Assessing the potential needs for Telehealth in Papua New Guinea (PNG)

A dissertation submitted in partial fulfilment of the requirement for the Degree of Master of Health Sciences

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Abstract

Papua New Guinea has the highest infant and maternal morbidity and mortality rates in the Western Pacific Regions and 50% of hospital admissions are from vaccine preventable diseases. About 85% of 6 million inhabitants live in rural PNG where basic services are lacking or non-existent. Difficulties such as lack of infrastructures like road network and communication, geographical barriers like big mountain ranges, large rivers and swamps, shortage of skilled health professionals and higher concentration of health workers in cities pose great challenges in delivering health services effectively across the country. Telehealth may play an important role in reaching health services to the underserved population in PNG. As part of this study, it is essential to assess the potential of telehealth to enhance the delivery of health services. Specifically, this research aims to report the knowledge, attitudes and skills towards information and communication technology of health care providers in PNG. The study used a cross sectional method of health professionals working at the time of the survey. It collected 174 questionnaires from four hospitals and used SPSS (version17.0) to analyse the data. The results showed that younger male physicians, paramedics, those with gadgets, higher educational qualifications and exposed to ICT resources possess better knowledge and skills than female, older age group and those without gadgets or under exposed to ICT. Currently, the health care professionals in general have leap frogged the technology by focusing on handheld devices such as cell phones rather than landlines. This represents scope for growth and willingness by health workers to adopt and expand telehealth in PNG.

Glossary of Terms

Asynchronous Communication: Discussions or chats are conducted among individuals who are connected via Internet or email simultaneously at different times.

ATM (Asynchronous Transfer Mode): A means of digital communications that is capable of very high speeds, suitable for transmission of images or voice or video as well as data.

Attachment: Data/information that is attached as a file to an email message.

Bandwidth: Is a measure of available or consumed data communication resources expressed in bit/s or multiples of it (kbit/s, Mbit/s etc).

Browser: Is a software application for retrieving, presenting, and traversing information resources on the World Wide Web.

CAT scan (Computer assisted tomography): Is a complex x-ray technique used to produce serial detailed internal images of any part of the body. The patient lies on a couch, which gradually moves through the x-ray machine, and a computer as a cross-section of the body builds up the image.

Cross-sectional study: Is one of the research methods involving observation of some subset of a population of items all at the same time.

Gigabyte G/byte: A unit of memory or data on a computer equal to the amount used to represent one character.

Digital technology: Devices that store and manipulate numbers. These devices format font and can translate words and pictures into numbers and then process them to produce a replica.

Download: Process of copying/saving data e.g. from a database onto a disk, web page or CD-ROM.

Email (Electronic mail): Is a way of transmitting messages between computers through use of internet.

Gadgets: Is a small technological object (such as a device or an appliance) that has a particular function, but is considered as a novelty.

Interoperability: The ability of different forces to exchange services so as to operate effectively together; the ability of software systems that may be running under different operating systems and hardware to exchange information through compliance with technical interoperability.

ISDN (Integrated Services Digital Network): An international communications standard for sending voice, video, and data over digital telephone lines.

LAN (Local Area Network): Is a computer network covering a small physical area, like a home, office, or small group of buildings.

Leapfrog Technology: Is a concept that areas, which have poorly developed technology or economic bases, can move themselves forward rapidly through the adoption of modern systems without going through intermediary steps.

Morbidity Rate: Is the rate of illness in a population that is the number of people ill during a period divided by the number of people in the total population.

Mortality Rate: Is the ratio of deaths in an area to the population of that area; expressed per 1000 per year.

Multivariate Analysis (MVA): Is based on the statistical principle of multivariate statistics, which involves observation and analysis of more than one statistical variable at a time

Software: Set of instructions for a computer. There are two kinds of software: system software and application software. System software is usually stored on a computer's hard drive until needed by the computer. Application software ('apps' for short) is more commonly known as programs.

SPSS (Statistical Package for the Social Sciences): A computer program used for statistical analysis.

Synchronous Mode: Discussions or chats are conducted among individuals who are connected via Internet or email simultaneously in real time.

Videoconference system (also known as a video teleconference) is a set of interactive telecommunication technologies that allow two or more locations to interact via two-way video and audio transmissions simultaneously.

VSAT (Very Small Aperture Terminal): An earthbound station used in satellite communications of data, voice, and video signals, excluding broadcast.

Webcams: Video capturing devices connected to computers or computer networks, often using USB or, if they connect to networks, Ethernet or Wi-Fi

WWW (World Wide Web): Used to refer to that part of the Internet that contains searchable information.

Chapter One: Introduction

1.1 Background

Papua New Guinea (PNG) is the largest developing country in the Pacific. Its geography includes mountain ranges and large swamp regions. Dense rainforests are found in the lowland and coastal areas. It has 600 outer islands and a mainland. This terrain has made it difficult for the country to develop an efficient transportation infrastructure. In some areas, planes are the only mode of transport. PNG is perhaps the most heterogeneous nation in the world: it has around 820 languages, over 1000 dialects, and three common languages, English, Pigin and Motu (World Health Organization, 2007).

About 85% of the people live in the rural areas, which are underserved, and access to basic health services are limited. Due to limited services, shortage of health workforce and rugged terrain, most pregnant mothers deliver at home and about 40% of them are cared by trained health professionals (Naraqi, Feling, & Leeder, 2003). The country has an estimated figure of 1200 mothers dying from obstetric complications every year. Factors that contribute to high mortality rate are ante and post partum haemorrhage, eclampsia, anaemia and puerperal sepsis. Maternal deaths have remained high in the some Pacific countries, while in other Island countries, it has improved. Countries like Vanuatu its maternal mortality rate is, 96 per 100,000 live births, Samoa 87 per 100,000 live births, and Cook Island 20 per 100,000 live births, despite the reportedly high proportion of births that are attended by skilled birth attendants (Robertson, 2004). PNG's statistics shows that maternal mortality rate remains high. Infant mortality rate for the country alone is 64 per 100, 000 live births. Most children under the age of five years die from acute respiratory infections, diarrhoea, malaria, and perinatal complications and injuries during birth (United Nations Development Programme, n.d.).

Immunizible diseases are preventable however; it is still a problem in PNG. Vaccine-avoidable diseases, such as measles, whooping cough and Haemophilus influenza infection, still kill children in PNG. The vaccination coverage is low and varies between the provinces. According to figures in the National Health Plan, vaccination coverage averaged 64% for diphtheria-tetanus-pertussis and 60% for measles, while, in the Western Province, these percentages are only 30% (Naraqi, et al., 2003). One of the problems that lead to low immunization coverage is the approach of delivering vaccine. Curative health services in

rural areas were not effective in delivering and administering vaccines due to most of them being closed down and the cold-chain was not managed properly, thus destroying the potentials of vaccines (Duke, 1999).

A Telemedicine study has done at Tabubil mining hospital in PNG by Wootton, Menzies, & Ferguson, (2009) for over two years from 2005 until 2008. Several results produced from this study show; firstly, it enables the local physicians to receive expert consultations from specialists abroad on time to manage patient's health problems. This type of service aids in enhancing services rendered and at the same time, it improves the physician's knowledge on how to deal with similar problems in future. Secondly, patients benefited from this service by saving costs and time compared to if they were to fly out to a major centre to get the same treatment. The study recommends that similar studies can be conducted elsewhere in PNG where resources are available because resources used during the study were simple, reliable, cost less and suitable to the available technology (Wootton, Menzies, & Ferguson, 2009).

National Referral Hospital in Honiara, Solomon Island has used an internet-based system in Switzerland for Telepathology consultation since September 2001. Due to limited bandwidth of internet connections on Solomon Island, an email interface was developed that allows users in Honiara to submit cases and receive reports by email. Consultants from the other end use a more sophisticated Web-based interface that allows discussions of cases among an expert panel. Result of a hybrid email and Web-based telepathology system over 2 years indicates 333 consultants were performed, in which a remote pathologist could diagnose up to 94% of the cases. A computer assisted virtual institute of pathologist was established. This form of organization helped to reduce the median time from submission of the request to a report from 28 hrs to 8.5 hrs for a preliminary diagnosis and 13 hrs for a final report (Brauchli et al., 2004). Previous studies within PNG and abroad indicate the gaps and benefits of telehealth applications (Brauchli, et al., 2004; Wootton, et al., 2009). As an initial step to establish and implement telehealth in PNG, the availability of medical and technical resources and the possible users need to be identified.

1.2 Research Focus

As an initial step, a formal assessment is required to identify strategies for implementing telehealth in PNG. It is essential that this study will focus on local needs and issues, as they

are paramount in determining what needs to be implemented. Without this local assessment, the imposition of any telehealth service is likely to be unsuccessful. These needs are health workforce and technical logistics.

Physicians, nurses and other health workers are expected to be the principal users of new information technologies including applications of telemedicine connecting to rural areas. Elford, (2004, p. 3) states that if we "build a technical telehealth network, people will not automatically come and use it." Many unsuccessful or underutilized telehealth programs testify that "people network" is just as important, (if not more important) than the technical network. Diener, Muller, & Fletcher, (2001) support health professionals networking that for telehealth programs to be successful they have to be driven by the needs of users rather than technology. For this reason, it is necessary to carefully identify, educate, train and support the potential users. Furthermore, studies indicate that it is essential to have an influential, enthusiastic clinical person at both sending and receiving sites of a telehealth network (Elford, 2004). Users must be guided and supported continuously so that when difficulties arise, they may interact with experts who can be readily available to help them solve the problems.

Another major aspect of this study is to assess the technical needs in each hospital. To introduce a new technology can be a challenge to the existing structures and its operation. Gagnon, Duplantie, Fortin, & Landry, (2006) state that when new technologies are introduced, they must adjust themselves well into the system or organisation. Meuller, (2000, p. 3) stressed that "experiences with telehealth projects and recommendations from the consultants in the field, all direct to the importance of matching technology to the needs and capabilities of the intended users". Each clinical setup in PNG hospitals differs, for example, Port Moresby is level one hospital; meaning that it is a major referral hospital in the country and the type of ICT and medical electronic devices available may not be similar to a level four hospital. Some hospitals may have advanced technologies while others might not nor if they are available, do the staffs know how to use them with confidence. It is important to identify exactly what equipment is already owned and what must be leased or purchased to begin offering telemedicine services. The same approach should be taken when considering Information and Telecommunication services. Identify from the information technology resources what speed of telecommunication services and bandwidth has been installed. Then to seek further advice on what kinds of upgrades are needed for each institution (Wachter,

2000). Apparently, the need to identify users and technological assessment of telehealth is essential. Most of the telehealth applications to date have been implemented in the industrialized world. The need to implement telehealth in developing countries like PNG might help to alleviate some of the shortages of specialists reaching rural areas, provision of medical information and continuing of education for health professionals (Patricia, 2007). By providing, such services may help to improve some of the current health problems in the country as mentioned (World Health Organization, 2005). Assessing the telehealth needs are prime factors to the success of modem telehealth applications and therefore, an area worthy of study, as it would enhance the delivery of health services across different scales: local, regional, national and even global.

1.3 Overall Research Aim and Individual Research Objectives

The aim of this study is to gain a general understanding of the knowledge, attitudes and skills of potential users of Telehealth in Papua New Guinea. These users are the physicians, nurses, and other allied health workers who work in the main provincial hospitals in the country. In addition, a stock take was done to identify Information and Communication Technology (lCT) and medical electronic devices that are used in each hospital.

The individual research objectives of this study are to:

- Identify the health professionals' Knowledge, Attitudes and Skills (KAS) towards use often at the workplace.
- Identify ICT and Medical Electronic equipment available in each hospital.
- Make recommendations regarding the appropriate applications of telehealth in PNG based on the survey's findings.

1.4 Telehealth Assessment Model

To answer the research objectives and aim, this study has adopted Andersen's model on behavioural access to medical care (1995) (Appendix H). This was modified according to the instrument of the study. The model is comprised of predisposing, enabling and need variables measuring knowledge, attitudes and skills of utilizing ICT of health workers in PNG.

Predisposing characteristics are those variables that can be associated with proneness of using information and communication technology. This includes demographic profiles like age and

gender, availability of gadgets and adoption to technology, which are considered as predisposing characteristics in this study.

Enabling variables are necessary conjunctions associated with individuals to inspire or enable health workers to use information and communication technology. This includes computer training, availability of computers at home, access to internet at workplace and educational qualifications applied in this study.

Need variables are perceptions or attainments of whether an individual has a requirement to use information technology. In this study, the need for computer literacy is the only variable assessed.

The predisposing characteristics and enabling variable were cross-tabulated using Cochran Mantel Haenzel chi square to test for significant relations between predisposing characteristics and enabling variables. The model clearly demonstrates the relationship and direction between each variable on how KAS of health professionals towards lCT was measured as shown in figure I below.

Telehealth assessment model used to measure KAS of ICT of health workers in PNG

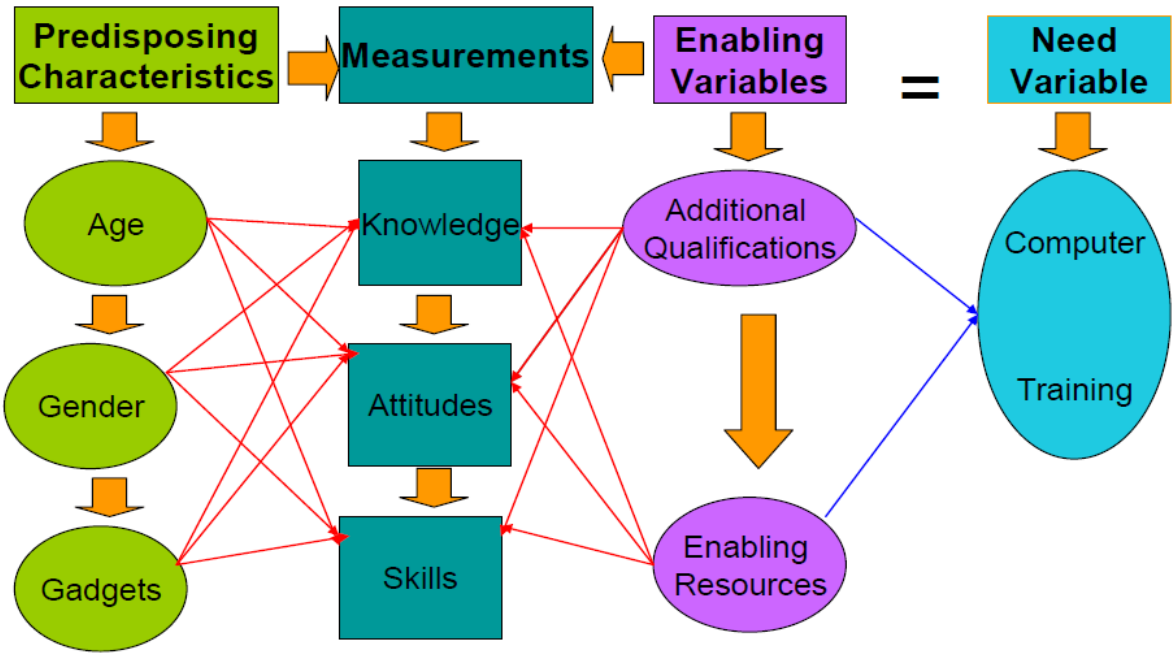

Figure 1.-Telehealth assessment model used to measure KAS of ICT of health workers in PNG. (Adapted and modified from Andersen 1995).

1.5 Significance of the Study

Papua New Guinea is one of the developing nations that experience some of the difficulties that other developing countries in the world are encountering such as: shortage of general and specialist health workers in each health settings, the poor road infrastructure and rugged topography pose great challenges in delivering health services effectively across the nation (World Health Organization, 2008). All these coupled to current health problems as mentioned earlier.

Therefore, this study was initially conducted to identify a mechanism that can be able to address the issue of geography and limited health workforce. By introducing leT into the health system, may alleviate the issue of geography and shortage of staff thus, improving the delivery of health services. Telehealth is the prime focus in this study because it is a unique global tool, which has the capability to cross all existing geographical, temporal, political, social and cultural barriers within the health sector (Pryor, 1999). Through the applications of te1ehealth, it will bridge the gaps between urban and rural health settings, akin to overcoming the digital divide between the technologically advanced and the less developed, so this could lead the majority of the people having access to health services. This may add up to reduce the current health problems mentioned and improve health status of the public.

1.6 Chapter Summary

Papua New Guinea is one of the developing countries in the Pacific. Its geographical terrain has made it difficult for reliable transport infrastructure and that limits the delivery of basic services for 85% of populations living in the rural areas. With limited skilled health professionals, most are practicing in the urban canters. The current high rates of infant and maternal morbidity and mortality in the country are increased from complications related to pregnancy and childbearing process. Vaccine preventable diseases are still major problems in children in PNG. Factors such as poor road infrastructures, lack of skilled health professionals and rugged terrain lead to increased current health problems. Therefore, the concept of introducing telehealth into PNG health system would bridge the gap between the rural and urban health facilities to improve the delivery of services where by the current methods are not effective as expected.

The aim of this study was to gain a general understanding on the knowledge, attitude and skills of potential users of Te1ehealth in PNG. Its objectives were to assess the physicians, nurses and other allied health workers who work in the main provincial hospitals. In addition, it identifies the types of medical equipment, and Information and Communication Technologies available in each hospital. The model used in this study was able to measure the knowledge, attitudes and skills of ICT of health professionals in PNG. The study highlights that identifying needs of telehealth are paramount, because the health professionals cannot implement telehealth if there are no technical and medical devices available. On the other hand, both devices maybe available but if health workers do not have the required knowledge and skills to operate those technological devices, then application of telehealth would become ineffective. Therefore, if all the necessity tools required introducing Telehealth such as ICT technology appropriate for the purpose, the know-how and positive attitude are available. These will all contribute to executing a successful telehealth programme.

Chapter Two: Current Infrastructure in Papua New Guinea

Infrastructure can be defined as the "basic physical and organizational structures needed for the operation of a society or enterprise" (Snow, n.d.). The term typically refers to the technical structures that support an organization functioning and in this study it focuses on telehealth. This includes Telecommunication and Information Systems, electrical infrastructure, the structure of the health care system and current projects based on IT health in various hospitals in the country. Without these organizational structures, applications of telehealth would be dysfunctional.

2.1 Telecommunications and Information Communication technology infrastructure.

2.1.1 Telikom PNG

Telikom PNG is a telecommunication company owned by the government and works in cooperation with Pacific Mobile Communications (PMC) which operates B Mobile services. Both companies provide fixed lines and mobile services at local, national and international levels (Business Services Industry, 2007). Apart from Telikom PNG, other private companies (Datec, Global, Online South Pacific, DG Computers and Dalton) provide various telecommunication services including the internet, emails, facsimile, telex, data transfer, mobile and fixed line networks, cabling, private automatic branch exchange, key systems, paging, modems, network termination units and private payphones, (Stanley, 2008).

The current Telikom network in PNG is based on digital microwave radio technology. This technology is well suited to the country because of its terrain. The rugged topography of the country makes transport and any sort of road systems difficult. In The current Telikom network in PNG is based on digital microwave radio technology. This technology is well suited to the country because of its terrain. The rugged topography of the country makes transport and any sort of road systems difficult. In addition, communication systems and other infrastructure are arduous to construct. The digital microwave radio technology has limited capabilities in supporting high speed broadband services. Despite the technical hitches, Telikom has supplied approximately 90 000 fixed lines of which 65% are for businesses. This represents one of the lowest ICT penetrations in the world (Global Information and communication Technology, 2008).

2.1.2 Marketing and Competition

Digicel is another mobile services provider introduced into PNG in mid 2007. Prior to the introduction of Digicel, the cost of simcard and mobile phones were significantly higher, PGK125.00 ($US46.70) for simcard and prices of phones varied with models and supply. Since Digicel's entry into the market, it sold its simcard at PGK15.00 (US$5.60) and posed an aggressive competitor to B Mobile. The monopoly enjoyed by B Mobile meant that subscribers were paying higher fees. For example, B Mobile's initial subscription fee was PGK125 but this was reduced to PGK25 ($US9.34) (Global Information and communication Technology, 2008). The marketing and competition strategies may be considered as a loss for B Mobile however, the people benefited by having access to affordable and improved communication services. Digicel has provided alternative service options by introducing coverage to rural areas and its mobile penetration has tripled by the end of 2008. It has built over 200 sites reaching nearly 80% of the population. In addition, Digicel has dropped the price of making a call by over 60% of its competitors. The figures from the mobile world database estimated that Digicel ended the first quarter of the year with around 610,000 mobile subscribers, compared to B Mobile 380,000 subscribers (Cellular News, 2008). Thus, the entry of Digicel and the ensuing marketing strategies and competitions has led to improved and affordable access to communication in the rural areas.

2.1.3 The Internet

Pacific Mobile Communication (PMC) is the gateway bandwidth wholesaler under Tiare that runs the internet service in PNG since 1996. PMC leases bandwidth as a product to the Internet Service Providers who distribute directly to the customer. Growth of PNG Internet traffic has been considerable over the last four years: it has expanded its International bandwidth from 256Kbit/s to 6,080Kbit/s. Internet traffic will continue to grow as more people discover and take advantage of the readily available information. In addition, Telikom provides a satellite service to remote provinces, mining and petroleum companies, as well as providing back-up services to the network (Pacific Mobile Communications Company Ltd, 2004). The current traffic is carried over four separate routes: two via satellite from Optus and one though submarine cable from Reach (formally Telstra) Australia. This provides diversity in automatic connectivity maintenance if one link fails.

There are five ISPs in the country: Daltron Electronics, Datec, Global Technologies, DG Computers and Online South Pacific. Each ISP links to the gateway via 64kbps leased lines,

however, a number of ISPs have upgraded to 128kbps links and all are intending to increase their bandwidth. A report from the Business Services Industry, (2007) indicated that general access to the internet was poor or non-existent in remote areas and Global Information and Communication technology, (2008) confirmed that 85% of population in PNG had limited access to the internet. Access was only through a very small Aperture Terminals (VSAT). Few people about 0.4% (24 000) of the country's population, particularly those in urban areas have access to public internet centres (Lahari, 2004). The ICT industry in PNG is gradually increasing, lately business houses are introducing more Internet Cafes accessible to the public, but the ICT industry has no reliable statistics in place.

2.1.4 Barriers to Information System Service Delivery

PNG's mountainous terrain, bad weather conditions, and vandalism are additional barriers, which delayed or clogged the flow of services (Investment Promotion Authority, 2006). A case study analysis on factors, which were influencing information systems in PNG, has highlighted PNG communication network as ineffective. For example, landowner compensation issues and vandalism often disrupt the operations of the mountain repeater stations (Kelagai & Middleton, 2004). Due to such technology hitches, PNG Telikom has introduced satellite technology as an alternative to the compensation and vandalism problems. The main limitations with Telikom services are; its current bandwidth provides 64kb leased lines across the country. For companies and agencies that need l28kb bandwidth would purchase two leased lines. Most of the ISPs and universities argue that Telikom does not give discounts for purchasing a higher bandwidths and charges too much for connecting these lines to its Tiare Internet gateway (Pacific Mobile Communications Company Ltd, 2004).

2.2 Electrical Infrastructure

PNG Power limited (PPL) is owned by the government and it is the only utility in the country that is responsible for the generation, transmission and distribution of electricity in PNG. It has branches in 20 provinces. Most branches are operating in isolation except for the Ramu system, which has a grid connection to four provinces: Madang, Morobe, Eastern Highlands and Simbu. Currently, there are six power sources of energy in PNG: thermal, hydro, solar, wind, biomass and hydrocarbons (Renewable energy and energy efficiency partnership, n.d.). PNG Power uses thermal and hydro plants for the country's power generation because they

are affordable. It does not use much of other energy sources such as the wind, solar power and hydrocarbons. Wind was introduced into the country recently and the technical know-how is yet to be grasped. Solar generation is widely used by individuals and private sectors however PPL is not adopting this energy because of factors considered not doable to the company (Ururu & Makati, n.d.). Many outstations, institutions and industries including mines, use hydropower and geothermal while others use diesel generators. Most generator operators use the power that is limited to four hours usually from 6-10 pm.

PPL supplies power 24 hours a day to mainly urban areas including institutions and industrial areas that are located close to power poles. The Technical Assistance Report from the Asian Development Bank, (2007) reported that 90% of the population from rural areas have no electricity. Rural electrification policy guidelines developed in 1993 attempted to address this dilemma but due to high costs of grid connections, delayed the implementation and it may continue to meet the electricity demands in near future (Renewable energy and energy efficiency partnership, n.d.). In urban centres, the power supply is often unreliable: There are frequent outages resulting from natural disasters including landslides, storms and lightning strikes (Ururu & Makati, n.d.). Such disruptions may lead to delay of services and substantial damage to electrical devices in businesses, schools, hospitals, clinics and government offices. Vandalism is another barrier. For instance, a number of power poles were destroyed in 2002 because of unsettled political disputes. This caused continuous power interruptions at Pogera Joint Venture Gold Mine. The mine was not operating for a month and lost 10% of its production (Lyday, 2002).

2.3 Structure of Health Care Systems in PNG

The Health services in Papua New Guinea are provided by the Government and the Church and are primarily financed by public funds. This section briefly highlights the general scope of health status, its system, and workforce and performance indicators.

2.3.1 General Health Status

The health status of the country is the lowest in the South Pacific region. According to World Health Organization, (2005) life expectancy in 2000 was estimated to be 52.5 years for men and 53.6 years for women. Almost 45% of pregnant women are cared for by trained health personnel and about 45% of births are in health facilities. About 9% of women are using modern family planning methods. The demographic report showed maternal and child

morbidity and mortality were not improving (World Health Organization, 2007). A comprehensive statistical report produced by World Health Organization, (2005) highlighted that communicable diseases remain the major cause of morbidity and mortality in all age groups. Around 50% of all mortality is due to communicable diseases. Malaria is the leading cause of all outpatient visits and the third leading cause of hospital admissions and deaths. Malaria and pneumonia were accounted for one-third of all recorded deaths. Tuberculosis and diarrhoeal diseases remain common. PNG was stated as free poliomyelitis in the country in 2000. In addition, the national leprosy elimination target has reached less than one case per 10 000 population. In 2003, PNG was declared to have a generalized epidemic HIV/AIDS.
Lifestyle diseases were not public health problems in PNG. Since 1970, there has been a rapid increase in these diseases particularly amongst the urban and peri-urban populations. Increasingly PNG and the other Pacific islanders) are suffering and dying from heart related diseases and diabetes (Business Services Industry, 2007).

The major challenge to improve health in PNG relates to perceptions of illness and health among the general population. There is a widespread lack of awareness of risk related and health-promoting behaviour, and little involvement by local communities in health-promoting activities.

2.3.2 Health System

The national health system is based on the primary care approach. According to the report from the Asian Development Bank, (2007) PNG has a total network of 2400 aid posts, 50% of which were reported to be closed due to lack of staff, drugs and medical supplies, about 500 health centres, 45 urban clinics, 20 provincial hospitals and a national hospital. The government is the largest provider of health services for all provincial hospitals, aid pots and nearly half of the health centres and sub centres. Churches operate half of the rural health centres and sub centres. Mining and other companies also operate a small number of clinics. They are mostly located in the remote places and could be a good source for the use of telehealth applications. Clinics provided by the companies are possibly providing the highest quality of health services. This was signified by the type of advanced facilities, equipment, utilities and number of staff working per shift per beds. Some churches run facilities that have good reputation but a proportion of these services and the government services in rural areas are no longer in use (Asian Development Bank, 2007). Churches are important providers of

care and they provide almost 60% of health services in the rural areas (World Health Organization, 2005).

Papua New Guinea has relatively few development partners. According to statistics provided by the Organisation of Economic Co-operation and Development (OECD), 96% of Official Development Assistance for health in 1998-2000 was from Australia. Other major external agencies providing loans or grants were the Asian Development Bank (ADB), the Government of Japan International Cooperation Agency (nCA) and New Zealand Agency for International Development (NZAID). There have been smaller contributions from, the United States Agency for International Development (USAID), the European Union and United Nations agencies. A major new source of funds for health since 2004 has been the Global Fund to Fight AIDS, Tuberculosis and Malaria (GFATM (Asian Development Bank Report, n.d.; World Health Organization, 2005, 2007).

2.3.3 Health Workforce and Training

Health professionals play a central and vital role in improving health of the people. Currently, the health workforce in the country comprises around 9000 nurses, 1000 physicians and 10,000 others mainly community health workers and ancillary staff (Dermody, 2008). Most of the health workforces get their trainings from various universities across in both government and church run institutions in the country.

The School of Medicine and Health Sciences in Port Moresby trains all health professionals including doctors, laboratory technicians, pharmacists, x-ray technicians and dentists. The institution also offers courses for nurses taking postgraduate studies in various disciplines in clinical, administration and education at a bachelor level. It also trains staff for postgraduate Diplomas and Masters in Public Health (Kevau, 2004). The University of Divine Word in Madang offers courses for allied health sciences, which include Health Extension Officer (HEO), Health Inspector (HI), Physiotherapist and Health Information Management. University of Goroka offers diploma programmes for Health teaching and Health Education to nurses, HI, HEOs and community health workers. AUSAID is the major partner in sponsoring physicians, allied health and nurses for higher degrees abroad. Other donors include NZAID and JICA. The tables below briefly summarize the number of health workers in the country; unfortunately, some records of health personnel are unavailable.

Table 1. PNG health workforce indicator per 10,000 population, 2000.

Indicator	Value (year)
Dentistry personnel density (per 10 000 population)	< 1 (2000)
Number of dentistry personnel	90 (2000)
Number of nursing and midwife personnel	2, 841 (2000)
Number of physicians	275 (2000)
Nursing and midwifery personnel density (per 10 000 population)	5 (2000)
Physician density (per 10 000 population)	< 1 (2000)

(WHO, 2005)

Table 2. *PNG health workforce indicator per 10,000 population, 2005.*

Indicatoras	(10,000 per populations)	Value (Year)
Physicians	750	1.26 (2005)
Dentists	182	0.3 (2005)
Pharmacists	No data available	(2005)
Nurses	14.98	8914 (2005)
Midwives	0.95	567 (2005)
Other nurses/auxiliary staff	6.60	3926 (2005)
Other paramedical staff, (medical assistance, x-ray, laboratory tech)	0.64	385 (2005)
Other health personnel (HEO, Health Inspectors,)	1.79	1065 (2005)
Yearly new graduates – physicians		50 (2005)
Yearly new graduates – nurses		165 (2005)

(Western Pacific Health Databank, 2006)

The ratio of nurse-to-population is I nurse to 1,818 people. Another 600 registered nurses, 600 community health workers and 100 midwives are required to fill the vacant posts. The ratio of doctors to population is 1 doctor per 7,692 people, however, majority of the doctors are practice in the cities (World Health Organization, 2005). Kevau, (2004) stated that 132 Papua New Guineans "clinical specialists have been trained, of whom 93 (71 %) are working within the public health service including UPNG, School of Medicine and Health Sciences." The other 29% of specialists are involved in running private clinics, working with the companies or are abroad. Due to the country's annual growth of 2.7%, the total number of health work force produced is insufficient to meet the demand. This is especially true for staff working in the rural areas. One possible way to improve delivery of health services is through

telehealth, where limited workers) including specialist, can b e fully utilized from a distance in the delivery of health services to the rural population.

2.3.4 Performance of Health Sector

Studies have underlined the mixed performance of health sector in PNG. According to the Asian Development Bank Report, (n.d.) some health indicators in PNG are hard to change due to influences outside of health sector: such as women's education and nutritional status, and geographical barriers. Although literacy rates have improved over the last 30 years from 32% to 65% only half of all women aged 15 years and above have ever been to school (World Health Organization, 2007). The Asian development bank (n.d.) further stressed that the difficult terrain combined with poor infrastructure and lack of transport have reduced accessibility of health services. Other indicators have also fluctuated due to availability of funds and involvement of health personnel. For example, a review of the National Health Plan 1996-2000 showed a deterioration of several indicators such as immunization coverage, high mortality rate .from malaria, an increase in malnutrition and wide spread shortage of medical supplies.

2.4 Current IT health Projects

Telehealth is a relatively new technology for many health settings in the country and so far only two IT projects have been prototyped.

2.4.1 Telehausline Project in Kundiawa and Kupiano District

Papua New Guinea Radio telecommunication and Telecommunication technical Authority (PANGTEL) had established a first pilot project known as Telehausline in Kundiawa (Simbu Province) and Kupiano District (Central Province) in 2006 (Appendix E). "TeleHausline," in neo-Pidgin English means cluster of villages under a chief or councillor. The project was started in two different sites whereby students and workers could exchange information through emails and video chat. The aim of that project was to make the network available for general use and it allowed the public to use the free service for three months. The project may lead to e-applications and e-services of specific sectors of the community. The project has installed Wireless local area network (LAN), internet protocol camera, voice over internet protocol (VoIP) gateway, Fax and telephone sets in the hospital, Police station and the School. One common server and dialup/modem! was installed at the main provincial

government centre for monitoring (Appendix G). The outcome of the study showed that local people and leaders including business firms were attracted to the service (Gari, 2006). The service was convenient and improved the communication methods. The pilot project recommended that it would consider similar applications and support for e-medicine, e-agriculture, e-education and other private sectors. However, the two projects are not functioning currently due to administration costs and human resources within the health fraternity that lacks basic ICT knowledge and skills.

2.4.1 Goroka Base Hospital IT Health Website

Goroka Base Hospital (GBH) is a level two and regional hospital in the country. It provides specialist health services to the entire Highlands regions. For the first time in history, GBH has taken a leading step into the information age and e-health revolution in the country to set up a website. Volunteer IT Manager Mr. Schilt set up the website http://www.ggh.org.pg/.This opportunity leads the staff to have access to Internet and Health Inter Network Access to Research Initiatives (HINARI). The aim of introducing Information Technology (IT) as part of its overall strategic direction is to improve the delivery of Health Services to people of the Eastern Highlands and other residents of Goroka Township. The hospital has implemented several other IT-related projects over the past 18 months under Schilt, which include: A Business Resource Centre (BRC). This has an IT training facility with 12 PCs and conducts regular computer training to hospital staff. In addition, it deploys 50 PCs and laptops to various sections within the hospital. Furthermore, it provides internet service for staff, including access to the HINARI Online Subscription. Several hospital information systems were developed and programmed including laboratory results application, medical stores application, attendance register' and various statistical reporting tools to assist departments with their reporting requirements. The hospital intranet was developed and accessible to hospital staff, it provides information such as staff telephone directories, standard forms etc ... An online forum for PNG doctors and other health professionals to discuss and share relevant clinical information (Schilt, 2008) The current internet broadband used in GBH is 16 kbps, and is very slow during high traffic volume. This limits the institution from sending or receiving large files. Appropriate resources may be sought to upgrade the bandwidth for an efficient and effective service. Compliments and recommendations from various sources indicate that GBH has paved the way in introducing electronic health and that should model the 20 other hospitals in the country.

2.5 Summary and Conclusion

Telikom PNG fixed lines and mobile services deployed at local, national and international scales. Telecommunication was costly and its penetration to rural areas was ineffective and non-existent before the arrival of Digicel. Digicel was introduced in 2007 as a competitor to Telikom PNG and as a result, the mobile penetration significantly improved to cover 80% of the population having access to communication. The internet services are mostly located in urban centres, mines and petroleum companies. However, statistics proved that 85% of the population do not have access to the internet. Despite the provisions of services of information system, constraints such as bad weather conditions and vandalism~ pose barriers. Satellite was introduced to improve the situation. PPL is mostly using hydro and thermal as its main source of energy to generate electricity for the country. In the future, as human resources advance into sophisticated knowledge and skills, wind and solar as an alternative energy source may be utilized to supply electricity to the rural areas where bulk of the population live. Disruptions of electricity flow and vandalism annoy and delay the flow of services. This area needs improvement to provide and maintain a reliable service delivery system. The general health status of the country is the lowest compared to other Pacific regions. Communicable diseases contribute 50% of morbidity and mortality in all age groups. Lifestyle diseases were not a concern in the 60s until late 70, when there has been an increase. The Health system is based on primary approach. Churches provide half of the rural health facilities and mining and other companies operate a small number of clinics. Health workforces play central roles in improving health of the population. Most of their training is undertaken in PNG except for higher degrees, which are done abroad. The ratio of staff per population is lowest compared to other pacific and developing Third World countries. Some performances of health indicators were difficult to change due to the country's terrain and influences outside of health sector. P ANGTEL has installed basic telecommunication equipment required for telehealth applications in Kundiawa and Kupiano as prototypes. The service is not in use any longer due to shortage of funding and lack of skilled workers. Introduction of IT health in Goroka Base Hospital has opened doors to implementing telehealth. The hospital has trained most of its workers to use computers and the internet for medical information and research articles.

Chapter Three: Literature Review

This literature review highlights the general scope of telehealth. It identifies the definition of telehealth, its history, usages, benefits and the barriers. The literature further focuses on studies from the USA, UK, NZ and the South Pacific Islands. Those studies are related to knowledge, attitudes and skills of health professionals towards ICT.

3.1 Definition

By exploring the above areas of literature, telehealth is defined as use of electronic information and telecommunications technologies to support long-distance clinical health care, patient and professional health-related education, public health and health administration (Felkey, Fox, & Thrower, 2006; Hebda, Czar, & Mascara, 2005) (Pryor, 1999; Felky et al, 2006; Hebda et al, 2005). Telemedicine, "and telehealth are used interchangeably; Telemedicine involves direct "provision of health services at a distance between a provider and a patient using telecommunication technologies" (Hebda et al, 2005, p.356). Telehealth encompasses telemedicine as well as delivery of distance education and information to health workers and consumers (Burgiss, 2006; Hebda, et al., 2005).

3.2 History

The literature reveals that telehealth is generally considered a new method of providing and improving health services. However, telemedicine has been used for several decades. The first documented example is in 1920, in which radio links were established to provide health services to ships at Auckland Hospital in Norway (Felkey, et al., 2006). As sophisticated technologies are introduced, telehealth is becoming more advanced (Kerr, Dew, & Abernethy, 2002). The earliest records of telehealth activities took place in the mid 1950s in a Nebraska Psychiatric Institute Omaha, in USA. In the early 1960s, the National Aeronautics and Space Administration (NASA) pioneered telehealth by using remote physiological monitoring of astronauts in the space (Felkey, et al., 2006; Kerr et al., 2006). The practice of telehealth programmes then became established in Australia in the early 1990s and after a decade, has reached almost 90 % of health facilities especially outside major centres (Attend Anywhere Pty Ltd, 2009). From the late 1990s, New Zealand and other South Pacific Islands started using telehealth and in mid 2000s, a pilot study was done on telemedicine in PNG.

Medical students from Queensland University have carried out a telemedicine study or over two years at Tabubil mining hospital in PNG from 2005 until 2008. They used still images,

data, captured audio or video clips and (store and forward mode) refer patients' medical information and emailed as attachments to the referring clinicians in Queensland Medical Centre through an internet. This was followed, up by the previous referrals. The results of the study indicate that the resources used cost less were simple, reliable and suitable to the available technology (Wootton, et al., 2009). Service and advice provided was significant to the outcome of patient's improvement, even if resources were insufficient. The study recommends similar project be conducted in other parts of the hospitals where appropriate resources are available (Wootton, et al., 2009). This was the only study done so far on Telehealth applications in PNG.

3.3 Applications and benefits

Telehealth has several modes of applications: it may be used as a real time (information, audio/ video send and receive simultaneously, live e.g. video conference) or store -and - forward (exchange of data, video, audio, still images later e.g. email and with attachment) system. Usually it is used to monitor activities, evaluate diagnostics, support systems for decision-making, store and disseminate information, compress image for efficient storage and retrieval and to continue research (Hebda, et al., 2005). Telehealth is particularly useful in countries where traditional delivery of health services is affected by distance and the lack of local specialist clinicians. Its application is beneficial to patients, services and providers. Most benefits of telemedicine include improved access to information and improved services. It has increased care delivery, improved professional education, provided quality control of screening programmes; and reduced health-care costs (Hebda, et al., 2005; Hjelm, 2005; Telemedicine Association of Oregon, 2004). Although, its benefits look promising, many potential telemedicine projects have been held back by lack of appropriate telecommunications technology (Brown, 1996 updated 2005). Other barriers associated with the use of telehealth applications are: technology compatibility, skills of potential users, costs of ICT equipment and maintenance and lack of cable wiring for rural areas. Often a higher telecommunications require sophisticated technologies so those who could benefit from the telemedicine may not be able to access it. In developed countries, it may be difficult to reimburse costs from health insurance companies (Brown, 1996 updated 2005; Hebda, et al., 2005). These barriers need to be addressed before telehealth can be fully implemented or else its application may not meet the required health system needs.

3.4 Similar Studies Done in Other Countries

The review of literature examines objective one and two of the dissertation to identify the current levels of health professionals' knowledge, skills and attitudes to ICT and the availability of technologies to implement telehealth. The literature highlights that to assess telehealth/telemedicine, health workers' knowledge, attitudes and skills of ICT are imperative. Without this, health workers will not perform a telehealth job satisfactorily. Kerr, et al, (2006) states that there is a gap between medical and nursing staff in New Zealand in their knowledge, skills and attitudes towards ICT, which mirrors overseas studies in which nurses are reported to have a lower level of confidence in ICT. A study done in Belfast Northern Ireland shows that nurses' perception towards ICT did not differ when compared with midwifes social workers and other allied health staff. In addition, their perceptions and skills were lower than that of doctors and dentist (Sinclair et al., 2007). Kerr, et al., (2006) says that this could be due to the limited hours of information system and ICT training provided for nurses at all levels. Despite this, nurses generally show positive attitudes towards computer use. A survey done to assess potential users of telehealth services in rural Nebraska USA, concluded that over 68% of non -telehealth users did not know about telemedicine technologies and did not know how to implement telemedicine in their practice (Diener, et al., 2001). A similar study conducted in Northern Ireland, which identified knowledge, skills and attitudes of health professionals towards ICT, indicated that skills ratings in ICT decreased with older age (Sinclair, et al., 2007). A factor influencing this outcome could be social and educational exposure to technological innovation outside the working environment. For instance, younger health care professionals have however, had greater exposures to ICT in schools/colleges and universities (Sinclair, et al., 2007).

The assessment of users' attitudes to technologies is another important consideration when introducing telehealth projects. Telehealth providers need to assess whether users will adapt to the new technology or prefer to keep to the existing methods (Ballantyne, 2007; Diener, et a1., 2001). Studies have indicated that attitudes of practitioners are significant factors in determining acceptance and effective usage of IT (Ward, Stevens, Brentnallfp &: Briddon, 2008). The same authors commented that flexibility of system is another factor that contributes to their practice; technologies used must adjust well and meet the needs. This would have positive impact on their attitudes otherwise; they will not tolerate technologies that are complicated and, reliable for the intended purposes. Attitudes and skills are necessary

recipes required in any health professionals to meet new challenges during their professional lifetime.

To accommodate a new paradigm in delivering health services, training is an essential need that would fill the skills and knowledge gap. Health workers in PNG are used to the traditional methods of providing health services, which have been practised for decades. In contrast, te1ehealth theoretically encourages a different and more collaborative approach. This would be new to most PNG health professionals and training would be a requirement. Elford, (2004, p. 3) states that digital telehealth users require proper training in technology, which will enhance their knowledge and skills and "failure to do so will lead to users being intimidated by the technology and frustrated when they cannot get to do what they wanted." In addition, program providers may provide constant supervision to ensure that users are confident in using the technology with minimal or no mistakes.

Technical and medical electronic devices are another essential needs assessment to consider before introducing telehealth activities. Telemedicine requires a 28 · communications infrastructure that may transfer larger files of data quickly. A fast and reliable technology is an important aspect in the development of a successful telernedicine program (Diener, et al., 2001; Elder & Clarke, 2007). Normally, a real time mode will require higher bandwidth telecommunication technologies to have live interactions from both parties. It would become a problem if the receiving or sending site operates on a low bandwidth or sending a large file size that contains a series of x-ray through a store -and -forward system that would take more time to transmit to the other end (Diener, et al., 2001). On the other end, if a high bandwidth of telecommunication technology such as video conferencing systems is available, it still may be unaffordable or difficult to implement for health settings that do not have access to high-speed data lines. To purchase a higher bandwidth of technologies involves cost and this represents another barrier to use (Elder & Clarke, 2007).

To minimize the costs and other technical problems, it is vital to identify the medical and technical equipment that is already available at the project sites and then decide what must be purchased or leased. It is better to obtain further information and advice from the technical staff regarding the availability of the current speed of telecommunication services and the upgrades required within a project area. Once this has been determined, the type of telemedicine applications will be decided, either to use real-time (synchronous) or store-and-

forward (asynchronous) interactions depending on the availability of the resources (Wachter, 2000).

3.5 Chapter Summary and Conclusion

The review of literature in assessing the needs of telehealth in PNG reveals that before starting any telehealth programmes, it is imperative for the programme providers to train and equip the physicians, nurses and other allied health workers in the areas of 29 ICT. The potential users of telehealth must know how to use both technical and medical equipment confidently. Limited training and lack of supervision from the programme specialists will lead to unsatisfactory implementation and not meeting the required obligations. It is also essential to decide which type of telehealth applications to use. The correct choice of real time or store and forward mode, and the right amount of bandwidth needed for an effective telemedicine activity is essential.

The next stage of this research will examine the research methods that were used to capture the empirical data. This includes details on the research strategy to be adopted, data collection techniques, data analyses and management of the researcher's roles.

The results produced from this study identified the training needs for health workers. The scenario reflects on current situations of the health workers in PNG which provides insights on how to prepare health professionals towards adopting telehealth practice.

Chapter Four: Methodology

4.1 Introduction

This is a quantitative study based on survey design. Quantitative research designs can be either descriptive (subjects usually measured once) or experimental (subjects measured before and after a treatment) (Hopkins, 2000). In this study, a descriptive study was used to establish associations between the variables by collecting data from four different hospitals in PNG. Each of these hospitals is spread throughout the mainland of New Guinea and represented different levels of hospitals within the health sector (Appendix F). There are four levels in the country: level 1 is at the national referral hospital, which has more workforce and specialists, highest number of beds, all kinds of services, and advanced medical technologies are provided. Level 2 is at the regional referral hospital with less number of staff, services and resources compared to the first level, but has more compared to other levels. Level 3 is at a provincial level with minimal specialists and general workforce, including basic services. Level 4 hospitals are in rural areas with less staff, barely any specialists, and provide basic services only.

In order to achieve the aim of this study a valuable aspect of this research relates to objectives one and two of the dissertation. The objectives of the dissertation were to obtain information on:

i) Knowledge, attitudes and skills of health professionals relating to ICT.
ii) Types of Medical devices, Information and Communication Technologies available in each hospital.

This section provides the details of research design together with the means of design of questionnaires, collection of data, sample selection, procedure, the approach taken to analyse the data and the ethical consideration.

4.2 Research Design

This study used a cross-sectional survey design based on validated structured questionnaires. Polit & Hungler (1987, p. 56) state that survey design is "used to gather data from a proportion of population for the purpose of examining the characteristics, opinions or intentions of that population." The researcher decided to use this descriptive survey to identify relationships between the characteristics of the respondents in order to assess their

knowledge, attitudes and skills to ICT rather than to test the hypothesis. It also allows to gather information from a larger population group representing the health professionals and institutions at different levels with very little effort and cost involved.

4.3 Design of Questionnaires

The design of validated questionnaires were adopted and modified from two sources: 1) Dr. Kerr's study on "A Needs Assessment of a South Pacific Telehealth Project" in 2002.

2) Associate Professor Kirk's survey on "Basic personal computer competency survey" for Health Sciences students at Canterbury University

The researcher developed the other set of questionnaires not included above according to the objectives of the study. These were then pretested among colleagues to find out the time frame, clarity and general perceptions of the questions being answered. The participants stated that it took an average of five minutes to complete filling the forms and the questions were easy to understand.

Questionnaires were divided into three parts A, Band C. All questions in Sections A and B were close-ended with multiple choices and C has two tables listed with names of the technological equipment (Appendix D).

Section A

This section contains six questions based on participant's demographic variables. The participants answered each question by circling the options provided or, "yes", or "no". It includes the following information:

1. branch of discipline, or section of work
2. health category
3. age
4. gender
5. extra professional qualification gained apart from basic training

Section B

Section B has 14 questions, which expose variables to measure health workers' knowledge, attitudes and skills of ICT. The participants answered the questions by circling "yes" or "no" or using rating skills 1 to 4, 1 is rated as poor and 4 as excellent. Following details were included to gather

information:

1. use of cellular phone
2. availability of landline at home
3. use of personal digital assistance (PDA)
4. usage and access to personal computer (PC)
5. skills of using a Microsoft office such as word processing skills, spreadsheet, presentation, access and outlook.
6. access to internet to send emails and with or without attachment
7. digital camera for image processing, and presentation
8. use of Medline
9. adoption to technology
10. need for computer literacy
11. preference for training

Section C

The last component of the questionnaires examines the type of medical and technical devices available in each hospital. This section has two tables listed with names of medical and technical equipment. The senior officer of each hospital answered them by putting a tick to indicate if it was available and functioning or available but not functioning.

1. Table 1 includes names of medical devices, which are pulse oxymeter, electrocardiogram monitor, blood pressure monitor, foetal monitor, ultra sound scanner, glucose monitor, CAT scan, ophthalmoscope and defibrillator.

2. Table 2 contains list of ICT equipment such as personal computer, telephones lines, photocopiers, printers, digital cameras, scanners, video conferencing system and web cameras.

4.4 Sample and Data Collection

The population of the study focussed on physicians, registered nurses, community health workers, dentists, pharmacists, x-ray technicians, pathologists, physiotherapists and paramedics working in the main referral hospitals. Other ancillary staff such as drivers, cooks, cleaners, secretaries and biomedical staff were not included in the survey. They were excluded due to job description of task, as they will not be directly implementing telehealth. This will aid to exclude artifacts and erroneous results.

A sample of convenience method was applied to obtain data from the populations. This method is applied to collect a representative of each subject from the population working at that time per shift to avoid bias.

Data collected from each site was packed in an envelope with labels to avoid mixing of samples and kept away in a bag and brought to NZ. Anonymous data were coded and entered into a password protected university computer. Both electronic and hard copies were kept in a locked cabinet and would be destroyed after the completion of the report. No other person has access except the dissertation supervisors.

4.5 Procedures

The study was proposed to carry out in 20 government hospitals (appendix I) excluding the private and church run institutions due to ethical regulations of each organization. The proposal was discussed with the Director of Human Resources for National Department of Health in PNG and she volunteered to act as the contact person in PNG for any negotiations to do with dissemination and collection of questionnaires from the participating hospitals. It took three months to negotiate with the contact person in PNG and potential officers from each hospital to gather data through mail and phone, however, this concept did not eventuate as planned due to various reasons responsible officials were unavailable at either the workplace or communications failed. This has goaded the researcher to go to the study site.

Chief Executive officers (CEO) from 17 hospitals throughout the country including Director of Human Resources Manager received a letter outlining the purpose of the study attached with copies of questionnaires, ethical approvals and consent forms.

The CEO allotted either Director Medical Services or IT staff to become the team leader. The questionnaires were faxed to each hospital for team leader to distribute to the participants four weeks in advance of the researcher physically presented at the site. Prior arrangement was made with CEOs of each hospital indicating time of arrival and duration of stay before arriving. Every participant received a questionnaire with a covering letter explaining the purpose of the study, informed that it is voluntary to participate and may withdraw at anytime. They were assured of the complete confidentiality of data collected and that identity of any individuals will not be made public without their consent. All the participants signed a

consent before filling the questions in sections A and B. It took at least 5 minutes or less to complete the questionnaires, for those who wish to enter the draw to win one of the incentives wrote their names on a separate paper, and returned with completed forms to the team leader. One of the senior staff of each hospital answered section C because variables included in the questionnaires were to assess an institution rather than an individual. The actual time taken to collect the data was three weeks and another month was extended to those who did not post the questionnaires to return to the contact person in Port Moresby. This was then followed up by several phone calls and emails but the responses rate was less than favourable (refer to table 3). One of the causes for technical problems, the communications network either was down or disconnected due to non-payment of bills. Another reason was that managers responsible were attending other commitments and therefore not being available at the time of survey.

Table 3 -Distribution of study sites illustrates the outcome of the survey

Outcome	Number of Hospitals
Proposed study sites	20
Communications failed	3
Information sent but no feedback at all	8
Information sent and partially responded but no feedback after several follow up	4
Questionnaires and shipping cost delivered but no feedback after several follow up	1
Actually participated in the survey	4

The researcher distributed 850 questionnaires to 17 hospitals in December 2008 and was able to gather 174 questionnaires from four hospitals by end of January 2009. The figure below illustrates a description of the target population, sample size and the response rate. The response rate was 20.47%, which is reasonable in this study, because one study site represented each level of hospital in the country as highlighted previously. Therefore, samples collected represented a general perception of staff and the types of technologies available in other non-participating hospitals.

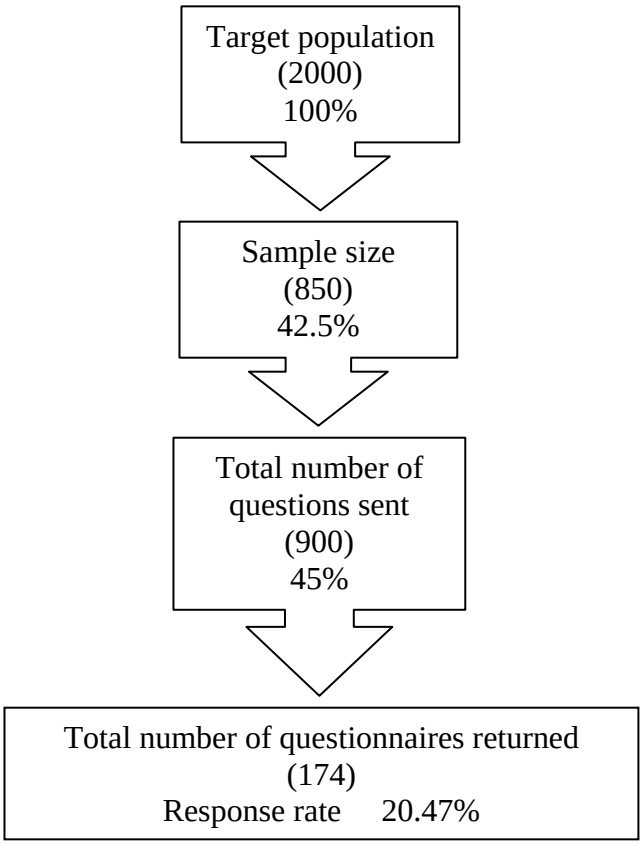

Figure 2.Flow chart indicating target population, sample and response rate.(Adopted from Sinc1air, et al., 2007)

4.6 Data Analysis s

Data collected were entered in to a spreadsheet, and then transferred into a Statistical Package for Social Sciences (SPSS) format using 17.0 versions. The descriptive statistics included frequency of tables and percentages of population. The analysis examines:

1) Comparison of demographic and socioeconomic characteristics of variables from the four hospitals.

2) Cross tabulation of associations of study instruments, which include predisposing characteristics and enabling variables. These were cross tabulated using Cochran Mantel Haenzel chi square to test for significant relations to measure the knowledge, attitudes and skills of health professionals. The model in figure 1.explicitly explains this method.

3) Comparison of hospitals to recognize the types of ICT and medical equipment available and functioning in each hospital.

4.7 Ethical Consideration

A proposal was submitted to the Human Ethic Committees of the University of Canterbury outlining the purpose of the study, methods, types of data, and how it would be collected and stored. The proposal has attached questionnaires (Appendix D), consent forms (Appendix A), information sheet for participants (Appendix B) and ethics approval from PNG Medical Research Advisory Board. An ethical clearance was obtained from the Human Ethic Committees of the University of Canterbury (Ref No. HEC 2008/132), dated 24th of November 2008. The same proposal was sent to PNG Medical Research Advisory Committees and received an approval dated 21st of

September 2008 (Ref MRAC No. 08/20). CEOs from the participating hospitals were consulted and approval was obtained to involve in the survey. All participants consented and pseudonyms will be used to ensure anonymity and confidentiality, so that it does not identify any individuals.

4.8 Chapter Conclusion

This study is based on a quantitative method using a cross-sectional survey design and it is more descriptive than experimental. Data was collected from four different hospitals across mainland New Guinea. The descriptive design used was to obtain information of associations of variables rather than to test for hypothesis. A convenience sampling method was applied to gather a sample of each category of health professional working at that time of the survey covering three shifts per day. The study proposed 20 hospitals to gather data from but due to communication failure and unavailability of responsible assistance on site, only four hospitals took part.

The response rate was 20.47% (n=174), the figure looks insignificant but, for the purpose of this study it is reasonable considering the time and resources allocated in collecting the data. Because each study site represents each level of hospitals in the country, this

could mean that samples collected represented a general perception of health professionals' knowledge, attitudes and skills of using ICT and availability of technologies in other non-participating hospitals.

Chapter Five: Results

5.1 Participants' Demographic, Social and Occupational Background

The majority of the participants were aged below 40 of years and a higher percentage of females (61.5% vs 38.5%) involved in the survey (see Table 4). More nurses (64%) have participated in the survey followed by allied health workers (14%), physicians (12%) and others (14%).

Half of the respondents were from internal medicine followed by the surgical branch and other sections. Participants from Kundiawa hospital dominated in this study, followed by Goroka, Port Moresby and Mendi.

Table 4. Demographic, social and occupational characteristics

Variable	Category	Frequency (n)	(%)
Age in years	< 30	62	35.6
	30-39	75	43.1
	40-49	30	17.2
	>= 50	7	4.10
Gender	Male	67	38.5
	Female	107	61.5
Occupation	Physician	21	12.1
	Registered Nurse	84	48.3
	Allied health Professional	24	13.8
	Paramedic	11	6.3
	Community Health Worker	27	15.5
	Other	7	4.01
Division of work	Internal medicine *[1]	67	38.5
	Surgery *[2]	52	29.9
	Allied Health *[3]	24	13.8
	Other *[4]	31	17.8
Hospital	Kundiawa	60	34.5
	Goroka	44	25.3
	Port Moresby	38	21.8
	Mendi	32	18.4

*[1] *Medical & Paediatric Units*
*[2] *General Surgery, Obstetrics & Gynaecology and Dentistry*
*[3] *Pharmacy, Radiology and Pathology)*
*[4] *Administrative officials, physiotherapist & Outpatient's Staff*

5.1.1 Predisposing Characteristics

Availability of Gadgets indicated that over 80% of respondents have used cell phones (see table 5). This signifies that people have leap frogged the technology; they use advanced and sophisticated handheld devices rather than landline phone technology. Over 90% (n = 158) of the respondents are interested to adopt new technology. This also might be an effect of age, where most of the respondents were aged 40 years or younger and hence are more receptive to adopting of new technologies compared to the older colleagues.

Table 5.-Availability of gadgets and attitude towards technology adoption

Variable	Category	Frequency (n)	(%)
Availability of Gadgets	Cell phones	153	87.9
	Landline	50	28.7
	PDA*	13	7.50
Willingness to adapt new technology	Not interested	16	9.20
	Interested	158	90.8

PDA Personal Digital Assistant*

5. 2. Enabling Variables

Over 60% of respondents have undertaken computer training and only (39%) used a personal computer at home but very few (14%) have access to the internet at the workplace (see table (6). This represents a very low access to the Internet in the workplace that might be affecting the practice of evidence-based health care. Just fewer than half of the respondents undertook basic training (40%), some attained a certificate level qualification (19%) and over 40% attained diplomas and higher degrees. There is clearly room to increase the qualification level of the majority of the workforce who responded to this study.

Table 6.**Training of computer and accessibility of resources.**

Variable	Category	Frequency (n)	(%)
Accessibility of resources	PC training	109	62.6
	PC use at home	67	38.5
	Internet at work place	24	13.8
Additional qualifications	Basic training only	69	39.7
	Certificate	29	16.7
	Diploma	33	19.0
	Degree and above	43	24.0

5.3 Need Variable

Nearly everybody 97% (n = 168) need computer literacy (see table 7). Again, this demonstrates that there is much room to provide further ICT training to the health care workforce in PNG.

Table 7.-**Need for computer literacy**

Variable	Category	Frequency (n)	(%)
Computer literacy	Need PC training	168	96.6
	Do not need PC training	6	3.41

5.4 Knowledge Components

Four questions were asked to assess the knowledge components of health workers. The questions include

- self –rated rating of skills in using Microsoft Office programmes,
- use of digital camera,
- processing of images in the computer
- frequency of utilizing a computer (see table 8).

As can be seen, 50% of staff have a self-rated lower knowledge in using a Word processor and the remainder reported that they have moderate to higher knowledge in using word processor (see table 8). The self-rated knowledge of spreadsheet software indicated that almost 60% (n = 103) have limited knowledge, with the other 40% reporting that they have higher knowledge in using spreadsheet software. Generally, a higher percentage of staff reported having a good knowledge in using word processor programmes; spreadsheet and presentation software compared to a higher figure reported lack of knowledge in handling

data management (76%) and email office programmes (78%). Use of email software is one of the main communication technologies in the developed world; this would seem to be an area where the healthcare workforce in PNG could immediately gain from further training. Possibly the limited knowledge of email software might be coupled with the limited access at work to the Internet. If access to the Internet is increased, as might be expected, then the use of email as a means of communication is also likely to increase.

Table 8.Self-rated ratings of assessing Microsoft office programmes

Variable	Category	Frequency (n)	(%)
Word processor	Low	87	50.0
	Moderate-high	87	50.0
Spreadsheet	Low	103	59.2
	Moderate-high	71	40.8
Presentation*[1]	Low	109	62.6
	Moderate-high	65	37.4
Data Management *[2]	Low	133	76.4
	Moderate-high	41	23.6
Desktop email clients *[3]	Low	136	78.2
	Moderate-high	38	21.8

*[1] Power point
*[2] Access
*[3] Outlook

Over 60% of respondents lack knowledge in handling the features of a digital camera and processing its images. If the use of digital camera technology is to be engaged as part of a telehealth practice in PNG, then more training of the healthcare workforce is required to maximise efficiencies obtained from using such technology (see Table 8.1).

Table 8. 1-Knowledgeable of handling digital camera and image processing.

Variable	Category	Frequency (n)	(%)
Handling of digital camera	Low	108	62.1
	High	66	37.9
Image processing	Low	114	65.5

	High	60	34.5

The frequency of using computer was reported by 60% (n = 106) of respondents with 40% (n = 68) reporting that they had never utilized one (See table 8.2). Unfortunately, the majority of the staff who own computers use them at home but have no access to PC at the workplace.

Table 8. 2–Frequency of using a PC.

Variable	Category	Frequency (n)	(%)
Frequency of using PC	Never used	69	39.7
	Ever used	105	60.3

5.5 Skills Components

The skills components section of the survey contained four questions, which were:

- the frequency of accessing internet
- using Medline to search for medical information
- if the staff know how to send an email and
- if they can send an email with an attachment.

These were grouped into as web surfing and email-client handling skills. The results are presented in table 9 below.

Only 11% of staff mostly physicians and administration staff, have access to the internet at their work place and almost 89% of the respondents had no access (see table 9). Seventeen percent of staff reported that they know how to use Medline to search for medical information and 83% did not know how to use Medline. About two-thirds of respondents do not know how to send emails and 28% reported that they can send an email with attachments. Therefore, most of those who reported sending an email also reported the ability to send attachments with their emails. Again, the results demonstrate clearly that low level of knowledge for the use of Internet related skills and there is an urgent need to upgrade the skills of health care workforce in these skills.

Table 9 - **Web surfing and email client-handling skills.**

Variable	Category	Frequency (n)	(%)
*[1] **Access to internet (at workplace)**	No	155	89.1
	Yes	19	10.9
***[1] Use of Medline**	No	144	82.8
	Yes	30	17.2
***[2] Sending email**	No	114	65.5
	Yes	60	34.5
***[2] Sending email with an attachment**	No	124	71.3
	Yes	50	28.3

*1 Web surfing skills, *2 Email client- handling skills

5.6 Attitude Variables

Attitude variables contained two questions on adopting technology such as new technology, for example telehealth and their choices of method of learning (see Table 10).The results on attitudes on technology adoption show over 90% of respondents were interested to adopt new technology and 9% were not (see table 10). Reported attitudes towards training preferences indicated that just over half (55%) of the respondents prefer job training followed by a quarter saying they preferred self-tutoring.

Table 10.-**Attitude of technology adoption and training preferences**

Variable	Category	Frequency (n)	(%)
Technology adoption	Not interested	16	9.20
	Interested	158	90.8
Training preferences	Job training	96	55.2
	Group training	34	19.5
	Self-tutoring	44	25.3

5.7 Cross Tabulations

A cross tabulation is a statistical method used to combine the distributions of two or more variables into a concise format for analysis and reporting. The variables are usually presented in a contingency table in a matrix format. Relevant and significant relationships of variables derived from the study are presented in tables below under each sub-section of interest.

This study uses Cochran Mantel Haenzel chi square to test for significant relations between predisposing characteristics and enabling variables to assess the knowledge, attitudes and skills of health workers working in PNG health settings as clearly demonstrated in the telehealth assessment model (figure 1).

5.8 Characteristics of predisposing variables to assess knowledge components.

There was an association found between the age group and frequency of computer usage to assess the knowledge component of the health professionals, $\chi^2 = 10.79$; d.f. =3; $p<0.05$ (see table 11). Seventy four percent of the younger age groups below 40 years of age reported using a computer often compared to those above 40 years of age. More than 70% of those over 50 years of age had never used computer.

There was no association between the gender and the frequency of computer usage, $\chi^2 = .666$; d.f = 1; $p> 0.05$. Both genders are comparably equal in utilizing and not utilizing computer. It shows a little variation with, 6% of males use computer more often compared to females.

There was an association found in the availability of gadgets such as cell phones and PDAs with the frequency of computer usage but not with the landline usage. Cell phone usage, $\chi^2 = 10.07$; d.f; = 1; $p <0.05$, PDA usage, $\chi^2 = 9.23$; d.f; = 1; $p <0.05$ and landline usage $\chi^2 = 2.73$; d.f; = 1; $p >0.05$. The analysis showed that staff with gadgets used computers more frequently compared to participants who had no gadgets for example, cell phone usage (64%), landline usage (70%) and PDA usage (100%) was related to computer usage.

However, staff without landlines 56%, PDAs 57% and cell phones 28%, handled computer often.

There was an association found in the attitude of adopting new technology with frequency of computer usage, $\chi^2 = 3.84$; d.f.= 1; $p<0.05$. Sixty three percent of people who were interested in adopting new technology utilized computers and with no interest in adopting new technology expressed by only 38% of respondents. Over 60% of staff with no interest in adopting new technology had never used computer. These results are expected as you would expect computer users are more likely to try new technology than non-computer users.

Table 11 - Predisposing Characteristics and frequency of computer use.

Predisposing Characteristics	**Category**	**Frequency of using Computer**				**p-value**
Age		Never		Ever *		
		(n)	(%)	(n)	(%)	
	<30	16	25.8	46	74.2	0.012^
	30-39	37	49.3	38	50.7	
	40-49	11	36.7	19	63.3	
	>= 50	5	71.4	2	28.6	
Gender	Male	24	35.8	43	64.2	0.413
	Female	45	42.1	62	57.9	
Cell phone	No	15	71.4	6	28.6	0.002^
	Yes	54	35.3	99	64.7	
Landline	No	54	43.5	70	56.5	0.098
	Yes	15	30.0	35	70.0	
PDA	No	69	42.9	92	57.1	0.002^
	Yes	0	0	13	100	
Attitude of adoptability	Not interested	10	62.5	6	37.5	0.050^
	Interested *	59	37.3	99	62.7	

Footnote

- *Ever* refers to use of computer either sometimes or always*
- *Interested* refers those who were both moderately or highly interested to adopt technology*
- *^ $p \leq 0.05$, refers to a statistically significant result*

There was an association between predisposing variables such as gender, age and availability of gadgets with the use of a digital camera to assess the knowledge components except for attitude of technology adoption (see Table 11.1).

Gender, $\chi^2 = 5.933$; d.f. = 1; $p < 0.05$. Forty nine percent of males were highly knowledgeable in handling digital cameras compared to females (31%). Sixty-nine percent of females lacked knowledge in handling digital camera compared to 51% of males.

Age, $\chi^2 = 16.7$; d.f = 3; $p < 0.05$. Just over half (55%) of the younger age groups below 30 years possessed higher knowledge in operating digital camera compared to 86% of respondents over 50 years of age who reported having limited knowledge (see table 11.1). In other words, people in the older age group might need extra training compared to the younger workers.

Respondents who use cell phone, landline and PDA showed a significant association, ($p < 0.05$) with knowledge of handling a digital camera. Users of the following gadgets cell phone (42%), landline (52%) and PDA (77%) self-rated reported to have advanced knowledge in operating digital cameras compared to those who did not use gadgets during the survey. For example, 86% of respondents reported having no cell phone, 68% reported having no landline, 65% reported having no PDA and they all reported lacking knowledge in using digital camera.

Attitude of adoptability to technology was not significant to the knowledge of using digital camera, $\chi^2 = 1.25$; d.f. = 1; $p > 0.05$. People with an interest in adopting technology (39%) reported having a higher knowledge in operating the digital camera than those with no interest in adopting technology (25%). Over 60% of both groups have lower knowledge in using the camera either because they did not own one or not have the knowledge to use one.

Table 11. 1 - **Predisposing Characteristics and knowledge of using digital camera handing.**

Predisposing characteristics	**Category**	**Digital camera handling**				**p-value**
		Low		High*		
		(n)	(%)	(n)	(%)	
Gender	Male	34	50.7	33	49.3	0.015^
	Female	74	69.2	33	30.8	
Age Group	<30	28	45.2	34	54.8	0.004^
	30-39	55	73.3	20	26.7	
	40-49	19	63.3	11	36.7	
	>= 50	6	85.7	1	14.3	
Cell phone	No	18	85.7	3	14.3	0.017^
	Yes	90	58.8	63	41.2	
Landline	No	84	67.7	40	32.3	0.015^
	Yes	24	48.0	26	52.0	
PDA	No	105	65.2	56	34.8	0.003^
	Yes	3	23.1	10	76.9	
Attitude of adoptability	Not interested	12	75.0	4	25.0	0.236
	Interested	96	60.8	62	39.2	

^ *$p \leq 0.05$, refers to a statistically significant result*
*High ***** means those who can takes pictures from digital camera, save it in the computer and know how to crop and resize the images.*

There was no association found in landline and technology adaption with processing of images downloaded to computer from digital camera (see table 11.2). However, there were associations between gender, age group, cell phone and PDA.

Gender, $\chi^{2} =$ 6.99; d.f. = 1; $p < 0.05$. Fourty six percent of male participants have higher knowledgeable in processing images compared to female 27%. Thus, 73% of females lack knowledge in processing images compared to male only 54%.

Age, χ^{2} = 16.7; d.f. = 3; $p < 0.05$. Fifty three percent of younger respondents below 30 years have better knowledge in processing images than 14% of those over 50 years. As age increases knowledge decreases.

Cell phone, χ^2 = 9.34; d.f. = 1; p < 0.05, PDA, χ^2 = 9.07; d.f. = 1; p< 0.05 and landline, χ^2 = 7.48; d.f. = 1; p> 0.05. Staff with gadgets have higher knowledge in processing the images; cell phone 39%, landline 50% and PDA 62% compared to staff without gadgets; cell phone 5%, landline 28% and PDA 32%.

Attitude of adapting new technology, χ^2 = 3.77; d.f. = 1; p > 0.05. People with no interests in adopting new technology have less knowledge than those with interests in adopting technology.

Table 11. 2 - Predisposing characteristics and knowledge of processing images.

Predisposing characteristics	**Category**	**Image processing**				**p-value**
		Low		High*		
		(n)	(%)	(n)	(%)	
Gender	Male	36	53.7	31	46.3	0.010
	Female	78	72.9	29	27.1	
Age Group	<30	29	46.8	33	53.2	0.001
	30-39	59	78.7	16	21.3	
	40-49	20	66.7	10	33.3	
	>= 50	6	85.7	1	14.3	
Cell phone	No	20	95.2	1	4.80	0.002
	Yes	94	61.4	59	38.6	
Landline	No	89	71.8	35	28.2	0.006
	Yes	25	50.0	25	50.0	
PDA	No	109	67.7	52	32.3	0.033
	Yes	5	38.5	8	61.5	
Attitude of adoptability	Not interested	14	87.5	2	12.5	0.052
	Interested	100	63.3	58	36.7	

High means adjust the images and can manipulate it in other office programmes such as for storage and presentation.*

There were associations between the age group, cell phone and PDA with knowledge of utilizing word processor except gender and landline (see table 11.3).

Gender, χ^2 = 1.19; d.f. = 1, p>0.05. Fifty five percent of males have moderate to higher knowledge in using word processor software compared to females 47%. This indicates male staff are more advanced in using word processor and there is a need to train females to improve their knowledge in handling this software.

Age, χ^2 = 10.5; d.f. = 3; p >0.05. Participants below 50 years of age have advanced knowledge in utilizing word processor compared to those over 50 years of age.

Cell phone, χ^2 = 4.39; d.f. = 1; p <0.05, landline, χ^2 = 2.81; d.f. = 1; p <0.05 and PDA, χ^2 = 14.1; d.f. = 1; p <0.001. Respondents with gadgets reported to have higher knowledge in handling word processor than staff without any gadgets. For instance, 100% of staff with PDA were advanced in using word processor compared to those without PDA only 54% have moderate to higher knowledge in using word processor. This signifies that availability of gadgets enhance staff's knowledge in using word processor software.

Table 11. 3- Predisposing characteristics related to knowledge of word processing.

Predisposing characteristics	**Category**	**Word processor**				**p-value**
		Low (n)	(%)	Moderate –high * (n)	(%)	
Gender	Male	30	44.8	37	55.2	0.275
	Female	57	53.3	50	46.7	
Age Group	<30	22	35.5	40	64.5%	0.015
	30-39	46	61.3	29	38.7	
	40-49	14	46.7	16	53.3	
	>= 50	5	71.4	2	28.6	
Cell phone	No	15	71.4	6	28.6	0.036
	Yes	72	47.1	81	52.9	
Landline	No	57	46	67	54	0.094
	Yes	20	40.0	30	60.0	
PDA	No	87	50.0	87	50.0	0.000
	Yes	0	0	13	100	

**refers to as good, very good and excellent levels of using MS office suites*

There was an association between landline and spreadsheet but no significant relationship was found between age, gender, cell phone and PDA (see table 11.4).

Gender, χ^2 = 1.35; d.f. = 1; p> 0.05. Forty six percent of male staff had moderate to high knowledge in using spreadsheet than females 37%. This means 63% of females lack knowledge in using spreadsheet compared to male 54%.

Age, χ^2 = 11.9; d.f. = 3; p >0.05. Younger age groups below 30 years 56% and those between 40-49 43% reported that they have advanced knowledge in handling spreadsheet compared to others. Over 70% of respondents between 30-39 and over 50 years age groups lacked knowledge in using spreadsheet.

Usage of cell phone and PDA were not significant with usage of spreadsheet software with a p value less than 0.05 and only landline showed positive association. Generally, participants with gadgets reported to have high knowledge in using spreadsheet than staff without gadgets.

Table 11. 4- Predisposing characteristics related to knowledge of using spreadsheet

Predisposing characteristics	**Category**	**Spreadsheet**				**p-value**
		Low		Moderate –high		
		(n)	(%)	(n)	(%)	
Gender	Male	36	53.7	31	46.3	0.246
	Female	67	62.6	40	37.4	
Age Group	<30	27	43.5	35	56.5	0.008
	30-39	54	72.0	21	28	
	40-49	17	56.7	13	43.3	
	>= 50	5	71.4	2	28.6	
Cell phone	No	16	76.2	5	23.8	0.091
	Yes	87	56.9	66	43.1	
Landline	No	80	64.5	44	35.5	0.025
	Yes	23	46.0	27	54.0	
PDA	No	106	62.1	61	37.9	0.006
	Yes	3	23.1	10	76.9	

Gender, age and gadgets were all associated with usage of PowerPoint presentation software (see table 11.5).

Gender, χ^2 = 5.04; d.f. = 1; <0.05. About 48% of male staff had higher knowledge of using presentation software programme compared to females 31%.

Age, χ^2 = 19.9; d.f. = 3; = p <0.001. Again, male staff (48%) possessed higher knowledge in handling presentation software (PowerPoint) than female participants 31%. Female staff reported to lack the knowledge in handling presentation software and therefore, training will be focused more on female than male staff.

Cell phone, χ^2 = 5.43; d.f. = 1; p<0.05, landline, χ^2 = 10.4; d.f. = 1, p< 0.05 and PDA, χ^2 = 9.39; d.f. = 1; p< 0.05. Staff with gadgets have moderate to high knowledge in using presentation programme compared to staff without gadgets during the survey. Availability of gadgets increases the knowledge of using Microsoft office suites.

Table 11. 5- Associations between predisposing characteristics and knowledge of using presentation.

Predisposing characteristics	Category	Presentation				p-value
		Low		Moderate –high		
		(n)	(%)	(n)	(%)	
Gender	Male	35	52.2	32	47.8	0.025
	Female	74	69.2	33	30.8	
Age Group	<30	26	41.9	36	58.1	0.000
	30-39	58	77.3	17	22.7	
	40-49	19	63.3	11	36.7	
	>= 50	6	85.7	1	14.3	
Cell phone	No	18	85.7	3	14.3	0.020
	Yes	91	59.5	62	40.5	
Landline	No	87	70.2	37	29.8	0.001
	Yes	22	44.0	28	56.0	
PDA	No	106	65.8	55	34.2	0.002
	Yes	3	23.1	10	76.9	

There was no association found in age group and cell phone related to knowledge of using data management software programme except gender, landline and PDA were significantly associated (see table 11.6).

Gender, χ^2 = 7.10; d.f. = 1; p < 0.05. Male staff had high knowledge in utilizing using the database management programme compared to females.

Age, χ^2 =6.38; d.f. = 3; p >0.05. As age increases the level of knowledge decreases. For instance, 34% of staff below the age of 30 years have moderate to high knowledge in using database than staff over 50 years of age 14%.

Cell phone, χ^2 = 2.61; d.f. = 1; p >0.05, landline, χ^2 = 8.12; d.f. = 1; p <0.05 and PDA, χ^2 = 3.98; d.f. = 1; p <0.05. Participants who used gadgets have higher knowledge in using database management programme and those without any gadgets lack knowledge.

Table 11. 6- Predisposing characteristics and knowledge of using data management.

Predisposing characteristics	Category	Data management				p-value
		Low		Moderate -high		
		(n)	(%)	(n)	(%)	
Gender	Male	44	65.7	23	34.3	0.008
	Female	89	83.2	18	16.8	
Age Group	<30	41	66.1	21	33.9	0.095
	30-39	63	84	12	16	
	40-49	23	76.7	7	23.3	
	>= 50	6	85.7	1	14.3	
Cell phone	No	19	90.5	2	9.5	0.106
	Yes	114	74.5	39	25.5	
Landline	No	102	82.3	22	17.7	0.004
	Yes	31	62.0	19	38.0	
PDA	No	126	78.3	35	21.7	0.046
	Yes	7	53.8	6	46.2	

There was association between age and gadgets knowledge of handling with email-client interaction (see table 11.7).

Gender, χ^2 = 1.61; d.f. = 1; p >0.05. Twenty seven percent of males have higher knowledge in using email client interaction compared to females 19%.

Age, χ^2 = 9.53; d.f. = 3; p<0.05. Staff below the age groups of 30 years was likely to be highly knowledgeable in handling email software programme compared to staff over 40 years of age.

Cell phone, χ^2 = 6.67; d.f. = 1; p< 0.05., landline, χ^2 = 4.24; d.f. = 1; p< 0.05 and PDA, χ^2 = 8.43; d.f. = 1; p <0.05. Participants who owned and used gadgets reported to have high knowledge in using email client office programme compared to those without gadgets.

Table 11. 7-Predisposing characteristics and knowledge of using email client interaction.

Predisposing characteristics	**Category**	**Email client interaction**				**p-value**
		Low		Moderate –high		
		(n)	(%)	(n)	(%)	
Gender	Male	49	73.1	18	26.9	0.204
	Female	87	81.3	20	18.7	
Age Group	<30	41	66.1	21	33.9	0.023
	30-39	64	85.3	11	14.7	
	40-49	24	80	6	20	
	>= 50	7	100	0	0.00	
Cell phone	No	21	100	0	0.00	0.010
	Yes	115	75.2	38	24.8	
Landline	No	22	17.7	102	82.3	0.039
	Yes	34	68.0	16	32.0	
PDA	No	130	80.7	31	19.3	0.004
	Yes	6	46.2	7	53.8	

5.9 Predisposing Variables Assessing the Attitude Variables.

The attitude variables include adoption to new technology and the preferences of training.

Predisposing variables with attitude to technology indicate that gender, age, landline and PDA show no significant association (see table 12). However, there was a significant relation with owing of cell phone with technology adoption.

Gender, χ^2 = .983; d.f. = 1; p > 0.05. Both genders showed positive attitude towards adopting new technology. Age, χ^2 = 3.58; d.f. = 3; p > 0.05. There was willingness to learn as the age increases, for instances, 100% of staff over the age group of 50 years were interested to adopt new technology.

Cell phone, χ^2 = 10.7; d.f. = 1; p <0.05. Twenty eight percent of respondents with no cell phones were not interested to adopt technology, however it shows over 70% of respondents who had no cell phones and 93% with cell phones were highly motivated to adopt new technology. Landline, χ^2 = 1.20; d.f. = 1; p > 0.05 and PDA, χ^2 = 1.42; d.f. = 1; p > 0.05. Most of the participants, with or without landline and PDA showed positive attitude towards adopting new technology. This kind of positive attitude indicates that health professionals in PNG are receptive to adopting telehealth in their health settings.

Table 12. ***Predisposing characteristics and attitude towards technology adaption***

Predisposing characteristics	**Category**	**Technology Adaption**				**p-value**
		Not interested (n)	(%)	Interested (n)	(%)	
Gender	Male	8	11.9	59	88.1	0.321
	Female	8	7.50	99	92.5	
Age	< 30	5	8.1	57	91.9	0.311
	30-39	10	13.3	65	86.7	
	40-49	1	3.3	29	96.7	
	>= 50	0	0.00	7	100	
Cell phone	No	6	28.6	15	71.4	0.001
	Yes	10	6.50	143	93.0	
Landline	No	12	9.70	112	90.3	0.729
	Yes	4	8.00	46	92.0	
PDA	No	16	9.90	145	90.1	0.233
	Yes	0	0.00	13	100	

There were no significant associations found between gender, age and gadgets with the attitude of training preferences (see table 12.1).

Gender, $\chi^2 = 1.64$; d.f. = 2; $p > 0.05$. Almost equal number of percentages from both genders prefers job training and self-tutoring except in-group training, 22% of female in favour of the last style of learning method compared to male 15%.

Age, $\chi^2 = 9.71$; d.f. = 6; $p > 0.05$. Seventy percent of participants over the age of 50 years prefer job training, followed by those between the age groups of 40-49 and 30-39.

Cell phone, $\chi^2 = 0.040$; d.f. = 2; $p > 0.05$. Over 50% of staff with or without cell phones prefer job training followed by self-tutoring. Landline, $\chi^2 = .062$; d.f. = p > 0.05. PDA, $\chi^2 = 4.26$; d.f. = 2; $p > 0.05$. Over 50% participants with or without gadgets prefer job training, followed by self -tutoring.

Table 12. 1**Predisposing characteristics and training attitude**

Predisposing characteristics	**Category**	**Training attitude**						**p-value**
		Job training (n)	(%)	Group training (n)	(%)	Self-tutoring (n)	(%)	
Gender	Male	38	56.7	10	14.9	19	28.4	0.440
	Female	58	54.2	24	22.4	25	23.4	
Age	< 30	27	43.5	19	30.6	16	25.8	0.137
	30-39	44	58.7	10	13.3	21	28.0	
	40-49	20	66.7	4	13.3	6	20.0	
	>= 50	5	71.4	1	14.3	1	14.3	
Cell phone	No	12	57.1	4	19.1	5	23.8	0.980
	Yes	84	54.9	30	19.6	39	25.5	
Landline	No	68	54.8	24	19.4	32	25.8	0.969
	Yes	28	56.0	10	20.0	12	24.0	
PDA	No	92	57.1	29	18.0	40	24.8	0.119
	Yes	4	30.8	5	38.5	4	30.8	

Gender and PDA were significantly associated with skills of using web surfing but age; cell phone and landline were not significant (see table 13).

Gender, $\chi^2 = 7.72$; d.f. = 1; $p < 0.05$. About 33% of male participants reported to have higher web surfing skills compared to female participants 15%.

Age, $\chi^2 = 3.38$; d.f. = 3; $p > 0.05$. Participants from the older age groups have less web surfing skills than those below the age group of 50 years.

Cell phone, $\chi^2 = 2.12$; d.f. = 1; $p > 0.05$, landline, $\chi^2 = 2.74$; d.f. = 1; $p > 0.05$ and PDA $\chi^2 = 4.87$; d.f. = 1; $p < 0.05$. The skills of handling web surfing is low for those who both own gadgets or not. Though there is a little difference for staff who own PDA, 46% of them had advanced skills of web surfing compared to those with cell phone and landline.

Table 13. Predisposing characteristics with web surfing skills

Predisposing characteristics	Category	web surfing skills *				p-value
		Low		High		
		(n)	(%)	(n)	(%)	
Gender	Male	45	67.2	22	32.8	0.005
	Female	91	85.0	16	15.0	
Age	< 30	46	74.2	16	25.8	0.337
	30-39	61	81.3	14	18.7	
	40-49	22	73.3	8	26.7	
	>= 50	7	100	0	0.00	
Cell phone	No	19	90.5	2	9. 50	0.145
	Yes	117	76.5	36	23.5	
Landline	No	101	81.5	23	18.5	0.098
	Yes	35	70.0	15	30.0	
PDA	No	129	80.1	32	19.9	0.027
	Yes	7	53.8	6	46.2	

***** *Can both access to internet and know how to use Medline to search for medical information*

Gender, age, landline and PDA were not significantly associated with email client-handling skills except cell phone was significant (see table 13.1).

Gender, $\chi^2 = 7.29$; d.f. = 1; $p > 0.05$. Forty nine percent of male reported to have higher skills in handling email client interaction compared to female 29%. However, both genders male (50%) and female (71%) reported to have limited skills in handling email programme comparably.

Age, $\chi^2 = 12.2$; d.f. = 3; $p > 0.05$. As age, increases email client handling skills declines. For instance, those over the age groups of 50 years 14% had high skills in using email programme compared to those below 30 years of age 53%. The younger age groups were more skilful in using email client interaction programme.

Cell phone, $\chi^2 = 5.19$; d.f. = 1; $p < 0.05$, landline $\chi^2 = 3.79$; d.f. =1 $p > 0.05$ and PDA, $\chi^2 = 3.70$; d.f. = 1; $p > 0.05$. Generally, staff with gadgets reported to have advanced skills

compared to those without gadgets, but majority of them with or without gadgets lack skills in handling email client interactions.

Table 13. 1 Predisposing characteristics and email client handling skills

Predisposing characteristics	Category	Email client interaction skills *				p-value
		Low		High		
		(n)	(%)	(n)	(%)	
Gender	Male	34	50.7	33	49.3	.007
	Female	76	71.0	31	29.0	
Age	< 30	29	48.6	33	53.2	0.007
	30-39	55	73.3	20	26.7	
	40-49	20	66.7	10	33.3	
	>= 50	6	85.7	1	14.3	
Cell phone	No	18	85.7	3	14.3	0.023
	Yes	92	60.1	61	39.9	
Landline	No	84	67.7	40	32.3	0.051
	Yes	26	52.0	24	48.0	
PDA	No	105	65.2	56	34.8	0.054
	Yes	5	38.5	8	61.5	

***** *can send email and with attachments.*

5.10 Enabling Variables and Knowledge Components.

All the enabling variables have significant associations with frequency of computer usage (see table 14).

Additional qualifications and frequency of computer usage, χ^2 = 22.7; d.f. = 6; p <0.05. Seventy seven percent of people with higher degrees used computers either always or sometimes compared to staff with lower levels of education.

Computer training, χ^2 = 65.3; d.f. = 1; p <0.001. Eighty four percent of people who have done computer training used personal computers often compared to those without computer training. 22%. PC at home and frequency of computer usage, χ^2 = 56.3; d.f. = 1; p < 0.001.

Respondents who have computers at home reported utilizing computer regularly compared to those who did not own computers.

Internet available at work place and frequency of computer usage, $\chi^2 = 6.15$; d.f. = 1; $p < 0.05$. Eighty three percent of respondents that had access to internet at the workplace utilized computer regularly compared to 57% of staff without access. This result indicates that health workers, who had accessed internet, used this technology to search for medical information and for effective and efficient means of communications, either with other co-workers or for consultation.

Table 14. Additional qualifications and enabling resources with frequency of using computer

Enabling variables	Category	Frequency of PC use				p-value
Additional qualifications		Never used (n)	(%)	Ever used (n)	(%)	
	Basic training only	34	49.3	35	50.7	0.024
	Certificate	16	48.5	17	51.5	
	Diploma	9	31.0	20	69.0	
	Degree & above	10	23.3	33	76.7	
PC training	No	51	78.5	14	21.5	0.000
	Yes	18	16.5	91	83.5	
PC at home	No	66	61.7	41	38.3	0.000
	Yes	3	4.50	64	95.5	
Internet at work	No	65	43.3	85	56.7	0.013
	Yes	4	16.7	20	83.3	

Additional qualifications, computer training, availability of computer at home and internet at the work place have significant associations with knowledge of using word processing (see table 14.1).

Additional qualifications, $\chi^2 = 12.8$; d.f. = 3; $p < 0.05$. Apparently, 72% of staff with higher degrees reported to have advanced knowledge in using word processor followed by participants with diplomas 48%, basic training 45% and certificates 33%.

PC training and word processor have strong relations, $\chi^2 = 49.7$; d.f. = 1; $p < 0.001$. People who have done computer training, 71% reported that they had advanced knowledge to use word processor compared to those without computer training 15%. This result clearly

justifies that ICT training enables staff to utilize a Microsoft Office suite programme with ease and improve their perception about the particular software.

PC at home, $\chi^2 = 44.9$; d.f. = 1; $p < 0.001$. Staff that had computers at home, 82% have higher knowledge in using word processing compared to those without computers available at home 30%.

Internet at work place, $\chi^2 = 4.83$; d.f. = 1; $p < 0.05$. Seventy one percent of people who accessed the internet at the workplace reported having moderate to high knowledge in using word processor compared to staff without access to interne.

Table 14. 1 - Additional qualifications and enabling resources with knowledge of using word processing

Predisposing Variable	Category	Word processor				p-value
		Low		Moderate-high		
		(n)	(%)	(n)	(%)	
Qualifications	Basic training	38	55.1	31	44.9	0.005
	Certificate	22	66.7	11	33.3	
	Diploma	15	51.7	14	48.3	
	Degree & above	12	27.9	31	72.1	
PC training	No	55	84.6	10	15.4	0.000
	Yes	32	29.4	77	70.6	
PC at home	No	75	70.1	32	29.9	0.000
	Yes	12	17.9	55	82.1	
Internet at work	No	80	53.3	70	46.7	0.028
	Yes	7	29.2	17	70.8	

Attaining of additional qualifications, computer training, availability of computer at home and internet at work place all have significant relations with knowledge of using spreadsheet (see table 14.2).

Additional qualifications, $\chi^2 = 15.5$; d.f. = 3; $p < 0.05$. Again, staff with higher degrees have advanced knowledge in using spreadsheet compared to those with lower qualifications.

Computer training, $\chi^2 = 47.1$; d.f. = 1; $p < 0.001$. Sixty one percent of participants who have done computer training are better at handling spreadsheets than 8% of those without computer training.

Availability of computer at home, $\chi^2 = 51.6$; d.f. = 1; $p < 0.001$. Seventy five percent of staff who access computers at home and frequently use them are highly knowledgeable in handling spreadsheet software compared to 20% of staff without access to personal computers at home.

Internet at the work place, $\chi^2 = 10.4$; d.f. = 1; $p < 0.05$. Participants who reported accessing internet at workplace had high knowledge in handling spreadsheet compared to those without access to internet.

Table 14. 2 - Additional qualifications and enabling resources with knowledge of using spreadsheet

Predisposing Variable	Category	Spreadsheet				p-value
		Low		Moderate -high		
		(n)	(%)	(n)	(%)	
Qualifications	Basic training	40	58.0	29	42.0	0.001
	Certificate	25	75.8	8	24.2	
	Diploma	22	75.9	7	24.1	
	Degree & above	16	37.2	27	62.8	
PC training	No	60	92.3	5	7.70	0.000
	Yes	43	39.4	66	60.6	
PC at home	No	86	80.4	21	19.6	0.000
	Yes	17	25.4	50	74.6	
Internet at work	No	96	64.0	54	36.0	0.001
	Yes	7	29.2	17	70.8	

Attaining of additional qualifications, computer training, availability of computer at home and internet at work place all have significant relations with knowledge of using presentation programme (14.3).

Additional qualifications, $\chi^2 = 10.0$; d.f. = 3; $p < 0.05$. Health workers who obtained higher qualifications during their career possess higher knowledge in using power point presentation programme compared to staff with lower level of education.

PC training, $\chi^2 = 31.3$; d.f. = 1; $p < 0.001$, PC at home, $\chi^2 = 54.7$; d.f. = 1; $p < 0.001$, Internet at work place, $\chi^2 = 12.9$; d.f. = 1; $p < 0.001$. It is very obvious that participants who have done computer training, have access to computers at home and internet at the

working environment reported that they had moderate to high level of knowledge in handling presentation software than those without any training or access to ICT resources.

Table 14. 3 - **Additional qualifications and enabling resources with knowledge of using presentation**.

Predisposing Variable	Category	Presentation				p-value
		Low		Moderate -high		
		(n)	(%)	(n)	(%)	
Qualifications	Basic training	44	63.8	25	36.2	0.018
	Certificate	27	81.8	6	18.2	
	Diploma	18	62.1	11	37.9	
	Degree & above	20	46.5	23	53.5	
PC training	No	58	89.2	7	10.8	0.000
	Yes	51	46.8	58	53.2	
PC at home	No	90	84.1	17	15.9	0.000
	Yes	19	28.4	48	71.6	
Internet at work	No	102	68.0	48	32.0	0.000
	Yes	7	29.2	17	70.8	

Additional qualifications, computer training, availability of computers at home and internet at workplace are all significantly associated with knowledge of handling database management (see table 14.4).

Additional qualification, $\chi^2 = 9.26$; d.f. = 3; $p > 0.05$. Participants with low levels of education have lower knowledge in handling data management programme; on the other hand, highly educated staff reported having higher level of knowledge in using the same software.

Computer training, $\chi^2 = 20.6$; d.f. = 1; $p < 0.001$, usage of computers at home, $\chi^2 = 39.9$; d.f. = 1; $p < 0.001$ and having access to internet at working environment, χ^2 (4, N = 14.5; d.f. = 1; $p < 0.001$. Staff who have done computer training, having access to PC at home and internet at the workplace possess moderate to higher knowledge in using data management compared to those with no training or access to any of the resources mentioned above.

Table 14. 4 - Additional qualifications and enabling resources with knowledge of using data base management.

Predisposing Variable	Category	Data management				p-value
		Low		Moderate -high		
		(n)	(%)	(n)	(%)	
Qualifications	Basic training	54	78.3	15	21.7	0.026
	Certificate	29	87.9	4	12.1	
	Diploma	24	82.8	5	17.2	
	Degree & above	26	60.5	17	39.5	
PC training	No	62	95.4	3	4.60	<0.001
	Yes	71	65.1	38	34.9	
PC at home	No	99	92.5	8	7.50	<0.001
	Yes	34	50.7	33	49.3	
Internet at work	No	122	81.3	28	18.7	<0.001
	Yes	11	45.8	13	54.2	

Additional qualifications, computer training, accessibility of computer at home and internet at work place all have significant relations to handling email programme (see table 14.5).

Additional qualification, χ^2 = 15.5; d.f. = 3; p <0.05. About 40% of staff with higher degrees reported to having high knowledge in email software than those with lower educational qualifications. Comparably more than 60% in all categories of qualifications attained lacked knowledge in handling email client-handling programmes. This result indicates that there is a room to conduct more training in this area.

Computer training, χ^2 = 18.3; d.f. = 3; p < 0.001, computer usage at home, χ^2 = 38.1; d.f. = 1; p < 0.001 and accessing internet at work place, χ^2 = 12.9; d.f. = 1; p < 0.001. Participants who have done computer training, having access to computers at home and internet at the working environment have advanced knowledge in using email programme compared to those with no access to any ICT resources. Comparably all groups still lack knowledge and need more training and access to internet.

Table 14. 5 - **Additional qualifications and enabling resources with knowledge of email client interaction.**

Predisposing Variable	Category	Email client interaction				p-value
		Low		Moderate-high		
		(n)	(%)	(n)	(%)	
Qualifications	Basic training	54	78.3	15	21.7	0.002
	Certificate	32	97.0	1	3.00	
	Diploma	24	82.8	5	17.2	
	Degree & above	26	60.5	17	39.5	
PC training	No	62	95.4	3	4.60	0.000
	Yes	74	67.9	35	32.1	
PC at home	No	100	93.5	7	6.50	0.000
	Yes	36	53.7	31	46.3	
Internet at work	No	124	82.7	26	17.3	0.000
	Yes	12	50.0	12	50.0	

5.11 Enabling Variables with Attitude Variables.

There was no significant relationships found in additional qualifications and enabling resources, yet both variables showed that health professionals were highly motivated to adopt new technology (see table 15).

Additional qualifications with technology adoption, $\chi^2 = 6.20$; d.f = 3; $p > 0.05$. Respondents with higher degrees reported to be highly motivated to learn new technology. Apparently, over 84% of all levels of qualifications attained were highly interested to adopt technology.

Computer training, $\chi^2 = 2.67$; d.f = 1; $p > 0.05$, computer usage at home, $\chi^2 = 2.90$; d.f. = 1; $p > 0.05$ and access to internet at workplace, $\chi^2 = .843$; d.f. = 1; $p > 0.05$. The self-rated attitudes of staff adopting new technology is very high for all categories of people with additional qualifications and those who have or not done computer training and having or no access to ICT resources.

Table 15. Additional qualifications and enabling resources with attitude towards technology adoption.

Enabling variables	Category	Technology adaptation attitude				p-value
		Not interested (n)	(%)	Interested (n)	(%)	
Qualifications	Basic training	9	13.0	60	87.0	0.102
	Certificate	5	15.2	28	84.8	
	Diploma	1	3.40	28	96.6	
	Degree & above	1	2.30	42	97.7	
PC training	No	9	13.8	56	86.2	0.101
	Yes	7	6.40	102	93.6	
PC at home	No	13	12.1	94	87.9	0.088
	Yes	3	4.50	64	95.5	
Internet at work	No	15	10.0	135	90.0	0.358
	Yes	1	4.20	23	95.8	

There were no significant relationships found in additional qualifications and enabling resources with attitudes towards training preferences (see table 15.1).

Additional qualifications, $\chi^2 = 6.28$; d.f. = 6; $p > 0.05$. A higher percentage of staff in all categories of additional qualifications preferred job training followed by self-tutoring and group training.

Computer training, $\chi^2 = 1.37$; d.f. 2; $p > 0.05$, usage of computers at home, $\chi^2 = 0.133$; d.f. = 2; $p > 0.05$ and access internet at workplace $\chi^2 = 2.48$; d.f. = 2; $p > 0.05$. All categories of health workers who had access or no access to computer training and ICT resources prefer job training followed by self-tutoring. Only few respondents prefer group training particularly females.

Table 15. 1 - **Additional qualifications and enabling resources with attitude of training preferences.**

Enabling variables	Category	Training preferences						p-value
Additional qualifications		Job training (n)	(%)	Group training (n)	(%)	Self-tutoring (n)	(%)	
	Basic training only	35	50.7	14	20.3	20	29.0	0.392
	Certificate	18	54.5	8	24.2	7	21.2	
	Diploma	13	44.8	7	24.1	9	31.0	
	Degree & above	30	69.8	5	11.6	8	18.6	
PC training	No	39	60.0	10	15.4	16	24.6	0.503
	Yes	57	52.3	24	22.0	28	25.7	
PC at home	No	58	54.2	21	19.6	28	26.2	0.935
	Yes	38	56.7	13	19.4	16	23.9	
Internet at work place	No	84	56.0	31	20.7	35	23.3	0.289
	Yes	12	50.0	3	12.5	9	37.5	

5.12 Enabling variables with skills.

Additional qualifications, computer training, accessibility of computers at home and internet at workplace all have strong significant associations with handling email client handling skills (see table 16).

Additional qualifications, $\chi^2 = 18.5$; d.f. = 3; $p < 0.001$. Fifty eight percent of staff with higher degrees reported to have higher skills in using email client-handling programme, followed by those who did basic training only 40%. Those with diplomas and certificates reported to have lower skills.

Computer training, $\chi^2 = 17.6$; d.f. = 1; $p < 0.001$, usage of computers at home, $\chi^2 = 39.1$; d.f. = 1; $p < 0.001$ and access to internet at workplace, $\chi^2 = 13.8$; d.f.; = 1; $p < 0.001$. Participants who have done computer training and having access to ICT resources reported with advanced skills in handling email programmes than those without computer training and access to ICT facilities.

Table 16. Additional qualifications and enabling resources with email client interaction.

Enabling variables	Category	Email client handling skills				p-value
Additional qualifications		Low		High		
		(n)	(%)	(n)	(%)	
	Basic training only	41	59.4	28	40.6	0.000
	Certificate	27	81.8	6	18.2	
	Diploma	24	82.2	5	17.8	
	Degree & above	18	41.9	25	58.1	
PC training	No	54	83.1	11	16.9	0.000
	Yes	56	51.4	53	48.6	
PC at home	No	87	81.3	20	18.7	0.000
	Yes	23	34.3	44	65.7	
Internet at work place	No	103	68.7	47	31.3	0.000
	Yes	7	29.2	17	70.8	

Additional qualifications, computer training, accessibility of computers at home and internet at workplace all have strong significant associations with handling web surfing skills (see table 16.1).

Additional qualification and web surfing skills, $\chi^2 = 21.5$; d.f. = 3; $p < 0.001$. Participants with higher degrees have advanced skills in using web surfing compared to those with lower educational qualifications.

PC training, $\chi^2 = 17.6$; d.f. = 1; $p < 0.001$, computer usage at home, $\chi^2 = 38.1$; d.f. = 1; $p < 0.001$ and access to internet at workplace, $\chi^2 = 46.1$; d.f. = 1; $p < 0.001$. Participants who have done computer training and having access to ICT reported to have advanced skills in handling web surfing compared to those with no computer training or access to ICT resources.

Table 16. 1 - Additional qualifications and enabling resources with web surfing skills

Enabling variables	Category	Web surfing skills				p-value
Additional qualifications		Low (n)	(%)	High (n)	(%)	
	Basic training only	54	78.3	15	21.7	0.000
	Certificate	30	90.9	3	9.10	
	Diploma	28	96.6	1	3.40	
	Degree & above	24	55.8	19	44.2	
PC training	No	60	92.3	5	7.70	0.000
	Yes	76	69.7	33	30.3	
PC at home	No	100	93.5	7	6.50	0.000
	Yes	36	53.7	31	46.3	
Internet at work place	No	130	86.7	20	13.3	0.000
	Yes	6	25.0	18	75.0	

There were no significant associations found between additional qualifications and internet at workplace with skills of operating digital camera but there were strong positive relations between computer training and usage of computer at home (see table 13.2).

Additional qualifications with usage of digital camera, $\chi^2 = 12.3$; d.f. = 3; $p > 0.05$. As educational attainment improves, self- reported skills of using digital camera improve. This has implications for health professionals in the area of telehealth practice.

Computer training, $\chi^2 = 25.6$; d.f. = 1; $p < 0.001$, usage of computers at home, $\chi^2 = 72.8$; d.f. = 1; $p < 0.001$ and access to internet at workplace, χ^2 7.14; d.f. = 1; $p > 0.05$.

Staff who have done computer training and using it at home, and accessing internet at the workplace have higher skills in using digital cameras compared to those who had no training or access to internet.

Table 16. 2- **Additional qualifications and enabling resources with skills of handling digital cameras**.

Enabling variables	Category	Digital camera handling skills *				p-value
Additional qualifications		Low (n)	(%)	High (n)	(%)	
	Basic training	41	59.4	28	40.6	0.006
	Certificate	26	78.8	7	21.2	
	Diploma	22	75.9	7	24.1	
	Degree & above	19	44.2	24	55.8	
PC training	No	56	86.2	9	13.8	0.000
	Yes	52	47.7	57	52.3	
PC at home	No	93	86.9	14	13.1	0.000
	Yes	15	22.4	52	77.6	
Internet at work place	No	99	66.0	51	34.0	0.008
	Yes	9	37.5	15	62.5	

** Can handle digital camera to take still pictures of images and able to crop images.*

There were no significant associations found between additional qualifications and skills of processing images transferred from digital camera to computer except all other enabling resources were strongly associated (see table 16.3).

Additional qualifications, $\chi^2 = 11.9$; d.f. = 3; $p < 0.05$. Fifty one percent of respondents with higher degrees have advanced skills in processing images, followed by basic training 38% and the rests rated as having lower skills.

Computer training, $\chi^2 = 22.6$; d.f. = 1; $p < 0.001$, usage of PC at home, $\chi^2 = 66.6$; d.f. = 1; $p < 0.001$ and access to internet at workplace, $\chi^2 = 12.8$; d.f. = 1; $p < 0.001$. Staff that did computer training and had access to ICT resources reported having higher skills in handling image processing than those with no training or access to any ICT resources.

Table 16. 3 **Additional qualifications and enabling resources with image processing skills**

Enabling variables	Category	Image processing skills *				p-value
Additional qualifications		Low (n)	(%)	High (n)	(%)	
	Basic training	43	62.	26	37.7	0.008
	Certificate	27	81.8	6	18.2	
	Diploma	23	79.3	6	20.7	
	Degree & above	21	48.8	22	51.2	
PC training	No	57	87.7	8	12.3	0.000
	Yes	57	52.3	52	47.7	
PC at home	No	95	88.8	12	11.2	0.000
	Yes	19	28.4	48	71.6	
Internet at work place	No	106	70.7	44	29.3	0.000
	Yes	8	33.3	16	66.7	

***** *Able to download images from digital cameras to computer, adjusting the images and do presentations.*

5.13. Stock Take of Medical and ICT Devices available in each Hospital.

This was an exploratory assessment done to identify the basic medical and ICT devices available and operating in each hospital.

Nearly all the hospitals have the basic necessary medical devices except CAT scan is available in the country's national referral hospital, which is Port Moresby (see tables 17-17.3). Other diagnostic tools such as fetal monitor and glucose monitor were not available in Mendi hospital at the time of the survey.

The basic daily applications of ICT devices were available in all the hospitals except advanced technologies such as video conferencing system, web cameras, digital cameras differs from each hospital.

Table 17. **Stock takes of medical and ICT devices in Kundiawa hospital.**

Hospitals	Kundiawa	Available (Yes)	Available (No)	Functioning (Yes)	Functioning (No)
Medical devices	Pulse oxymeter	√		√	
	Electrocardiogram	√		√	
	Blood pressure Monitor	√		√	
	Fetal Monitor	√		√	
	Glucometer	√		√	
	Defibrillator	√		√	
	Ultra sound scan	√		√	
	Ophthalmoscope	√		√	
	CAT scan		√		
ICT devices	Personal computer	√		√	
	Scanners	√		√	
	Photocopier	√		√	
	Printers	√		√	
	Internet	√		√	
	Landlines	√		√	
	Digital camera		√		
	Videoconference system	√			√
	Web camera		√		

Table 17. 1 - **Stock takes of medical and /ICT devices in Goroka hospital**

Hospitals	Goroka	Available (Yes)	Available (No)	Function (Yes)	Function (No)
Medical devices	Pulse oxymeter	√		√	
	Electrocardiogram	√		√	
	Blood pressure Monitor	√		√	
	Fetal Monitor	√		√	
	Glucometer	√		√	
	Defibrillator	√		√	
	Ultra sound scan	√		√	
	Ophthalmoscope	√		√	
	CAT scan		√		
ICT devices	Personal computer	√		√	
	Scanners	√		√	
	Photocopier	√		√	
	Printers	√		√	
	Internet	√		√	
	Landlines	√		√	
	Digital camera	√		√	
	Videoconference system		√		
	Web Camera		√		

Table 17. 2- **Stock takes of medical and ICT devices in Port Moresby hospital**

Hospitals	**Port Moresby**	**Available** (Yes)	(No)	**Function** (Yes)	(No)
Medical devices	Pulse oxymeter	√		√	
	Electrocardiogram	√		√	
	Blood pressure Monitor	√		√	
	Fetal Monitor	√		√	
	Glucometer	√		√	
	Defibrillator	√		√	
	Ultra sound scan	√		√	
	Ophthalmoscope	√		√	
	CAT scan	√		√	
ICT devices	Personal computer	√		√	
	Scanners	√		√	
	Photocopier	√		√	
	Printers	√		√	
	Internet	√		√	
	Landlines	√		√	
	Digital camera	√		√	
	Videoconference system		√		
	Web camera		√		

Table 17. 3 - **Stock takes of medical and ICT devices in Mendi hospital**

Hospitals	**Mendi**	**Available** **(**Yes)	(No**)**	**Function** (Yes)	(No)
Medical devices	Pulse oxymeter	√		√	
	Electrocardiogram	√		√	
	Blood pressure Monitor	√		√	
	Fetal Monitor		√		
	Glucometer		√		
	Defibrillator	√		√	
	Ultra sound scan		√		
	Ophthalmoscope	√		√	
	CAT scan		√		
ICT devices	Personal computer	√		√	
	Scanners	√		√	
	Photocopier	√		√	
	Printers	√		√	
	Internet	√		√	
	Landlines	√		√	
	Digital camera		√		
	Videoconference system		√		
	Web camera		√		

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5.14 Summary of the Key Findings

The findings are listed in the same order in which they have been analysed according to the model. The model consists of predisposing and enabling variables, which were cross-tabulated using Cochran Mantel Haenzel chi-square test for trend to measure the knowledge, attitudes and skills of health professionals.

5.14.1 Participant's Demographic, Social and Occupational Background.

The total sample in this study is 174 participants. Females dominated 61.5% and males 38.5%. In terms of age range a majority 43.1% of participants from 30-39 age group followed by <30, (35.5%) and above 40 21.3%. Categories of occupation shows nurses dominated 64% followed by allied health professionals 14% and physicians 12%. Majority 38.5% of participants worked in internal medicine followed by surgery 29.9%, other sections 17.8% and allied health 13.8%. Majority of the participants were from Kundiawa hospitals with 34.5% followed by Goroka 25.3%, Port Moresby 21.8% and Mendi 18.4%.

5.14.2 Predisposing Characteristics and Frequency of Computer Uses.

Frequency of computer usage indicates that 74% of participants below 30 years tend to use computers often followed by 63% of those between 40-49 age groups. Over 70% of staff at or over 50 years of age groups never used a computer. There is no significant difference between male 64% and female 58% uses computers. Only 6% differences to indicate that male were more knowledgeable in using computers compared to female participants.

The availability of gadgets indicates that cell phone and PDA were both statistically significant to frequency of using computers with a value of $p < 0.05$ and landline was not significant. Participants with no cell phone 29% ever used computers and those who own computers 65% used it regularly during their practice. The result further shows that 70% of respondents who own landline utilized computers and 30% did not use one. One hundred percent of respondents (13/13) who own PDA have utilized computer either "sometimes" or "always" during their work and those without computers only 57%. This part of the assessment indicates that availability of gadgets is likely to encourage staff to use computers frequently compared to those who did not own gadgets.

Attitudes of adopting new technology shows 63% of staff who had "no interest" to adopt new technology never utilized computers and the other 38% sometimes used one during their

professional career. Staff with interest in adopting technology 63% of them used computers and the other 37% never used any. This indicates that positive motivation or attitude leads one to do something and where there is no motivation staff remain inactive to adopt new concepts.

Key findings:

- Computer usage was utilized more frequently amongst younger male staff compared to those in older age groups.
- Participants who used gadgets had higher computer use than those without gadgets.
- Staff who were highly motivated to adopt new technology were likely to utilize computer more frequently in their practice than those with no interest to adopt new technology.

5.14.3 Predisposing Characteristics and Knowledge of Handling Digital Camera and Image Processing from Computer.

The multivariate analysis shows age, gender and gadgets were all statistically significant to knowledge of handling digital camera except attitude of technology adoption. However, with image processing, all variables were significant except landline and attitude to adopt new technology were insignificant. Fifty five percent of younger staff below the age group of 30 years were likely to be more highly knowledgeable in using a digital camera and 53% in processing of images compared to older age groups of those above 50 years only 14% knew how to operate a digital camera and processing the image and 86% did not. Both genders were almost equally knowledgeable in using the camera and processing images, however, a difference of 19% indicated that men were more knowledgeable compared to females.

The availability of gadgets shows that cell phone, landline and personal digital assistant were all associated with handling a digital camera and image processing, ($p < 0.05$) except landline was not significantly associated to image processing. The findings clearly indicate that people with gadgets are more likely to have advanced knowledge in operating digital cameras and processing the images compared to those without gadgets. For example, 77% of people who own a PDA have higher knowledge in handling a digital camera and 62% in image processing compared to those without a PDA 35% in handling camera and 32% in processing images.

Tables 11.1 and 11.2 show that 39% of staff with interest to adopt new technology was likely to be highly knowledgeable in handling a digital camera and 37% in processing of images of those who were not interested in adopting technology, 25% can operate digital cameras and 13% can process images. However, over 60% of staff who were interested in adopting technology did not know how to operate and process images downloaded to computer from digital camera, but they have showed positive attitudes to adopt new technology.

Key findings:

- Younger male staff show increased knowledge in handling digital camera and processing images from computer compared to female counterparts and older age groups.
- Participants with no gadgets lack knowledge and the availability of handheld devices improve the knowledge of handling digital camera and processing images.
- Respondents with interest in adopting technology show increased knowledge in handling digital cameras and processing images.

5.14.4 Predisposing Characteristics of Using Microsoft Office Programmes.

Analysis of the self-rated ratings of Microsoft office programmes showed that males were more likely to have advanced knowledge in all the office suites compared to females as shown in tables 11.3 to 11.7. For example, table 11.3 shows 55% of male have moderate to higher level of knowledge in using a word processor compared to females of only 47%. In table 11.4, 46% of males have better knowledge in using spreadsheet software compared to females of only 37%. The result further shows that younger male participants below the age of 30 years were advanced in utilizing all office suits, followed by 40-49 and 30-39 age groups. Those above 50 years of age groups had less knowledge in all Microsoft Offices programmes. For instance, of those within 50 years or greater age group; 29% rated as having higher knowledge in using word processor and spreadsheet, 14 % in presentation and data management and no knowledge in email client interaction. The percentage of “moderate to higher” level of knowledge have a tendency to increase in most commonly used office programmes such as word processor, spreadsheet and presentation and the figure reduces in uncommonly used office suites such as data management and email-client interaction.

The availability of gadgets highlights that the significant tests for cell phone, landline and PDA tend to vary in each office programme as indicated in tables 11.3 to 11.7. Usage of cell phone was significant ($p < 0.05$) to word processing, presentation and email programmes. Whereas, usage of landline phone was significant to all office suites except word processor, and PDA was significantly associated to all MS software except presentation. Generally, participants with gadgets were likely to have more advanced knowledge in using Microsoft Office programmes than those without gadgets.

Key findings:

- Younger male health workers have advanced knowledge in utilizing all Microsoft Office suite programmes compared to female staff and older age groups above 50 years of age.
- Participants with handheld devices have advanced knowledge in using Microsoft Office programmes compared to participants without gadgets.

5.14.5 Predisposing Characteristics with Attitudes towards Adopting Technology.

There was not much difference between genders; comparably male 88% and female 93% were both interested to adopt new technology. Nearly all age groups have positive attitudes towards adopting new technology, for instance, those above 50 years of age groups 100% of them were in favour of the idea and ages range between <30 (92%), 30-39 (87%) and 40-49 (97%).

There was an association found between owning of cell phones and technology adoption except landlines and PDAs were not statistically significant. Staff that had no gadgets showed no interests in adopting new technology. Other possible explanation includes that, these people were not interested because they did not have gadgets available at the first place; therefore they were never interested in any gadgets.

Key findings:

Both genders and all age groups were highly interested to adopt new technology.

Participants with gadgets showed an interest to adopt new technology compared to those without gadgets.

5.14.6 Predisposing Characteristics with Attitude towards Training Preferences.

There were no significant associations found between gender, age and gadgets with training preferences. There is not much difference of age with preference of training; nearly all of them prefer job training followed by self-tutoring as indicated in table 12. Nearly the same proportion of genders, male (57%) and female (54%) chose to do "job training" and in "self-tutoring" male (28%) and female (23%). Slight differences of 8% of female indicated that they prefer group training compared to male counter parts.

The availability of gadgets indicates that staff with or without gadgets over 50% prefer job training compared to group training and self-tutoring. Usage of cell phone 55% and without 57%, with landlines 56% without 55%, with PDA 31%, and without 57% prefer job training.

Key findings:

- All age groups and both genders prefer job training as a method of learning.
- Both groups of participants with or without gadgets prefer job training and self-tutoring than group training.

5.14.7 Predisposing Characteristics with Web Surfing Skills.

The multivariate analysis shows that gender and owning of a PDA were significant to handling web surfing skills. Whereas age groups, usage of cell phone and landline were not significant to skills of using web surfing. Thirty three percent of males had higher web surfing skills compared to females (15%). However, over 60% from both groups still lack skills. The older age groups were found to have lower web surfing skills compared to younger age groups. For instance, 100% of those over 50 years of age have rated themselves as having less skills in handling web surfing programmes and those between the ages of 40 - 49 27% had higher skills followed by <30 years, 26%, and 30-39 years, 19%.

The self-rated web surfing skills are low for both groups who own and did not own gadgets of staff that own a PDA 46%, and without 20% have higher skills in handling web surfing software compared to staff with cell phone 24% and without 10%, and landline 30% and without 19%. Respondents with PDAs were slightly advanced in skills of utilizing web surfing software compared to staff with landlines and cell phones.

Key findings:

- Male participants were reported to have higher skills in handling web surfing programmes compared to female staff.
- Older age groups lack skills in handling web surfing programmes as opposed to younger age groups.
- Rates of web surfing skills are low for both groups of staff with and without gadgets.

5.14.8 Predisposing Characteristics with Email Client-Handling Skills.

The results of multivariate analysis of predisposing with skills of email client-handling programmes shows that cell phone was the only significant, variable and age, gender, landline and PDA were not significantly associated. Forty nine percent of male staff reported having advanced skills in handling email client programme compared to females 29%. A major proportion of females (71%) lack skills in using email software and of males only 51% do. Fifty three percent of staff below the 30 years of age groups were highly skilled in handling email client programmes as were, and 33% from 40-49 years age groups. Eighty six percent of those above 50 years of age lacked skills in using email software. In addition, over 40% of all age groups lack skills in email programmes. Again, the email client-handling skills are determined by accessing and utilization of the internet. This area needs more improvement in health settings of PNG.

Health professionals who had gadgets were likely to have advanced skills in using email compared to those without gadgets. For instance, 62% of staff that own PDA had higher skills in using email software compared to 35% of staff without gadgets. The availability and usage of gadgets enabled the staff in utilizing email client handling skills.

Key findings:

- Male staff had higher skills in utilizing email client-handling programmes compared to female respondents.
- Participants below the 30 years age group and the 40-49 age group had more advanced skills than those above 50 years of age.
- Participants who have gadgets available improved the skills of using email client interaction.

5.14.9 Enabling Variables with Frequency of Computer Use.

The enabling variables were found to have strong association with frequencies of computer usage. People with higher degrees (78%) used computers regularly followed by diplomas 69%, certificates 52% and basic training 51%. The higher the level of education corresponds with increased frequency of computer usage.

Eighty four percent of staff who had done a computer training course have utilized computers regularly compared to staff without computer training 22%. Those without computer training (79%) never used computers and with training 17% did not use one. Of staff who have computers available at home, (96%) of them utilized computers and 5% never used computers of those with no PC at home 62% never used one, 38% used computers often. Eighty three percent of staff that accesses the internet at the workplace used computers regularly and 17% did not. However, 43% of people without access to internet at the workplace never used computers.

Key findings:

- Participants with higher degrees used computers frequently compared to those with lower levels of educational qualifications.
- Respondents who attended, Computer-training courses, have a personal computer at home, and access to the internet has higher computer usage compared to those who do not meet the above.

5.14.10 Additional Qualifications and Enabling Resources with Knowledge of handling Microsoft Office Suites.

Additional qualifications were found to be strongly associated with using word processing, spreadsheet and power point presentation with the exceptions of data management and outlook programmes as shown in tables 14.1 to 14.5. Participants that had higher degrees have advanced levels of knowledge in utilizing all the office suites followed by basic training, diplomas and certificates. For example, people with “higher degrees” 40% have higher knowledge in handling data management, “basic training” 22%, “diplomas” 17% and “certificates” 12%. Over 40% of all categories of qualifications still lack knowledge in all office programmes; again, the distribution of knowledge varies. The level of knowledge

increases in commonly used office programmes such as word processor, spreadsheet and presentation, and reduces in other uncommonly used software.

The enabling resources such as computer training, availability of computer at home and internet at the work place have strong significant relation with knowledge of using Microsoft office programmes. People who have done computer training 70%, PC at home 82% and internet at workplace 71% have moderate to higher knowledge in using a word processor. Those with no training 15%, no PC at home 30% and no access to internet 47% have moderate to higher knowledge in word processing. People with no training and access to ICT resources lack knowledge in handling all Microsoft office suites.

Key findings:

- Higher level of qualifications increases knowledge of handling Microsoft office suites.
- Availability of resources enables improvement of knowledge.
- Most health professionals were familiar with the use of word processor, spreadsheet and presentation but not so much with data management and outlook.

5.14.11 Additional Qualifications and Enabling Resources with Attitude of Adopting Technology.

Additional qualifications and enabling resources with technology adoption have no significant associations. Interestingly, nearly all categories of qualifications over 80% were in favour of adopting new technology. Almost everybody showed a positive attitude towards technology adoption as indicated in table 15, they did not consider whether resources were available or not. This result is intriguing because it indicates positive attitudes to establishing telehealth in their facilities.

Key findings:

- There is a positive attitude of health professionals towards adopting new technology, despite the level of additional qualifications required to be attained and whether there is enabling resources accessible.

5.14.12 Additional Qualifications and Enabling Resources with Training Attitude.

No significant relationship was found between additional qualifications and enabling resources with training attitude. Over 40% of staff from all categories of qualifications attained prefers job training, followed by self-tutoring and group training as their method of learning new technology.

The enabling resources also indicate that whether there are resources accessible or not; the majority of staff (over 50%) prefer job training followed by self-tutoring and group training. The result suggests that job training will be preferred learning method to train staff when introducing telehealth.

Key findings:

Nearly everyone prefers job training as their method of learning followed by self-tutoring.

5.14.13 Additional Qualifications and Enabling Resources with Skills of Using Email-Client Interaction.

There is a strong significant ($p < 0.001$) relation found between additional qualifications and enabling resources with skills of using email software. Fifty eight percent of people with higher degrees were highly skilled in using email client handling programme followed by basic training 41% and diplomas and certificates 18% each. Thus, higher level of education improves skills of using email –client interaction programme.

Forty seven percent of staff reported to have done computer training courses have advanced skills in using email programme and those without training 17%. Staff that accessed computers at home 66% and access to internet at the workplace 71% self-rated themselves to have higher skills than those without access to any ICT resources. Accessibility and usage of ICT resources enriches the skills of email client handling skills.

Key findings:

- Participants with higher educational qualifications have high skills in email client-handling programmes compared to staff with low educational qualifications.
- Respondents with access to enabling resources have higher skills than those without access to any.

5.14.14 Additional Qualifications and Enabling Resources with Web Surfing Skills.

Additional qualifications and enabling resources have strong significant ($p < 0.001$) relations with web surfing skills. Again, participants with higher qualifications 44% were highly skilled in handling web surfing followed by basic training 22% and the rest of the participants were below 10% as shown in table 16.1.

Where there are resources accessible the skills of using web surfing increase, and those no resources lack skills. For instance, respondents who have done computer training 30%, those accessing computers at home 64% and internet at work place 75%, reported to have higher skills in web surfing than those without training and access.

Key findings:

- Participants with a higher level of education have higher skills in web surfing compared to those with lower levels of qualifications.
- Respondents with enabling resources have higher skills in utilizing web surfing programmes compared to those without enabling resources.

5.14.15 Additional Qualifications and enabling Resources with Skills of using Digital Camera and Processing Images.

Level of additional qualifications was not significant to handling a digital camera and processing images downloaded to a computer. Health workers with higher degrees and basic training reported having higher skills of using digital camera and processing images except for people with diplomas and certificates as indicated in tables 16.2 and 16.3.

The availability of enabling resources have strong significant ($p < 0.001$) associations with skills of handling digital cameras and processing images. Availability and application of enabling resources have a great influence on health professionals' skills in utilizing digital camera and processing image.

Key Findings

- Health workers with higher level of education have high skills of handling digital cameras and processing image.
- Accessibility and training of ICT resources enable skills of handling and processing image from digital cameras downloaded to computer.

5.14.16 Stock Take of Medical and ICT Devices.

The stock take of medical and ICT devices in each hospital indicate that nearly every hospital has some basic devices needed for telehealth applications except the most advanced technologies such as video conferencing system, web cameras and digital cameras were not in placed. Apparently, Kundiawa hospital is the only institution in the country that has the video conference facility available but it was not functioning at the time of the survey due to lack of funds and skilled personnel to operate and maintain its cost.

Impressively, Port Moresby the national referral hospital in the country has a computerized axial tomography (CAT) scan facility where all other patients in the country that require detailed radiological investigations are referred to.

Chapter Six: Discussion

This study intends to examine whether health professionals in PNG possess the required knowledge, attitudes and skills (KAS) for using information and communication technology to implement telehealth in clinical health settings. The model applied in this study was able to determine KAS of health professionals in using ICT. In addition, it identified which groups of health professionals are advanced with ICT skills, and which of them lack skill and determines the "need factor". The stock takes of medical and technical devices undertaken in each hospital gives a clue to initiate telehealth projects in future. This survey is the first of its kind for PNG, and information obtained from this study provides a clear understanding of the general perception about KAS of health workers in ICT distributed across each level of participating hospitals in the country.

6.1 Predisposing Variables

When assessing age, gender and gadgets to measure knowledge, attitudes and skills of ICT of health workers, the results clearly show that younger, male physicians and paramedics below the age of 50 years use computers more frequently compared to female staff and those over 50 years of age. This study is consistent with McNeill, (2007) findings that age was a key factor, with the majority of older adults reporting that they did not own and had never used a computer. The study further elaborated that more physicians (57%) participated in this study and worked in Port Moresby, which is the level one hospital in PNG; followed by 19% of participation in the level two Goroka hospital, and then the participation rate reduce in smaller rural hospitals. This part of the result is aligned with the report from World Health Organization, (2006) that higher concentrations of physicians are based in Port Moresby and some provinces have fewer or no doctors compared to Port Moresby. The results further demonstrated that younger males below 30 years of age were significantly more skilful and leading in using all the Microsoft Office suite software programmes. This same age group and gender were highly knowledgeable and skilful in handling digital cameras and processing images downloaded to a computer. This finding is essential in the application of telehealth as supported by Loane & Wotton, (2001) that staff may utilize those skills to take digital images of microscopic specimens, radiographs, wounds and skin lesions to store on laptops or desktop computers and then transmitted through emails to a specialist for further consultation and management. Several studies (Durrani & Khoja, 2009; Yamashiro, Taira, Matsubayashi,

& Manabu Azuma, 2009) have shown that digital images transmitted through an electronic medium to specialists is feasible in both advanced and developing countries.

Health workers with gadgets use computers frequently, and they are reported to have advanced skills and knowledge in using ICT. They showed positive attitudes towards adopting new technology and prefer job training as a method of learning over other methods. On the other hand, the majority of staff without gadgets do not utilize computers regularly and as a result, they lack skills and knowledge in handling information technologies. In this study, health professionals have leap frogged the technology; they tend to use handheld devices such as cellular phones (88%) and PDAs (8%) rather than traditional landlines 29%. This result indicates that since the majority of health professionals use cellular phones as a means of communication, they may apply the similar principle to manage patients' health data remotely at rural and urban areas using cell phones and PDA. Several studies (GSM; Association, 2007; World Health Organization, 2007; Fornell, 2008) stress that these two hand-held devices will allow health workers in the field to enter information and data. Once the data is entered, it is mapped, analysed by the system, and is available to health authorities at multiple levels through the network. Timely medical information needed, can also be dispatched amongst health care providers for better, safer and high quality of care for everyone. Fornell, (2008) supports the concept that many physicians like to use PDA because of its size, which, fit easily into their coat pockets, and the functions built in those devices are similar to a desktop/ laptop. This makes it convenient for mobile services.

The attitude variables show no significant associations between gender and age. However, both men and women, old or young showed positive attitudes towards adopting new technology. This result is consistent with several studies (Loomis, Ries, Saywell, & Thakker, 2002); Araújo, Paiva, Jesuino, & Magalhães, 2000) which found that age and gender were not statistically significant in explaining the attitude towards IT. However, there is evidence of strong intention towards utilization of IT and these intentions are conditioned by attitude. Another study done by Diener, et al., (2001) reported that 68% of non-users of telemedicine's attitude to adopt telemedicine technology stated that they did not have enough knowledge to adopt telemedicine technologies. In other words, knowledge is a prerequisite to having an attitude to adopt telemedicine technologies. Contrary to (Diener, et al., 2001), health professionals in PNG know little or have no information about telehealth, yet they did not consider knowledge as a condition for adoption of such technology, with over 88% being

interested in adopting new technology. Although it is anticipated from previous arguments about non-significant factors of attitude, a study done by Lai, Leung, Wong, & Johnston, (2004) reported that physician's attitudes on the impact of computerization to clinical practice was statistically associated. Other confounding factors may determine the attitude as mentioned above.

6.2 Enabling Resources

This study reported that people with higher degrees, those who have done computer training courses, have access to a computer at home and internet at the work place were more likely to use a computer often than those with lower levels of education and without computer training and exclusive use of ICT resources at the workplace. This study is consistent with McNeill, (2007) results that greater level of education has positive associations with regular computer use. In addition, Yaghmaie & Jayasuriya, (2004) have shown in their study that users with higher levels of computer training have more positive attitudes toward computers than those with lower levels of computer training. However, on the other hand, 84% of people in this study who completed computer training did not use a computer and 94% of respondents have no access to the internet. This could be due to inaccessibility of computers and internet either at the work place or at home. The inaccessibility of ICT resources in the work place could be due to limited assets and associated costs. Therefore, only office administration staff and senior officials access the ICT facilities to minimise the cost of such facilities to the organization.

The study further indicated that attaining of additional qualifications, computer training, access to the internet in the working environment, and computer access at home have a significant relationship to improved knowledge and skills in using Microsoft Office suite software programmes compared to those with lower qualifications and without training or no access to ICT facilities. This part of the study supports Cuckle, Clarke, and Jenkins, (2000) who reported that a lack of access to ICT equipment at school has influenced students' skills and knowledge in using a computer. This survey also showed that the majority of people were familiar in using word processor, spreadsheet and presentation software compared to using data management (Access) and MS Outlook office programmes. This reflects the type of duties they perform, availability of the internet at each facility and their expertise of office

suites programmes. On the other hand, it also enables the identification of training needs required especially in the area in using Microsoft Office programmes.

The attitude variable showed no significant associations between additional qualifications and enabling resources. Respondents with over 80% of all levels of qualifications attained demonstrated positive attitudes toward adopting new technology. This part of the result is fascinating because staff with higher degrees is not contented with their knowledge and skills in ICT; and they are highly motivated to learn. The same applies to people with access and no access to ICT facilities and those who have done computer training or not. This is a positive indication that if telehealth is introduced in PNG, health professionals will easily and readily adopt the technology.

6.3 Need Factor

In this study, training for ICT was highly importantly by the participants, as 97% of them raised the concern that they needed training. Other researchers (Elford, 2004; Jennett, Watson, & Watanabe, 2004) support this result that need for training and informal network support were some of the issues identified when assessing the potential effects of Telehealth on Canadian Health. Elford, (2004) further supports the concern raised from the staff that health professionals who will use the technology have to know what it is, how it operates and what are the advantages and implications when using it. Staff must possess the required skills and knowledge before applying the technology.

As telehealth would be new to most health settings in the country, it requires much time, funding and technical support from organizations like PNG Telikom or other IT firms and human resources with experience and knowledge to prepare training manuals. Training involves educating and training users how to use general information and communication systems as well as specific telehealth technologies. This can involve learning how to use the workstations for distance health education or specifically to do remote consultations. An on-going training programme may be customized and designed specifically for the programmes. A variety of media could be used for these training programmes, for example, Internet, DVD, videotape, textbooks, live presentations and videoconferencing presentations or any combinations of them.

6.4 Stock takes of Medical and ICT Resources

The exploratory assessment of medical and ICT devices shows that Port Moresby hospital has most of the basic electronic and medical devices and functioning in PNG except video conferencing systems and web cameras. Port Moresby is the only hospital that has installed a CAT scan recently. Previously, patients across the country were referred to one of the private international hospitals, which would cost PGK800.00 (US$307.95) for the service, excluding other expenses involved. The provision of this technology has obviously alleviated the expense and made it possible for an average salary earner to access the service. Most of the ICT equipment and services were located in administration units and only senior officials and office administration staff have access to these facilities. It is the major referral and training hospital where over 50% of the physicians and specialists from all disciplines are employed both at the hospital and at the University (School of Medicine and Health Sciences). There is a need to install a video conferencing systems and web cameras purposely to utilize the skilled human resources to dispatch information and services to other centres with this technology.

Goroka is the only hospital in the country that has gone online by launching its web page and therefore has a presence on the World Wide Web. It is fortunate to employ an IT specialist who established the Business Resource Centre to train staff and for them to access the internet for research and education. Other medical resources were available and functioning except a CAT scan. The main aspect that requires improvement is continuous funding and technical support from the government. Goroka is identified as one of the hospitals for future implementation of telehealth and training of staff from other hospitals because the IT foundation has already been established and in operation.

Kundiawa is a rural hospital and only facility available is a video conferencing unit. However, it was not functioning at the time of the survey because of lack of funding and skilled professionals. Other basic medical and electronic devices were available and functioning except CAT scan and web cameras. General staff do not have access to ICT services except senior officials and administrative staff. Kundiawa is another possible institution for further implementation of telehealth because it has a video conferencing unit but it needs funding and training for its upkeep and usage.

Mendi is another rural hospital and is disadvantaged compared to the other hospitals that were surveyed. It lacks basic medical equipment such as ultra sound and a fetal monitor or a CAT scan. In addition, there were no advanced technological devices as mentioned above. General staff had no access to information and communication services except senior officials and administration staff. The staff in this institution obviously needs more training.

6.5 Strengths

The quantitative survey design used in this study was able to identify relationships between characteristics of respondents to assess the staff's knowledge, attitudes and skills in ICT. This cross sectional study has identified a number of key strengths. It was able to gather information from a larger group of the population representing the health professionals and institutions at different levels with very little efforts, time and costs. Two hospitals represented levels one and two and the other two study sites come under rural and level three health settings in PNG. The samples collected in those four hospitals indicate a general scope of staff and technologies that would be available in other non-participating health facilities. This gives a fair idea to the health planners about the quantity and categories of health workers, medical and ICT equipment available in each level of hospital. The survey has identified which of those hospitals have resources and established ICT projects and will make recommendations to introduce a telehealth programme. This would contribute to minimizing the cost and labour if telehealth is to be introduced to a health setting where there are no resources on hand.

Being physically present at the study site made a great impact when collecting data over a short period. As stated in the methodology section, the researcher took three months to negotiate with potential resources in PNG to gather data through the post. However, that plan did not eventuate as proposed. When the researcher travelled to the study areas, the staff were motivated to participate in the survey. This may be due to various reasons, it is either whom you know or personal communication could play a role in respondents' willingness to cooperate. The other reason could be lack of awareness, procrastination of duties and responsibilities from the study sites.

This is the first study on this topic in PNG. However, there was a study done on telemedicine in Tabubil as stated in the literature review but that study was more confined to a rural mine

hospital and did not involve the government run health facilities. Its objectives were to facilitate telemedicine service to rural hospitals in developing countries, which is different from this study. Further, there is no record of any published paper or a project indicating a study on telehealth and this proved that this study is the first and will be considered a pioneer of telehealth in PNG.

This study has found that professionals in PNG have leapfrogged the ICT technology going straight to cell phone use before using landline phones. Nearly all of them have positive attitudes to adopt the new ICT technology, regardless of their level of educational qualifications, whether they have gadgets or not and whether or not they have access to ICT resources. Lack of access to ICT resources, knowledge and skills in their use were not a condition of wanting to use them. In other studies (Diener, et al., 2001), finding was contrary to what was reported in this study: people set conditions that they did not possess knowledge to adopt to telemedicine technologies.

6.6 Limitations

The study had a lower response rate (20.5%) than expected, as stated in the methodology section. However, the lower response rate was due to numerous unforeseen circumstances beyond the control of the researcher. One of the factors was failed communication between the researcher and potential human resources at study sites in PNG, which were due to unforeseen technical problems; the communications network was either down or disconnected because of non-payment of bills. The period involved in collecting data was limited (3 weeks) and to visit each site around the entire country was not possible. Due to the rugged topography of the country, it takes at least a day to travel from one province to another, which resulted in only four hospitals participating in the research. There was either delay or non-return of survey forms from some hospitals. Collectively, all these have contributed to a lower response rate.

It may be argued that many hospitals were not involved in the study or regionally represented and the results presented could be biased. It may even be considered that the total sample is insufficient to generalize to the population of health professionals working in PNG. Again, some of the main contributing factors were those mentioned above; these dilemmas were beyond the researcher’s control and were considered as unforeseen circumstances. Also,

while there was a lower than expected response rate, there is no reason to believe that the study respondents were atypical or unrepresentative. On the contrary, it would seem that a larger sample might have actually provided results that were even stronger in terms of the associations found. That is, inclusion of more rural communities where access to ICT issues are a bigger concern than in some of the sampled sites would have shown even a stronger association among the variables investigated than reported in this study.

6.7 Implications

As this study is an initial step to establish and implement telehealth in PNG health settings, the survey has identified several factors that could be implemented. Based on the findings from the survey, it suggests recommendations to the National Department of Health in PNG for planning and implementation of services related to telehealth. The findings highlight three major areas to start with:

1. A need for education and training
2. Professional practice
3. Recommendation for future research

6.7.1 Education and Research

The results of this study highlight and support the importance of a training needs strategy. This would lead into the development of a standardized and effective training package of ICT for health:

1. Meet the particular needs of the different professional groups.
2. Design a module to meet the base line ICT skills and knowledge required by all health professionals including particular needs of age groups who perceive themselves as being less familiar with ICT technology.
3. Provide a range of skill development units of study from a basic level to more advanced ICT skills. This refers to the hospitals that have the ICT facilities in place.
4. Implement and evaluate annual updating in ICT skills training for all staff.
5. Provide opportunities to enable individuals to enter at levels appropriate to the needs of the service, and to re-enter if there is a requirement for professional development. This could be at a provincial, national and international level.
6. Enforce and establish online learning strategies on health information.

6.7.2 Professional Practice

The results indicate a general positive disposition towards the use of ICT in healthcare. This would be implicated in the following areas.

1. Health professionals' knowledge and skills should be recognised and acknowledged, and any technologies or interventions applied should be based on the existing perceptions and skills currently available within the service and deficits will be addressed through training.
2. In order to ensure the effectiveness and efficient use of existing resources and services there would be a need to provide ICT support on call 24 hours.

6.7.3 Future Research

This survey has only touched the surface of telehealth, and there are vast areas in this discipline that need more research. Some of these areas include perceptions about ICT and pilot projects.

6.7.3.1 ICT Perceptions

There were differences between professional groups and age regarding their perceptions and skills about ICT. How accurate these perceptions are, and how best to address the differential needs of various professionals need further investigation. Some health workers have little access to ICT compared with others, so studying the interplay between involvement with ICT in the workplace and attitudes to this utility of ICT in health care will be important. How best can the sophisticated systems be introduced into the workplace without alienating staff? The answers to such questions will be important to ensure the successful and efficient implementation of telehealth.

6.7.3.2 Pilot Project

To adopt telehealth into the PNG health system, it must be embedded into a conducive and receptive environment. According to the survey's findings, the three hospitals (Port Moresby, Goroka and Kundiawa) have part and partial resources on ICT available. However, some of the ICT equipment need upgrading and funding to fully maximise their potential. The operators will have to be trained on how to use the technology before introducing pilot projects like telepathology, teledermatology, telepaediatrics and video conferencing with specialists within PNG and abroad can be identified. The projects can be evaluated at the end

of the pilot period to assess their successes and failures and to make recommendations for future implementation of ICT in PNG. The next phase of projects will learn from the previous projects and roll out to other provinces. The main equipment needed in those pilot studies would be a web camera, digital camera, and a higher bandwidth of more than 128kb /s and a network of specialists.

In addition, mobile medical technology could be piloted involving cell phones and PDAs to collect information, and data, and to communicate between health professionals and clients across PNG or within provinces of PNG. This application would be feasible because the national coverage of mobile services has reached 80% of the country's population. The service it provides would benefit the patients and health professionals at a distance from each other. It would also reduce costs due to travel and other costs required when patients and specialists meet together for a consultation. Due to limited resources and accessibility of ICT, it is wiser to start with something small and simple and build on that base of knowledge.

6.8 Conclusions and Recommendations

The study has highlighted the health professions' knowledge, attitudes and skills of using ICT in health settings of PNG. It used a cross sectional study method to gather data from four hospitals to determine that majority of health workers have done computer training but have limited access to any ICT resources within the workplace. Only senior physicians and officials at administrative levels have access the facilities because of the inadequate resources and the costs involved.

Despite the lack of ICT resources, younger male physicians and paramedic staff possessed higher knowledge and skills in using ICT compared to other health professionals, specifically female and older age groups. Nearly all health professionals have positive attitudes to adopting telehealth technology. Training and extra ICT resources are the foremost needs identified in this study. The study suggests that health administrations at provincial and national levels should generate adequate resources and funds in providing training and ICT equipment. This would have a great impact in improving the knowledge and skills of health workers in using ICT. This sort of intervention would then enable the staff to use telehealth applications effectively and with confidence.

Only one hospital in the country has established IT services and has trained its staff. This particular hospital (Goroka) has paved the way for IT health into the 21st century of the digital world. In addition, this hospital may become a training institution for telehealth because it has established the foundation and has employed an IT specialist, who may conduct training. This study recommends that other hospitals in the country should adopt its model.

Currently, PNG has leapfrogged the technology largely by focusing on handheld devices such as cell phones rather than the landline phones. This represents scope for growth and willingness by health workers to adopt and expand telehealth in PNG. By adopting and implementing telehealth, it may contribute towards improving the health services to the underserved areas of PNG through an information and communication system. Its application would benefit patients, services and providers. Most benefits of telehealth include improved access to information and services, increased care delivery, professional education, quality control of screening programmes and reduced health-care costs. These benefits would collectively improve the current health situation in PNG, a goal for any country to work towards achieving it.

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Appendix A: Respondents' consent form.

College of Health Sciences

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

Respondent's Consent form:

I agree to participate in this survey conducted by Lucy Au from the above institution. The purpose of the study is to identify the knowledge, attitude and skills of doctors, nurses, and other health care workers who work in the fields of obstetrics, gynaecology and paediatrics on how they intend to use Telehealth in the delivery of health services.

I understand that all personal information obtained shall be kept confidential and no reports will identify me in any way.

I was explained that my participation is voluntary and I may refuse or withdraw at any time without penalty.

The study will help to introduce telehealth into the health system to improve the health of mothers and children in the country. I understand the results of this study will be given to me if I ask for them.

Date.....

Participant…….

Supervisor…….

Appendix B: Participant's information sheet

Health Sciences Centre

Tel: +64 3 364 2987, Fax: + 64 3 364 2490
Email: healthsciences@canterbury.ac.nz

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

INFORMATION

You are invited to participate as a subject in this research survey on "Assessing Needs of Telehealth in PNG".

The aim of this survey is to identify knowledge, attitude and skills of physicians, nurses, and other health care workers who use computer related to work in main referral hospitals in PNG. In addition, to identify the availability of Information and Communication Technology (ICT) and Medical Electronic Devices (MED) in each main referral hospitals in the country.

Your involvement in this project is to read each question and provide the answer that suits you. The survey has 14 questions over two pages, which will take approximately 5 minutes to complete. The results of the project will be published, but you may be assured of the complete confidentiality of data gathered in this investigation: the identity of participants will not be made public, only aggregated data will be published. To ensure anonymity and confidentiality, data will be coded and locked away in a filing cabinet in a locked office at the University of Canterbury and later transferred to a laptop computer for data analysis and report writing.

This project is carried out as a requirement for a course degree of Master of Health Sciences by Lucy Au under the supervision of Dr. Arindam Basu and Professor Ray Kirk. They will be pleased to discuss any concerns you may have about participation in this project.

The project has been reviewed and approved by the University of Canterbury Human Ethics Committee and the PNG Health Research and Ethics Committee.

By completing this survey, you will go in to the draw to win one of the two prizes. **MP3 and MP4 player 2 GB. 4th Generation, 2008 Model. Stores up to 650 songs and files. Games, High Quality Voice Digital Recording, built in FM Radio, plays AMV Video, E-Book, etc…** To enter the draws please provide your contact details at the end of the survey. Your contact details should include postal address and phone numbers for confirmation. The draw will be drawn on the 30th of November 2009 and your prize will be sent through a registered courier.

For more information, contact Lucy on this cell phone number +64211374263 or email-lau17@student.canterbury.ac.nz.

Appendix C: Research protocol for all staffs

Health Sciences Centre

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

To all staff in PNG:
Research Protocol on Assessing Needs of Telehealth i

The purpose of this study is to identify the knowledge, attitude and skills of health workers who work in all main referral hospitals in Papua New Guinea. PNG is still a developing nation and 85% of the people live in the rural areas are underserved. Many rural areas have insufficient number of primary health workers and problems accessing specialty care. Therefore, this study is trying to identify strategies towards assessing those needs through applications of telehealth.

Data collected from the 20 hospitals would be analysed using statistical programme in the computer. It will compare population with all the characteristics of respondents from all the study sites. Results of the study will be disseminated to the Department of Health Sciences at University of Canterbury (NZ) and National Health Department in PNG for further implementation on applications of telehealth.

Expected Outcome

The expected outcome of the study will be likely that health professionals would be interested in this latter method of health care delivery and exchange of information. Health services would be provided from a distance allowing physicians and specialists from all disciplines for consultation, diagnoses and possible treatment without meeting the patient directly. Health workers would have access to medical information for research and continuing of education. Telehealth network would improve local health care efficiency and this concept is being in cooperated with PANGTEL's vision or goals to expand e-applications and e-services in all rural areas of PNG. Through the implementation of telehealth applications, the services would be efficient, affordable, acceptable and accessible to majority of the stakeholders.

Thank you.

Lucy Au (MHS Student Canterbury University, Christchurch

Appendix D: survey questionnaires

Health Sciences Centre

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

Questionnaires for Telehealth assessment needs in Papua New Guinea.

Part A: Particulars of participants

1. What is the name of your institution?.....
2. Which section do you work? (Circle one answer below)
1. Paediatric Branch
2. Medical Branch
3. O&G Branch
4. Surgical Branch
5. Outpatients Departments
6. Dental Departments
7. Pharmacy Department
8. Pathology
9. Imaging and Radiology Branch
10. Administration

3. What is your health category? (Circle one number)
1. M/O
2. HEO
3. N/O
4. CHW
5. Pharmacist
6. Pathologist
7. Radiologist
8. Dental therapist
9. Other please specify (……)

4. What is your age? (Circle one)
1. Below 30 years
2. 30-39
3. 40-49
4. =.> 50

5. What is your gender? (Circle one number)
1. Male
2. Female

6. Do you have any other professional qualifications apart from your basic training?
1. Yes

2. No

6.1 If yes, what is the name of your qualifications? (Circle one number)
1. Certificate
2. Diploma
3. Degree
4. Masters
5. PHD

Part B: ICT Knowledge, Attitudes and Skills
These questions are based on the use of Information and Communication Technologies.

1. **Do you own a cellular phone? (Circle one number)**
1. Yes
2. No

2. **Do you have a landline phone at home? (Circle one number)**
1. Yes
2. No

3. **Have you used or owned a PDA? (i.e. Palm or CE) (Circle one number)**
1. Yes
2. No

4 **Have you ever had formal or informal training on how to use a personal computer (PC)?**
1. Yes
2. No

5. **How often do you use a computer? (Circle one number**)
1. Never (None)
2. Sometimes (1-3 days per week)
3. Always (4-7 days)

6. **How can you rate your skills in using the following Microsoft office programmes? The ratings are (1) poor (2) Good (3) Very good (4) Excellent.Circle one number for each office.**

Microsoft Office	1	2	3	4
Microsoft excel	1	2	3	4
Microsoft Power point	1	2	3	4
Microsoft access	1	2	3	4
Microsoft Outlook	1	2	3	4

7. **Do you have access to PCs at home? (Circle one number)**
1. Never (None)
2. Sometimes (1-3 days per week)
3. Always (4-7 days)

8. **Do you have access to internet at the work place? (Circle one number**)
1. Never (None)

2. Sometimes (1-3 days per week)
3. Always (4-7 days)

8.1 **If yes, indicate frequency for accessing internet to search for medical information.**
1. Never (None)
2. Sometimes (1-3 days per week)
3. Always (4-7 days)

9. **Do you know how to send an email? (Circle one number)**
1. Yes
2. No

9.1 **If yes, have you ever sent an email with an attachment? (Circle one number)**
1. Yes
2. No

10. **Do you know how to take a picture with digital cameral and save it in your computer?**
1. Yes
2. No

10.1 **If yes, do you know how to crop and resize the image? (Circle one number)**
1. Yes
2. No

10.2 **If yes, can you adjust the colour, brightness and contrast of the image? (Circle one number).**
1. Yes
2. No

10.3 **Can you insert the image in word processing document or presentation?**
1. Yes
2. No

11. **Can you do a Medline search using Boolean operator (: and, or, not"). (Circle one number)**
1. Yes
2. No
12. **How would you rate your attitude towards adopting new technology e.g. Telehealth? The ratings are (1) no keen (2) moderately keen (3) Highly keen. Which of this best describes you?**
1. Not keen
2. Moderately keen
3. Highly Keen

13. **Do you feel you need more basic computer literacy skills? (Circle one number)**
1. Yes
2. No

14. **How would you like to be taught to use a new computer application? (Circle one number)**
1. On the job training
2. Hands on small group training
3. Provide instruction and I will teach myself

Part C: Assessment of Medical Electronic and ICT Devices. This part of the questionnaire is to identify the medical and ICT equipment available in each hospital. The supervisors of each hospital will only answer this section.

1. **Does your institution have any of these following Medical Electronic devices available?**

Devices	**Availability**		**Function**	
Pulse Oxymeter	Yes	No	Yes	No
Electro Cardiogram monitor				
Blood pressure Monitor				
Fetal Monitor				
Glucose Monitor				
Defibrillator				
Ultra Sound Scanner				
Ophthalmoscope				
Computed tomography (CT Scanner)				

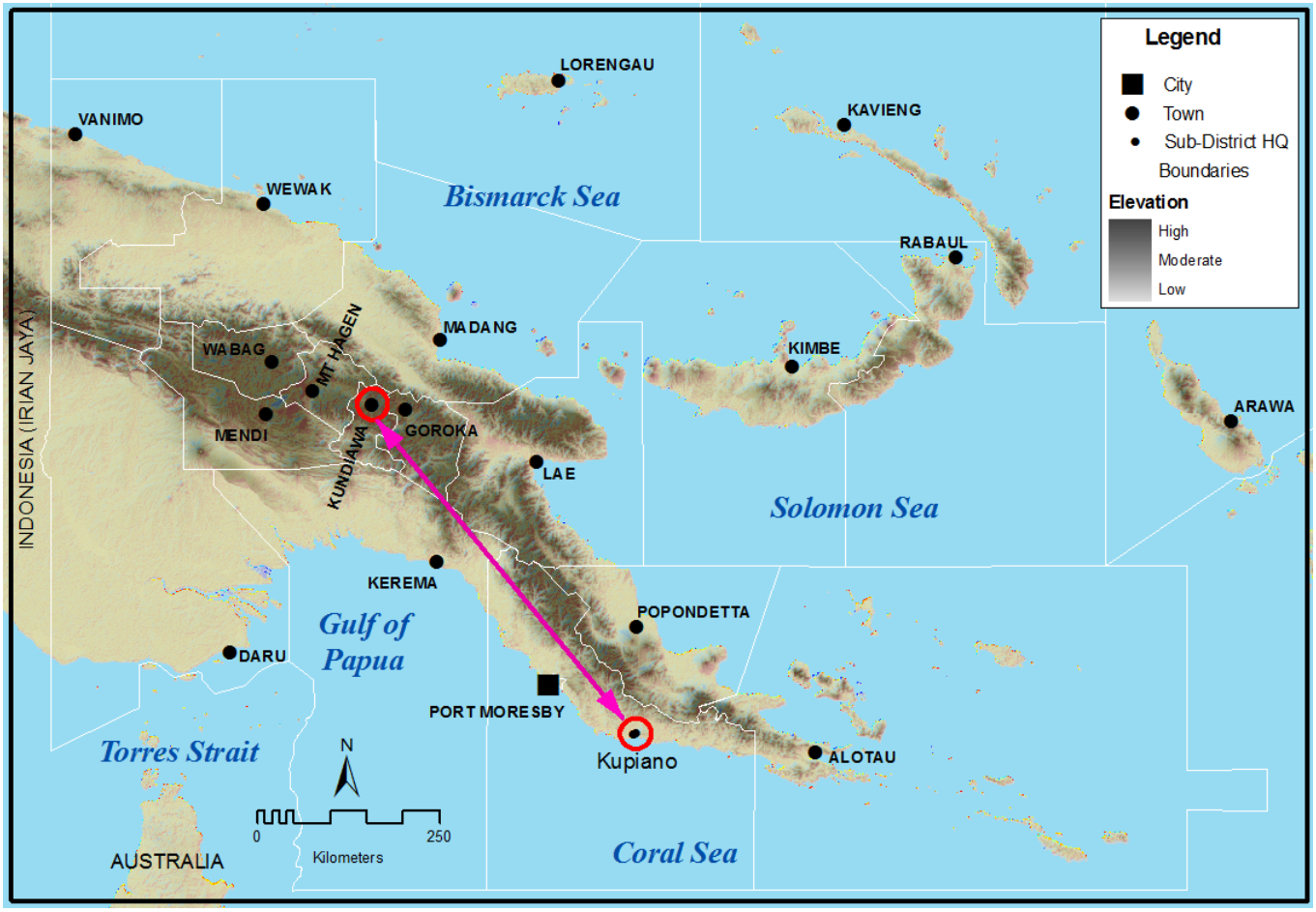
2. **Does your institution have these following ICT devices?**

Devices	**Availability**		**Function**	
Personal Computers	Yes	No	Yes	No
Scanners				
Photo Copiers				
Printers				
Internet Lines				
Landlines				
Digital Cameras				
Video Conference Unit				
Webcam				

Thank you for your time in filling this form.

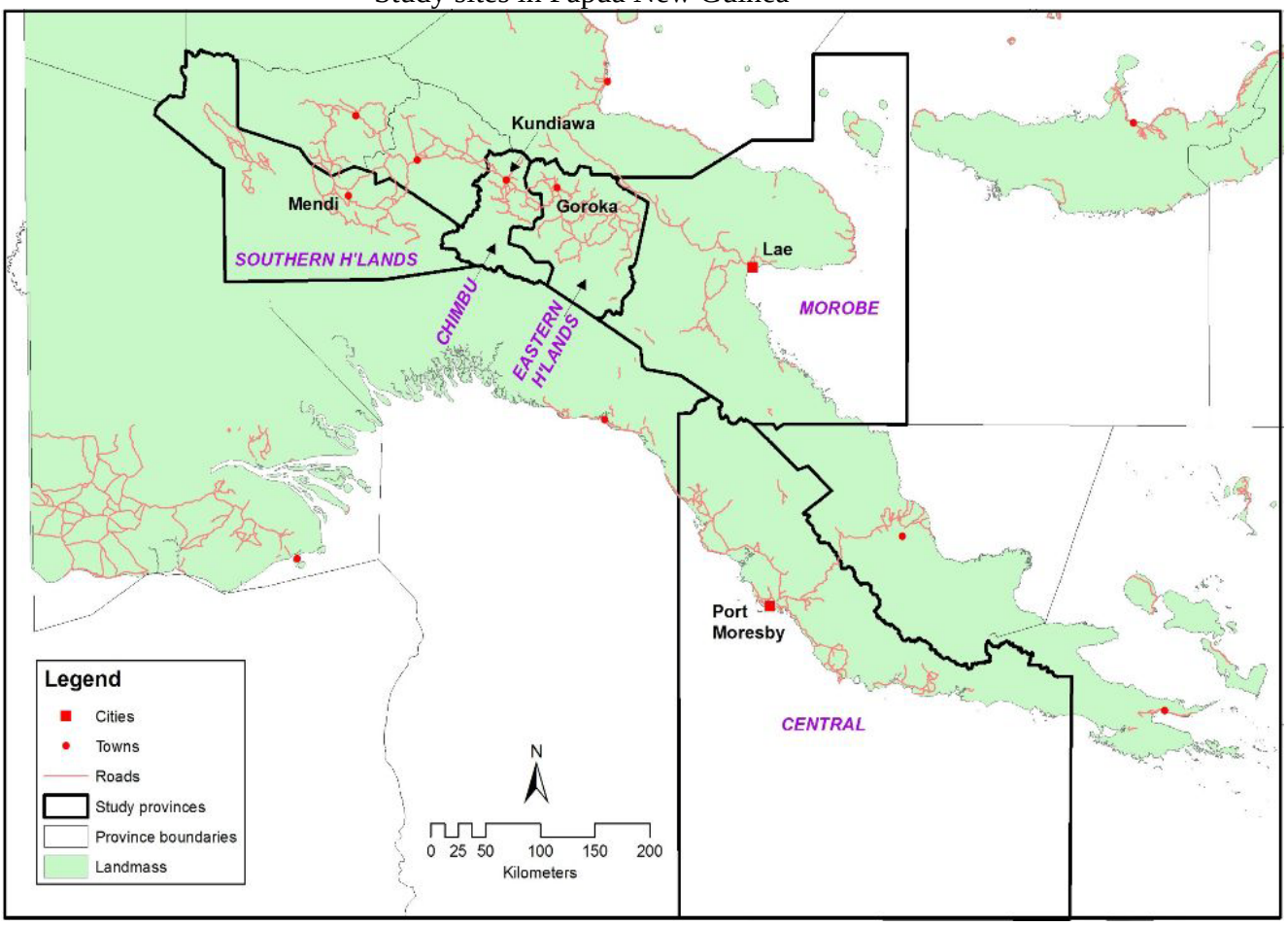
Appendix E: Telehaus line projects in PNG

Telehaus line projects in Kundiawa and Kupiano (PNG)

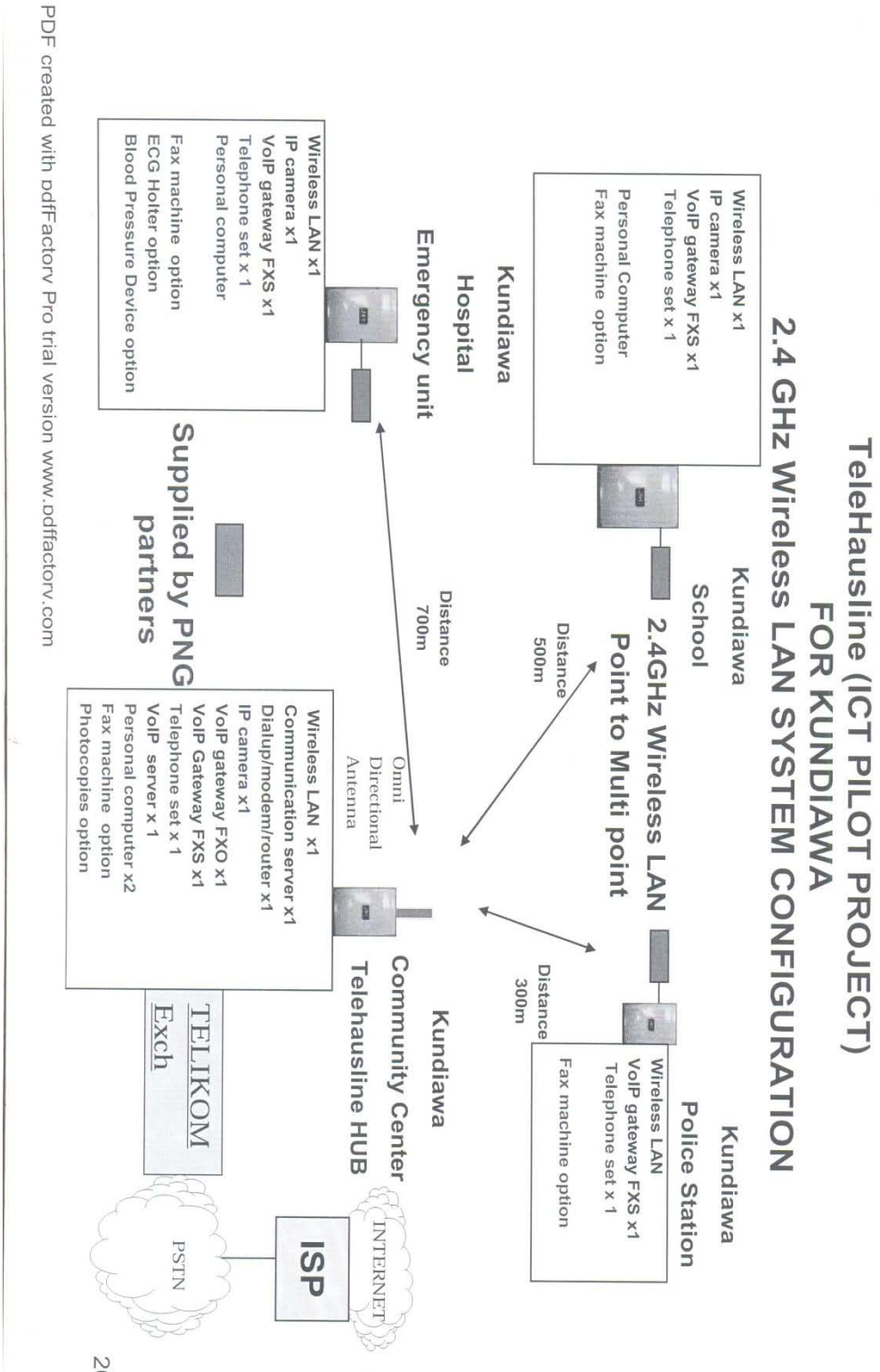


Appendix F: Study sites in PNG

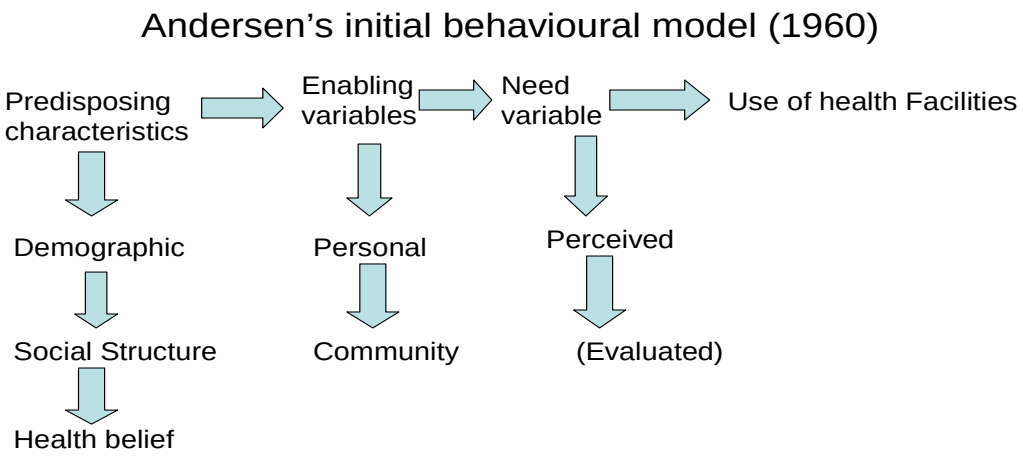
Study sites in Papua New Guinea



Appendix G. TeleHausline pilot project in Kundiawa



Appendix H: Andersen's initial behavioural model



Appendix I: Proposed study sites in PNG

Proposed study sites in Papua New Guinea