed continuous cleaning in

houses. Nevertheless a percentage of 88 or 91% is still considered high. Percentage of contamination of offices computer keyboards came in between this could be attributed to the higher number of heterogeneous users, periodic cleaning and dusting of the office furniture and computers. Most common contaminating microbes for computer keyboards were commensal skin organisms followed by some pathogenic microbes, thus, keyboards have become reservoirs for pathogens especially in hospitals and schools (Al-Ghamdi *et al.*, 2011). Samples were collected from public access computer of faculty, staff and students at Troy University in Troy, Alabama, from these samples identify species of Gram-negative bacteria (Blankinship *et al.*, 2013).

In large urban U.S university, after reported of increased severity of bacterial in surface from community institutions, sampled was collected from computer keyboards of students and other surfaces. Bacterial counts were high on computer keyboard (Joanna *et al.*, 2009). A study was conducted that increase colonization of inanimate surfaces (computer keyboard) with multiresistant Gram-negative bacteria (MDR) (Follon *et al.*, 2009). A study was conducted at the University of North Carolina Health Care System, where there are approximately 3,500 computers in use in such areas as nursing stations. Specimens were collected from 25 computers that were located in the burn intensive care unit, cardiothoracic intensive care unit, and 6 nursing units housing patients receiving short-term care, were found non fermentative Gram-negative bacteria 36%. The risk of

transmission of pathogen from computer keyboards to an individual would be prevented by compliance with current hand hygiene guidelines. Unfortunately 34 studies, have demonstrated that mean rate of compliance with the center for disease control and precreation guidelines on hand hygiene is approximately 40% among health workers (Rutala *et al.*, 2006).

2.5. Gram-negative bacteria on computer keyboards

Robert- Koch institute reported that Gram-negative bacteria which contaminated computer keyboards such as *Escherichia coli*, *Klebsiella* spp, *Pseudomonas aeruginosa*, *Serratia marcescens* or *Shigella* spp. also as *Bordetella pertussis*, *Haemophilus influenza*, *Proteus vulgaris* or *Vibrio cholerae*. Only persist for days (Kramer *et al.*, 2006). In the city of Jeddah, Saudi Arabia, 95.5% of the total samples collected from computer keyboards were contaminated with mixed bacterial growth. Like *Pseudomonas* spp. and Gram-negative Bacilli, Results indicate that internet cafe computer keyboards showed 100% contamination in comparison with other objects (Al-Ghamdi *et al.*, 2011). A simple random technique was used to sample 100 keyboards from office and internet cafes by swabbing their surfaces. All samples were contaminated with bacteria showing greater than 10^5 ($>10^5$) CFU by aerobic counting technique. The counts showed *Proteus mirabilis* as Gram-negative bacteria which is highest isolate in internet cafe keyboards. However, *Klebsiella*, *Pseudomonas* was the most resistant Gram-negative isolate (75.0%), followed by *Proteus* (65.0%) with *Escherichia coli* the least (50.0%) (Tagoe and Kumi-ansah, 2010).

2.6. Prevention

Inadequately performed hand hygiene and non disinfected surface are two reasons why the computer keyboards could be source of microbial contamination resulting in transmission of pathogens (Siegmund *et al.*, 2010). To get rid of crumbs and dust that have found their way between the keys, first unplug the keyboard, turned it upside down and gently shaken. Afterward, to remove any remaining debris, vacuum between the keys using a hand –held vacuum cleaner. Or wipe between the keys with a computer brush (Eltablawy and Elhifnawi, 2009). Or you can use the disinfectant to prevent contamination of keyboards by microorganism but some disinfectants are reported to share the same mechanism of action with some antibiotics and this can causes resistance to disinfectants used in cleaning of computer keyboards (Heath *et al.*, 2001). Clorox wipes appear to work the best, eliminating 100% of bacteria especially for antibiotic resistant bacteria (Rutala *et al.*, 2006).