PARASTATALS' INVOLVEMENT

IN THE TELEMEDICINE

IMPLEMENTATION PROGRAMME

IN SOUTH AFRICA

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November 2004

Dissertation submitted in partial fulfillment of the requirements for the degree Masters in Business Administration at the Potchefstroom University for Christian Higher Education

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Potchefstroom

November 2004

ACKNOWLEDGEMENTS

My deepest gratitude and appreciation to:

- My study leader, Mr. J.C. Coetzee for his invaluable assistance and guidance.
- The Potchefstroom Business School for the insightful tuition and academic knowledge.
- The members of my study group who guided me through on my shortfalls and supported when necessary.
- Medical Research Council – Dr. Moretlo Molefu Millicent Kachienga and Dr. Steve Ololouje for providing invaluable guidance for the topic.
- Department of Health – specifically to Ursula Le Roux in assisting with inputs to the business model derived in this research.
- Eskom Telecommunication Division – Ezzard de Lange for introducing the topic and guidance, and Mark Dingle for great help in assisting to draw the discussed models in this research.
- To all the willing participants for their support and information.
- All family, friends and colleagues, especially Joe Manyisa for continued support.
- My wife, Nobuntu, for her patience and understanding throughout the MBA studies.
- My daughter, Boitumelo for putting up with Daddy's long periods of absence.
- God, who gave me the persistence – I say to the Lord, "You are my Lord; all the good things I have come from you" (Psalm 16:2).

Dedicated to

Boitumelo

Nobuntu

And

My late Father

John

ABSTRACT

PARASTATALS' INVOLVEMENT IN THE IMPLEMENTATION OF TELEMEDICINE PROGRAMME IN SOUTH AFRICA

By

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DEGREE: MASTER IN BUSINESS ADMINISTRATION

- *Social implications* - It has been highlighted in the literature study that social issues surrounding Telemedicine include questions such as, if health care is a right, can Telemedicine services reasonably be withheld anywhere where there is access to telecommunications and who will be allowed to provide telecommunication services. Some of the social issues included Telemedicine concerns about reduced comfort of human interface between a patient and a doctor. However in some instances patients reported being more self assured and better focused without the physician being physically in the room. Another issue cited is that technical systems may be poorly adapted to the human infrastructure of health care. It was mentioned that sustainable Telemedicine programs also require attention to organisational business objectives and strategic plans that are not always evident in current applications.
- *Economic implications* - It has been cited that Home Telemedicine, which enables ambulatory patients to live at home under the supervision of home health nurses, is viewed as effective in reducing costs that may be occurred by expensive inpatient stays in nursing home facilities. Literature states that despite its advantages, clinicians may see Telemedicine as an economic threat due to increased competition, structural alliances, and surpluses of some categories of health professionals. In addition, the current lack of payment for Telemedicine service is considered to be one of the major barriers to its deployment. Most third party payers have taken a "wait and see" approach toward Telemedicine reimbursement. Other economic considerations include the cost of equipment and of information transmission. It has been cited that, for rural study determined that a major impediment to the widespread implementation of Telemedicine in rural areas is the lack of resources for acquisition of appropriate telecommunications equipment.

Secondly an empirical study was done, and provinces were chosen (Kwazulu Natal, Mpumalanga and Eastern Cape) to replicate the findings to a national level. This was done means of field study of which two structured questionnaires (for health care providers and consumers) were used to diagnose and conclude on factors to be considered for implementation of Telemedicine in South Africa. The results of the questionnaires were processed statistically. Based on the literature study concerning the ideal Telemedicine implementation and system, and the empirical results, it was possible to determine the gap, problem areas and issues of Telemedicine implementation programme in South Africa. The research clearly showed the numerous areas for focus and improvements exist.

To bridge the present Telemedicine implementation gap that exists in South Africa, a practical and feasible Telemedicine implementation framework and plan was recommended. Although some research studies have been conducted and have not yet convincingly shown the economic returns on Telemedicine system, the recommendations presented in this study seek to show tangible economic benefits of a practical Telemedicine system suitable for South Africa. The study shows that the achievement is attainable through private partnership strategies such as Parastatals' involvement in the Telemedicine implementation programme.

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ABSTRACT

PARASTATALS' INVOLVEMENT

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The South African Government has identified Telemedicine as a strategic tool in order to improve delivery of health care and training services to remote rural areas in South Africa. Telemedicine is a general term used to define health care activities carried out at the distance.

The digital globalisation has surrounded and inter-connected most of urban communities and has brought visible challenges in developed and urban communities. However, the challenges faced in reaching or covering all areas nationally, especially rural areas, continue, development is not accelerated and as a results programmes such as Telemedicine implementation face challenges or barriers to be overcome. These challenges include and are not limited to technology deployment, infrastructure development and economic approach for implementation of a sustainable Telemedicine system in South Africa.

The objective of this study was to derive a model based on the results of the research, which can provide a solution to the concerns and challenges as mentioned above.

The model demonstrates the sustainable value Parastatals' can add through their participation in the national Telemedicine implementation programme. The research identifies the obstacles encountered in achieving successful implementation of and the benefits of implementing a Telemedicine project successfully. A derived practical and feasible Telemedicine implementation framework and plan is presented towards the end of the study.

To realise this objective an extensive review of the current literature was undertaken on the concept of Telemedicine applications and deployment from local and international experiences point of view. The following main results from literature review are presented:

- *Traditional information support* – It was pointed out that there are modern routine data or information collection practices, which replace traditional non-economic practices. Higher level of sophistication of the uses of Telecommunications is that of actual examination and care of a remotely located patient, known as Telemedicine is important and as a growing field is expected to change many of the traditional approaches in health care.

- *Rationale for Temedicine* - It was highlighted that the cost of health care increases to such an extent that government which have had major burden of funding the healthcare services and schemes are unable to meet the requirements and demands of their populations. These demands come in two fold, those that appear to be contradictory first, to provide equitable access to health care services and second, to reduce or at least control the increasing cost of health care services. In this case Telemedicine is suggested as the most suitable way of overcoming these economic obstacles.

- *Barriers* – these were cited as, infrastructure planning and development, Telecommunications regulations, reimbursement for Telemedicine services, licensure and credentialing for medical personnel, and malpractice liability and privacy of patient records. Attributes from the lack of rigorous research and evaluation on Telemedicine delivery has also been cited as an impediment to its wide adoption.

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CHAPTER 1
PROBLEM IDENTIFICATION AND RESEARCH PROPOSAL

1.1 INTRODUCTION

South Africa (SA) has embraced the use of Information and Communication Technologies (ICTs) in order to address the pressing development goals. The application of ICTs can contribute towards the improvement of health, education, empowerment and economic growth. The SA Health Care System ranges from highly specialised urban academic centres to small rural clinics throughout the country. These centres are divided into three categories, namely tertiary, secondary and primary health care centres (Department of Health, 2002:5). The functions of these centres are discussed in detail in the literature review section of this research study. The current skewed distribution of health care facilities and expertise in urban areas has resulted in limited access to basic health care in rural areas. The principles of the Reconstruction and Development Programme and the National Health Plan, as ascribed by the Department of Health (DoH), will guide the vision and implementation strategy of a Telemedicine System (Department of Health, 2001:1).

Telemedicine is a general term used to define health care activities carried out over a distance. It is defined as the practice of medical care using audio, visual and data communications; this includes medical care delivery, consultation, diagnosis, treatment education, and the transfer of medical data. The term *education* covers both the education of the patient and the continuing education of the health care staff. *Telehealth* is a broader concept than *telemedicine.* In addition to *telemedicine*, it also encompasses the use of computer-assisted telecommunications to support functions other than the clinical aspects of health-care, such as management, surveillance, literature, and access to knowledge (Mandil, 1999:84). Thus, in a simple manner *telemedicine* may be defined as an innovative technological tool that can be used for the delivery of basic and sophisticated health care practises. This definition will serve as the basis for understanding what aspects are encompassed in telemedicine.

The Department of Health (DoH) in SA has initiated a process that seeks to facilitate the establishment of telehealth stations in rural hospitals and clinics. This process was

intended to be in accordance with the SA Health Care System and determined under the auspices of DoH. This process included:

- Establishment of a TELEMEDICINE Task Team in July 1998;
- Development of a Telemedicine Strategy and Implementation Plan by the Task Team;
- The project is managed by the DoH.

Telemedicine key stakeholders include the Department of Health (DoH), The Medical Research Council (MRC), parastatals (Eskom Telecommunications, Telkom, CSIR and Transtel, The South African Committee for Essential Community Services) and National Health Information Systems (NHIS).

The telemedicine programme, as envisaged by key stakeholders, will focus on four areas, identified as Human Resources: Applications, Infrastructure, and Maintenance. These focus areas are addressed at every step of the implementation of this programme. Related projects, such as tele-education and e-health, must comply and are within the medical guidelines and the principles agreed to by the Telemedicine Task Team and National Health Information System of South Africa (NHISA). These guidelines are discussed in detail in the literature review of this research study. It is envisaged that the programme will be implemented in three phases on an incremental basis. It is worth noting, however, that the first phase of this programme has already been completed (Department of Health, 2001:3).

The Telemedicine Research Centre was established as a joint project between the DoH and the Medical Research Council (MRC) in SA and aims to be a centre of excellence in telemedicine research on the African continent. Telemedicine aims to deliver cost-effective and equitable health care to both peri-urban and rural areas. The telemedicine programme will enlist the services of SA Medical Schools for cost-effective medical education and will seek to facilitate recruitment and retention of health care professionals in rural communities (Department of Health, 2001:2).

An Eskom subsidiary, The South African Centre for Essential Services (SACECS), was formed in the commercial division to identify essential social projects that can assist in

the alleviation of poverty by rendering commercial services. To date its projects have concentrated on water and sanitation, electricity for the poor, communication and small-scale agricultural projects. Telemedicine provides a unique opportunity for SACECS to leverage its expertise by entering this market and implement a commercially viable telemedicine project for the DoH (Anon, 2003:2).

The study will compare and contrast the literature and empirical experiences from the global point of view throughout the entire research process. This will assist in the facilitation of the implementation of the intended telemedicine through best practices captured from international experience, such as Europe and the United States of America. A detailed discussion on the conceptual and implementation approach utilised by the international fraternity will guide the research outcomes for the approach that is most relevant in the South African context.

1.2 PROBLEM STATEMENT

The digital globalisation has surrounded and inter-connected most urban communities and has brought visible changes in developed and urban communities. However, the challenges faced to reach or cover all areas nationally, especially rural areas, continuous development is not accelerated and the result is that the gap between the "haves" and "have-nots" remains (Yasuhiko, 2001:7).

South Africa has the most extensive communications infrastructure in Africa and therefore has an opportunity to emerge as a recognised leader in the Information and Communications Technology (ICT) Industry (Mandil, 1999:84). However, there is a 2% penetration of telecommunications services into Africa, of which 90% occurs in SA (Department of Health, 2001:3). This scenario therefore presents an opportunity for parastatals and private telecommunication networks to have a share in the telecommunications industry in SA and Africa. Telemedicine is a telecommunications service, which can enhance the current penetration of telecommunications services in SA and Africa as a whole (Yasuhiko, 2001:8).

The South African Government has identified telemedicine as a strategic tool in order to improve delivery of health care and training services to remote rural areas in SA. The

focus of telemedicine in South Africa, as adopted by the National Task Team on Telemedicine, is mainly telehealth for an example, (health promotion, prevention, education, research, population data collection and health management) and tele-education or teleconsultation (occurs every time clinicians utilise telemedicine links in order to perform patient consultation).

Telemedicine encompasses all aspects of health care, from diagnosis and management, to the continuing education of health care professionals, whenever distance is involved (Wainwright & Wootton, 2003:557-563). It is therefore imperative to emphasise that telemedicine is not technology as such, but rather a *technique* for delivering care when the individuals concerned are located in different places. This *technique* involves modifying normal clinical practice to adapt to the novel circumstances of communicating at a distance, rather than in person and this will comprise of numerous technological approaches. This, in comparison with the traditional approach of delivering health care systems, substitutes the human interfaces between health care provider and the health care consumer by means of technology.

From these excerpts it is clear that this research undertaking necessitates a comprehensive review of literature, using different terms such as *telemedicine, tele-health, video conferencing, effectiveness, access, outcomes, satisfaction, quality of care, education, empowerment* and *costs*.

According to Seong (1999:5) international research underlines that the term *telemedicine* and its definition have become less clear, because of the inevitable convergence of technology in such a manner that it would be difficult to separate telemedicine from other health care activities. This research has also shown that telemedicine at its embryonic stage will be marked by a lack of healthy competition, and that barriers to the industry's development are normally substantial. These findings are supported by the theory known as "technology adoption life cycle", simply defined as *crossing the chasm* (Burgelman et al., 2001:269). It is also highlighted that, with time, certain aspects will mature; these include industry association, research bodies, journals, healthy competition, private investment and high levels of use in some instances. Substantial obstacles, such as competition from incumbents in the medical fraternity, will also have to be overcome before the industry takes off in a dynamic, enduring manner.

It will also be difficult to demarcate industry boundaries, particularly in areas that involve fast changing information and communication technologies.

From the above discussion it may be deduced that *industry* is defined loosely by:

- types of technologies used,
- the markets,
- or the stakeholders (e.g., customers, vendors, suppliers, users).

According to Seong (1999:5) international research has proven that most people involved found it difficult to see the industry as a range of technologies markets and customers. Many see this from a single angle only, such as video conferencing. To overcome this short-sighted view, it is crucial to pursue a comprehensive view of the telemedicine industry.

One other major challenge faced by telemedicine projects is to survive beyond the initial phase of government subsidy. This situation is compounded by a lack of achieving sustainable development through new projects in a business-like manner. According to Mitchell (1998:2) the business model should constitute the rigorous process of analysing the factors indicated below:

- Identification of major environmental trends that may impact on the industry over the next three years.
- An examination of the industry's internal strengths and weaknesses.
- An examination of the industry's external opportunities and threats.
- Identification of barriers to entering the market.
- The needs of various segments of the market.
- The availability of core and peripheral equipment.
- The quality of systems integration.
- An understanding of customer motivations and unmet needs.
- The opportunity to offer value-added aspects of products and services.
- Barriers to customer adoption.

It is important to emphasise the fact that from this model an intangible and tangible value can be derived and this will be representative of quantitative and qualitative factors. This value will be denoted by the value contributed to the country's economy and the change brought to the delivery of health services in a permanent and sustainable manner. The most important aspect to be included in this project is the strategic planning exercise at two levels, namely national and regional levels.

The provision of primary health care services (PHC) to rural South African communities requires advanced technologies (telecommunications infrastructure, telemedicine equipment, power supply, etc.), which are currently lacking in the rural areas (Garz, 2002:2). Although donor funding may be sought to assist in eradicating these problems, the issue around sustainability, ownership and theft remains a concern.

The participation of parastatals will highlight a diverse role to communities. Parastatals could become the primary interface between telemedicine and communities. This work will help to identify health care issues that need to be addressed and develop expertise in various telemedicine conditions, which will lead to further opportunities. These opportunities include telemedicine spin-offs such as development of rural business, improved level of literacy through tele-education and access to information through Internet.

1.2.1 DEFINITION OF TELEMEDICINE

In SA telemedicine has been practised in a basic form for many years, such as nurses providing clinical advice over the telephone. In its more sophisticated form, it is a technology that employs advanced image, audio and data capabilities, such as video conferencing (Wainwright & Wootton, 2003:562).

1.3 OBJECTIVES OF THE STUDY

The research study objectives will include primary and secondary objectives and are discussed below in the sub-sections.

1.3.1 PRIMARY OBJECTIVE

The objective of the research is to use the results of the research study to derive a model which can provide a solution to the concerns indicated in the problem statement. The model will demonstrate the value parastatals can add through their participation in the national telemedicine implementation programme. This research will identify the obstacles encountered in achieving successful implementation and the benefits of implementing a telemedicine project successfully. For example, questions about the sustainability of the project will be addressed through detailed research and a commercial rationale for participation will be provided.

This scenario therefore presents an opportunity for parastatals to have a share in the telecommunications industry in SA through the provision of telecommunication networks in previously disadvantaged areas. These will be used in order to improve the delivery of Primary Health Care through telemedicine, and furthermore to improve the delivery of educational services as the same infrastructure deployed for telemedicine could be used for e-learning.

1.3.2 SECONDARY OBJECTIVES

To realise the above-mentioned primary objective, the following secondary objectives will be pursued:

- To analyse and assess the impact improved efficiency and cost effectiveness in the delivery of rural health care services using telemedicine.
- To recommend the best technology practices in implementing the telemedicine system.
- To analyse and assess the impact of delivery of education and other social services to rural communities.
- To provide or suggest an adequate business model for the implementation and sustaining of telemedicine in Sub-Saharan Africa.

- To identify, from a holistic point of view, the human psychological obstacles that may hinder the application and usage of the telemedicine concept, and to suggest the best approach to overcome the situation.

1.3.2.1 SCOPE OF THE STUDY

This study focused on assisting parastatals to improve the progress of delivering telemedicine networks as described in the previous sections of this report. This was made possible through studying the available literature aimed at formulating the role of parastatals in the national telemedicine implementation programme. This is necessary to discuss the most important problems which were identified, and also to align the project objectives with the capability of parastatals in terms of delivery. The completion of this research scan will facilitate the possibility of the sub-pilot projects which are pursued as well as their successful implementation.

The intended outcomes of each phase proposed by the National Task Team on Telemedicine will be discussed in detail. Various health care providers, particularly nurses, will be identified for further training in telemedicine technology. Relevant telemedicine technology applications will be researched to serve disadvantaged rural communities. Results of the pilot phase will be published and the attention will be shifted towards transforming the SA telemedicine system into an operational stage. The positive outcomes of this project will be highlighted and translated into telemedicine being a profitable venture for parastatals. This will be supported by a possible business model that will indicate a positive return on investment. Furthermore, the impact of Eskom's absorption into the SNO, in terms of satisfying social obligations, will be leveraged for the benefit of the telemedicine project. Experience in both instances will satisfy the criteria for ownership and sustainability.

The impact of parastatals' involvement in this project should contribute towards overcoming the current telemedicine skill shortage in SA and it therefore creates an opportunity for Eskom and other stakeholders to obtain the required skills. The scope of this study also covers the impact of providing PHC services to remote rural SA communities. This is a demonstration of how telemedicine will be used for health

promotion programmes, prevention, early diagnosis, intervention and management of various diseases. Furthermore, this study will also cover the various problems experienced prior to the project implementation, for example the occurrence of regulatory problems such as licensing and other administrative problems, such as service level agreements.

1.4 RESEARCH METHODOLOGY

In pursuing the above-mentioned objectives, two approaches will be used:

1.4.1 LITERATURE REVIEW

Locally, the DoH published its research work based on its projects. The published work provides information on pertinent data on telemedicine, the telemedicine implementation plan in SA, current telemedicine research pilot sites, telemedicine equipment and technology, power supply technologies for remote telemedicine sites and telecommunications access technologies for telemedicine sites. This was aimed at assisting in formulating the role of the Department of Health in the national telemedicine implementation programme.

International literature on telemedicine covers both North America and Europe. It documents the initiatives of this innovative concept in providing health care in remote areas and peri-urban areas. Lessons from both local and international literature will form the basis for arguing for a company like SACECS to implement this service as a lead service provider for the DoH as the policy custodian.

1.4.1.1 STRATEGIC USE OF TELEMEDICINE AND AREAS OF FOCUS

The SA government has identified telemedicine as a strategic tool in order to improve the delivery of health care and training services in SA to remote rural areas (Department of Health, 1998:2). The focus of the National Task Team on Telemedicine is mainly on telehealth, that is, health promotion, prevention, education, research, population data collection and health management. Tele-consultation occurs every time clinicians utilise telemedicine links to perform patient consultation. Telehealth comprises all aspects of

health services. This section discusses the objectives of Telemedicine, deliverables, key stakeholders, telemedicine implementation in SA, progress to date in the various provinces, telemedicine research pilot sites, power supply technologies for telemedicine sites and other access technologies.

1.5 OBJECTIVES OF TELEMEDICINE

This section discusses the objectives of the National Telemedicine Research Centre and, by extension, the objective of the research:

- To evaluate the operations and systems of national telemedicine projects to ensure improved delivery of health care services.
- To use a clinical research test-bed to test new telemedicine technologies for clinical abilities and cost effectiveness.
- To provide tools for implementing telemedicine such as training, teaching materials and local capacity professional development and research into relevant protocols, standards and medico-legal aspects.

1.6 DELIVERABLES

Some of the key deliverables of the South African telemedicine programme include the following:

- functional clinical services to remote rural communities of SA;
- medical research, education and training of SA rural health care providers;
- technical task teams for developing tele-education, clinical protocols, legal licensure ethics & infrastructure systems and guidelines;
- ensuring affordable, clinically acceptable primary care telemedicine workstation suitable for the region is researched;
- efficient management of the images (static & dynamic);
- improved efficiency and cost effective delivery of rural health care services in SA;
- technical task teams for developing educational, clinical, legal and infrastructure guidelines;
- and using appropriate telecommunications infrastructure for sustainability.

1.7 IMPLEMENTATION OF TELEMEDICINE IN SOUTH AFRICA

The SA telemedicine programme will be implemented on an incremental basis (Department of Health, 1998:8). This will allow users, health care providers and administrators an opportunity to obtain skills in modern medical technologies. The implementation plan is divided into three phases; namely, the securing of funding, development of telemedicine connections and the identification of rural sites on the basis of need. The NHIS will ensure that the projects adhere to and are within the guidelines and principles agreed to by the telemedicine task team. At the end of the third phase, the project will move into the clinical application stage and will no longer be regarded as a pilot project.

1.7.1 Telemedicine research pilot sites

The Medical Research Council pilot sites are in Mpumalanga, Free State and Eastern Cape Province. The aim of the pilot study is to investigate the appropriate and cost-effective connectivity hardware, software and telecommunications access. These must be both sustainable in and adaptable to developing countries in order to support PHC services.

1.7.2 Power supply technologies for remote telemedicine sites

The lack of energy supply in many remote areas can be a major obstacle in the deployment of telecommunications infrastructures in order to support telemedicine (Department of Health, 1998:42). However, this obstacle can be overcome through the adoption of a feasible power supply technology. Currently a number of technologies to be considered for remote power supply exist. These power supply technologies include solar system, diesel generators and micro diesel turbines (Garz, 2003:4). This study, however, will recommend appropriate power supply technologies to be implemented. Detailed information on recommended power supply technology is covered in chapter 3.

1.7.3 Telecommunication access technology for telemedicine sites

Various technologies such copper, fibre and wireless may be used in order to provide basic access telecommunications technology. The wireless infrastructure provides faster roll out times, lower maintenance costs and greater network flexibility. Therefore, it will be the intention of the researcher to recommend suitable technologies for telemedicine implementation. For cost structure see annexure B of this document.

1.8 EMPIRICAL FIELD INVESTIGATION

The approach chosen are primarily based on the collection of the most updated primary data analysed for informed decision making of the relevant telemedicine implementation strategy and plan. The approach of collecting data is based on three methods, namely critical, systematic and scientific methods. These methods are used to convey the interpretation of data and what it signifies in terms of each aim. The three selected methods proposed for use during the research are briefly discussed in this section, as well as the method for data analysis.

1.9 DATA COLLECTION METHODS

1.9.1 Critical Method

The researcher will use the critical method to collect information based on facts and knowledge from the relevant established sources. These sources will include knowledge supplied by the key stakeholders currently driving the telemedicine programme. This ensures the overall sustainability of the project, as each player has a contribution to be made to ensure project sustainability and furthermore to prevent duplication of effort.

1.9.2 Systematic Method

The second method of data collection used is the systematic method. This approach involves consultation of reliable researched literature on telemedicine, such as books

and the internet. Interaction with stakeholders on pursued projects and practical site visits to proposed area and meetings with the rural municipalities will be conducted. This will assist in understanding the telemedicine requirement as well as the issues that need to be overcome for successful implementation of telemedicine services.

1.9.3 Scientific Method

The implementation of the scientific method will complement the combination of research methods to be used. The scientific method uses the basis of inductive reasoning, and does not begin with a preconceived conclusion or a major premise, but with observation (Leedy, 1990:80). This method begins by identifying the problem that defines the goal of the quest, gathering the data with the hope of resolving the problem, positing the hypothesis both as logical means of locating the data and as an aid to resolving the problem, and lastly empirically testing the hypothesis by processing and interpreting the data to see if the interpretation of them will resolve the question that initiated the research (Leedy, 1990:81). Therefore, in this case the process will include data collection from the community on health and other services consumed and those that can be consumed, thus providing a list to form an inventory of information. Established communication with affected parties such as professionals and government authorities, will facilitate access to quantified information through tools such questionnaires. Recent surveys, statistical releases, local data and other public documentary sources will be used in this process.

1.9.4 Development and composition of questionnaires

Based on the important issues gathered from the literature study, the questionnaires seek to determine the current state of telemedicine, including all issues relating the establishment of improved medical infrastructure, by making use of related questions that will measure the importance of various aspects relating to this topic.

The reliability of these draft questionnaires was tested by means of a pilot study. In this pilot study the questionnaires were distributed to all stakeholders in the medical fraternity, including rural communities, affected parties such as professionals and government bodies, and public and private businesses. Indistinct and ambiguous

questions will thus be adapted, if necessary, to ensure intangibility and reliability. The questionnaires were again checked and contrasted with the medical authorities and professionals to ensure relevance of the research topic and were amended where necessary.

1.10 DATA ANALYSIS

The same methods will be used during the data analysis stage and applied as follows:

- scientific method – coding, capturing and descriptive statistical analysis, including multivariate methods analysis so as to count frequencies and estimate the properties of the responses. The estimations of the cluster samples will be aggregated for different locations. This information will then be interpreted by using sample charts, graphs and dummy tables in order to transform the data into meaningful forms that will facilitate the understanding of this research.
- systematic and critical methods – previous experiences and facts based on new research findings will be used to prove or substantiate a need for sustainable telemedicine rollout in SA.

1.11 LIMITATIONS OF STUDY

The scope of the topic or mini-dissertation is limited to a study of telemedicine implementation in South Africa with the considerations of international experiences being replicated as an approach. Although the possibility exists that the results may be representative of the implementation of telemedicine in other countries in Africa, the results of this study are only representative of South Africa and neighbouring countries.

The business model of the research will, to a larger extent, emphasise the focus on the public as opposed to private business involvement.

Although the total information resource covers all aspects of telemedicine, the main focus of this dissertation will concern the infrastructure implementation of the telemedicine in South Africa including technological, cultural and business aspects.

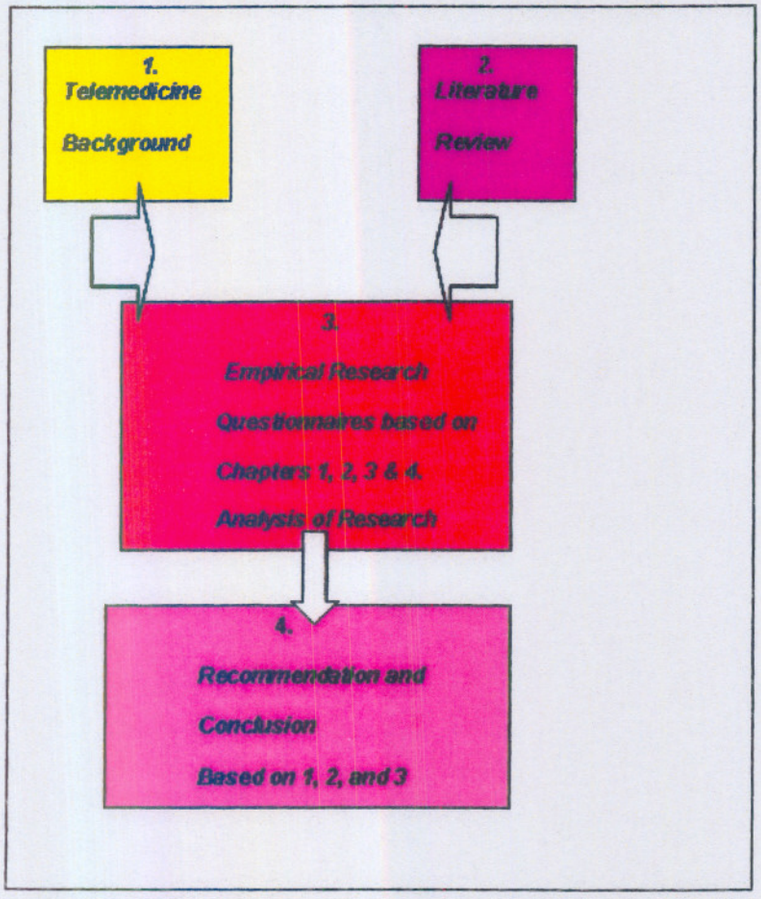
All literature used for reference purpose will be chosen from the period January 1998 to November 2004.

1.12 CONCLUSIONS AND RECOMMENDATIONS

To complement the research process a survey consisting of an in-depth literature research will be used to formulate arguments that will test previous theories and concepts. This information will then be tabled to form a list of qualitative facts in the form of measuring the SWOT and PESTEL analyses of the intended telemedicine project.

1.13 SUMMARY OF THE RESEARCH METHODOLOGY

The research methodology is graphically illustrated in Figure 1.1
Figure 1.1: Research methodology



1.14 CLARIFICATION OF TERMINOLOGY

- **Telemedicine –TM**

The definition of telemedicine by NHISA/SA is the practice of medical care by means of interactive audio, visual and data communications; this includes medical care delivery, consultation, diagnosis and treatment, as well as education and the transfer of medical data.

- **Telehealth**

Telehealth involves telemedicine, telesurveillance, as well as other general functionalities.

- **Telemedicine Task Teams**

This is a team of role players in the implementation of telemedicine in South Africa, consisting of government representatives, medical professionals and councils and a community representative.

- **Medical Research Council (MRC)**

The institute of medical research is to form a council as mandated by the government and other medical authorities.

- **Medico Legal**

A body which constitutes medical legal practitioners to approve and disapprove medical practices from a local and international perspective.

- **National Health Information System of South Africa (NHIS/SA)**

A committee made up of nine provincial health information representatives, the national office, the district Health Systems Committee, the South African Military Health Services, the Medical Research Council, Statistics South Africa and representation by the private sector (Health Standards Committee and Hospital Association of South Africa).

- **South African Committee for Essential Community Services (SACECS)**

A subsidiary of Eskom Enterprises hosted within Technology Services International, which develops, and implement technologies through demonstration projects based on identified needs, utilising Eskom and other local and international resources.

- **Parastatals**

Any public enterprise asset with majority ownership belonging to the SA government. These enterprises include Eskom Co. Pty Ltd, Transnet Co. Pty Ltd, Telkom, Postnet Co. Pty Ltd, etc.

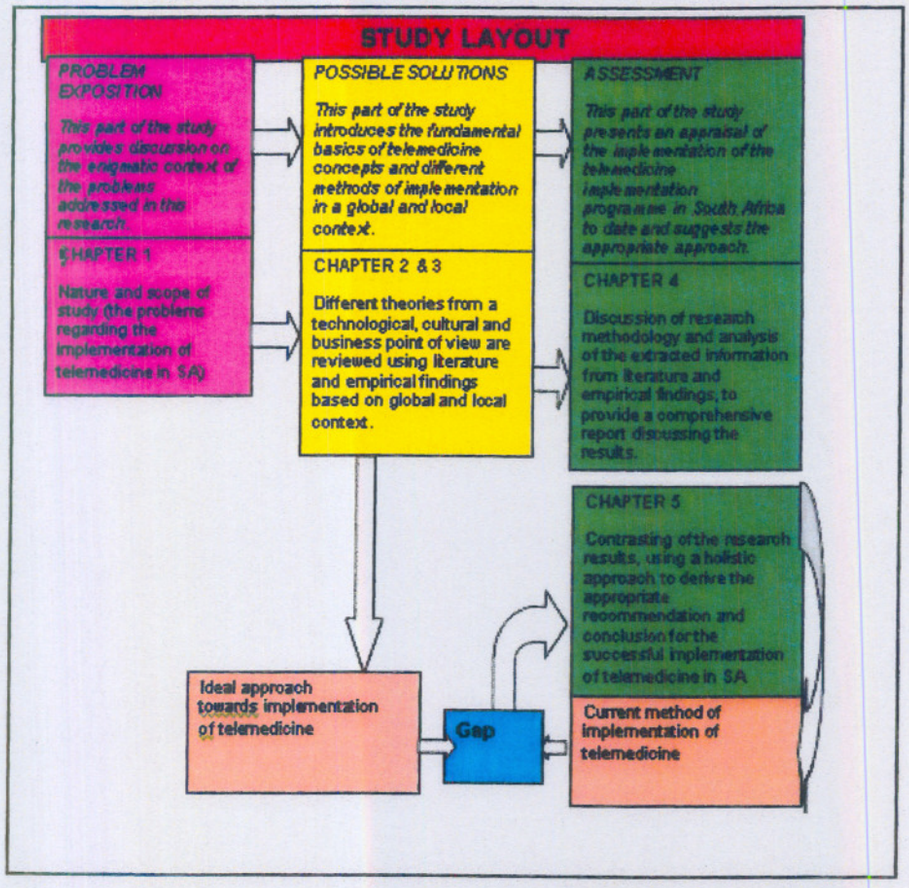
1.15 LAYOUT OF STUDY

This section seeks to discuss, explain and elaborate on the contents and intentions of the chosen research study. This will entail the format and chronology of chapters and contents as intended by the researcher.

- ***Chapter One*** - This chapter briefly discusses the contents of the proposal presented in this document. A concise review of this document includes headings (i.e. background to study, problem statement, objective of study, scope of study and research methodology).
- ***Chapter Two*** - This chapter discusses the details captured by means of the literature study, leading to empirical research findings. The topics covered tests the literature discussed in the research proposal and further literature research findings undertaken in the proposed study.
- ***Chapter Three*** - This chapter continues to discuss the details captured by means of the literature study, leading to empirical research findings. However, topics covered in this chapter emphasize the approach to the intended technology and business models.
- ***Chapter Four*** - The research methodology is discussed and the results of the study are analysed and discussed in detail in a comprehensive report. The findings of the empirical study are used to underscore the concepts discussed in the literature review. The discussion of the research methodology used elucidates the results of the report and present observations. This includes the hypothesis, procedures of data collection by means of a questionnaire, data analysis and tools used in the study.

- ***Chapter Five*** - The value and expectation of the research results is contrasted as discussed in the proposal and a comparison of previous studies with the intended study results are discussed. A holistic approach is followed to derive the recommendation for the intended study as emphasised in the proposal. The report is concluded by highlighting or demonstrating the essential catalysts, which serves for provision of a reliable indication of the application suitable for the implementation of the main subject of this research.

Figure 1.2 Layout of study



CONCLUSION

The study is required to provide a solution to a very serious problem which is experienced world wide, namely the delivery of health and medical services to rural communities and the sustainability of such services. This is achieved by means of a literature study that provides a background against which the empirical study is conducted and on the basis of which the questionnaires is formulated. The questionnaires are used to measure the current level of problems and progress of the telemedicine implementation and current methods used to render health and medical services to rural communities. This is then compared with the requirements of the ideal telemedicine implementation plan and system established during the literature study. Clear guidelines and recommendations are finally formulated for the implementation of an effective security framework and plan that would meet future requirements regarding telemedicine implementation for SADC countries. This is done against the background of the literature, as the gap between the ideal and current level of telemedicine implementation problems and progress becomes apparent.

CHAPTER 2

LITERATURE REVIEW: TELEMEDICINE EXPERIENCES

2.1 INTRODUCTION

Telemedicine as accepted in the international forums such World Health Organisations (WHO) and adopted in the medical fraternity is defined as: the practice of medical care using audio, visual and data communications; this includes medical care delivery, consultation, diagnosis, treatment education, and transfer of medical data. *Telehealth* is broader than *telemedicine.* In addition to telemedicine, it also encompasses the uses of computer-assisted telecommunications to support functions other than the clinical aspects of health care, such as management, surveillance, literature, and access to knowledge (Mandil, 1999:84). In short, telemedicine can be defined as an innovative technology tool that can be used for the delivery of basic and sophisticated health care practises. For the purpose of this study, the researcher revisits the definitions as defined by different international countries.

The provision of health care requires a wide variety of data and information which needs to be collected, processed, distributed and used. One way to view the scope of the uses of informatics and telematics in health is through an understanding of the principal functions and the types of data and information in the health sector. The term *health and informatics* is used as an umbrella term, to encompass the rapidly evolving discipline of using computing, networking and communications methodology and technology to support the health related fields, such as medicine, nursing, pharmacy and dentistry (Mandil, 1999:79).

There are basically five main types of information and data (Mandil, 1999:78):

- *Management information* is the information for day-to-day administrative needs and for planning, programming, budgeting, monitoring and evaluation of functions such as a health care institution (e.g. a hospital, health care, a laboratory), an immunising campaign, the health services in a geographic area (e.g., a province, district, a city) a community, or the whole nation.

- *Clinical information* is the data and information required for carrying out clinical functions (and it is also generated by these clinical functions), such as diagnosis and treatment, including medical images (Struber, 2003:392). There is a distinction between data (raw facts or observation, typically about physical phenomena or business transactions) and information (data that has been converted into a meaningful and useful context for specific end users) (O'Brien, 2002:13).
- *Epidemiological information*, also known as surveillance information, describes the patterns and trends of diseases and related health care measures and services.
- *Literature* consists of written notes, reports, formal publications and grey literature.
- *Knowledge* is information on the actual know-how needed to carry out a medical or technical task, such as how to diagnose a specific medical problem, how to conduct a specific laboratory test, and how to treat an ailment (O'Brien, 2002:14).

The sources of these types of data and information exist within and outside the health care infrastructure and are located at varying distances from the users. In practice, users require and generate a mix of these types of information and at differing stages of their respective functions. For example, a physician may consult a knowledge base while examining a patient's record, which may be used by the management system for billing purposes. The clinical data would also eventually be stripped of its personal and private items and passed on to contribute parts of the health surveillance information (Mandil, 1999:81). Thus, the collection, flow, processing and distribution of health-related data and information are instrumental to the efficacy, efficiency and economy of the operations and development of health care services. Health care encounters and transactions are therefore multi-faceted (Mandil, 1999:81). They occur, for example, between a patient and a physician, an expert consultant or a health institution (e.g. laboratory, a pharmacy or rehabilitation centre) or between two physicians. Such encounters may occur in one's own community, in another part of the country or in another country. Such encounters require data and information prior to the actual start of the encounter or soon thereafter. Such data and information could be in differing volumes, at differing times and in different forms such as voice, numbers, text, graphics, and static or dynamic images, and are often a judicious mix of these.

The use of technology in the clinical or medical aspects of the health-care services have steadily grown and include sensing and measuring equipment, laboratory services, and

static and dynamic imaging (Struber, 2003:391). With the growth of the usage of such technologies and of the variety and sophistication of these, it is inevitable that many of such technological services became separated from the mainstream of health care institutions – separated in distance, and significantly, in management. The communications between such technology-based services became an important consideration in the efficiency and economy of the health sector.

The sources and repositories of such data and information could be spread over different locations and would take different forms, for example, complete patient records; hand-written prescriptions; reports by a physician, a consultant or a laboratory; the response from the library; a surveillance system; or a drug interaction information service (Mandil , 1999:90).

2.2 TRADITIONAL INFORMATION SUPPORT

Traditionally, all health care encounters occurred face-to-face and the spoken and written word were the main modes of communication and medical record keeping, while transport was mainly by road, rail or air, public and private services. The inception and popularisation of the telephone led to it becoming a key liaison tool in the health care services, firstly through the spoken word, and decades later, through the facsimile transmission of the written word (ITU, 2003:1). As telephone services grew, it became the communication network of the health profession and in institutions, both nationally and internationally.

Epidemiological surveillance essentially involves the study of the patterns of distribution and the trends of diseases and related health care measures by geographical areas, age groups, and communities, etc., so as to establish relevant priorities and optimise health care measures through monitoring and evaluation (Mandil, 1999:94). Surveillance requires the collection and analysis of varied and relatively large amounts of data, from and about the locations where diseases and related health problems occur and from where patients present themselves, typically in urban and rural health centres and general specialist hospitals (Mandil, 1999:81). Traditionally, the raw data is extracted from completed forms and reports, prepared according to long established procedures of reporting by the smaller units (e.g. health centres), through interim units (e.g. a provincial

general hospital), to a central facility (e.g. ministry of health or medical research council) charged with the responsibility of analysing and storing such data and issuing relevant periodic surveillance reports.

The arrangements and related facilities have long been recognised as slow, inaccurate, and incomplete and they present major problems in the logistics of transmission, processing and storage. The reporting of serious infectious diseases and epidemics often follows a totally different operating reporting system. In some African countries these processes consume up to 80 percent of the health information budget; so much that it is not possible to do anything else with health information (Mandil, 1999:78).

Certain traditional, routine data collection practices could be replaced by more economic computer-supported sampling techniques. In addition, relatively simple computer support to the patient admission, discharge and transfer function in a hospital, and the equivalent in the health centre, could eliminate and improve on the inaccuracy, time and cost of manually maintaining statistical forms (Department of Health, 1998:4). Furthermore, more effective utilisation of satellite-based remote sensing data could provide the essential intelligence sought for the surveillance of certain problems (e.g. water-borne vectors and diseases) (Cardno, 200:6).

The developments in and growing availability and uses of computing, networking and telecommunications in most countries stress the need for a major rethinking of the traditional methods employed for surveillance, early warning and sentinel systems, especially with regard to communicable diseases (Department of Health, 1998:4).

An area that is, relatively speaking, not recent but will usefully expand with the spread of Telematics support is the access to, and uses of knowledge-based systems. The systems, which are also known as expert systems and decision support systems, are computer applications that provide expert advice and guidance on medico-scientific issues and procedures. These systems replicate the traditional approach of one health professional consulting another in search of advice and knowledge on how to tackle certain tasks (Mandil, 1999:86).

A higher level of sophistication of the use of telecommunications is that of actual examination and care of a remotely located patient. This part of the field is known as telemedicine, which is an important and growing field and is expected to change many of the traditional approaches in health care (Mitchell, 1998:3).

2.3 THE AIM FOR TELEHEALTH AND TELEMEDICINE

Nearly all countries are, in one form or another, involved in a reformation of their respective health sectors (Department of Health, 1998:3). The common aim for such reform is to meet the problems and challenges of inadequate health sector resources that are diminishing, while the population's expectations and demands for quality health care services are rising. The cost of health care has been increasing to such an extent that governments, which have had the major burden of funding the health care services and schemes, are unable to meet the requirements and demands of their populations. In industrially developed countries this has resulted in a significant reduction in health insurance coverage by governments, and in developing countries, particularly the poorest, where the health care services have to a large extent been free, this has resulted in a significant decline in the extent and quality of the health care services (Mitchell, 1998:4).

The health sectors in almost all countries face two apparently contradictory demands: first, to provide equitable access to health care services and second, to reduce, or at least control, the increasing costs of health care services. One of the initial measures that may be taken to solve this problem is to optimise the use of existing resources (professional staff, health care institutions, expensive equipment, etc., with the use of information technologies). It is thus not an exaggeration to state that all health sector reform plans or programmes include a significant dose of "informatics and telematics support". It is imperative at this stage to provide the definition of *reform*, as a process involving steps which attempt to modify the current status quo to the desired future state (Cummings 2001:23), as explained by Lewin's change model. These change steps involve:

(1) *Unfreezing* – reducing the forces maintaining the organisation's or people's behaviour at its present level.

(2) *Moving* – shifts the behaviour of the organisation or people to a new level.
(3) *Refreezing* – stabilises the organisation or people at a new desired state of equilibrium.

Telecommunications, in particular, is viewed as one of the means that could support such optimisation.

The question arises of how telemedicine practically contributes to the improvement of the quality and coverage of health care services in a cost efficient manner. The following scenarios could provide answers to this question. First, telemedicine could enable a general practitioner, located in a rural setting, to seek and obtain a second or an expert opinion from colleagues located in a national speciality hospital, for example, or anywhere else in the world (Wainwright & Wootton, 2003:4). Secondly, telemedicine could enable a health worker such as a remotely located nurse, to obtain the technical guidance of a physician to attend to a patient. Thirdly, telemedicine could enable the sharing of the uses of pooled equipment that is centrally located, often not affordable to smaller health care institutions (Mitchell, 1998:4).

2.4 RELATIONSHIP TO TELE-EDUCATION

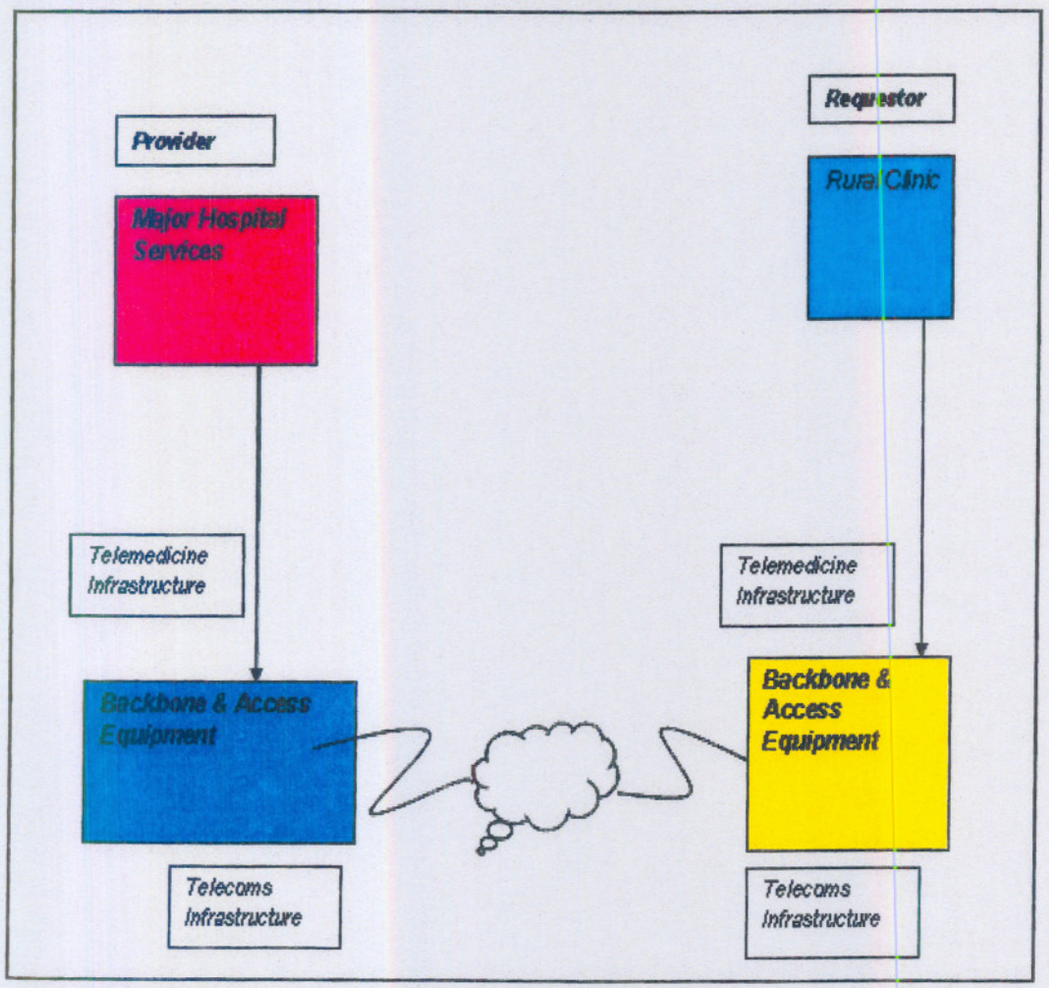
The technological facilities and protocols needed for telemedicine are mostly the same as those for tele-education and training in health care. For example, telemedicine might involve a video-conferencing session where an expert advises or consults for a general physician on a specific case with the aid of shared static or dynamic medical images and data. The very same facilities, with the aid of images, would support a lecture or a training session to any number of students at the other end, sharing a single workstation, or each with his/her own workstation but spread over a campus, city, a nation or the world (Mandil, 1999:91).

Experiences in telemedicine have shown that invariably, the user requirements for telemedicine services and facilities include a significant portion of tele-education, particularly Continuous Medical Education (CME). In some countries such as Australia and United States, CME is a compulsory requirement for re-licensure of a medical practice (Mitchell, 1998:4).

2.5 THE ESSENTIAL PREREQUISITES

It is important to identify the main requisites of telemedicine services that would support the scenarios presented in section 2.4 above. These requisites are shown in Fig.1 as a simplified model. This model applies telemedicine links over any distance between nations or positions. There will professionals at both ends, namely the requestor and the provider, for example at a medical consultation. At each end a telemedicine infrastructure is needed, depending on a telecommunications infrastructure. What makes the difference, and thus decides the extent of the medical care to be supported this way, are the power and speed of the telemedicine peripheral equipment and the telecommunication lines.

Fig. 2.1 Simple Model of Telemedicine Link



Adapted from Mandil (1999:91)

The telemedicine infrastructure is the means by which medical data and any subsequent remote medical analyses are exchanged between the requestor and the provider of the telemedicine service (Clay, 1999:2). For example, for a physician seeking the support of a radiologist to interpret a radiological image, the telemedicine infrastructure could comprise the facility at both ends to scan, compress and transmit the image, to have it accurately reproduced at the radiologist's end and to transmit his/her interpretation and comments expressed either on the image or as a separate report, or both (Department of Health, 1998:4). The telemedicine infrastructure could be simple or complex, reasonable or costly, depending on the types of telemedicine services provided.

Telepathology, for example, requires special cameras to digitise slides or films, and tele-psychiatry requires two-way interactive video conferencing. The telecommunications infrastructure comprises the means to actually carry the content of the two-way communications between the requestor and the provider for the telemedicine service. That is, it comprises the communications software and the communications medium between two locations. The telecommunications service would also depend on the telemedicine services to be supported, which could require narrow or broadband, standard or high-speed telecommunications (ITU, 2003:4).

2.5.1 EXPERIENCE FROM AFRICA AND INTERNATIONALLY

It is important to emphasise that the approach of this research is not intended to imply that telehealth or telemedicine services are more important or more effective than tackling the basic causes of poor health: poverty, education, lack of clean water, basic nutrition and sanitation. If these resources were available, then eliminating the medical causes of poor health would be the undisputed priority.

The argument which is demonstrated continuously by experiments and examples in a number of developing countries, is that telemedicine is a means by which the uses and value of existing or relatively smaller additional resources could be optimised (Mitchell, 1998:3). For example, the five Ethiopian expert radiologists who travel to different parts of the country where only radiographers are available, and provide their much needed expert services, could multiply their output threefold and fourfold if the radiological

images travelled to them via telematics (Samba, 1997:21). Another example is that the money to send two doctors abroad to attend a course for a few days could be used to transmit the course via telematics to the benefit of many other doctors, nurses, and public health educators.

According to Hurreli & Woods (1998:25) telehealth experience in Africa may be grouped into these four main categories:

- Paper consultancies or studies.
- Studies which include actual practical demonstrations.
- Practical studies or experiments over a significant period of time.
- Operational services.

Examples of the above-mentioned four categories are cited in the sections below. These examples are cited neither exhaustively nor exclusively, but are chosen in order to illustrate the scale and the variety of the types of experiences and to underline the non-technical issues that are critical to eventually proceed beyond studies and experimentation; issues such as policy towards external collaboration, the importance of a national strategy, the adherence to standards, and legislation to facilitate public-private sector activities.

Compared to the rest of the world, the total telehealth and telemedicine activities in Africa is very small, mainly due to the lack of infrastructures vital for computing, networking and telecommunications (Wootten & Herbet, 2001:6). Nevertheless, the examples cited point to significant work that can be accomplished with existing goodwill and resources augmented in a careful fashion and in co-operation with other countries, organisations and institutions.

2.5.2 OPERATIONAL SERVICES

The best example to cite in this case is the Onchocerciasis Control Programme (OCP) involving 11 West African countries. OCP has had sound managerial, economic and technical reasons for having an appropriate, reliable, effective information and communication system. This was required for communications between field teams, with

five centres located in different countries; for the overall management of the programme based in Ouagadougou, Burkina Faso; and for the collection of data critical for the surveillance of the disease and the black fly larvae living in about 50, 000 square kilometres of waterways.

OCP used sensors placed in waterways for periodic readings and transmission via satellite to the main centre in Ouagadougou, and used traditional but most reliable radio frequency communications for voice communications and reporting between the different teams and five centres (Mandil, 1999:87). The mix of traditional and modern means of communications enabled the epidemiological surveillance, the modelling and the inter-teams liaison, which optimised its decision making for technical operations (for example aerial insecticide spraying by a small fleet of helicopters) and for its 11-country programme co-ordination and management (Mandil, 1999:86).

Another example of an operational service is that of the Non-Governmental Organisations Network for Africa (NGONet) (Mandil, 1999:87). Supported by IDRC, Canada, it has four major nodes, one in each of the main geographic areas of Africa: Harare in the south, Tunisia in the north, Nairobi in the east and Dakar in the West. It supports the work of the NGOs to connect internationally and provides training in this regard. These networks are also vital for establishing solid telemedicine networks from African continent to the global world and thus Tele-education is one such application that will be instrumental for improving primary health care.

While these networks maintain their identities, they are effectively bound together by the Internet. Thus an internet network provides a most economic opportunity for establishing telemedicine network infrastructure.

2.6 PRACTICAL EXPERIMENTS

One of the earliest successful practical experiments with international telemedicine links and co-operation between developing countries and industrially developed countries took place in 1986 and involved two African countries – Tanzania and Uganda – through the *Project Share* implementation (Samba, 1997:21). Intelsat satellite links were used to transmit electrocardiograms to experts in a Memorial Hospital, St. Johns, Newfoundland, for diagnostic support or a second opinion on proposed treatment. The link lasted for two

months with Tanzania, and several more months with Uganda. It is perhaps one of the earliest and most cited of such examples (Wootten & Hebert, 2001:6).

Three other examples from Mozambique, South Africa and Tunisia may be cited. In Mozambique, a variety of telecommunication links (dial-up, digital microwave and [Intelsat] satellite) are used for an experimental teleradiology link between a major hospital in Maputo and another in Beira (Grigsby, 1995:116).

In South Africa an ongoing study by the Department of Health include three pilot sites equipped with the necessary telemedicine links for teleradiology, telepathology and tele-ophthalmology. This study is partly based on the experience of a successful brief experiment in 1995 linking a general hospital in Tintswalo, Northern Province, with the university hospital in Johannesburg, Gauteng, for interpretation of radiological images and consultative advice to general practitioners (Department of Health, 1998b:5).

The Pasteur Institute in Tunis has for almost seven to eight years established an experimental telemedicine link with the Hospital Antoine Nice, for teleradiology and telepathology with the emphasis oncology (Sistero, 1999:24). France is an active contributor to the G-7 Global Information Society Initiative, which includes a few health related projects, and one specifically on telemedicine. The Tunis-Nice telemedicine link is being extended to link with an Italian institution.

2.7 STUDIES

According to ITU (2003:3) the inadequacy of telecommunications infrastructure and services in many developing countries is increasingly recognised as a major impediment. Virtually all major indicators, such as GDP per capita , teledensity, human development index, literacy, power consumption, child mortality and life expectancy, are negative in developing countries. The European Space Agency (ESA) selected a proposal by the United Nations Officer of Outer Space Activities (UN/OOSA) for a Satellite-based Co-operative Information Network, referred to as COPINE, which links professionals in Africa and Europe. COPINE is supposedly based on further refinements of the successful technology of the DIANA system (for agricultural information via FAO, Rome) and the MECURE system (for environmental information via UNEP, Nairobi) in which

ESA plays a major role (ITU, 2003:3). The technical characteristics of COPINE and the conditions offered for its eventual utilisation are quite attractive.

Technically, it is based on one parent satellite station in each country connected to the Intelsat global network and any number of secondary stations installed in hospitals, universities, research stations, etc., communicating with the parent station. The entire network is to be managed from Leuk, Switzerland. The services to be provided by COPINE are wide area networking, full video conferencing and full connectivity to the Internet. These services were to be offered to the health, education and neutral resources sectors of initially nine African Countries named by ESA: Ethiopia, Ghana, Kenya, Morocco, Nigeria, South Africa, Tanzania, Tunisia and Zimbabwe. This infrastructure is vital for serving as the main hub linking Europe for establishing global telemedicine forums. These forums are to be used for telehealth and tele-education applications (ITU, 2003:7).

The main condition is that each country contributes a one-time sum of between US$100 000 and US$250 000, or the equivalent in local currency, in return for five years of cost free equipment, installation, training and operational support and maintenance (Fraser, 2001:8).

The World Health Organisation (WHO/AOI) was invited to give a presentation on telemedicine to ESA and the UN/OOSA and was then challenged and funded to articulate an initial statement of the "The Potential Requirements of COPINE Health Sector Users" in Africa by visiting and making an initial assessment of the likely interest and requirements of the nine African countries cited above. The COPINE proposal raised a great deal of interest and expectations, and significant requirements in the relevant countries' health sectors will be well met by COPINE or similar services. The WHO/AOI study presented clear findings and recommendations to the COPINET Provisional Governing Board in 1998 (Samba,1997:21).

Northern Norway has one of the broadest ranges of telemedicine applications routinely used in day-to-day health care, and the same facilities are neatly used for Continuous Medical Education courses through tele-education. Norway is actively negotiating

support to Botswana on the development of telemedicine links within Botswana and with Norway (Peterson ,1997:12).

2.8 HEALTH INFORMATION STRUCTURE

The policy and strategy papers of WHO concerning National Health Information Systems in the 1970s and early 1980s stress that needs were for health information systems that would provide the right information to the right person in the right place at the right time in the right format (Zasshi, 1998:58). The emphasis was on the system seeking and providing the information. The appropriate adaptation of the above, to our emerging telematics age, would differ in a number of ways (Zasshi, 1998:58). For example, not only systems are involved, but a whole health information infrastructure; and this does not seek and provide the potential user, but it seeks and provides the user's access and decides what information is necessary for the user, when it is needed, and in what format it is to be provided. Thus, with the emerging telematics age, it could be argued that the need is for health info-structures comprising systems that contain validated and evidence-based information, accessible by the right and authorised person or institution, from wherever this may be required and in any format chosen at the moment of access.

According to Grigsby (2002:8) a Health Info Structure may be defined as the infrastructure that supports health information and comprises these four main entities:

- People and institutions;
- Content: primarily information and knowledge;
- Usage: its management and governance (protocols, standards); and
- Technological support: computing, networking and telecommunication.

The above definition may be further clarified with the aid of a simple model. According to Kennedy (1984:7) information flows when a user, a service or a resource communicates with another user, service or resource to fulfil a specific task or function using a certain tool (or tools) over a certain communications medium. Examples of this would be a general practitioner transmitting an X-ray image to a specialist radiologist to interpret, and a surgery professor delivering a lecture and a demonstration of a specific surgical intervention. This may be represented by the general model Fig. 2 for a main function

such as telemedicine. The figure depicts the typical network infrastructure for telemedicine system and applications. This consists of a patient station (guest side), where a health professional or assistant with patient are located, and the caregiver station (host side), where the health practitioner or specialist is located. Both sides have communication equipment consisting of peripherals (camera, display, microphone, speakers, controls, status indicators and sensors). These peripherals connected to platforms (cables, routers, and servers) by using standardised interface structures. These routers are then interfaced with the data or voice transmission equipment (microwave radio link, satellite link, fibre optic link, and carrier link). The information transmitted from the patient station to the caregiver station may be in the form of voice, video, data or hybrid of data, video and data.

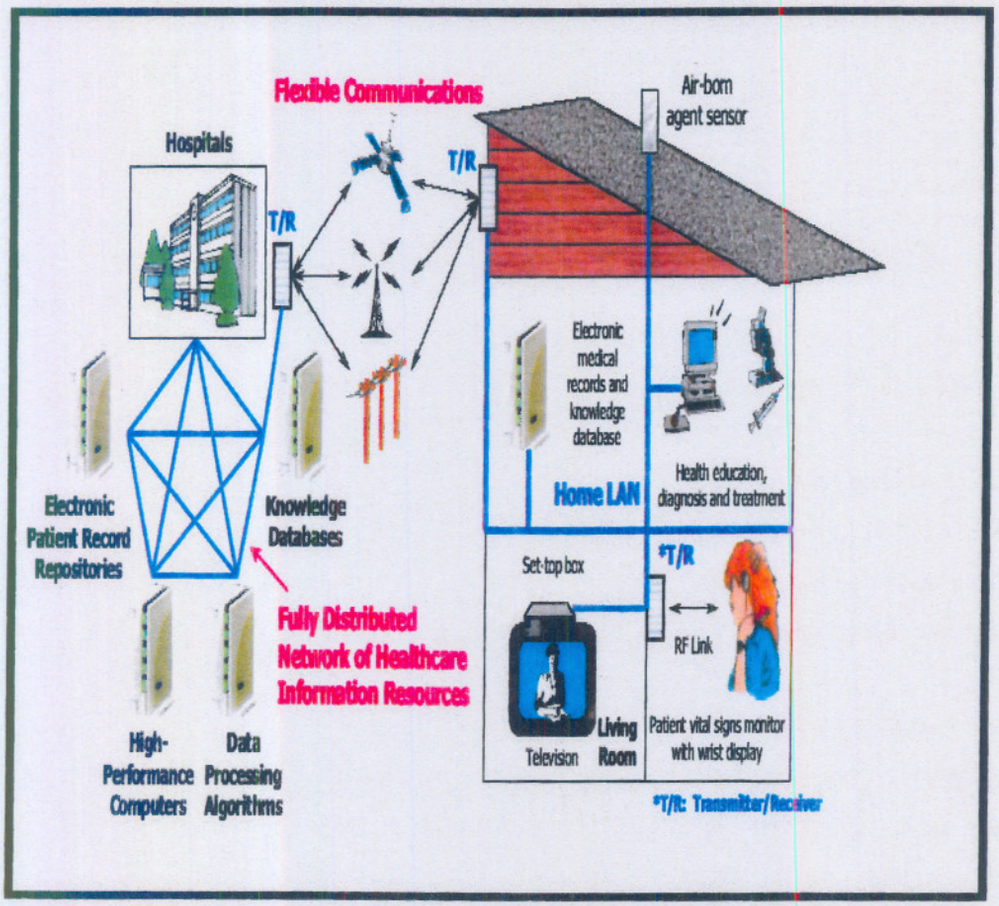
Figure 2.2: Model of a Simple Health Info-Structure



Adapted from (Jennett, et al., 2004:150)

Many of the needs of specific uses are common and thus able to be shared, for example, sending and receiving messages and reports, video conferencing, listening to a lecture, accessing the internet, accessing the telecommunications or telephone line, etc. These common needs can be aggregated and created by one physical infrastructure over which there may be any number of logical structures, as shown in Fig. 3. The common physical infrastructure and its services are then governed by rules of authorisation access, usage and accounting (Kronhaus, 2001:73).

Figure 2.3: Model of aggregate Health Info-Structure



Adapted from Garz, 2002:6

The past five years have witnessed an explosive start to informatics and telematics support to health care (Wright & Loughery, 1995:310). This is also true for developing countries, though to a much lesser extent in the poorest of the African countries. The infrastructure increasingly includes the Internet, either through direct connections, or as in some poorest developing countries, over the networks of a simpler technology and a cheaper infrastructure that bridge onto the internet. Reliable e-mail services via the internet have for example been introduced and are used in parts of the health sector of at least 38 of Africa's 49 countries (Samba, 1994:3). It is anticipated that reliable e-mail coverage will include the health sector of at least some parts of every African country within the next couple of years. The Internet services include discussion groups, bulletin boards and newsletters for nearly 6000 common interest groups. Tens of thousands of databases are also hosted on internet nodes in a variety of forms, such as gophers and World Wide Web (www) sites. Significantly, it is estimated that more than 15 to 25 percent of the content of the Internet deals with health or health related topics.

At present 12 countries in continental Africa have truly full connectivity to the internet, meaning that they can benefit from its full range of services (Samba, 1994:13). The majority has only off-line connections to the internet, meaning that they can use e-mail services but they cannot benefit from World Wide Web services. This is already a "haves" and "have-nots" situation because the current wealth and growth of the internet is in online services. The internet is by far the largest source of information and knowledge-based systems, but the validity of the knowledge contained in many of its sites and its relevance to the different African circumstances should be heeded. Along with the WHO, the internet is one of the largest media resources for health issues. The telecommunications medium is the most critical for many institutions in most African countries, and it is often the main hurdle and limiting factor to full global connectivity (Smit, 2002:30).

Public Data Networks are networks developed and operated by telecommunications operators to cater for data communications. An increasing number of African countries have PDNs already operational in main cities and along routes (e.g. railway lines) connecting main cities. The PDNs can be equated to Public Switched Telephone Networks (PSTNs) in South Africa, such as Telkom SA (Smit, 2002:38).

2.8.1 TELEMEDICINE APPLICATIONS

According to the Department of Health (1998:6) present applications of telemedicine include:

- Interactive video conferencing to remotely diagnose, treat, and consult patients, especially those living in rural areas. Typical applications include telepsychiatry, remote surgery, and interactive examinations.
- Storage and transmission of patient records to aid diagnostic treatment and to increase the speed at which such information can be made available to health care providers.
- Image compression for efficient storage and retrieval of image data.
- Medical education and training.

Other applications are explored in conjunction with the applicable business model.

2.8.2 BENEFITS OF TELEMEDICINE

Proponents of telemedicine believe there are many benefits to be gained by applying advanced computer technology to health care delivery (Mitchell, 2000:3). One of the most cited benefits is that patient and doctor need not be in the same geographical location. This is especially useful in providing high quality health care to rural areas. Indeed, politicians and legislators in states with large rural populations have been among the most vocal supporters of telemedicine funding and research. The USA Western Governors' Association (WGA), for example, recently produced a Telemedicine Action Report extolling the benefits of telemedicine in member states and outlining obstacles that prevent full implementation (Mitchell, 2000:5). The challenges faced by such states are particularly apparent in Wyoming, a geographically large state with many needs for medical care, but no medical school. The ability to provide medical services over any distance is also seen as a way to solve the inequitable of medical services to undeserved populations.

In addition, telemedicine technologies offer a useful tool for delivering education to health care professionals. Training in new techniques and technologies can be

enhanced through a telemedicine network. In addition, contact with other professionals through video conferencing reduces the sense of professional isolation for those who work alone.

Reduced costs are also associated with some aspects of telemedicine. Travel costs for both patients and medical professionals can be greatly reduced. In addition, telemedicine can also cut costs by decreasing the duplication of services, technologies, and specialists. For example, one pathologist can provide services to a number of locations using telepathology (Mitchell, 2000:6).

2.9 BARRIERS TO TELEMEDICINE

If telemedicine can improve the overall quality and delivery of health care, equalise the distribution of medical resources and services, and reduce costs, it could be expected to be used more widely than is currently the case. However, despite the widely acknowledged benefits of telemedicine, substantial barriers exist. These obstacles include infrastructure planning and development, telecommunications regulation, reimbursement for telemedicine services, licensure and credentialing for medical personnel, malpractice liability, and privacy of patient records (Wainright & Wootton 2003:559). The lack of rigorous research and evaluation on telemedicine delivery has also been cited as an impediment to its wide adoption. Others have identified the "human" dimensions that limit its utilisation, including the lack of acceptance by both professionals and patients (Stanberry, 1998:72). These human dimensions can be explained further by the theory of the human tendency of resistance to a change. Change can arouse considerable anxiety about letting go of the known and moving to an uncertain future and thus generating deep resistance in people (Cummings; 1999: 157). Professionals fear loss of position and status and also worry about their lack of training in the use of advanced technologies. Patients, on the other hand, want to be assured that they are receiving care from a certified professional and that their medical records remain confidential (Stanberry, 1998:75).

Finally, despite some proof to the contrary, hard evidence is lacking to show that telemedicine saves money. With the exception of one programme (Memorial University of Newfoundland), none of the telemedicine programmes begun before 1986 have

survived (Mitchell, 2000:5). As soon as external funding sources were withdrawn, programmes perished, mostly due to their inability to justify themselves on a cost-benefit basis. However, they provide care that was unavailable, this being a soft benefit.

Each of the above issues has generated much discussion. Of the many barriers to telemedicine, the physician licensure issue is one of the *key stumbling blocks* to the development of interstate telemedicine networks. This is mainly caused by the differing interstate medical practises and regulations.

2.10 THE LICENSURE PROBLEM FROM UNITED STATES EXPERIENCE

For the purpose of this study, it should be noted that topic of licensure problems discussed under this section is not applicable with the current formation of South African constitution, however, in future, as global forces encroach, this might be applicable.

The purpose of telemedicine is to improve the quality, cost, and access of health care services in underserved areas. In the past, nations have attempted to rectify the maldistribution of health care personnel by various imposed solutions, such as National Health Service Corps. These policies failed to generate the anticipated results because physicians, like other professionals, cannot be told where to locate their practices. However, telemedicine offers a solution whereby physicians may render their services electronically, relatively unhindered by the location of their practice or the geographic distribution of their patients, as stated in the (Western Governors' Report, 1995:5). Thus, telemedicine has the potential to help alleviate the health care crisis in the most undeserved regions.

A problem arises when telemedicine networks cross state boundaries. Under the police powers recognised by the USA Constitution, each state has the authority to regulate the practice of medicine to ensure the health and well being of its citizens. Thus, any physician wishing to practice medicine *within* a particular state must obtain a licence to practice *from* that state. Prior to the advent of telemedicine, the licensure system presented few problems to the practice of medicine; typically, a patient would travel to the physician's practice site to obtain care. However, telemedicine enables physicians to

practice medicine over great distances (and over state borders), thereby reducing the need for patients to travel (Western Governors' Report, 1995:6).
The extant licensure system indicates that telemedicine physicians must maintain licences in all the states with which they are *linked* electronically. This conclusion depends on how states define "the practice of medicine". In North Carolina, "any person shall be regarded as practising medicine or surgery who shall diagnose or attempt to diagnose, treat or attempt to treat, operate or attempt to operate on, or prescribe for or administer to or profess to treat any human ailment, physical or mental, or any physical injury to or deformity of another person. Similarly, in Alabama the practice of medicine means to "diagnose, treat, correct, advise or prescribe for any human disease, ailment, injury, infirmity, deformity, pain or other condition, physical or mental, real or imaginary, by any means or instrumentality" (Western Governors' Report ,1995:7).

All state licensure statutes contain similar language. Clearly, these definitions are broad enough to encompass the practice of telemedicine. Thus, based on the definition of the practice of medicine, out-of-state physicians are subject to a state's licensure laws when they use telemedicine to *enter* the state, (Western Governor Report, 1995:6).

The temporal and economic burdens of maintaining licences in multiple states discourages physicians from participating in interstate telemedicine networks. To apply for licensure, physicians must supply original copies of their high school, college, and medical school and residency transcripts. Further, they must submit passing scores on the Examination of the National Board of Medical Examiners or the Federal Licensure Examination (FLEX). Some states require personal interviews or even oral exams. The process typically takes several months and is expensive, often costing in excess of one thousand US dollars. For most physicians it would not be practical or economically feasible to go through this process for each state they may *enter* using telemedicine.

2.11 LEGISLATIVE ACTIONS

In 1994 Federal, Senator Kent Conrad of North Dakota USA formed the Ad Hoc Steering Committee on Telemedicine and Healthcare Informatics to explore telehealth and related issues. The committee consisted of telehealth experts representing the federal government, private industry, and health care professionals. Their purpose was to

evaluate federal policies on telehealth and how to use telecommunications technology more effectively to increase access to health care throughout America. From meetings and policy forums held by this committee, it became clear that there was an enormous effort being expended by the federal government and private industry in their support of health care. Because so many rural and undeserved communities lack the ability to attract and support a wide variety of health care professionals and services, telehealth was suggested as a way of bringing important health care services into these communities.

Other issues addressed by this Bill included interstate licensing and disciplining of telemedicine providers, records maintenance and federal reporting of telemedicine initiatives in rural communities, research and development of telemedicine programmes to determine cost-effectiveness in rural communities, grant and loan criteria for establishing telemedicine programs, and the mission and delineation of responsibilities of the Joint Working Group on telemedicine under a newly designated name, *Joint Working Group on Telehealth*, directed by an appointee of the Director of the Office of Rural Health Policy (Wattenberg, 2000:1). The bill was introduced on the last day of the 1996 legislative section where it was read twice and referred to the Committee on Finance, after which no further action was taken.

The issue of telemedicine in Congress has focused on cost rather than need. Currently there is over a billion dollars worth of legislation related to telemedicine that has been introduced to US Congress (Wattenberg, 2000:2). The challenge of the Congress, faced with funding limitations, will be whether to approve bills that globally address the nation, such as Senator Conrad's bill, or to approve bills that affect single states.

In South Africa the current state of affairs relating to the legislative and administering of Telemedicine is a key deliverable for Department of Health. As discussed in Chapter 1 section (1.1), the Telemedicine task team established in July 1998 to develop a Telemedicine strategy and implementation plan. The strategy's intentions are to identify relevant stakeholders, and as envisaged, will focus on four identified areas namely: Applications, Infrastructure and Maintenance. Related projects such as Tele-education and e-Health must apply and are within the medical guidelines and principles agreed to

by the Telemedicine Task Team and National Health Information System of South Africa (NHISA) (Department of Health, 2001:3a).

2.12 SOCIAL IMPLICATIONS

The social issues are vital to be considered as they can hinder the implementation of Telemedicine (Mitchell, 2000:5).The social issues surrounding telemedicine include:

(1) If health care is a right, can telemedicine services reasonably be withheld anywhere where there is access to telecommunications?
(2) Who will be allowed to provide telecommunication services?

So far, there has been very little discussion of these social issues in Health Care orientated forums. Instead, existing studies have focused on the psychosocial impact of telemedicine on consumers as well as providers (Peterson, 1995:10). One of the greatest benefits of telemedicine is reducing the distance and isolation in patient-practitioner encounters. Diane Bloom (1996: 6), in her study of a North Carolina rural population utilising telemedicine, determined that telemedicine saves time and reduces discomfort for both the provider and the patient. There was effective communication reported between the patient and the health care provider. This was further enhanced by the use of a large screen to create life-sized images, which immediately increased the intimacy and immediacy of the face-to-face encounter. She found that the patients preferred telemedicine visits over in-office encounters because they were more comfortable and less intimidating.

In addition, patients reported being more self-assured and better focused without the physician being physically in the room. Also, because of the lack of interruptions, the patients reported feeling "supported and good". However, the Telemedicine for Rural South Carolina Study found that while younger patients readily accepted telemedicine as a mode of health care delivery, many older rural patients were uncomfortable with the presence of cameras, computers, and recorders during their examination (Western Governors' Association, 1996:5).

From the provider's perspective, Bloom (1996:7) found that televideo reliance on verbal communication made some physicians more communicative and less distracted. The providers reported feeling as if the patients were in the office. In addition, providers felt that encounters with multi-consultations, through telemedicine, were superior to the conventional style of consultations. Involving the patient, referring physician, and specialist at the same time, improved communication and care. For both patients and physicians, available home videotapes of the encounters allowed for review of information that may have been unclear during the encounter. The primary social disadvantage was reported by nurses, who missed the physical contact of touching patients (Peterson, 1995:9).

Perhaps the greatest challenge to introducing telemedicine in rural communities is a human one. Rural physicians are typically burdened with the tasks of treating patients and are very resistant to using the telemedicine technology. This is particularly true of the older providers and patients. At the other end of the process, urban specialists with established practices are often hesitant to meet the scheduling needs of a telemedicine programme. Both groups of providers take issue with using technology to practise medicine without the official acceptance of telemedicine as a proper standard of medical care (Gates, 2000:3).

These issues lead to broader scale obstacles that limit the widespread use of telemedicine. Competition among vendors has prevented the development of hardware and software standards. This makes it difficult and frustrating to assemble system components that work together (Peterson, 1995:11). In addition, technical systems may be poorly adapted to the human infrastructure of health care. This refers to the work environment, needs, and preferences of clinicians, patients, and other decision-makers. Sustainable telemedicine programmes also require attention to organisational business objectives and strategic plans that are not always evident in current applications (Peterson, 1995:9).

2.13 ECONOMIC IMPLICATIONS

Support for the telemedicine project developed because of profound changes within the nation's health care system and because of the relentless financial pressures to fund

affordable and readily available services. An important premise of telemedicine is that affordability of health care leads to increased access to health care. This, in turn, leads to increased utilisation of health care and, thus, a healthier population. The primary allure of telemedicine has become the universality of its utilisation from urban to rural settings. In particular, telemedicine offers a mechanism for centralising specialists and supporting primary care clinicians (Wainwright & Wootton, 2003:7).

Managed care plans realise the financial potential of utilising telemedicine applications in concentrated patient areas. Managed care is a generic term referring to systems which integrate the funding and the delivery of health-care through contracts with selected physicians and hospitals, linked with health insurance companies to provide health-care to enrolled participants to for a pre- determined annual premium. Academic medical centres and other organisations facing reduced revenues and exclusion from managed care organisations, view telemedicine as a methodology to internationally market their highly specialised clinicians (Whitten et al., 2000:7). Home telemedicine, which enables ambulatory patients to live at home under the supervision of home health nurses, is viewed as effective in reducing costs that may be occurred by expensive inpatient stays in nursing home facilities (Whitten et al., 2000:6).

Despite its advantages, clinicians may see telemedicine as an economic threat due to increased competition, structural alliances, and surpluses of some categories of health professionals. In addition, the current lack of payment for telemedicine service is considered to be one of the major barriers to its deployment. Most third party payers have taken a "wait and see" approach toward telemedicine reimbursement. Very few private payers cover telemedicine consultation services, although most cover radiology and imaging services (Grigsby, Kaehny, & Sandberg, 1995:44).This may be of the view that Telemedicine services are not yet significantly recognised in Health Care market.

Federal and state government reimbursement for telemedicine services is variable, and depends on the service. Under Medicare, the service is covered if standard medical practice does not require face-to-face contact between the patient and the health care provider. Covered services include teleradiology and other methods of direct visualisation including electrocardiograms (ECG), and electroencephalograms (EEG) (Telemedicine Report to Congress, 1997:14).

Much of the political action driving telemedicine is derived from the anticipated use of managed care incentives to provide accessible, low-cost health care to all Americans. Health maintenance organisations (HMOs) and physician-hospital alliances are competing for regional contracts on the basis of cost, quality, and access to care (Peterson, 1995:9). In the managed care arena, telemedicine is seen as a tool that could help manage the medical and financial risks of providing patient care in rural and undeserved areas.

Other economic considerations include the cost of equipment and of information transmission. The Telemedicine for Rural South Caroline Study determined that a major impediment to the widespread implementation of telemedicine in rural areas is the lack of resources for acquisition of appropriate telecommunications equipment (Whitten et al., 2000:6). The cost of transmission will vary based upon the amount of bandwidth, frequency of use, and distance involved (Hakansson, 2002:133). While the cost of such services may be incorporated into the fee for a covered service, it raises a more looming issue. This is whether the additional benefits provided to patients and health care providers by telemedicine are worth the potential additional costs of providing the service. This, in particular, is of concern to the Medicare and Medicaid programmes, which face consistent threats to their financial solvency.

The case for new or continued investment in telemedicine remains incomplete, given the competition for financial resources in an era of budgetary retrenchment in health care and government (Mitchell, 2000: 7). Most clinical applications of telemedicine have not been subjected to systematic comparative studies that assess quality, accessibility, or cost of health care. While it is true that telemedicine, in lacking evidence of its effectiveness, is hardly unique among health care services, the increasing demand for such evidence by health plans, patients, providers, and policymakers challenges advocates of telemedicine to undertake more and better evaluations of its practicality, value, and affordability (Mitchell, 2000: 7).

2.14 ETHICAL, LEGAL, AND POLITICAL CONSIDERATIONS

Telemedicine raises a number of ethical, legal, and political concerns regarding licensure, liability, and professional accountability, particularly related to interstate practice. The purpose of licensing health care professionals is to protect the public from incompetent or impaired practitioners. When a telemedicine consultant crosses state lines, the issue becomes in what state the provider has to be licensed and which state's standards of practice must the provider adhere to. While universal cross-state licensure is already established within the United States Department of Veterans Affairs and the Indian Health Services, state licensure laws are perceived as a barrier to the expansion of telemedicine. Quality review systems, standards of care, and confidentiality rulings vary widely from state to state, and it is into this void that questions related to licensure and malpractice falls. State actions, such as that by Kansas, to tighten current licensure laws in response to telemedicine, have raised further concerns about state licensure (Stanberry, 1998:72).

New technologies have vastly improved the ability to electronically record, store, transfer and share medical data. While these new advances have the potential for improving health care delivery, they also create serious questions about access and security, particularly access by unauthorised persons. Due to the unique combination of patient data, video imaging, and electronic clinical information that is generated between distant sites during a telemedicine encounter, privacy and security concerns must be ensured before patients and providers participate in the telemedicine practices. This is particularly true, as it relates to treating mental illness, substance abuse, and other conditions that carry a social stigma. Due to weakness in state and federal policies to protect the privacy and confidentiality of personal medical information, this has been considered as concern for legislative reform proposals (Stanberry, 1998:72).

In summary, telemedicine has the potential to radically reshape health care in both positive and negative ways and to fundamentally alter the personal, face-to-face, relationship that has been the model for medical care for generations (Mitchell, 2000:4). From a sociological perspective, telemedicine reduces isolation and promotes quality health care in the most remote geographical areas of the United States. From an economic perspective, while the expenses of setting up and maintaining systems may be

initially quite large, over time, the long term effect of preventative health care will ultimately result in a healthier population making the program beneficial. Ethically, politically, and legally, US policy makers are actively addressing the issues surrounding the effective use of telemedicine, as is evident by the legislation that has been introduced in Congress over the past two years.

Some of challenges discussed above, are common to those faced by South African Telemedicine implementation. Department of Health has been mandated by the government to lead the project management of the Telemedicine implementation programme (Department of Health, 2001:4).The Task Team will seek to consult and abide by the guidelines of medical standards and requirements as discussed in Chapter 1, section (1.1). In exception of the interstate licensure problems experienced internationally, most of these challenges are verified and validated through the empirical studies presented in Chapter 4 of the research study.

2.15 THE SOUTH AFRICAN TELEMEDICINE SYSTEM

The objective of the South African telemedicine system is to deliver health care services at a distance to South African rural communities. The System should, through telemedicine technology, provide rural communities with access to physicians and "specialist" expertise that is available at major South African medical centres. The telemedicine system will be designed on a hub and spoke concept. The main hubs will be the major South African medical centres and academic institutions with their superior facilities and expertise, while spoke sites, as satellite sites, will be the undeserved community health centres and clinics in the rural areas of South Africa. The South African Telemedicine Committee, under the auspices of the National Health Information System (NHIS/SA) Committee, will develop the programme of the telemedicine system (Department of Health, 1998a:2). Telemedicine terminology, as adopted in South Africa, can be broadly defined as the use of information and telecommunications technologies to provide medical information and services at a distance.

2.15.1 Background

According to Department of Health (1998b:3) South Africa's health care system ranges from highly specialised urban academic centres, to small rural clinics throughout the country. The legacy of recent decades is an inappropriate distribution of health practitioners and expertise that are concentrated in major urban centres, while people living in rural areas have limited access to basic health care because of geographical isolation and poor public transportation.

Telemedicine is one form of advanced technology that may be part of the solution to a number of health care and education problems in South Africa. In this telemedicine project the computer-assisted medical communications will be used in all three their components, namely textual data transfer and audio and visual communications (Department of Health, 1998:4).

2.15.2 Mission

The mission of the South African telemedicine system is to facilitate the provision of high quality and cost-effective health care to all the citizens of South Africa, particularly to women and children in the rural areas. The telemedicine system will be used to establish an amalgamation of South African Medical Schools for the purpose of providing cost-effective medical education to health care providers in South Africa. The system will also facilitate the recruitment and retention of health care providers in rural communities (Department of Health, 1998a:4).

2.15.3 Key Deliverables

Some of the key deliverables of the SA telemedicine programme are the following:

- Functional clinical services to remote rural communities of SA.
- Medical research, education and training of SA rural health care providers.
- Technical task teams for developing tele-education, clinical protocols, legal licensure, ethics and infrastructure systems and guidelines.

2.16 CLINICAL SERVICES TO THE REMOTE RURAL COMMUNITIES

According to Department of Health (1998b:7), the implementation of telemedicine is intended to leverage the primary health care in following manner:

- The South African telemedicine system will focus on supporting primary health care services, particularly for women and children in rural areas of South African. This modern technology will be used for health promotion programmes, prevention, early diagnosis and intervention as well as management of various diseases affecting women, children and other residents in rural areas of South Africa.
- Physicians and specialists at major South African medical centres will supervise routine pre-natal care and sonogram examinations of rural women by midwives and other rural health care providers, thereby reducing perinatal and neonatal mortality rates.
- Internal medicine specialists will make use of high-resolution cameras to study skin and mucosal lesions and assist in the diagnosis, management and control of various sexually transmitted diseases, infectious diseases and HIV/AIDS.
- Cardiologists and surgeons will evaluate patients with cardio-vascular diseases in rural South African communities at a distance, without patients leaving their community health centres. Medical experts at major South African Medical centres will supervise, through telemedicine, local health care providers in assessing heart and lung sounds using magnifying electronic stethoscopes, and direct Doppler studies of patients' blood vessels, thereby preventing strokes, heart attacks and limb loss from vascular occlusion.
- Ophthalmologists from tertiary centres will examine eyes and retinas of patients in remote rural areas. Specialists will supervise ear, nose and throat examinations with laryngoscopes and otoscopes. They will direct endoscopic examinations of upper and lower gastro-intestinal tracts and possibly prevent fatal bleeding from these organs or discover malignant disease earlier.
- Mammographic surveillance of women in rural areas can be carried out and interpreted faster.
- Radiologists from major centres will be able to receive and interpret diagnostic radiographic studies from the remote areas of different Southern African countries, without moving from one area to another. They will be able to provide immediate

diagnosis to victims of trauma and other patients requiring emergency medical attention in remote South African areas.

- Surgeons in remote secondary hospitals will be able to obtain frozen section results of pathologic tissue specimens while the patient is still under anaesthesia and be able to complete the treatment without having to bring the patient back to the theatre for a second operation.
- Pathologists from different medical centres of South Africa will examine pap smears, blood smears, bone marrow and other tissue smears, thereby facilitating early diagnosis and intervention while diseases are still at a preventable or curable stage.

In order to deliver the clinical services mentioned above, the South African telemedicine system will conduct regularly scheduled electronic clinics (ECs). Electronic clinics are an effective way to apply telemedicine as they are modelled after real-life clinics. At regularly scheduled times, doctors in designated centres will be available to provide consultations; local health care providers and their patients arrange to be on-line during those periods. Emergency consultations will be initiated by a local primary site co-ordinator through a telephonic call to the medical centre whose services are required.

The overall type of medical services to be delivered during the South African telemedicine pilot project will be based on clinical needs of various South African communities in remote areas, the available telecommunications infrastructure, and cost (Department of Health, 1998:4). The carrying capacity or bandwidth needed to transmit a given amount of information within a fixed period of time still serves as a practical limit to the size, cost and capability of today's telemedicine systems. Although telemedicine is often conceived of in terms of dynamic interactive real-time video consultations, non-real-time applications are also effective. The latter will transmit static images or audio and video clips over low bandwidth links, typically overnight, for review by health care practitioners the following day.

2.17 MEDICAL RESEARCH, EDUCATION AND TRAINING OF RURAL HEALTH CARE PROVIDERS

One of South Africa's health care challenges is the drain of medical doctors from the less developed rural communities to the more developed urban areas (Department of Health, 1998c:4). It is difficult to attract and retain doctors in rural communities because of professional isolation from their peers, lack of continued medical opportunities, low patient volume and loss of continuity when patients are referred to hospitals in larger urban centres (Department of Health, 1998:7). The recruitment and retention of rural medical doctors will be one of the main deliverables of the South African telemedicine system. Through telemedicine technology the medical doctors in underdeveloped communities will find their practice less isolated because the system will facilitate frequent contact with distant colleagues who share their interests in more developed centres. Such interaction will simulate the professional associations that are commonplace in developed urban areas (Department of Health, 1998:7).

The telemedicine system will facilitate co-ordination of health research by South African medical centres. Improving health research capacities will help South Africa carry out the steps that are necessary to improve health care in the region. South African medical centres will have to establish their own agendas and policies, identify cost-effective health care systems that are suitable to South African conditions and target remote rural health care communities to improve quality health care services and monitor progress regularly (Department of Health, 1998b:7).

2.18 DELIVERY OF EDUCATION AND OTHER SOCIAL SERVICES TO SOUTH AFRICAN RURAL COMMUNITIES

The South African telemedicine system will improve general links and communications between developed economic centres and the underdeveloped rural areas. The components of the telemedicine technology to rural communities will be mounted on mobile telemedicine workstations that are easily adaptable for other

interactive technology use, such as tele-education and information exchange services (Department of Health, 1998c: 5).

The rural telemedicine centres will be expected to function as part of rural multi-purpose community telecentres. This approach will empower the rural South African communities to have access to information from governmental and non-governmental developmental agencies associated with programmes for socio-economic developments of rural communities. Through education and information exchange, the rural community telecentres will co-ordinate various community activities aimed at health promotion and development of commerce, culture and tourism in rural South African areas. The availability of telemedicine infrastructure can be utilised and provides opportunity for other telemedicine applications such as telehealth and tele-education (Medical Research Council, 2000:7).

The strategies to improve health conditions in South Africa include encouraging remote communities and individuals to make sound health care management decisions. The decentralisation of health services through community Telecentres will give greater authority to local health care staff and magnify the role of the community whose members will not only be recipients of services but also active participants in monitoring and managing these services.

2.19 IMPLEMENTATION PLAN

The programme of the South African telemedicine system will be implemented on an incremental basis to allow its users – health care providers and administrators – to obtain skills in modern medical technologies and see concrete benefits early in the development process (Department of Health,1998c:8).

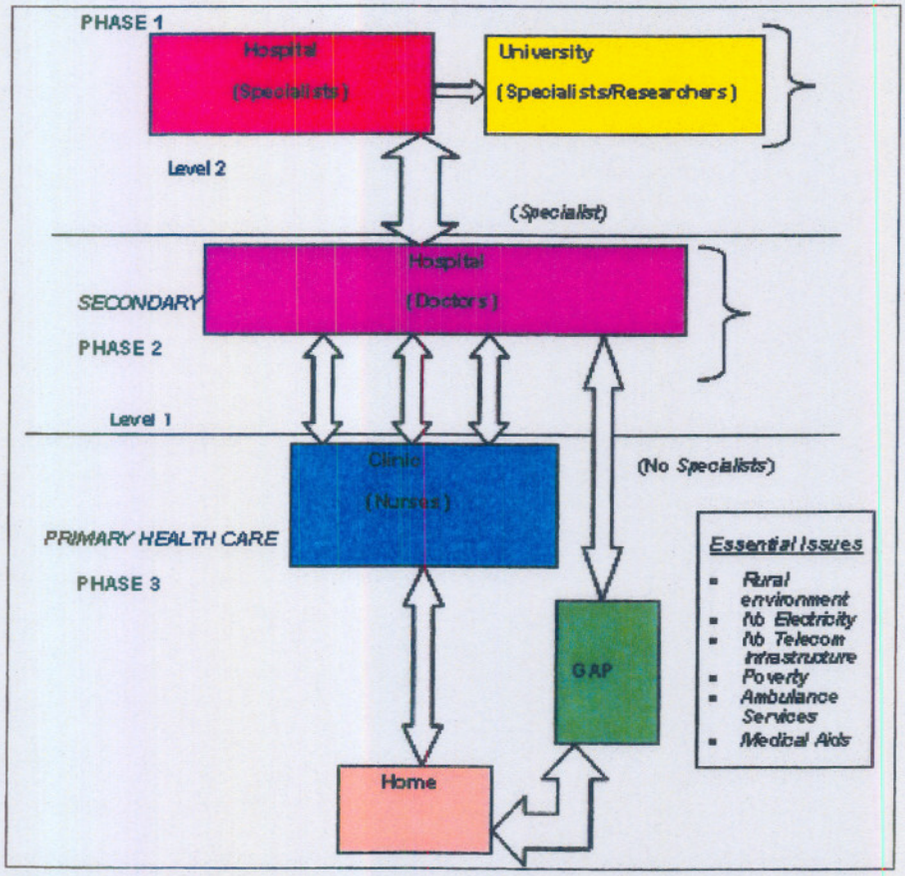
The implementation of the South African telemedicine pilot project will be divided into three phases to be conducted over a period of three years. The view is that at the end of the third phase, the project will be ready to move out of the pilot stage into the clinical application stage. Initially efforts will be made to obtain outside funding to offset equipment installation and programme management costs.

The South African telemedicine system can be sustained if it is considered by the participating provincial governments as part of their strategy for socio-economic

development of rural societies. Since most of the start-up financial grants are usually limited in duration, the affordability and sustainability of the system must be attended to early in the process of the three phase pilot project. The providers of telemedicine services will explore ways of sharing costs with other users of the communication system such as education services security and defence networks, as well as other commercial services to the remote rural communities.

In approaching the implementation of this national telemedicine system the service levels were categorised as per the needs from the medical fraternity. Figure 2.4 depicts the overview of the approach to be utilised.

Figure 2.4: Overview of the Approach to the Project Implementation for NTS



The pilot project of the South African telemedicine system will be composed of four networks, linked as depicted in table 2.1:

Table 2.1: Planned Network Configuration

Network 1	Links Free State medical centre --- Umtata medical centre --- University of Natal Medical Centre WITH secondary and primary sites in Free State, and Northern Cape, Eastern Cape and KwaZulu-Natal.
Network 2	Links MEDUNSA --- University of Pretoria WITH secondary and primary sites in Mpumalanga, North West, and Northern Province.
Network 3	Links South African Military medical services WITH secondary and primary sites in some provinces.
Network 4	This will be a special network that links all eight South African Medical Schools to form an amalgamation or Corporate Consortium of South African medical schools.

Adopted from Department of Health, 1998:7

The South African telemedicine system begins with a 71-point network connection, which will have to be developed to acceptable clinical utilisation before embarking on expansion to additional sites (Department of Health, 1998c: 5). The key to rapid improvement of telemedicine quality of services is the training capabilities of the South African telemedicine system pilot project. The project conducts regular training sessions for nursing staff and other health care providers to become effective telemedicine site co-ordinators (Department of Health, 1998b: 7).

To achieve the above-mentioned tasks of research and training, the South African telemedicine system will establish a research and training centre in one of its sites to co-ordinate research and training activities with all other sites. The sites that have already started some research and training activities will be encouraged to play a leading role in this campaign (Department of Health, 1998b: 6).

2.19.1 PLANNED PHASE 1

Telkom is expected to complete ISDN infrastructure network between the South African tertiary sites, within the first three months of implementation of the project. Efforts were made to establish a teleradiology system between various South African medical centres. In preparation for expanding teleradiology into telemedicine system, the teleradiology equipment will be mounted in typical telemedicine working stations (Department of Health, 1998a:9)

The first phase involved implementation of the teleradiology pilot project in the Free State and North West, a telepathology project in the Eastern Cape, a tele-ophthamology project in KwaZulu-Natal and a telemedicine research and training centre in Mpumalanga. With the exception of the Mpumalanga project, funds were available to start these projects by September 1998.As depicted in figure 2.4 the Mpumalanga project was implemented in the year 2001 (Medical Research Council, 2004:4).

2.19.2 PLANNED PHASE 2

As depicted in figure 2.4, the second phase of implementation of the South Africa Telemedicine Pilot Project is focused on developing an effective telemedicine connection between 71 sites divided into three networks for management purposes in the following manner (Department of Health, 1998a:9)

Table 2.2: South African Telemedicine System

Network 1	The three tertiary sites are the Free State Medical Centre, Umtata Medical Centre and University of Natal Medical Centre. Each tertiary site will service two secondary sites in the Free State, Eastern Cape and KwaZulu-Natal. Each secondary site will in turn service three primary sites. **Total = 27 sites.**
Network 2	The two tertiary sites are MEDUNSA and University of Pretoria. MEDUNSA will be linked to two secondary sites in the North West and two others in the Northern Province. The University of Pretoria will be linked to two secondary sites in Mpumalanga. Each of the secondary sites will be linked to three primary sites in the rural areas of these provinces. **Total = 26 sites**
Network 3	The two tertiary sites are one Military Hospital at Thaba-Tswane and two Military Hospital in Bloemfontein. These sites will serve two military base hospitals in Nelspruit and Musina as well as two secondary sites in the Northern Cape. Each secondary site will be linked to two primary sites. **Total = 18 sites.**

During the second phase in the year 1999, the possibilities of including some Correctional Services sites was also investigated.

Table 2.3: Number of sites in Telemedicine system

	Tertiary Sites	Secondary Sites	Primary Sites	Total
Network 1	3	6	18	27
Network 2	2	6	18	26
Network 3	2	4	12	18
Total	**7**	**16**	**48**	**71**

The Total equipment cost for the initial 71 sites was anticipated to be about 20 million rand. This does not include programme management, training, equipment maintenance or transmission costs.

2.19.3 PLANNED PHASE 3

The third phase of the pilot project is dedicated to establishing additional networks of secondary and primary sites. These rural communities will base the selection criteria

of rural sites on the need for access to medical expertise and technical support. The possibility of connecting remote rural clinics to surrounding secondary medical centres through microwaves and mobile radio communications infrastructure was investigated. Figure illustrates the intended integration of all sites at different levels one and two.

2.20 PROGRESS ON THE PROJECT IMPLEMENTATION OF TELEMEDICINE

2.20.1 Specific Case Studies

The National Telemedicine Conference organised by the Department of Health, held in Johannesburg from 22 to 24 November 2000, reviewed the results of the first phase of the SA NTS. The information for the report was collected through evaluation forms, interviews and questionnaires, in order to explore project management, clinical impact, technical infrastructure, and the organisational factors at the pilot sites that aid or impede the successful development and implementation of the telemedicine system (Department of Health, 2001:5).

The users of telemedicine raised some concerns about various technical problems and project management. Doctors doing their community service in the remote health facilities of the Free State reported that the telemedicine system improved their medical ability to diagnose and manage various medical conditions, particularly those related to trauma and chest diseases. They felt that the system was able to reduce the number of transfers. In the North West Province the community service doctors noted that the system enabled them to differentiate between chronic TB lesions and occupational lung diseases such as asbestosis and lung cancers. A number of transfers were avoided by enabling the doctor to correctly diagnose the lung disease rather than transfer the patient because of uncertainty about the diagnosis. The system was noted to be useful in detecting bone tumours from symptomatic patients. Some of the symptoms that were thought to be from arthritis were found to be from bone tumours, requiring a change of health management (Department of Health, 2001:5).

During the survey the respondents indicated that before the introduction of telemedicine in their facilities, many trauma patients who complained of neck pain were transferred unnecessarily because the primary care providers to could not provide clear cervical spine X-rays. Now, with the teleradiology system, primary care providers are able to

institute appropriate management in their community health facilities without having to transfer the patient to urban tertiary centres. One case of a walk-in traumatic cervical spine dislocation was diagnosed within a few minutes by means of the system, and the patient was immobilised and transferred immediately, thereby avoiding further injury (Department of Health, 2001:5).

Some trauma patients had cervical abnormalities that were not initially recognised at the remote sites. The diagnosis was made by the specialist radiologist and appropriate management was instituted. The provincial tertiary institution has requested that, for the time being, all trauma spine X-rays from the telemedicine site must be cleared by the specialist radiologist through the tele-radiology system. The current practice is that the primary doctor in charge clears the X-rays and specialist consultation is requested as needed (Department of Health, 2001:5).

The tele-ultrasound antenatal application for the first phase of the national telemedicine system was designed to move the antenatal ultrasound services from the provincial referral centre to the primary care centre in the remote and rural antenatal community health centres. According to the Medical Research Council, (2000:5) the purpose of the application was:

- to train health care providers in the use of ultrasound service for pre-natal care;
- teleconsultation for prenatal care;
- provision of diagnostic and management services for complicated pregnancies.

Cases of antenatal tele-ultrasound consultation were selected with a view to the training of primary care providers by obstetrician specialists, as well as the training of these primary care providers in the consultation of complicated pregnancies. As a result a number of cases that would have been transferred for further investigation were managed locally, without transferring the patient to the tertiary site.

2.21 TELEMEDICINE INFRASTRUCTURE

The implementation of the telemedicine system with the above-mentioned programme, ranging from phase 1 to phase 3, poses a great challenge for the government and relevant stakeholders, such as telecommunication providers and business at large. The

implementation programme requires an immense buy-in of the major role players from the social and business fraternities. Currently, a task group consisting of stakeholders from different backgrounds has been formed to work closely together in order to find a solution to the challenges associated with the implementation of the telemedicine infrastructure. The details of the guidelines and recommended technologies are discussed in Appendix 4.

2.22 TELECOMMUNICATIONS TRANSMISSION AND ACCESS TECHNOLOGIES

Various technologies (e.g. copper, fibre, wireless, etc.) may be used in order to provide a basic access (connecting subscriber) telecommunications technology. However, wireless technology is currently viewed as one of the most important tools for reducing the digital divide. According to Yasuhiko (2001:6) *wireless* refers to telecommunication in which electromagnetic waves, as opposed to wires, carry the signal over the communications medium and can be broadly divided into four categories:

- Portable wireless
- Mobile wireless
- Fixed wireless
- Infra-red (IR) wireless.

Wireless infrastructure provides faster rollout times, lower maintenance costs and greater network flexibility. International Telecommunications Union for Standards identified, through its case studies, ten types of wireless access systems illustrating existing and emerging access options for rural communities (Yasuhiko, 2001:7).

Eskom Telecommunications and Transtel, as a part of the SNO, have investigated suitable telecommunications technologies (voice and data) to be applied in order to provide telecommunications services as part of their social obligation (Garz, 2002:3). It was found that wireless technologies are most suitable due to the reasons indicated above. Possible wireless technologies that can be implemented as last mile solutions (extending the backbone to the customer premises' equipment) are the following:

Table 2.4: Wireless Technologies

Time Division Multiple Access (TDMA)	- 2,4 GHz – 2,8 GHz
Code Division Multiple Access (CDMA)	- 1,8 GHz – 2,6 GHz
Satellite Applications	- 1,5 GHz – 1,8 GHz
Cellular	- 0.9 GHz – 1,8 GHz
Analogue two way radio systems	- Sub 500 MHz
Digital two way radio systems	- Sub 500 MHz
Analogue trunking systems	- MPT 1327 – Sub 500MHz
Digital trunking systems	- Tetrapol, TETRA – 500 MHz

Adopted from Garz, 2002:4

The application, advantages, disadvantages and costs associated with the various technologies indicated are presented in Appendix 2 (Garz, 2002:3). For the purpose of this it should be considered that the cost comparison is purely an example, as the costing between different manufacturers of the same technology varies greatly (Garz, 2002:3).

2.22.1 POWER SUPPLY TECHNOLOGIES FOR REMOTE TELEMEDICINE SITES

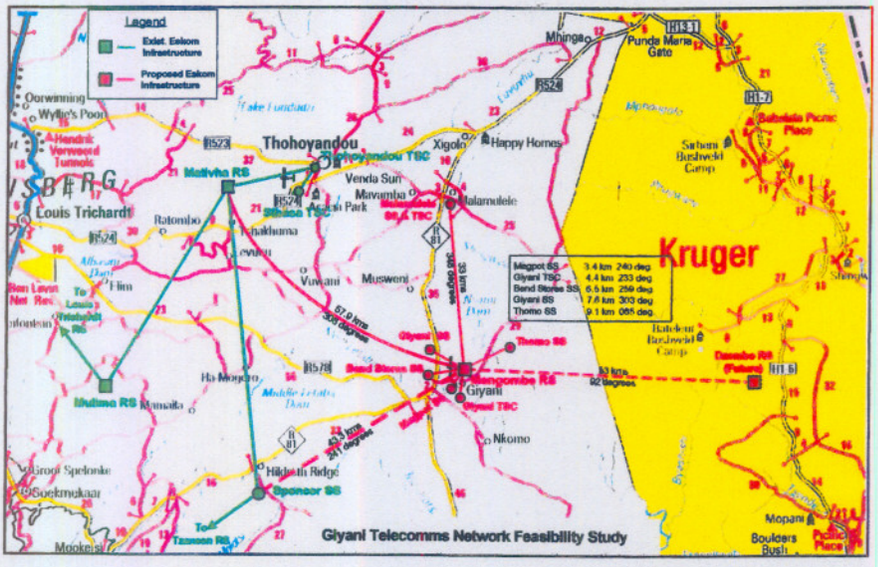
One of the main impediments experienced with the implementation of the telemedicine infrastructure, is the lack of the energy supply to the rural areas. The lack of electricity supply in many remote (deep rural) areas can be a major obstacle in the deployment of telecommunications infrastructures in order to support telemedicine (e.g.,Mbuzini Clinic is an example of this). However, this obstacle can be overcome through the adoption of a feasible power supply technology. Currently a number of technologies exist which are to be considered for remote power supply. This study recommended certain power supply technologies (see Appendix 1 for the summarised results of a technical assessment and economical analysis of the recommended power supply technologies). The cost comparison is provided in Figure 2.6:

- Diesel generators
- Photo Voltaic (PV) systems

➢ Micro turbine generators

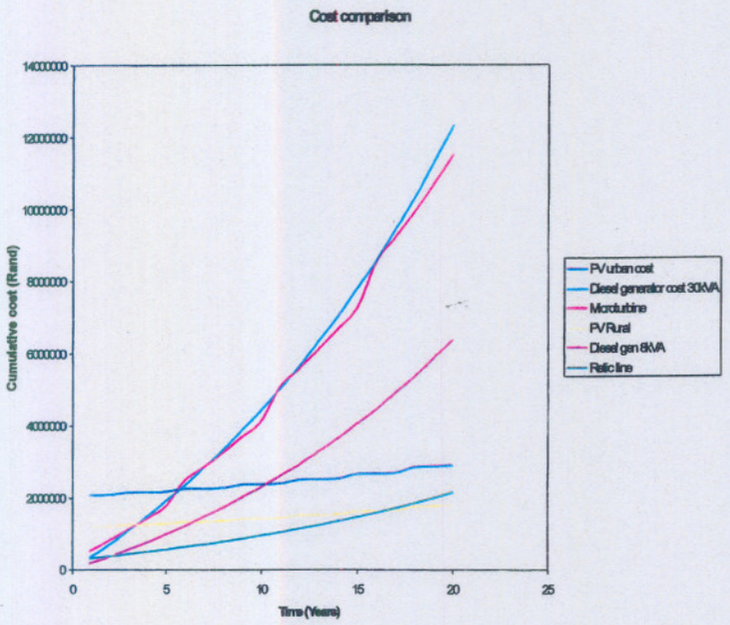
Figure 4 shows illustrates a new development sites in Northern Province, potential sites and Telecommunication links and power supply are planned for Giyane area. Established sites such as Mathiva Radio sites and Spencer substations use typical power supply technologies such diesel generators or Nicad batteries for standby purposes, this Parastatals' rural infrastructure could be used for Telemedicine links.

Figure 2.5: Typical Eskom Power Development sites (Northern Remote/Rural sites)



Adopted from Wallace, 2004:3

Figure 2.6: Power Supply Technologies Cost Comparison



Adopted from Morris, 2001:12

2.22.2 DIESEL GENERATORS

Diesel powered generators can provide power where the electricity grid is not available (Anon, 2000:12). They are relatively inexpensive (R3000/kW) and ideal for supplying emergency power. However, they have a number of disadvantages such as fuel storage, fuel supply and noisiness, and they require regular maintenance and security aspects. Hence, the technology is seen to be unattractive for remote applications.

2.22.3 PHOTO VOLTAIC SYSTEMS

Photo voltaic (PV) systems consist of solar cells. Solar cells are electronic devices that use the PV effect in order to convert light into an electrical voltage. Each cell produces a small voltage and requires large arrays of cells to be connected together in order to provide a usable supply of electricity (Anon, 2000:12). The output of the solar cells is used to charge a set of batteries. PV systems are very reliable, require virtually no

maintenance and can be left running with minimal supervision for a number of years (approximately 20 years). This makes the technology attractive for supplying power in remote areas. PV systems can therefore be used in order to supply power to remote TM sites.

2.24.4 MICRO-TURBINE GENERATORS

Micro-turbine generators can provide power where the electric grid is not readily available and operates on the same principle as a conventional natural gas turbine. It was designed in order to compete effectively with commercial plant applications, with the potential to open new markets in the sub-Megawatts distribution generation. It has various technological, environmental and financial advantages such as lower emissions, low maintenance, multi-fuel capabilities (diesel and natural gas) and compact construction. This technology can therefore be considered for remote telemedicine sites due to low maintenance requirements. However, there is currently no support structure for micro turbines in South Africa (Wallace, 2002:5).

2.22.5 RETICULATION LINES

Rural telecommunication systems are typical customers of Landrate 1 (tariff). It is supplied from 11kV or 22kV overhead networks at a nominal voltage, lower than 500V. It is suitable for supplies where consistently more than 1000kWh monthly is consumed and cannot supply loads greater than 100kVA. No maintenance is required. This technology should be considered if the telemedicine site is within 5 kilometres from the nearest reticulation line (Wallace, 2002:4).

2.24 ROLE OF PARASTATALS IN THE IMPLEMENTATION OF TELEMEDICINE IN SOUTH AFRICA

The South African Committee for Essential Community Services (SACECS) seeks to add value to the current telemedicine program in SA, utilising Eskom and other local and international resources (Garz, 2002:7). There are currently a number of shortfalls within the telemedicine programme towards which SACECS can contribute. Typical problems that are evident include power supply, site identification based on needs and

sustainability, telecommunications innovation, the entire market analysis requirement, and applicable business model.

SACECS can provide electrical power consulting to areas where reticulation supply is not readily available or is unreliable. This can be made available through the Energy Services Programme within SACECS that investigates renewable and alternative energy technologies, which could benefit the telemedicine programme in SA by recommending appropriate energy supply technologies (Anon, 2000:12).

SACECS can assist in identifying appropriate telemedicine sites and so possibly could the Ministry of Arts, Science and Technology (as they are working with approximately 15 rural sites on a variety of developmental and empowerment issues) and the Eskom Corporate Division (as it has a Rural Development Project Section that supports sustainability and integrated development) (Garz,2002:7). These are sites that are positioned within the coverage area of the Second Network Operator (SNO) backbone, have appropriate geographical characteristics for the successful roll out of a wireless network and can utilise the excess bandwidth made available for telemedicine, for other telecommunications services that will ensure sustainability. This will overcome problems that are currently being experienced in the Nkomazi District and will offer some learning experiences for future telemedicine sites (Garz, 2002:7)

SACECS can contribute towards technological innovation with regard to telecommunications infrastructure and end-user interface. During the pilot study it was found that the SNO will not be responsible for providing end-user interface and hence SACECS can identify and collaborate with external bodies such as the CSIR and local universities in order to develop appropriate technologies that can service this telemedicine requirement.

SACECS can evaluate telemedicine sites in terms of health care benefits provided by telemedicine and where appropriate SACECS can become involved in facilitating health care training programmes in conjunction with the MRC for both health care practitioners and the local communities. This is regarded as necessary for ensuring competent medical staff and for determining the competency of medical staff (e.g. a nurse), with respect to operating telemedicine equipment. SACECS can also determine the

requirements of a nurse in order to effectively communicate with a medical doctor over a distance and to determine the level of awareness of the local communities regarding telemedicine and medicine as opposed to healing herbs.

SACECS as mandated by Eskom Rural Development Programme can furthermore add value to the programme by:

- Facilitation of synergy development within the respective communities in order to take ownership of the telemedicine sites (preventing vandalism and theft).
- Evaluating doctor-on-call possibilities in order to assist in remote management of a nurse on duty.
- Identifying means of effectively deploying ambulance services to telemedicine sites (for emergency health care).
- Identifying and recommending challenging entertainment programmes for children (e.g., while mother is being attended to by the doctor, entertainment programmes can stimulate the development of children).

2.25 BUSINESS MODEL FOR TELEMEDICINE IN SOUTH AFRICA

Based on the discussion in the previous sections of the literature study, it can clearly be seen that one of the most important considerations in the implementation of telemedicine is the sustainability of the service. It is imperative that a radical approach in defining and promoting the telemedicine system as a potential end-user product for an untapped market is clearly demonstrated through a convincing business model. This should position the telemedicine system as a lucrative and attractive business with a significant return on investment to the potential investors from the business fraternity. However, striking a balance between a social and business benefit should be achieved. For the purpose of the study the approach to a business model is suggested and discussed in chapter 3.

2.26 CONCLUSION

Telemedicine has been practiced in one form or another for many years. At the simplest level it consists of a nurse providing clinical advice over the telephone. However, today telemedicine uses applications that employ advanced images as well as audio capabilities. Telemedicine now has the potential to make a difference in the lives of communities in South Africa, especially in rural areas, as well as in neighbouring countries.

Despite the availability and growing sophistication of telemedicine/telehealth technologies over nearly four decades, utilisation has been limited and growth has been slower than might have been expected. Telemedicine, in principle, has been making certain health services more available to rural populations, but there is little evidence of any significant increase in access to care provided by any research study. Another important factor to emphasise is that telemedicine has appeared to be medically effective, although there is limited research to support its effectiveness convincingly. However, sizeable studies of different telemedicine technologies over past decades found that interactive video, the use of still images, and telephone-only applications appeared to be about as effective as face-to-face medical consultation. Research demonstrates that providers using telemedicine for consultation at the time appeared to be convinced of the effectiveness and the utility of the technology.

Research studies on the cost effectiveness of telemedicine are still limited in number and in scope; most research has dealt only with costs per se, and not cost savings. In one study unit, costs per session of providing telemedicine and telehealth services in rural parts of the United States were reported in 1997 as ranging between $476 and $1181, but the researchers' noted that the data reporting and other analytical problems weakened the reliability of these figures (Mitchell,2000:5). The cost savings of specific applications such as telepsychiatry in Australia have been reported from teleradio and Canadian sources. Although useful as benchmarks, the differences in health services systems among these countries as well as incomplete information about the unit costs incorporated into these calculations limit their general applicability to the US setting.

Telemedicine has been used to decentralise the delivery of hospital care and improve access, and it has been particularly successful in rural areas of countries such as Scandinavia and Australia (Crowe, 1998:15). In this environment there are barriers to the transport of patients in these relatively sparsely populated regions with few doctors. Telemedicine has been shown to be cheaper than conventional health care. It seems perfectly reasonable to speculate that as the cost of the required technology falls, telemedicine will become decentralized to the level of patient's home.

From the literature research conducted, it is evident that the next logical step is the use of the internet as a vehicle for delivery of health care. The internet will enable most telemedicine products, such e-Health, e-pharmaceutical and simple modes of storing and forwarding to be leveraged, to be utilised in volumes where economies of scale can be speedily achieved. In fact, this is already happening on a small scale, but is poised to having it become a major factor in the delivery of health care over the next five years. There are numerous companies that are quietly investing in telecommunications delivery services and health care systems in an effort to emerge as major players in providing consultations, diagnosis, treatment and delivery of prescription medications. All of these are online, suggesting the customer will pay for the services by credit card (Mitchell, 2000:8). This practice opens the potential for horizontal monopolies for health care, the virtual online medical system. These services will be primarily in general medical treatment at first, but will eventually include specialty care services as well. This potential development has created a challenge in regulating the safe delivery of health care for nations with established medical systems as well as for international bodies.

As today's technologies are further developed and refined, they will become cheaper as new applications are developed. Already we are witnessing the application of the personal computer and the Internet and other broadband mechanisms in medical informatics to transmit patient data in community based care. Importantly, telemedicine will probably transit from being used mostly in its current settings to into more widespread use. By early in this new century, health care delivery will emphasise the importance the importance of bringing care to patients rather than bringing patients to the health care system and tertiary hospitals, regardless where patients live.

Multimedia is the current buzzword in telemedicine (Mandil,1999:79). It refers to the development of storing and forwarding electronic mail, allowing transmission of not just text, but also audio, still images and video. In future we will have more sophisticated and affordable real time video consultation, and the luxury of multimedia consultation, to be accessed when convenient.

Significant hurdles remain, including legal and regulatory barriers and acceptance of the use of telemedicine by traditional medical establishments. However, these barriers are starting to come down and there is a growing body of research data that indicates how telemedicine can improve patient outcomes and reduce health care costs (Mair, 2000:38).

CHAPTER 3

LITERATURE REVIEW: TECHNOLOGY AND BUSINESS MODELS

3.1 INTRODUCTION

Rising costs in health care, increased global competitions and rapid advances in networking and telecommunications promise to close the gaps between e-commerce and digital enterprising technologies and health care service delivery (Tan & Morais, 2002:3). The closing of these gaps will result in drastic changes to ways in which patients and health care consumers will be receiving health care services, how various sectors of the health care industry will be restructured, and how public health care services will be managed. Technology applications such as e-commerce and the internet have already asserted a long lasting impact on virtually every facet of our modern society.

Today, technology with applications of the internet networks has changed the way we interact with the world and conduct our daily business and life. For many of us, a computer with online capabilities is as familiar and necessary as a telephone or a stapler (Tan & Morais 2002:1). While providing a convenient way to shop or conduct transactions and find information, the internet and the growing world of e-commerce offer tremendous opportunities to improve business processes and the quality of life in general. In the context of the health care industry, improvement in the quality, accountability, accessibility, and affordability of health care services represents one of the greatest opportunities of our time.

High costs and rapidly changing technologies are most likely to blame for the relative slow adoption of advancing technologies among hospitals and health provider organizations (Tan & Morais, 2002:2). Most hospitals and health service delivery organisations have developed static websites that contain some health information but have not made major investment in interactive technologies to engage patients and

health care consumers more actively. Managed care has forced hospitals to operate on ever-leaner budgets (Tan & Morais, 2002:3).

As the above factors also influence the health care sector, this chapter discussed the feasibility of the appropriate technology strategies and a suitable business model for health care which utilises technology, such as telemedicine. The chapter will conclude by discussing security issues to be considered for sustainable deployment of the intended telemedicine services.

3.2 TECHNOLOGY STRATEGY

For the purpose of this study, the following definition of *technology* is suggested: "Technology is created capability; it is manifested in artifacts, the purpose of which is to augment human skill (Burgelman et al., 2001:3). Key concepts associated with technology include *creation*, *capability*, *artefacts* and *augmentation*.

Technology and innovation should be managed and this requires concepts, tools and management processes to facilitate successful technological innovations. The changing trends of industrial operations lead to anxiety-provoking developments where a new revolution was in the making: the digital revolution (Burgelman et al., 2001:1). The first wave of the digital revolution was dominated by radical impact of microprocessor technology on computing and communications which lead to the establishment of two technological giants during the mid 1990s – Microsoft and Intel. The second wave was the growing importance during 1990s of the digital networks for enterprise data communications, which created yet another new giant, Cisco, and also spawned a new ecosystem of high technology companies (Chau, 2002:6).

The digitisation of telecommunications equipment, the adoption of digital broadband technologies, the growth of wireless data and voice telecommunications are unfolding aspects of the digital revolution. In the context of health care, in addition to the digital revolution, the realisation of the long anticipated biotechnological/telemedicine revolution also seems eminent. Building on the first gene splicing techniques developed in 1973, practical applications of cloning technologies have dramatically gained in power during the late 1990s (Burgelman et al., 2001:2). These developments and publishing of

documents on the complete human genome promises to revolutionise the pharmaceutical and health care industries during the first half of the 21st century.

3.2.1 MOORE'S AND GATE'S LAWS OF TECHNOLOGY INNOVATION

For more than thirty five years Moore's Law has guided the computer technology industry, bringing a seemingly unending spiral of falling prices and rising performance (Blake, 2002:2). Many technology driven industries have taken advantage of this concept, and in expanding this concept, its impact promises to touch every realm of human activity.

Moore's Law, as it came to be known; has proven more accurate, lasted longer and produced more far-reaching changes than Dr Moore ever expected. Despite its name, Moore's Law is not a law of science or nature. It is a principle that describes the unique opportunity for exponential improvements provided by advances in semiconductor technology. The genesis of the law was an article Gordon Moore wrote for the 35th anniversary issue of *Electronics magazine*, published in April 1965 (Blake, 2002:1). In his quest to balance the economic factors and innovation Moore extrapolated that the number of devices on a silicon chip could double each year for the decade, and this was later dubbed by Professor Carver Mead as Moore's Law (Blake, 2002:2). Organisations such as Intel took advantage of this law, as by 1975 the number devices on a chip was slightly more than predicted. Moore, however, adjusted the doubling cycle to twenty-four months, to compensate for expected increases in the complexity of semi conductors (Blake, 2002:2). The term *Moore's Law* is also used to describe the law's results: the continuing exponential growth of digital capability and improved price/ performance; this law may be said to be functioning as the "time pacing of technology", and further states that, "microprocessors will double in power every 18 months".

The real importance of Moore's Law is less in what it predicts than in the efforts which organisations such as Intel have produced to make and keep it a reality. Today's microprocessors power the economy, fuel the growth of the internet, and run everything from toys to traffic lights. As the technology evolves, Moore's Law catalyses the development of whole new application areas, bringing the seamless integration of computing and communications and extending the reach of Moore's Law well beyond

today's digital realms (Chau,2002:8). These technology applications offer opportunities for medical practices to extend beyond conventional practices to application such as telemedicine (Blake, 2002:5). Moore's Law, is complemented by Gate's Law which states "that all kinds of everyday devices will have computing power added to them and will be linked into computer networks, whether locally within offices or globally over the Internet" (Gates, 1998:4). The discussions in this section lead to a literature on the development of innovation, which results in a specific technology application resulting in a product. Telemedicine applications can be viewed as a medical product emanating from technology innovation. At this stage it is important to understand/ discuss the model for technology decisions as this will be pivotal to the positioning of the product such as telemedicine.

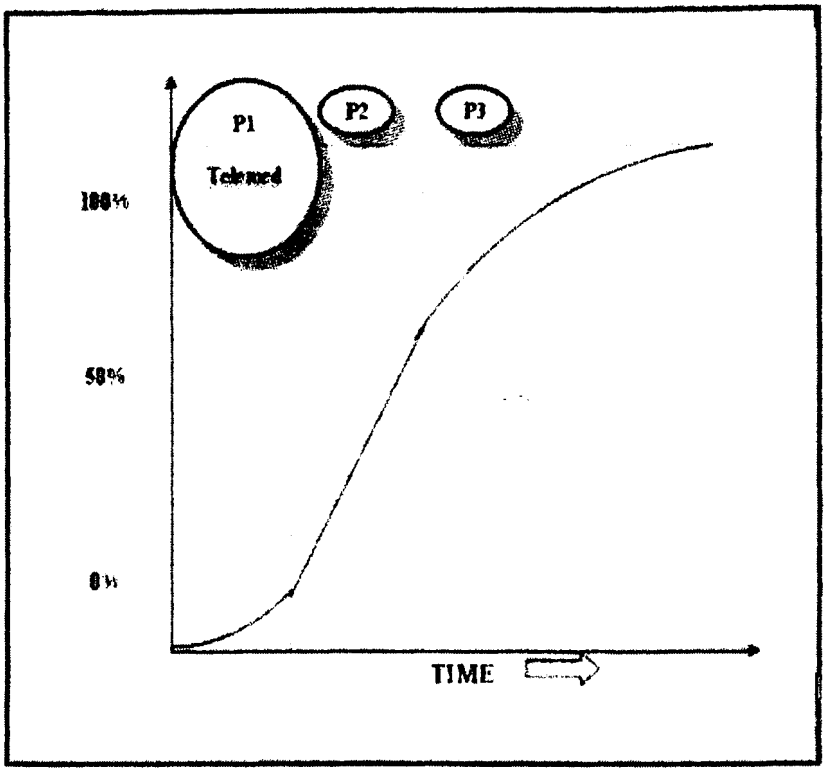
3.2.2 USING THE S-CURVE MODEL FOR TECHNOLOGY DECISIONS

The s-curve model is a theoretical concept which uses empirical groundwork of other models which attempts to provide the basis of decision making in the technological strategies. The model consists of two families, known as the diffusion and product life cycle models (Norman, 1998:3), as depicted in figure 3.1 and figure 3.2.

3.2.2.1 DIFFUSION MODEL

This model attempts to analyse the process by which an innovation is diffused throughout a determined social system. An illustration of this model is provided in Figure 3.1 below (Norman, 1998:3). As shown in figure, the model has three phases (P1, P2 and P3).This concept is used for any technology adoption strategies and is also to Telemedicine.

Figure 3.1: Diffusion model



Adapted from Norman, 1998:3

The model consists of three phases:

Phase I (P1): During the first phase, there is a great uncertainty in the results and investment is risky, the number of firms that incorporate new technology is reduced, the diffusion process is slow, learning process is slow and the rate of technology performance is slow. Currently telemedicine barriers are impacting on the diffusion for the technology to be adopted by potential key stakeholders. There is a perception of high risks for potential investors and thus a lobbying is required. However, this will be possible as soon the stakeholders are convinced that the technology will be accepted by users at large.

Phase II (P2): During this time the technology shows its utility and achieves success, the diffusion process accelerates; accumulated understanding accelerates the increments in technology performance and improved infrastructure results. As soon as telemedicine technology is accepted by all users and the market, the technology will be used widely and as a result successive improvements on technology performance will be realised.

Phase III (P3): As long as the proportion of firms that have not adopted it is smaller and/or as long as the ones that lag behind opt for another new technology, the speed of diffusion is reduced. In this phase the technology approximates its performance limit and its productivity diminishes. Telemedicine is expected to reach this phase in long future from and anticipated period usually ranging from ten years and more after phase two.

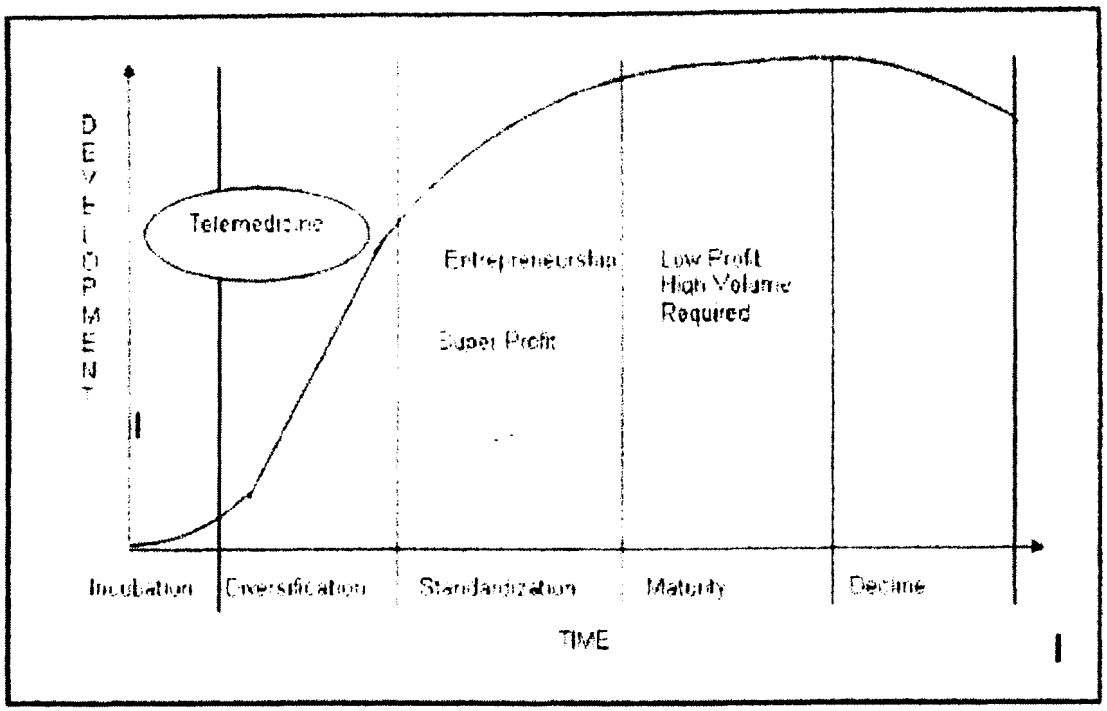
3.2.2.2 LIFE CYCLE MODEL

These models are mostly used to describe the different stages of in the temporary evolution of the sales product. The models assume that life cycles of technologies, industries and products follow similar patterns to that of the biological cycle of living beings and therefore are easily predictable (Sloan, 2000:23).

3.2.2.3 PRODUCT LIFE CYCLE

The model is illustrated in Figure 3.2.

Figure 3.2: Product life cycle



Adopted from (Burgelman et al., 2001:189

According to Burgelman et al. (2001:265) the model has four phases:

- Introduction/Incubation: A product is introduced. Few companies enter the market, competition is limited, and a rate of sales growth depends on the newness of the product. This product modification generates faster sales than a major innovation (Burgelman et al., 2001:266).
- Growth/diversification: The new product gains wider consumer acceptance and the objective is to expand the range of available product alternatives. Industry sales increase rapidly as a few more companies enter the market place (Burgelman et al., 2001:266).
- Standardisation: To accommodate the growing market modified versions of the basic models are offered. Successive incremental increases the technology performance

rate of the product. A standard is introduced with which the product must comply, so as to dictate the market for players (Burgelman et al., 2001:266).

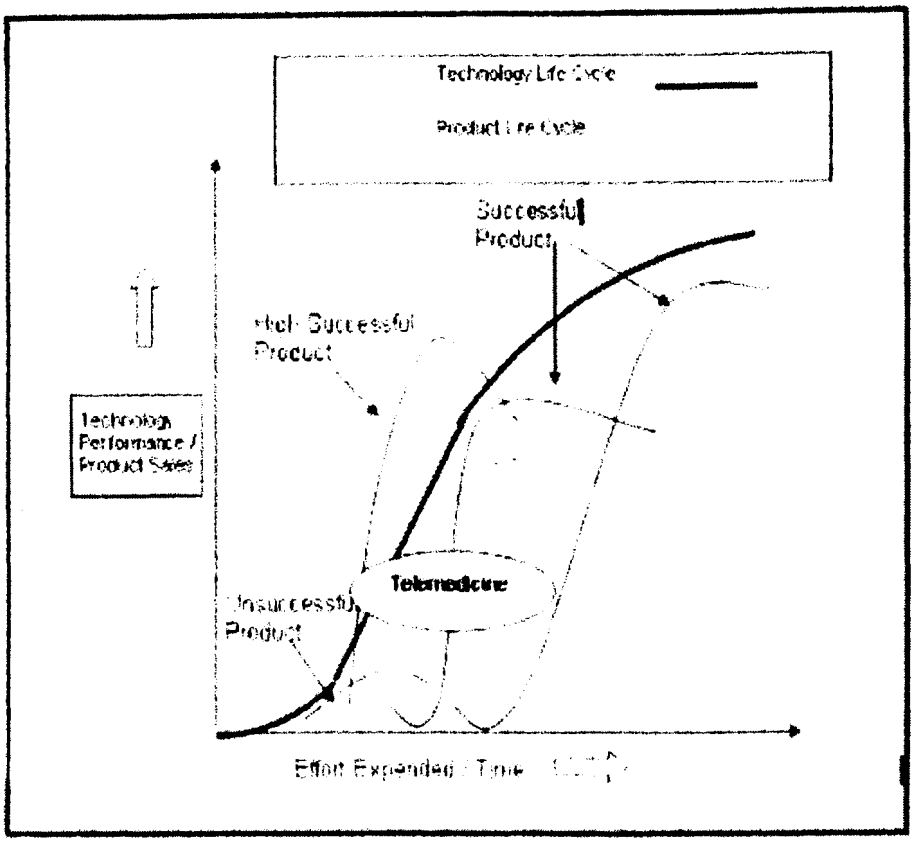
- Maturity: Industry sales stabilise as the market becomes saturated and firms enter to capitalise on the still sizeable demand. The possibility of increasing product contributions is limited. Innovations are less frequent and the technology performance rate stabilises (Burgelman et al., 2001:266).

Telemedicine is currently positioned just after the incubation stage and approaching the diversification stage. This implies that the product is about to be accepted at large and will gain the acceptability from users and potential investors.

3.3 RELATIONSHIP BETWEEN TECHNOLOGY AND PRODUCT LIFE CYCLE

Figure 3.3 illustrates the relationship between technology and product life cycle. The model can be superimposed on the technology diffusion model. It demonstrates a difference between a successful and unsuccessful product in its technology life cycle as depicted by the *s-curve*. For instance, successful product has a positive correlation to its technology life cycle. The technology performance and product sales rise in a sustained manner over a period throughout the technology life cycle.

Figure 3.3: Relationship between the technology and product life cycle



Adapted from Ettliene, 2002:7

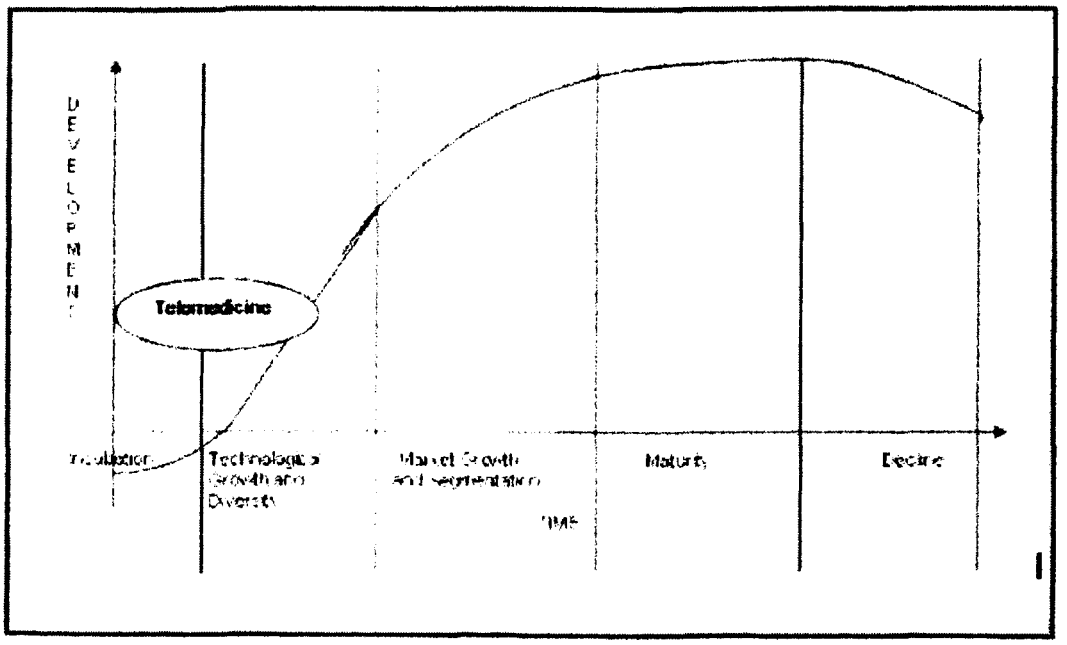
The duration of different stages and the total life of the product depend on factors of a technological nature. When the diffusion speed of new technology is increased, product performance improves and/or the efficiency of the process increases as shown in Figure 3.3. The figure shows the existing relationship between the life cycles of the technology and that of the products.

The acceptability of telemedicine will imply that the diffusion speed has increased and the success of the product will be realised. However, currently the product is positioned between the stages of being a successful and unsuccessful product, as illustrated in figure 3.3.

3.4 TECHNOLOGY S-CURVE

The model is used to verify rationality of technological strategies. By means of this model a company may determine the situation in which a specific technology is found at a particular point in time, as well as foresee its future evolution and its development limits. This is illustrated in Figure 3.4.

Figure 3.4: Technology / Industry life cycle



The empirical findings reveal the general evolution process of the performance of technologies. The curve will facilitate the understanding of the process of technological change, in reality what is demonstrated is the speed at which incremental innovations in a given technology are produced.

Telemedicine is positioned in middle of incubation and growth/diversification stage. This implies that the technology and industry is still in the uncertainty stage and the associated risks are still high. However, as illustrated in figure 3.4, telemedicine is gradually approaching the growth stage and associated risks are about to reduce. Section 3.5 summarises characteristics of this model.

3.5 INDUSTRY LIFE CYCLE

Figure 3.4 demonstrates the five phases of the industry life cycle:

i) Incubation:

- Technology emphasis – invention, applied research, radical innovation
- Market emphasis – specialists, very small
- Cost emphasis – low
- High status – R&D
- Organisation – informal
- Risk and uncertainty – very high

ii) Technological growth and diversity:

- Technology emphasis – product performance, speed of development
- Market emphasis – short product lives, high variety
- Cost emphasis – low
- High status – R&D and marketing
- Organisation – informal
- Risk and uncertainty – high

iii) Market growth and segmentation:

- Technology emphasis – dominant design, fewer new designs
- Market emphasis – rapid growth
- Cost emphasis – increasing
- High status – marketing
- Organisation – formalising

- Risk and uncertainty – low

iv) Maturity:

- Technology emphasis – process innovation, minor improvements
- Market emphasis – price, promotion, competition
- Cost emphasis – high
- High status – production, finance
- Organisation – formal
- Risk and uncertainty – medium

v) Decline:

- Technology emphasis – in-use life, technological diversion
- Market emphasis – price, quality, service
- Cost emphasis – very high
- High status – production, finance, marketing
- Organisation – formal
- Risk and uncertainty – high

3.6 TECHNOLOGY PORTFOLIO MODEL

The model represented in Figure 3.5 tends to identify the technology importance expressed in terms of the value it could potentially add to other product classes for the customer/user. Relative technology is expressed with reference to competitor in terms of know-how, trade secrets, learning curve and key talent. Technology importance is strongly affected by technology life cycle/linkages in the market. Figures 3.5.1 and 3.5.2 illustrate how the model is utilised (Donnely, 2000:26-28).

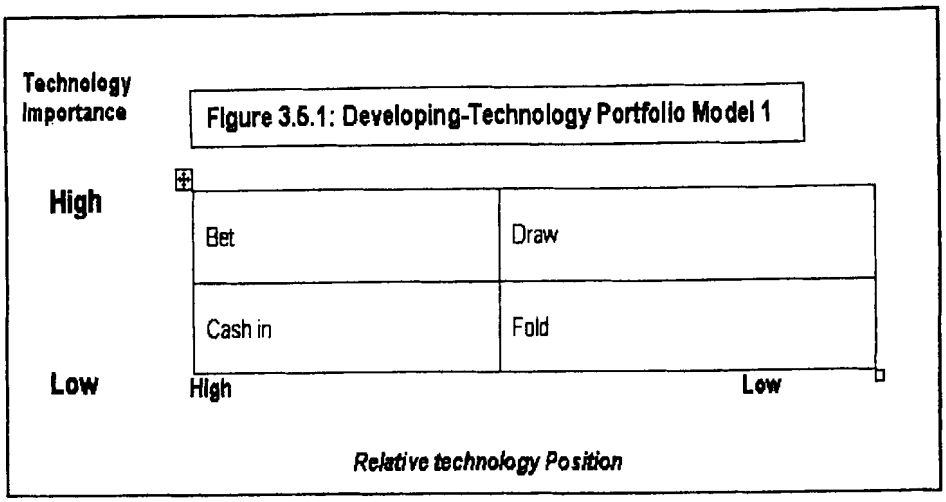


Figure 3.5.1: Developing-Technology Portfolio Model 1

Adopted from Donnely, 2000:26-8

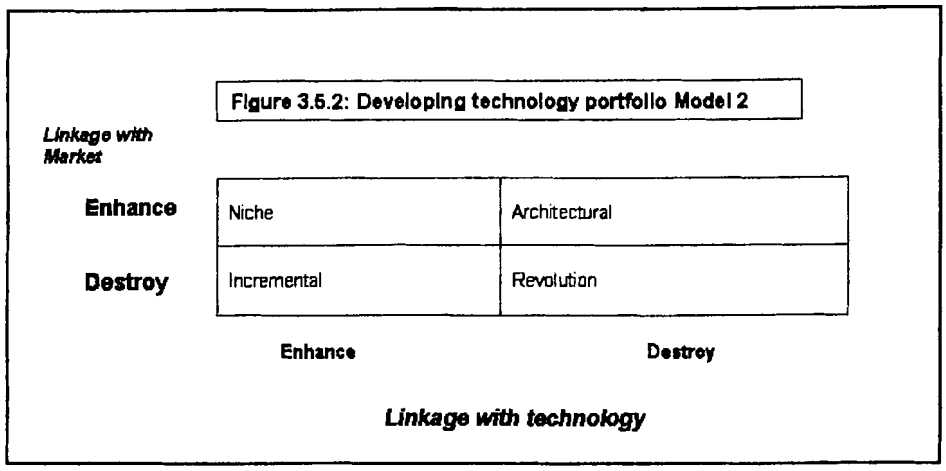


Figure 3.5.2: Developing technology portfolio Model 2

Adopted from Donnely, 2000:26-28

Bet/Niche: technology in this quadrant warrants a company's full commitment, an R&D engagement is required, pushing the limits of product development process, and investment in new equipment should be undertaken (Donnely, 2000:26-28).

Cash/Incremental: Technologies should be examined carefully. They have been very important at one time, but due to competitive changes they now have reduced importance. For the right decisions to be made it is essential to know what caused the changes. Sometimes parts of this technology may be linked with other technologies (Donnely, 2000:26-28).

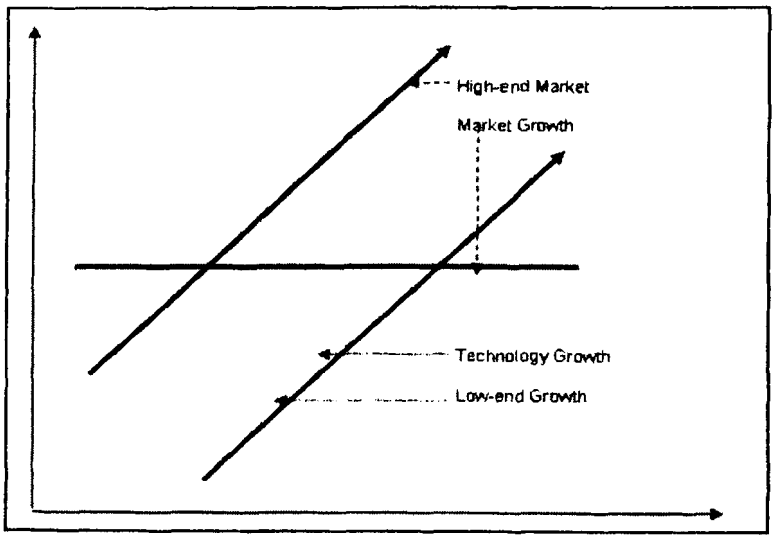
Draw/Architectural: Technologies here are positioned ambiguously. It may be placed here because of changes in the basis of the industry or competition. A decision to invest or not should be taken here so as to increase a significant market share

Fold/Revolution: This requires that a company reconsider its investment in this technology placed in the quadrant. Inertial forces often lead to continued investment in R&D beyond the level where reasonable returns can be expected. Regular reviews may indicate a need to disengage and re-deploy resources (Donnely, 2000:26-28).

3.7 TECHNOLOGY BUSINESS PLAN MODEL

The model helps define the strategies to be pursued when competing in the established technology markets.

Figure 3.6: Technology business plan model



Adapted from Natarajan, 2002:19

In Figure 3.7 the following uses of the model are illustrated:

- A business model should be aligned with the technology model
- A company's decision to enter established markets should be position itself lower than competitors as opposed to aggressive approach and gradually compete with incumbents, this is a sustainable strategy.

A telemedicine strategy should begin in the low-end growth, as this provides an opportunity for the technology to penetrate the existing health markets. This will increase the likelihood of destabilizing existing markets.

3.8 GUIDELINES FOR CONNECTING RURAL COMMUNITIES

The introduction of voice and multimedia communications services to the disadvantaged SA rural communities are regarded as a great challenge for government and telecommunications service providers (ITU, 2003:23). Within the ITU Telecommunications Development Sector (ITUD), a task force of Focus Group 7 is working closely with the Telecommunication Development Bureau (BDT) in order to find solutions to this challenge. The task force is a follow-on committee to the 1999/2000 Focus Group on Rural Applications, known to many simply as FG7. FG7 released a major report entitled *New Technologies for Rural Applications*. After one and a half years of work mainly conducted over its website (ITU, 2003:24), FG7 collected sixty cases globally. The FG7 report is based on the analysis of these studies and recommends new technologies for rural applications. New technologies are telemedicine, distance education, community and small business development, emergency support, disaster relief and environmental monitoring. It presents six recommendations to BDT, which should accelerate the development of rural communications as a means of bridging the Digital Divide (Kawasumi, 2001:12). In essence, the recommendations highlight the need for BDT to:

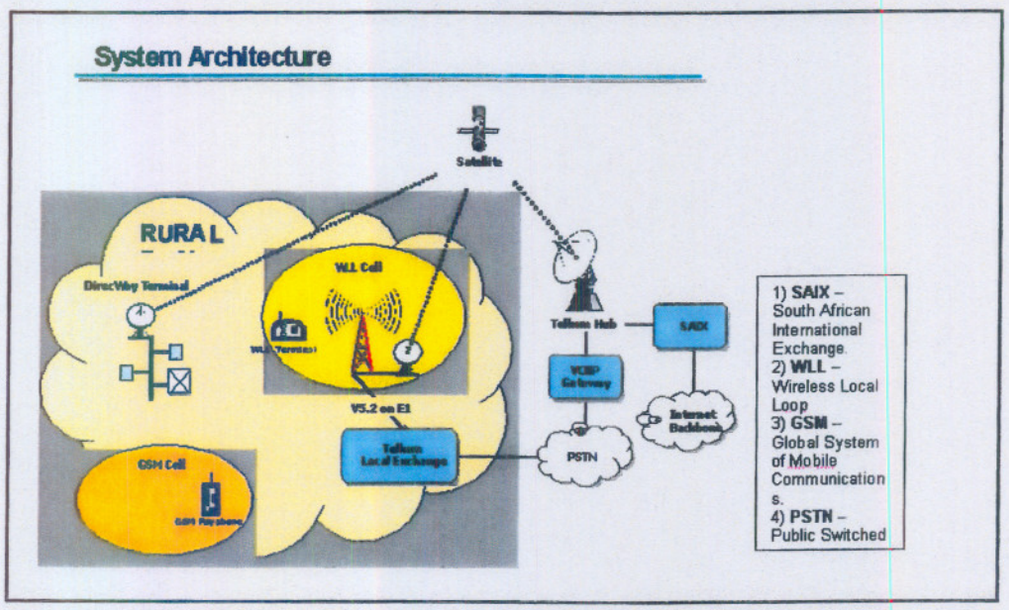
- Promote the development of low-cost information appliances for rural use.
- Create a renewable energy handbook on power systems for rural ICTs.
- Increase collaboration with micro financing organisations in order to assist in developing communication based rural business and applications.
- Conduct pilot projects of packet-based wireless access infrastructure for multimedia applications (CSIR in the Eastern Cape).
- Maintain and expand the FG7 website.
- Hold a symposium on new technologies for rural applications.

This section highlights the recommendations of technologies, modularity and scalability, remote network management, simplified user terminal configuration and operation, flexible user interface design, long life cycles, multi-user terminal and compliance with standards aimed at assisting during the connection of telemedicine sites.

3.8.1 RECOMMENDED TECHNOLOGIES

The FG7 report recommends "packet-based wireless technology combined with Internet Protocol (IP) routers" as being suitable for the connection of rural areas. This is due to the nature of packet-switching technology, which breaks up the data to be transmitted and sent in the form of packets along various routes to the destination (Kawasumi, 2001:12). This type of communication between sender and receiver is known as a connectionless service (e.g. internet). Figure 3.8 depicts a recommended rural network infrastructure.

Figure 3.7: Typical Rural Infrastructure



Adapted from Garz, 2002:9

Voice calls using the internet's packet-switched system are possible, for example Voice over Internet Protocol (VoIp). Circuit-switching technology (e.g. the regular voice telephone network in which the communications circuit is dedicated to the participants in

that call) is distinguished from packet-switching technology. For the duration of the connection using circuit-switching technology all resources on that circuit are unavailable for other users. Hence, packet-based networks have become the platform of choice for new telecommunication networks (Kawasumi, 2001:13).

3.8.2 WIRELESS TECHNOLOGY

Wireless refers to telecommunication in which electromagnetic waves, as opposed to wires, carry signal over the communication path (Garz, 2002:9). Wireless infrastructure can be divided broadly into four categories:

- Portable wireless
- Mobile wireless
- Fixed wireless
- Infra-red (IR) wireless

Wireless technology evolved rapidly and is viewed at present as one of the most important tools for reducing the low accessibility of information and communication technology. Wireless infrastructure provides faster rollout times, lower maintenance costs and greater network flexibilities. Through its case studies FG7 identified ten types of wireless access systems illustrating existing and emerging access options for rural communities.

Wireless technology is feasible for rural telemedicine applications because of the current lack of infrastructure and mountainous rural terrain's in South Africa. The technology is less sensitive to the line-of-sight requirement. As discussed in this section, rollout times are faster and maintenance costs are lower (Garz, 2002:10).

3.8.3 ROUTERS

A wireless router is a device or software in a computer that determines the next network point through which a packet should be forwarded to its destination (Garz, 2002:10). The router is connected to at least two networks and decides which way to send each packet-based information on its current understanding of the state of the networks to

which it is connected. A router creates or maintains a table of the available routes. Router conditions and uses for this information along a distance and cost algorithms in order to determine the best route for a given packet. It is therefore technologically possible to establish an access network in rural and remote areas using routing technology.

Router-based local access networks using the Transmission Control Protocol (TCP) / IP and transport layers (OSI layers 3 and 4) can be interconnected with the PSTN using gateways that comply with International Telecommunications Union for Standards (ITU-T) recommendation H.323. Real time voice calls can be transmitted at any quality over closed router networks with the use of Voice over Internet Protocol (VoIP) software. The quality of service can be maintained on a properly configured and managed network because traffic is controlled from the subscriber to the Public Switched Telephone Network (PSTN) gateway by a single service provider (Garz, 2002:10).

In this way, a router-based access network using IP is more analogues to a LAN than to the global Internet. When combined with wireless technology in the local loop, such a network may provide an affordable and sustainable solution for rural areas, particularly when the primary services delivered over the network employ multimedia and in the case of telemedicine this would constitute the store and forward mode with applications such teleradiology.

The wireless router provides circular coverage with a radius of up to 5 kilometres when configured in compliance with certain regulations on frequency use and maximum transmission power. In general, if higher power is allowed, the wireless reach can be much longer. Wireless routers are available for usage in the 2,4GHz band allocated to Industrial Science and Medicine (ISM) Services (Garz, 2002:11).

3.8.4 MODULARITY AND SCALABILITY

Service providers in rural areas often lack sufficient data on market demand in order to accurately access the demand for services in a given region (Kawasumi, 2001:13). Modular systems that allow the network to expand when required at the lowest

incremental cost are preferable. The requirements for rural telemedicine networks can expand in future, hence scalability is an important economic consideration.

Telemedicine networks will be deployed at rural sites at large and with the economics of such environment it is essential to utilise a scalable network infrastructure which can be expanded when required and is in line with the cost and income requirements.

3.8.5 REMOTE NETWORK MANAGEMENT

One of the most successful technology strategies for minimising operation and maintenance costs of rural installations has been the shift from network functions to remote management systems (Tan & Morais, 2002:6). Travel to rural areas for network configuration, maintenance and repairs increases the risks and expenses for network operators. Hence, remote management systems are critical for the deployment of telemedicine in rural areas.

3.8.6 SIMPLIFIED USER TERMINAL CONFIGURATION AND OPERATION

Rural communities often lack the technical skills needed to install, configure and upgrade software on a typical PC. This makes it difficult in order to promote effective and broad-based use of internet resources. Computers and clients that can be managed over communication lines can help reduce the cost resulting from poor maintenance et al. (Tan & Morais, 2002:3). It further reduces the high failure rate associated with training rural inhabitants in the complexities of PC hardware and software configuration. As the current telemedicine drive employs the use of PCs, simplified user terminal configuration and operation should not be overlooked.

3.8.7 FLEXIBLE USER INTERFACE DESIGN

The end users of connectivity-based services in rural areas may be unfamiliar with telephones, computers and technology in general (Kronhaus, 2001:73). A certain proportion of potential users will be illiterate or semi-literate. They may have cultural behaviour, which makes it difficult to use certain types of user interfaces. Input and output mechanisms incorporating icons, voice-based instructions, choice of language

and text may improve usability for rural customers and hence revenue generation for service providers.

3.8.8 LONG LIFE CYCLES

Rural markets cannot financially sustain the rapid turnover of equipment every two to three years (Struber, 2003:299). Telemedicine equipment therefore has to be designed to be durable, rugged and robust. Provisions must also be made for servicing, repairing and providing spare parts for the equipment over a number of years.

3.8.9 MULTI-USER TERMINAL

The developed country standard of a telephone in every household and a PC on every desktop is much too costly for the income levels in the rural areas of developing countries (Struber, 2003:298). As a result, many countries have encouraged the development of local phone shops and Multi-purpose Community Telecentres (MCT) where villagers can access telephones, e-mail, educational media, training courses, telemedicine and other related services on a pay as you go basis. Telephones and information technology (IT) devices installed in shared facilities may require metering functions, software in order to manage multiple accounts or users and other specialised payment or billing.

3.8.10 COMPLIANCE WITH STANDARDS

A wide variety of factors are involved in the design applications of IT networks in rural areas. Governmental, educational, international and non-governmental organisations routinely design and implement Information Technology projects in order to support their own applications (Garz, 2002:9) As a result, it is even more important, now and in the future, that equipment used in rural and remote areas conform to standards approved by ITU and other recognised standard setting bodies. Software applications should support open protocols applicable to ISO Layer 3 and higher and should comply fully with relevant ITU recommendations on Local Area Network (LAN) / Public Services Telephony Network (PSTN) interconnection.

3.9 DISCUSSION OF THE APPROACH TO BUSINESS MODEL FOR THE NETWORK SERVICES

From the telecommunications service provider point of view, telemedicine can be viewed as a product or service to be consumed by the end user. This suggests that telecommunications will play a pivotal role making the implementation and validating existence of the telemedicine system. The purpose of this discussion is to analyse and suggest a suitable telemedicine business model for business at large and primarily the telecommunications industry.

The telecommunications industry is currently simply experiencing a cyclical downturn; past trends suggest that the changes are symptomatic of a more fundamental and permanent shift in the nature of competition (Smit, 2002:5). Indeed, many industry leaders are challenging and reinventing their business and organisation models to better position their companies for market leadership, or at the very least for survival.

3.9.1 KEY INDUSTRY TRENDS

The internal and external forces are increasing the pressure on the traditional telecommunication incumbent's margins (Smit, 2002:33). It is imperative to highlight that the following macro trends are changing the rules of doing business, and threatening the viability of the traditional telecommunications model:

End users are becoming more sophisticated and demanding. End users have come to expect ongoing improvements in the service and value over the life of their contracts. In addition, the carrier realise that bundled products are critical for satisfying core customer needs and that bundling will become a given in the future. This trend has implications for developing, pricing, branding and deploying carrier solutions (Tan & Morais, 2001:7).

End users expect significantly greater transparency, simplicity and self-service from their carriers, while large enterprises, such as financial institutions and industrial conglomerates, are beginning to bundle telecommunications outsourcing with traditional IT souring. One example of this is the multi-billion dollar deals conducted by the Bank of

America and Air Liquide, which have turned systems integrators such as EDS and IBM into mega-customers that can drive down margins (Tan & Morais, 2001:6).

3.9.2 COMPANIES ARE BUNDLING OR MODIFYING EXISTING PRODUCTS

The search for the next killer application has to date turn up few truly new products or services, and carriers are continuing to focus on bundling and cross selling traditional products and services. Although the triple play offerings (voice, data and video/cable TV) from cable operators have enjoyed some success, real success will ultimately be driven by new products and services.

Wireless penetration has peaked or is peaking in many countries, ending the belief that mobility is the growth panacea, at least for the next few years (Tan & Morais, 2001:7). The complexity of carrier product and platform portfolios continues to grow, and at significant cost. This is primarily because these companies have not managed product life cycles and have not rationalised products. It is unclear, for an example, how long carriers will continue to accept ADSL (asymmetric digital subscriber line), as it is still in the loss-making growth phase, when most carriers have already missed the payback estimates in their original business cases (Tan & Morais, 2001:8).

IP telephony is likely to temporarily cushion eroding margins in voice services, but quality of service remains an issue. Expensive 3G (third generation) and high speed mobile data technologies have not yet taken off, while more modest technologies (as an example Blackberry), have had a success in the business segment. Video on demand is emerging as the next battlefield in the fight to control customer access. With its newer compression technologies, video on demand is fuelling for broadband, but at significant cost to carrier cases (Tan & Morais, 2001:9).

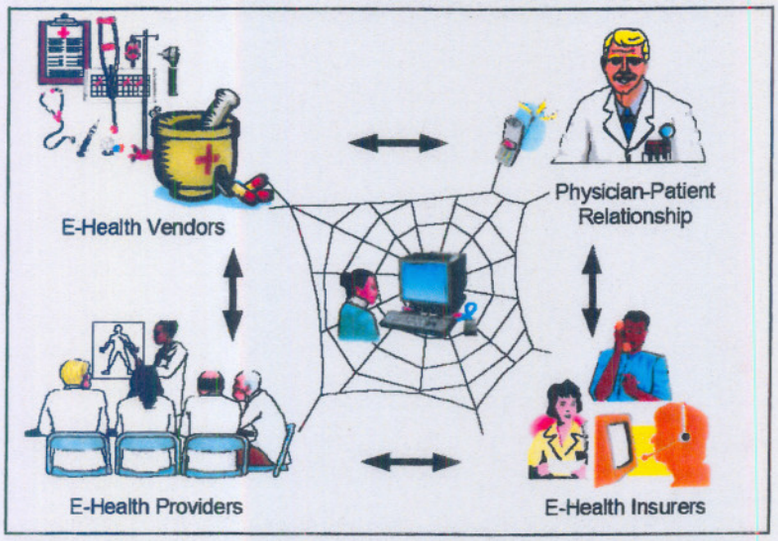
It is of utmost importance that the current barriers to telemedicine infrastructure investment and rollout are compounded by initial input cost to be incurred by current telecommunications operators (Telkom, Vodacom, MTN and Cell-C) (Smit, 2002:13). This has compounded the situation of cost minimisation when supplying telecommunications services in the value chain. These operators need to adapt modern IP technology, which has a potential to cushion the input network costs. This can reduce

foreseen telemedicine infrastructure costs and thus enhance the sustainability of telemedicine.

3.9.2.1 SUPPLIERS ARE CONSOLIDATING AND BROADENING THEIR SERVICES

Although there are fewer original equipment manufacturers (OEMs), they are all scrambling to build stronger alliances and partnerships with carriers (Tan, 2001:9). More carriers are outsourcing their non-core partnerships with carriers, and they are also beginning to outsource their core, commodity functions, for example network activities, to their vendors.

Figure 3.8: Telemedicine value chain (partnerships)



Adapted from (Jennett, et al., 2004:260)

This strategy may enhance the anticipated public private partnerships for the completion of telemedicine implementation and thus leveraging the value chain. These partnerships are essential for sharing or minimising telemedicine start-up costs.

3.9.3 COMPETITION IS DRIVING THE PRICES DOWN

In the access domain new players have entered the market in carriers territory, including satellite and cable companies and conglomerates such as America On Line (AOL) and Time Warner (Tan & Morais, 2001:6). Many of these organisations have fundamentally more competitive cost structures than existing carriers and often large funds.

The liberation of Information Communication Technologies (ICT) provides a foundation for a competitive environment. The introduction of a second fixed line operator will be beneficial for stakeholders as the probability of cost reduction through innovative strategies and modern IP-based network technology will be realised (Smit, 2002:38).

3.9.4 KEY CONSIDERATIONS FOR THE BUSINESS MODEL

For the emphasis of this research based on problems discussed in chapter two, it is imperative to indicate that the business model should constitute the rigorous process of analysing the factors indicated below (Mitchell, 2000:7):

- Identification of major environmental trends that may have impact on the industry over the next three years.
- An examination of the industry's internal strengths and weaknesses.
- An examination of the industry's external opportunities and threats.
- Identification of barriers to entering the market.
- The needs of various segments of the market.
- The availability of core and peripheral equipment.
- The quality of systems integration.
- An understanding of customer motivations and unmet needs.
- The opportunity to offer value-added aspects of products and services.
- Barriers to customer adoption.

This model will constitute derivatives of tangible and intangible value and will represent qualitative and quantitative factors.

3.9.5 INTERNATIONAL MARKET RESEARCH

According to Mitchell, (1998:1) discussions with industry representatives for the Commonwealth Department of Industry, Science and Tourism (DIST) in Australia report revealed that the market was expected to grow considerably in 1998 and beyond, due to:

- the increasing popularity of a number of cheaper video conferencing units, in the price bracket of $10-20,000, leading to the purchase of multiple codes for the one hospital building or for the development of application-specific networks (e.g. a mental health network in South Australia, managed by the Women's and Children's Hospital);
- the wider availability of the new European style of ISDN through local, digital Telstra exchanges was expected to lead to many more ISDN connections to community health centres and small hospitals, in locations where ISDN was not previously available. In contrast to this, ADSL will begin to grow as Telecommunication incumbents adapt to complexity of carrier product and platform portfolios ;
- ISDN usage was expected to grow in proportion to the number of new video conferencing units and because of a growing interest in the more expensive 384kbps-transmission rate, compared to the lower costs for 128kbps;
- desktop video conferencing, operating over the plain old telephone service (POTS), is expected to be used more frequently for telemedicine to the home;
- and industry representatives expect the teleradiology market to grow by 50% to $7.5m in 1998.

Telemedicine can be expected to grow even more in coming years, for the following additional reasons:

- the possibility of telemedicine consultations becoming eligible under the Medicare Schedules Benefit, as recommended in Health on Line;
- private health practitioners embracing this currently public-dominated arena; and
- equipment and transmission options becoming economical and more widespread.

Hence, according to Mitchell, (1998:3) estimates of the growth of the telemedicine industry in Australia, based on consultations for the DIST study, were as follows:

- 1997: $24m;
- 1998: $36m;
- 1999: $54m.

The full value of telemedicine cannot be gauged by these figures. Telemedicine needs to be seen as part of a new, flexible way to deliver health services and will also become increasingly enmeshed with the integrated application of other information and communication technologies. This integration will also add considerable value to the Australian economy and will change the delivery of health care permanently.

Mainstream video conferencing-based telemedicine market segments in Australia include teleradiology, teleconsulting (particularly telepsychiatry) and telehealth education. Teleconsulting includes a range of applications, for example tele-ophthalmology, tele-cardiology, tele-ophthalmology, tele-dermatology, tele-oncology and tele-paediatrics and Telemedicine.

These markets can be replicated to be potential telemedicine products for South African situation. However, some of the applications can be rolled out at a later stage when most users have adapted to the technology as discussed in 3.2.2.1 (diffusion model). At that stage, telemedicine technology will have improved considerably and user resistance will be minimised. Figure 3.9 (site 1 & site 2) shows some of telemedicine applications (teleconsultation and teleradiology) that have been rolled during the pilot project stages in Mpumalanga and the Eastern Cape.

Figure 3.9: Telemedicine Applications

Site 1: Typical Referring site



Site 2: Typical Referral site



Adopted from Wynchank, 2004:7

According Mitchell, (1998:1) the emerging telemedicine markets are depicted by following products and services in Australia.

- call centres;
- telemedicine to the home;
- telemedicine to aged care facilities;
- correctional services telemedicine;
- aboriginal telemedicine;
- defence forces telemedicine;
- ambulance telemedicine;
- emergency, outback telemedicine;
- combining digital communications at the GP's desktop;
- telehealth information on the Web;
- and export of telemedicine services to Asia.

3.9.6 THE SIGNIFICANCE OF TELEMEDICINE TO THE HOME

It is estimated that telemedicine-to-the-home will be the largest single application increasing the market in the USA in the next few years (Mitchell et al., 2000:4). The low cost of the technology involved and the benefits arising make these attractive propositions for administrators. A current trial at the Queen Elizabeth Hospital in Adelaide is providing concrete proof of the value of telemedicine to the home and has shown significant effect in delivering health care services. Normally a trial is conducted through a pilot test project.

The availability of desktop video conferencing systems is likely to drive expansion of the market. However, desktop units are expected to be used in community health care, health information, staff contact and education and training, and not in clinical situations. In telehealth this would be applicable when a session between the practitioner and health care provider share information (image or text) and have discussions on a real-time basis through enabled video and audio transmission.

3.9.7 THE IMPORTANCE OF STRATEGIC PLANNING

Strategic planning is essential for organisations involved in telemedicine, particularly because of the nature of telemedicine, as outlined above. In particular, telemedicine is changing all the time, due to improvements in technology, the development of new applications and the expansion of telecommunication networks. Telemedicine is unavoidably caught up in the massive changes occurring in information and communications technology.

Strategic planning for telemedicine at a Commonwealth and State level involves consideration of issues such as national coordination, remuneration, liability, standards, evaluation, ethics and technological infrastructure. Strategic planning for telemedicine at a regional level involves consideration of issues such as cost benefits, barriers and incentives to adoption, project management and project evaluation (Mitchell et al., 2000:8)

Currently there are certain barriers to the implementation of telemedicine in South Africa, and some of the issues mentioned above require strategic planning. This aspect is covered in the recommendation and conclusion of this study.

3.9.8 BUSINESS MODEL FOR SUSTAINABLE TELEMEDICINE

The vast majority of telemedicine activity in Australia is government funded and occurs in public hospitals. One of the major challenges for telemedicine projects is to survive beyond the initial phases of government subsidies (Mitchell et al., 2000:8). An important way to achieve sustainable development of telemedicine is to establish new projects in a business manner. Features of the business model for government funded projects recommended in this study include:

- The development of cost benefit analyses of the telemedicine project.
- The use of targets and forecasts of usage levels and types of usage in any one year.
- An appreciation of the market for telemedicine, and segments and trends in the market.
- The development of both objectives and strategies to achieve those objectives.

A number of private hospitals and general practices have installed telemedicine systems in the last few years (Mitchell et al., 2000:11). Given the necessity to make profits in order to stay in business, the business models for these private operations will need to include all of the above points and in addition a close attention to financial matters such as:

- a break-even analysis, to determine the volume of business required in order to break even in terms of profit and loss; and
- a projection of the level of activity required to achieve a given level of profitability or return on investment.

Much can be learned from radiology and pathology companies who have used teleradiology and telepathology techniques for a number of years. Teleradiology is the largest single application of telemedicine in Australia, with an estimated 150 sites around the country (Mitchell et al., 2000:9). Many of these companies use telemedicine not just to save time and expenses in transporting films and samples, but to provide a superior service to their clientele. This customer service focus is an indication that the technology of telemedicine has proved itself to be profitable and has become embedded in these companies' corporate cultures.

In the USA, the move towards managed care has been a stimulus for the development of business models for telemedicine (Mandil, 1999:90). Technology is being used as part of the mix of intervention strategies to improve health and to encourage wellness. Accordingly, one of the major companies investigating telemedicine to the home in California is the large health insurance company, Kaiser Permanente (Mandil, 1999:90).

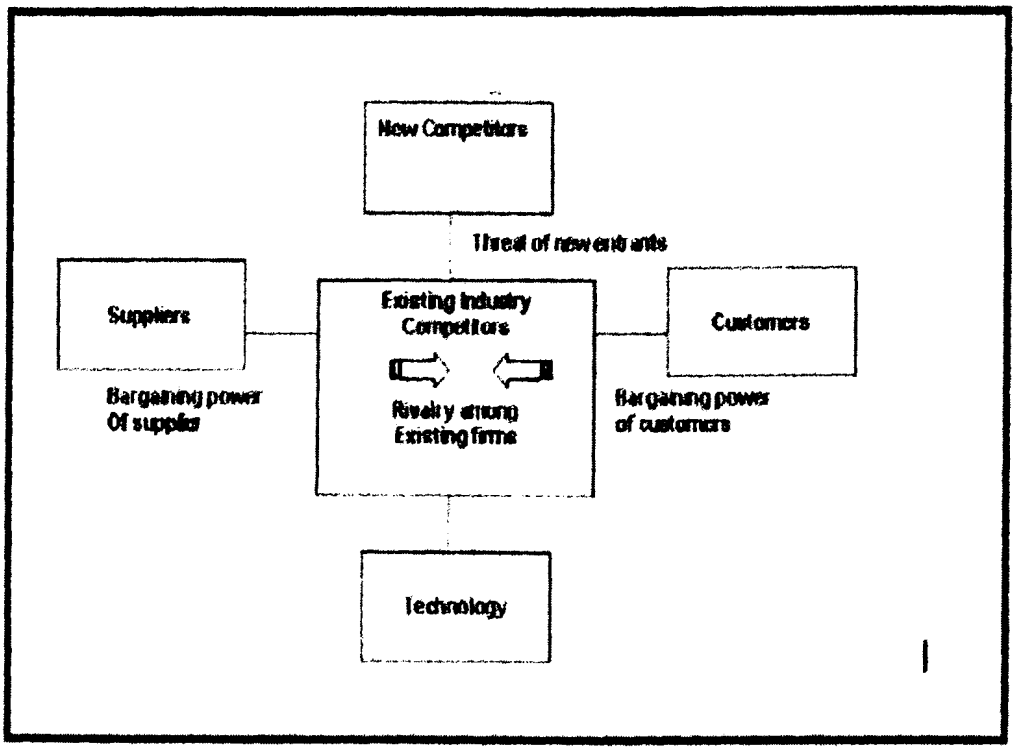
3.9.9 EXPANDING ON KEY CONSIDERATIONS

3.9.9.1 Technology and Industry – Michael Porter Model

The power of technology as a competitive variable lies in its ability to alter competition through changing industry structure (Strickland and Thompson, 2003:79). For competition there are five fundamental competitive forces at work

in any industry whose collective strength determines the ability of companies to earn rates of return on investment in excess of the opportunity cost of capital, namely threat of entry, substitution, bargaining power of suppliers, bargaining power of customers, and rivalry among incumbent competitors. The model is shown in figure 3.11.

Figure 3.10: Forces driving industry competition



Adopted from (Strickland & Thompson, 2003:81

All these forces have economic, technical and situational determinants which represent industry structure and also define the rules of competition (Strickland & Thompson, 2003:79). Technological changes can potentially affect a wide spectrum of determinants of industry structure. Where a company's technological innovation is appropriate, these impacts of technological change on structure are

the fundamental motivations underlying the company's choice of technological strategies (Burgelman et al., 2001:40).

Barriers to entry

Technology change can enhance or eliminate opportunities for product differentiation, through proprietary product designs (enhancing differentiation) and reducing the need for after-sale service. This change can affect access to distribution through facilitating the circumvention or conventional distribution channels, or conversely through increasing industry dependence on distribution channels by requiring greater needs demonstration after sale service (Burgelman et al., 2001:41).

Technology and Buyer power

Technology change can shift the bargaining relationship between and industry and its buyers. As described above, technological change causes product differentiation or switching costs, which are both instrumental in determining buyer power. This can also affect ease of backward integration for the buyer, which is a key buyer bargaining power (Burgelman et al., 2001:41).

Technology and Supplier Power

Technological change can also shift the bargaining relationship between an industry and its suppliers. This change can eliminate the need to purchase from a powerful supplier group or, conversely, can force an industry to purchase from new, powerful supplier. This can also allow substitute inputs to be used in company's product, which creates bargaining leverage against suppliers (Burgelman et al., 2001:41).

Technology and rivalry

Technology can alter the nature and basis of rivalry amongst existing competitors in an industry. The change can raise or lower fixed costs and hence the pressure for price cutting. For example, the shift to continuous process technology in the corn wet-milling industry has raised fixed costs and contributed to elevated warfare, as has the increasing size of oil tankers (Burgelman et al., 2001:40). Technology can affect product differentiation and switching costs, and hence the responsiveness of buyers to price cuts or other competitive moves, and thereby incentives for competition (Burgelman et al., 2001:41).

Technology and substitution

Perhaps the most commonly discussed effect of technology on industry structure is its impact on product substitution. Substitution is a function of relative price versus performance of competing products and the switching costs of changing between them. Technology change also impacts on both relative price performance and switching costs among existing products, as manifested in the two decade old struggle for supremacy between steel and aluminium beverage cans (Burgelman et al., 2001:41).

Technology and industry boundaries

Technology can widen boundaries in a variety of ways. It can reduce transportation or other logistical costs and thereby enlarge the geographic scope of the market. The change that reduces the cost of responding to national market differences can make global industries out of domestics ones (Strickland & Thompson, 2003:79). It can also enhance the functions the product performs, thereby bringing new customers and competitors into the market. These include industries such as bank cash dispensers, watches, and telecommunications. Technological change is blurring industry boundaries and folding the whole industry into one (Strickland & Thompson, 2003:79).

Competitive Analysis of Telemedicine

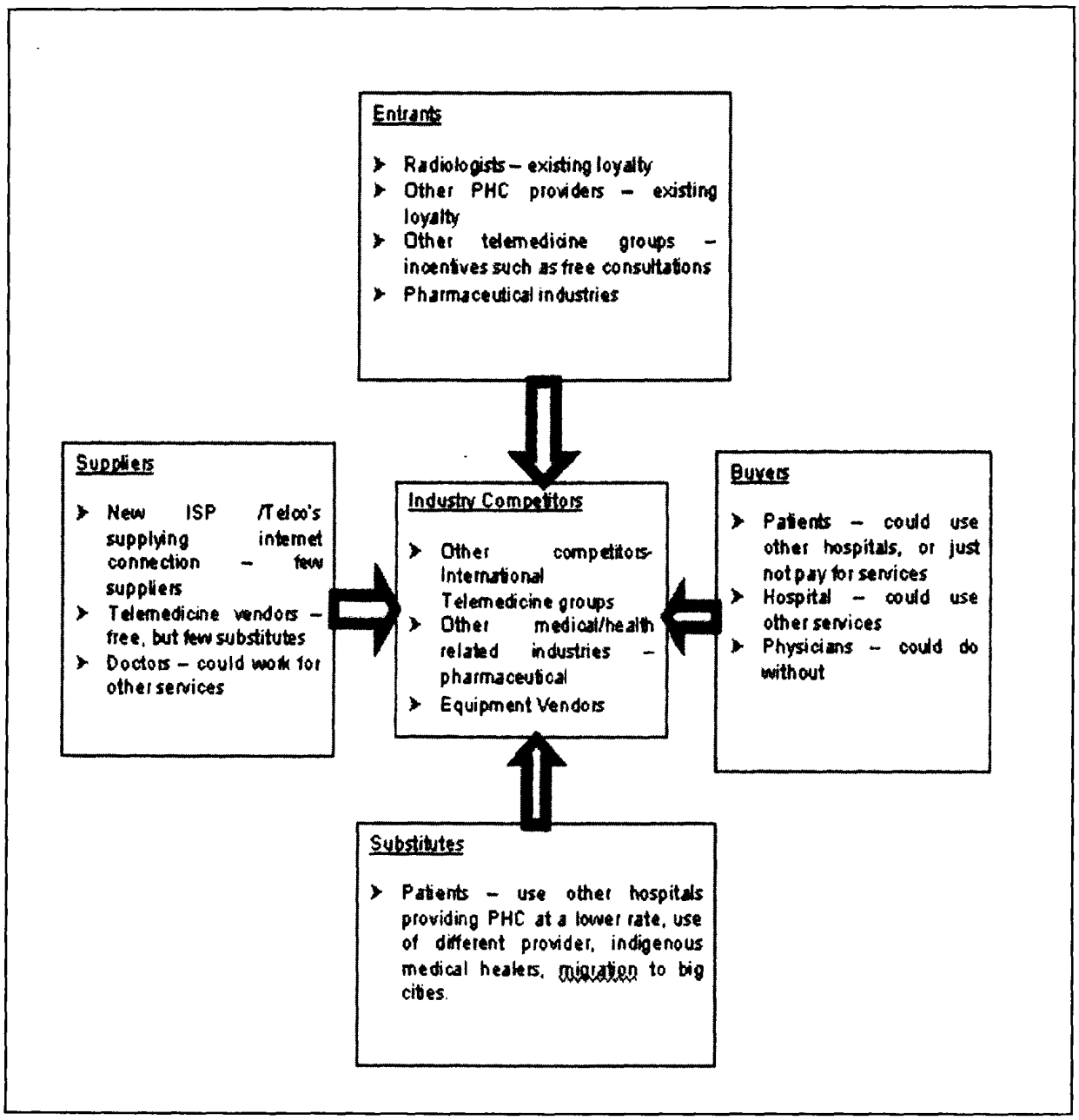
Before the successful implementation of telemedicine applications can take place, it is necessary to do significant research of the local market, an analysis of key competitors and stakeholders, assessments of financial, technical and human resources and an evaluation of the service in the pilot stage. It is therefore important to focus on the following factors for the implementation of a telemedicine project:

- Stakeholder Analysis
- Business Plan
- Evaluation Plan.

The stakeholder analysis in this case is the task team with health care consumers and providers, and it provides information on all people and organisations that stand to benefit from the telemedicine system. The list of stakeholders is expansive but is necessary for driving the business plan.

In order to introduce the telemedicine system and to ensure sustainability and user satisfaction, the development team must fully understand the financial, technical, and human costs of implementing such a change and must prepare to meet those demands. The next section discusses several factors that affect a community's and stakeholder's adoption of technology using Michael Porter's model, as depicted below in figure 3.11. The model demonstrates how Telemedicine can be positioned as a competitive product or service in the Health Care industry.

Figure 3.11: Factors for adoption of Technology – Michael Porter's model



Adopted from Strickland & Thompson, 2003:81

Barriers to entry

Below is a discussion on considerations for overcoming barriers in implementing Telemedicine.

* Economic considerations

Although telemedicine is likely to be cost-effective for the delivery of care to remote populations, compared to costs of weekly consultations in which a specialists travels to remote site, few studies currently demonstrate that adequately. Until proven, this legitimate concern will continue to adversely affect diffusion.

* Societal considerations

As in the developed countries, there are barriers to diffusion of technology that include aspects such as a lack of coverage and concrete payment policy, a lack of infrastructure and engineering standards, and concerns over security and confidentiality. Concerns about liability and licensure issues will remain prevalent in telemedicine practice.

* Organisational considerations (hospitals, health care organisations)

According to Bashur, (2002:23) when technological innovations are not accepted or implemented properly, generally the failure may be traced to a poor fit between the nature of the innovation and the vested interests, resources and expectations of its major gatekeepers. Scott (2000:44) identifies sixteen intra-institutional variables that influence adoption of telemedicine, while Mitchell (1998:5) maintains that the three most important of these are:

- anticipated rate of payoff (break-even point);
- rate of recovery on investment (ROI); and
- social approval.

Adoption at the institutional level is influenced by the authoritarian structure and the ability to mandate the use of technology. This is evidenced by wide adoption of telemedicine programmes at public hospitals and the Department of Defence, where mandates are commonplace.

* Individual considerations (physicians, hospital staff, patients)

Certain variables at the individual level can be barriers to adoption and the diffusion of telemedicine. These can be considered in term's people's attitude and perceptions toward technology, their comfort and experience level with it, and their willingness to use it.

Threat of new entrants

- *Radiologists.* Most patients and hospitals currently have an established relationship with a radiologist. However, this technology could allow the hospital to bypass radiologists. The best approach would likely include developing the system so that consultations with existing radiologists could continue more efficiently.
- *Other health care providers.* Other primary health care providers, such as pharmacists, could develop their own systems and connections. However, according to the current medical legislation, they can only dispense the medicine and drugs and not provide a primary health care in any form.
- *Other telemedicine groups.* There is the potential for larger established groups to offer similar services, especially international conglomerates, where globalisation plays a role.
- *Consultants/Practitioners/Professionals.* The telemedicine programme relies on previously established network of professionals/ doctors willing to volunteer their services. The extent to which they can stretch themselves will be limited, and the demand for their services will most likely increase over time. If consultants see this opportunity, they will make this a profitable venture and may compete for the currently targeted customer base.

Bargaining powers of buyers

- *Hospitals.* Hospitals and clinics could use other telemedicine providers, such as potential competitors highlighted in the previous sections. However, due to an effective buy-in, the hospitals and clinics can work together to help develop a telemedicine system. The greatest strengths that this initiative offers include energy, enthusiasm and free labour. However, the government, as custodian of the intended telemedicine programme, cannot continuously raise funds and offer free equipment and other technologically oriented products that larger companies could offer.

- *Physicians.* Physicians could do without these services. They have been working without telemedicine so far and may decide that the effort is not worthwhile. In addition, the radiologists at the hospital may feel threatened and the other doctors may try to avoid alienating them. On the other hand, if they find the service useful, efficient and their career skills develop as a result of this interaction, it is possible that they will want to continue to use and expand this programme.
- *Patients.* Patients could decide to use another service, or not to pay for the service. At this time, most of rural areas have only a few small medical clinics and remotely located hospitals. It is left to the discretion of the patient to use the service or not, or to consult a medical clinician on whom he/she relies solely. There's a hope that if the clinician feels the consultation is warranted, he/she will explain this to the patient and get him/her to agree to the consultation. As the fee schedule evolves, the hope is that by using this mostly free service, a sliding scale will give access to any patient in need of a consultation.

Threat of substitutes

- Patients could use other clinics and other individual health care providers or even turn to indigenous medical healers if they did not want to use the telemedicine services. The idea of the programme is not substitute for the services provided by the hospital, but to supplement them. The threat of moving one to another mode of health care provider should not be the significant one since the services offered are not forced upon the patients, but are available as an additional benefit if desired.

Bargaining power of supplies

- *New ISP /Telcos supplying Internet connection.* In South Africa there is currently one public fixed line operator and three mobile operators, with the prospects of a second fixed line operator. The current telecommunications policy/ regulatory changes with a vision to liberalise the industry, poses low probability for these operators to increase the network services fees. More companies are expected to enter the market and this competition should keep the costs down.
- *Telemedicine vendors.* The dominant telemedicine vendor is offering the services at a cost which is presumably competitive. However, there are substitute companies

with similar products on the market. The current situation is not yet profitable and it would be adequate to incur low investment costs; thus competition will be worthwhile in this case. However, for the sake of sustaining the telemedicine services, a collaborative approach with the suppliers to be lured into the idea of supplying equipment at low cost with an intention to increase the market and to make higher profits through volumes in future should be pursued.

- *Doctors.* The consultants working with the telemedicine stakeholders could work for other services, or stop working altogether as most of the time the work provided is volunteered. However, the pool of doctors available for this type of volunteer work is quite large. The government, as the custodian of the telemedicine implementation programme, has established resources to facilitate the implementation of this programme.
- *Digital Equipment Companies.* There are many companies supplying the digital equipment, which helps keep costs low. However, certain equipment standards must be complied with for the telemedicine practise.

Competitive rivalry within industry

- *Other competitors.* Other telemedicine groups are also emanating from the international environment. In this initial/start-up phase of telemedicine in South Africa, however, this should not be taken as a threat.
- *Other medical/health-related industries.* Other industries in the medical fraternity, such as the pharmaceutical industry, may decide to apply disruptive strategies by competing with telemedicine services through supply chain strategies.
- *Equipment Vendors.* Equipment vendors may collaborate with the current network operators and sign service level agreement with them for reduce equipment costs and thus creating price war in the industry.

3.10 EXPANDING ON BUSINESS MODEL FOR TELEMEDICINE

It is of utmost importance to compile a business case that would indicate the feasibility and viability of the intended telemedicine services. For the purpose of this research study it is essential to emphasise that from economic point of view, there exists a correlation between access to telecommunications (teledensity) and primary health care services. The common denominator to these two variables is the economic activity which is constituted by industrialisation and employment. The market analysis for rural areas where telemedicine services are expected to play a crucial role depends on the demarcated areas under review. These areas include the Eastern Cape, Mpumalanga, KwaZulu-Natal, the Free State and the Northern Province; however, for the purpose of this study Mpumalanga and the Eastern Cape will be used as a case study for the intended model. It is important to emphasise that these areas have been identified as Underserviced Areas according to BMI – Techknowledge (Smit, 2002:399). Each of these areas has different but similar challenges and economic fundamentals that would influence the viability of the technology infrastructure and business model.

The mobile and fixed operators and private telecommunication operators cover these areas to a limited extent (BMI – Techknowledge, 2002:30). According to ITU (2002: 32) these areas are classified as having a teledensity of less than 5%, based on the ITU definition, which is the number of telephone lines per 100 people in a walking distance.

3.10.1 TYPICAL EXISTING SERVICES IN THE AREAS IDENTIFIED FOR THE STUDY

Telkom has hundred percent geographical coverage of all the small towns in South Africa (BMI – Techknowledge, 2003:34). Telkom has over the years increased the availability of public phones and has fixed line service directly to the homes and business in the small towns in the coverage areas.

Vodacom has deployed public phones in all towns where they have coverage, through a public phone franchise model. The operation of community pay phones whose tariffs are capped by the Universal Service Agency regulations at 70 cents per minute is posing

challenges for the operators; conversely, this creates a business opportunity for other applications such as telemedicine services.

In Umtata alone there are more than 20 GSM public pay phones, the majority of which are Vodacom phones. The big demand for these pay phones is shown by the fact that in UNITRA (University of Transkei) alone there are five GSM public payphones (BMI-Techknowledge, 2002:45). The cost per unit ranges from R0.65 to R0.98, depending on the number of seconds per unit. Therefore on average, the cost per minute could be R2.00 for the GSM payphones. Although these tariffs are 180% more than those of community payphones, the demand for communication services makes the businesses of the entrepreneurs who run public pay phones a profitable exercise.

Other services that are available in these areas are Internet cafés, which are used by the public for all internet transactions. Geographically telecommunications services are currently limited to towns, although the cellular coverage reaches those villages along the main national roads, making communications services also available in these rural areas in the form of pay phones (BMI-Techknowledge, 2002:399). In the rural areas and townships more than 80% of users are pre-paid users. This is based on the level of employment in these areas. Other services that are available include and are limited to electricity supply services rendered by Eskom, and transport services by Transnet. As emphasised in the previous section and chapter 2, these parastatals have established private power supply and telecommunication infrastructure for their intended business purposes. The established infrastructure can be used to facilitate or bridge the gap of a lack in access of services such as telemedicine and telecommunications for rural communities.

3.10.2 DEMAND FOR SERVICE IN THE UNDERSERVICED AREAS

The demand for services in the underserviced areas may be addressed in the following ways:

- Public payphones as a primary revenue stream, in large town/ cities, small towns and villages.

- Pre-paid phone services as a secondary source of revenue. Access to residential areas will work only if the pre-paid approach is also applied and users do not have to incur high rental expenses for the phones.
- Public internet access in towns.
- Business voice and data services in larger towns/cities.

3.10.3 MARKET SEGMENTATION

Segmentation is provided based on the size of the settlement, which determines the following key factors, as illustrated in Table 3.1:

- Type of services required
- Quantity of services
- Delivery network.

Table 3 a: Segmentation of the services

Services	Large town/City	Small town	Village
1. Public Access	Telephony Internet	Telephony Internet	Telephony
2. Residential	Pre-paid voice Voice subscription Internet	Pre-paid voice Voice subscription	Telephony
3. Business/ government	Small business voice/Internet Medium size PABX Large PABX Data services	Small business voice/Internet	Telephony

Adapted from Africa Venture Partners (2003:17)

3.10.4 TARIFFS

Market and regulatory factors converge in determining end-user tariffs. Prices are assumed to be equivalent to Telkom's existing tariffs, except for GSM-based public access services (BMI-Techknowledge, 2002:399), which have been based on the Vodacom wholesale subsidised rate to its franchisees.

Tariffs for incoming calls to the USAL are not set by the USAL, but the interconnect rate established for incoming calls, together with regulation, will have a bearing on the tariffs charged for these calls.

3.10.5 TECHNOLOGY PLATFORMS

The technology model analysis for rural services is based on the demarcated areas under review, in this case specifically in the Eastern Cape. In order to determine the extent of the network that should be used for rural areas, an analysis of the current infrastructure is essential. Although operators are generally not at ease with divulging the availability of their network infrastructure, certain assumptions can be made about network availability, based on public information.

Networks which are relevant here are fixed line and mobile (GSM) networks. Telkom owns telecommunications exchanges in all towns within the demarcated areas. In all cases there is a limited access from the Telkom exchanges to outlying rural areas (Smit, 2002:348). All mobile operators have GSM network presence in all the small towns, but Cell-C's network coverage is still limited. Vodacom and MTN have coverage along most national roads, thus providing access to all rural areas at close proximity to national roads. GSM broadband satellite and DECT based Wireless Local Loop (WLL) network are considered as good examples of viable technology platforms based on the segmentation, service offerings, scalability and the ability to leverage existing infrastructure. The possible platforms for this are discussed in detail in the following sections.

3.10.5.1 GSM PLATFORM

The coverage of the existing GSM operators is generally good in small towns and even extends to surrounding villages (Smit, 2002:78). Therefore, it is assumed that the existing GSM networks would be used mainly for fixed mobile services, in the coverage area where no other USAL network is available, for small installations of payphones or small phone bureau's, implying less than four lines.

3.10.5.2 BROADBAND SATELLITE

Broadband satellite networks provide flexible IP based services from customer terminals, which are rapidly coming down in price. The advantages of this technology are the following (Hinberg, 2000:115):

- Access is independent of geographical location, which is well suited to low density and unpredictable deployments.
- The network is scaleable and achieves economies of scale based on aggregate and dispersed demand.
- It is IP based and can therefore provide services from simple voice to sophisticated data services on a common network.
- Terminal equipment is rapidly coming down in price to a U$ 1,000 level.
- Telkom has an existing Gilat 360E hub, which could be leveraged on a facilities lease basis.

The main disadvantage of the platform is the ongoing satellite capacity charge, which again could be leased from Telkom (as a signatory to Intelsat) on an incremental basis with regulatory support from ICASA (Smit, 2002:348). This platform has been specified for medium to large Cyber Centres, which typically have five to ten workstations, including public telephony services, and for businesses of all sizes. Typically, small businesses requiring data service would only select this platform if there was no available Wireless Local Loop service, while large businesses and/or organisations would select this platform due to flexibility in providing a range of voice and data services.

3.10.5.3 WIRELESS LOCAL LOOP (WLL)

Wireless Local Loop can typically only be cost justified in high density areas due to the fixed cost component of the network, and typically also high per user CPE costs. This DECT based technology class has been used due to following underlying factors indicated below:

- Low fixed network cost, implying that it can be viable in lower density areas such as small to medium sized towns.
- Low CPE cost, making it a viable delivery mechanism to market segments that cannot afford high up-front or rental charges for equipment.
- Ability to offer an always-on 32-64 kps data service simultaneously with a voice service.

The main disadvantage of this technology class is that it is channel based and therefore has limited scope of data services it can offer (Hinberg & Tan, 2000:115).

Based on the suggested technology applications for demarcated areas under discussion, the technology business model can be compared and summarised as indicated below:

- Satellite is well suited to cyber centres and larger business due to the CPE cost and ability to provide voice and data.
- Cost of CPE will limit the residential market, with the WLL technology probably best suited to this segment.
- Small business is well suited to the WLL platform, where an always-on data line or up to 4 voice ports can be quite economical.
- GSM fixed mobile is cost effective where there is existing coverage, with no infrastructure costs for USAL.

3.10.5.4 OWNERSHIP OF USAL NETWORK SERVICES

The Telecommunications Amendment Act clearly states that the USAL will be owned by historically disadvantaged small to medium enterprises and communities that reside within the demarcated districts (Smit, 2002:348). The draft regulations on ownership prohibit existing telecommunications operators from applying for USAL and from having a stake in more than two other USALs. Limitations on ownership reduce financing options. These regulations prohibit consolidation, which may become an economic necessity during the tenure of the licenses. However, the regulations do not prevent the establishment of a shared platform or infrastructure facilities envisaged.

3.11 TELEMEDICINE FINANCIAL MODEL APPROACH

3.11.1 USAL APPROACH

The USAL business model will complement this model, which is a facilities based local service provider. This model emphasises the essential participation of a parastatal such as Telkom and mobile operators in the deployment of the network. Upstream, the USAL will lease certain facilities and interconnect at local the local level, with licensed operators carrying the long distance and international services. In turn, the USAL will provide services to downstream public access providers such as cyber centres, tele-centre and payphone operators, who will invest in CPE and other facilities to provide public access services. Specifically, the USAL will provide Internet bandwidth and voice lines to public access providers.

A typical case study in the OR Tambo District in the Eastern Cape demonstrates an approach in deriving the model and the viability of the business model at high level. Inputs to the business model include service tariffs assumptions; interconnect assumptions, usage assumptions and operating cost assumptions (Medical Research Council, 2004:20).

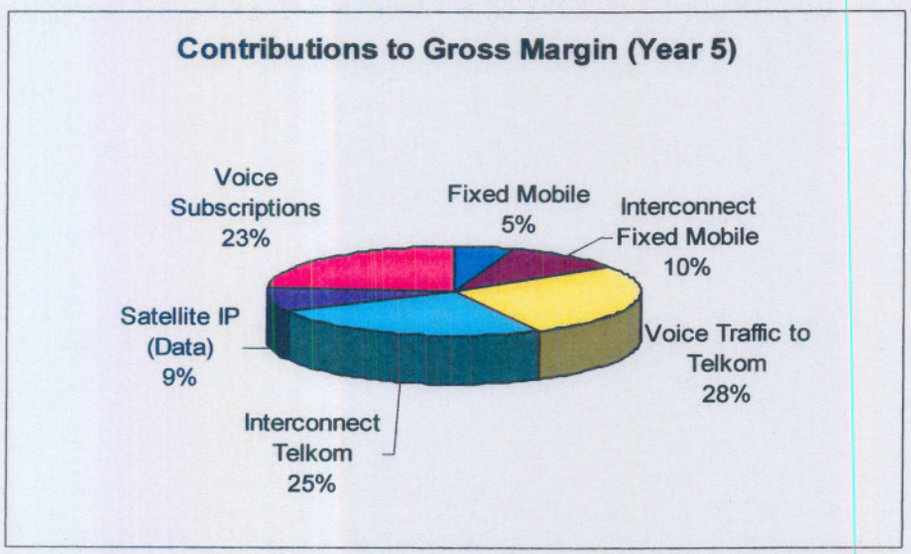
Financial Model Results

The base case financial model showed that a viable case could be made for a USAL based on the assumptions stated above, without subsidies. The case showed break-

even in year 3 and payback in 4 years. Peak funding is R10.7 million in month 22 and the gross margin is approximately 80%, while net margin (based on profit before tax) is 18-20%. The IRR is 30.5% and the NPV at a discount rate is R1.25 million, with a terminating factor of 3 x EBIT.

The chart below shows the contributions to the gross margin in year 5. The interconnect for Telkom and mobile operators are based on incoming traffic from these respective networks. These revenues do not have direct costs and translate directly into the gross margin. It clearly demonstrates how the interconnect agreement can be a revenue generator, with traffic from Telkom accounting for 25% and traffic from Mobile operators accounting for 10% of the GM.

Figure 3.12 USAL Model-Contributions to margins in year 5



Adopted from Africa Venture Partners (2003:20)

Using the draft interconnect regulations as the basis for interconnect assumptions in the financial model, with symmetrical interconnect on Telkom local and mobile calls, and a minimum differential of 30% on long-distance interconnect with Telkom, the business case becomes unviable (all else remaining equal).Table 3b shows interconnect tariffs applied by South African public Telecommunications operators.

Table 3 b: Interconnect tariffs

INTERCONNECT							
					CALCULATOR		
Mobile Operator	Peak		Off-peak		Maximum	Percentage	Telkom to
	Local	Trunk	Local	Trunk	Interconnect	of minimum	Cellular
Outgoing	R0.53	R0.53	R0.53	R0.53	R0.530	50%	R1.56
Incoming	R0.53	R0.53	R0.53	R0.53	R0.530	50%	R1.06
Telkom	Peak		Off-peak		ASYMMETRY CALCULATOR		
	Local	Trunk	Local	Trunk		Differential %	Differential R
Outgoing	R0.21	R0.36	R0.10	R0.18	Peak	30%	R0.310
Incoming	R0.21	R0.67	R0.10	R0.34	Off-peak	30%	R0.155

Adopted from Africa Venture Partners (2003:19)

Under this scenario the payback period exceeds 5 years, the IRR is 5.5% and the NPV at a 25% discount rate is negative (R4.12 million). This clearly shows the ability of the Interconnection agreements to make or break the USAL business. A start-up subsidy of R6 million to the USAL by the Universal Service Agency would have the equivalent effect over the 5 year financial period, of the base case interconnect assumptions, with an IRR of 30.9%.

Funding of the USAL

The base case financial model with an IRR of 30.5% would be marginal from a funding point of view. This is a conservative view of the business, based on the OR Tambo district, and there may be factors which can improve the business plan. In this case the peak funding is R10.7 million in Month 22. Subsidies from the Universal Service Agency (USA) would also improve the overall investment returns. A guarantee from the USA to institutional investors would reduce their risk.

Typically, the operator would rely on equity funding initially. At a later stage project (debt) finance could be contemplated, once the revenue model had been proven, and the cash flows could realistically pay back the interest and capital of the loan.

Vendor (debt) finance is usually a secondary source of funding, although in this particular network architecture, the capital expenditure on network is relatively low, and therefore the scope for vendor financing is limited.

3.11.1.1 INSTITUTIONALISED MEDICAL APPROACH

This model emphasises the essential participation of a parastatal such as Eskom, Transtel and CSIR (NGO) for the deployment of the network. Section 2.24 of chapter 2 discusses the important role of SACCESS in telemedicine implementation. A brief pilot study to be used as a case study for the intended business model was conducted in Tilitswa in the Eastern Cape. As discussed in section 2.24 of chapter 2, typical problems that are evident include power supply, site identification based on needs and sustainability, and telecommunications infrastructure. Thus this case study provides an opportunity for innovation, and the market analysis that can be replicated to represent a national picture to a larger extent. The rural electrification model hosted within Eskom's rural development model could facilitate the expansion of Eskom's private telecommunication network. This could simultaneously complement both power supply and ICT infrastructure in this rural environment.

3.11.2 PILOT PROJECT DEPLOYMENT AND DESCRIPTION

The telemedicine application formed part of the Department of Science and Technology's Innovation Fund project entitled "Information and Communication Technologies (ICTs) in support of communities in deep rural areas". The project was implemented between 2001 and 2003 and the CSIR was the lead organisation of a consortium comprising the HSRC, ARC, Naledi ya Africa and Renewable Energy (Pty) Ltd, Medical Research Council (LVB telemedicine Technology and Training, 2004:3).

The community leader from Tsilitwa approached the CSIR in 1999 to draft a funding proposal after having visited a similar CSIR project at Lubisi. The request was for Information Communication Technology (ICT) to support health, education, agriculture and small business. The pilot site was implemented in the deep rural village of Tsilitwa in the former Transkei, Eastern Cape, South Africa.

Project aim

This project's aim was to develop and implement an innovative communications infrastructure that was independent of the state telecommunication utility companies, and to develop capacity within the community involved, with appropriate information content, to support sustainable development in rural areas.

The key objectives of the project were:

- Research, develop and pilot a viable, alternative communications infrastructure and delivery platform utilising renewable energy.
- Provide a communications platform for the delivery of local content, government and private sector information services as well as for health and education applications.
- Develop human capacity in the rural environment.
- Implement business units in order to achieve sustainable, integrated rural development.
- Develop an assessment methodology for monitoring and evaluation of rural development initiatives involving ICTs.
- Develop a replication model for the sustainability of Multi-Purpose Community Centres.

From the discussion above it is evident that the project implementation included the participation of key parastatal such as Eskom (rural electrification model) and CSIR for infrastructure deployment. The case study provides an opportunity for invention of the required technology and business model for a successful implementation of the research understudy.

3.11.3 KEY INPUTS AND ASSUMPTIONS

Inputs in the business model included service tariffs assumptions, uniform patient fee schedule, patient categories, single and family income, hospital categories (level1-3), Patient groups, medical services categories, utilisation, operating cost assumptions, number of patients and visits per day, number of inpatients. The information is supported by statistics availability for both the Eastern Cape, Mpumalanga areas and the remaining seven-province (Department of Health, 2004g: 4).

Table 3 shows the tariffs or illustrative fees known as Uniform Patient Fee Schedule derived by the Department of Health (DoH) for different primary health care services. Key variables, codes and definitions of patients and hospital groups are discussed in the following section.

Categories of patient groups according to subsidisation (H1, H2 &H3)

This is the default group for subsidised patients and the level of subsidisation depends on the assessment of income (frequently called the means test). The income cut-off point between H1 and H2 patients is set at the 80th income percentile as determined by Statistics South Africa (Department of Health, 2004b: 5). This means that 80% of employed individuals earn less than the cut-off amount per annum. Currently this amount is a yearly income of R36 000 for a single person. The cut-off between H2 and H3 is set at the 90th percentile, namely R72 000 per annum. Patient earning above this amount will pay full UPFS fees. This is to encourage those individuals to take out medical aid cover. Table 4 below lists the subsidisation percentages for H1 and H2 for the services covered by the UPFS.

Table 3.1: Illustrative Fees (based on 2002 UPFS fees)

Service	H1		H2	
Hospital	Level 1 & 2	Level 3	Level 1 & 2	Level 3
Consultations				
Routine, General Practitioner	R20	R20	R70	R85
Emergency, General Practitioner	R20	R20	R145	R155
Inpatient day				
General ward, GP	R50 per 30d	R60 per 30d	R50 per day	R60 per day
ICU, GP (per 12hours)	R50 per 30d	R60 per 30d	R 110 per 12h	R135 per 12h
Procedure, Imaging & Oral Health				
Ambulatory procedure Cat A (GP)	Free	Free	R155	R170
Theatre procedure Cat C (GP)	Free	Free	R1 420	R1 643
Category A X-ray (Radiographer)	Free	Free	R30	R35
Category B Oral Health (Non specialist)	Free	Free	R40	R45

Patient & Emergency Transport				
Patient Transport (per 100km)	R10	R10	R25	R25
Basic Life Support (per 50km)	R25	R25	R70	R70
Intermediate Life Support (per 50km)	R30	R30	R95	R95
Advanced Life Support (per 50km)	R50	R50	R155	R155

Table 3.2: Categories for Partial Subsidisation

Category	Means Test	Subsidisation (% of UPFS)
H1	Individual : Income less than R36 000 per annum Household : Income less than R50 000 per annum	Consultations : 20% with no differentiation for emergency consultations Inpatient : 1% of the UPFS general ward day tariff summed for 7 days for each 30 days or part thereof (Note 1). No differentiation on the basis of bed type. Patient and Emergency Transport: 5% Assistive devices : 25% All other services : Free Calculated amounts should be rounded to the nearest R5 to facilitate cash accounting.
H2	Individual : Income less than R72 000 per annum Household : Income less than R100 000 per annum	Consultations: 70% with differentiation for emergency consultations Inpatient days: 7% per day with differentiation on the basis of bed type Procedures, imaging and oral health: 50% Patient and Emergency Transport: 15% Assistive devices : 75% All other services : Free Calculated amounts should be rounded to the nearest R5 to facilitate cash accounting.
H3	Individual : Income greater or equal to R72 000 per annum Household : Income greater or equal to R100 000 per annum	All services listed in the UPFS at full price

Adopted from Department of Health (2004g: 3)

Notes:

1. The H1 inpatient fee is expressed as a percentage of 7 days of the UPFS General Ward Inpatient fee to approximate the average length of stay of inpatients in this category. Although the fee calculation is based on 7 days, for H1 patients this fee will be applicable for each 30 days of inpatient stay or part thereof. No differentiation is made on the basis of bed type.

Table 3.3: Distribution of Service utilisation per billing/patient group

Billing Group	Eastern Cape	Free State	Gauteng	KwaZulu-Natal	Mpumalanga	Nothern Cape	Northern	North West	Western Cape
H1	86.7%	77.5%	83.0%	80.0%	77.0%	61.9%	80.0%	65.4%	64.0%
H2	5.3%	2.0%	5.0%	7.0%	8.0%	0.1%	5.0%	1.0%	16.0%
H3	4.2%	2.0%	5.0%	8.0%	8.0%	0.0%	4.0%	0.9%	7.0%
Full Paying	3.5%	12.5%	7.0%	5.0%	7.0%	2.4%	3.5%	1.5%	13.0%
Other	0.0%	6.0%	0.0%	0.0%	0.0%	35.6%	7.5%	31.2%	0.0%
Total	99.7%	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Adopted from Department of Health (2004h:4)

Figure 3.13: Eastern Cape Service Utilisation

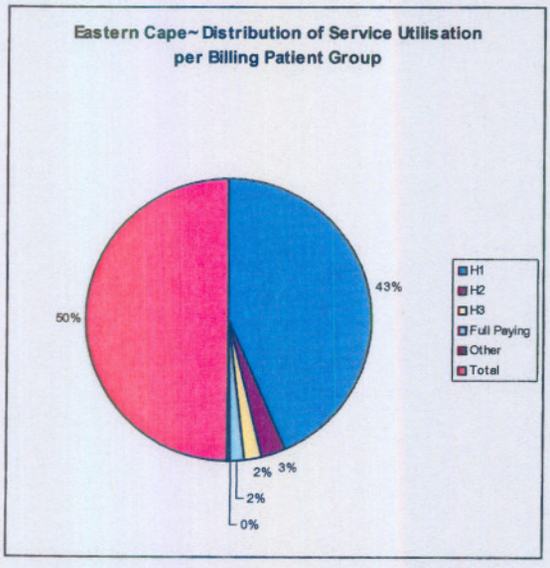
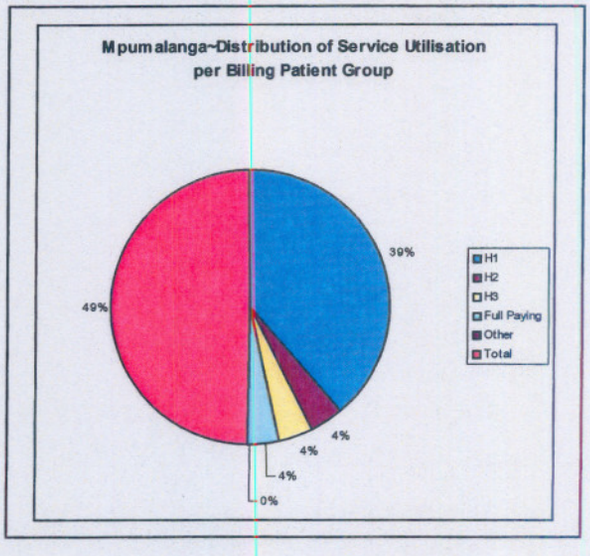


Figure 3.14: Mpumalanga Service Utilisation



Distribution of service utilisation per billing/ patient group

The utilisation figures for the set of services as determined for the 2001/2002 financial year using best available statistics from each province is shown Table 3.5 (Department of Health, 2004h:4).

The proportion of services rendered to each patient billing group (H1, H2) was through available statistics. Breakdown was based on actual data and estimated on the distribution of individual income levels per province and an estimation of the proportion of medical aid patients making use of public facilities in the province. The results of this estimation is contained in Table 3.6.

When these proportions are then applied to each service category and combined with the particular tariff for the service and the billing group, the potential annual revenue per billing group service can be calculated and tailored to arrive at an estimate of the total potential hospital service revenue. It is important to emphasise that all calculations are based on level 1 tariffs and they are therefore an underestimate of the potential revenue, implying that a conservative approach was pursued in this case. Due to the number of assumptions made in calculating these figures, they should be seen as illustrative and are only used as basis for comparing the impact of alternative fee schedules.

Table 3.4: Revenue Comparison (R Millions)

	Eastern Cape	Free State	Gauteng	KwaZulu-Natal	Mpumalanga	Nothern Cape	Northern	North West	Western Cape	Total
Potential Revenue	72	103	181	254	37	12	53	48	304	1064
Actual Revenue (99/00)	29.5	32	77	98	12	6	23	11	62	350.5
Total value of services	3164	997	4873	4591	813	375	1529	1912	2210	20464
Revenue recovery rate	41%	31%	43%	39%	33%	55%	42%	22%	20%	33%
Cost recovery rate	2%	10%	4%	6%	5%	3%	3%	2%	14%	5%

Adopted from Department of Health (2004h:3)

Notes:

Potential revenue: Revenue based on current fee schedule assuming 100% collection of fees.

Total value of services: Total services rendered valued using the UPFS tariffs. This is proxy measure for the cost of services.

Revenue recovery rate: Actual revenue as a percentage of the potential revenue.

Cost recovery rate: potential revenue as a percentage of total value (cost) of services. Average for Africa is five percent (5%); the recommended norm is ten percent (10%).

Table 3.6 compares the total potential revenue with the actual revenue collected per province. The table shows that roughly thirty (30%) percent of potential revenue is collected for hospital services. If the potential revenue is compared with the total value (cost) of services rendered as measured using the UPFS, the average subsidisation of services rendered at public hospitals stands ninety five percent (95%). This is comparable to other African countries. From a different angle this figure represents a five percent (5%) potential cost recovery rate, compared to a recommended norm of ten percent (10%).

For the purpose of this study Figures 3.15 and 3.16 indicate the revenue comparison of actual, lost and potential revenue using UPFS schedule without factoring telemedicine services in the calculations.

Figure 3.15: Revenue Comparison (%)

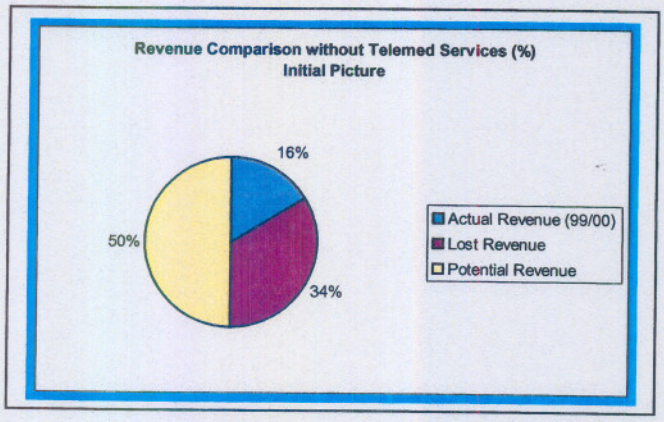
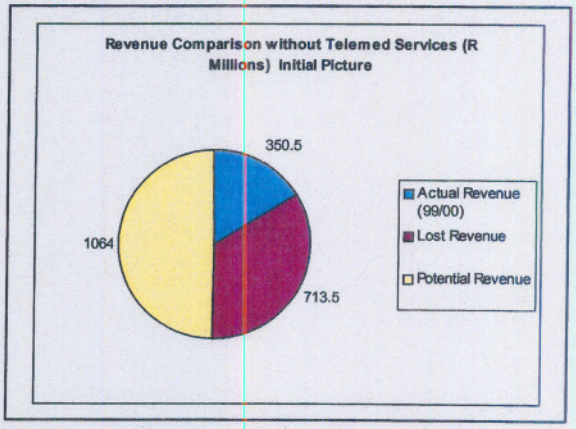


Figure 3.16: Revenue Comparison (R Millions)



As depicted in Table 3.7, service utilisation figures are indicated in three categories, namely consolations, inpatient and theatre case. Inpatient represents a higher figure than other categories; however, as indicated in Table 3.8, the cost and revenue per patient billing is much less than the consultation fees. For the purpose of this study, demarcated case study areas, namely Mpumalanga and the Eastern Cape, are used for comparison. In Figures 3.17 and 3.18 the factor of telemedicine services is not taken into account, whereas Table 3.7 identifies the potential telemedicine services for projecting the intended business model.

Table 3.5: Service Utilisation figures used as basis for calculations

Service	Eastern Cape	Free State	Gauteng	KwaZulu-Natal	Mpumalanga	Nothern Cape	Northern	North West	Western Cape
Consultations									
Routine visits	1988100	1009196	3711076	3850175	429536	202612	1297886	886629	2112341
Emergency visits	504905	35520	579185	228400	75800	1223	165669	133657	508430
Admissions	478679	210999	709481	681278	212841	95654	331233	288794	341758
Inpatient days									
General Ward	3560064	995915	5037315	4390587	851364	425741	1607299	2223714	1712920
High Care Ward	5718								
ICU	10950	886	8656	3202	341	153	298	289	21257
Theatre Cases									
30 min OP Procedures	172518	73336	285461	272057	46551	19757	106301	79894	165214
1 Hour Operations	78477	57392	168856	243216	50656	11383	44968	49095	142342
3 Hour Operations	13849	10128	29798	42921	8939	2009	7936	8664	25119

Adopted from Department of Health (2004h:3)

Figure 3.16:Service Utilization (%) ~ Eastern Cape

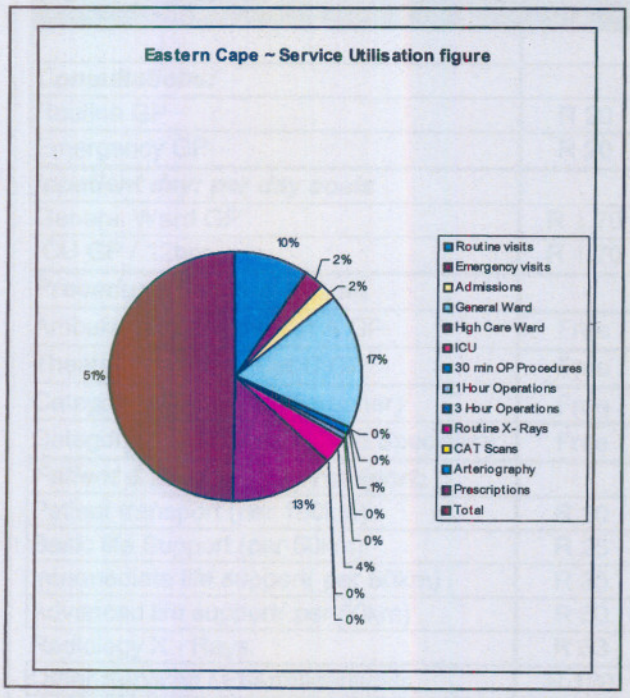


Figure 3.17:Service Utilization (%) ~ Mpumalanga

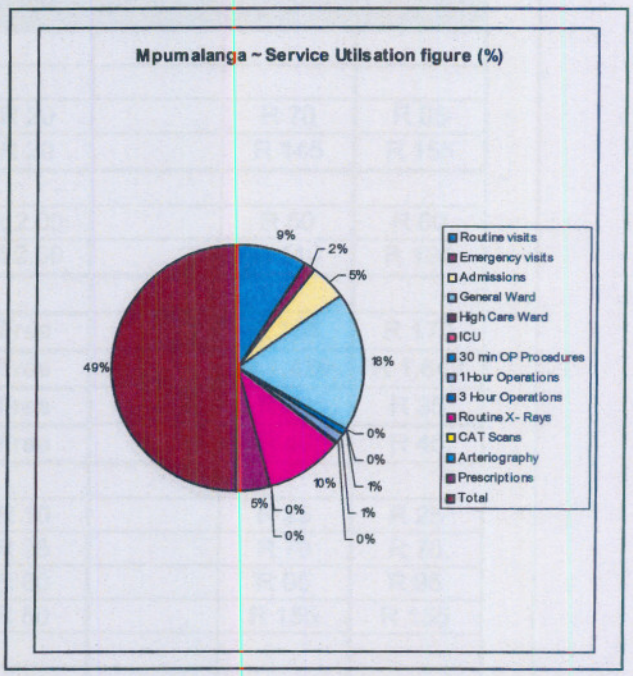


Table3.6: Potential telemedicine services (in blue) /UPFS Schedule

Service		H1		H2	
Hospital	level 1&2	level 3		level 1&2	level 3
Consultations:					
Routine GP	R 20	R 20		R 70	R 85
Emergency GP	R 20	R 20		R 145	R 155
Inpatient day: per day costs					
General Ward GP	R 1.70	R 2.00		R 50	R 60
ICU GP / 12hrs	R 1.70	R 2.00		R 110	R 135
Procedure, Imaging & Oral:					
Ambulate Procedure Cat A GP	Free	Free		R 155	R 170
Theatre Procedure Cat C GP	Free	Free		R 1,420	R 1,643
Category A X-ray(Radiographer)	Free	Free		R 30	R 35
Category B Oral Health (Non Specialist)	Free	Free		R 40	R 45
Patient & Emergency Transport:					
Patient transport (per 100km)	R 10	R 10		R 25	R 25
Basic life Support (per 50km)	R 25	R 25		R 70	R 70
Intermediate life support(per 50km)	R 30	R 30		R 95	R 95
Advanced life support(per 50km)	R 50	R 50		R 155	R 155
Radiology X - Rays	R 53				
Other Services / Pharmaceuticals	R 130				

Adopted from Department of Health (2004h:5)

Inclusion of identified telemedicine services in two case studies (Mpumalanga and Eastern Cape) are represented in table Tables 3.9 and 3.10 respectively. The Mpumalanga case study represents urban telemedicine and the latter represents the rural scenario. The new total mean values are indicated in both Tables 3.9 and 3.10. The urban telemedicine application has a much larger potential revenue than its rural counterpart, as indicated by a rise in revenue recovery rate of 61% and 34%. Another important variable to measure is the cost recovery rate, indicating an increase to 9% in urban telemedicine application for Mpumalanga. Figures 3.18 - 3.25 depict both cost and recovery revenue rates with telemedicine applications for both urban and rural environment.

Table 3.7 Representation of Eastern Cape (Tsilitwa ~Rural)

	Eastern Cape	Free State	Gauteng	KwaZulu-Natal	Mpumalanga	Nothern Cape	Northern	North West	Western Cape	Total	New Total (mean values)
Potential Revenue	72	103	181	254	37	12	53	48	304	1064	1087
Actual Revenue (99/00)	29.5	32	77	98	12	6	23	11	62	350.5	373.5
Total value of services	3164	997	4873	4591	813	375	1529	1912	2210	20464	20441
Revenue recovery rate	41%	31%	43%	39%	33%	55%	42%	22%	20%	33%	34%
Cost recovery rate	2%	10%	4%	6%	5%	3%	3%	2%	14%	5%	5%

Table 3.9: Revenue (R Millions) compared with rural telemedicine applications

Figure 3.19: Revenue Recovery Rate (%)

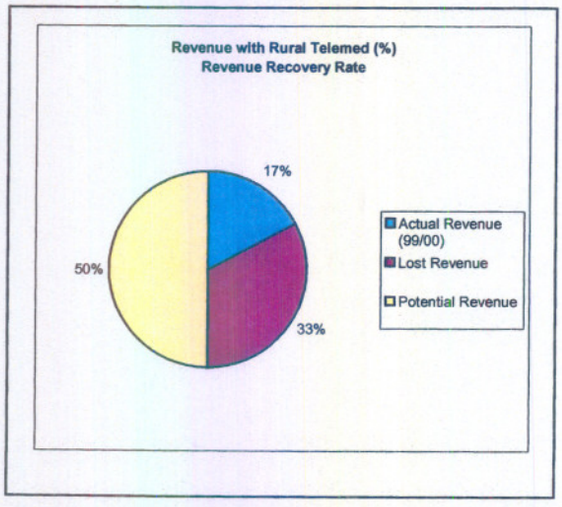


Figure 3.20: Revenue Recovery Rate (R Millions)

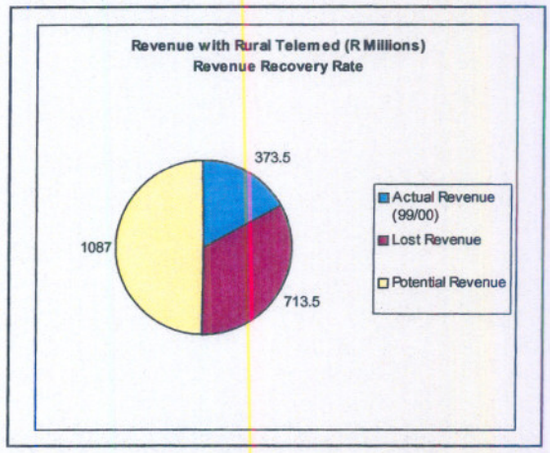


Figure 3.21: Cost Recovery Rate (%)

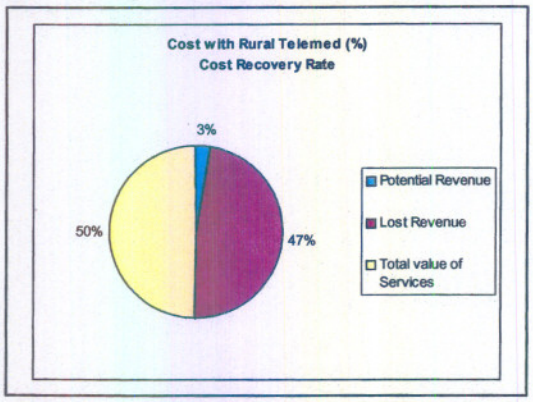


Figure 3.22: Cost Recovery Rate(R Millions)

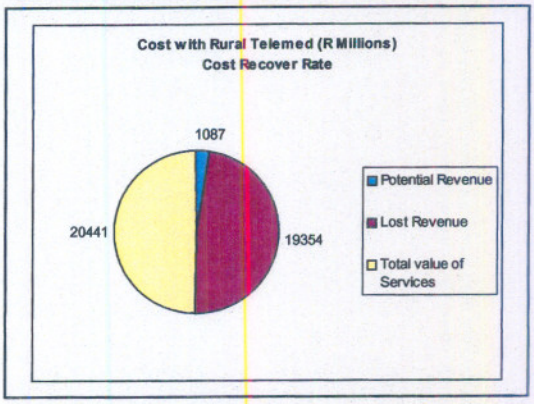


Table 3.8 Representation of the situation in Mpumalanga

	Eastern Cape	Free State	Gauteng	KwaZulu-Natal	Mpumalanga	Nothern Cape	Northern	North West	Western Cape	Total	New Total (mean values)
Potential Revenue	72	103	181	254	37	12	53	48	304	1064	1853
Actual Revenue (99/00)	29.5	32	77	98	12	6	23	11	62	350.5	1139.5
Total value of services	3164	997	4873	4591	813	375	1529	1912	2210	20464	19675
Revenue recovery rate	41%	31%	43%	39%	33%	55%	42%	22%	20%	33%	61%
Cost recovery rate	2%	10%	4%	6%	5%	3%	3%	2%	14%	5%	9%

Table 3.10: Revenue (R Millions) compared with urban telemedicine applications

Figure 3.23: Revenue Recovery Rate (%)

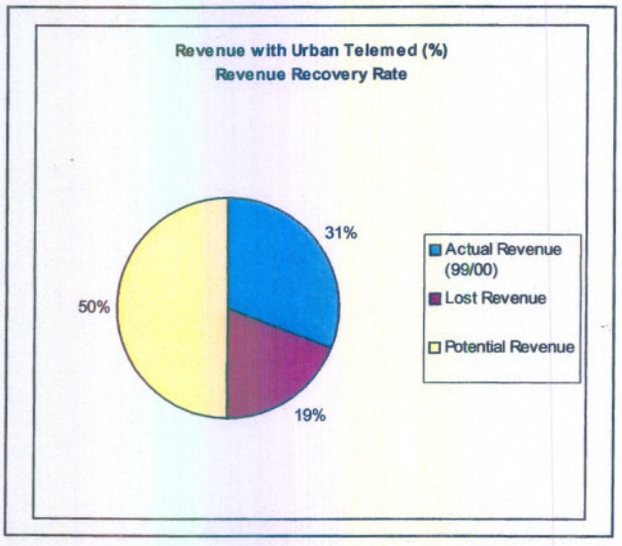


Figure 3.24: Revenue Recovery Rate (R Millions)

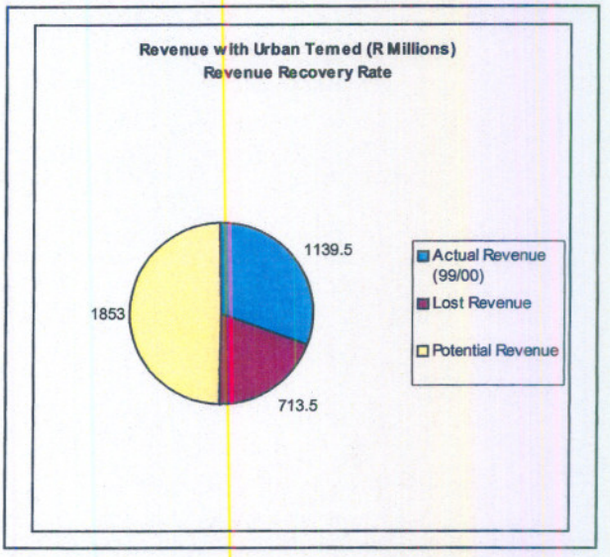


Figure 3.25: Cost Recovery Rate (%)

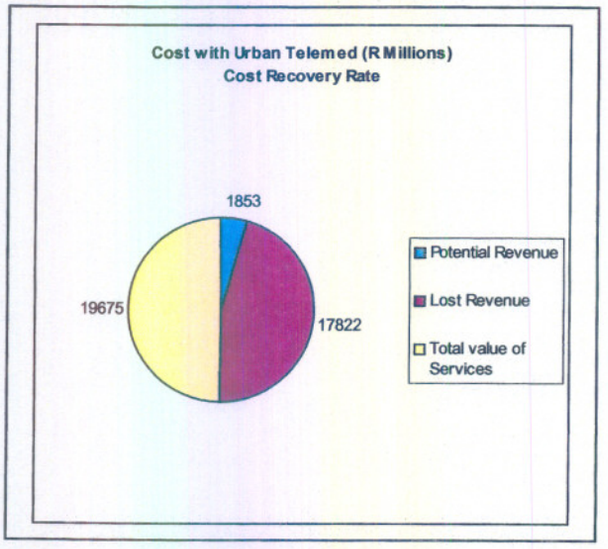
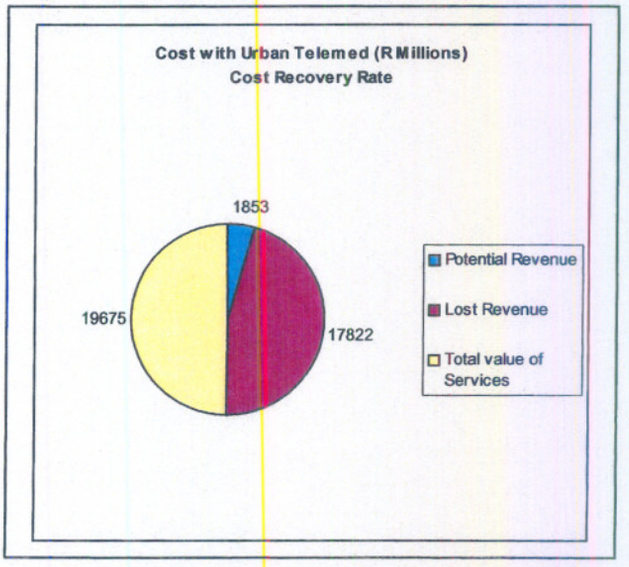


Figure 3.26: Cost Recovery Rate (R Millions)



3.11.3.1 Representation of national telemedicine applying both urban and rural telemedicine

3.11.3.2 Key Assumptions and Method of calculations

Eastern Cape ~ Rural telemedicine application (Source: Tsilitwa Clinic, 2004)

Raw data:

Number of patients per day ~ 30

Distance between two points (Tsilitwa/Sulenkama) ~ 30 km

Number of patients for teleconsultations per day ~ 2

Number of Clinics in the region ~ 780

Number of Emergencies per day ~ 5

Assumptions:

1) Rural population in a given area is similar to that of Tsilitwa, with same PHC daily trend/ statistics.
2) For conservative approach for National figures (costs), "means/averages" of the lowest values for 9 provinces were used.
3) Cost of rendering PHC services were taken from H1 Patient group at Level 3 Hospital charges for rural applications.
4) The 1999/2000 statistics show the average number of services rendered to H1 Patient group to be 75%, while rest was rendered to (H2/H3).
5) The average number of rural settlements/areas (PHC centres) is 780 per province.

Mpumalanga ~ Urban telemedicine application (Source: Witbank Provincial Hospital, 2004)

Number of X-ray patient/diagnosis ~ 80 per day

Number of referrals on X-ray patient/diagnosis ~ 40 per day

Distance between two points (Witbank / Pretoria) ~ 120km

% Reduction in wrong referrals ~ 50%

Cost of P1 Ambulance per round trip R8,000

Assumptions:

1) Number of urban specialist referring hospitals is the same as Eastern Cape picture at an average of 4 000 rural clinics nationally.
2) Each referral will require pharmaceutical service based on Level 1 costs.
3) Cost of P1 Ambulance at average value will be the same as in Mpumalanga/Witbank area at R8 000.
4) It is assumed that service utilisation will grow three-fold in five years (based on technology adaptation theories and experiences).

Table 3.9 Representation of combined situation for Mpumalanga and the Eastern Cape

	Eastern Cape	***Free State***	***Gauteng***	***KwaZulu-Natal***	***Mpumalanga***	***Northern Cape***	***Northern***	***North West***	***Western Cape***	***Total***	***New Total (mean values)***	***Projections on Impact of utilisation growth per annum (Year 5) x factor of 3***
Potential Revenue	72	103	181	254	37	12	53	48	304	1064	1876	3500
Actual Revenue (99/00)	29.5	32	77	98	12	6	23	11	62	350.5	1163	2786.5
Total value of services	3164	997	4873	4591	813	375	1529	1912	2210	20464	19652	18028
Revenue recovery rate	41%	31%	43%	39%	33%	55%	42%	22%	20%	33%	62%	79.61%
Cost recovery rate	2%	10%	4%	6%	5%	3%	3%	2%	14%	5%	10%	19%

Table 3.11: Revenue (R Millions): combined factor for rural & urban telemedicine applications

Figure 3.26: Revenue Recovery Rate

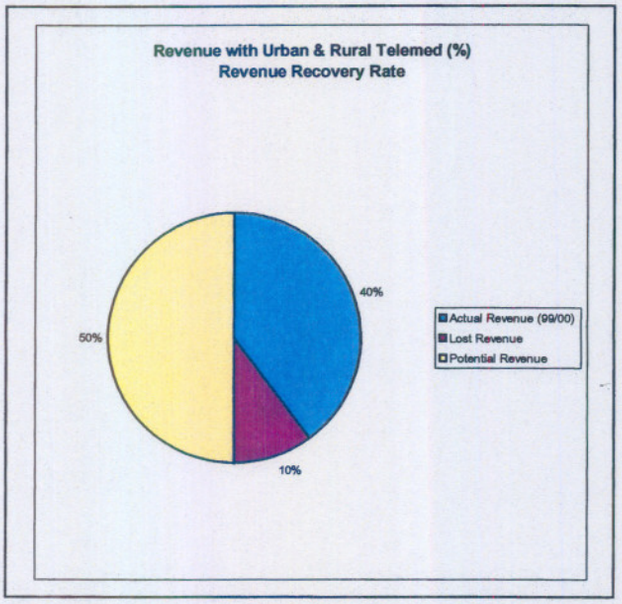


Figure 3.28: Revenue Recovery Rate (R Millions)

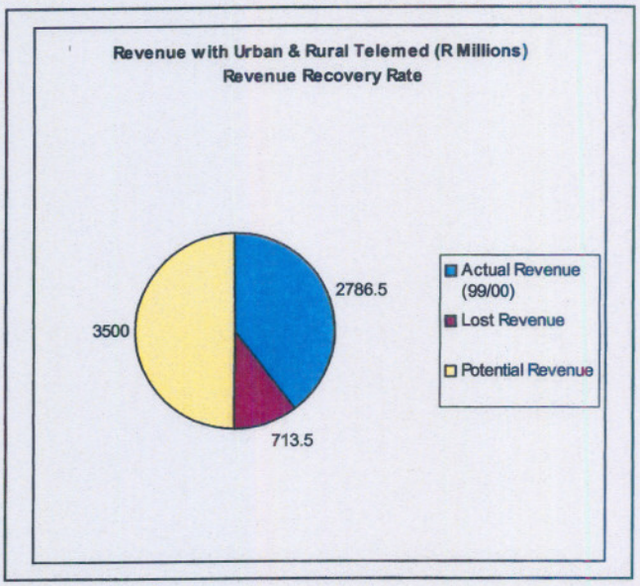


Figure 3.28: Cost Recovery Rate (R Millions)

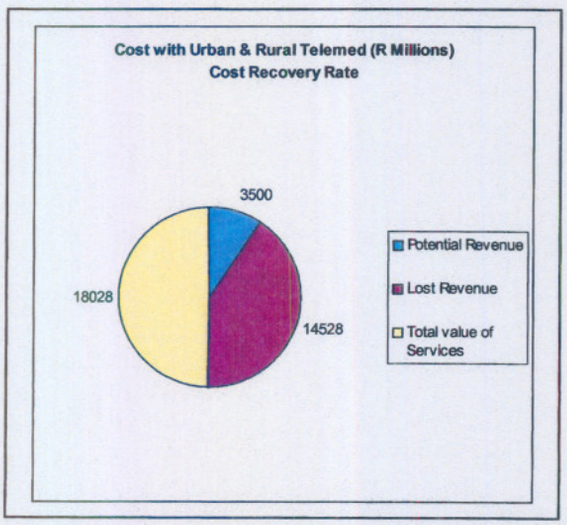


Figure 3.30: Cost Recovery Rate (%)

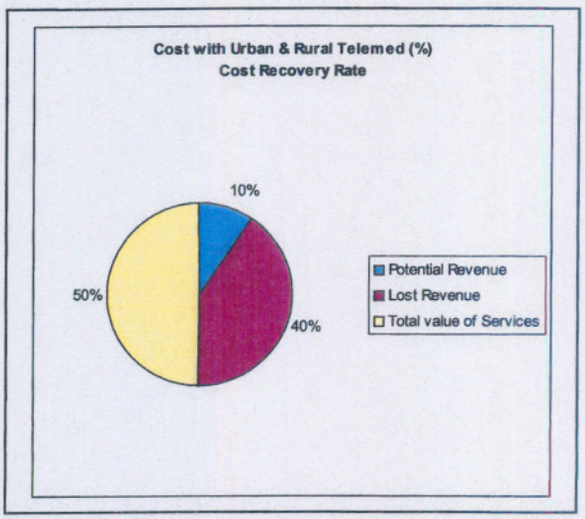


Table 3.10 Potential patient cost savings per day in the region (H1 Patient group) Telemedicine services

Telemed service	*Per day*	*No. of Clinics*	*Cost/patient*	*Per day*	*Per annum*
Teleconsultations potential (x 2 Admin)	5	780	R 20	R 78,000	R 936,000
Travelling costs	5	780	R 10	R 39,000	R 468,000
Patient & Emergency Transport (BLS 50km)	5	780	R 25	R 97,500	R 1,170,000
					R 2,574,000
				Total (costs 9 provinces)	***R 23,166,000***

Table 3.10: Case 1 Cost Savings Calculations (Rural telemedicine Applications)

Table 3.11 Potential patient cost savings per day in the region (H1/H2/H3) Patient group)

Telemed Services	*Per day*	*No. of Clinics*	*Cost/patient*	*Per day*	*Per annum*
Patient & Emergency Transport (P1)	40	780	R 8,000	R 249,600,000	R 2,995,200,000
Radiology Specialists referrals for Level 1	40	780	R 53	R 1,653,600	*R 87,640,800*
Pharmaceuticals	40	780	R 130	R 4,056,000	*R 527,280,000*
		Total (costs 9 provinces)			***R 788,767,200***

Table 3.11: Case 1 Cost Savings Calculations (Urban telemedicine Applications)

Calculations are applied using both key assumptions and raw data as illustrated in Tables 3.9 and 3.10. Table 3.11 illustrates the combined factor of both rural and urban telemedicine application. The projection on a five-year investment and application indicates that potential revenue will increase from R1.8bn to R3.5bn. Actual revenue will increase from R350M to R2.7bn, and the total value of service costs will drop from R20.4bn to R18bn. The revenue recovery will increase from 33% to 79% and cost recovery rate will increase from 5% to 19%.

3.11.5 POTENTIAL MARKETS AND SPIN-OFFS EXTRACTED FROM CASE STUDY MODEL

A pilot project highlighted the following potential spin-offs:

- Development of information and communication technologies (ICT) in rural and urban areas.
- Development and demonstration of technology innovation.
- Economic and social development of the rural and urban communities, with viable business opportunities for small micro medium enterprises (SMMEs).
- Development of human capacity in the rural areas.
- Development of innovative telemedicine products, such as e-health and pre-paid medical facilities.
- An opportunity for infrastructure sharing through public-private participation.
- Internet application for enabling business-to-consumer (B2C) and business-to-business (B2B) procurement for vendors in pharmaceutical industry.
- Health insurers have huge potential for cost savings by offering web sites to thousands of subscribers who look for information on physicians and file health insurance claims.

This research study seeks to construct a model for integrated community participation and lobbying with all stakeholders. The technology model requirements are low cost and highly reliable for initial investment. This also provides an opportunity for an application to enhance quality of life for rural communities, and sustainability through an integrated approach and sense of ownership is of utmost importance here.

3.12 MANAGEMENT OF INFORMATION THROUGH TELEMEDICINE APPLICATION

3.12.1 Risk Management of information

The application of ICT to education, health care, supply chain management, banking and news reporting, among others, has changed the way in which health care is delivered or news is consumed. It is important to signal that not all changes are positive and that the society at large has yet to make their first telephone call. However, according to Stavrou, (2002:18) ICT has provided new and enhanced opportunities for perpetrating crime. The application of ICT makes criminal activities in the physical world more effective and efficient.

For the purpose of the study, it is therefore important to analyse the implications of the management of information relevant to telemedicine. According to Stavrou, (2002:18) from a generic perspective, ICT allows certain activities to be performed to and with digital information. Information can be:

- stolen (e.g., plagiarised content, which is a copyright violation);
- destroyed (e.g., an identity can be destroyed);
- modified (e.g., website can be vandalised); and
- prevented from flowing (e.g., distributed denial of service attacks).

The dual potential for legitimate and illegitimate use of ICT is not new. It is similar to legitimate and illegitimate use of physical tools such as using hammer to hang a picture frame with the intent of improving one's living space, and using a hammer to wantonly destroy someone else's property, and thus it is important to focus on intent. The above discussion introduces a necessity to initiate an Information management strategy that should be able to support the strategic goals for intended telemedicine application. This must encompass the provision of knowledge and documentation management, collaboration, workflow, fast information retrieval and organisation via an integrated information portal. The information portal should be easily accessible by multiple users both within the public, private and medical fraternity and indirectly via the internet, with centralised management ensuring information security and integrity.

3.12.2 Problems with information security

Advances in technology are often ahead of the development of important supportive functions such as auditing and computer security that protect information from intentional losses. Sophisticated networks and use of the internet further contribute to this problem. There are basically three types of primary risks concerning information security, namely:

- The integrity of data, programmes and systems: Only authorised persons should be able to write, change, delete or modify data (Alexander, 1995:30).
- The confidentiality of data and systems: The protected entity (for example information, software, and equipment) should be accessible, read, viewed and printed by authorised people only (Alexander, 1995:30). The confidentiality goal often includes restrictions on the flow of information (Oliver, 1991:9).
- The availability of data and systems: The assets should be available to authorised people (Pritchard, 1979:13). An authorised person should not be prevented from accessing the data or objects to which he or she has legitimate access (Pfleeger, 1989:5-6; Van Zyl, 1990:2).

Louw (1990:76-77) pointed out that if these risks are not adequately controlled, it might cause a variety of secondary risks, namely business interruption, loss of or damage to assets and information; erroneous management decisions; excessive expenditure; erroneous record keeping; unacceptable accounting; loss of employee morale; loss of customer confidence fraud and embezzlement or commercial espionage. Any of these risks may culminate in a measurable cost to the company, thereby directly affecting its competitive position and profits.

The major risk areas may also be classified as:

- Hardware risks: The portability of computer equipment (for example memory, modems), accessories (for example removable disks) makes it an attractive target for office thieves (Wong & Watts, 1990:327).
- Software risks: Many systems only have a limited password system, while the password table is held in clear text (Wong & Watts, 1990:327).

- Network risks: The host usually does not recognise any local intelligence of a workman's station. Once the data is downloaded, the host security system cannot impose restrictions on a subsequent copying, printing, interrogation or modification of the data, or its forwarding to another workstation on the network (Wong & Watts,1990:327).
- User related risks: Usually the office personal computer user does not appreciate the need for security, and therefore does not practice routine backup and control procedures. Common English and Afrikaans words are generally used as user passwords, passwords are seldom or never changed and computers are left unattended after log-on. Removable disks are interchanged between work and home, which aggravate the virus problem (Wong & Watts, 1990:90).

3.12.3 Telemedicine Management information system

Guiding principles identify the behaviours that an organisation will adopt to achieve the above objectives. The following six principles should serve as a basis for guidelines for telemedicine (MIS) (O'Brien, 2002:334):

- Create data once, as close to the source as possible, and use it many times.
- Take a "corporate" approach to the creation, management, dissemination and use of data and information.
- Adhere to the approved Standards for Information Management.
- Share data and information freely among stakeholders.
- Make telemedicine data discoverable and ensure metadata is managed in a sustainable way.
- Maximise the use of partnerships to build collaborative working relationships and optimise the use of collective resources.

In developing a set of principles specific to the telemedicine portal, the following should be adapted and enhanced from various data infrastructure guiding principles (O'Brien, 2002:337-347). These are listed in priority sequence:

Open: The telemedicine portal will be based on open and shared specifications for operational transactions and information exchange. *Open and shared* in this context means that the specifications are available for the world to take, to use, and to modify for other purposes. These specifications will be based on national and international standards where available.

Co-operative: The telemedicine portal will facilitate the co-operation and interoperability of participating groups while respecting the specific mandate of each group. The portal should be based on common technologies and standards

Self-sustaining: The telemedicine portal will ensure its long-term sustainability through its relevance to the needs of the participating users. The establishment of a sustainable infrastructure is critical to fostering telemedicine application integration with the portal and supporting the associated dependencies upon the portal.

Evolving: The network of participating organisations will continue to encompass new requirements and business applications for information and service delivery to their respective users. The telemedicine portal will evolve to meet these changing requirements while remaining open to new models of delivering services.

Best Available Data: The telemedicine portal will provide data and services based on the best available data, in particular the most current data available. Provision of more timely or accurate data than currently available, or the definition of minimum levels of service that must be met by participants in order to offer a service to the infrastructure, will be negotiated between participants as part of the implementation programme.

Transparent: The telemedicine portal will allow users to access data and services seamlessly in a manner that removes the complexities of the underlying technology and information infrastructure. By *seamless* is meant the elimination or hiding of artificial boundaries introduced by organisation structure or by technical considerations such as scale or quality of information.

Self-organising: The telemedicine portal will enable various levels of participating organisations to contribute information, metadata, services and applications without the requirement for centralised administration, access, and warehousing. Management and administration of data will remain as close to source as possible.

Balanced Data Access: The telemedicine portal, as a powerful means of integrating a wide range of data holdings, must balance freedom of information with the protection of privacy for users within existing legislation and policy.

3.12.4 Portals and Security

Portals aggregate services from multiple providers and place them into organised presentations that are appropriate to their customers' workflow. The providers use multiple systems, which all have different hardware, different operating systems, and different application paradigms for managing security (O'Brien, 2002:334):

- **Single-Sign-On** – Single-sign-on technologies are critical to portals. In short, a portal may need to co-ordinate information from several web sites, data stores, XML Feeds, and other transactional systems. All of these have different security paradigms that single-sign-on solutions will address. Single-Sign-On (SSO) technology alleviates this. Examples of vendors in this arena are Netegrity, Oblix, IBM, and Entrust.
- **Delegated Management** – an evolution of single-sign-on technologies. Where SSO attempts to facilitate activity, delegated management systems attempt to act as a single point for managing all application and operating system level security issues. Delegate management systems will eventually replace single-sign-on systems as they mature. Examples of vendors in this arena are Netegrity and IBM.
- **Firewalls** – Firewalls are computers that run software that analyses and filters network packets and make security decisions based upon this.
- **Intrusion Detection** – Intrusion detection software also analyses patterns of activity within a network to determine if it is under "attack".
- **Cryptography** – The science of cryptography provides for a mathematically rigorous means of authentication, encryption, and non-repudiation. Highly secure portals all implement cryptography for all of these capabilities.
- **Access controls** – Access control systems enforce rules upon lists of identity to determine whether an identity which is part of a role or a group, may have an appropriate level of access to perform an operation against a resource. The science of computer security is a combination of access control and cryptographic technologies. All portals use access controls.
- **Authentication** – Authentication has both a cryptographic form and an access control form. Cryptographic forms of authentication use a certificate-based schema for ensuring identity. Access control forms are simpler; they generally use credentials such as user-id/password.

- **Non-Repudiation** – The act of proving that the data has not been tampered with is called non-repudiation. The science of cryptography provides an elegant and efficient means of non-repudiation through the use of public key technologies and cryptographic hash functions. Financial portals and health care portals will benefit most from this technology.
- **Authorisation** – This is essentially an access control function. Essentially, a portal will maintain an authorisation list, (also known as an access control list,) to determine the appropriate level of access that each identity will have to a resource. Such a system will determine if a user is authorised to act upon that resource.
- **Policy** – Prior to implementing a security paradigm, a security policy needs to be established for any organisation. This security policy outlines the organisational needs for security and the organisational procedures for meeting these organisational needs. Such a policy is used to define access control and certificate policies.
- **Certificates** – Digital certificates are part of the X.509 standard. They are public documents, based upon Public Key Infrastructures that provide security services such as authentication, encryption, and non-repudiation. Portals can use these to secure transaction and provide non-repudiations. From a technical standpoint, a digital certificate contains identity information, at least one public key from a Certificate Authority, and a public key representing the identity in questions.
- **Groups** – Groups are organised collections of identities. They are configured by administrative personnel and maintained on a day-to-day basis. Portals always need to manage groups as an economic convenience to manage the privacy, integrity, and appropriate accessibility of the data.
- **Roles** – Roles are organised collections of capabilities. The collections of capabilities tend to be maintained by developers. Roles may have groups and/or users as members who have access to the capabilities defined by the developers. The memberships of the roles tend to be maintained by administrators.
- **LDAP** – The Lightweight Directory Access Protocol is a common directory structure accepted through most of the industry. Portals use these to maintain user information, organisational information and access control and cryptographic certificate information.
- **Certificate Authorities** – Certificate authorities are arbitrators of proofs of digital identity, although they tend not to stand liable for their work. Due to this, and the

broadly based Digital Signatures Act, they have not been widely adopted. Certificate authorities can generate certificates. While there are public CAs, such as Valicert and Verisign, companies are generating their own certificates. CAs are useful to portals which provide high-value trade services or health care services, however, as they provide a third party mechanism for validating identity. Smaller portal applications may generate their own certificates. The Digital Signature Act allows for self-certification. These self-certified certificates are legally valid for transactions.

- **Validation Authorities** – The X.509 standard is vague, and not all certificates generated from all vendors are alike. In addition, when company's exchange certificates prior to performing e-business, the "source" company generating the certificate would be in control of the certificate maintenance. In other words, if a source user "goes bad", the source user's company would need to revoke the certificate. A validation authority allows a destination company to perform a "local certificate revocation" operation, thus alleviating the need for strong organisation communication between two companies performing cryptographically certified transactions. In addition, VAs have real-time validation capabilities, making them suited for extremely high-end, highly secure environments. Validation authorities will be highly useful to portals that wish to provide cryptographic protections to their customers, yet maintain the highest levels of both interoperability and control over their certificates.
- **Public Key Infrastructure** – Public key cryptography provides elegant implementations of encryption, non-repudiation and authentication that require a minimum of key management activity. This makes public key infrastructures more efficient to manage than traditional symmetric key infrastructures. Portals which need cryptographic security will use PKIs.
- **Secure Sockets Layer** – a standard for securing transactions through the use of public key cryptography and X.509. It specifically provides for authentication (two-way) and encryption of information sent over a TCP/IP socket. Portals that require financial or health care transactions will all use SSL.
- **Secure Access Mark-up Language** – Inspired by Netegrity, this language has been developed to facilitate a delegated management strategy. It contains non-reputable transactions for managing access controls. It is expected that software vendors will embrace SAML to facilitate their own SSO (soon to be known as Delegate

Management) strategies. Portals will reduce their costs in the mid-term by adopting SAML, as their integration with other security paradigms will be simpler.

- **Digital Signatures** – Digital Signatures exploit the non-repudiation capabilities of PKIs to provide a cryptographic means of ensuring that data has maintained its integrity.

If various information security threats and information management system guidelines, as discussed above, are not implemented for telemedicine applications, it can lead to variety of information loss and security problems such as i.e. theft or worse put patient records on public domain or illegal /unlicensed data networks etc.

3.13 CONCLUSION

In any initiative involving the use of technology for the development purposes, there is always a delicate balance that has to be maintained between "technology push" actions (actions at realising the promise of technology), and actions aimed at meeting the "pull" of the potential users' needs. Specific user development needs have to be ascertained first in order to know where the technology might be most effectively. This is the reason for one of the first actions that was undertaken in the pilot projects conducted in the demarcated areas in the case studies for intended production of both technology and business models. This was intended to meet with all representatives of the communities in order to find out what the local development needs were, and to explain how ICTs could best be used to meet these needs. In exception of the initial intentions of the pilot project more specific needs were identified and these are discussed in this chapter as potential markets and spin-offs. These included the use of ICT in local community for educational, health, and agricultural purposes. In this case the major economic spin-offs were the development of guesthouses for tourism, as this would stimulate local rural economy and ownership in the community, and ultimately the returns would be realised.

The technology models discussed in the previous section were used as guidelines to deploying telemedicine technology model especially at pilot project phase. In this case the wireless technology has proven to be robust and effective in providing the connectivity between the rural clinic and community hospital. This technology allows for routing and can be designed in a point to point or point to multi point configuration. This

is important when trying to link up clusters of clinics that do not have line of sight, as this is prevalent with rural areas at large. Technology transfer has been successful and a community business established for provision of first line maintenance for the network. This business is run by two community members who will be contracted by the Department of Health. The clinic sister has been trained to use the telemedicine equipment for remote and referral site usage. These will encompass an element of sustainability of the telemedicine services in the area.

The use of innovative ICTs can significantly enhance community health care and create access to the information society. Wireless technology can provide connectivity to rural communities at low capital costs and zero operating costs, albeit on an intranet basis.

The business models discussed covered the USAL and institutional telemedicine approach to complement one another in achieving economies of scale and shared upfront capital costs for rural ICTs. This would stimulate or enhance the participation or lobbying of private public partnerships for rural infrastructure development. This partnership as demonstrated in the pilot project would include parastatals such as Eskom, Transtel, Telkom and private sectors such as Internet service providers, equipment suppliers. The calculations as demonstrated for both models are projected to produce sustainable returns on the investment of the telemedicine and rural ICTs.

This chapter concluded with a discussion of an important factor for the adoption of telemedicine services from a human point of view, namely the management of information for telemedicine services. Key guidelines and important security parameters are provided in this last section of the chapter. These guidelines cover and emphasise the securing of information and portal applications for receiving, transmitting, and maintaining data in the internet (World Wide Web) environment for telemedicine applications.

This chapter also highlighted possible spin-offs from implementing telemedicine. These spin-offs can improve the health care and lifestyles of the South African rural population at large. The development of human capital in rural and urban areas will be leveraged, thus improving the economic conditions of these areas.

CHAPTER 4
EMPIRICAL RESEARCH

4.1 INTRODUCTION

The empirical research on the involvement of parastatal institutions in the South African National telemedicine implementation programme was done by means of a field study using a structured questionnaire as the main component. The aim of the field study was to determine the state of the telemedicine implementation programme in South Africa, thus highlighting progression or regression with related characteristics and variables.

The objective of this chapter is to set out the background to the design of the questionnaires, as well as the processing of the data and the results of the field study. Because of the importance of the questionnaire to gather information for the empirical study, specific attention will be paid to the development procedure, structuring and distribution of the questionnaire.

This chapter begins with a discussion of the development of the questionnaire for measuring the current state of the telemedicine implementation programme with and without the involvement of parastatals in South Africa. The chapter includes significant literature to enforce the method of this empirical research, as well as literature on the statistical review method used to analyse the data that will be presented following the completion of the questionnaire.

After the development of the questionnaire it was administered to key stakeholders in the telemedicine implementation programme to determine their perceptions and evaluation of the state of the telemedicine implementation programme with and without the involvement of parastatals in South Africa.

The second part of this chapter will be devoted to analysing the information gathered and the results.

4.1.1 OBJECTIVES

The first aspect that needed clarification before the designing the questionnaire were the objectives of the research. It was necessary to distinguish objectives of the research and the objective of the questionnaire. The main objective of the research, as indicated in chapter 1, is to develop a formula that can demonstrate the value which parastatals can add through their participation in the national telemedicine implementation programme. To realise this primary objective, certain specific goals or secondary objectives were identified in chapter 1 of this research study, which included conducting the analysis and assessing the impact of improved efficiency and cost effectiveness in the delivery of rural health care services using telemedicine. The objective of the questionnaire was to collect information regarding the state of the telemedicine implementation programme with or without the involvement of parastatals.

The purpose of determining the state of telemedicine implementation programme with or without the involvement of parastatals is to identify the impediments and gaps in the telemedicine implementation programme, so as to eventually demonstrate the value that parastatals can add to the implementation programme. Through the literature review it became evident from both local and international research that telemedicine can be used for delivery of primary health care services for rural communities, although the economic cost of this has not been quantified and qualified. Thus, a tangible business model for attracting and winning the involvement of the business sector is yet to be identified. The empirical study will focus on the following:

- Identify the obstacles encountered in achieving successful implementation and the benefits of implementing a telemedicine project successfully. In this case questions about the sustainability of telemedicine will be addressed to provide a commercial rationale for participation in telemedicine implementation.
- Develop a formula that can demonstrate the value which parastatals can add to the process by participating in the implementation of the telemedicine programme.
- Analyse and assess the impact of the delivery of education and other social services to rural communities.
- Recommend the best technology practises in implementing the telemedicine system.

4.2 COLLECTION OF RAW DATA FOR THE DEVELOPMENT OF THE EVALUATION MODEL

The empirical study can be approached as an exercise or project which entails the following considerations (Wood, 2001:3):

- A choice between studying the existing situation, and conducting an experiment or a "quasi-experiment". This implies changing something and seeing what effect it has. Experiments and quasi-experiments are particularly useful for gathering support recommendations.
- The type or sort of examples to be taken by the researcher: this may be a large sample or study of a single case.
- Whether the researcher intends to use a standard theory of framework, and if so determination of such a framework. In either case, theories are important.
- How the researcher intends to collect or gather an empirical study. The possibilities include, among others, a written questionnaire, interview, observation, participant observation, document and data archive analysis and the internet.

4.2.1 Selection Method

The intended research study approach was primarily based on the collection of the most updated data. This includes a survey of the existing scenario using a questionnaire to collect the necessary data in order to draw certain conclusions about the state of the telemedicine implementation programme in South Africa.

The word *survey* is composed of two elements that indicate precisely what happens in the survey process (Leedy, 1985:141). *Sur-* is derivative of the Latin *super* meaning "above", "over" or "beyond"; the element *vey* comes from Latin verb *vide re,* meaning "to look" or "to see". Thus the word *survey* means "to look or to see over or beyond" the casual glance or the superficial observation.

The are two types of survey research methods. The descriptive survey method, or what is sometimes called the normative survey method, is employed to process the discrete

data that come to the researcher through observation (Leedy, 1985:140). The data used in this method is verbal because the means to elicit the data is verbally orientated in the form of questionnaires, interviews, written records descriptive observational reports. The second type of survey method, known as analytical survey method, involves observing the discrete data using an entirely different approach that leads towards the discovery of the conclusion (Leedy, 1985:173). It uses a different language: the language not of words but numerals. The grammar of that language is the syntax of mathematical operations. The data of descriptive surveys or studies can be thought of as qualitative data and data of analytical survey or studies as quantitative data. For the purpose of this research both qualitative and quantitative survey methods will be used to draw a substantiated conclusion.

When reduced to its basic elements, a survey study becomes essentially a simple design method. It is a common approach used with more or less sophistication in many areas of human activity. It should not be suggested that because of its frequent use the survey is any less demanding in its design requirement or any easier for the researcher to conduct than any other research method. In fact, the survey design makes certain specific and critical demands upon the researcher that, if not carefully respected, may place the entire research effort in jeopardy.

The survey makes use of a questionnaire as one of the techniques to draw information or data. Data sometimes lies buried deep within the minds or within the attitudes, feelings, or reactions of men and women. The first problem is to device a tool to probe below the surface. The questionnaire is a common-place instrument for observing data beyond the physical reach of the observer. The questionnaire may be sent to people thousands of kilometres away, whom the researcher may never see. Because the questionnaire is an impersonal probe, the researcher needs to be governed by several practical guidelines when employing it as a tool in survey research (Leedy, 1985:142). The following guidelines were used to ensure that the objective and intended the results are matched and achieved:

- The language must be unambiguous – each question must be analysed to ensure that the assumptions correspond with the realities of life.

- The questionnaire should be designed to fulfil a specific research objective – a questionnaire should be courteous, brief and consistent, and it should take the other person into consideration and concentrate on the universal issues.
- Questionnaires succeed as their success is planned – the letter to be sent to the population or sample must be well structured and focused; the letter should be courteous, request co-operation and state the importance of the questionnaire to study; and the contents of the letter should clearly express concern for those who receive it.

The structured interview is closely related to the questionnaire. The questions in the interview should be carefully planned and as accurately worded as the items in the questionnaire. For the purpose of this research, interviews were considered as professional situations that demand equally professional planning and conduct on the part of the interviewer. The following guidelines were used for obtaining focused and objective results or conclusions:

- Interviews were set up well in advance.
- The agenda of questions were forwarded to the interviewee prior to the interview session.
- Permission to tape the interview session was obtained from the interviewee.
- The date of the interview was confirmed in writing.
- The reminder, together with another agenda of questions, was sent to the interviewee ten days before the interviewer's arrival.
- The interviewer was prompt, followed the agenda and presented a copy of the questions to the interviewee in case the interviewee had mislaid his or her copy.
- After the interview a typescript of the interview was submitted and a written acknowledgement of the accuracy of the interview's script was verified with the interviewee.
- The material incorporated in the final research document was sent to the interviewee for final approval and written permission for using the data in the final research report.

Three main types of questions may be included in a questionnaire (Neuman, 1997:237):

- Closed questions asking for a category ("In which province do you operate – tick the appropriate box").
- Closed questions asking for a number ("What is your annual primary health care expenditure?" or questions asking respondents to rate their agreement with series of statements).
- Open-ended questions. ("Rate your relationship with your service provider based on the improvement in customer service"). These may be coded for analysis (in which case it may be better to use closed question in the first place) or simply read and used for quotations and as a means of coming to understand the respondent.

With closed questions in particular the researcher must make provision for respondents who do not know the answer. One does not want to force respondents to make up an answer.

Wood (2001:14) identifies the following common problems with questionnaires:

- Low response rate.
- Too much information to analyse.
- Inconclusive answers.
- The researcher will only find what people want to (and can) tell.

Cummings (1999:116) points out the following three shortcomings of the questionnaire:

- Responses are limited to the questions asked in the instrument and thus provide little opportunity to probe for additional data or to ask for points of clarification.
- Questionnaires tend to be impersonal, and respondents may not be willing to provide honest answers.
- Questionnaires often elicit response biases, such as the tendency to answer questions in a socially acceptable manner and thus make it difficult to draw valid conclusions.

When a questionnaire was developed for this research, all the above considerations were taken into account.

4.2.2 Identification and Selection of Possible Input variables

An extensive literature study was conducted so that the researcher could familiarise himself with the concept, current situation, issues and problems regarding the implementation of telemedicine programme in South Africa with involvement of parastatals. The most important aspects of the topic understudy were used to design the questionnaire. The aspects were translated into questions to correspond with the aim of the study.

These aspects were used for formulating the input variables of the questionnaire that would be used during the field study. Data collected through the questioning technique can be classified as either variables or attributes. Variables are those characteristics which are measurable, such as amount or costs spent on primary health care per capita in rural areas per annum or the use of a specific service, while attributes are characterised by either a conformance or non-conformance to specifications (Wisniewski, 2002:15).

It is important that the input variables identified relate to the objectives of the study which has been proposed. With the objectives of this study in mind, as formulated in chapter 1, the input variables were selected based on two criteria:

- Input variables used by the other studies in America, Australia and Africa at large.
- A selection of criteria that will address the objectives posed in chapter one of this dissertation.

The intention of using input variables from past studies is to conduct a benchmark of how South African perceptions compare with those of America, Australia and Africa at large. In the case of variables which are more specific to South Africa, the second set of variables was selected to match the objectives of this study.

4.2.3 Determination of Population and Size

A theory of statistical techniques need to be developed before a statistical analysis may be conducted of the results of a questionnaire. This section details those techniques used for this research.

4.2.3.1 Definition of Data

Statistics deals with numerical data, as one kind of data (Hilderbrand, 2001:1). Another example of data is anecdotal data, which involves specific results that happen in particular situations and can also be used to point out problems or a need for change.

A full description of data requires answers to two questions: How are the quantities defined, and how are the measured entity chosen? Some variables, such as acidity, have well defined measured scales, such as Ph, while other variables are not clearly defined. Customer satisfaction with repair work done under warranty by a car dealer, for instance, might be measured by customer answers to a questionnaire, the percentage of a second attempts at repair, or the number of complaints received by the manufacturer.

Understanding data well requires knowledge of the operational definition of the variables. An operational definition specifies just how a variable is measured or counted. Understanding the operational definition of a variable can help one understand the uses and limitations of the data. This requires information about the entities that were actually measured (Hilderbrand, 2001:1). For example, were the participants in a taste test of two brands of a cola beverage selected from people who were in the act of purchasing brand A, or were they chosen on a more neutral basis? Asking how individual measurements were obtained can sometimes uncover loaded data, which was designed for propaganda, not information. This highlights the important point that data collected in obviously biased ways should be discounted, although that does not mean that data collected honestly but imperfectly should be ignored.

In summary, data is numerical results of measurements on specified variables. To begin to understand data, it is necessary to know the operational definitions of how the

measurements or counts were made and how the entities in the data gathering process were selected.

4.2.3.2 Definition of Statistics

A process that provides methods for collecting, presenting, analysing and meaningfully interpreting data is known as statistics et al. (Srivastava 1994:3). Thus, statistical methodology in the collection, analysis and interpretation of data for better decision making is a sine qua non for decision making and research in different fields, such as physical and social sciences, and particularly in business and social sciences. For the purpose of this study, however, it is essential to use other definitions of statistics. According to Wisniewski (2002:91) and Besterfield (1979:11), statistics has two generally accepted meanings:

- A collection of quantitative data pertaining to any subject or group, especially when the data is systematically gathered and collated.
- The science that deals with the collection, tabulation, analysis, interpretation, and presentation of quantitative data.

Wisnieswski (2002:91) and Besterfield (1979:11) argue that statistics has two phases:

- Descriptive or deductive statistics, which endeavours to describe and analyse a subject or group, to determine some measure of an average and some measure of variability around average.
- Inductive statistics, which endeavours to determine from a limited amount of data (sample) an important conclusion about a much larger amount of data (universe or population).

Wisnieswski (1997:92) identifies two measures of average:

- The arithmetic mean, which is the sum of the total values divided by number of values measured.
- The median, which is the middle value from the total values recorded.

The measure variability used in this study is that of standard deviation. Its intent is to demonstrate the measure of variability around average value (Wisniewski, 1997:96).

In designing the sample of data to be used the researcher selected from the general population a sample population that was both logically and statistically defensible; this included analysing the integral characteristics of the total population type.

Due to the nature of and limited period available for this research, inductive statistics was used to develop a solution to the problems identified in chapter 1. The size of the population usually makes it impractical and uneconomical to involve all members of the population in a research project (Welman & Kruger, 1999: 47). Therefore a sample was taken from the population, which was assumed to be representative of the entire population.

Wisniewski (2002:100) describes the population as the entire set of data that is of interest to the researcher; it is that representative part of the population that can economically and practically be used to reflect a meaningful result for the entire population.

4.2.3.3 Members of the sample

Due to the limited establishment and underdeveloped life cycle of telemedicine in South Africa, a sample of key stakeholders who are known to have an interest in and participate in telemedicine application was identified as appropriate for this descriptive research. The sample included role players from all sectors of SA health care industry. The population included four persons representing the telemedicine task team of the Department of Health and the Medical Research Council; three persons from the South African Committee for Essential Community Services hosted within Eskom; two persons from Transtel (Private Telecommunications Operator); two persons from Eskom Telecommunications (Private Telecommunications Operator); three from the private health care sector; four from local equipment suppliers; one from mobile communication operators; one from the non-government organisation CSIR; seven consumers/patients who have experience of telemedicine; seven health care providers and one from Telkom (public fixed line operator).

As the purpose of this study is to determine the solution to the barriers to final implementation of telemedicine in SA, and most importantly the economic sustainability of telemedicine, especially in rural areas, a number of research institutions were consulted to provide an overview of communication technology market in South Africa and SADC countries.

4.3 DEVELOPMENT AND COMPILATION OF RESEARCH QUESTIONNAIRE

It is of critical importance that the questions developed in the questionnaire must be related to the aspects under investigation and the objectives of the study as a whole. According to (Riley et al., 2000:90) questions represent the facets of an empirical domain that the researcher most wants to explore, and these questions may be general or particular, descriptive or explanatory. The questionnaires were therefore developed by a process which included the following steps:

4.3.1 Literature Study

A literature study was conducted in chapter 2 and 3 (also see the attached Annexures C and D) to become familiar with the concept, current situation, issues and problematic factors regarding the implementation of telemedicine. The most important aspects of the telemedicine that were identified in the literature study were used to design the questionnaire. These aspects were translated into questions to correspond with the aim of the study.

4.3.2 Pilot Study

The approach used to derive the questionnaire included identifying a need for a pilot study. Personal interviews were held with various telemedicine stakeholders, including primary health care providers and consumers, in order to determine the problems and issues regarding the telemedicine industry at large.

Based on the theory of chapter 2 and 3 and the attached Annexures C and D and the unique circumstances of the telemedicine implementation in SA, preliminary

questionnaires were formulated and tested with key members of the telemedicine task team to get clarity on concepts and questions (Leedy, 1989:143). The testing was done by means of a pilot study with two telemedicine project leaders (Medical Research Centre), and by submitting the questionnaires to the Chief Medical Doctor for telemedicine projects responsible for Universal Service Agency in South Africa. Recommendations were added and various improvements were made.

To ensure that questionnaires were practically feasible, the following guidelines, as stipulated by Leedy (1989:143-145), were followed when the questionnaires were designed:

- Questions were formulated in words and concepts with which the respondents were familiar (also see Daellenbach (1999:102)). One of the main objectives of the pilot study was to ensure clarity of terminology.
- Questions were simplified and changes were made so that the questionnaire as a measuring instrument could be as simple to read and to respond to as possible.
- Leading and loaded questions were avoided.
- Consistency was accounted for, and for questions on debatable or opinion-sensitive issues, a countercheck question was incorporated later in the questionnaire. This helps to verify the consistency with which the questionnaire was answered.
- The respondent was taken into consideration, and cognisance was taken of human behaviour factors, such as the impression created by the questionnaire and the way in which a stranger would respond to it. Care was taken to ensure that the tone was courteous and that the demands were reasonable.
- Open-ended questions were limited because it requires a higher level of education on the part of the respondents and respondents are often unwilling to exert the special effort required by open-ended questions. The possibility of obtaining inappropriate responses is also much greater with open-ended questions. Thus open-ended questions were only used where there were too many possible responses and to determine whether any important aspect of telemedicine had been omitted.
- Reduplication of questions were avoided.
- The respondents' literacy level and field experience were taken into account and indigenous languages were catered for, especially when patients were interviewed.

- Leading and loaded questions were avoided.
- Questions were kept as simple and unambiguous as possible to ensure accurate responses.

4.3.3 Refined Questionnaires

After a pilot study, the preliminary questionnaires were refined to eliminate the obscurities and possible problems, as well as to suit the specific situation and circumstances of telemedicine implementation in South Africa. Mostly semantic changes were made to suit the specificity of the health care provider and health care consumer.

The refined questions were again submitted to the two telemedicine project leaders (Medical Research Centre), and to the Chief Medical Doctor for telemedicine projects responsible for the Universal Service Agency in South Africa. It is important to emphasise that for academic compliance the study leader conducted a final screening of the questionnaire, where small adjustments were made to the questionnaire.

4.3.4 Final Questionnaires

The final questionnaires were then designed and furnished to all key stakeholders of telemedicine according to the list of people identified in Appendix 9.The final questionnaires are attached in Annexures C and D.

4.3.5 The Structure of the Questionnaire

Two different questionnaires, each consisting of different sections, were used:

- A general questionnaire for all stakeholders of telemedicine, which encompass the primary health care providers, including suppliers of equipment and infrastructure for both public and private sectors.
- A questionnaire specific to primary health care consumers, such as patients at both clinics and hospitals for both private and public institutions.

Each section was introduced by a heading to simplify the completion of the questionnaire (see attached Annexures C and D).

4.3.5.1 Section A

The nine questions in this section were aimed at obtaining biographical data of respondents and thus included questions concerning the demographic and personal particulars of users (see attached Annexures C and D).

Due to the nature and status of telemedicine implementation in SA, it was essential to identify respondents, and only in exceptional instances this was not required. The relevance of applicable data was aimed at compiling profiles of the various respondents in order to interpret the rest of the obtained data in context.

The questionnaire meant for the primary health consumers was slightly amended to suit the applicability and reduce the sensitivity of identification for encouraging the respondent to participate and provide honest responses.

4.3.5.2 Section B

Section B is aimed at obtaining general information on telemedicine, depicting the current status of telemedicine implementation in South Africa. This consists of thirty-five statements primarily measuring the awareness of the telemedicine implementation programme and the knowledge of telemedicine from users and providers. (see attached Annexures C and D).

4.3.5.3 Section C

Section C also measures the knowledge of the both users and providers of primary health care services. It consists of ten statements, which specifically measure the perceived obstacles/barriers to the implementation of telemedicine in South Africa, in contrast to the international experiences. The section also extracts or measures any unique barriers applicable to South African scenario (see attached Annexures C and D).

4.3.5.4 Section D

The section was aimed at identifying critical success factors to the implementation of telemedicine in South Africa in contrast to international experiences. The section has six open-ended and twenty close-ended questions for health care providers. For primary health care consumers only close-ended questions were posed in this section, because different levels of knowledge and literacy were expected from the two different types of respondents. The section seeked to measure the telemedicine applications from a human behaviour point of view, key attributes of telemedicine applications or service and a social and business approach for the implementation of telemedicine (see attached Annexures C AND D).

4.3.5.5 Section E

The section covers six key issues pertaining to the security of information for telemedicine implementation and utilisation. The diagnosis seeks to obtain a level of security awareness on information and the sensitivity of sharing, divulging, intercepting and losing the information when utilising telemedicine services (see attached Annexures C and D).

4.3.5.6 Section F

The section focuses on the most relevant key economic issues considered for the implementation and sustainability of telemedicine in South Africa. The sections consists of twenty six questions expanding on economic factors which are specific to producing a

suitable model for the implementation of telemedicine in South Africa. This model will seek to provide inputs or factors necessary for striking a balance between the social and economic needs for a sustainable telemedicine implementation (see attached Annexures C and D).

4.3.5.7 Section G

This section deals with an analysis of ethical, political, legal and social issues which may be perceived to be crucial to the implementation of telemedicine in South Africa. The respondents were asked to rate these aspects, and thereby to indicate the importance of issues that should be considered (see attached Annexures C and D).

4.3.5.8 Section H

This section focuses on key factors to be measured for the management of information or data when utilising telemedicine for primary health care. The results obtained from the respondents would then be used to assess the importance of issues to be considered for the management of telemedicine in South Africa (see attached Annexures C and D).

4.4 DISTRIBUTION OF QUESTIONNAIRES

A list of all active, all-active and non-active key stakeholders of telemedicine was compiled based on the information obtained from literature research. To conduct a more realistic diagnosis or research the questionnaires were divided into two main target audiences, namely primary health care consumers and providers. Because the response rate to questionnaires is often below 50% (Huysamen, 1994:148-150), it was decided to personally deliver the questionnaire to respondents to ensure the maximum response. A low response rate restricts the usefulness of a survey because it is uncertain to which extent a biased and consequently unrepresentative sample has been obtained (Huysamen, 1994: 148-150). The personal delivery of questionnaires also eliminates the possibility that someone who did not form part of the targeted audience answered the questionnaire. However, due to the limitations of time and the distance required to reach the targeted audience, it was necessary to also use tools such as e-mail and fax to distribute the questionnaire.

To further increase the response rate and to limit error and bias (Berenson & Levine, 1996:43) all questionnaires were followed up by telephone before the return date. After the return date questionnaires were personally collected (Huysamen, 1994: 148-150).

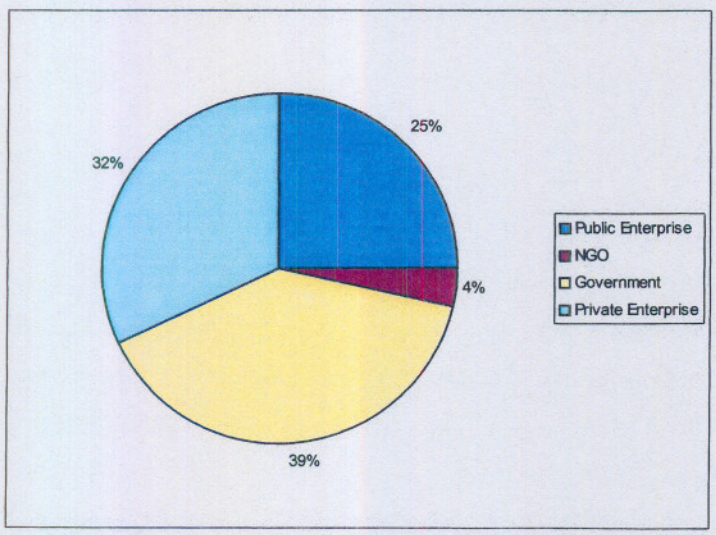
4.4.1 RESPONSE

Out of a total of 35 questionnaires distributed, 28 questionnaires were received back, which gives a total response rate of 80%. The response rate for the targeted audience per group is presented below in table 4.1.

Table 4.1: Response rate

Industry Sector	*Number of respondents*	*Percentage of Total respondents*
Public Enterprise	7	25.00%
NGO	1	3.57%
Government	11	39.29%
Private Enterprise	9	32.14%
Total	***28***	***100.00%***

Figure 4.1 Respondents according to targeted audience



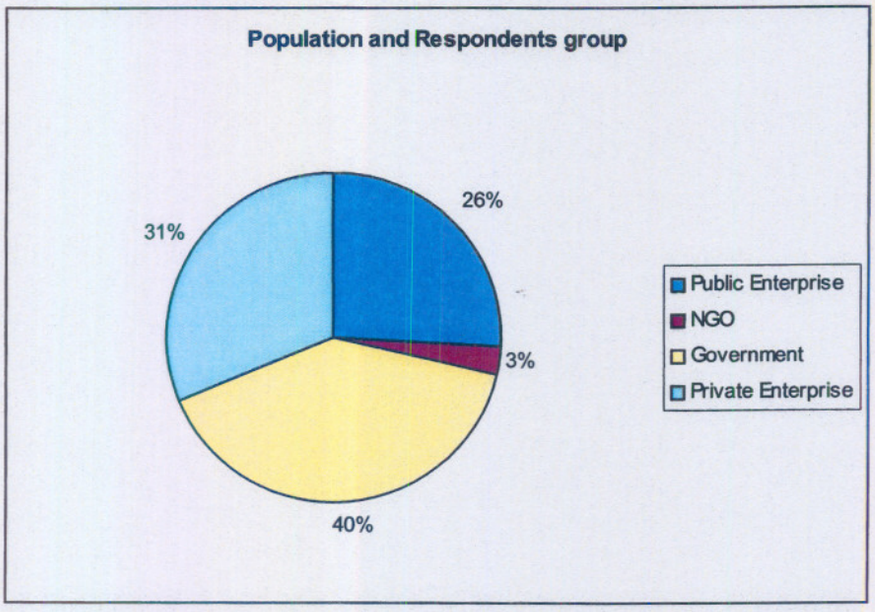
From Table 4.1 and Figure 4.1, it is evident that the most response was from the government sector at (39.3%), which could be ascribed to the fact that telemedicine is driven by the government, as the key custodian for primary health care services. The next highest number of responses was obtained from the private and public enterprises, at (32%) and (25%) respectively. Only one non-government organisation was targeted and a 100% response rate was achieved. The reason for this was a limitation in terms of knowledge and participation of such organisations in the implementation of telemedicine programme.

Differences between the composition of population and respondents according to groups are illustrated below.

Table 4.2: Population vs Respondent according to groups

Industry Sector	*Population*	*Number of respondents*	*Percentage of population*	*Percentage of Total respondents*
Public Enterprise	9	7	25.71%	25.00%
NGO	1	1	2.86%	3.57%
Government	14	11	40.00%	39.29%
Private Enterprise	11	9	31.43%	32.14%
Total	***35***	***28***	***100.00%***	***100.00%***

Figure 4.2: Population vs Respondent according to



From Table 6.2 and Figure 6.2 it is clear that the respondents are fairly representative of the population. This can probably be ascribed to the fact that the active role and participation of telemedicine in South Africa is still in the development phase and thus there is a limited audience to be targeted for this research study.

4.5 RESULTS OF THE EMPIRICAL RESEARCH AND ANALYSIS

4.5.1 PROCESSING OF THE DATA

The response included nominal data (responses to demographic questions), as well as ordinal data on a six-point scale. The processing of data was made by means of a statistical programme from Windows XP 2001. In the processing of the data the major emphasis was on descriptive statistics, which is defined by Berenson and Levine (2000:5) as those methods involving the collection, presentation and characterisation of a set of data in orders to describe features of the set of data. Descriptive statistics was

thus used to organise and summarise the masses of numerical data that have been collected (Lind and Mason 1997:8).

A frequency distribution analysis and analysis of variance was used to identify the most important information and security problems that users experience, and to investigate the variation in the interval scaled variables. Because of the exploratory nature of the research and because most of the data are generally ordinal or nominal in nature, the degree of statistical analysis of the results were limited to tabulations and graphical representations. Open-ended questions were classified and listed (Berenson and Levine 1996:143).

- In order to evaluate the respective statements and questions, the processed data was presented as a frequency distribution to facilitate certain calculations, namely the mean, standard deviation and levels of confidence, as well as to make process of data analysis and interpretation more manageable and meaningful (Berenson and Levine 1998:65). According to Wisniewski (2002:50) a frequency distribution is a grouping of data showing the number of observations in each mutually exclusive category and is thus an indication of how many respondents assigned a specific value to a question or statement. Histograms were used to portray the frequency distributions graphically for easier interpretation.

- The arithmetic mean, which most commonly used average or a measure central tendency (Wisniewski, 2002:92), was calculated for each question or statement. The arithmetic mean is calculated by summing the responses received from all respondents, divided by quantity of times which item occurred (n) (Wisniewski, 2002:92). It pinpoints the centre of the values of the specific set of data.

- The 95% intervals, which state the range within which the total population parameter is expected to lie (Wisniewski, 2002:200).

- To determine the representivity and reliability of the mean standard deviation as measure of dispersion was calculate for each question. The standard deviation is a deviation from the arithmetic mean and thus indicate the clustering of values around the mean (Wisniewski, 2002:149). The lower the value of the standard deviation, the

larger the similarity of the respondents' answers to the specific questions. The higher the value of the standard deviation, the smaller the similarity between responses received to specific questions (Wisniewski, 2002:150). When approximately two thirds of observations were between the mean plus or minus one standard deviation, the mean was regarded as a reliable average.

- However, when a few extremely large and extremely small items are encountered in a set of data, the mean might not be an appropriate measure of central tendency (Wisniewski, 2002:104). To overcome this and to determine the shape or symmetry of the frequency distribution the degree of skewness of the distribution was determined. If a distribution is positively skewed (right-skewed), the mean is higher than the medium and was influenced by data influenced by a few extremely high values. If the distribution is negatively skewed (left-skewed), the mean is lower than the medium and was influenced by a few extremely low values (Wisniewski, 2002:105). If a distribution is highly skewed the mean is probably not a good average to use. The coefficient of skewness generally lies between -3 and +3, with 0 as an indication that a frequency distribution is symmetrical with no skewness (Wisniewski, 2002:105).

- Correlation analysis was done to determine the strength of association between the different variables of the biographical data (Wisniewski, 2002:326). Correlation analysis may be defined as a group of statistical techniques used to measure the strength of the relationship (correlation) between two variables. The strength of the relationship between two variables is usually measured by the coefficient of correlation (r), whose values range from -1 (perfect negative correlation) to +1 (perfect positive correlation) (Wisniewski, 2002:326). Only coefficients of correlation with a 95% level of confidence were taken into account.

- Throughout the statistical analysis the number of respondents were determined by the number of people.

For missing data the casewise deletion technique was employed, which resulted in a variation of the valid number of respondents (valid N). Only cases that did not contain any missing data for any of the variables selected for the statistical analysis were

included in the analysis. This is especially important in the case of the calculation of correlations.

Although use could have been made of mean substitution of missing data (replacing all missing data in a variable by the mean of that variable) in order to eliminate missing data in the file, it was decided not to use this method, because mean substitution artificially decreases the variation of scores. This decrease in individual variables is proportional to the number of missing data, which means that the more missing data, the more "perfectly average scores" will be artificially added to the data set. The second reason is that mean substitution substitutes missing data with artificially created "average" data points and may thus considerably change the values of correlations.

4.5.2 PRESENTATION OF THE RESULTS

The results of the empirical study are reported in tabulated form, where applicable, and also in diagram form. The various sections of the questionnaire will be discussed as follows:

- Firstly, biographical questions as answered in section A of both questionnaires will be discussed.
- Secondly, section B presents the responses of the information regarding the current status of telemedicine implementation in South Africa and will be discussed in logical groupings in accordance with the type of information diagnosed.
- Section C presents the barriers to the implementation of telemedicine in South Africa. The questions are grouped logically in accordance with the type of information diagnosed and to reflect the unique and non-unique local scenario relative to international experiences.
- Section D presents critical success factors for the implementation of telemedicine in South Africa. The questions are grouped logically in accordance with the type of information diagnosed, so as to reflect the unique and non-unique local scenario relative to international experiences. Some of the questions are open-ended to obtain opinion and critical information for South African telemedicine implementation.
- Section E presents the critical factors to be considered for security of information in the telemedicine application and practise.

- Section F presents economic factors to be considered for telemedicine implementation in South Africa. The questions are grouped logically in accordance with the type of information diagnosed. Feedback on open-ended questions is presented to reflect the broader view of economic factors to be considered for successful implementation of telemedicine in South Africa.
- Section G presents human issues such as ethical, political, legal and social factors. This will reflect critical issues to be considered for successful implementation of telemedicine in South Africa.
- Section H presents the management of information systems relevant to telemedicine application and practise. The questions are grouped logically in accordance with the type of information diagnosed.

The results will be discussed in terms of three main aspects:

- The topic of the statement or question.
- Results obtained – the results will be presented in tables, frequency distributions and graphs.
- Deductions – certain tendencies will be pointed out. Conclusions will, however, be left for chapter 5.

4.5.3 Results of section A: Profile of the respondents

4.5.3.1 Age

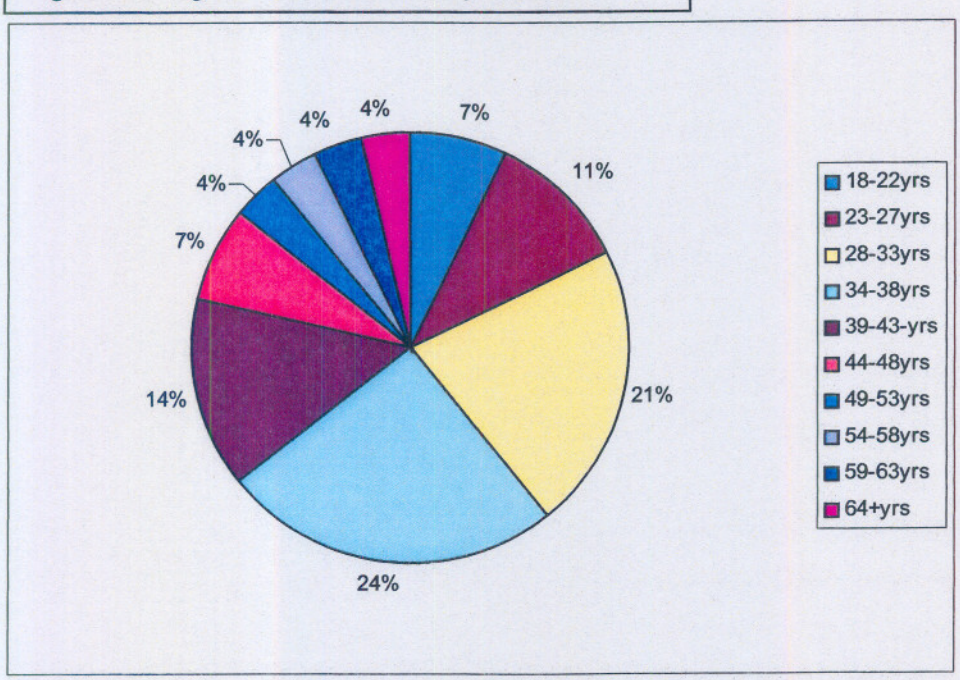
The respondents were measured according to ten categories. A frequency distribution of the age of respondents among the targeted audience who are currently active in the implementation of telemedicine is shown in Table 4.3. From table 4.3 it is evident that more than 70% of respondents are under the age of 43 years. The largest number falls within the age group of 23 to 38 years, which accounts for about 56% of the total sample. This is indicative of the fact that the majority of targeted or chosen age group in this research range from young to middle age adults.

Table 4.3: Age distributions of respondents

Age Group	*Number of respondents*	*Cumulative count*	*Percentage of Total respondents*	*Cumulative percentage of total respondents*
18-22yrs	2	2	7.14%	7.14%
23-27yrs	3	5	10.71%	17.86%
28-33yrs	6	11	21.43%	39.29%
34-38yrs	7	18	25.00%	64.29%
39-43-yrs	4	22	14.29%	78.57%
44-48yrs	2	24	7.14%	85.71%
49-53yrs	1	25	3.57%	89.29%
54-58yrs	1	26	3.57%	92.86%
59-63yrs	1	27	3.57%	96.43%
64+yrs	1	28	3.57%	100.00%
Total	***28***	***28***	***100.00%***	100.00%

Figure 4.3 presents the picture in a summarised form for clear and quick view of the age distribution of respondents.

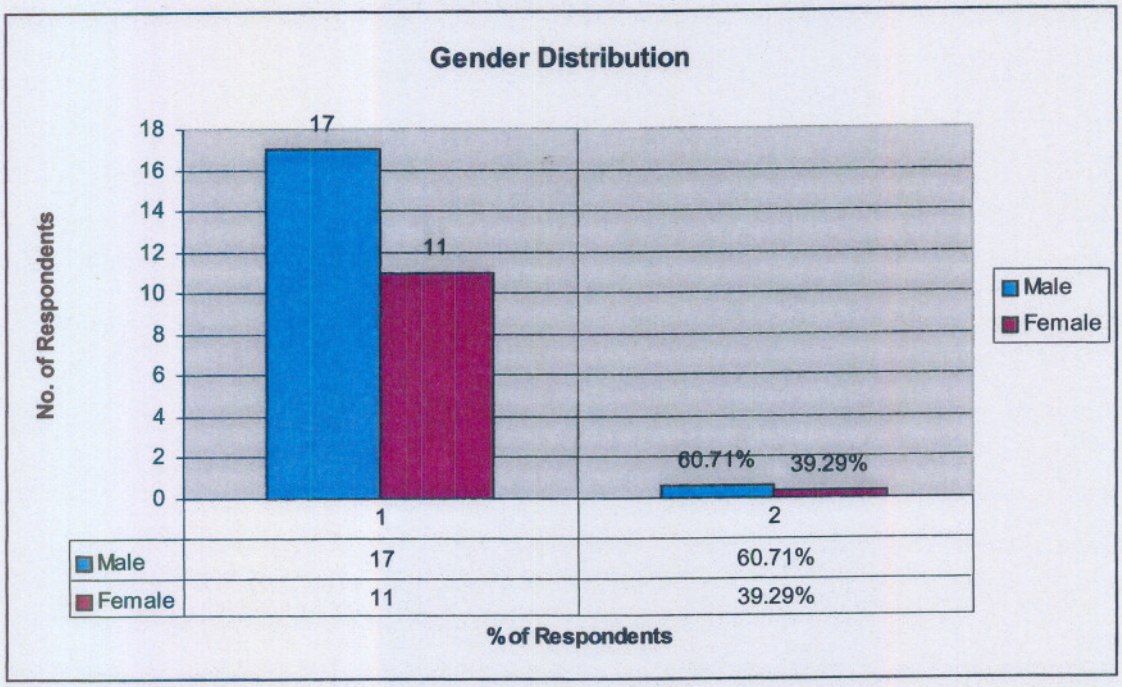
Figure 4.3: Age distributions of respondents



4.5.3.2 Gender

Figure 4.4 shows that 40% of the respondents were females and 60% were males.

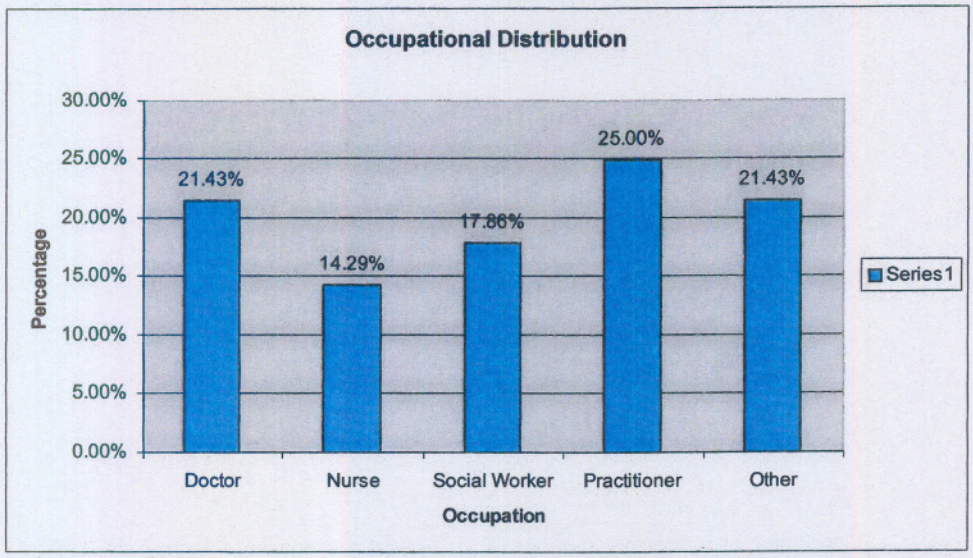
Figure 4.4: Gender distribution of respondents



4.5.3.3 Distribution of respondents' occupations

Figure 4.5 indicates that most respondents were practitioners (25% were doctors); patients and other role players represented 21.3% of the sample; and social workers 17.8%.This is representative of the key active role players in the telemedicine implementation, as the programme is still in the development phase.

Figure 4.5 Occupational Distribution



Distribution of respondents' province of origin

Figure 4.6: Distribution of provinces

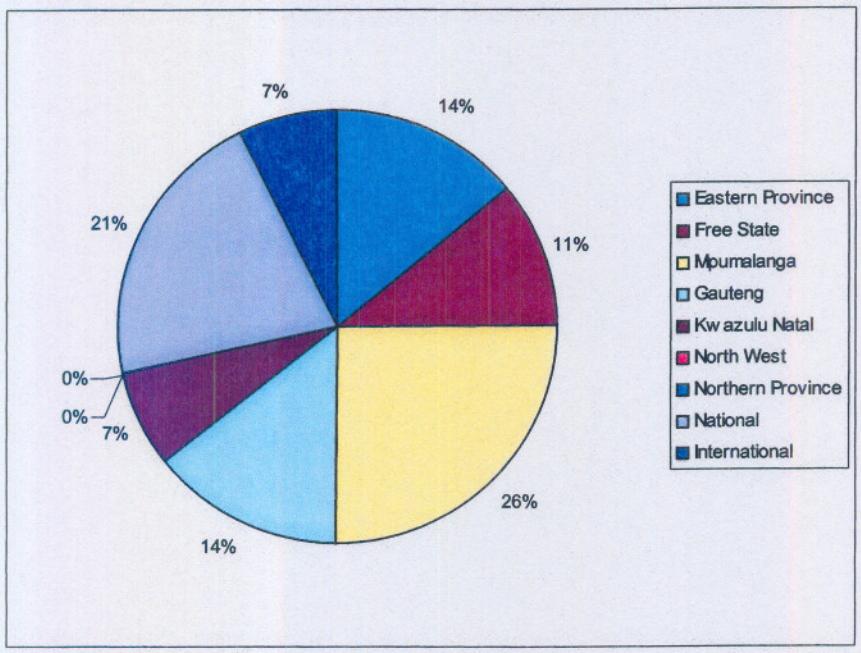
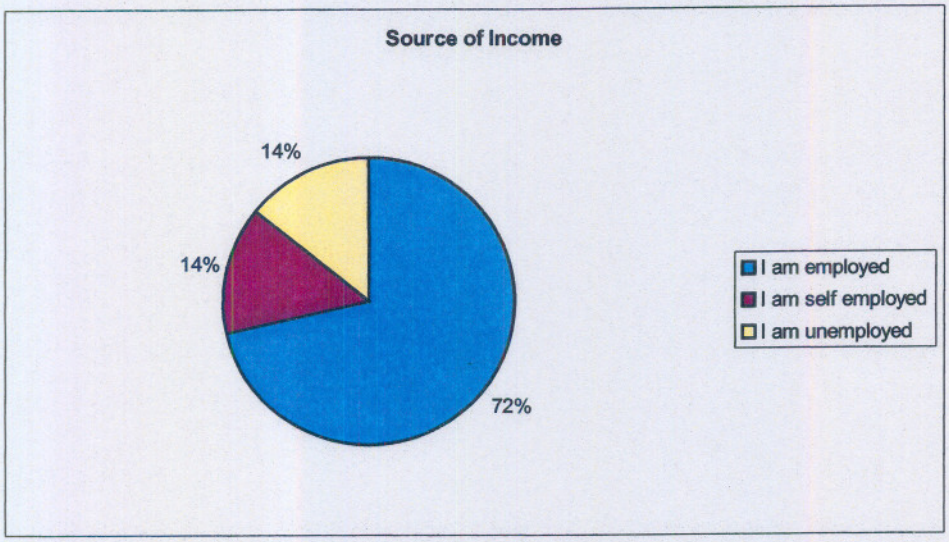


Figure 4.6 shows the distribution of provinces for the respondents. Mpumalanga and the Eastern Cape are well represented at 26% and 21% respectively. This is also in accordance with the approach of the demarcated areas as per activity of the pilot projects for the study.

4.5.3.4 Respondents' source of income

Figure 4.7 shows that the majority of respondents are employed at 72%, while 14% are self-employed and 14% are non-employed. This result is to be expected, because most of the actively involved role players are employed by the public sector.

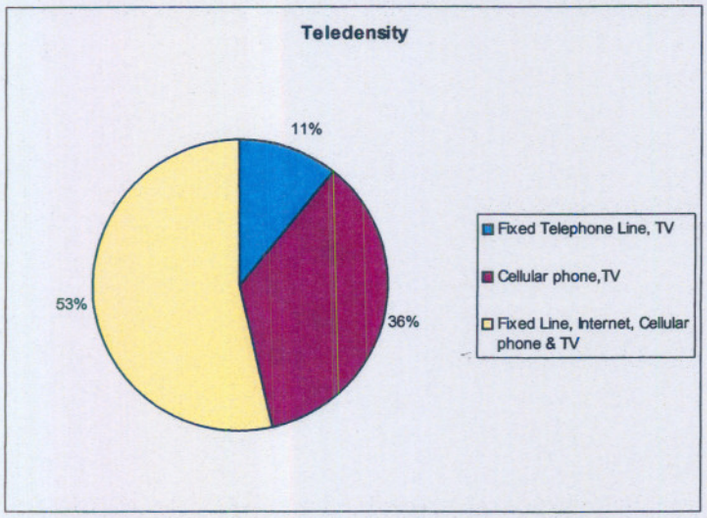
Figure 4.7: Source of income



4.5.3.5 Access to information and technology

Figure 4.8 shows that most of the respondents have access to fixed line, internet, cellular phone and television at 53%. This is not unexpected, as most of the respondents (72%) are employed and close to 50% are doctors and practitioners, with the rest being nurses and other professionals.

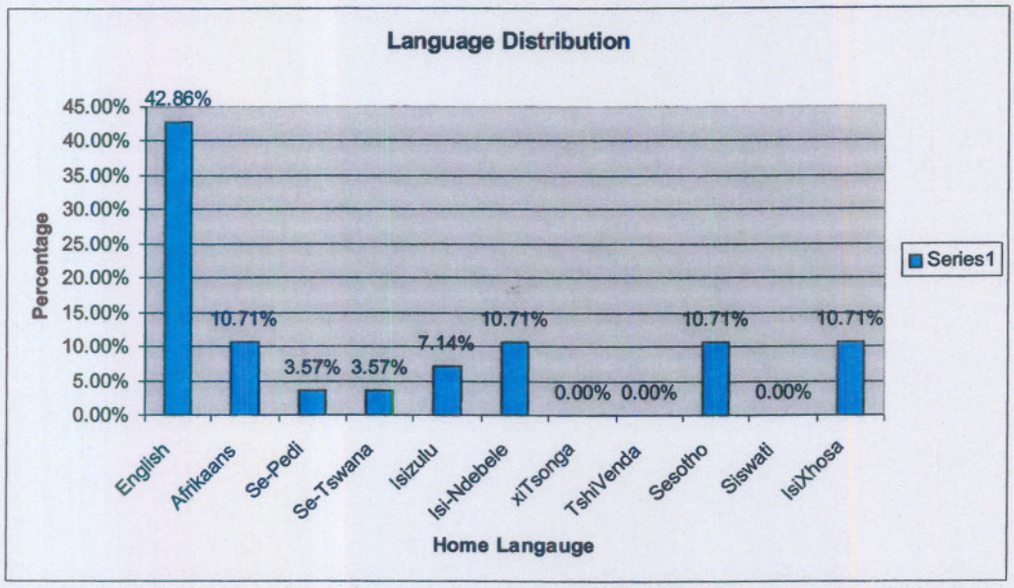
Figure 4.8: Access to information and technology



4.5.3.6 Language distribution

Figure 4.9 shows that all 11 official languages were identified and respondents were chosen randomly from a language point of view. English was indicated as a home language by the most respondents (42.6%). Other indigenous languages indicated as home languages by 10% of the respondents were IsiXhosa, Sesotho, Setswana and IsiZulu.

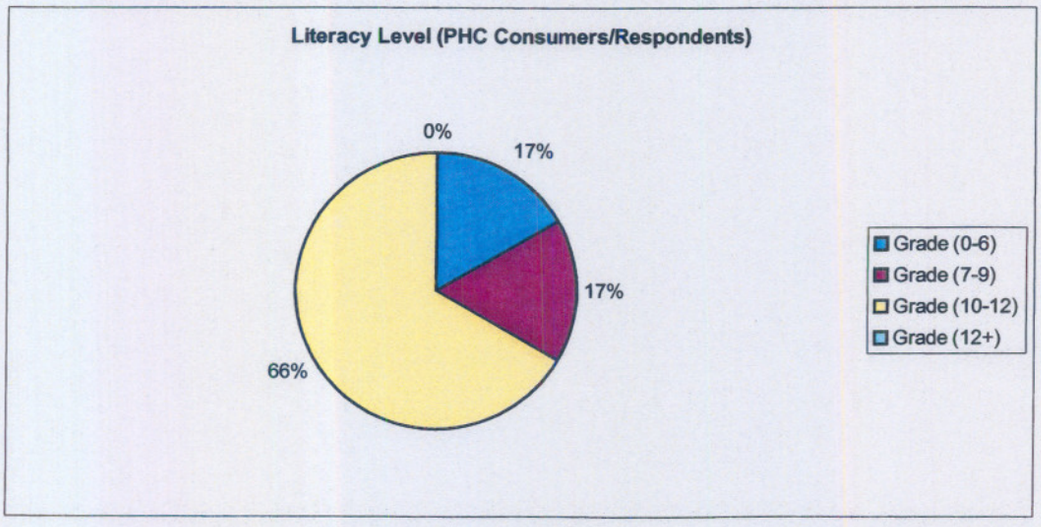
Figure 4.9: Language Distribution



4.5.3.7 Literacy levels of primary health care consumers

Figure 4.10 shows that 66% of the respondents, as primary health consumers, have matric as a minimum qualification.

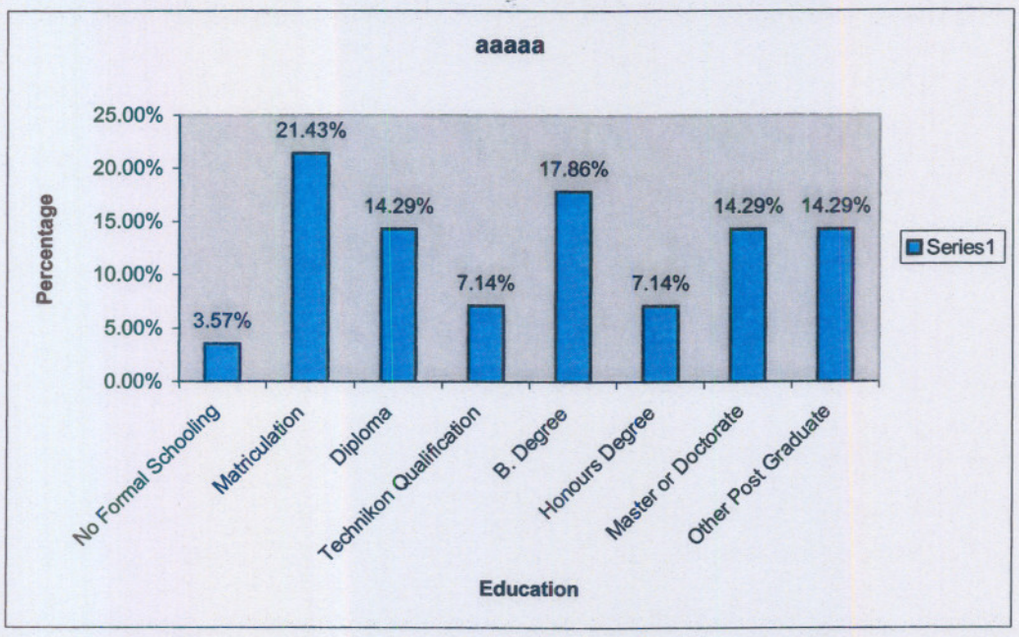
Figure 4.10: Literacy levels of primary health care consumers



4.5.3.8 Literacy levels of primary health care providers

Respondents who were primary health care providers had to indicate their literacy in terms of tertiary qualifications or qualifications beyond matriculation. Figure 4.11 confirms the data on occupational biography, namely that almost 50% of the respondents held B-degrees, Master's degrees and other post-graduate qualifications.

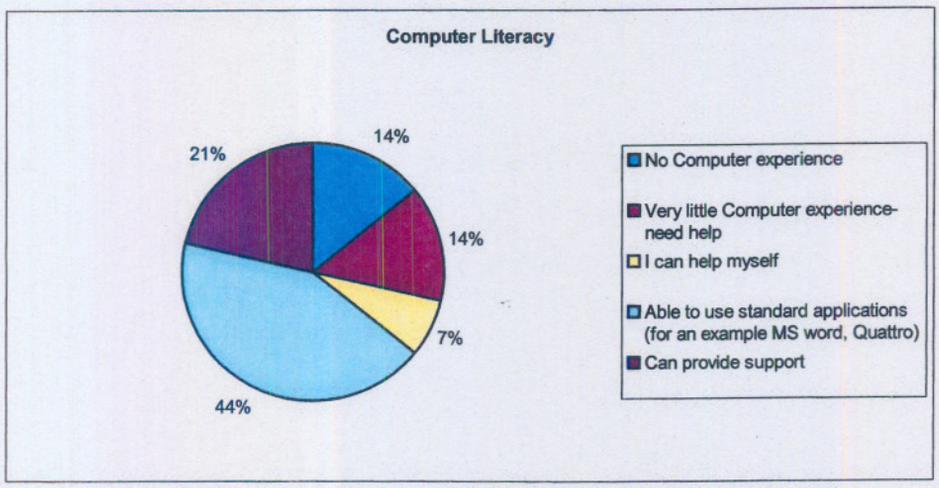
Figure 4.11: Literacy levels of primary health care providers



4.5.3.9 Computer Literacy of respondents

Figure 4.12 presents the different levels of computer literacy of the respondents. Many respondents (44%) have a fair level of computer experience, such as using computer packages. This percentage is indicative of professionals. The remainder of the sample (56%) indicates very little or no experience; these respondents are mostly nurses in rural environments and some professionals and primary health care consumers.

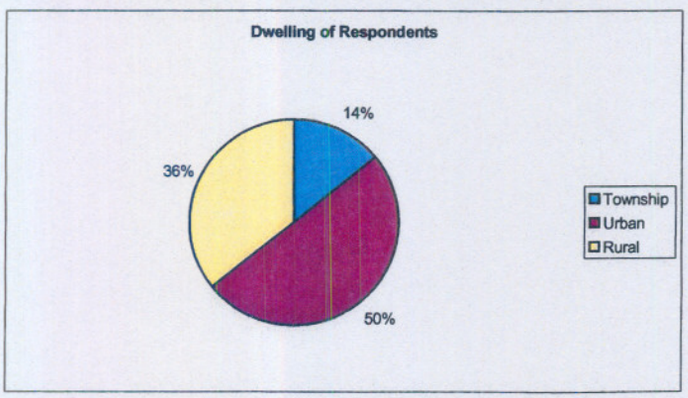
Figure 4.12: Computer Literacy



4.5.3.10 Dwelling of Respondents

The respondents' dwellings are described in Figure 4.13. 50% of respondents were from urban areas, which is representative of the fact that most of health care providers are found in the urban areas. The remaining responses came from semi-rural and rural areas.

Figure 4.13: Dwelling of Respondents



4.5.4 Results of section B

The respondents from targeted groups and backgrounds completed section B. The section was grouped in accordance with the specific details to be diagnosed for the intended research purposes.

4.5.4.1 Awareness and Knowledge of Telemedicine in SA.

Six statements were used to determine the general information on the awareness and basic knowledge of telemedicine in South Africa. Table 4.4 illustrates the results obtained from the respondents.

Table 4.4: Awareness and knowledge of Telemedicine in SA

Variable	*Description*	*Valid N*	*Mean*	*Confid. (-95%)*	*Confid. (+95%)*	*Std. Deviation*	*SK (Skewness)*
10	Familiarity with telemedicine Disciplines (Radiology, Pathology)	28	3.750	3.621	4.379	1.022	-0.734
11	Familiarity with telemedicine Disciplines (Health care broadcast)	28	4.071	3.780	4.220	0.593	0.361
12	Familiarity with telemedicine Disciplines (video conferencing/real time practicing)	28	3.857	3.763	4.237	0.639	-0.671
13	Most utilised mode of telemedicine as e-mail	28	3.786	3.681	4.319	0.860	-0.747
14	Most utilised mode of telemedicine as video conferencing	28	2.964	2.610	3.390	1.052	-0.102
15	Being aware of Hospitals/Clinics practicing Telemed	28	3.214	3.588	4.412	1.113	-2.117
	Mean for Population		***3.607***				

Table 4.4 shows that most of the targeted respondents are aware of the telemedicine implementation in South Africa: approximately 88% agreed with all six statements at a mean of over 3.6. However, about 30% of the respondents did not agree that video conferencing mode was the mostly utilised telemedicine application, as depicted by the

lowest mean score of 2.964. The next lowest score was 3.24, which measures the awareness of hospitals and clinics which are actively practicing telemedicine (accounting for about 15% of respondents). This is because some respondents strongly disagreed with the statement.

4.5.4.2 Knowledge of telemedicine application and technology

This statements grouped in this category tested the knowledge of telemedicine application and technology of the respondents. Table 4.5 shows the results obtained from the respondents, using the statistical analysis and calculations.

Table 4.5: Knowledge of telemedicine application and technology

Variable	*Description*	*Valid N*	*Mean*	*Confid. (-95%)*	*Confid. (+95%)*	*Std. Deviation*	*SK (Skewness)*
16	Familiarity with telemedicine software application	28	3.571	3.637	4.363	0.979	-1.313
17	Familiarity with telemedicine hardware application	28	3.500	3.636	4.364	0.982	-1.528
18	FAX as widely used communication link for Telemed	22	1.047	3.612	4.388	1.047	-1.126
19	Internet & ISDN links as widely used communication link for Telemed	22	3.821	3.765	4.244	0.658	-0.815
	Mean for Population		***2.985***				

The results shown in Table 4.5 indicate that about 90% of the respondents have knowledge about the essential telemedicine application and technology, at an average mean of over 3.5. However, 75% respondents disagreed with the fact that faxes are used widely as an application for telemedicine services. It is clear from this table that most of the respondents are actively or to a greater extent involved with the implementation of telemedicine.

4.5.4.3 Source of information about telemedicine

Three statements grouped in this category were used to determine the source of information, or the way in which respondents have acquired the information on telemedicine as a topic. Table 4.6 shows the results obtained from the respondents.

Table 4.6: Source of information about telemedicine

Variable	*Description*	*Valid N*	*Mean*	*Confid. (-95%)*	*Confid. (+95%)*	*Std. Deviation*	*SK (Skewness)*
20	Source of information on Telemed: (People)	28	2.214	1.500	2.500	1.350	1.111
21	Source of information on Telemed: (Journals & Books)	28	2.786	2.032	2.968	1.264	0.678
22	Source of information on Telemed: (Other, not mentioned above)	28	3.143	3.108	3.892	1.059	-1.011
	Mean for Population		***2.714***				

As shown in Table 4.6 the results indicate that respondents at large (70%) obtained the information on telemedicine through other sources other that journal, books and people, as shown by the mean (3.143). However, 30% of respondents have obtained telemedicine information through the sources which were tested.

4.5.4.4 Sourcing of telemedicine resources

Four statements were identified to test the issues on resources availability, and more specifically the sourcing of the resources. Table 4.7 presents the results as obtained from the respondents.

Table 4.7: Sourcing of telemedicine resources

Variable	Description	Valid N	Mean	Confid. (-95%)	Confid. (+95%)	Std. Deviation	SK (Skewness)
23	Adequate technical expertise is available	28	3.143	2.633	3.367	0.990	0.433
24	The government is the source of expertise for telemedicine implementation	28	3.643	3.640	4.360	0.972	-1.103
25	The public sector provides more expertise for telemedicine implementation	28	3.964	3.650	4.350	0.944	-0.113
26	The private sector provides more expertise for telemedicine implementation	28	2.857	2.560	3.440	1.187	-0.361
	Mean for Population		***3.402***				

The results in Table 4.7 indicate that 50% of the respondents agreed that the there is an adequate availability of resources, while 50% disagreed. However, about 70% of respondents were aware that the government and public sectors play an important role in supplying the resources for telemedicine implementation. The mean result of 2.85 for the role of the private sector is an indication that a more participative role is required.

4.5.4.5 Progress of telemedicine Implementation

Sets of statements grouped together in this section were used to test the knowledge of the progress of telemedicine implementation in South Africa. Table 4.8 shows the results as obtained from the respondents.

Table 4.8: Progress of Telemedicine implementation in SA

Variable	Description	Valid N	Mean	Confid. (-95%)	Confid. (+95%)	Std. Deviation	SK (Skewness)
27	Telemedicine implementation programme on target	28	2.893	2.625	3.375	1.012	-0.318
29	Significant progress realised on the telemedicine implementation	28	3.286	2.674	3.326	0.881	0.973
30	Telemedicine is to be completed in near future <5yrs	28	2.893	2.543	3.457	1.235	-0.260
31	Telemedicine is to completed in a distant future >5yrs & above	28	3.143	2.633	3.367	0.990	0.433
	Mean for Population		***2.331***				

Table 4.8 shows that about 70% of respondents (at a mean of 2.893) were of the opinion that telemedicine implementation is not on target as initially planned. However, 80% of the respondents indicated that there was significant progress to date with telemedicine implementation. More than 60% of the respondents were of the view that the implementation will take longer than five years to be completed.

4.5.4.6 Approach to resource planning and responsibilities

Seven statements were grouped to test the respondent's opinion and knowledge on the approach on resource planning and respondents. Respondents were asked to elaborate on statements regarding the active participation of parastatals in the implementation of the telemedicine programme. The results are shown in Table 4.9.

Table 4.9: Approach to resource planning and responsibility

Variable	Description	Valid N	Mean	Confid. (-95%)	Confid. (+95%)	Std. Deviation	SK (Skewness)
32	There should be a centralised task team for implementation	28	3.964	3.650	4.350	0.944	-0.113
33	The responsibility of telemedicine should lie with the government	28	4.071	3.780	4.220	0.593	0.361
34	The responsibility of telemedicine should lie with the public sector	28	3.143	2.633	3.367	0.990	0.433
35	The responsibility of telemedicine should lie with the private sector	28	2.214	1.500	2.500	1.350	1.111
36	The implementation of telemedicine in SA should be a joint venture	28	2.857	2.560	3.440	1.187	-0.361
37	Parastatals' participation in telemedicine implementation can have a great impact.	28	3.536	3.598	4.402	1.085	-1.284
38	Parastatals' participation in telemedicine implementation will not have any impact.	28	2.964	2.610	3.390	1.052	-0.102

From the Table 4.9 it is evident that respondents (80%) feel that the responsibility for telemedicine should lie with the government and that a centralised team is required to steer the implementation (a mean of 4.01). However, there was a subtle response about the responsibility of the private sector. Most of the respondents felt that parastatals' participation was essential, mainly because of reasons of infrastructure development and sharing. Below are some of the main reasons offered by respondents:

- Parastatals' participation will depend on the main focus, being for the benefit of the society and community at large.
- All participant involvement is crucial and vital for telemedicine implementation.

- Participants believed that joint ventures could add value.

4.5.4.7 Identifying involvement of other key stakeholders

The purpose of the two statements was to identify and asses the viability and the nature of the involvement of other key stakeholders (suppliers), apart from local (national) stakeholders. Table 4.10 shows the responses to this regard.

Table 4.10: Identifying involvement of other key stakeholders

Variable	*Description*	*Valid N*	*Mean*	*Confid. (-95%)*	*Confid. (+95%)*	*Std. Deviation*	*SK (Skewness)*
39	Envisioning suppliers of telemedicine to be local & foreign	28	3.857	3.763	4.237	0.639	-0.671
40	Envisioning suppliers of telemedicine to be local & not foreign	28	3.821	3.671	4.329	0.889	-0.603
	Mean for Population		***3.839***				

Approximately 50% of the respondents were of the view that local and foreign involvement of telemedicine suppliers was sensible (3.857), while the other half was opposed to foreign involvement. This may be attributed to the fact that foreign equipment might be too costly to establish the infrastructure, and in this regard a local technology development from institutions such as the CSIR was preferred.

4.5.4.8 Validating the implemented sites/projects and structures

These questions were intended to provide an indication of telemedicine sites which respondents knew were operational. Table 4.11 shows the results from respondent's view.

Table 4.11: Identifying Telemedicine sites and structures

Variable	Description	Valid N	Mean	Confid. (-95%)	Confid. (+95%)	Std. Deviation	SK (Skewness)
41	Prior to completing this questionnaire, Respondent has been aware of telemedicine structures/forums	28	3.214	3.588	4.412	1.113	-2.117
42	Exposure to documents on telemedicine already published	28	1.047	3.612	4.388	1.047	-1.126
43	Have already visited telemedicine site which is operational	28	3.500	3.636	4.364	0.982	-1.528
44	Can confidently mention a state a site known to be operational	28	3.143	3.108	3.892	1.059	-1.011
	Mean for Population		***2.637***				

The results shown in Table 4.11 indicate that 30% of respondents were not aware of or had outdated information about the implemented sites (3.1). 70% of the respondents were updated on this issue, although the mean and confidence regarding this measurement was not as high as previous mean values in section B, and results were also more skewed. This might be reflective of the fact that more communication among stakeholders should be emphasised and that updates should be provided at a higher frequency than the current rate.

4.5.5 Results of section C

Section B was also grouped according to the specific details which had to be investigated for the intended research purposes.

4.5.5.1 Barriers to implementation of telemedicine and uniqueness

Statements and open-ended question were used to test the identifiable barriers and barriers which were unique to the South African situation. Table 4.12 presents these results. Respondents were also asked to elaborate by giving their opinions.

Table 4.12: Barriers to implementation

Variable	Description	Valid N	Mean	Confid. (-95%)	Confid. (+95%)	Std. Deviation	SK (Skewness)
45	There exist barriers to implementation of telemedicine in SA	28	3.821	3.671	4.329	0.889	-0.603
46	I can name the barriers to the implementation of telemedicine	28	4.071	3.780	4.220	0.593	0.361
47	I believe that there are unique barriers to the SA scenario	28	3.857	3.763	4.237	0.639	-0.671
	Mean for Population		**3.916**				

In this test about 95% of respondents indicated that there are barriers to telemedicine implementation in South Africa, at mean of 3.8. Barriers could be named and included the availability of specialists/practitioners, training of key role players (such as health care providers and technicians), start-up costs, support and management. One of the most crucial barriers was human resources. There was an indication of acceptance from the respondents (80%, at mean of 3.85) that there are unique barriers in the South African context, as stated below:

- An established information and communications technologies (ICT) infrastructure in South Africa was more problematic than the international norm.
- Teledensity is very low in Sub-Saharan Africa (of 10 telephone lines per 100 people/inhabitants).
- Gross domestic product costs per capita for primary health care in Sub-Saharan Africa is far below the international norm.
- First-world technology and devices have to be implemented differently in a Third-world environment.

4.5.5.2 Comparing local barriers with international barriers

The statements were constructed to test the comparison of local and international barriers, according to the respondent's knowledge and experiences. Table 4.13 shows the results as obtained from the respondents.

Table 4.13: Local vs international barriers

Variable	Description	Valid N	Mean	Confid. (-95%)	Confid. (+95%)	Std. Deviation	SK (Skewness)
49	Infrastructural planning & development	28	3.821	3.671	4.329	0.889	-0.603
50	Telecommuni-cation regulations	28	2.964	2.610	3.390	1.052	-0.102
51	Reimbursement for telemedicine services	28	3.964	3.650	4.350	0.944	-0.113
52	Licensure and accreditation	28	2.964	2.610	3.390	1.052	-0.102
53	Medical malpractice liability	28	2.964	2.610	3.390	1.052	-0.102
54	Confidentiality	28	2.964	2.610	3.390	1.052	-0.102
	Mean for Population		***3.297***				

85% of the respondents did not feel that factors which dominate the international telemedicine scene – such as medical malpractice, licensure and accreditation – are applicable in the local environment. Accordingly, these factors scored a mean of 2.94. However, the results show that infrastructure planning and development and telemedicine reimbursement remain major barriers, as indicated by almost 100% of the respondents.

4.5.6 Results of section D

Section D began with six open-ended questions, to maintain consistency and focus before the close-ended statements and questions. This section was also arranged in

accordance with the specific details which were investigated for the intended research purposes.

4.5.6.1 Comments on critical success factors (open-ended questions)

Open-ended questions were posed to the respondents to obtain an indication of the best known critical success factors in the respondent's opinion. Below are the results or comments obtained from the respondents:

- Government buy-in and community support and maintenance
- Technology training
- Sustainability.

Respondents made the following suggestions to improve on previous undertakings when implementing telemedicine project:

- Co-ordination of and communication with all role players
- Good site selection and training
- Budgeting upfront
- Accountability and ownership are required from all stakeholders, including the communities
- Infrastructure development is crucial to successful implementation.

Three key points of advice for successful implementation of telemedicine are:

- The project should begin at a national level, then a provincial level and lastly should be taken to a municipal and community level.
- Adequate planning, training and budgeting are required.
- Start the project at a small scale and, when necessary, grow within identified areas.
- Provision of sustained funding is required.
- Implement user-friendly technology

Internationally acclaimed critical success factors for telemedicine implementation include:

- The availability of adequate resources (budget, human resources and expertise)
- Availability of start-up costs
- Attained ownership
- User commitment on projects.

Unique critical success factors which affect the implementation of telemedicine in South Africa:

- Understanding rural environment
- Communication to all stakeholders
- Lack of budget
- Planning of ICT infrastructure sharing with other government structures, such as parastatals and NGOs
- Human resources and sustainable revenue returns through Department of Health and other stakeholders
- Improvement of literacy through investing in education.

4.5.6.3 Measuring and identifying critical success factors applicable to SA in comparison to the international scenario

The statements were grouped to measure and identify critical success factors (CSFs) applicable to SA in comparison to international scenario as captured from the respondents. Table 4.14 shows the results as obtained from the respondents.

Table 4.14: Measuring CSF applicable to SA vs international scenario

Variable	Description	Valid N	Mean	Confid. (-95%)	Confid. (+95%)	Std. Deviation	SK (Skewness)
61	Marketing: involving users	28	3.857	3.763	4.237	0.639	-0.671
62	Marketing: involving community as a whole	28	3.536	3.598	4.402	1.085	-1.284
63	Promotion of telemedicine programmes	28	3.964	3.650	4.350	0.944	-0.113
	Mean for Population		***3.786***				

The table indicates that 80% of the respondents, at a mean value of 3.8, are of the opinion that telemedicine requires a marketing approach to stimulate the implementation of such a health delivery service. However, there was a slight uncertainty (3.5) as to whether the involvement of the community is required, as was evident from about 30% of the responses.

4.5.6.5 Telemedicine administration according to best practices

The section was used to investigate telemedicine administration according to best practices as determined by international norms. Table 4.15 shows the results as captured from the respondents.

Table 4.15: Measuring best practices for telemedicine administration

Variable	Description	Valid N	Mean	Confid. (-95%)	Confid. (+95%)	Std. Deviation	SK (Skewness)
64	Efficient and simplified administration	28	3.500	3.636	4.364	0.982	-1.528
65	Training in the use of telemedicine equipment	28	3.143	2.633	3.367	0.990	0.433
72	Administrative support	28	3.286	2.674	3.326	0.881	0.973
73	Strategic planning of project implementation	28	4.071	3.780	4.220	0.593	0.361
	Mean for Population		**3.500**				

From table 4.15 it is evident that efficient and simplified administration and training of equipment were seen by 80% of respondents (mean of 3.5) as critical success factors for the implementation of telemedicine. It can also be seen from table 4.15 that strategic planning scored high (4.071) among about 90% of the respondents.

4.5.6.6 Identifying suitable telemedicine equipment

A set of statements was used to identify suitable telemedicine equipment. Table 4.16 shows the responses in this regard. 80% of the respondents placed a high premium on the user friendliness of such equipment (4.14).Other requirements included flexibility, accuracy and freedom of choice to compare vendors.

Table 4.16: Suitable telemedicine equipment

Variable	Description	Valid N	Mean	Confid. (-95%)	Confid. (+95%)	Std. Deviation	SK (Skewness)
66	Equipment characteristics: reliability, accuracy and flexibility	28	3.786	3.681	4.319	0.860	-0.747
67	Purchasing flexibility: ability to compare a range of equipment supplied by vendors	28	2.786	2.032	2.968	1.264	0.678
68	User friendliness of equipment	28	4.143	3.809	4.191	0.515	0.832
	Mean for Population		**3.572**				

4.5.6.7 Human factors influencing technology application

Two factors were grouped to determine the sensitive human elements crucial for accepting or adapting to the technology. Table 4.17 scores the results as captured from the respondents.

Table 4.17: Human factors influencing the application of technology

Variable	Description	Valid N	Mean	Confid. (-95%)	Confid. (+95%)	Std. Deviation	SK (Skewness)
69	Patient confidentiality	28	3.536	3.598	4.402	1.085	-1.284
74	Human elements: Charismatic leaders/ champions of the project	28	3.857	3.763	4.237	0.639	-0.671
	Mean for Population		**3.697**				

100% of the respondents agree that telemedicine leadership is vital for stakeholders (health care providers and consumers) to accept telemedicine services as an alternative to conventional health care services (3.85). Another human element, which scored average (3.56) among 60% of the respondents, was patient confidentiality. However, as pointed out earlier in this chapter, there are solutions to this problem.

4.5.6.8 Infrastructure

One statement was used to determine the efficiency required for telemedicine network. Table 4.18 shows the responses in this regard.

Table 4.18: Network requirement

Variable	Description	Valid N	Mean	Confid. (-95%)	Confid. (+95%)	Std. Deviation	SK (Skewness)
70	High speed reliable networks	28	3.750	3.621	4.379	1.022	-0.734
	Mean for Population		**3.750**				

From table 4.18 it is evident that 100% of respondents felt that telemedicine networks should be high speed and reliable (3.75). *Reliable* in this case implies that the quality of the network should comply with required communication and medical practice standards.

4.5.6.9 Cost factors for telemedicine

One statement was used to specifically probe the cost requirement for telemedicine infrastructure. Table 4.19 shows these results.

Table 4.18: Network requirement

Variable	Description	Valid N	Mean	Confid. (-95%)	Confid. (+95%)	Std. Deviation	SK (Skewness)
71	Affordable costs	28	4.143	3.809	4.191	0.515	0.832
	Mean for Population		**4.143**				

It can be seen from table 4.18 that 98% of the respondents were of the opinion that telemedicine implementation should be affordable (4.14); this may be regarded as a major factor to be considered by key custodians of the implementation programme.

4.5.6.10 Ownership of and motivating factors for telemedicine

Two statements were used to measure the opinion of the respondents regarding ownership and motivating factors. Table 4.19 shows the results as obtained from the respondents.

Table 4.19: Ownership and motivating factors

Variable	Description	Valid N	Mean	Confid. (-95%)	Confid. (+95%)	Std. Deviation	SK (Skewness)
75	Enthusiasm and commitment by the users to implementation	28	4.071	3.780	4.220	0.593	0.361
77	Enthusiastic referring health care practitioners	28	4.143	3.809	4.191	0.515	0.832
	Mean for Population		**4.107**				

According to table 4.19, 90% of the respondents consider enthusiasm and commitment by users as important factors (4.071) for the implementation of telemedicine services. This would motivate the user and encourage the spirit of ownership of telemedicine services. An enthusiastic referring health care practitioner was considered as very important (4.14), as it is an important motivating factor for the use of telemedicine services by practitioners.

4.5.6.11 Telemedicine system support and structure

This section was used to probe respondents' opinion about the minimum requirements for a practical telemedicine service. Table 4.20 shows the results obtained from the respondents.

Table 4.20: System support and structure

Variable	*Description*	*Valid N*	*Mean*	*Confid. (-95%)*	*Confid. (+95%)*	*Std. Deviation*	*SK (Skewness)*
76	Skilled technical support staff	28	3.750	3.621	4.379	1.022	-0.734
78	Knowledgeable and enthusiastic referral practitioners	28	3.857	3.763	4.237	0.639	-0.671
79	Referring and referral practitioners who are acquainted with each other	28	3.143	2.633	3.367	0.990	0.433
80	Local site co-ordinators	28	4.071	3.780	4.220	0.593	0.361
	Mean for Population		***3.705***				

Table 4.20 clearly illustrates that 90% of the respondents feel that the system and support structure for telemedicine should include skilled technical support staff (3.75), and knowledgeable and enthusiastic referral practitioners (3.857). Local site co-ordinators was regarded as a crucial requirement (4.071). The respondents did not deem it crucial for referring and referral practitioners to be acquainted with each other.

4.5.7 Results of section E

Section E begins with four close-ended questions. This section was also organised in accordance with the specific details to be gauged for the intended research purposes.

4.5.7.1 Awareness and knowledge of security of information

The aim of this undertaking was to determine the level of awareness and knowledge of the security of information for telemedicine application. Table 4.21 shows results as obtained from the respondents.

Table 4.21: Awareness and knowledge of security

Variable	Description	Valid N	Mean	Confid. (-95%)	Confid (+95%)	Std. Deviation	SK (Skewness)
81	Information and security are important to me personally	28	3.286	2.674	3.326	0.881	0.973
82	I feel confident that I will not lose any information or data when I use telemedicine	28	3.786	3.681	4.319	0.860	-0.747
83	I have been orientated about the security of information when using telemedicine applications.	28	3.750	3.621	4.379	1.022	-0.734
85	Since the implementation of telemedicine, security information and data security risks have been reduced	28	3.536	3.598	4.402	1.085	-1.284
	Mean for Population		**3.590**				

Table 4.21 makes it evident that the security of information is important for 70% of the respondents (3.28). However, other issues, such as being confident that information will not be lost, scored higher (3.786) for 80% of the respondents. It is also interesting that 98% percent of respondents felt that telemedicine security risks have been reduced (3.536) since the implementation of the programme.

4.5.7.2 Sensitivity about the level of information disclosure

A measurement was conducted about the sensitivity regarding the level of information that would be disclosed. Table 4.22 presents the results on this investigation.

Table 4.22: Sensitivity about the level of information

Variable	Description	Valid N	Mean	Confid. (-95%)	Confid (+95%)	Std. Deviation	SK (Skewness)
84 a)	The perceived level of threat of unauthorised disclosure of information is very serious due to following reasons: Public Interest Groups	28	2.786	2.032	2.968	1.264	0.678
84 b)	Health caregivers who do not need to know	28	2.786	2.032	2.968	1.264	0.678
84 c)	Practitioners and others who do not need to know	28					
84 d)	Intruders such as infrastructure providers	28	3.786	3.681	4.319	0.860	-0.747
84 e)	Suppliers of equipment	28	3.750	3.621	4.379	1.022	-0.734
84 f)	Other telemedicine stakeholders	28	2.786	2.032	2.968	1.264	0.678
	Mean for Population		**2.649**				

The results obtained and presented in Table 4.22 shows that 85% of the respondents did not perceive the level of information disclosure to be a threat, as reflected by average scores below 3.0 for a security measure for telemedicine. This is in contrast with statements presented to respondents.

4.5.7.3 Key concerns about the security of information

This group of questions were meant to establish those aspects of data security which are considered as vital for telemedicine application. Table 4.23 reflects the responses in this regard.

Table 4.23: Key concerns on the security of Information

Variable	*Description*	*Valid N*	*Mean*	*Confid. (-95%)*	*Confid (+95%)*	*Std. Deviation*	*SK (Skewness)*
86 a)	*I am very much concerned about information and data security with regard to the following:* Network security	28	3.214	3.588	4.412	1.113	-2.117
86 b)	Multiple logons and passwords	28	4.071	3.780	4.220	0.593	0.361
86 c)	End user computing security awareness	28	3.750	3.621	4.379	1.022	-0.734
86 d)	Monitoring user compliance with policies	28	2.964	2.610	3.390	1.052	-0.102
86 e)	Distributed computing security	28	3.214	3.588	4.412	1.113	-2.117
86 f)	Internet access	28					
86 g)	External/remote access dial-up.		4.071	3.780	4.220	0.593	0.361
	Mean for Population		***2.869***				

The results indicate that 90% of respondents are concerned about all the specified aspects of security, although the level of sensitivity varies in some aspects from low (3.2 for network security, distributed computing security) to high (4.07 for multiple log-ons, external dial-up).

4.5.8 Results of section F

Section F was constructed to identify economic factors to be considered for telemedicine implementation in South Africa. This section was also structured in accordance with the specific details to be identified for the intended research purposes.

4.5.8.1 Affordability and access to primary health care

The measurement was conducted to obtain an indication of affordability and access to primary health care in South Africa. Table 4.24 depicts the relevant responses.

Table 4.24: Affordability and access to primary health care

Variable	Description	Valid N	Mean	Confid. (-95%)	Confid. (+95%)	Std. Deviation	SK (Skewness)
87	Convinced that cost of primary health care is affordable for SA citizens	28	2.964	2.610	3.390	1.052	-0.102
88	All rural communities in SA have access to primary health care	28	2.786	2.032	2.968	1.264	0.678
89	All urban communities in SA have access to primary health care	28	3.500	3.636	4.364	0.982	-1.528
90	Convinced that cost of primary health care increases directly proportional to the cost of living.	28	4.071	3.780	4.220	0.593	0.361
	Mean for Population		**3.330**				

From Table 4.24 it is evident that 75% of the respondents feel that primary health care is not affordable for all South African citizens (2.964). About 89% of the respondents were of the opinion that urban communities have access to primary health care (3.5), and 70% were of the opinion that the cost of primary health care increased proportionally to the cost of living.

4.5.8.2 Cost of telemedicine in comparison to conventional delivery of primary health care

A set of three statements was constructed to probe the cost of using telemedicine in comparison to conventional delivery of primary health care. Table 4.25 shows the results of this investigation.

Table 4.25: Comparison cost of using Telemedicine for delivery of primary health care

Variable	Description	Valid N	Mean	Confid. (-95%)	Confid. (+95%)	Std. Deviation	SK (Skewness)
91	Telemedicine services are much more economic than conventional medical services.	28	3.571	3.637	4.363	0.979	-1.313
92	I am convinced that telemedicine will significantly reduce the number of required health professionals per given area.	28	3.821	3.765	4.244	0.658	-0.815
93	I am convinced that implementing telemedicine can reduce primary health care per GDP capita costs.	28	3.821	3.765	4.244	0.658	-0.815
	Mean for Population		**3.738**				

Table 4.25 illustrates that 80% of the respondents were of the opinion that telemedicine services were more economic than conventional means of delivering primary health care services (3.57). An 80% response is also in line with the opinion that telemedicine services can reduce the number of required practitioners in a given area. About 95% of

respondents insisted that the implementation of telemedicine services would reduce GDP per capita costs on primary health care services.

4.5.8.3 Economic approach towards telemedicine implementation

Only two sets of statements were used to grasp the relevant economic approach towards implementing the telemedicine system in South Africa. Table 4.26 presents the results as captured from the respondents.

Table 4.26: Economic approach for Telemdicine Implementation

Variable	*Description*	*Valid N*	*Mean*	*Confid. (-95%)*	*Confid. (+95%)*	*Std. Deviation*	*SK (Skewness)*
94	Utilising the existing infrastructure can reduce the cost of implementing telemedicine services in SA, especially in rural areas.	28	3.786	3.681	4.319	0.860	-0.747
96	I believe that the fast tracking of ICT liberation will reduce the cost of telemedicine infrastructure.	28	3.750	3.621	4.379	1.022	-0.734
	Mean for Population		***3.768***				

Table 4.26 shows that 95% of respondents are of the opinion that utilising the existing infrastructure can reduce the cost of implementing telemedicine services in South Africa, especially for rural application (3.786). However, 30% of respondents were not convinced that the fast tracking of ICT infrastructure could reduce the cost of telemedicine implementation.

4.5.8.4 Measuring the benefits of telemedicine services

A combination of two close-ended statements and two open-ended questions was used to diagnose or measure the benefits of telemedicine services from the respondent's point of view. Table 4.27 shows the results of this measurement.

Table 4.27: Benefits of Telemedicine

Variable	*Description*	*Valid N*	*Mean*	*Confid. (-95%)*	*Confid. (+95%)*	*Std. Deviation*	*SK (Skewness)*
95	Urban communities will benefit more from the implementation of telemedicine than rural communities.	28	2.964	2.610	3.390	1.052	-0.102
107	Telemedicine has both social and economic benefits	28	4.071	3.780	4.220	0.593	0.361
	Mean for Population		***1.607***				

Table 4.27 illustrates that 95% of the respondents feel that, telemedicine has both economic and social benefits for both urban and rural communities. This indicates that the delivery of primary health care services is also not adequate in urban areas. Open-ended questions provided the variety of following answers.

Economic benefits include:

- Access to primary health care services for rural areas.
- Cost improvement in service delivery.
- Using scarce human resource more effectively.

- Socio-economic development.
- Network maintenance, which will provide job creation as a spin-off.
- Urban economies will benefit from the supply of equipment to rural areas.
- Rural opportunity for business development.
- Rural primary health care costs will become cheaper.
- Rural patients will not have to travel long distances for primary health care services.
- Fewer referrals and less separation of patients from their families.
- Reduced primary health care operating costs.

The most significant economic loss is that there will be fewer qualified doctors in remote areas.

Social benefits include:

- Support and empowerment of rural primary health care providers.
- Using technology to improve health care services.
- Improving the health of citizens.
- Improved diagnosis will result in improved life style.

Social losses are primarily related to fear of job losses.

4.5.8.5 Perceived economic benefits

One statement was used to gauge the perceived level of economic benefits from the respondents. Table 4.28 shows these results.

Table 4.28: Perceived economic benefits

Variable	*Description*	*Valid N*	*Mean*	*Confid. (-95%)*	*Confid. (+95%)*	*Std. Deviation*	*SK (Skewness)*
97	I believe that telemedicine services will reduce the cost associated with erroneous referrals in both urban and rural environments.	28	4.071	3.780	4.220	0.593	0.361
	Mean for Population		***4.071***				

According to table 4.28, 98% of the respondents believe that telemedicine will reduce the costs associated with erroneous referrals in both urban and rural areas (4.071).

4.5.8.6 Telemedicine investment approach

A set of three statements were designed and used to find the appropriate investment approach for telemedicine implementation from the respondents. Table 4.29 presents the results in t his regard.

Table 4.29: Telemedicine investment approach

Variable	Description	Valid N	Mean	Confid. (-95%)	Confid. (+95%)	Std. Deviation	SK (Skewness)
98	I believe that telemedicine projects should be funded by the government only.	28	2.964	2.610	3.390	1.052	-0.102
99	I believe that there should be collaboration with micro-financing organisations for telemedicine implementation.	28	3.750	3.621	4.379	1.022	-0.734
100	The use of low-cost information appliances for telemedicine in rural areas should be promoted.	28	3.821	3.671	4.329	0.889	-0.603
	Mean for Population		**3.512**				

It is evident from the above table that 70% of respondents feel that government alone should not be responsible for funding telemedicine implementation (2.94). About 95% of respondents are of the opinion that there should be other sources of financing (3.75) and that low-cost information appliances must be used for telemedicine in rural areas (3.8).

4.5.8.7 Approach to infrastructure development

A set of statements were used to establish an appropriate approach to infrastructure development in accordance with the view of the respondents. Table 4.30 illustrates the relevant results.

Table 4.30: Approach to Infrastructure development

Variable	Description	Valid N	Mean	Confid. (-95%)	Confid. (+95%)	Std. Deviation	SK (Skewness)
101	I believe that parastatal institutions such as Eskom, Dennel, Transnet, and Telkom, can utilise their existing remote / rural infrastructure for telemedicine.	28	4.393	3.771	4.329	4.229	1.908
102	I believe that the internet based telemedicine networks are cost effective.	28	3.964	3.650	4.350	0.944	-0.113
103	Internet-based network services are feasible and economically viable.	28	3.964	3.650	4.350	0.944	-0.113
105	I believe that the type of technology to be deployed for telemedicine will have a significant impact on the cost of infrastructure.	28	4.071	3.780	4.220	0.593	0.361
	Mean for Population		**4.098**				

Table 4.30 shows that 90% of the respondents believe the utilisation of the infrastructure of parastatals should be used for the rural application of telemedicine (4.39). About 40% of the respondents are uncertain about using internet-based networks for telemedicine application for economic benefit (3.96). However, 99% of the respondents believe that the type of technology used will have an impact on the cost of infrastructure.

4.5.8.7 Telemedicine economic sustainability

One statement was used to determine the core factors for the economic sustainability of telemedicine services in South Africa. Table 4.31 shows these results.

Table 4.31: Core factor for sustainability of telemedicine

Variable	*Description*	*Valid N*	*Mean*	*Confid. (-95%)*	*Confid. (+95%)*	*Std. Deviation*	*SK (Skewness)*
104	The sustainability of telemedicine services depends on guaranteed revenue returns and not on donor funding.	28	3.821	3.765	4.244	0.658	-0.815
	Mean for Population		***3.821***				

Table 4.31 makes it clear that about 90% of the respondents believe that the sustainability of telemedicine services depends on guaranteed revenue returns and not on donor funding.

4.5.8.8 Identifying telemedicine needs (supply vs demand)

This section was used to identify the degree of demand for telemedicine services among the respondents. The results are illustrated in Table 4.32.

Table 4.32: Identifying telemedicine needs

Variable	Description	Valid N	Mean	Confid. (-95%)	Confid. (+95%)	Std. Deviation	SK (Skewness)
108	I believe that the proliferation of private hospitals and clinics has absorbed significant service provisioning for primary health care in urban areas.	28	3.857	3.763	4.237	0.639	-0.671
109	Private hospitals and clinics offer most competitive and economic primary health care services.	28	3.214	3.588	4.412	1.113	-2.117
110	I believe that telemedicine can improve the efficiency in delivering primary health care services for public and private hospitals and clinics.	28	3.821	3.765	4.244	0.658	-0.815
	Mean for Population		**3.631**				

85% of the respondents felt that private hospitals and clinics have absorbed significant service customers for primary health care in urban areas (3.85). About 40% of respondents do not believe that private hospitals and clinics offer most competitive and economic primary health care services (3.2). However, 95% of the respondents are of opinion that telemedicine can improve efficiency in the delivery of primary health care services in public and private hospitals and clinics (3.82).

4.5.9 Results of section G

The section was constructed to determine political, ethical, legal and social factors which must be considered for telemedicine implementation in South Africa. This section was also structured in accordance with the specific details which were investigated for the intended research purposes.

4.5.9.1 Verifying the need for telemedicine

A single statement was used to verify and validate the need for telemedicine among the respondents, as illustrated in Table 4.33.

Table 4.33: Verifying the need for telemedicine

Variable	*Description*	*Valid N*	*Mean*	*Confid. (-95%)*	*Confid. (+95%)*	*Std. Deviation*	*SK (Skewness)*
113	I believe that there is a definite need for telemedicine implementation in SA.	28	3.964	3.650	4.350	0.944	-0.113
	Mean for Population		***3.964***				

90% of the respondents were of the opinion that there is a definite need for telemedicine implementation in SA (3.964).

4.5.9.2 Preferred interface between patient and primary health care providers

Two sets of statements were used to determine the preferred interface between patient and primary health care providers. Table 4.34 shows the relevant results.

Table 4.34: Preferred interface

Variable	*Description*	*Valid N*	*Mean*	*Confid. (-95%)*	*Confid. (+95%)*	*Std. Deviation*	*SK (Skewness)*
114	I prefer to interact with the patient/doctor on a face-to-face mode and not remotely.	28	3.643	3.640	4.360	0.972	-1.103
115	I believe that telemedicine will reduce the distance and isolation in the patient-practitioner relationship.	28	4.071	3.780	4.220	0.593	0.361
	Mean for Population		***3.857***				

From table 4.34 it is evident that 70% of the respondents preferred to interact with the doctor/patient on a face-to-face mode (3.64), or that the human interface was still preferred. Thus, telemedicine as technology still needs to be adopted by people. The results also show that 49% of the respondents were felt that telemedicine would not reduce the patient-doctor distance.

4.5.9.3 Perceived telemedicine quality

One statement was used to determine the perceived telemedicine quality from the respondent's point of view, as shown in Table 4.35.

Table 4.35: Perceived telemedicine quality

Variable	*Description*	*Valid N*	*Mean*	*Confid. (-95%)*	*Confid. (+95%)*	*Std. Deviation*	*SK (Skewness)*
116	I believe that telemedicine services can deliver acceptable quality standards for primary health care services.	28	3.571	3.637	4.363	0.979	-1.313
	Mean for Population		***0.000***				

The above data indicates that 98% of the respondents believe that telemedicine services can deliver acceptable quality standards for primary health care services (3.571).

4.5.9.4 Buy-in or lobbying among patients / primary health care providers

One statement was used to determine the buy-in or lobbying among patients / primary health care providers. Table 4.36 shows the responses to this statement.

Table 4.36: Patient/primary health care provider lobbying

Variable	Description	Valid N	Mean	Confid. (-95%)	Confid. (+95%)	Std. Deviation	SK (Skewness)
117	I do not believe that medical services should be delivered by means of technology such as telemedicine.	3.643	3.640	4.360	0.972	-1.103	
	Mean for Population		1.820				

Thus, 90% of the respondents believe that telemedicine technology can be used to deliver primary health care services (3.64).

4.5.9.5 Measuring political barriers to telemedicine implementation

One statement was used for measuring political barriers to telemedicine implementation, as illustrated in Table 4.37.

Table 4.37: Political barriers to telemedicine implementation

Variable	Description	Valid N	Mean	Confid. (-95%)	Confid. (+95%)	Std. Deviation	SK (Skewness)
118	I believe that there are other sources of barriers to the implementation of telemedicine (e.g. pharmaceutical	28	3.143	2.633	3.367	0.990	0.433

	industry).						
	Mean for Population	***3.143***					

In Table 4.37, 90% of respondents believed that there are other sources of barriers (3.14), such as:

- Private practitioners.
- A lack of staff trained to utilise the technology.
- Resistance to the level of telemedicine that is desired to be achieved.

4.5.10 Results of section H

This section was constructed to identify crucial factors regarding the management of telemedicine information. This section was also organised in accordance with the specific details which were explored for the intended research purposes.

4.5.10.1 Management of data storage

Three statements were used to determine the critical issues to be considered for the management of data storage applicable to telemedicine services. Table 4.38 illustrates these responses.

Table 4.38: Management of data storage

Variable	*Description*	*Valid N*	*Mean*	*Confid. (-95%)*	*Confid. (+95%)*	*Std. Deviation*	*SK (Skewness)*
120	I believe that the archiving of information is essential for effective and efficient services (e.g. X-rays).	28	3.643	3.640	4.360	0.972	-1.103
121	The storage of electronic information through telemedicine will make information easily accessible for health care providers.	28	3.821	3.765	4.244	0.658	-0.815
122	I am concerned about the utilisation of archived information for purposes other than its original purpose.	28	3.964	3.650	4.350	0.944	-0.113
	Mean for Population		***3.809***				

The results in the above table show that 98% of respondents believe that the archiving of information is essential for effective and efficient primary health care services (3.64). The same percentage of respondents (98%) believes that stored data through telemedicine services facilitates easy access to primary health care services. Comments were made to the effect that this information (data warehouse) could be used for other purposes of medical research studies. However, 40% of the respondents were concerned about the utilisation of archived information for uses other than its original purpose (3.964).

4.5.10.2 Strategic planning of data management and recovery

This section was used for determining the core factors to be considered for strategic planning of data management and recovery applicable to telemedicine services. Table 4.39 shows these responses.

Table 4.39: Strategic planning of data management and recovery

Variable	*Description*	*Valid N*	*Mean*	*Confid. (-95%)*	*Confid. (+95%)*	*Std. Deviation*	*SK (Skewness)*
123	It is important to implement the disaster recovery plan.	28	4.071	3.780	4.220	0.593	0.361
124	There should be contingency plans for managing information used in telemedicine applications.	28	3.536	3.598	4.402	1.085	-1.284
	Mean for Population		***3.804***				

99% of the respondents believed that a disaster recovery plan and contingencies should be in place as part of information management in telemedicine applications (3.53).

4.5.10.3 Sensitivity and importance of data / information management for telemedicine application

A single statement was used to identify the most important aspects of data/information management for telemedicine application. The responses are depicted in Table 4.40.

Table 4.40: Sensitivity of data management

Variable	*Description*	*Valid N*	*Mean*	*Confid. (-95%)*	*Confid. (+95%)*	*Std. Deviation*	*SK (Skewness)*
125	I believe that telemedical information should be managed in real time (e.g. video-conferencing), and that it should not be stored and forwarded	28	4.536	4.815	5.185	0.499	-2.793
	Mean for Population		***4.536***				

In this case the results show that 100% of the respondents believed that it is crucial to treat information as real-time data (video conference) rather than to store and forward it. This may be attributed to the premium placed on live/real-time diagnosis for medical practice, such as in the event of an operation, where there is no room for errors.

4.6 CONCLUSION

The chapter presents the results of the empirical study conducted among the targeted audience, both those who are actively involved in the telemedicine implementation and those who are passive role players. The objective of the research is to develop a formula based on the results of the research study which can provide a solution to the concerns indicated in the problem statement. The formula will demonstrate the value which parastatals can add through their participation in the national telemedicine implementation programme. In the first part of the chapter attention was paid to the development and structure of the two questionnaires which were developed for the purpose of the research. The first questionnaire was aimed at extracting information from the primary health care providers regarding all aspects discussed in the literature review.

The second questionnaire was aimed at primary health care providers and dealt with the relevant aspects of telemedicine. Except for a few open questions, a five-point Likert scale was used.

In the second part of the chapter the process of data collection, the response rate and the results were discussed. Data was collected by means of questionnaires that were distributed and collected personally and via e-mail and fax. The overall response rate was 80%.

The results of three questionnaires were processed statistically. Frequency tables were drawn up, arithmetic means, 95% confidence levels, standard deviations and skewness were calculated. The results were then presented in tables and graphs according to the eight sections of the questionnaires. Every table and graph according was discussed to point out certain tendencies in the results.

In the next chapter, conclusions and recommendations based on these results of the empirical study will be provided.

CHAPTER 5
CONCLUSIONS AND RECOMMENDATIONS

5.1 INTRODUCTION

In this final chapter recommendations and conclusions are presented based on the literature study in chapter 2 and 3 and the empirical study conducted in chapter 4. The most important findings of the literature study as well as the interpretation of the results of the imperial study are indicated. Conclusions about the research are made and recommendations are suggested regarding a practical and feasible telemedicine framework and plan based on appropriate technology and business models. The following conclusions and recommendations are presented:

- Conclusions arrived at as a result of the analysis of the biographical and demographical data.
- Conclusions with regard to statement and questions where respondents indicated various problems and issues on telemedicine.
- Recommendation for an overall telemedicine framework and plan for implementation in South Africa and possibly in Sub-Saharan Africa.

5.2 RESEARCH PROBLEM

Telemedicine has been identified by the government as a strategic tool in order to improve the delivery of health care and training services to remote rural areas in South Africa. The focus of telemedicine as currently adopted by the government is mainly on telehealth and tele-education. Telemedicine encompasses all aspects of health care, from diagnoses and management to the continuing education of health care professionals whenever distance is involved (Wainwrigth & Wootton, 2003:567-573). Previous research studies have highlighted the importance of telemedicine services, but tangible technology and business models have not been highlighted. This research seeks to highlight the formula for these models and emphasises the involvement of parastatals as key stakeholders.

5.3 PURPOSE OF THE STUDY

As highlighted in the previous section the main objective of the study is to develop a model based on the results obtained in chapter four of the research study. The model demonstrates the value which parastatals can add through their participation in the telemedicine implantation programme.

5.4 METHOD

5.4.1 LITERATURE STUDY

To establish a sound theoretical background a literature study was performed of seven major aspects of telemedicine.

5.4.1.1 Traditional information support

Chapter 2 pointed out on modern routine data or information collection practices which could replace traditional non-economic practices. Modern practises consist of computer supported sampling techniques. A relatively simple computer support to the admission, discharge and transfer functioning in hospitals and the equivalent in the health centre could eliminate and improve in accuracy the time and cost of manually maintaining statistical forms. A higher level of sophistication of the uses of telecommunications is that of actual examination and care of a remotely located patient. This function is known as telemedicine, which is an important and growing field and is expected to change many of the tradition approaches in health care (Mitchell, 1998:3). According to Mitchel (1998:3), telemedicine as a form of technology can be used to bridge the distance between the health care provider (professional) and the consumer (patient).

5.4.1.2 Rationale for Telehealth and Telemedicine

Chapter 2 emphasised that nearly all counties have been involved in some form of reformation of the respective health sectors. The common rationale for such reform is how to meet the problems and challenges of inadequate health sector resources that are

diminishing while the population's expectations and demands for quality health care services are rising. It was highlighted that the cost of health care increases to such an extent that government which have had major burden of funding the health care services and schemes are unable to meet the requirements and demands of their populations. These demands are twofold and appear contradictory: to provide equitable access to health care services, and to reduce or at least control the increasing cost of health care services. This introduces a couple of measures to be taken to sustain health care services, which ultimately leads to the topic of telemedicine. However, the question arose as to how telemedicine practically contributes to the improvement of the quality and coverage of health care services in a cost efficient manner. In response to this issue the sustainability of telemedicine was the emphasis of the study. It was highlighted that telemedicine could address the problem in the following manners:

- Telemedicine could enable general practitioner who for an example is located in rural settings to seek and obtain a second or an expert opinion from colleagues located for in a national speciality hospital or anywhere else in the world.
- Telemedicine could enable a remotely located health worker to obtain technical guidance over physician to attend to a patient.
- Telemedicine could enable the sharing of the uses of pooled equipment that is centrally located and often not affordable to smaller health care institutions.

5.4.1.3 Essential prerequisites of telemedicine system

A simple model was discussed which applies telemedicine links over any distance between nations or positions. There will be professionals at both ends, namely the requestor and the provider ends. For a medical consultation at each end they need telemedicine resting on a telecommunication infrastructure. It was highlighted that what could make a difference and thus determine the extent of medical care to be supported this way are the power and speed of the telemedicine peripheral and telecommunications lines.

5.4.1.4 International experiences of Telemedicine

This research study does not suggest that telehealth or telemedicine services are more effective than tackling the basic causes of poor health, such as poverty, lack of clean

water, basic nutrition and sanitation. If these resources were available, then eliminating the basic causes of poor health would be the undisputed priority. It was emphasised that telemedicine is the means by which the uses and value of existing or relatively smaller additional resources could be optimised.

Several practical applications of telemedicine in African and European countries were cited (chapter 2, section 2.4.1), where telemedicine was implemented through managed programmes. These experiences were used to compare and contrast the approach used in the implementation of telemedicine in South Africa.

Some studies, according to ITU (2003:3), point out the inadequacy of telecommunication infrastructure and service in many developing countries as increasingly being a major impediment to the implementation of telemedicine. Virtually all major indicators, such as GDP per capita, teledensity, human development index, literacy, power consumption, child mortality and life expectancy are prominent in developing countries. It was indicated in chapter 2 that counties such as Norway have one of the broadest ranges of telemedicine applications which are routinely used in day-to-day health care and that the same facilities are used for continuous medical education courses through tele-education.

5.4.1.5 Telemedicine applications

According to the Department of Health (1998:6) the current applications of telemedicine include:

- Interactive video conferencing to diagnose, treat, and consult patients over a distance, especially those living in rural areas. Typical applications include telepsychiatry, remote surgery and interactive examinations.
- Storage and transmission of patient records to aid diagnostic treatment and to increase the speed at which such information can be made available to health care providers.
- Image compression for efficient storage and retrieval of image data.
- Medical education and training.

5.4.1.6 Benefits of Telemedicine

In chapter 2, section 2.8, telemedicine benefits were cited. The most important benefit is that the patient and doctor need not be in the same geographical location, which has several advantages for providing high quality health care to rural areas. The ability to provide medical services over any distance is also seen as a way to solve the uneven distribution of medical services among different communities.

In addition to the benefits identified in chapter 2, technology used for telemedicine may also be used as a tool for delivering education to health care professionals. Training in new techniques and technologies can be enhanced through a telemedicine network. In addition, contact with other professionals through video conferencing reduces the sense of professional isolation for those who work alone.

It was cited that reduced costs are also associated with some aspects of telemedicine. Travel costs for both patients and medical professionals can be greatly reduced. Telemedicine can also cut costs by decreasing the duplication of services, technologies, and specialists. Based on the Eastern Cape pilot project discussed in section 3.11.2 and the business model in section 3.10, an illustration of revenue reimbursement and cost reduction for primary health care was provided.

5.4.1.7 Barriers

Currently telemedicine is not widely used, although it could improve the overall quality and delivery of health care, equalise the distribution of resources and services, and reduce costs. This is because there are still substantial barriers to the implementation of telemedicine, such as:

- infrastructure planning and development;
- telecommunications regulations;
- reimbursement for telemedicine services;
- licensure and accreditation for medical personnel;
- malpractice liability and

- privacy of patient records.

These barriers have been ascribed to a lack of rigorous research and a proper evaluation of telemedicine. Other impediments were identified as human dimensions that limit its utilisation, including a lack of acceptance by both professionals and patients (Stanbery, 1998:72). Professionals fear the loss of their position and status and also worry about their lack of training in the use of advanced technology. Patients, on the other hand, want to be assured that they are receiving care from a certified professional and that their medical records remain confidential (Stanberry, 1998:75). Finally, it was pointed out that despite some proof to the contrary, hard evidence is lacking to show that telemedicine saves money. It was stated that most telemedicine programmes did not survive when external funding sources were withdrawn, because most of these programmes could not be justified on a cost befit basis; hence the question of sustainability remained.

5.4.1.8 Licensure

Chapter 2 covered the licensure problems experienced from the international scene, which included policies that failed to generate anticipated telemedicine results because physicians, professionals, cannot be told where to locate their practices. In contrast, telemedicine offers a solution whereby physicians may render their services electronically, relatively unhindered by the location of their practice or geographic distribution of patients.

5.4.1.9 Social implications

It has been highlighted in chapter 2 that social issues surrounding telemedicine include questions such as, given that health care is a right, whether telemedicine services may reasonably be withheld anywhere where there is access to telecommunications, and who will be allowed to provide telecommunication services. Some of the social issues included telemedicine concerns about the reduced comfort of human interface between a patient and a doctor. However, in some instances patients reported being more self-assured and better focused without the physician being physically in the room.

Whereas younger patients readily accepted telemedicine as a mode of health care delivery, many older rural patients were uncomfortable with the presence of cameras, computers and recorders during their examination. One of the challenges cited was the fact that the introduction of telemedicine in rural communities depended on a human factor. Physicians, especially older ones, were set to be typically burdened with tasks of treating patients and are reportedly resistant to using telemedicine technology (Peterson, 1995:9). Another issue cited is that technical systems may be poorly adapted to the human infrastructure of health care. It was mentioned that sustainable telemedicine programmes also require attention to organisational business objectives and strategic plans that are not always evident in current applications (Peterson, 1995:9).

5.4.1.10 Economic implications

An important premise of telemedicine is that affordability of health care leads to increased access to health care, which will in turn lead to the increased utilisation of health care and, thus, a healthier population. Managed health care plans realise the financial potential of using telemedicine applications in concentrated patient areas. This system, as discussed in chapter 2, presents an opportunity for organisations to use telemedicine as a means to market their highly specialised clinicians internationally.

Home telemedicine, which enables ambulatory patients to live at home under the supervision of home health nurses, is viewed as effective in reducing costs that may be occurred by expensive in-patient stays in nursing home facilities (Whitten & Kingsley, 2000:5).

According to the literature studied in chapter 2, clinicians may see telemedicine as an economic threat due to increased competition, structural alliances, and surpluses of some categories of health professionals. In addition, the current lack of payment for telemedicine service is considered to be one of the major barriers to its deployment. Most third party payers have taken a "wait and see" approach toward telemedicine reimbursement. Very few private payers cover telemedicine consultation services, although most cover radiology and imaging services (Grigsby et al., 1995: 118). In the managed care arena, telemedicine is seen as a tool that could help manage the medical and financial risks of providing patient care in rural and undeserved areas.

Other economic considerations include the cost of equipment and of information transmission. It has been noted that a major impediment to the widespread implementation of telemedicine in rural areas is the lack of resources for the acquisition of appropriate telecommunications equipment (Western Governors' Association,1996:7). The cost of transmission will vary based on bandwidth, frequency of use, and distance (Hakansson, 2002:135). While the cost of such services may be incorporated into the fee for a service, it raises the more looming issue of whether the additional benefits provided to patients and health care providers by telemedicine are worth the potential additional costs of providing the service. This, in particular, is of concern to the Medicare and Medicaid programmes, which face constant threats to their financial solvency.

5.4.1.11 General Information on telemedicine knowledge and status in SA

The literature review primarily concentrated on the objectives of telemedicine as adopted by the government, namely to deliver health care services to rural communities and supplemented services such tele-education and improved access to information for rural communities. However, for the purpose of the study not only rural communities were targeted but also the urban application of telemedicine. Telemedicine as adopted by the South African government is broadly defined as the use of information and telecommunication technology to provide medical information and services over a distance.

The implementation plan was discussed in chapter 2, which also covered the approach of split phases 1, 2 and 3. All three levels of primary health care institutions are to be connected through telemedicine technology for implementation of the services. It was pointed out in chapter 2 that level 2- and 3-institutions have been linked through telemedicine services, but that the main objective of connecting level 1 (mostly rural clinics and hospitals) has not been achieved.

This brought into light the barriers and most critical success factors to be considered for the successful implementation of telemedicine in South Africa. The barriers and critical success factors pointed mostly to two important factors, namely the business and technology approach models to be used for telemedicine implementation. The literature

review in chapter 3 demonstrated how appropriate models could be used for the implementation of sustainable telemedicine services in South Africa. At this stage, it is important to emphasise that the models which were discussed were mainly applicable to the participation of parastatals in the implementation of the telemedicine programme in South Africa. The participation of parastatals such as Eskom was discussed in detail. This chapter also covered the establishment and usage of existing infrastructure for cost sharing purposes in order to reduce the input cost for telemedicine infrastructure.

To achieve this, technology and business strategies were discussed in detail. Market and industry analyses in the medical fraternity were discussed and analysed through proven theoretical models, such as Michael Porter's five force model and technology product and life cycle models applicable to telemedicine implementation.

Based on this approach a questionnaire was designed to collect empirical data, and this is discussed in short in the next section.

5.4.2 EMPIRICAL STUDY

The purpose of the empirical investigation was to test the literature and to find practical solutions to the problem. The approach was to demarcate areas to conduct the empirical research and to apply these findings to the national situation. These demarcated areas consisted of active sites where telemedicine has been implemented and include Mpumalanga, the Eastern Cape and to a lesser extent KwaZulu-Natal, as explained in chapter 4.

The empirical study was done by means of a field study which included two structured questionnaires on telemedicine. The objective of the field study was to determine the state of the telemedicine implementation programme in South Africa.

The theoretical knowledge gained from the literature study (chapter 2 to 4) was used to develop two preliminary questionnaires, which were tested by means of a pilot study. Two final questionnaires aimed at two groups or categories were designed, namely primary health care providers and primary health care consumers.

The questionnaires were distributed and collected personally or by e-mail and fax. The results of two questionnaires were processed statistically. Frequency tables were drawn up, arithmetic means, 95% confidence levels, standard deviations, skewness, and correlations of coefficient were calculated and presented in tables and graphs in chapter 4 (section 4.5).

5.5 RESULTS AND CONCLUSION

Based on the theory of the ideal telemedicine system (chapter 2 to 3), it is now possible to determine the gap, problem areas and issues of telemedicine implementation in South Africa. This gap can be used to provide government and other stakeholders with a conceptual framework and recommendations for sustainable telemedicine implementation in South Africa.

5.5.1 BIOGRAPHICAL AND DEMOGRAPHICAL INFORMATION: SECTION A

The biographical data of the total number of respondents was analysed by means of a correlation analysis. From the correlation analysis of the biographical data the following positive and negative correlations with a 95% level of confidence became evident:

- There is a positive correlation between the level of education (honours, master's degree) and the age (28 to 43 years) of the primary health care providers. The older the professionals have a higher level of education.
- About 79% of respondents are primary care professionals and close to 71% of the industry is made up of is public/government-orientated sectors.
- About 72% of respondents are employed and 79% of these occupations are doctors, nurses, social workers and practitioners employed in government sectors.
- About 50% of the respondents have experience with computers and around 53% have access to a fixed telephone line, the internet, a cellular phone and television.

A negative correlation was found with regard to location and computer literacy. 14% of the respondents had no computer experience and 14% had very little computer experience (a total of 28%). Since 50% of the respondents lived in an urban area, one would have expected the percentages to be more or less the same, as respondents in

urban areas could be expected to be more computer literate. It may thus be concluded that computer literacy in urban areas is not proportional to the population size.

5.5.2 TELEMEDICINE ANALYSIS IN SOUTH AFRICA: SECTIONS B, C, D, E, F, G AND H

The analysis in chapter 5 identified a number of problems with compounding factors. These problems and compounding factors will be presented according to the various aspects of telemedicine discussed in chapters 2 and 3.

5.5.2.1 Awareness and knowledge of telemedicine in SA

Telemedicine is still in its development stage in South Africa, as indicated in the technology portfolio model discussed in chapter 3 (3.6) it is evident from the empirical research that it is in the niche phase/quadrant. Consequently, the custodians/government should be fully committed to research and development, to pushing the limits of the telemedicine development product process, and to investing in new technology equipment. Most of the respondents were relatively familiar with telemedicine technology, but (as discussed in chapter 3 (3.2.2), the diffusion speed has not increased, because the product is still in its uncertainty stage and most of the potential investors in the value chain are sceptical about the success of the product.

5.5.2.2 Source of telemedicine information

To increase awareness of the product, strategic tools are required in a form of communication media. This implies that sources of communication other than those specified in the questionnaire should be used, such as advertising media, to draw attention to innovative means of delivering primary health care. This will in turn encourage potential custodians in the value chain to provide information to everyone, including the public. Chapter 2 dealt with the importance of thorough telemedicine research, which requires information resources for proving the value that telemedicine can add to delivering primary health care services (2.8).

5.5.2.3 Progress of telemedicine implementation

There has been significant progress in telemedicine implementation, as shown by the results in chapter 4. However, as anticipated by the government implementation plan (2.9), the progress to date has not achieved the initial targets. It is anticipated that the final implementation of telemedicine will be completed over more than five years. This may be attributed to the fact that technology adoption or diffusion speed has not increased, due to uncertainty about technology product success (3.2.2) and other reasons, such as fear of technology (2.12).

5.5.2.4 Approach on resource planning and responsibility

The responsibility of pursuing telemedicine implementation should lie with the government as the main custodian. It was clear that the involvement of parastatals (2.2.4) and the business model approach (3.10) will enhance the chances of a successful implementation of telemedicine, and it will thus increase the speed of technology diffusion or adoption (3.2.2).

5.5.2.5 Identifying the involvement of other key stakeholders

Other stakeholders in the process who should get involved include role players in the private sector, such as suppliers and potential investors in the medical industry value chain. The results showed that the participation should remain local rather than international. This might be seen as a barrier, due to cost effectiveness and social requirements for different local terrain experiences, as discussed with reference to Porter's five forces model in chapter 3 section 3.9.9.

5.5.2.6 Validating the implemented sites and structures

Active telemedicine sites have been confirmed, but there is limited knowledge about these sites among other stakeholders, thus necessitating effective communication. However, implementation in rural sites as planned by the government's implementation plan must still take place (2.9). This is the main challenge, as pointed out in chapter 1 section (1.2) and also the objective of this research study section (1.3).

5.2.2.7 Barriers to the implementation of telemedicine

Barriers to telemedicine implementation included the availability of specialists/practitioners, training of key role players (such as health care providers) in technology, start-up costs, support and management and lack of human resources . As made clear in chapters 2 and 3 (2.10, 3.10), these barriers were experienced internationally. Barriers which are unique to the implementation of telemedicine in South Africa included the following:

- A lack of information and communication technology (ICT) infrastructure in South Africa.
- Very low teledensity in Sub-Saharan Africa, with 10 telephone lines per 100 people).
- Very low gross domestic product costs per capita for primary health care in Sub-Saharan Africa.
- First-world technology and devices have to be implemented differently in a Third-world environment than in a First-world environment.

Due to factors such as social differences, South Africa experiences different barriers to telemedicine implementation than those experienced elsewhere in the world.

5.2.2.8 Comparing local administrative barriers with international barriers

Some administrative barriers discussed in chapter 2 (2.10, 2.11 and 2.14), such as licensure and accreditation, are not applicable to South Africa. However, the results show that infrastructure planning and development (2.22) and telemedicine reimbursement (2.13) are common barriers to telemedicine implementation.

5.5.2.9 Critical success factors

Critical success factors consisted of a combination of social and economic factors required to successfully implement a telemedicine system in South Africa. These included:

- Government buy-in and community support and maintenance
- Technology training
- Sustainability.

The following aspects of implementation could be managed differently than in previous undertakings:

- Co-ordination and communication of all role players
- Good site selection and training
- Budgeting upfront
- Accountability and ownership by all stakeholders, including the communities.
- Infrastructure development.

Furthermore, the following requirements must be complied with:

- The project should begin at a national level, then proceed to a provincial level and finally be taken to a municipal and community level.
- There must be adequate planning, training and budgeting.
- The project must be started at a small scale and grow when necessary within identified areas.
- Sustained funding must be available.
- Technology must be user-friendly.

The following critical success factors for telemedicine implementation have been identified internationally:

- The availability of adequate resources (budget, human resources and expertise)
- Availability of start-up costs
- Attained ownership

- User commitment on projects.

Unique critical success factors which affect the implementation of telemedicine in South Africa include:

- Understanding the rural environment
- Communication with all stakeholders
- The availability of a budget
- Planning of ICT infrastructure sharing with other government structures, such as parastatals and NGOs.
- Human resources and sustainable revenue returns through the Department of Health and other stakeholders
- Improvement of literacy through investing in education.

Certain critical success factors were identified by means of the empirical results, and were compared and contrast with the results of the literature study in chapter 2 (2.10, 2.11 and 2.14) as administrative barriers and planning issues (2.22 and 2.13). The success factors also indicate that social and economic factors must be addressed for the successful implementation of telemedicine.

5.5.2.10 Measuring and identifying critical success factors applicable to South Africa

A marketing approach is required to promote and position telemedicine in the value chain, as covered in the business model approach (3.10). This approach would be vital for potential key stakeholders, as this would enhance investment opportunities.

5.5.2.11 Telemedicine administration according to best practises

In this regard strategic planning is seen as key to best administration practices. Other important features are simplicity, training and support structures (2.7).

5.5.2.12 identifying suitable equipment

It is essential for telemedicine equipment to comply with medical standards and social requirements such as reliability, accuracy and flexibility and user friendliness (2.7, 2.12). Freedom of choice should be exercised to select vendors as this provides flexibility to apply appropriate equipment for utilisation.

5.5.2.13 Human factors influencing application of technology

Telemedicine and its custodianship require charismatic leaders to forge the implementation of telemedicine (2.14) and to deal with political/legal and ethical issues. This is paramount to a breakthrough of the project and to the lobbying of all stakeholders.

5.5.2.14 Issues of infrastructure

Telemedicine networks should be reliable and high speed, to comply with expectations of quality of telemedicine services as proposed in the technology model approach (3.9.9).

5.5.2.15 Telemedicine cost factors

In the discussion of economic factors it was emphasised that telemedicine implementation must be economical to be sustainable (21.4, 3.10), as indicated in the business model approach.

5.5.2.16 Telemedicine ownership and motivating factors

To have enthusiastic technology or system users, a culture of ownership should be encouraged among users. This serves as a motivating factor and can reduce the resistance to technology adoption (2.12).

5.5.2.17 Telemedicine system support and structure

To implement telemedicine system support, structures such as knowledgeable and enthusiastic referral practitioners are required. Specific site co-ordinators are critical for telemedicine implementation (2.7), as is a basic health information structure.

5.5.2.18 Awareness and knowledge of security information

The fear of loss of information was not a major concern among stakeholders. However, it must be ensured that information is well managed in telemedicine (2.12). Telemedicine was initially implemented in 1998 and through experience the risk concerns have been reduced.

5.5.2.19 Key concerns about the security of information

In the literature discussed in chapter 3 (3.12) security concerns appeared to be a priority. Careful management of this issue will encourage the utilisation of telemedicine services.

5.5.2.20 Affordability and access to primary health care

It was found that primary health care is not affordable (2.3), especially in rural areas, where economic conditions are unfavourable and resources are scarce (2.10).

5.5.2.21 Cost of using telemedicine in comparison to conventional delivery of primary health care

Telemedicine is seen as an economical means of delivering primary health care services (2.13 & 3.10), according to the business model (3.10) and calculations of illustrative cumulative cost savings when utilising telemedicine for both urban and rural applications.

5.5.2.22 Economic approach for telemedicine

Utilising the existing infrastructure can reduce the cost of implementing the telemedicine services in South Africa, especially for rural application (3.10). This necessitates fast tracking of ICT infrastructure for telemedicine implementation and is achievable by involving parastatals and utilising their existing infrastructure (2.24).

5.5.2.23 Measuring the benefits of telemedicine

Telemedicine has both economic and social benefits for both urban and rural communities (3.10). It was also indicated that the delivery of primary health care services is not adequate in urban areas. Open-ended questions provided the following responses in this regard:

Economic benefits include:

- Access to primary health care services for rural areas.
- Cost improvement in service delivery.
- Using scarce human resources more efficiently.
- Socio-economic development.
- Network maintenance, which will provide job creation as a spin-off.
- Urban economy will gain from the supply of equipment to rural areas.
- Rural opportunity for business development.
- Rural primary health care will become cheaper.
- Rural patients will not have to travel long distances to get access to primary health care services.
- Fewer referrals and less separation of patients from their families.
- Reduced primary health care operating costs.

Economic losses include fewer qualified doctors in remote areas.

Social benefits include:

- Support and empowerment of rural primary health care providers.

- Using technology to improve health care services.
- Improving the health of citizens.
- Improved life style through accurate diagnosis.

Social losses concern fear of job losses.

The above responses may be contrasted and compared with the benefits highlighted in chapter 2 (2.8).

5.5.2.24 Approach to investment in telemedicine

Telemedicine may become sustainable through guaranteed revenue returns (2.13), and to that end business models were considered in chapter 3 (3.10).

5.5.2.25 Identifying needs (supply vs demand)

There is an element of competition in the medical industry and it was indicated that private hospitals and clinics have absorbed significant service customers for primary health care in urban areas. Some competitors include pharmaceutical companies, as pointed out in chapter 3. Michael Porter's five forces model is applied to asses the competitive model of telemedicine (3.9.9). However, respondents do not believe that private hospitals and clinics offer the most competitive and economic primary health care service. There is therefore a need for telemedicine implementation for both public and private sectors (3.10).

5.5.2.26 Preferred patient-doctor interface

People will naturally prefer human contact, but this tendency will change in a world with changing demands. The use of technology to deliver primary health care services will eventually also be accepted (3.2.2).

5.5.2.27 Perceived quality of telemedicine

Telemedicine technology can deliver the required technology. Moreover, as proven by different technological theories and models, innovation and the speed of technology can triple in a short space of time once it has been adapted (3.2.1). This is known as "time pacing technology", and implies that the quality can always be improved exponentially.

5.5.2.28 Lobbying among primary health care consumers and providers

The willingness to adapt to telemedicine technology is dependent on the approach towards the implementation of such services. Social and economic factors, among others, must be taken into account to reduce resistance to the implementation of this type of technology (2.13).

5.5.2.29 Measuring political barriers

Other sources of barrier to telemedicine implementation include factors such as:

- Private practitioners
- Staff who are not sufficiently trained to utilise the technology
- Resistance to the desired level of telemedicine.

Because there will always competition in this industry, as in any other industry, it is important to handle social, economic and other issues with sensitivity and to know what the priorities are; otherwise issues may be politicised and the implementation plans may be met by overall resistance et al. (Cummings, 2003:46).

5.5.2.30 Management of data storage

As indicated in chapter 3 section (3.12), the management of the telemedicine information system should be carefully planned, as this will enhance the effectiveness of telemedicine business operations and strategies and will improve the sustainability of telemedicine.

5.5.2.30 Strategic planning of data management and recovery

Contingency plans should be in place for a telemedicine information system, to limit the chances of information loss and thus reduce resistance against adopting the technology (3.12).

5.5.2.31 Representation of the seven major factors which were identified (Section B, C, D, E, F, G and H)

Results of the study showed that the results of the seven factors measured in sections B, C, D, E, F, G and H of the questionnaire as a tool to reflect the importance and status of each. Table 5.1 and Figure 5.1 illustrate the results obtained in chapter 4 regarding these seven factors (4.5.4, 4.5.5, 4.5.6, 4.5.7, 4.5.8, 4.5.9, 4.5.10; see also 5.5.2)

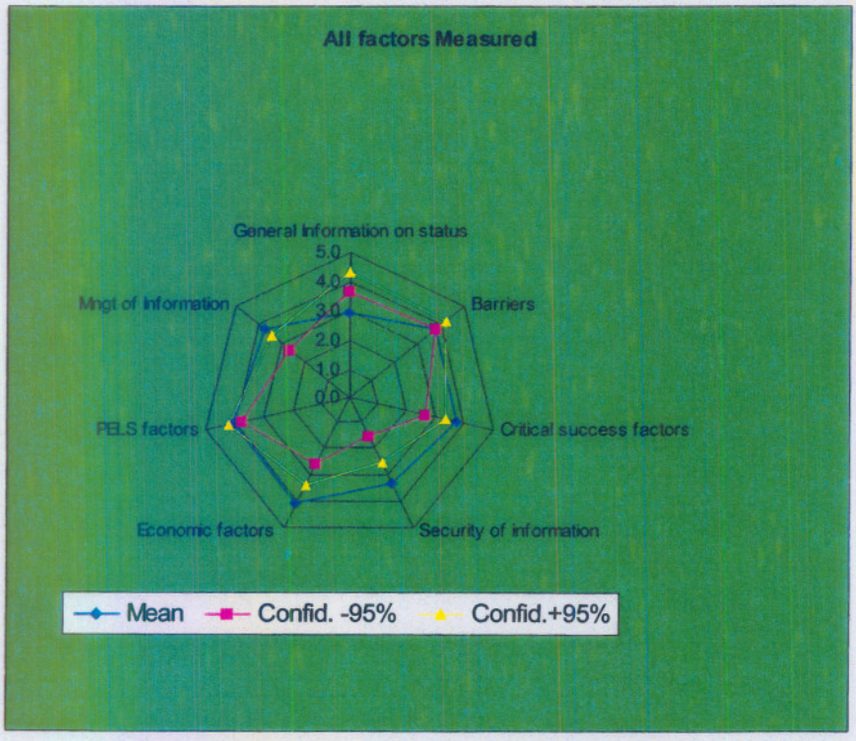
Table 5.1 Representation of seven major factors measured by the questionnaires

Variable (factors in sections)	*Description*	*Mean*	*Confid. (-95%)*	*Confid. (+95%)*	*Std. Deviation*	*SK (Skewness)*
B	General Information on status of telemedicine implementation	2.9	3.7	4.4	0.944	-0.113
C	Barriers	3.8	3.8	4.2	0.593	0.361
D	Critical success factors	3.8	2.6	3.4	0.990	0.433
E	Security of information	3.3	1.5	2.5	1.350	1.111
F	Economic factors	4.1	2.6	3.4	1.052	-0.102
G	Political, ethical, legal and social (PELS) factors	4.1	3.8	4.2	0.6	0.4
H	Management of Information	3.7	2.6	3.4	1.187	-0.361
	Mean for Population	***3.650***				

The respondents' input was used to determine the means for the factors in sections B, C, D, E, F, G and H of the questionnaire. The mean value was averaged to obtain an overall mean for each factor and, as illustrated in Table 5.1, the final mean values were obtained to reflect how each factor scored during measurement and the extent to which each factor needed to be addressed.

Figure 5.1 presents the results plotted on a radar chart, which also contains the mean value as well as the upper and lower limits of this study. The respondents could observe how each factor scored and suggests an area that needs attention in prioritised manner. These results also provided an indication of areas that would not need an immediate attention. Those would be items with a score below 3.5 on the Likert scale. Factors scoring above this point would indicate an area of great concern and would receive a high priority.

Figure 5.1 *Radar chart* – for representation of seven major factors measured from the questionnaires



It is evident that *economic* and *human (political, ethical, legal* and *social)* factors have the highest mean scores, at 4.1. These factors and possible solutions are discussed in more detail in section 5.5.2.

The next highest scores, as shown in Figure 5.1, are barriers and critical success factors to the implementation of telemedicine in South Africa (each with a mean of 3.8). These factors and possible solutions are discussed in more detail in section 5.5.2.

5.6 RECOMMENDATIONS

To successfully implement a system of telemedicine in South Africa, the government and other stakeholders will have to implement a feasible framework and plan. Eventually this plan will be translated into detailed action plans to be presented to key custodians (government) at all strategic levels. Detailed action plans, however, falls beyond the scope of this study. The framework and plan are based on the literature study in chapter 2 and are intended to fill the gap between the ideal telemedicine situation and the present telemedicine situation in South Africa.

5.6.1 A TELEMEDICINE FRAMEWORK

This research emphasised the importance of feasible business *and* technology models for the sustainability of telemedicine. The intended models will be facilitated by the participation and involvement of parastatals, who will be involved in the implementation of the last phase of the programme, namely the connection of rural hospitals and clinics (level 1) to urban or peri-urban hospitals and clinics (levels 2 and 3).

- **Consolidation of implementation plan**

A review of the implementation plan and a possible consolidation of phase 3 are required. This will require rigorous analyses of the current situation and pitfalls highlighted in the empirical findings, by application of the best practise of implementing a telemedicine system found in literature. The framework aims to introduce a simple telemedicine system, allowing primary care practitioners to conduct teleconsultations

with medical specialists via Internet connection anywhere in locally and internationally. The configuration of the telemedicine system considers both the power of the technology and the way in which it can be used to address existing problems, as well as the reality that successful telemedicine projects must balance the needs of the rural and urban community and culture with the technological and business possibilities, such that people's needs come before the desire to implement innovative technological solutions.

Individuals from the telemedicine task team with a full mandate and support structures from government must facilitate the process of development, evaluation and implementation of the individual rural and urban health and ICT development ventures. Teams should be selected in following manner:

Development team – to lay groundwork for the implementation and evaluation plan of each project. Each will consist of an individual rural or urban formation and a project will be launched for the implementation of a telemedicine system. The team should consist of stakeholders such as NHIS, DoH, MRC, USAL, CSIR, Telkom, Transnet, Eskom, Vodacom, MTN and the private sector in the form of technology suppliers and vendors.

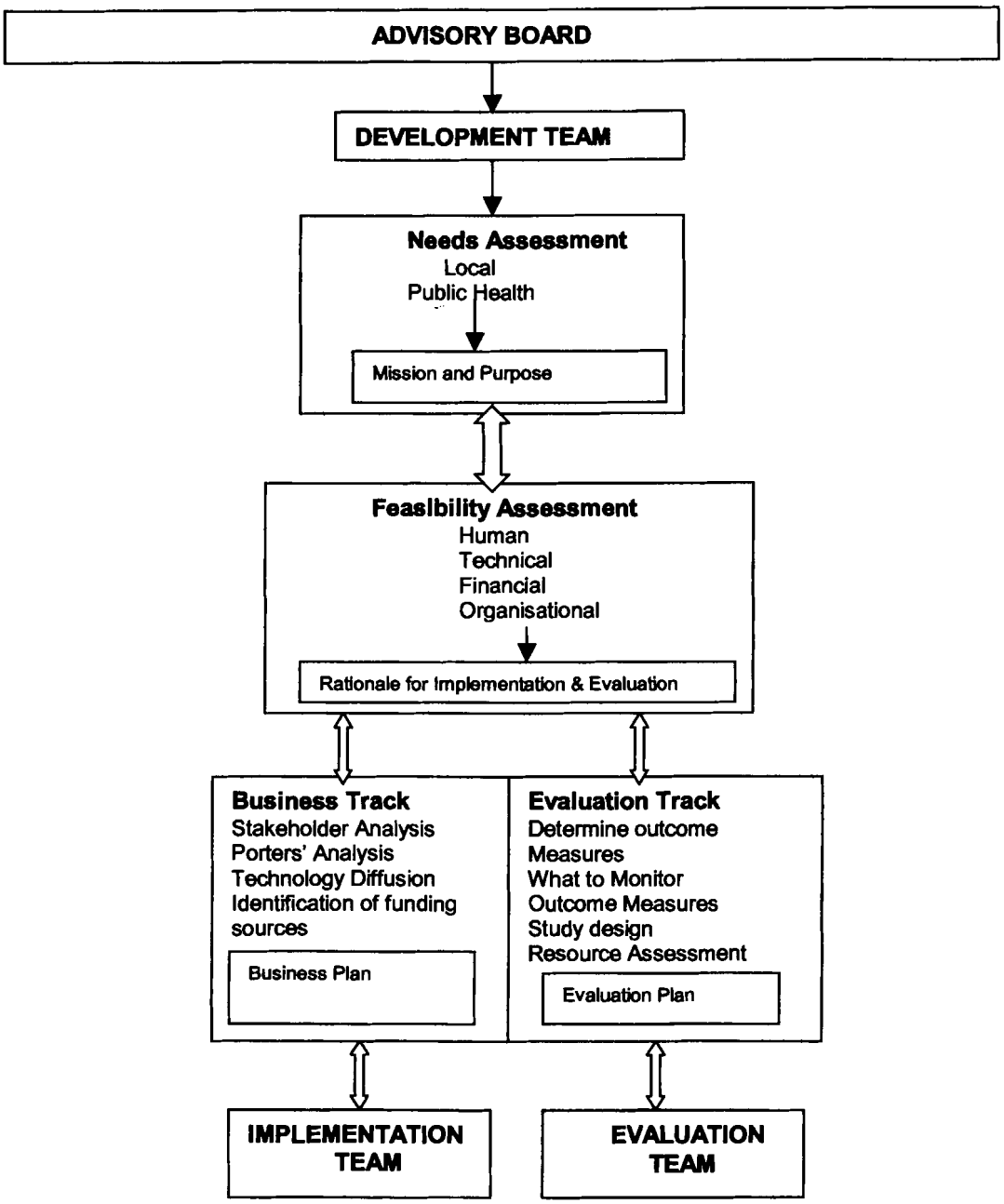
Implementation team – to introduce the project into the current health care delivery system. this should be in accordance with individual rural and urban configuration.

Evaluation team – to monitor and evaluate the impact measures and outcomes.

Advisory Board – to provide guidance throughout the entire process, including offering their networks and contacts.

A strategic approach towards devising the intended telemedicine service is presented in Figure 5.2, and is suggested as the most logical approach towards implementing the telemedicine system. For the purpose of the study only the most essential elements of this framework will be discussed.

Figure 5.2: Proposed Framework for Telemedicine implementation



Note: A Repeating cycle of *develop* → *implement* → *evaluate* will continue as the project matures.

- **Determining the target community**

Efforts should initially be focused on the target community (rural or urban), and should measure potential opportunities so that the model of the community could be used for future projects. The efforts to replicate the project model should be anticipated to lead the way to a nation-wide (large-scale) approach to integrate ICTs into health sector.

Bibliographic and demographic information for the targeted telemedicine sites should be determined for detailed analysis to be undertaken. The local economic conditions should be studied and explored and major sources of income, such as the agricultural, manufacturing and tourism sector, should be determined as well. This will provide an indication of the biggest employers in the area and will thus provide an analysis of the business opportunities and potential spin-offs from the intended telemedicine project. Local community leaders and organisations should be consulted to align their needs and future plans with the intended telemedicine project.

The terrain should be carefully studied and distances between towns and community service centres such as schools, clinics, hospitals, police stations and local markets should be determined beforehand. Statistical information on local health care services should be extracted for analytical purposes. Any forthcoming developments and sources for funding such development should be determined and aligned with the intended telemedicine project.

- **Need Assessment**

Prior to the development of and implementation of a telemedicine service, it must be established what the community in question is lacking that can be delivered via telemedicine. This should be the standard to be applied when approaching communities for telemedicine and other related projects.

- **Conducting clinical needs based on an examination of existing services**

The number of physicians, emergency medicine physicians, family practice physicians, surgeons and anaesthetist must be established. The resource availability in terms of day

and night shifts and number of physicians per patients at a time should be known. The time schedules for all clinic or hospital operations should be determined. The number of specialist physicians should be known and the number of services provided (X-rays, ultrasound) must be known, as must the time and money needed to conduct these services. This will help to determine where most of the resources are utilised and where technological tools such telemedicine applications could be best utilised.

- **Determining the referral methods**

Any formal or informal system could be investigated by means of telephone or personal interviews, but this method is often unreliable and unpredictable because it contains no standardised format for clinical texts or clinically relevant texts.

- **Determining other local health facilities and available services within the demarcated area**

It should be established which health care facilities, such as hospitals, clinics or indigenous services, are in the vicinity of the intended telemedicine site. This may present potential threats or opportunities to the intended telemedicine services in the demarcated area. Based on this information, the travelling cost and resource implications should then be determined.

- **Determining patient referrals or transfers to other facilities**

The modes and costs of transferring patients by ambulance to or from other destinations or facilities (such as hospitals) should be known. Hospital statistical data should at least include the following information, as shown in Table 5.1:

Table 5.1: Patient visits (2004 annual)

Outpatient visits	3300 (average of 14 visits per day)
Emergency room visits	759
Transferred patients	89
Inpatient admissions	(average of 1.3 admissions per day)

Birth deliveries	311
Dental visit	1209

This information should be viewed in conjunction with the type of admissions or visits (outpatients, emergency room visits, hospitalised patients and transferred patients), and this should be linked with the frequency of admissions per day.

- **Public Health Needs**

A study should be made of the current services system and the current disease burden for the country as a whole. Any means to manage these diseases through telemedicine should be explored, and may include information such as:

- Major causes of morbidity and mortality may involve image-dependent diagnoses, compatible with the use of telemedicine.
- Comprehensive care for diseases prevalent in childhood may be focused primarily on acute respiratory infections and regularly involves the use of X-ray imaging.
- Unequal distribution of health funding and services should be detected.
- The number of people living in the rural areas and those living in urban areas should be determined.
- There may be several existing prevention and control programmes that involve diagnosis that are image-dependent and thus can be potentially augmented with the use of telemedicine.

- **Needs to be identified by the focus group or task team**

The problems and needs of each targeted area should be identified and listed. According to the empirical study these may include:

- Physician uncertainty regarding diagnosis and treatment and associated mismanagement.
- Time and cost to patients referred to other facilities for definitive care at their own expense, time and risk.

- Lack of definitive care for patients due to factors prohibiting transport to facilities with specialists (unstable patients, lack of finances, lack of adequate transportation).
- Physician isolation.
- Loss of local revenue from patients referred to other facilities for definitive care.
- Physician education in a form of specialist feedback.

- **Alignment of current clinic or hospital goals**

Prior to the implementation of the telemedicine project specific clinic or hospital goals should be determined for alignment purposes. These can be set to in order to improve the quality of services and to increase clinic or hospital revenue. A list of services that will be affected by telemedicine implementation should be obtained, as this will provide the number of telemedicine services or product to be offered.

- **Proposed work plan and use of policy**

The required bill of materials as per telemedicine service requirement should be provided as part of the implementation plan. The telemedicine system should be used solely at the discretion of the individual attending a physician and used on a case-by-case basis for those patients with exceptional diagnostic and treatment challenges, or as determined by hospital administrators.

Evaluation of early use will be important to refine the use of the policy. The hospital or clinic administrators and local physicians will be responsible for final logistics and policies of the system to promote a sense of ownership and to minimise interruption of the typical clinical flow.

- **Competitive analysis of telemedicine**

Before a successful launch of the telemedicine service project is possible, significant research into the local market, an analysis of key competitors and stakeholders, an assessment of government's financial, technical, and human resources and an evaluation of the service in its pilot stage (see 3.11.2) are necessary. To this end the task team or focus group should focus on the following components:

- Stakeholder analysis
- Business model/plan
- Evaluation plan.

➢ Stakeholder analysis

A list of current and potential stakeholders should at least include:

- Medical Research Council (MRC)
- Department of Health (DoH)
- Task team as adopted from Government
- National Health Information System (NHIS)
- Targeted urban and rural communities
- Health care providers and telemedicine users
- Private sectors (suppliers of equipment and infrastructure)
- Public sector
- Public enterprises/parastatals (Eskom, Telkom, Transnet, Dennel)
- NGOs (CSIR)
- GSM operators (Vodacom, MTN, Cell C).

These stakeholders stand to benefit from the telemedicine projects. Those listed will some way be affected by the change to telemedicine, even if they are not directly involved with using the software, taking patient images, or providing consultations. The main objective of conducting the stakeholder analysis is to determine a number of key trade-offs, spin-offs and benefits/losses that each stakeholders might experience through telemedicine implementation. The list is expansive but necessary, as it also drives the business model.

➢ Applying Michael Porter's Five Forces model

In order to introduce the telemedicine system in both rural and urban areas, and to expect sustainability and user satisfaction, the development team must fully understand the financial, technical and human costs of implementing such a change and must be

prepared to meet the demands. Chapter 3 (3.9.9) covered the model for telemedicine application in detail.

- **Barriers to entry**

Economic issues

Though telemedicine is likely to be more cost effective for the delivery of care to remote populations than weekly consultations by a specialist who travels to a remote site, few studies currently demonstrate that adequately. Until proven, this legitimate concern will continue to adversely affect telemedicine technology diffusion. Therefore it is important to include in the framework a telemedicine business model which is applicable to each demarcated area (3.10).

Societal issues

Barriers to the diffusion of technology include a lack of coverage, of a concrete payment policy, of infrastructure and of engineering standards, and concerns over security and confidentiality. There should be means to prove these legitimate concerns, as they will continue to adversely affect diffusion. In chapter 4 (4.5.5.1) unique barriers were highlighted and it was stressed that some concerns will disappear with time due to experience and adaptation of technology.

Organisational considerations (hospitals, clinics and health care institutions)

According to Barshur (1998:510), when technology innovations are not accepted or implemented properly, generally the failure may be traced to a poor fit between the nature of the innovation and the vested interests, resources and expectations of its major gatekeepers. In chapter 4 (4.5.5.1) key factors for the successful implementation of telemedicine were identified as the training of key role players (health providers) in technology, budgeting/lobbying for start-up costs (anticipated rate of payment, rate of recovery of investment), implementation of support and management structure, social approval and leverage of available human resource through resource or operations strategy implementation.

- **Feasibility assessment**

A feasibility assessment consists of four components, namely human, technical, financial and organisational. These areas should be examined to identify resources that will likely be necessary to implement a telemedicine project. For the purpose of this study brief guidelines were identified based on the problems identified through empirical findings.

- **Human considerations**

User attitudes and perceptions about telemedicine

The attitudes and perceptions of the community and local physicians should be measured through interviews, so that the demand for the services can be determined. User attitude can be used to measure the success of any technological project, and thus suggest an increase or decrease in its feasibility and sustainability.

- **Staffing Requirements**

The aim in this regard is to determine the short-term (immediate) and long-term (future) human resource requirements. This is crucial for the successful implementation of telemedicine, as the people are necessary to operate technology (4.5.5.1).

- **Training requirements**

An assessment of training requirements for technology users should be conducted, including local physicians, health care providers and telemedicine technicians.

- **Prerequisites for telemedicine users**

Local physicians must have predictable access to the internet to retrieve e-mail responses from e-health specialists. They must be able to read English and consult with English-speaking e-health specialists. Catering for indigenous languages should also be taken into consideration.

- **Existing human resources**

Encouraging voluntary programmes where local and international organisations have networks for volunteers can be utilised to speed up the process of telemedicine implementation. Volunteer support can make future expansion of telemedicine more feasible, especially in rural areas.

- **Technical considerations**

The project should put the user before the implementation of equipment and avoid being technology driven. Thus, technical aspects of the system should be developed with the identified needs of the specific hospital or clinic guiding the project and upgrading as necessary. A physician demand for new more sophisticated applications will probably occur if the initial system proves useful.

The initial system should be a simple asynchronous store and forward configuration which allows the transmission of text detailing clinical information and any relevant captured still images or video clips. Due to its relative simplicity, such a system becomes technically feasible and satisfies concerns about interoperability, compatibility, reliability, and scalability.

The software should be primary component and must be available in English and probably other South African languages. It should simplify the steps for transmitting text and images via the internet by including image acquisition, processing (i.e., conversion to greyscale for X-rays), compression, annotation capability, and placement within a usable medical document. Additionally, dedicated servers should be utilised to allow increased security, a web based rather than e-mail based system, and the ability to archive cases.

- **Infrastructure and equipment requirements**

Recommended technologies were covered in chapter 3 (3.8.1), and details of the suggested technology and equipment, as well as the rationale for such selection were provided. The framework suggests that this step is vital for telemedicine implementation.

- **Risk management**

The successful implementation of any telemedicine project is dependent on many variables. Special attempts to make assumptions about laying the foundation for the use of telemedicine at specific rural and urban areas should be applied. Task teams or focus groups must anticipate and plan for various risks and setbacks.

Community buy-in: Community members may view the project as someone else's political agenda and may abandon the system in a long run. The public and physicians may also question the security of transmitting the information over the internet. In this case a custodian from the clinic and community should communicate with the community to educate them about the process and benefits of the project.

Provider buy-in: The remote radiologist may need convincing that teleconsultations are more efficient for reading films, as it means he/she no longer needs to frequently travel to remote rural clinics or hospitals. Health care providers will need to be convinced that checking their e-mail and using the software will not greatly disrupt their schedules and their patient interactions. There must also be incentives and compensation for specialists at levels 2- and 3-hospitals who are providing the teleconsultations. In the long run it may be difficult to get specialists to consistently donate their time and check their e-mail to do teleconsultations. In this case specialists from other private institutions or volunteer groups can be hired on a per case basis.

Political buy in: Obtaining political buy-in requires the backing of the national Department of Health. Efforts should be made to show that the project addresses government interests in linking rural and urban hospitals and clinics in a functioning model to be implemented at large scale.

Technical difficulties: At some stage the equipment may fail, needing support or replacement. The proper protocol, resources and responsibility must be in place for when such problems arise, so that the system may operate as quickly as possible. Operational support systems such as a help desk and technical assistance must be in place, as well as a contract with a local computer technician for in-person service.

Communication difficulties: There is always a risk of communication problems when diagnosis and treatment do not take place in the mother tongue

5.7 CRITICAL EVALUATION OF THE STUDY

The success of the study can be measured in terms of the objectives formulated in chapter 1.

5.7.1 PRIMARY OBJECTIVE

The objective of the research was to develop a model based on the results of the research study, which can provide a solution to the concerns indicated in the problem statement. The model demonstrated the value which parastatals can add through their participation in the national telemedicine implementation programme. This research identified the obstacles encountered in achieving successful implementation and the benefits of implementing a telemedicine project successfully. For example, questions about the sustainability of the project were addressed through detailed research and a commercial rationale for participation was provided.

The primary objective was reached by developing the model of a practical and feasible telemedicine implementation framework and plan in chapter 5. It is believed that if the telemedicine framework and plan will be implemented by government and suggested key stakeholders, current problems and barriers will be overcome and phase 3-implementation of telemedicine system will be achieved.

5.7.2 SECONDARY OBJECTIVES

To realise the above-mentioned primary objective, the following secondary objectives were pursued:

- To analyse and assess the impact of improved efficiency and cost effectiveness in the delivery of rural health care services using telemedicine.

- To recommend the best technology practices in implementing the telemedicine system.
- To analyse and assess the impact of the delivery of education and other social services to rural communities.
- To provide or suggest an adequate business model for the implementation and sustaining of telemedicine in Sub-Saharan Africa.

The first secondary objective was realised through the literature review in chapters 2 and 3 (2.8, 3.11). Various international and local experiences were cited to illustrate the impact of telemedicine in terms of improved efficiency and cost effectiveness.

The second objective was discussed in chapter 3 (3.8) and specific guidelines and recommendations were provided for applicable telemedicine technology.

The third objective was discussed in chapter 2 (2.8), and various examples and possible spin-offs from telemedicine were highlighted. Pilot project case study covered in chapter 3 (3.11.2) discussed in detail the impact of the delivery of education and other social services to rural community.

Finally, a business model was developed (3.11.1) using two approaches, namely the USAL developed model and the institutionalised medical model (3.11.1.1). These models should complement each other in the deployment of the intended telemedicine sites for rural application.

5.8 RECOMMENDATIONS FOR FURTHER STUDY

Telemedicine presents an opportunity to change many lives of South African rural and urban communities, but, legitimate barriers such as those presented in this study deny these communities the opportunity to improve their health conditions and life styles. The most burning issues that came to light during this study are those of human resources and the input costs and sustainability of telemedicine services. The first issue requires a researched and well-informed plan of applying best practises on leveraging the scarce human capital in South Africa. The second issue will also require a researched and well-informed strategic plan on existing private and public sectors to form partnerships and

thus leveraging their available resources to raise a project that can economically and socially benefit the country.

5.9 CONCLUSION

We live in an age of technology, demanding health care needs, and a rising cost of living. Therefore, organisations and society at large will have to accept that technology innovation, such as telemedicine, has an impact on improving efficiency and cost effectiveness in the delivery of rural and urban health care services.

Various approaches in deploying telemedicine technology have been suggested in previous studies, and for the purpose of this study it was important to pursue the study from a different angle, so as to provide a holistic view of business and technology models suitable for telemedicine.

The empirical study discussed chapter 4 revealed barriers to the adoption of telemedicine technology. These barriers are both human and technical, with the latter being less difficult to overcome. It can also be seen from empirical studies in chapter 4 that human resource scarcity and a strategic approach to the implementation of telemedicine remain a major challenge in this endeavour.

In order to provide some guidelines to telemedicine custodians on how to implement a successful telemedicine service, a list of key factors for the successful implementation was identified. Based on these key factors a recommended framework and plan to implement telemedicine system for rural and urban application was suggested. This was supported by a method to evaluate progress, so that corrective measures may be taken in the case of any deviations.

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Annexure A

	1.1 DIESEL (30 kVA)	Micro - Turbines (Diesel)	PV (Solar)	Power VT's	Inductive Coupling	Reticulation Line
Technology Availability	Good	Available within ± 6 months	Good	Good	Vaal Tech is developing a 1kW system	Landrate 1 – Tariff Used
Reliability: Operating life Overhaul	Good 16 000 hours every 8000 hours	Good ~50 000 hours ~16 000 hours	Excellent 20 years (3 year battery replacement)	Excellent 15 – 20 years N/A	Good N/A N/A	Excellent N/A N/A
Efficiency	~28%	26 ± 2%	N/A	Unknown	85% – 90%	N/A
Fuel cost	R1-01 (R/kWh)	R1-14 (R/kWh)	N/A	N/A	N/A	19.43 c/kWh – 22.05 c/kWh
Capital cost Overhaul Costs	R 3 000/kW R 26 000/unit	R 9 000/kW Included in maintenance	Will depend on the system needed. (~R 41 000/Kw_e)	Module Prices: 10kVA: R176000 26kVA: R272000 30kVA: R176000	Unknown (Power Electronics costs are approximately R1000 plus R1 per watt)	Cost per km of installation is R54 545 (ex VAT) Monthly Basic Charge: R177-42
Maintenance Costs	69c/kWh (including engine overhauling)	10c/kWh (including overhauling the turbine)	Depend on the size of the battery bank.	Unknown	Nil	Nil
Practicality	Continuous power supply is a problem. Availability is not good. Major life cycle expenses are fuel costs and maintenance costs and are application specific. Highly dependent on load factor.	Has no support structure in South Africa. Availability is better than diesels. Major life cycle expense is fuel cost. Highly dependent on load factor.	Extremely practical and highly available.	Power ranges from 6kVA to 30kVA. Output voltages ranges from 120Vac to 1200VAC. Hence, maximum current that can be supplied is typically 25A. Possibility that voltage drops may occur.	The technology works, however, the CT is a problem. A good source of 5kW rated CT's are available. The electronics is another soluble problem.	Typical customers are farmers, rural businesses and rural telecomms systems.
Maintenance	Maintenance required every 250 hours (this includes oil and filter changes).	Maintenance required every 4000 hours (this includes filter changes, but no oil changes).	Maintenance includes battery checks (electrolyte levels, etc.). Batteries needs replacement every 3 years.	The power VT's requires cleaning during inspection.	Nil required	Nil required
Preferred Application	More economic when close to service centres (maintenance). Power back up system	Can be rural since maintenance is roughly required once annually.	Deep rural	Radio or cellular phone transmission stations. Power for HV line auxiliaries such as microwave and fiber-optic repeater stations. Rural electrification projects. Farming supplies for "Right of Way" compensation.	Limited: Rural and temporary installations (test sites).	Suitable for loads exceeding 1000kWh / month

Table 1: Summarised results of the Technical assessment and the economical analysis

Annexure B

COMPARISON COSTS FOR THE VARIOUS TECHNOLOGIES

Technology	Application	1.1.1.1 ro/con	2.1.1.1 at Cost	3.1.1.1 ubs Cost
TDMA	High and low density. Voice and data and leased lines	Cost effective for high speed data applications in low density areas. No additional routers and licences reqd	R800million (800000 subs no intersite connectivity reqd and no licence for software or routers reqd)	W T R25000 Hard wired sub R1000
Trunking MPT1327	Very low density areas	Can be piggybacked on mobile coverage.Low speed data.Remote payphone	R200 million	R10000
FCT	Voice and data	Cellular coverage	R25million (no network cost 10000 users)	R2500
VSAT	Total coverage Voice and highspeed data	Influenced by weather.	R50 million (1700users only)	R30000
LMDS	High density areas. Voice and highspeed data	Small coverage areas.	R3.5billion (1million subs excl inter site connection but includes routers and licencing of software	R100000
CDMA	High density areas. Voice and high speed data	More subs for same bandwidth which not a advantage in low density areas	R800 million	R100000

Table Cost Comparisons

Annexure C – Health Care Providers/Stakeholders)

Questionnaire used to conduct the descriptive survey.

PARASTATAL'S INVOLVEMENT IN THE TELEMEDICINE IMPLEMENTATION PROGRAMME IN SOUTH AFRICA.

RESEARCH QUESTIONNAIRE

I would like to thank you for providing opportunity for and assisting with the completion of this questionnaire. I would like to ask you questions about the implementation of Telemedicine Programme in South Africa. I hope that the information gained through this research study will contribute to the body of knowledge aimed at improving the delivery of health care services in SA.

GENERAL INSTRUCTIONS

Almost all the questions can be answered by encircling a number that appear on a scale to the right of the item. You are to choose the one number that best matches the description of how you feel about the item. For example, if you were asked how much you agree with the statement:

"I believe that there are unique barriers to implementation of Telemedicine in SA"
And you feel that you agree, you would check the number under *Agree*, like this:

I believe that there are unique barriers to implementation of Telemedicine in SA	Strongly disagree	Disagree	Not sure	Agree	Strongly Agree	I do not know
	1	2	3	(4)	5	6

It is essential that you mark your choice by **encircling the number using a pen** and not by a cross.

Use (mark) scale point 6: " I don't know only if you really don't have sufficient information to answer question.

Please note that the scale descriptions are different for different parts of the questionnaire.

You may for an example be asked whether you are satisfied or dissatisfied or whether you agree or disagree with a statement, etc. Please be sure to read the special instructions that appear in the boxes on each page. Be sure to read the scale descriptions before choosing and encircling your answers.

If any question is not clear, please state so and ask for clarity.

Please feel free to answer just what you think. You may skip questions that are not relevant to you or those that you are not sure of.

Your name will not appear on the questionnaire. Your answers will not be shared with anyone. Only the researcher and study leader will have access to the questionnaire once it has been completed.

RESPONDENTS DETAILS:

QUESTIONAIRE NUMBER:.....
NAME OF RESPONDENT:.....
NAME OF ORGANISATION:.....
POSITION HELD WITH ORGANISATION:.....
DATE:.....

SECTION A: DEMOGRAPHIC AND PERSONAL INFORMATION

1. How old are you?

Age – Group

18-22 yrs	23-27yrs
28-33 yrs	34- 38yrs
39- 43yrs	44- 48yrs
49-53yrs	54- 58yrs
59 –63yrs	64+ yrs

2. Gender

Male	1
Female	2

3. Which statement best describes your education level?

No formal schooling	1
Matriculation	2
Diploma	3
Technikon qualification	4
B. Degree	5

Honours degree	6
Maters or Doctorate	7
Other post-graduate qualification	8

4. What is your occupation?

Doctor	1
Nurse	2
Social Worker	3
Practitioner	4
Other	5

5. What is your source of income?

I am employed	1
I am self employed	2
I am unemployed	3

6. What is present level of computer experience?

No computer experience	1
Very little computer experience –need help	2
I can help myself	3
Able to use standard applications (for an example MS Word, Quattro)	4
Can provide Support	5

7. Do you have access to the following sources of communication/information

Fixed line Telephone	1
Cellular phone	2

Television	3
Internet	4

8. Where do you reside?

Township	1
Urban	2
Rural	3

9. What language do you speak?

English	1
Afrikaans	2
Se-Pedi	3
SeTswana	4
IsiZulu	5
IsiNdebele	6
xiTsonga	7
TshiVenda	8
Sesotho	9
SiSwati	10
IsiXhosa	11

SECTION B: INFORMATION REGARDING CURRENT STATUS OF THE IMPLEMENTATION OF TELEMEDICINE IN SA.

	Strongly Disagree	Disagree	Not Sure	Agree	Strongly Agree	I do not know
General Information on Telemedicine status in SA.						
10) I am familiar with the following disciplines of Telemedicine (Radiology, Pathology, Telepsychology)						
11) I am familiar with the following disciplines of Telemedicines (Health Care Broadcast).						
12) I am familiar with the following discipline of Telemedicine (Body transplant).						
13) The mode of Telemedicine that is widely utilized is E-mail						
14) The mode of Telemedicine that is widely utilized is Video conferencing.						
15) I am aware of hospitals, clinics, and practices or sites that utilize/offer Telemedicine.						
16) I know and have used the Telemedicine software application.						
17) I know and have used the Telemedicine hardware.						
18) The widely used data communication link is Fax & Telephone.						
19) The widely used data communication link is Internet & ISDN links.						
20) I obtain information on Telemedicine through the following source: (People)						
21) I obtain information on Telemedicine through the following sources: (Journals & Books)						

	Strongly Disagree	Disagree	Not Sure	Agree	Strongly Agree	I do not know
General Information on Telemedicine status in SA.						
34) I believe that the Implementation of Telemedicine in SA should lie with Public sector.						
35) I believe that the implementation of Telemedicine should lie with Private sector.						
36) I believe that the implementation of Telemedicine in SA should be a Joint Venture.						
37) I believe that the Parastatals partcipation in the Telemedicine implementation in SA will have an positive impact to success (e.g. Eskom Transnet)						
38) I believe that the Parastatal's participation in the Telemedicine implementation will not have any impact						
Please elaborate:						
39) I envision the suppliers of Telemedicine information to be local & foreign expertise.						
40). I envision the suppliers of Telemedicine equipment & infrastructure to be local and not foreign.						
41) Before filling in this questionnaire, I have been aware of Telemedicine forums/ structures that exists in SA						
42) I have visited Telemedicine published documents on the website previously.						
43) I have visited Telemedicine site that has been implemented and is operational.						
44) I can confidently mention the site that I know to be operational.						

The following barriers to the implementation of Telemedicine projects in the United States (US) were identified in the Western Govenors Report, Published in the US in August 1995 (http://tie .telemed.org/TIEexthome.html).Please rate the significance of these barriers to the South African situation according to your opinion.

	Strongly Disagree	Disagree	Not Sure	Agree	Strongly Agree	I do not know
Barriers						
I believe that the following are barriers to Implementation of Telemedicine in SA:						
49) Barrier 1: Infrastructural Planning and Development						
50) Barrier 2: Telecommunications Regulation						
51) Barrier 3: Reimbursement for Telemedicine Services						
52 Barrier 4: Licensure and Credentialing						
53) Barrier 5: Medical Malpractice Liability						
54 Barrier 6: Confidentiality						

SECTION D: CRITICAL SUCCESS FACTORS TO IMPLEMENTATION OF TELEMEDICINE IN SA.

The following three questions depicts the critical success factors emanating from Dr. Moore's study conducted in 1993 and 1994.Please try to answer them as openly as possible within the context of the Telemedicine projects or experiments with which you have been involved in SA.

55) Firstly, what do you consider to be the critical success factors for Telemedicine Implementation?.....
.....
.....
.....
.....
.....

56) Secondly, what would you do differently if you were to begin a Telemedicine delivery project
today?.....
.....
.....
.....
.....

57) Thirdly, what three pieces of advice would you give to those attempting to implement a Telemedicine
project?.....
.....
.....
.....
.....

58) What do you believe are the critical success factors which operate in the implementation of Telemedicine projects
internationally?.....

.....

.....

.....

.....

59) Do you believe that there are unique critical success factors, which affect or will affect the implementation of Telemedicine SA?
(Yes/No).....

.....

60) If you answered Yes to the above question (37), what do you believe are the critical success factors which will affect the implementation of Telemedicine projects in SA?.....

.....

.....

.....

In Dr. Mary Moore's study Telemedicine project in the US the following factors were identified as critical to the successful implementation of Telemedicine projects. Please rate the significance of these factors to the SA situation according to your opinion.

	Strongly Disagree	Disagree	Not Sure	Agree	Strongly Agree	I do not know
Success Factors						
I believe that the following are critical success factors to Implementation of Telemedicine in SA:						
61) Marketing: Involving users						
62) Marketing: Involving the community as a whole						
63) Promotion of Telemedicine programmes						
64) Efficient and simplified administration						
65) Training in the use of Telemedicine equipment						
66) Equipment characteristics: reliability, accuracy, and flexibility						
67) Purchasing flexibility: ability to compare a range of equipment supplied by the vendors						
68) User friendliness of the equipment						
69) Patient confidentiality						
70) High Speed Reliable networks						
71) Affordable costs						

	Strongly Disagree	Disagree	Not Sure	Agree	Strongly Agree	I do not know
Success Factors						
72) Administrative support						
73) Strategic planning of project implementation						
74) Human elements: Charismatic leaders and champions of the project						
75) Enthusiasm and commitment by the users to implementation						
76) Skilled technical support staff						
77) Enthusiastic referring health care practitioners						
78) Knowledgeable and enthusiastic referral practitioners						
79) Familiarity between referring and referral practitioners						
80) Local site co-ordinators						

SECTION E: SECURITY OF INFORMATION IN THE TELEMEDICINE PRACTICE

	Strongly Disagree	Disagree	Not Sure	Agree	Strongly Agree	I do not know
Security						
81) Information and data security is important to you personally.						
82) I feel confident with not losing any information or data when utilizing Telemedicine services.						
83) I have been orientated about the security of information when utilizing Telemedicine services.						
84) The perceived level of threat of unauthorized information being disclosed due to the following is very serious:						
a) Public interest groups						
b) Health care givers who do not need to know						
c) Practitioners and others who do not need to know						
d) Intruders such as infrastructure providers						
e) Suppliers of equipment						
f) Other Telemedicine stakeholders						
85) Since the implementation of Telemedicine in security information and data security RSKS have been reduced						

	Strongly Disagree	Disagree	Not Sure	Agree	Strongly Agree	I do not know
Security						
86) I am very much concerned about information and data security with regard to the following aspects:						
a) Network security						
b) Multiple log-ons and passwords						
c) End user computing security awareness						
d) Monitoring user compliance with policies						
e) Distributed computing security						
f) Internet access						
g) External/remote access (dial-up)						

SECTION F: ECONOMIC FACTORS TO BE CONSIDERED FOR TELEMEDICINE IMPLEMENTATION IN SA.

	Strongly Disagree	Disagree	Not Sure	Agree	Strongly Agree	I do not know
Economic factors						
87) I am convinced that the cost of primary health care is affordable for all citizens in SA.						
88) All rural communities in South Africa have access to primary health care.						
89) All urban and peri-urban communities in South Africa have access to primary health care.						
90) I am convinced that the cost of primary health care in SA increases proportionally to the cost of living.						
91) Telemedicine services are much more economic than conventional medical services.						
92) I am convinced that Telemedicine will reduce the number of required health professionals per given area significantly						
93) I am convinced that implementing Telemedicine can reduce primary health care per GDP capita costs.						
94) Utilizing the existing infrastructure can reduce the cost of implementing Telemedicine.						
95) The implementation of Telemedicine will socially and economically benefit Urban as opposed rural community						
96) I do believe that the fast tracking of ICT liberation will reduce the cost of Telemedicine infrastructure.						
97) I believe that Telemedicine services will reduce costs associated with erroneous referrals in both Urban and Rural environment						
98) I believe that Telemedicine projects should be funded by the Government only.						

	Strongly Disagree	Disagree	Not Sure	Agree	Strongly Agree	I do not know
Economic factors						
99) I believe that there should be collaboration with micro financing organizations for Telemedicine implementation in SA						
100) Low cost information appliances for rural use in Telemedicine services should be promoted.						
101) I believe those Parastatal utilities such as Eskom, Dennel, and Transnet can utilize their exixting rural/remote infrastructure for Telemedicine						
102) I believe that Internet based Telemedicine networks are cost effective.						
103) Internet based network services are feasible and economically viable.						
104) The sustainability of Telemedicine services is dependant on guaranteed revenue returns and not on donor funding						
105) I believe that the type of technology to be implemented for Telemedicine will largely have an impact on cost of infrastructure development						
106) I believe that the there is a market for Telemedicine.						
107) Telemdicine has both social and economic benefits.						
108) I believe that Proliferation of Private Hospitals and Clinics has absorbed significant service provisioning for Primary Health Care in Urban areas						
109) Private Hospitals and clinics offer most competitive and economic primary health care services						
110) I believe that Telemedicine can improve the efficiency in delivering primary health care services in Public & Private hostpitals and clinics						

SECTION G: ETHICAL, POLITICAL, LEGAL AND SOCIAL FACTORS TO BE CONSIDERED FOR TELEMEDICINE IMPLEMENTATION IN SA.

	Strongly Disagree	Disagree	Not Sure	Agree	Strongly Agree	I do not know
Ethical, Political and other related factors						
111) I believe that there is a definite need for Telemedicine implementation in SA.						
112) I prefer to interact with the patient/doctor on a face to face mode and not remotely.						
113) I believe that Telemdicine will reduce the distance and isolation in patient –practitioner encounters						
114) I believe that Telemedicine services can deliver acceptable quality standards for primary health care services						
115) I do not believe that medical services should be delivered using technology such as Telemedicine.						

SECTION H: MANAGEMENT OF INFORMATION FOR TELEMEDICINE IMPLEMENTATION IN SA.

	Strongly Disagree	Disagree	Not Sure	Agree	Strongly Agree	I do not know
Management of Information/data						
116) I believe that the archiving of information is essential for effective and efficient services (e.g. X-rays)						
117) The storage of electronic information through Telemedicine will make information easily accessible for Health care providers						

Annexure D – Primary Health Care Consumers

Questionnaire used to conduct the descriptive survey.

PARASTATAL'S INVOLVEMENT IN THE TELEMEDICINE IMPLEMENTATION PROGRAMME IN SOUTH AFRICA.

RESEARCH QUESTIONNAIRE

I would like to thank you for providing opportunity for and assisting with the completion of this questionnaire. I would like to ask you questions about the implementation of Telemedicine Programme in South Africa. I hope that the information gained through this research study will contribute to the body of knowledge aimed at improving the delivery of health care services in SA.

GENERAL INSTRUCTIONS

Almost all the questions can be answered by encircling a number that appear on a scale to the right of the item. You are to choose the one number that best matches the description of how you feel about the item. For example, if you were asked how much you agree with the statement:

"I believe that there are unique barriers to implementation of Telemedicine in SA"
And you feel that you agree, you would check the number under *Agree*, like this:

I believe that there are unique barriers to implementation of Telemedicine in SA	Strongly disagree	Disagree	Not sure	Agree	Strongly Agree	I do not know
	1	2	3	(4)	5	6

It is essential that you mark your choice by **encircling the number using a pen** and not by a cross.

Use (mark) scale point 6: " I don't know only if you really don't have sufficient information to answer question.

Please note that the scale descriptions are different for different parts of the questionnaire.

You may for an example be asked whether you are satisfied or dissatisfied or whether you agree or disagree with a statement, etc. Please be sure to read the special instructions that appear in the boxes on each page. Be sure to read the scale descriptions before choosing and encircling your answers.

If any question is not clear, please state so and ask for clarity.

Please feel free to answer just what you think. You may skip questions that are not relevant to you or those that you are not sure of.

Your name will not appear on the questionnaire. Your answers will not be shared with anyone. Only the researcher and study leader will have access to the questionnaire once it has been completed.

RESPONDENTS DETAILS:

QUESTIONAIRE NUMBER:.....

NAME OF RESPONDENT:.....

NAME OF FACILITY VISITED:.....

PROVINCE:.....

DATE:.....

SECTION A: DEMOGRAPHIC AND PERSONAL INFORMATION

1. How old are you?

Age – Group

18-25 yrs	26-30yrs
31-35 yrs	36- 40yrs
41- 45yrs	46- 50yrs
51-55yrs	56- 60yrs
61 –65yrs	66 +yrs

2. Gender

Male	1
Female	2

3. What is the level of your education (Grade)?

Grade 0-6	1
Grade 7-9	2
Grade 10-12	3
Grade 12+	4

4. Which statement best describes your education level?

No formal schooling	1
Matriculation	2
Diploma	3
Technikon qualification	4
B. Degree	5
Honours degree	6
Maters or Doctorate	7
Other post-graduate qualification	8

5. What is your occupation?

Doctor	1
Nurse	2
Social Worker	3
Practitioner	4
Other	5

6. What is your source of income?

I am employed	1
I am self employed	2
I am unemployed	3

7. What is present level of computer experience?

No computer experience	1
Very little computer experience –need help	2
I can help myself	3

Able to use standard applications (for an example MS Word, Quattro)	4
Can provide Support	5

8. Do you have access to the following sources of communication/information

Fixed line Telephone	1
Cellular phone	2
Television	3
Internet	4

9. Where do you reside?

Township	1
Urban	2
Rural	3

10. What language do you speak?

English	1
Afrikaans	2
Se-Pedi	3
SeTswana	4
IsiZulu	5
IsiNdebele	6
xiTsonga	7
TshiVenda	8
Sesotho	9
SiSwati	10
IsiXhosa	11

SECTION B: INFORMATION REGARDING CURRENT STATUS OF THE IMPLEMENTATION OF TELEMEDICINE IN SA.

	Strongly Disagree	Disagree	Not Sure	Agree	Strongly Agree	I do not know
General Information on Telemedicine status in SA.						
10) I am familiar with the following disciplines of Telemedicine (Radiology, Pathology, Telepsychology)						
11) I am familiar with the following disciplines of Telemedicines (Health Care Broadcast).						
12) I am familiar with the following discipline of Telemedicine (Body transplant).						
13) The mode of Telemedicine that is widely utilized is E-mail						
14) The mode of Telemedicine that is widely utilized is Video conferencing.						
15) I am aware of hospitals, clinics, and practices or sites that utilize/offer Telemedicine.						
16) I know and have used the Telemedicine software application.						
17) I know and have used the Telemedicine hardware.						
18) The widely used data communication link is Fax & Telephone.						
19) The widely used data communication link is Internet & ISDN links.						
20) I obtain information on Telemedicine through the following source: (People)						
21) I obtain information on Telemedicine through the following sources: (Journals & Books)						

	Strongly Disagree	Disagree	Not Sure	Agree	Strongly Agree	I do not know
General Information on Telemedicine status in SA.						
22) I obtain information on Telemedicine through other sources not mentioned above.						
23) There is adequate source of technical expertise used for Telemedicine implementation.						
24) The source of expertise utilized is obtained from government sectors						
25) The source of technical expertise utilized is largely obtained from public sector.						
26) The source of technical expertise utilized is largely obtained from private sector.						
27) The Telemedicine implementation programme/ deliverables is on target as initially scheduled.						
28) I know and have used the Telemedicine software application.						
29) I have seen a significant progress to date on the Implementation of Telemedicine in SA.						
30) Telemedicine implementation is planned to be completed in near future (less than 5yrs).						
31) Telemedicine implementation is planned to be completed in a distant future (from 5 yrs and above).						
32) I believe that there should be a centralized group/task team taking responsibility for Telemedicine implementation						
33) I believe that the responsibility of Telemedicine Implementation in SA should lie with Government.						

	Strongly Disagree	Disagree	Not Sure	Agree	Strongly Agree	I do not know
General Information on Telemedicine status in SA.						
34) I believe that the Implementation of Telemedicine in SA should lie with Public sector.						
35) I believe that the implementation of Telemedicine should lie with Private sector.						
36) I believe that the implementation of Telemedicine in SA should be a Joint Venture.						
37) I believe that the Parastatals partcipation in the Telemedicine implementation in SA will have an positive impact to success (e.g. Eskom Transnet)						
38) I believe that the Parastatal's participation in the Telemedicine implementation will not have any impact						
Please elaborate:						
39) I envision the suppliers of Telemedicine information to be local & foreign expertise.						
40). I envision the suppliers of Telemedicine equipment & infrastructure to be local and not foreign.						
41) Before filling in this questionnaire, I have been aware of Telemedicine forums/ structures that exists in SA						
42) I have visited Telemedicine published documents on the website previously.						
43) I have visited Telemedicine site that has been implemented and is operational.						
44) I can confidently mention the site that I know to be operational.						

SECTION C: BARRIERS TO IMPLEMENTATION OF TELEMEDICINE IN SA.

	Strongly Disagree	Disagree	Not Sure	Agree	Strongly Agree	I do not know
Barriers						
45) I believe that there are barriers to implementation of Telemedicine in SA.						
46) I am aware of these barriers to implementation of Telemedicine in SA and can state them						
Please state/elaborate:						
Please state/elaborate further:						
47) I believe that there are also unique barriers to implementation of Telemedicine in SA.						
48) Please elaborate:						

The following barriers to the implementation of Telemedicine projects in the United States (US) were identified in the Western Govenors Report, Published in the US in August 1995 (http://tie .telemed.org/TIEexthome.html).Please rate the significance of these barriers to the South African situation according to your opinion.

	Strongly Disagree	Disagree	Not Sure	Agree	Strongly Agree	I do not know
Barriers						
I believe that the following are barriers to Implementation of Telemedicine in SA:						
49) Barrier 1: Infrastructural Planning and Development						
50) Barrier 2: Telecommunications Regulation						
51) Barrier 3: Reimbursement for Telemedicine Services						
52 Barrier 4: Licensure and Credentialing						
53) Barrier 5: Medical Malpractice Liability						
54 Barrier 6: Confidentiality						

SECTION D: CRITICAL SUCCESS FACTORS TO IMPLEMENTATION OF TELEMEDICINE IN SA.

The following three questions depicts the critical success factors emanating from Dr. Moore's study conducted in 1993 and 1994.Please try to answer them as openly as possible within the context of the Telemedicine projects or experiments with which you have been involved in SA.

55) Firstly, what do you consider to be the critical success factors for Telemedicine Implementation?.....
.....
.....
.....
.....
.....

56) Secondly, what would you do differently if you were to begin a Telemedicine delivery project
today?.....
.....
.....
.....
.....

57) Thirdly, what three pieces of advice would you give to those attempting to implement a Telemedicine
project?.....
.....
.....
.....
.....

58) What do you believe are the critical success factors which operate in the implementation of Telemedicine projects
internationally?.....

.....

.....

.....

.....

59) Do you believe that there are unique critical success factors, which affect or will affect the implementation of Telemedicine SA?

(Yes/No).....

.....

60) If you answered Yes to the above question (37), what do you believe are the critical success factors which will affect the implementation of Telemedicine projects in SA?.....

.....

.....

.....

In Dr. Mary Moore's study Telemedicine project in the US the following factors were identified as critical to the successful implementation of Telemedicine projects. Please rate the significance of these factors to the SA situation according to your opinion.

	Strongly Disagree	Disagree	Not Sure	Agree	Strongly Agree	I do not know
Success Factors						
I believe that the following are critical success factors to Implementation of Telemedicine in SA:						
61) Marketing: Involving users						
62) Marketing: Involving the community as a whole						
63) Promotion of Telemedicine programmes						
64) *Efficient and simplified administration*						
65) Training in the use of Telemedicine equipment						
66) Equipment characteristics: reliability, accuracy, and flexibility						
67) *Purchasing flexibility: ability to compare a range* of equipment supplied by the vendors						
68) User friendliness of the equipment						
69) Patient confidentiality						
70) *High Speed Reliable networks*						
71) Affordable costs						

	Strongly Disagree	Disagree	Not Sure	Agree	Strongly Agree	I do not know
Success Factors						
72) Administrative support						
73) Strategic planning of project implementation						
74) Human elements: Charismatic leaders and champions of the project						
75) Enthusiasm and commitment by the users to implementation						
76) Skilled technical support staff						
77) Enthusiastic referring health care practitioners						
78) Knowledgeable and enthusiastic referral practitioners						
79) Familiarity between referring and referral practitioners						
80) Local site co-ordinators						

SECTION E: SECURITY OF INFORMATION IN THE TELEMEDICINE PRACTICE

	Strongly Disagree	Disagree	Not Sure	Agree	Strongly Agree	I do not know
Security						
81) Information and data security is important to you personally.						
82) I feel confident with not losing any information or data when utilizing Telemedicine services.						
83) I have been orientated about the security of information when utilizing Telemedicine services.						
84) The perceived level of threat of unauthorized information being disclosed due to the following is very serious:						
a) Public interest groups						
b) Health care givers who do not need to know						
c) Practitioners and others who do not need to know						
d) Intruders such as infrastructure providers						
e) Suppliers of equipment						
f) Other Telemedicine stakeholders						
85) Since the implementation of Telemedicine in security information and data security RSKS have been reduced						

Security						
86) I am very much concerned about information and data security with regard to the following aspects:						
a) Network security						
b) Multiple log-ons and passwords						
c) End user computing security awareness						
d) Monitoring user compliance with policies						
e) Distributed computing security						
f) Internet access						
g) External/remote access (dial-up)						

SECTION F: ECONOMIC FACTORS TO BE CONSIDERED FOR TELEMEDICINE IMPLEMENTATION IN SA.

	Strongly Disagree	Disagree	Not Sure	Agree	Strongly Agree	I do not know
Economic factors						
87) I am convinced that the cost of primary health care is affordable for all citizens in SA.						
88) All rural communities in South Africa have access to primary health care.						
89) All urban and peri-urban communities in South Africa have access to primary health care.						
90) I am convinced that the cost of primary health care in SA increases proportionally to the cost of living.						
91) Telemedicine services are much more economic than conventional medical services.						
92) I am convinced that Telemedicine will reduce the number of required health professionals per given area significantly						
93) I am convinced that implementing Telemedicine can reduce primary health care per GDP capita costs.						
94) Utilizing the existing infrastructure can reduce the cost of implementing Telemedicine.						
95) The implementation of Telemedicine will socially and economically benefit Urban as opposed rural commmunity						
96) I do believe that the fast tracking of ICT liberation will reduce the cost of Telemedicine infrastructure.						
97) I believe that Telemedicine services will reduce costs associated with erroneous referrals in both Urban and Rural environment						
98) I believe that Telemedicine projects should be funded by the Government only.						

	Strongly Disagree	Disagree	Not Sure	Agree	Strongly Agree	I do not know
Economic factors						
99) I believe that there should be collaboration with micro financing organizations for Telemedicine implementation in SA						
100) Low cost information appliances for rural use in Telemedicine services should be promoted.						
101) I believe those Parastatal utilities such as Eskom, Dennel, and Transnet can utilize their exixting rural/remote infrastructure for Telemedicine						
102) I believe that Internet based Telemedicine networks are cost effective.						
103) Internet based network services are feasible and economically viable.						
104) The sustainability of Telemedicine services is dependant on guaranteed revenue returns and not on donor funding						
105) I believe that the type of technology to be implemented for Telemedicine will largely have an impact on cost of infrastructure development						
106) I believe that the there is a market for Telemedicine.						
107) Telemdicine has both social and economic benefits.						

SECTION G: ETHICAL, POLITICAL, LEGAL AND SOCIAL FACTORS TO BE CONSIDERED FOR TELEMEDICINE IMPLEMENTATION IN SA.

	Strongly Disagree	Disagree	Not Sure	Agree	Strongly Agree	I do not know
Ethical, Political and other related factors						
106) I believe that there is a definite need for Telemedicine implementation in SA.						
107) I prefer to interact with the patient/doctor on a face to face mode and not remotely.						
108) I believe that Telemdicine will reduce the distance and isolation in patient –practitioner encounters						
109) I believe that Telemedicine services can deliver acceptable quality standards for primary health care services						
110) I do not believe that medical services should be delivered using technology such as Telemedicine.						

SECTION H: MANAGEMENT OF INFORMATION FOR TELEMEDICINE IMPLEMENTATION IN SA.

	Strongly Disagree	Disagree	Not Sure	Agree	Strongly Agree	I do not know
Management of Information/data						
110) I believe that the archiving of information is essential for effective and efficient services (e.g. X-rays)						
111) The storage of electronic information through telemedicine will make information easily accessable for Health care providers						

Annexure E – Introductory Letter of Intent

Motlale Cecil Ramonotsi
Graduate School of Management
No. 72 Fuhri Road
Randhart
Alberton
1449

Attentention: Primary Health Care Provider/Consumer

Dear Sir/Madam,

The ability of Telemedicine to facilitate medical care irrespective of distance and availability of personnel on site makes it attractive to both the public and private health care sectors, as well as other stakeholders such as public and private infrastructure providers. Telemedicine allows better utilization of scarce medical personnel and resources. It also has potential of improving access to and quality of, medical care at lower cost. In particular Telemedicine may be seen, as a valuable tool for providing much needed medical services to undeserved rural areas. It promises to enhance continued medical education of our young doctors, nurses and other health care practitioners in rural areas, both in training and in established practice.

The legacy of recent decades is an inappropriate distribution of health practitioners and expertise that are concentrated in major urban centres, while people living in rural areas have limited access to basic health care because of geographical isolation and poor public transportation. Telemedicine is one form of advanced technology that may be part of the solution to a number of health care and education problems in South Africa.

Currently, there is an existence of a task team consisting of different stakeholders with the main custodian being the government in pursuit to finalise the implementation of Telemedicine in SA. The are numerous factors which contribute to the barriers of the finalization of this project which include development of infrastructure, medical practice liability, human behavior, ethical political issues etc. However, according to the research conducted, most of these barriers can be overcome, in exception of the question of the

sustainability of Telemedicine in SA especially in rural areas. At this stage it is essential to emphasize that all Telemedicine projects have been implemented through a facilitation of donor funding within government structures.

In a quest to find answers to this question mark, I am currently conducting an information survey. The survey addresses the implementation of Telemedicine in SA and the sustainability thereof. In doing so topics such as economic issues, critical success factors, barriers, technology, infrastructure, security and management information for relevant Telemedicine system SA are covered in the questionnaire. Please select the option that best match how you feel about the implementation of Telemedicine in SA.

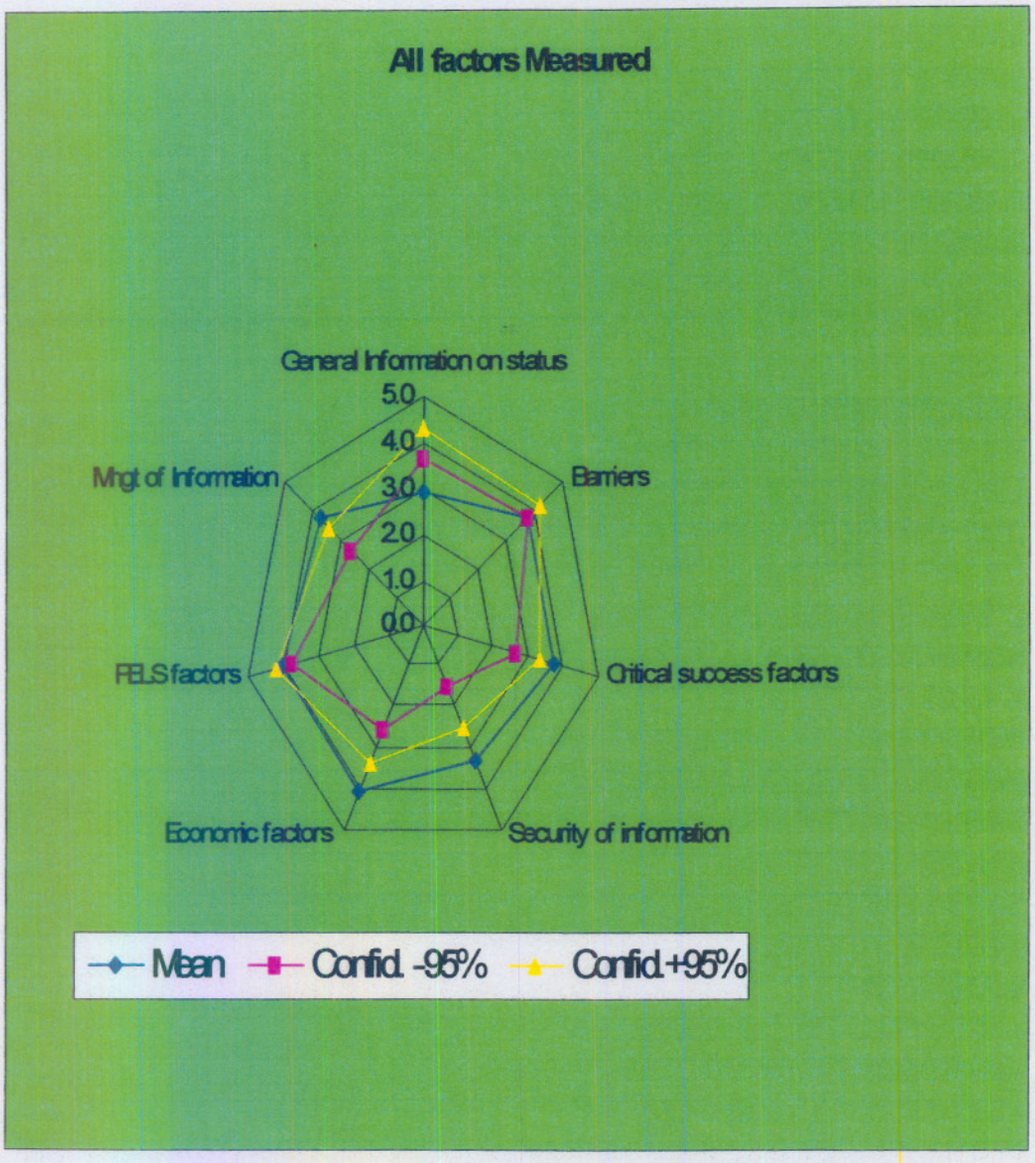
As the survey is intended for use as the basis for a research project, your answers will treated as confidential.

I thank you in advance for your participation.

Yours Sincerely

MC Ramonotsi
Graduate School of Management
Potchefstroom Business School

Annexure F- Radar Chart- for presentation of seven major factors measured from questionnaires



Annexure G

TELEMEDICINE SITE EQUIPMENT AND COST

Costs associated with TM equipment and technology required at the PHC and Secondary Health Care Hospital, respectively are indicated in this section. This is purely an example of the costs associated with the deployment of a TM site.

5.1 PHC SITE

The following equipment are required by the PHC site and the costs associated with the various equipment is as follows:

• 1 × MM225 Video conference device	R 17000
• 1 × Personal Computer (PC)	R 7000
• 1 × Digital phone (stethoscope sender)	R 37000
• 1× General examination camera	R 69000
• 1× Disposable tip cover for general examination camera	R 600
• 1 × Ear, Nose and Throat (ENT) scope plus camera and illumination	R120000
• 1 × Opthalmoscope	R 33000
• 1 × Utility case and trolley	R 13680
• 1 × Light box	R 570
ESTIMATED TOTAL:	R300000

5.2 SECONDARY HEALTH CARE HOSPITAL

The following equipment are required by a Secondary Health Care Hospital site and the costs associated with the equipment is as follows:

• 1 × MM225 Video conference device	R 17000
• 1 × Television Monitor	R 2280
• 1 × PC	R 7000
• 1 × Digital phone (stethoscope sender)	R 37000
• 1 × Trolley	R 9000
ESTIMATED TOTAL:	R 72000