

THE IMPACT OF TECHNOLOGY ON THE HEALTH CARE SERVICES IN GAUTENG PROVINCE SOUTH AFRICA

J. F. AGWA-EJON

Department of Quality and Operations Management, University of Johannesburg, Auckland Park Bunting Road Campus,
P.O. Box 17011, Doornfontein 2028, Johannesburg, Gauteng Province, South Africa. E-mail address: jagwa-ejon@uj.ac.za

A. PRADHAN

Department of Quality and Operations Management, University of Johannesburg, Auckland Park Bunting Road Campus,
P.O. Box 17011, Doornfontein 2028, Johannesburg, South Africa. E-mail address: anupp@uj.ac.za

Abstract

Modern technology has enabled global integration with an immense opportunity for sharing knowledge. This paper examines the impact of modern medical technology on the Gauteng medical services. Gauteng is the smallest of the nine provinces in South Africa with the highest population. It produces 33.9% of the GDP of South Africa, equivalent to 10% of that of the entire African continent. Gauteng has the fourth largest economy in Africa after Algeria. Although numerous studies have identified the impact of technology on the medical fraternity, little data and analytical attention has been given to South Africa regarding modern technology, especially its impact on medical tourism. Patients from poor countries lacking modern technology travel to South Africa to benefit from technology that has improved diagnosis and made surgery quick, safe, efficient, and reduced the post-operative recovery to a few days. A multi-case approach was used in this study to explore the benefits of modern technology on the health care services. An in-depth analysis was conducted on two public and two private hospitals, selected because of their location in Gauteng and their bed capacity. A five point Likert questionnaire was administered to the hospital managers, nurses, doctors and medical technologists. In conclusion the paper emphasises the need for improved environmental friendliness by utilising paperless medical records and prescriptions, and recommends upgrading technological acuity of policy makers and healthcare Managers about the impact of Medical Technology in Disease management.

Keywords: medical technology; medical tourism; health care

Introduction

Modern Technology has always been an important part of medical practice. Rapid technological development during the industrial revolution resulted in the development of various types of imaging systems for use in medical diagnosis and treatment. Computerised axial tomography and magnetic resonance imaging are systems that arose directly from the discovery of x-rays by Wilhelm Röntgen in 1895. Although these and other types of modern diagnostic equipment are available and used widely in the developed world, modern technology in Africa is usually found in major urban centres, and would in some cases be earlier models or those which are already obsolete in the developed world. Use of technology improves the clinical acumen of medical practitioners and provides for rapid diagnosis and

treatment, accelerating recovery and preventing, as well as reducing inevitable disability from disease.

Gauteng province is the economic heartland of South Africa, and most hospitals in this province use some form of technology in day to day patient care. Private hospitals in this province have embraced technology, with several of them boasting radiography practice with modern scanners and other imaging systems. This includes modern monitoring equipment in theatres, together with computerised record systems. Although doctors do not as yet provide an entirely paperless practice, most specialist medical practitioners are gravitating to computer-based paperless patient records. Because of modern technology, the South African health care system is considered to be advanced and is favoured by many sub-Saharan countries. A number of sub-Saharan countries, including all South African Development Community (SADC) and East African States have contracted with the South African Government to provide that extra level of health care which may not be available in these countries. These countries routinely transfer their patients to South Africa for treatment. Individuals in these countries who can afford private health care are also travelling to South Africa to access healthcare. A number of patients from Britain also travel to South Africa for surgery and spend their postoperative convalescence time enjoying the fauna and flora of the country.

Telemedicine, the provision of healthcare over distance using information and communication technology, if expanded in Africa would help to address some of the major healthcare problems afflicting Africa. Telemedicine can be used for health education of communities, for training healthcare workers and as a supervisory tool by other healthcare professionals over subordinates. Lastly the use of technology in health monitoring and treatment has advanced from hospital or surgery based equipment to those that are designed for an ambulatory patient. A Transcutaneous Electrical Nerve Stimulation (TENS) patch is attached on the skin surface over an area of pain. It functions by delivering a small voltage electrical impulse to alleviate pain. It has also found some use in alleviating labour pain in maternity wards. The objective of this paper is to improve the understanding of the impact of modern technology on health care facilities and establish the extent to which it affects the medical tourism in Gauteng province.

Literature Review

Technology is the future of healthcare. Over the last two centuries, medical technology has evolved from a simple stethoscope to modern day Information Technology (IT) based medical equipment. For instance, the stethoscope was invented in 1816; X-rays for medical imaging in 1895; electrocardiograph (ECG or EKG) machine in 1901; foetal ultrasound in 1955; whole-body computed axial tomography (CAT) scan in 1973; positron emission tomography (PET) image in 1975; whole-magnetic resonance imaging (MRI) scanner in 1977; commercial hybrid PET/MRI scanner in 2008, and so on (US DHHS, 2010). According to the American Hospital Association (AHA, 2006), hospitals must continually adopt innovative clinical and information technology in order to provide high quality health care. New technology helps minimise complications, reduce duplicative tests and improve outcomes; whereas enhanced information technology produces benefits through disease surveillance and health information exchange. Hospitals, patients and physicians all want the

most cutting-edge, clinically proven technologies available in the market. Modern technology today is a convergence of medical equipment and IT, for instance digital radiology (Coye and Kell, 2006). New medical devices generate streams of data for analysis and storage for future referrals.

In 2005, a study was conducted by the Productivity Commission in Australia to identify the impact of advances in Australian medical technology. The major advances in medical technology (including diagnostics, procedures, prostheses, devices and medicines) identified in recent decades were listed as: (i) MRI and CT scanning; (ii) Angiotensin-converting enzyme (ACE) inhibitors for high blood pressure; (iii) Angioplasty to unblock arteries; (iv) Statins to reduce cholesterol; (v) Selective serotonin reuptake inhibitor (SSRI) and non-SSRI antidepressants; (vi) Phaco cataract removal and foldable lenses; (vii) Hip and knee replacement; (viii) Inhaled steroids for asthma; (ix) laparoscopic surgery; and (x) Tamoxifen to treat breast cancer. This advancement in medical technology was driven by: income growth; community expectations; ageing population; awareness of new technologies and their potential benefits; skills, capabilities and supply of practitioners; needs of patient; financial and other incentives; and regulations and guidelines (Productivity Commission, 2005). The report also provides a list of predicted future advances in medical technology, such as advances in (i) rational drug design; (ii) imaging and diagnostics; (iii) minimally invasive surgery, robotics and virtual surgery; (iv) genetic testing, gene therapy and pharmacogenomics; (v) new vaccines for cancer and others; (vi) xenotransplantation and bioengineered organs, joint or tissue replacement; (vii) stem cell therapies; (viii) nanotechnologies and nanomedicines; and (ix) information and communication technologies.

Every year, ECRI Institute (a non-profit organisation based in Pennsylvania, USA) compiles a top 10 list of important technologies and technology-related issues to which hospital and health system leaders should pay close attention. The list is compiled based on financial, patient safety and regulatory factors. Table 1 shows ECRI's top 10 list for the preceding three years. The list provides an outline of the present day healthcare competitive structure, which might be essential for the hospitals to meet the rising standards of competition and modernity.

Table 1. ECRI Institute's top 10 list of hospital technology and technology-related issues

No.	2012	2013	2014
1	Electronic health records (EHR)	her	Computer-assisted sedation systems
2	Minimally invasive bariatric surgery	Mobile health	Catheter-based renal denervation for treatment-resistant hypertension
3	Digital breast tomosynthesis	Alarm integration technology	Emergency departments designed just for elderly patients
4	New CT radiation reduction technologies	Minimally invasive cardiac surgery	Copper surfaces in ICUs for preventing hospital-acquired infections
5	Transcatheter heart valve implantation	Imaging and surgery	Wearable powered exoskeleton rehabilitation for individuals with paraplegia
6	Robotic-assisted surgery	PET/MR hybrid	Magnetic resonance-guided focused ultrasound for cancer pain
7	New cardiac stent developments	Bariatric surgery	NanoKnife system to treat cancer
8	Ultrahigh-field-strength MRI systems	Supply chain	Real-time MRI adaptive radiation therapy
9	Personalised therapeutic vaccines for cancer	Radiation dose safety	Intelligent pills to improve medication adherence and prevent readmissions
10	Proton beam radiation therapy	Lung cancer screenings	Big data analytics

(Source: ECRI 2012, 2013 and 2014)

To cope with elevated cases of cancer, a new technology from Varian Medical Systems (VAR) for treating cancer with radiotherapy has been recently installed in Yangon General hospital in Myanmar (Gingsberg, 2014). The machine is fully capable of delivering high-quality treatments for many types of cancer and upgradable for future needs. The hospital has also acquired high-dose-rate (HDR) brachytherapy from VAR, which is useful to deliver radiotherapy directly to a tumour site from inside the body.

In Canada, following the example of Akershus University Hospital in Oslo, which is a fully digitised hospital since 2008, Humber River Hospital in Toronto is expected to open in 2015 with high tech facilities for patients (Stastna, 2013). The facilities provide patients with control of room temperature, lighting, video chat with nurses, and electronic medical charts by the patient's bedside. Automated guided vehicles will move supplies throughout the hospital. Furthermore, mobile devices such as smartphones are more rapidly gaining popularity among patients and practitioners as a modern day accessory for medical technology, as plenty of healthcare applications are being made available for these phones.

This last section of the literature review focuses on medical tourism. There have been several explanations and definitions about medical tourism, but in their recent work on medical tourism, Crush, Chikanda and Maswikwa (2012) refer to it as the global industry that promotes medical travel as a form of tourism. In general, medical migration refers to all forms of cross-border movement for medical or health reasons. There are three broad categories of medical migration: intra-bound, inbound, and outbound. Intra-bound medical migration refers to domestic movement of patients to access medical care. Inbound medical migration refers to cross border temporary movement to a foreign country for medical care. Outbound medical migration refers to a temporary movement from a foreign country to receive medical care. "Medical tourists" and "health tourists" are sub-categories of medical migration that refer to medical patients who cross international borders for treatment and tourist activities while they are abroad. In recent years, medical tourism has grown into a multi-billion dollar industry due to globalisation and increased human mobility, as increasing numbers of people migrate across international borders for medical reasons. Reasons for this are the lack of timely care in overburdened public health systems, the absence of treatment procedures and private health care options, inadequate insurance or personal funds to pay for expensive procedures, and the demand for cosmetic surgery in the North. These factors have driven Europeans and North Americans to travel to developing countries in the South for high quality and low cost medical treatments.

According to Kachipande, S. (2013) Thailand, India and Singapore are the major hubs, while Costa Rica, Hungary and South Africa are considered minor hubs for medical tourists. India is the cheapest of all the hubs where prices for surgical procedures average only a fifth of those in the US. India provides (i) specialist hospitals especially to treat foreign patients for heart surgery and joint replacements, (ii) rare facilities, such as hip resurfacing, (iii) well-trained health practitioners and good English speaking medical staff, (iv) a good mixture of super specialty centres with technologically advanced diagnostic equipment. Thailand offers a full range of medical services, especially routine check-ups and cosmetic surgery. Singapore offers highly skilled practitioners and state of the art technology to the medical patients.

South Africa cannot compete with most of the other medical tourist destinations on price alone. A survey of cost of different procedures in several countries showed that advertised

cosmetic surgery prices in South Africa are lower than in the USA but higher than in India, Croatia and Mexico. South Africa will benefit by providing a professional package tour which includes medical procedures with a related travel and tourism experience. For instance, a cosmetic surgery package in South Africa will consist of a consultation and surgery, personal physical therapist and personal assistant during recovery in a spa and a safari tour afterwards. Medical service providers generally promote South Africa as a cosmetic tourism destination, the main target for which is Europe (especially the UK and Germany) and the US. The most popular procedures include hip replacements, rhinoplasty, breast augmentation, liposuction, facelifts and tummy tucks. The enticing attributes of the country include a wonderful climate, wildlife, spectacular scenery, a favourable exchange rate and world-class medical care.

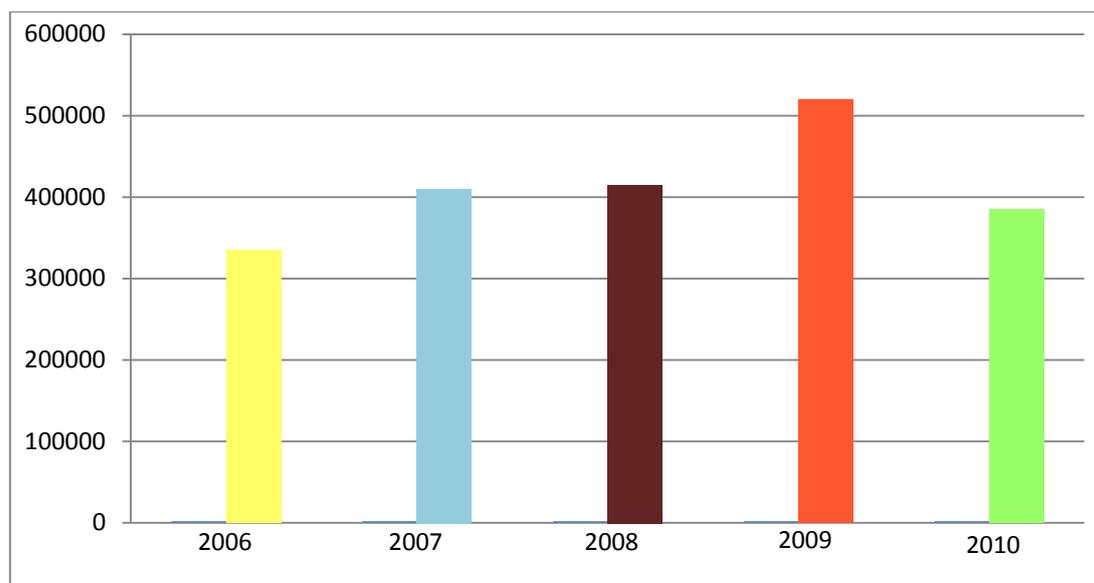
The “surgeon and safari” medical tourism experience is only one small segment of the industry in South Africa. The majority of medical migration to South Africa is from other African countries. According to Roberts and Scheper-Hughes (2011), Nicolaidis, A. (2011) many medical tourists are poor and medically disenfranchised persons desperately seeking life-saving drugs and therapies and corrective surgeries that they cannot get at home. South-South medical travellers from the rest of Africa consider South Africa as a centre of high quality and affordable medical care which is not available in their own countries. It has been observed that the middle class African medical tourists from East and West Africa come to South Africa to access medically necessary procedures, such as reconstructive surgery and chemotherapy. Also, the public health systems in the countries neighbouring South Africa are in a state of crisis, under resourced, understaffed and overburdened. These countries have much lower ratios of health-care workers to patients than South Africa or the recommended WHO minimum. The general lack of access to medical diagnosis and treatment in SADC has led to growing medical travellers in South Africa.

Different studies have reported the estimates on medical tourists travelling to South Africa with widely varied numbers. According to the 2002 Immigration Act of South Africa, medical permits are issued to people who intend to stay in South Africa for periods in excess of three months, which makes official South African data of limited use. Since the majority of medical tourists enter for shorter periods, any data on the issue of medical permits would only capture a small proportion of the market. Also, there is no medical option on visa applications or entry forms, hence most people entering the country for medical purposes give ‘holiday’ as their reason for coming to South Africa which generally entitles them to a 90 day stay.

According to South Africa Tourism (SAT), the number of medical migrants increased between 2006 to 2009, but it reduced again in 2010 due to the impact of the global recession (Figure 1). In the period 2006-2010, out of the total tourists entering South Africa, only 4.5% of the entries were reported for medical treatment; however the entries showed an increment from 3.9% in 2006 to 5.0% in 2010. Over this period of time, a total of 281,000 medical migrants entered South Africa from the global North whereas about 2 million travelled from the global South. The UK is a major source of medical tourists from the North, with 4.5% of the tourists visiting South Africa for medical purposes (out of the total tourists from the same country), followed by Germany (3.1%) and the US (2.8%). Other source countries in the North include Australia, France, Canada, Italy and Sweden. About 85% of the medical tourists were estimated to travel from other African countries. Small numbers entered from

non-Africa countries in the South including India, China and Brazil. The proportion of non SADC medical tourists (at 2 – 5%) is lower than the equivalent for SADC travellers (at 6 – 12%).

From 2004 to 2008, about 1.9 million (5.6% of total) visitors crossed into South Africa from its neighbours for medical treatment. The major source of medical tourists was Lesotho (44.9%), followed by Botswana (17.6%), Swaziland (14.9%), Mozambique (12.1%), Zimbabwe (5.3%), Namibia (3.5%), Zambia (0.9%), and Malawi (0.8%). (See figure 1)



Source: South Africa Annual Tourism Reports, 2008-2011

Figure 1 Number of Medical Migrants to South Africa, 2006-2010

The medical migrants stay for shorter periods compared to other visitors. In 2010, the average length of stay of all tourists was around 8.5 nights while medical migrants stayed for around 5.5 nights. However, the average length of stay of the medical migrants increased from 4.5 nights in 2007 to 5.5 nights in 2010. These medical migrants are generally restricted to a single destination and purpose, but they were reported to enjoy several tourist activities, such as shopping (94%), experiencing night life (80%), cultural activities (3%), going to beach (2%), and visiting a game park (1%). Medical migrants from African countries were observed to spend more time in South Africa than European medical tourists. For example, length of stay for the European medical tourist in 2010 was 8 nights compared to 20 nights for Angola and 13 nights for Nigeria.

The total expenditures by all visitors in South Africa have increased from R58 billion in 2005 to R71 billion in 2010. Over the same period of time, medical expenditures have also increased from R70 million to R1.9 billion. In addition to their medical expenditures, medical migrants will also be spending more money on accommodation, meals and goods while in South Africa. The average per capita expenditure estimate showed that medical tourists from Europe, the US and Canada spent relatively less than Asian and African travellers. The lower figure is due to the fact that those on a tourism package pay for airfare and accommodation before departure. The high figure for African travellers generally includes expenditures on

goods to take back home. Over 90% of medical expenditure is generated by South-South medical migrants from the rest of Africa.

In South Africa, medical tourism is largely driven by small scale medical tourism facilitators, who market the country at an individual level. These facilitators are a mixture of travel agencies and provider groups which act as intermediaries for international patients. Physicians in the home country and social network also seem to have an influence on medical travelling. Major destinations (India and Thailand) are viewed as having well-established and managed medical tourism industries where private hospitals, policy makers and tourism agencies work together to invest in, develop and promote the industry.

Medical tourism today has benefitted a lot from globalisation, technological advances, ease and convenience of the travel, high cost of local health care, long wait times for certain procedures, and improvements in the standards of local care in many countries (Stolk, 2009). Several factors influence the growth of medical tourism: (i) as long life continues to increase, baby boomers will represent an increasingly significant market; (ii) health insurance schemes will start considering providing benefits for patients traveling abroad. The internet is becoming one of the important sources of medical information for patients to learn about the primary information about facilities and procedures, enabling them to choose a destination catering for their medical needs.

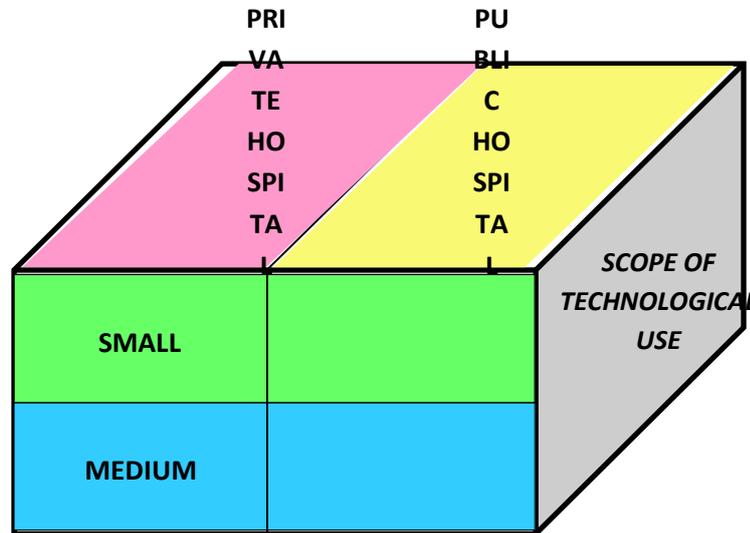
Stolk (2009) emphasised that South Africa is one of the most popular destinations for cosmetic tourism. The professionalism and polish of the South African cosmetic packages is unique and cannot be matched with that offered by other countries. In addition to cosmetic surgery, South Africa offers the best pre- or post-operative care and a diverse cultural experience. The medical tourists to South Africa can enjoy sun, relaxation, surgery and safari. However, there are a few barriers hindering the progress of medical tourism in South Africa: (i) lack of laws and policies for medical tourism, (ii) lack of awareness and poor presentation of the benefits of medical tourism, (iii) ethical aspects (issues related to patient's rights and privacy, healthcare for local people, and organ transplants), and (iv) data collection and keeping.

Hardly any data exists on the medical tourism industry in South Africa. Collaboration between various stakeholders is required to promote the medical tourism industry, and data must be kept and analysed. This will enable the industry to identify trends, react on them and in the end increase the industry's growth.

Research Methodology

In this study a multiple case study method was used by selecting six health care facilities as the appropriate site to address the objectives of the research. Most of the data obtained was from observations, interviews and documentation obtained from the hospitals. The criterion used for the selection of these hospitals was their distance from the University, their bed capacity, and the extent to which modern medical technology was used. After a pilot study two hospitals were dropped as one was found to be very large and the second had employees who were reluctant to participate in the interview. In the final survey the questionnaires were administered by the researcher through the various heads of departments in the hospital. The only problem during the survey was in the distribution of questionnaires to doctors in the private hospitals as they are not part of the hospital staff and operated independently as a

separate entity. Figure 2 below is a representation of the hospitals targeted in the interviews during the study.



Source: Adapted from "The case study as a Research Method". (Gagnon, 2010)

Figure 2: The diagrammatic illustration of the hospital selection criterion.

The number of questionnaires initially sent was 210, but this was reduced as a result of the two hospitals which were later dropped, resulting into only four hospitals being surveyed. The questionnaires were sent to two hospital administrators in each facility, resulting in eight persons (A=8). The second group were eight doctors in each facility, giving a total of thirty-two participants. (D =32). The third group of employees who were given the questionnaires were medical technologists who had ten questionnaires per hospital, giving a total of forty persons (T=40). The last group of employees to be interviewed were nurses who were given fifteen questionnaires per hospital. Therefore a total of sixty nurses participated in this survey (N=60). The total number of questionnaires administered amongst the four hospitals was therefore 140 but only 125 were returned which were properly completed.

The questionnaires were divided into three sections. The first part contained the demographic data regarding the participants such as age, gender, and educational level. The second portion covered information on the types of modern medical equipment used by the hospital. The last section requested information on the treatment offered to foreign patients. The Questionnaire sample was split into two areas based on the type of hospital. Two hospitals were private and the other two were public government hospitals. In each hospital the questionnaire was further sub-divided into professions as stated above.

Findings and Results

The data analysis was done using SPSS. The analysis is descriptive through the use of charts. The results showed a 55.2% response from the public government hospitals and 44.8% from the private hospitals. This was probably because the level of activities in government

hospitals is not as intense as in private hospitals, and therefore employees were able to squeeze time to respond to the questionnaire. (See figure 3)

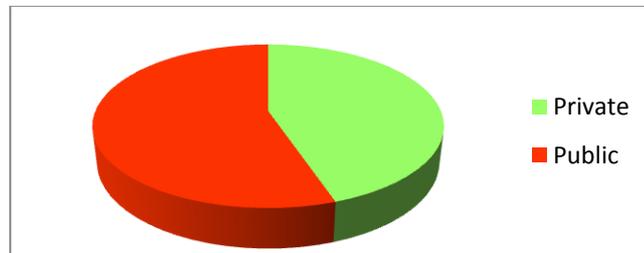


Figure 3: Responses based on hospital sectors

A total of 125 participants responded, of which 75.2% were female and 24.8% male. The dominance by females in the response could have been because of the high number of questionnaires administered to nurses. Figure 4 shows the dominant gender in the investigation and Figure 5 somewhat confirms a similar distribution based on the professions of the respondents.

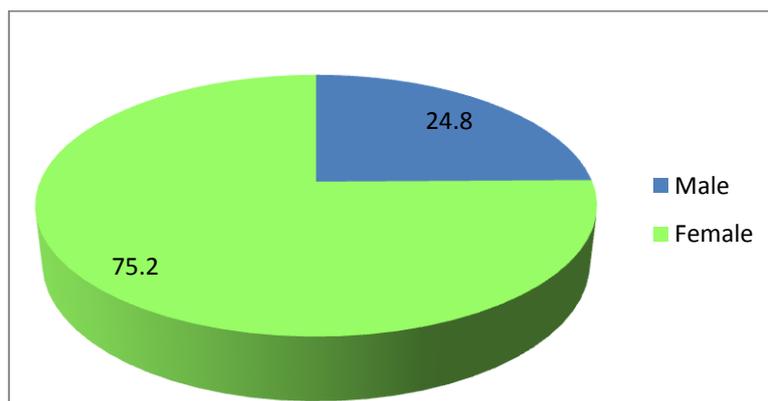


Figure 4: Responses based on Gender

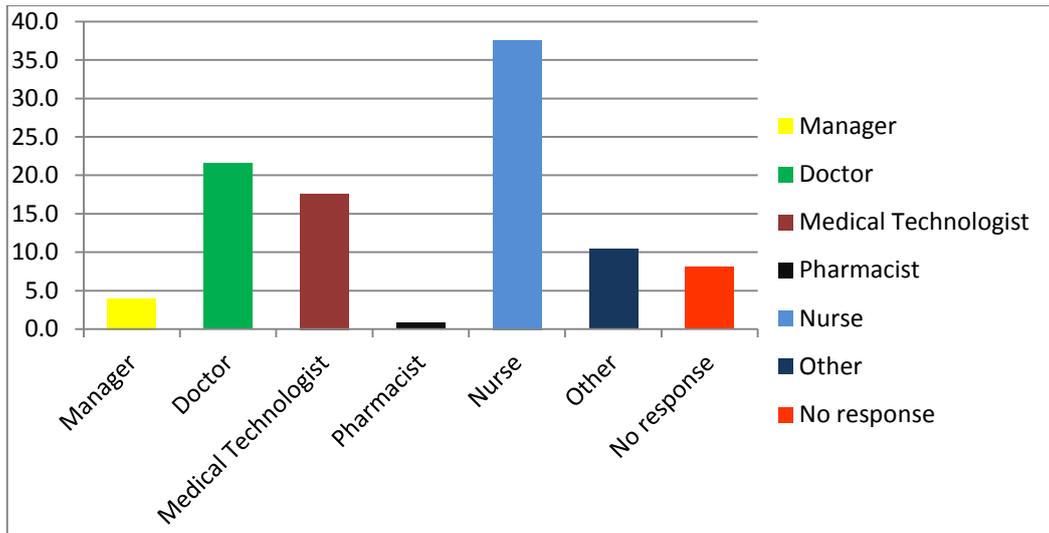


Figure 5: Professional position of respondents in the survey

The age group representation reflected in figure 6, shows that more than 52.4 percent are in the active age group of between 30 to 44 years; which means they still have the potential and desire to learn and improve their skills or qualifications through further training. On the other hand, Figure 7 shows limited training in modern medical equipment, and that an opportunity has not been given to most of the participants to acquire the necessary skill.

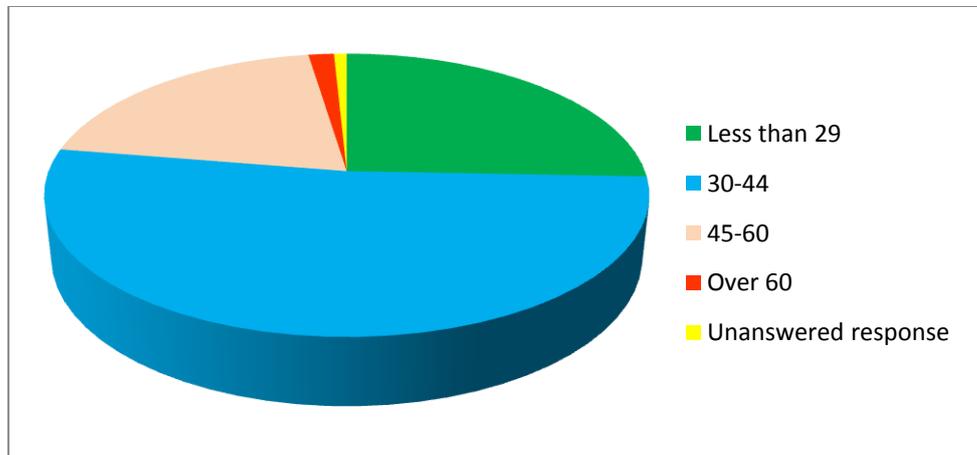


Figure 6: Age group of respondents

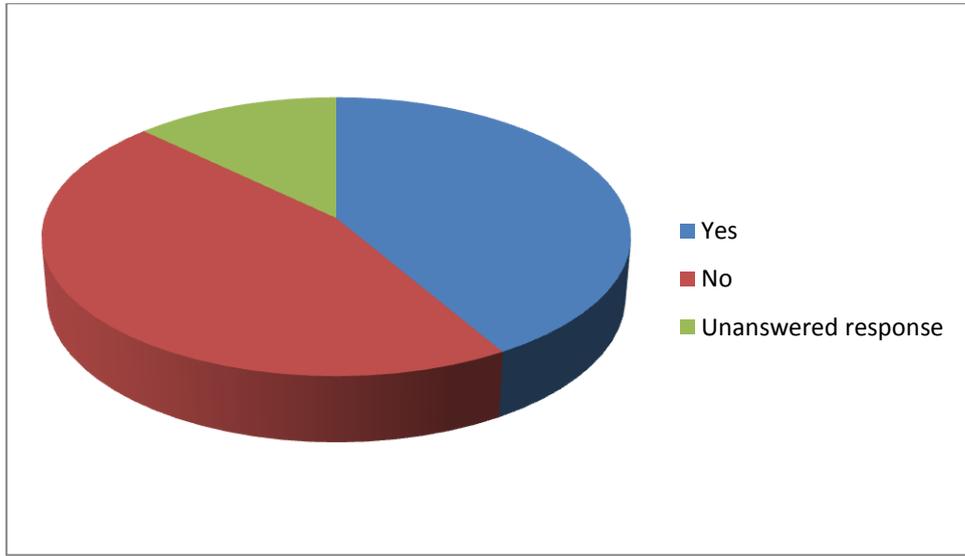


Figure 7: Training programme attended by respondents

The level of education recorded shows that most of the participants are well educated. Over 74.4% of the participants are holders of matric and post-matric qualifications. This means that most of these employees would be able to handle any modern medical technological equipment if given proper training and exposure. (See figure 8)

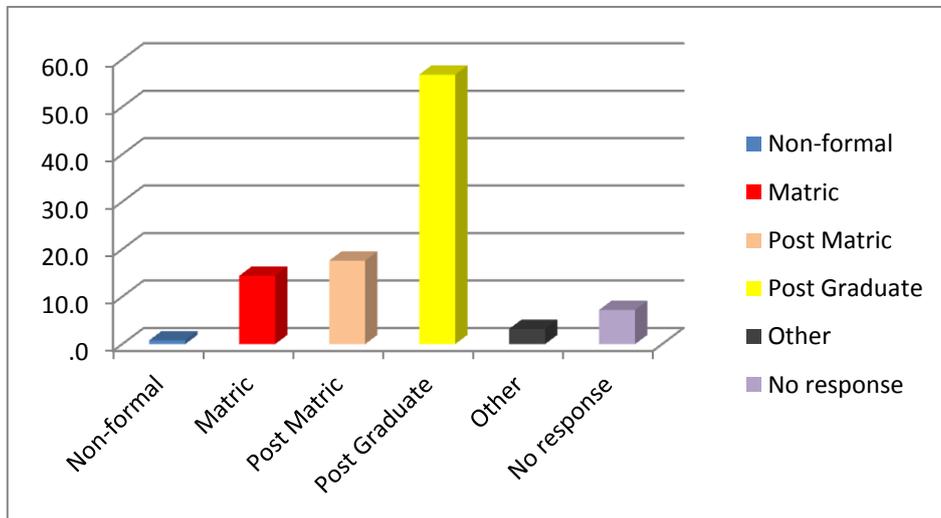


Figure 8: Level of education by respondents

The following questions were administered to the respondents with regard to modern medical technology. Question 1 requested when last the facility or hospital acquired any medical technological equipment. Figure 9 below clearly indicates that most of the hospitals had bought modern medical equipment within the last year. More than 8 percent reported having bought equipment within the last 4 years. Further investigations revealed that most of the hospitals delayed in replacing their equipment because of financial constraints, as some of

this equipment was extremely expensive. Discussions with the employees especially those in government hospitals gave an impression that employees were not keen to answer this particular question; this could explain the reasons why there was a very high non-response recorded, which is shown in the graph as no response in the last column of the chart.

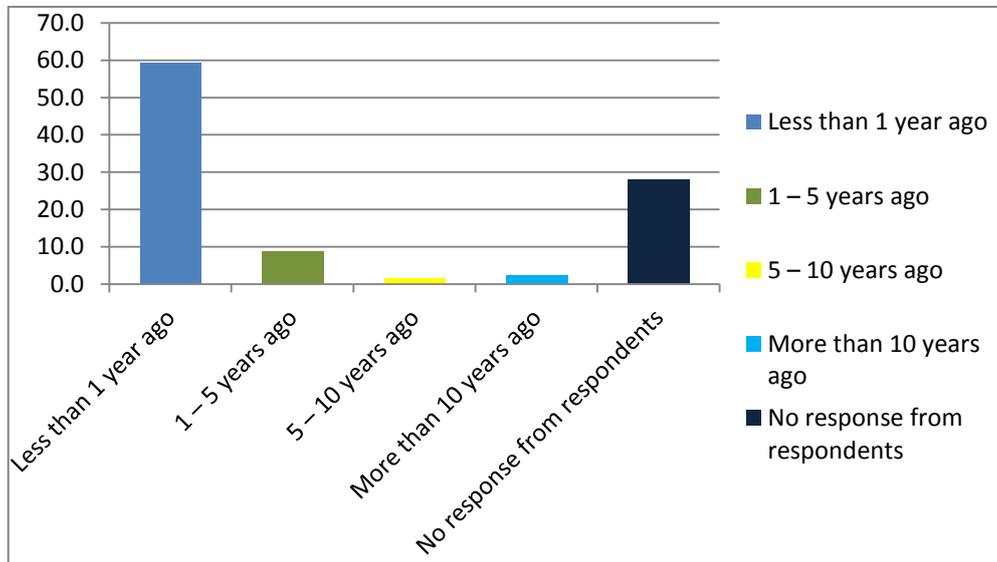


Figure 9: Hospital acquisition of technological medical equipment

The second question required the names and brief descriptions of the last technological equipment acquired. The response to this question gave a list of similar equipment for both private and public hospitals. The response showing about 60% of the medical equipment has been bought in the last one year. This is an indication that senior management is aware of the benefits of modern medical technology, and is keen to keep abreast with new developments and innovation.

Lastly Figure 10 conveys the percentage of participant’s observation of foreign patients who come for treatment in their hospital. The indication is that quite a large number of foreigners visit Gauteng for medical attention; but this is a very insignificant number if compared to overall 78% of the patients who come from Gauteng. Interviews with medical doctors also revealed that although foreigners do come for specialist treatment in these facilities, their numbers are insignificant compared to the locals (Figure 11).

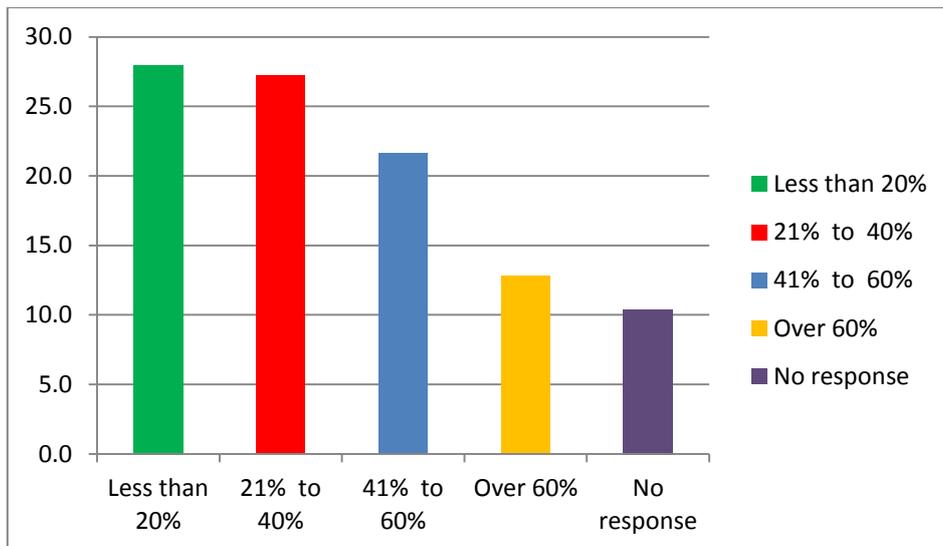


Figure 10: Foreign visitors to hospitals

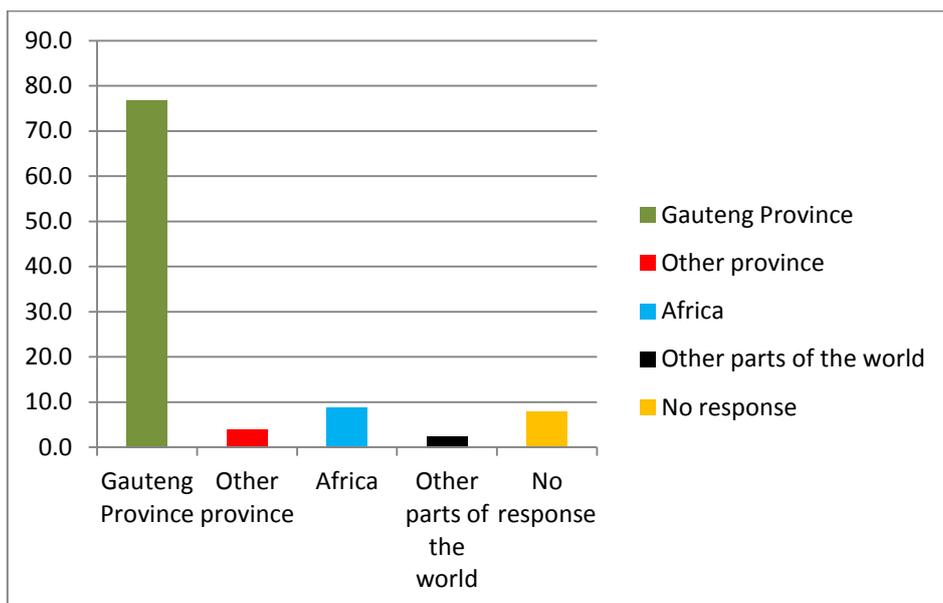


Figure 11: Geographical origins of patients

Considering Figures 10 and 11 and the open answers given by the respondents, although it is not indicated in the graphs, there has been a steady increase in the number of foreign patients visiting facilities in Gauteng. Most of these patients come for specialised treatment in areas like surgical, paediatric and medical fields, where medical technology has been reported as improving the patient treatment time resulting in savings due to lesser days in hospital. Doctors interviewed, especially in private hospitals, indicated availability of medical packages in Gauteng involving patient tourism after treatment has been completed. But these opportunities have not been well marketed and very few foreign patients seem to be aware about them.

Conclusion

The result of the study revealed that the number of foreign patients is increasing although most of them are unaware of the current tourism packages in Gauteng. The perception is that current medical technology has reduced the average number of days that patients spend in hospital and therefore patients are able to save both time and money and are therefore in a position to go for tourism. Currently the medical tourism in Gauteng Province is seen to be at a low level largely because of the number of local visitors; however there is a greater scope of development to medical tourism in the Province because of the Management interest in acquiring advanced modern medical equipment.

About 60% of the respondents indicated that modern medical equipment is being bought by their hospital within last one year. This is an indication that senior management of these facilities are aware of the current trends in new technology and innovation. Discussions with doctors revealed that paperless prescriptions and treatment records are being used to a limited extent in medical facilitations. It is therefore recommended that this should be further encouraged as a means of minimising cost.

The study showed that the level of education of most of the employees in Gauteng facilities is high, and that employees have the potential for training and improvement for their qualifications. Most of these employees have not been given the opportunity to train on modern medical equipment. It is therefore recommended that senior management needs to be made aware of this lack of training, and workshops should be held in order to improve the agronomics between the employees and the current modern medical equipment being bought frequently. In addition to formal education and training, several respondents who may have obtained skill through experience indicated that they find it very difficult to adapt to the newer more sophisticated equipment being introduced, such as understanding the incorporation of software into medical technology.

The major problem encountered was the administering of questionnaires to medical doctors in the private sector, as most of them are self-employed and only rent facilities within the hospital. It was also noted that most good or highly specialist medical officials tend to operate in the vicinity of each other; for example all good doctors rent facilities from within the same hospital. This is an added advantage for foreign patients since all the help they need, will be in one place. Interviews with surgeons, brought to light a challenge that modern medical technology may not operate as expected in most cases because of the lack of planned backup facilities due to limited resources.

Finally South Africa is a member of the SADAC (Southern African Development Corporation), and is currently involved with the BRICS countries making it an emerging economy in the world, therefore medical tourism is expected to mushroom significantly.

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