"Health Technology Assessment Report on Mobile Eye Surgical Unit"

A dissertation submitted in partial fulfillment of the requirements for the award of

Post Graduate Diploma in Health and Hospital Management

By

Swati Sharan

PG/11/104

International Institute of Health Management Research

New Delhi - 110075

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Under the Guidance of

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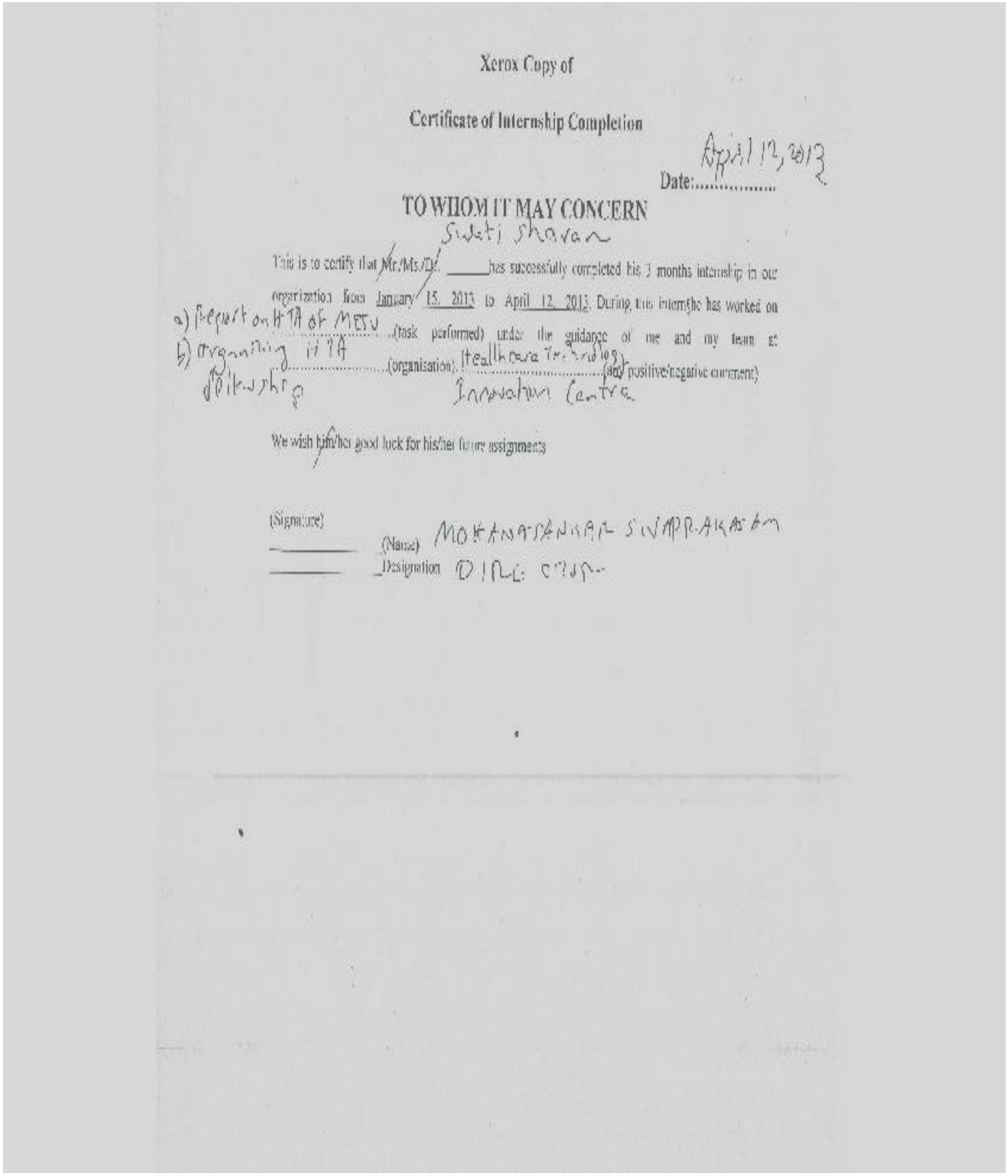
International Institute of Health Management Research
New Delhi - 110075
May, 2013

INTERNSHIP COMPLETION CERTIFICATE



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Certificate of Internship Completion

Date: April 12, 2013

TO WHOM IT MAY CONCERN

This is to certify that Mr./Ms./Dr. Sudeti Shravan has successfully completed his 3 months internship in our organization from January 15, 2013 to April 12, 2013. During this internshe has worked on a) Report on H1N1 of MERS (task performed) under the guidance of me and my team at b) Organising in IIA Pilanphy (organisation). Healthcare Technology Innovation Centre (any positive/negative comment)

We wish him/her good luck for his/her future assignments

(Signature)

(Name) MOHANASUNDAR SIVAPRAKASAM

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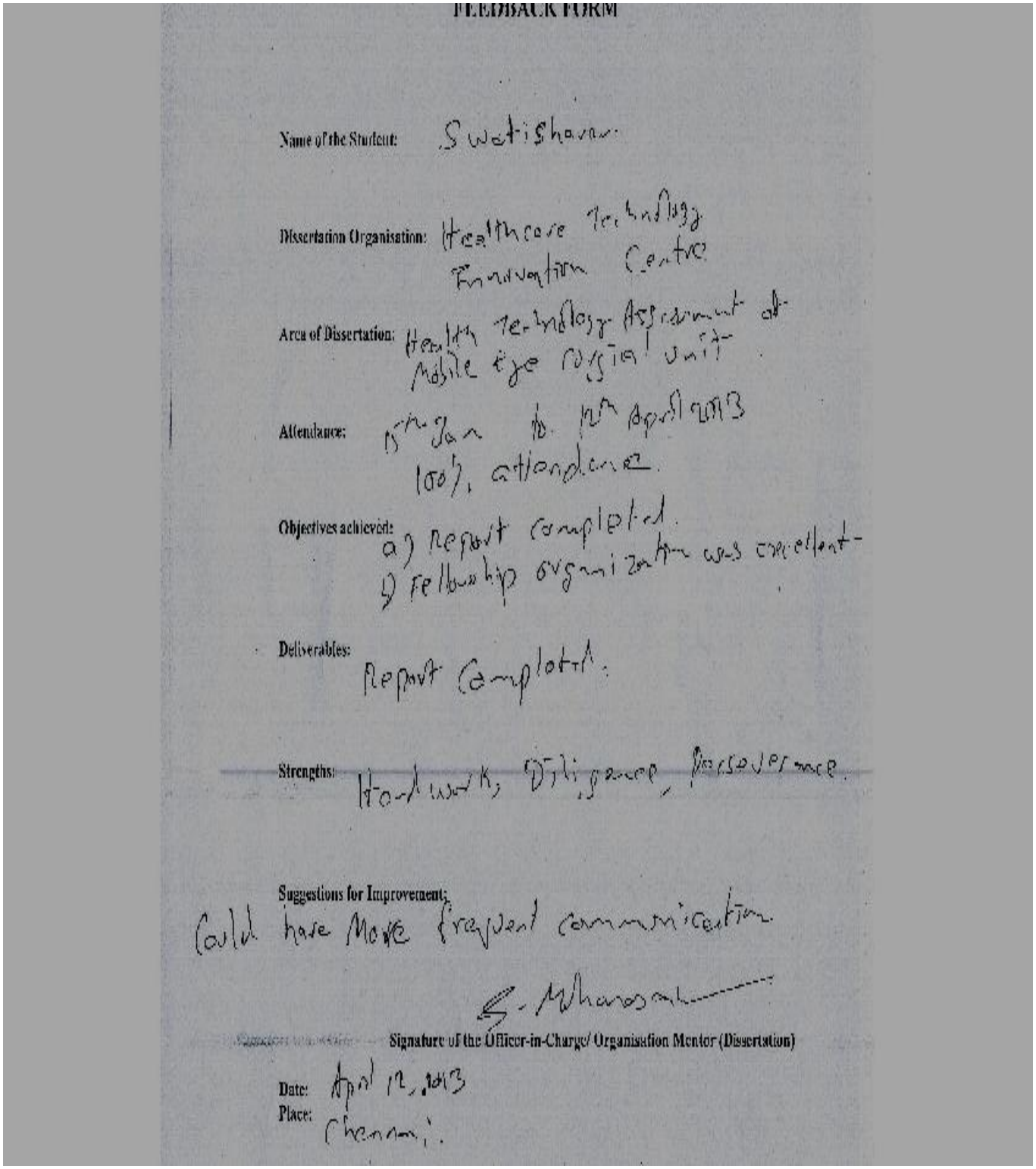

FEEDBACK FORM

Name of the Student: Swetishaan.

Dissertation Organisation: Healthcare Technology Innovation Centre

Area of Dissertation: Health Technology Assessment of Mobile Eye Surgical Unit

Attendance: Regular to the Assigned 100% attendance.

Objectives achieved: a) Report completed.
b) Fellowship organization was excellent.

Deliverables: Report Completed.

Strengths: Hardwork, Diligence, Perseverance.

Suggestions for Improvement:
Could have More frequent communication.

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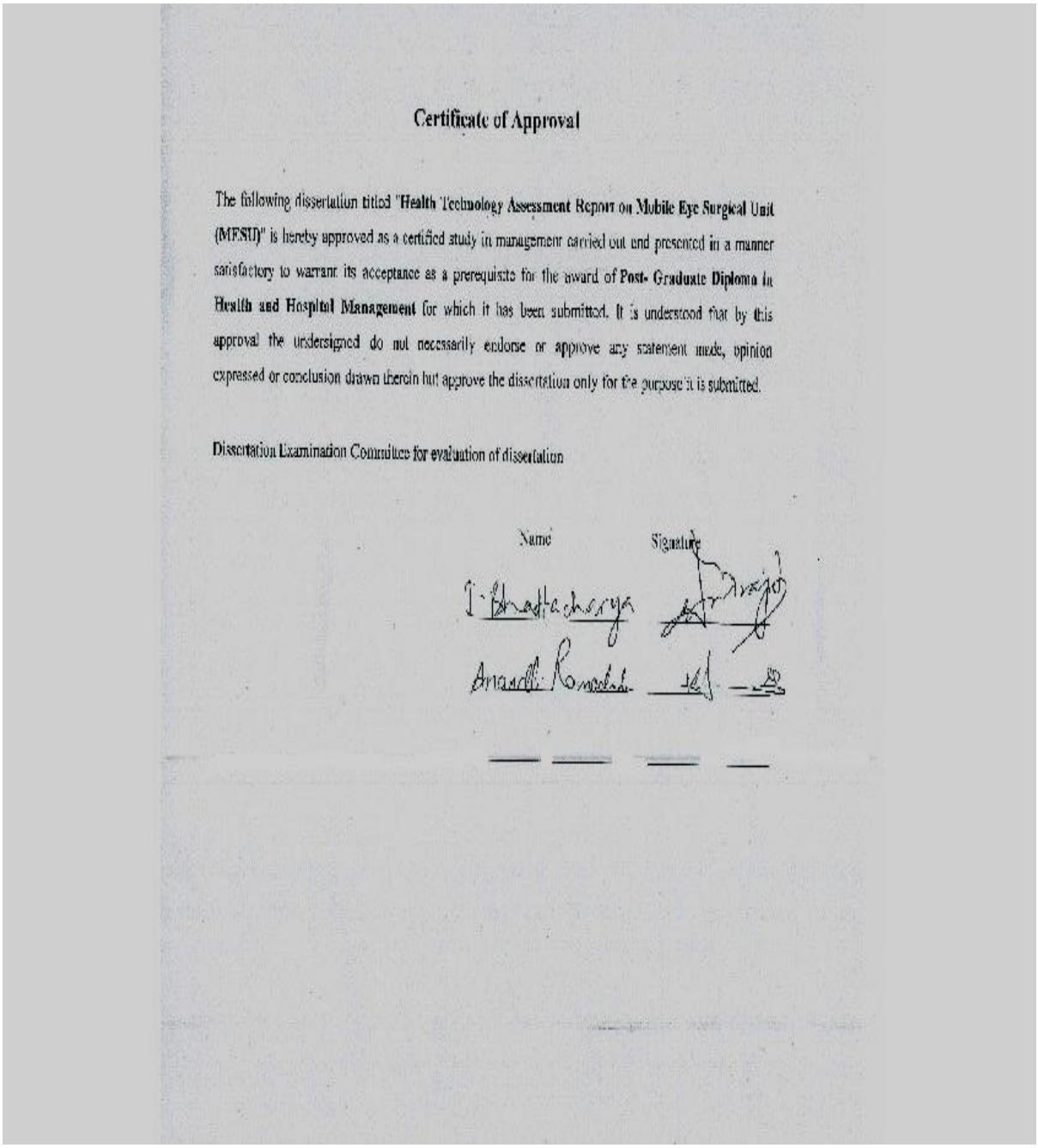
Signature of the Officer-in-Charge/ Organisation Mentor (Dissertation)

Date: April 12, 2013
Place: Chennai.

CERTIFICATE OF APPROVAL



Certificate of Approval

The following dissertation titled "**Health Technology Assessment Report on Mobile Eye Surgical Unit (MESU)**" is hereby approved as a certified study in management carried out and presented in a manner satisfactory to warrant its acceptance as a prerequisite for the award of **Post- Graduate Diploma in Health and Hospital Management** for which it has been submitted. It is understood that by this approval the undersigned do not necessarily endorse or approve any statement made, opinion expressed or conclusion drawn therein but approve the dissertation only for the purpose it is submitted.

Dissertation Examination Committee for evaluation of dissertation

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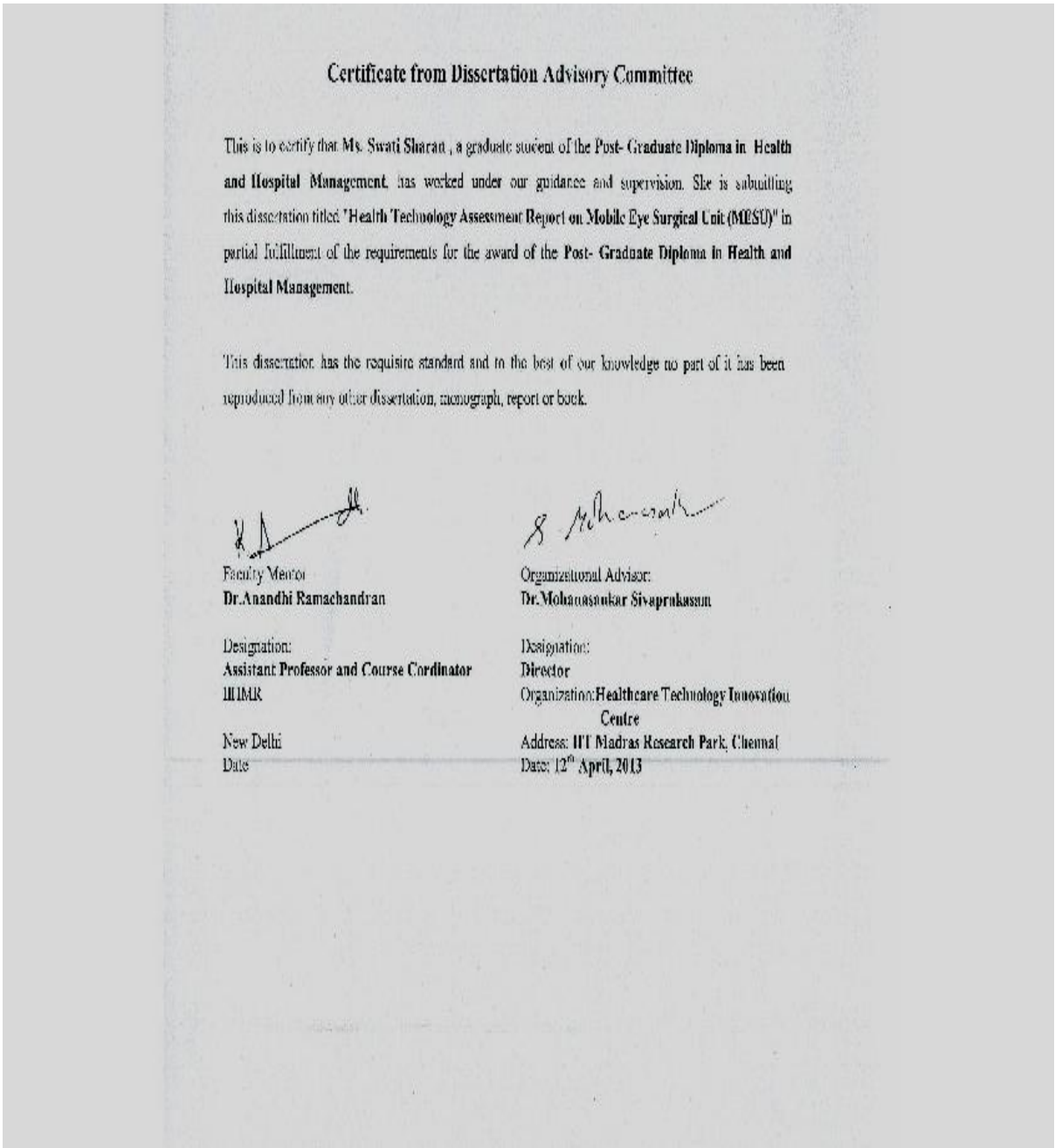
CERTIFICATE FROM DISSERTATION ADVISORY COMMITTEE



Certificate from Dissertation Advisory Committee

This is to certify that Ms. Swati Sharan , a graduate student of the Post- Graduate Diploma in Health and Hospital Management, has worked under our guidance and supervision. She is submitting this dissertation titled "Health Technology Assessment Report on Mobile Eye Surgical Unit (MESU)" in partial fulfillment of the requirements for the award of the Post- Graduate Diploma in Health and Hospital Management.

This dissertation has the requisite standard and to the best of our knowledge no part of it has been reproduced from any other dissertation, monograph, report or book.

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ABSTRACT

The MESU report summarizes the results of assessment of use of Mobile Eye Surgical Unit in undertaking cataract surgery in the rural and remote areas of South India. Cataract is a major cause of preventable blindness in India. National Programme for Control of Blindness, now merged with National Rural Health Mission (NRHM) has considered various strategies to scale up eye care facilities. After the ban on Mobile Eye Camps in India, the emphasis was on hospital based eye care.

The MESU project is a collaborative project between IIT Madras and Sankara Nethralaya, Chennai. The vehicles used for diagnosis and treatment provide proper surgical settings. It is therefore important to optimise the value for money.

To have the proper cost effectiveness and analysis of all the projects which can be recommend for public health care system in India HTA tool is used. It determines the most effective and efficient approach to achieve, implement and sustain a quality assured technology that takes into account disease burden, patient requirements and cost effectiveness. It includes qualitative and quantitative analytics for measuring effectiveness and impact assessment.

With this HTA Report of MESU, it was found that if MESU is integrated in the Health System of India then only 0.32 % of annual health budget every year on MESU can treat 50% of all cataract cases in India.

ACKNOWLEDGEMENT

A project of this nature is often the product of the time, effort and dedication of a large number of people. Many of whom remain in the background.

I am extremely grateful to my Project guide Mr.Jitendar Kumar Sharma for his invaluable guidance, enthralling advice, constructive criticism and ingenious inspiration throughout this Project endeavour.

I am also thankful to my mentor Mrs. Anandhi Ramachandran, Prof. - IIHMR New Delhi who helped me for completing this research report. Her untiring efforts and soothing concern have made it possible to bring out this report on time.

I would also like to thank all the professionals & companies who allowed me to conduct the study at their office and helped me in my endeavour.

I am also equally thankful to our institute 'International Institute of Health Management Research, New Delhi for providing me with the platform from where I can launch myself successfully and the necessary support without which the thesis report could not have been completed.

Thank You

Swati Sharan

TABLE of CONTENTS

List of Figures

List of Tables

List of Abbreviations

AHU	Air Handling Unit
AIOS	All India Ophthalmologic Society
CBM	Christian Blind Mission
CEA	Clinical Establishment Act
CHC	Community Health Centre
CINAHL	Cumulative Index to Nursing and Allied Health Literature
CSR	Cataract Surgical Rate
DALY	Disability Adjusted Life Year
DANIDA	Danish International Development Agency
DBCS	District Programme Committee (Blindness)
DGHS	Directorate General of Health Services
DOTS	Directly Observed Treatment, Short Course
DR	Diabetic Retinopathy
ECCE-PC-IOL	Extra-Capsular Cataract Extraction of Posterior Chamber Intra-ocular Lens
GDP	Gross Domestic Product
GIA	Grant-in-Aid
GSDP	Gross State Domestic Product
HAART	Highly Active Antiretroviral Therapy
HEPA	High-Efficiency Particulate Air
HIV	Human Immunodeficiency Virus
HTA	Health Technology Assessment
ICCE-AG	Intra-Capsular Cataract Extraction, using Aphakic Glasses
ICER	Incremental Cost Effectiveness Ratio
IIT	Indian Institute of Technology
INAHTA	International Network of Agencies for Health Technology Assessment
IOF	Indian Optometry Federation
IOL	Intraocular Lens
MEDLINE	Medical Literature Analysis and Retrieval System Online
MESU	Mobile Eye Surgical Unit
MoHFW	Ministry of Health and Family Welfare
MoU	Memorandum of Understanding

INTERNSHIP REPORT

1.1 INTRODUCTION TO ORGANIZATION

Healthcare Technology Innovation Centre (HTIC), started in 2010 is a multi-disciplinary R&D centre and is a joint initiative of Indian Institute of Technology Madras (IITM) and Department of Biotechnology (DBT), Government of India. The main aim of HTIC is to bring together technologists, engineers, doctors and healthcare professionals, industry and government to develop healthcare technologies for the country. The collaborators of HTIC include various leading medical institutions and industry players in various areas such as ultrasonography, neonatal care, patient monitoring. The organization also works with industry in developing R&D solutions, joint development of technology products, technology assessment and evaluation. It also helps in capacity building for the healthcare domain for the country through various programmes such as Innovation Fellowships, students and interns from across the country.

Some of the projects handled by HTIC are:

Mobile Eye Surgical Unit (MESU)

Its an innovative engineering solution which addressed the problem of accessibility to cataract surgery and provides a stable, self-sufficient and mobile platform to perform the surgery in a controlled and sterile environment even in rural areas of the country. The HTA of MESU has already been done by HTIC Team for which I was a part and has been published by NHSRC.

Figure 16: Mobile Eye Surgical Unit

Eye-PAC- Eye Image Processing, Analytics and Computing Platform

Eye diseases and disorders have a profound socioeconomic impact and directly affect the quality of life. Blindness can also affect day-to-day routine, livelihood, mobility, access to information, and thus alter the quality of life. But in a developing country like India to cater to chronic eye diseases is a major problem due to the shortage of ophthalmologists.

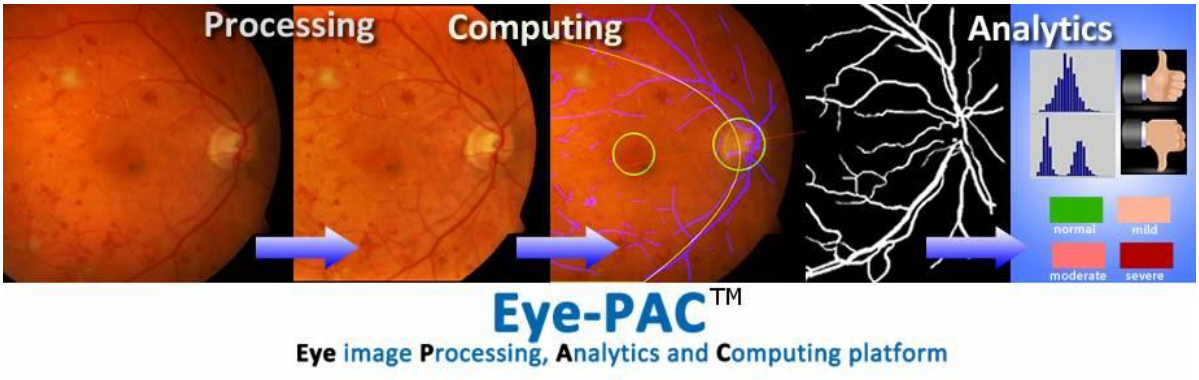

Figure 17: Eye-PAC

Clinical Need:

To combat this eye image computing platform was required. HTIC then develops Eye-PAC which consists of image analytics modules using advanced mathematical and computational techniques. The modules of Eye-PAC can be divided into 3 categories:

- Processing- It effect a transformation on the input image that results in a processed image.
- Computing- It helps in identifying and localizing anatomical structures in the image, which could be normal or pathological.
- Analytics- This module helps to derive clinically relevant information and decisions from the outputs of the computing modules.

The modules can be configured to create screening and diagnostic solutions for many vision-threatening diseases --such as diabetic retinopathy, hypertensive retinopathy, glaucoma, and age-related macular degeneration.

HTIC partnered with Forus Health to translate the eye-PAC technology to their multifunctional ophthalmic pre-screening device, 3nethra. The 3nethra images are captured through an undilated pupil. So the lower illumination of structures inside the eye posed tremendous challenge to achieve reliable performance of image computing algorithms.

The partnership of HTIC and Forus Health helps in the pre-screening of various eye conditions such as diabetic retinopathy, hypertensive retinopathy, glaucoma, and age-related macular degeneration by even a non-expert operator to make referral decisions. At the same time, this additional information can help the ophthalmologist in the specialist eye-care centre to make quicker decisions in computer-assisted manner.

Project Status:

The Eye-PAC modules for image pre-processing, identification of normal anatomy and diseases indicative of diabetic retinopathy are in advanced stage of development. Analytics modules and disease identification modules for glaucoma, disease progression tracking, screening and grading are in initial stage of development. Eye-PAC solutions for diabetic retinopathy screening and grading will undergo extensive clinical validation through a large scale clinical study spread across different parts of India.

ARTSENS- An Image Free Technology for Non-Invasive Evaluation of Arterial Stiffness

Patients with cardiovascular problems are observed to suffer with increased stiffness of arterial walls. Measurement of this stiffness can help in early detection of cardiovascular diseases and heart disease risk stratification. Non-invasive evaluation of the vessel wall properties typically require an imaging system such as ultrasound to visualize the arterial geometry and trained personnel to capture the correct images and identify arterial anatomical features for performing stiffness measurement. The requirement of expensive technology and extensive technical expertise to use that technology limits wide spread use of image based arterial stiffness measurement in clinical practice.

Figure 18: ARTSENS

Clinical Need:

An effective device for non-invasively measuring arterial stiffness in an automated manner that could be used by general medical practitioners and health workers would enable stiffness measurement to be part of large scale cardiovascular screening.

Technology Development:

ARTSENS is an image-less technology that enables non-invasive evaluation of arterial stiffness in an automated manner. The technology utilises a high frequency ultrasound

transducer to capture artery wall dynamics. The transducer insonates the region around the carotid artery and also receives the echoes reflected by different anatomical structures in the sound propagation path.

Intelligent signal processing algorithms, based on advanced mathematical methods, developed after extensive research into the echo signal characteristics, helps in the identification of arterial structures, and tracking of wall motion to measure arterial distension, with no operator inputs. Robust artery detection, wall-tracking and on-line distension wave analysis techniques developed in HTIC, enables the system to give a measurement of arterial stiffness within a minute of placing the probe over the neck of the subject. Hardware modules for transducer excitation and synchronised data acquisition were developed in-house, and integrated with software modules for real-time processing and on-line signal analysis to develop a desktop prototype device.

Project Status:

The measurement performance of the prototype device was characterised extensively using simulation studies and arterial flow phantoms. The device can measure arterial distension and end-diastolic diameter with error less than 10 %. In-vivo technical performance of the device was characterised by comparing measurements made using ARTSENS with those obtained from an imaging systems. This in-vivo study, conducted in collaboration with MediScan, Chennai, on nearly 100 volunteers demonstrated strong correlation between arterial stiffness measurements made by ARTSENS with those made by the imaging system. A strong trend of increasing stiffness with age was also apparent in the study. The utility of ARTSENS in screening scenario was examined by using the desktop prototype device to perform measurements on more than 50 volunteers over a period of 4 hours, in a vascular screening camp conducted in collaboration with Thambiran Heart and Vascular Institute, Chennai. An extensive clinical study of the ARTSENS device is currently underway at Sri Ramachandra University, Chennai.

1.2 AREA of INVOLVEMENT

The internship period was from 14th January to 10th April, 2013 during which I worked as an Intern in HTIC.

The area of my work was to have innovative technologies that were conceptualized at HTIC to be integrated in health systems and describe those efforts through scientific writings.

The main learning I gained is how to perform HTA of innovative technologies or processes on the basis of following criteria:

1. Clinical Impact
2. Economic Impact
3. Disease Burden
4. Budget Impact
5. Health System Integration
6. Ethical, legal or psychosocial implications
7. Patient Safety

1.3 LESSONS LEARNT

I was also actively involved in the management of the technical event organized by HTIC as 2nd International Fellowship on Health Technology Assessment. This fellowship was a certified program with collaborators such as WHO Country Office for India, National Health Systems Resource Centre (NHSRC), New Delhi, Quality Council of India (QCI), New Delhi and Joanna Briggs Institute of Evidence Based Medicine (JBI), Australia from 31st March to 6th April, 2013. Apart from this, we had other partners also, including:

- **Academic Partner:** Academy of Hospital Administration (AHA), Noida
- **Knowledge Partner:** Becton, Dickinson and Company (BD)
- **Healthcare Partners:** Dr.Mehta's Hospitals, Chennai and Care Group of Hospitals.
- **Media Partner:** DC Group of Magazines.

This fellowship had renowned national and international faculties such as:

- Dr Prakesh Shah, Associate Professor, University of Toronto
- Dr Rummona Dickson, Director, Liverpool Review Group, University of Liverpool
- Dr Krishna Rao, Health Economist, Public health Foundation of India
- Dr Mohanasankar Sivaprakasam, Director, Healthcare Technology Innovation Center
- Dr Jitendar Sharma, Senior Consultant and Division Head- Health Financing, National Health Systems Resource Center
- Dr Shakti Gupta, Medical Superintendent, All India Institute of Medical Sciences

- Prof. V.R.Muraleedharan, Department of Humanities and Health Sciences, IIT Madras
- Dr. Niranjan D. Khambete, Sree Chitra Tirunal Institute for Medical Sciences and Technology, Trivandrum
- Mr. Rajnish Rohtagi, Becton, Dickinson and Company

Health Technology Assessment as we know is a multi-disciplinary field of policy analysis that examines the medical, economic, social and ethical implications of the incremental value, diffusion and use of medical technology in healthcare (WHO Definition). It is intended to provide a bridge between the world of research and the world of decision-making. Health technology assessment is an active field internationally and has seen continued growth fostered by the need to support management, clinical, and policy decisions. It has also been advanced by the evolution of evaluative methods in the social and applied sciences, including clinical epidemiology and health economics.

Health Technology Assessment has found a great significance in healthcare decision making and Government of India under 12^{th} Five Year Plan has initiated work in this area. The government is now committed to build capacity in the country towards this skill.

HTA Report acts as a tool for:

- Conceptualization, recommendation, selection of health technologies
- Selection of interventions that improve healthcare delivery
- Harm Benefit Assessment through an integrated Patient Safety Approach
- Developing Economic Models by understanding basics of Health Economics.

The main objectives of the course were to:

- Assess clinical epidemiology questions through systematic reviews and critical appraisal of clinical studies/trials
- Basics of health economics modeling for technology selection in healthcare
- Assessment of Patient Safety aspects in technologies
- Legal and Regulatory dimensions in use and uptake of technologies
- Regulatory structures involved with medical technologies
- Impact assessment in selection and use of technologies
- To provide scientific tools and techniques for technology assessment

- To set up criteria for intake of safe and cost-effective technologies in health system of the country
- Integration of medical technologies in healthcare institutions and public health programs

This fellowship was intended for people who are related to healthcare in one way or the other. The audience consists of:

- Biomedical and clinical engineers
- Hospital and healthcare program managers
- Health Economists
- Patient Safety Officers and Care Providers
- Professionals and Providers who deal in healthcare technologies
- Students pursuing Public Health Management and Health Policy Courses

I was responsible for the planning, designing and uploading of the program brochure and the registration form on the website of HTIC after having finalised the dates and venue for the program and receiving approvals from the collaborators with consultation and approval by the concerned authorities.

Another aspect of my role was to send the program brochure to various hospitals, institutes, colleges, organizations and following up with them leading to registrations of participants both by registration form and online.

I was also responsible for keeping track of the funds involved in the entire course of the fellowship program.

I acted as a focal point contact for handling all the queries regarding the program which included deciding on the course material depending on the number of participants, getting it approved by WHO (World Health Organisation), Country Office for India, attending to queries regarding the program over phone and emails, making arrangements for travel, accommodation and transportation for the faculties and facilitating participants for the accommodation.

DISSERTATION REPORT

Health Technology Assessment on Mobile Eye Surgical Unit

1.1 INTRODUCTION

Cataract is clouding of the natural lens of the eye that causes loss of vision. Although cataract results from many conditions, the most commonly known cause for cataract is natural ageing process. The prevalence of cataract is usually found in the age group of 50+ years as a part of natural ageing process. Injury, chronic eye disease and diabetes are the other few causes for cataract. Visual acuity is measured with a standard Snellen's chart at 6 metre in shaded daylight wherein vision 6/6 is considered as normal vision, whereas anything above 6/9 is considered as visual impairment. The aim of cataract surgery is to rehabilitate blind or visually impaired people by restoring their sight to normal or as near normal as possible. This analysis distinguishes between two types of surgical interventions. Intra-capsular cataract extraction using aphakic glasses (ICCE-AG) is a technique where the whole lens is removed from the eye. After surgery special eyeglasses are provided to patients to restore sight. In extra-capsular cataract extraction with implantation of a posterior chamber intraocular lens (ECCE-PC-IOL), the lens and the front portion of the capsule are removed and then replaced with an artificial lens (Rob Baltussen et al, 2004).

Blindness due to cataract presents an enormous problem in India not only in terms of human morbidity but also in terms of economic loss and social burden. Cataract is a major cause of blindness and visual impairment leading to bilateral blindness in an estimated 20 million people worldwide. India is the country with one of the highest number of people living without vision (estimated 12 million) with a prevalence of 1% blindness (2006-07 survey). The main cause of blindness in India is cataract (62.6%) (India,2012). It was estimated that nearly 4 million people are blinded by cataract each year in India (Minassian & Mehra, 1990). National Programme for Control of Blindness (NPCB) was launched by Ministry of Health and Family Welfare, Government of India in the year 1976 as a 100% centrally sponsored scheme with an intention to reduce the prevalence of blindness from 1.4% to 0.3%.

The personal and social costs of blindness in terms of higher liability to dependence, potential loss of earning capacity, and increased likelihood of greater social support needs, are significant for individuals, for the caring services and for society. NPCB was merged into the National Rural Health Mission (NRHM) in 2005. According to NPCB and NRHM report, the number of cataract surgeries expected and performed in last five years is as shown in Fig.1, although it is to be noted that the requirement is a lot more.

Accessibility to eye care is also a major concern and only a small part of the population has access to specialized health facilities. To overcome this, local efforts can be utilized to meet the adverse circumstances even in the face of poor socio-developmental parameters.

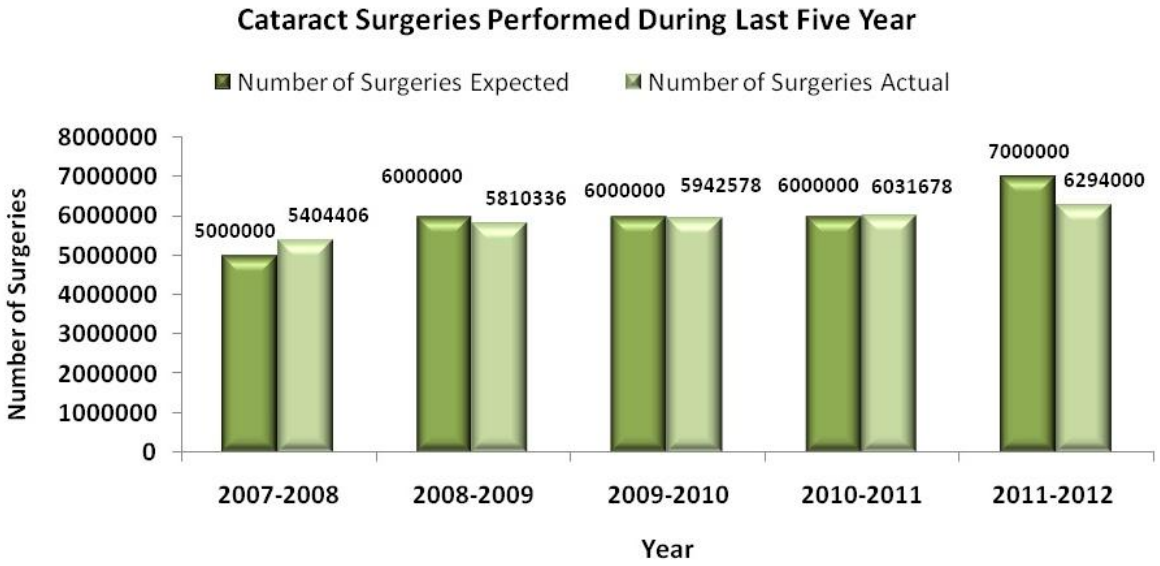

Figure 19: Cataract surgeries performed during the last Five Years (NRHM and NPCB Report)

According to conservative estimates, the number of cataract blindness cases and the number of surgeries required till the year 2020 is as follows:

Year	Population aged 50+	Cataract Blind per million 50+ (Prevalence +	Estimated Cataract Blind 50+ (Prevalence +	CSR/ million 50+	Estimated Cataract Surgery in 50+
1991	109013840	88800	9680429	12483	1360820
2001	140701089	66094	9299498	24025	3380344
2005	167315204	54353	9094083	27059	4527382
2010	194190840	46952	9117648	28487	5531914
2015	227979697	40962	9338504	28595	6519079
2020	275134737	36106	9934015	27817	7653423

Table 6: Number of cataract blindness cases and the number of surgeries required till the year 2020 (*Current Status of Cataract Blindness and Vision 2020: The Right to Sight Initiative in India, 2008)*

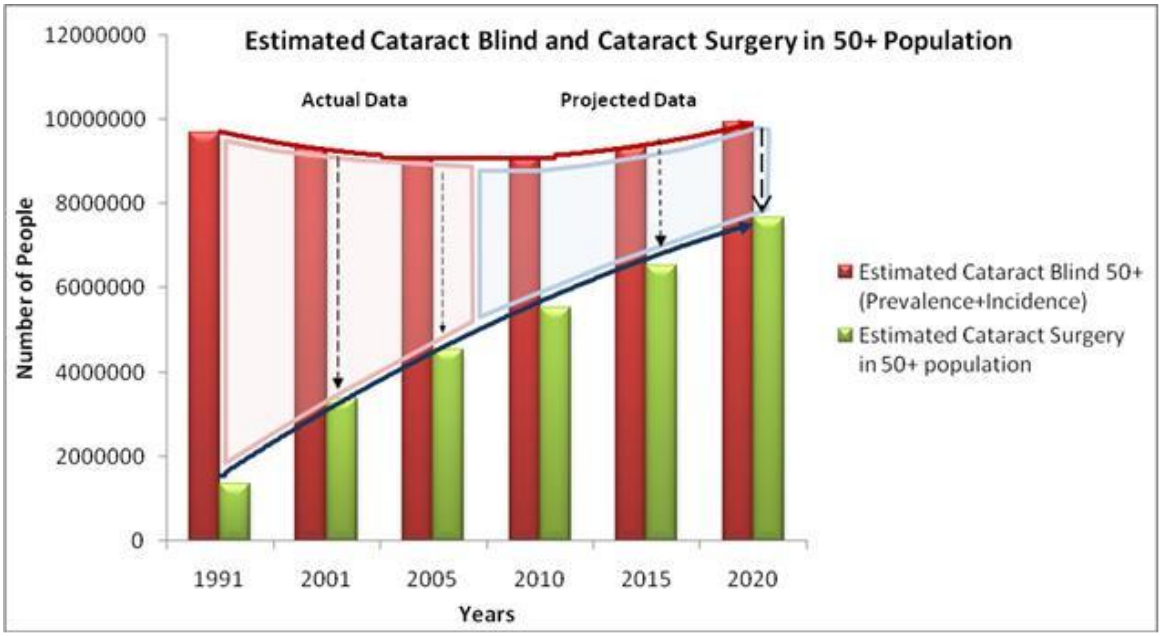

Figure 20: Estimated cataract blind and cataract surgeries in 50+ population (*Current Status of Cataract Blindness and Vision 2020: The Right to Sight Initiative in India, 2008)*

1.2 HISTORICAL DATA

In India, there are Mobile Van Units which deal with diagnostic and treatment aspects, but not the surgical aspect of ophthalmic care.

In 2003, Sankara Nethralaya introduced India's first Mobile Refraction Van for affordable eye care in rural India. The fully equipped mobile refraction van carries all instruments necessary to conduct a comprehensive eye examination and dispenses spectacles at a very nominal cost in a few hours to the patients at villages. Today, the mobile refraction vans dispense spectacles to rural people in Tamil Nadu, Karnataka, Maharashtra and West Bengal. Since its launch in 2003, the mobile refraction van has dispensed over 32,000 spectacles to adults and children in all four states.

Aravind Eye Care System, India runs Mobile Clinics for screening and diagnosis of diabetic retinopathy. The Mobile Clinic is set up on a van, which has a satellite antenna provided by Indian Space Research Organization (ISRO). An ophthalmic technician takes the retinal images of the diabetic patients using a special digital fundus camera. Video conferencing facility is also available by which the retina specialist at the base hospital can see and talk to the patient in the van directly. The diagnosis and advice is given in a report format and sent to the van. At the van this report is printed and given to the general physician or patient for

further follow up. This advanced eye screening unit benefits the diabetic patients to get the experts' opinion immediately and also the patients need not have to travel to the tertiary centre for screening.

Examples of similar approaches also exist in countries outside India such as the John Fawcett Foundation, an Australian-registered incorporated organization which works in Indonesia under its Indonesian action arm, the Yayasan Kemanusiaan Indonesia (YKI). The foundation started Sight Restoration and Blindness Prevention Program in which they deal with two aspects:

- Field Eye Screening
- Free Cataract Surgery

The program was started in 1991 with the mobile eye clinic offering cataract surgery free of charge for economically disadvantaged people in the villages of Bali.

For screening, the team visits villages and does eye screenings in Bali as well as other provinces. In a single day, more than 700 people can be screened. People with minor infections are treated, visual acuity is tested and remedial glasses are issued (to usually 70%-80% of those tested). Patients who are visually impaired with cataracts are referred to one of the mobile clinics for surgery. The team also visits schools for screening the children and provide them with spectacles free of cost. Till December 2012, a total of 733,188 people have been screened.

The surgery is performed with the help of Indonesian Air Force which helps the team with travel and logistics. The team also performs free surgery in the government hospital where the hospital teams perform the operations, with surgical consumables support from the Foundation. Till December 2012, a total of 35,630 people have received the benefits of this program.

Yet another example is the CNIB's Ontario Medical Mobile Eye Care Clinic, also known as the CNIB Eye Van, a fully-equipped eye care clinic on wheels. Each year from March to November, a group of 25-30 participating ophthalmologists assisted by two CNIB ophthalmic assistants carry out vision screening, treat eye conditions and perform minor surgeries in remote northern Ontario communities where services are not available. The unique and innovative Medical Mobile Eye Care Unit is an integral part of the Prevention of Blindness program for both CNIB and the Ontario Medical Association.

The Eye Van is a custom-made transport truck and48foot trailer including reception and waiting areas, a vision screening area, and a doctor's examination room. It has a reinforced floor and hydraulic levelling system that allows for minor surgery to be performed on site. Each year, the Eye Van travels more than 6,000 km to 30 communities, examining more than 5,000 patients. This service provides for an early diagnosis of eye conditions that could lead to blindness if left untreated.

Major cause of blindness in India, as throughout the globe is cataract and surgery remains the only solution till date. With increase in awareness and demand for high quality services, there is a rising trend of people undergoing surgeries much before significant vision impairment due to aggressive outreach screening/mobilizing activities of Government/NGO/private sector. Performance of cataract surgery continues to remain banned in make-shift operation theatres below district hospital/CHCs. Sentinel Surveillance Units (SSU) under NPCB have reported cataract surgery being undertaken in patients at a much earlier time than blindness has developed which is consistent with phenomenon seen in other parts of the world (Rose et al 2010). The primary reason for ban on all forms of cataract surgery (excluding screening of cataract in camp based settings) remains to be high post-operative damage and subsequent permanent loss of eye sight.

A very large number of cataract patients live in villages of India where access to even primary healthcare is an area of concern. In 2003, Sankara Nethralaya launched its tele-ophthalmology program which has benefited more than 350,000 patients till date by providing them with comprehensive eye care facilities at their door step and also provides spectacles within one hour using their mobile glass grinding unit.

The Indian Institute of Technology (IIT), Madras with Sankara Nethralaya developed the Mobile Eye Surgical Unit (MESU) as an innovative solution to address the issue of access to healthcare services for cataract surgeries to prevent blindness in rural population of India. The MESU was transferred to Sankara Nethralaya for conducting clinical testing and validation through a MoU between two institutions on July 22, 2011. The team from Sankara Nethralaya conducted 486 surgeries between December 14, 2011 and March 17, 2012 in three phases.

This report analyses the comprehensive effectiveness and efficacy of the medico-technological innovation piloted for MESU. The analysis uses Health Technology Assessment (HTA) as a comprehensive technology assessment tool, which examines the new

technology for its clinical efficacy and cost effectiveness from economic, social, political, legal and ethical perspectives.

This report can be used by policy makers (specifically for officials at National Programme for Control of Blindness, State Health Society under NRHM and Department of Health), clinicians, healthcare providers and NGOs including trust hospitals engaged in treatment for cataract for taking evidence based policy level decisions. Since the post-operative complications in MESU were none so far, Government of India gave further unlimited extension to MESU operations (vide letter 18.09.2012 – MoHFW) considering the fact that MESU is not a make-shift camp based surgical environment but the replica of a fixed hospital based, scientifically assessed, aseptic surgical environment that could be moved into rural settings.

1.3 HEALTH TECHNOLOGY ASSESSMENT (HTA)

The process of Health Technology Assessment mainly takes account of the five major components identified in Fig.3 viz. clinical effectiveness, organizational issues, patient issues, economic evaluation and epidemiology. Under HTA, technology is evaluated/assessed on the basis of various criteria. Countries use combinations of these criteria for evaluating innovative technologies in the light of clinical need and fiscal space to provide for such technologies. For the purpose of MESU assessment, the following criteria has been used, which commonly forms the framework of a HTA across the globe:

- Clinical Impact
- Economic Impact
- Disease Burden
- Budget Impact
- Health System Integration
- Ethical, legal or psychosocial Implications
- Patient Safety

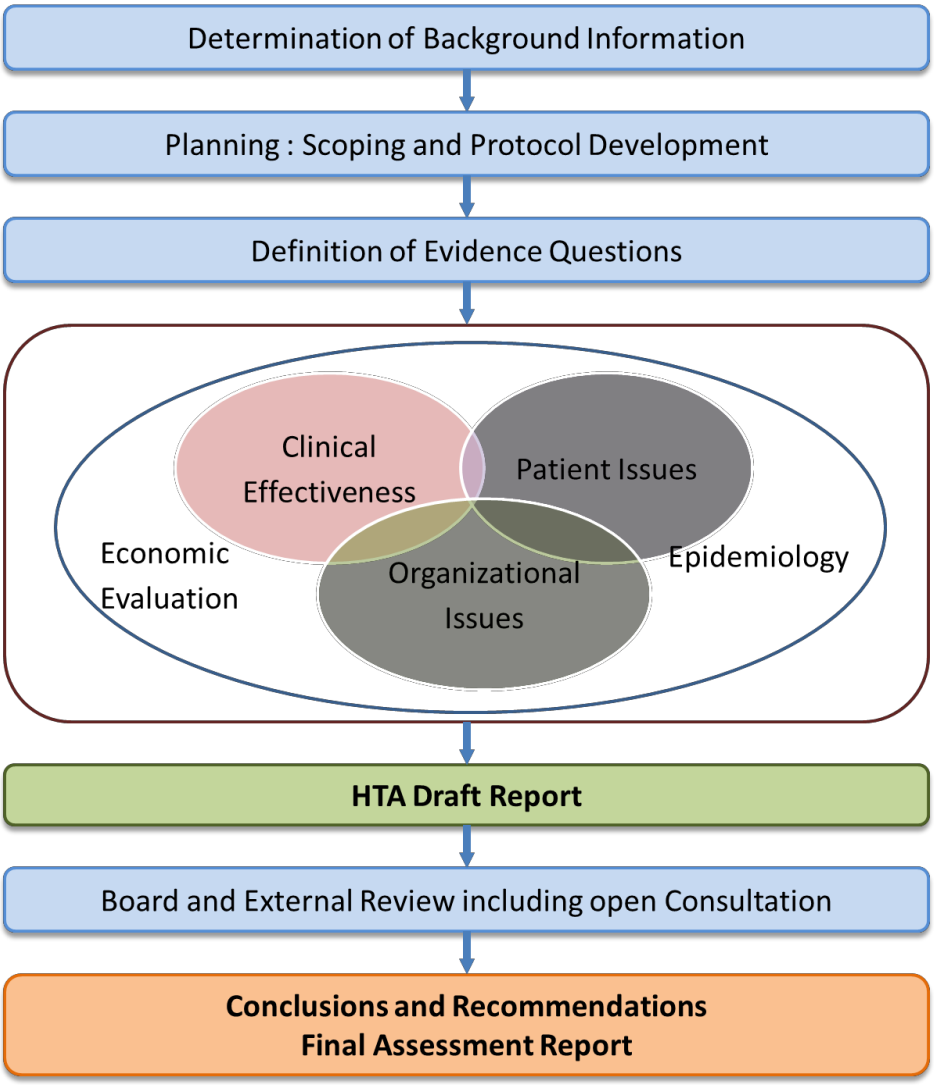

Figure 21: Process of Health Technology Assessment

1.4 DESCRIPTION OF TECHNOLOGY FOR MESU

The Mobile Eye Surgical Unit (MESU) is conceptualized to emulate the typical facilities of a land based cataract surgery theatre in a unit which could be moved to various locations across the country. The MESU consists of two vehicles, viz. (a) Preparatory vehicle and (b) Surgical vehicle. The use of two vehicles instead of one large vehicle enables the surgery unit to access rural areas with narrow roads. These two vehicles travel independently and are connected at the camp site through a retractable vestibule. The vestibule serves as a pathway, allowing movement of personnel and equipment between the two vehicles.

- **Preparatory Vehicle (PV)**

  The preparatory vehicle (PV) functions as a preparatory room for the patient before the surgery. It houses essential amenities such as a couch, a change room and a toilet. The vehicle is air- conditioned to provide a comfortable and clean environment to the patient. The patient is attended by a nursing staff inside the vehicle before the surgery. Once the pre-surgery clinical procedures are completed, the patient goes to the surgery theatre via a retractable vestibule that connects the preparatory vehicle and surgical vehicle.

  The preparatory vehicle has a 20 kVA diesel generator set to provide alternating current to all the electrical equipment and hydraulic cylinder system which lifts the vehicle off the ground and helps maintain a stable, immovable mechanical platform for the MESU. The PV also has a set of retractable steps that enables personnel to enter the vehicle after it has been lifted from the ground. The retractable vestibule that is used to connect the PV to the surgical unit is also stored inside the PV during transit. An air-curtain is also provided within the PV at the entrance to the vestibule. The PV is also equipped with an automated sensing and measurement system that continuously monitors and records the air-temperature, humidity and also the fuel level of the diesel generator set.

- **Surgical Vehicle (SV)**

  The surgical vehicle (SV) provides a safe, stable and sterile environment to perform surgery. It houses the cataract operation theatre (OT), a scrub area and a sterilization room. The interiors of the SV are entirely finished with 316 stainless steel (SS). The OT is equipped with all the medical equipment typically used in a land based cataract OT.

  The SV has an on-board Air Handling Unit (AHU), which performs multi-stage air filtering using a 10 micron pre-filter, a 5 micron filter and finally a 0.3 micron HEPA filter, and supplies sterile air to the OT. The AHU design ensures laminar flow of sterile air within the OT, and also establishes positive pressure inside the OT. An air-curtain is also provided within the SV at the entrance to the surgical vehicle from the vestibule to reduce ingress of dust. Water required in the scrub area is supplied from an on-board reverse osmosis based water treatment plant. The SV is

also provided with a hydraulic cylinder system to ensure the availability of a stable mechanical base during surgery. The SV also has a 3 kVA uninterrupted power supply system (UPS) that provides power to the medical equipment used in the OT. An on-board sensing and monitoring system measures and records the temperature and humidity of the environment inside the OT. It also continuously monitors the establishment of positive pressure inside the OT, and also the level of fresh water available for surgery.

- **Interconnecting Vestibule**

  The retractable, interconnecting vestibule establishes a pathway between the preparatory and surgical vehicles, and thus enables the two vehicles of the MESU to be connected together to form an integrated platform to perform cataract surgery. The vestibule is a double walled structure and finished with 316 SS. The vestibule is also protected from the external environment by an outer shell formed by a set of 6 doors, integrated into the two vehicles of the MESU.

1.4.1 Technology Design for Sterility and Safety

The sterility of the OT environment is ensured by multiple design elements such as (a) the use of dedicated AHU to provide sterile air to the OT, (b) continuous monitoring of the maintenance of positive air pressure inside the OT environment, (c) use of air-curtains at both ends of the vestibule, to alleviate ingress of dust and reduce exposure to external environment, and (d) use of 316 SS for the interiors of the vestibule and surgical vehicle. In addition, cleaning and fumigation of the OT is also done routinely to maintain sterility during clinical use of the MESU technology.

On-board water treatment plant provides clean water for hand-washing, while the autoclave in sterilization room allows for sterile surgical tools. The use of hydraulic cylinder systems in both the vehicles ensures the availability of a stable mechanical platform for performing the surgery.

The use of an UPS, along with an on-board diesel generator set provides self-sufficiency and redundancy in power sources. Installation of a dedicated earthing pit is dictated as part of the on-site installation procedure of the MESU to ensure electrical safety. Fire extinguishers are also provided in the MESU.

1.5 CLINICAL OPERATING PROCEDURE OF MESU

The typical process flow involved in conducting a mobile eye surgical camp using the MESU, based on the protocols adopted during the pilot phase of the project is illustrated in the flow chart shown in Fig. 4. After identifying a suitable location for conducting a camp and mobilizing people to participate in the eye-camp, the vehicles of the MESU travel to the site. After on-site installation and setting up of the various subsystems of the MESU, cleaning and disinfection is performed till sterile conditions are achieved inside the OT. Once sterility of the surgical environment is confirmed, surgeries may be conducted within the MESU. After surgery, the patients return home the very same day. The first follow up of the patient is scheduled the next day after surgery. The second follow up is scheduled within 3-7 days of surgery, and the final follow up is scheduled 4–6 weeks after the surgery.

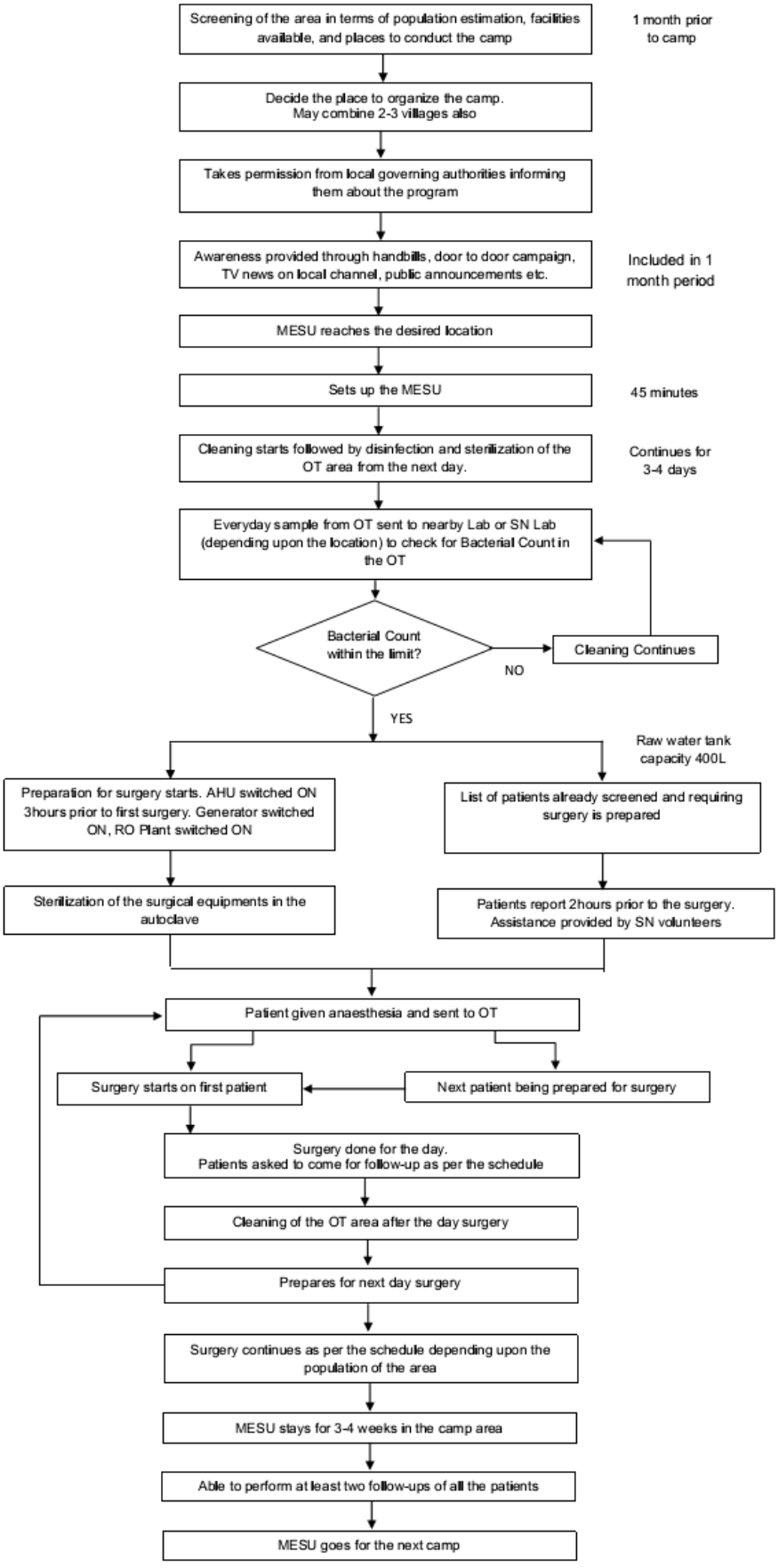

Figure 22: Process flow for conducting surgical camp utilizing MESU

1.6 SAFETY ISSUES

Patient Safety is an important parameter in Health Technology Assessment and includes design safety, device safety, process safety, staff safety and environmental safety.

- **Design Safety:** For the safety of the patient and to ensure a clean sterile environment for the surgery, the OT is provided with stainless steel surface (316 SS) to prevent the growth of bacteria and dedicated AHU with 3-stage air filtration process using 10 micron, 5 micron filters and 0.3 micron HEPA filter. A separate door for emergency exit is also provided for the people inside the OT just behind the driver's cabin. An RO unit (reverse osmosis water purification system) has been provided in the design to provide for clean water for hand-washing at the scrub station before surgical procedure and sterilization of instruments that is done in the sterilization system installed within the MESU. To maintain the sterility of the procedure, continuous cleaning and fumigation of the OT is done in the following sequence:
  - Continuous cleaning for 3-4 days with soap
  - Fumigation from the 2nd day
  - To know the bacterial count, the sample is periodically sent to the nearest lab
  - Process continues till air quality as prescribed by NABH is achieved

- **Process Safety:** Clinical processes are performed under highly clean and aseptic conditions. WHO surgical safety checklist adoption by the surgical team is encouraged to avoid wrong site surgery. Care is taken to provide for transfusion. A crash cart is maintained to provide for immediate resuscitation of patient in case there is any need.

- **Device Safety:** All electrical appliances are connected to 3-pin electrical sockets with proper grounding using a dedicated earthing pit (filled with salt and charcoal) prepared during on-site installation of the MESU. The electrical power supply is provided by the on-board 20 kVA diesel generator, which is also supplemented by a 3 kVA UPS for all surgery equipment. To establish mechanical stability during surgery, hydraulic jacks are provided to both the buses to keep them at uniform and zero degree level while the surgery is being performed. Two fire extinguishers have been provided and are checked on regular basis to prevent any mishap.

- **Employee Safety:** Safety of medical and paramedical staff, design and processes are configured in a way that promotes appropriate bio-medical waste management, including segregation at the point of generation, availability of puncture proof containers for sharps disposal and draping technique in accordance with universal precautions.

1.7 METHODOLOGY

To perform Health Technology Assessment on MESU, we have identified key result areas for evaluation and assessed innovation using four major components viz.

1. Economic Evaluation,
2. Clinical Evaluation,
3. Organizational Strategy
4. Epidemiology

Bringing in all these components together determines effectiveness and efficacy of newly introduced technology as compared with conventional technology i.e. hospital based surgery and also provides rationales for and against the use of MESU/innovative technology. Consultation with experts and manufacturers were performed to assess the clinical and cost effectiveness of MESU for cataract patients. Health system integration model is prepared with policy level feasibility of the project.

To model the cost-effectiveness of MESU using economic evaluation, three main methodologies were identified;

- Identifying the cost per patient treated coupled with prevalence rates for sight-threatening eye disease like cataract;
- Comparing cost-effectiveness of other healthcare interventions with MESU to calculate Incremental Cost-Effectiveness Ratios (ICER); and
- Modelling patients' progression through cataract and their likelihood of blindness or morbidity associated with the disease

To model clinical effectiveness of MESU, data of 486 patients operated during the pilot period were used. Patient safety concerns were evaluated using reports of any adverse events intra- operatively and post-operatively. Although none were classified as extremely adverse

events, four patients had posterior capsular rent with or without vitreous loss. This was managed in the mobile surgical unit using mechanized anterior vitrectomy machine; out of which, in two patients, the IOL could not be implanted due to very large rent. Patients were doing well during the final follow up. These rates are not inferior compared to a hospital based surgical setting.

Organizational issues were addressed using existing health system models as applied in national and sub-national structures.

Epidemiology of cataract was analysed using published literature and reports from government and other agency reports like those from WHO, World Bank and Global burden of disease databases.

1.7.1 Sources of Evidence

Relevant articles were identified by first searching MEDLINE, CINAHL, COCHRANE, EMB Reviews, and the National Library of Medicine (PubMed) databases using the key phrase *cataract surgery*, in combination with the terms *cost*, *cost-effectiveness*, *Disability Adjusted Life Years* (DALYs), *Quality Adjusted Life Years* (QALYs), ICER and *cost-utility*. For the purpose of calculation we have used value of DALY averted from published literature and discussion papers on DALY assessments of cataract as an intervention. We have used primary data collected from patient records of 486 patients operated during the pilot period of 3 months. Policy documents including documents of National Programme for Control of Blindness, State blindness control society plans and National and State annual budget documents were analysed for health system integration modelling.

1.7.2 Economic Evaluation

This report has adopted a modelling approach to identify patient benefits and the costs associated with it. The total cost of surgery performed is calculated over a period of 10 years using future value of money. To evaluate long-term effectiveness of the technology, the technology is assessed for a performance period of 10 years. Table 5 provides detailed information on cost effectiveness of the MESU over a period of 10 years.

1.7.3 Costs

Total cost for the purpose of evaluation includes

1. Direct Healthcare Costs- All direct healthcare costs on the basis of details provided by IIT Madras and Sankara Nethralaya, Chennai were captured. Direct healthcare costs include capital cost of vehicles and equipments which is spread over a normal life span of 10 years using depreciation rate of 20% for equipments and 15% for vehicles (as per Income Tax Act, 1961 amended as Finance Act, 2012). Cost of drugs and consumables used during the surgery, which forms a part of variable cost, is calculated for the period of 10 years using average inflation rate in India. Fixed costs are defined to be those that do not vary with the level of output. Human resource cost is calculated over a period of 10 years taking into consideration a 3% annual raise in salary.

2. Non-direct Healthcare Costs- In terms of non-direct healthcare expenditure we have estimated Rs.100/- per patient per day which includes transportation, food and beverages, etc. incurred during the course of the surgery. For the purpose of our assessment we have not captured productivity loss due to treatment, which can be calculated by conducting detailed survey of treated patients.

3. Productivity Loss during the treatment- From point of view of economic cost to the society, according to a report on Eye Care published in 2007, the estimated annual GDP loss for India and China (in million dollars) due to blindness is shown in the table.

Country	**GDP Loss in the Subsequent Year**	
	2010	**2020**
India	1012	613
China	1706	1451

Table 7: Annual GDP loss for India and China (in million dollars) due to blindness (Data Source: Eye Care in India)

1.8 COST-EFFECTIVENESS ANALYSIS

Disability Adjusted Life Years (DALY) is the sum of years of potential life lost due to premature mortality and the years of productive life lost due to disability (World Health Organization).

DALYs = YLL (years of life lost) + YLD (years of life lived in disability)

The effectiveness is calculated by determining the number of DALYs averted by implementing an intervention versus the base case of not doing anything, with the advantage that cost- effectiveness can also be estimated by combining different interventions. In this report, cost per DALY averted has been compared with other surgical and public health interventions to elaborate on cost-effective priorities and generate evidence for making health financing decisions.

Cost per DALYs averted for MESU is estimated at Rs. 5,068.22 (International dollars 316.76). Cost-effectiveness ratios below Rs.10,000 per DALY or YLL averted are considered as quite cost effective and should be included in a health entitlement package for publicly funded programs (Chow, Darley, & Laxminarayan, 2007). WHO Choice recommends that any intervention that costs per-DALY-averted of less than 1GDP or GSDP per capita, could be considered to be a highly cost-effective intervention from a public policy perspective keeping in mind the societal gains received due to such an intervention (World Health Organization, 2012). This cost has been compared with costs per DALY for other surgical interventions and public health interventions from published literature, where cost per DALY averted is observed to be on the higher side.

The cost effectiveness thresholds for other interventions mentioned in Table 4 were taken from WHO estimates as well as published literatures with International dollar conversion rate of Rs16/I$. In terms of cost/DALY, MESU intervention is more cost-effective than many comparators. This does not mean that cataract surgery and preventing blindness should replace other public health priorities like HIV, respiratory infections etc. but does bring home the message that cataract surgery when performed in an outreach program, using a cost-effective intervention like MESU, results in high societal gains comparatively and thus can be considered as one of the interventions in the cluster of health services.

Interventions	Cost (in Rupees per DALY Averted)
Cataract surgery (MESU)	5068.22 (all inclusive);4328.79 (excluding capital cost); 1368.17 (only consumable cost)
Structured Anti-retroviral therapy	12700.00
HIV: HAART Plus + DOTS for TB	20480.00
Human Papilloma Virus vaccination	48300.00
Management of Severe Neonatal Asphyxia	167920.00
Management of Neonatal Jaundice	484064.00
HIV: School-based education (50% coverage)	12640.00
Lower respiratory tract infections	38900.00
Screening and treatment of Syphilis (50%	58832.00
Breast cancer screening	20400.00

Table 8: Comparison of Cost Effectiveness of MESU with other Public Health Interventions

1.9 CLINICAL EFFECTIVENESS

After the launch of National Programme for Control of Blindness, camps were established for services such as ICCE surgeries with an aim to increase the expansion of access to surgical treatments for the rural people. With the financial assistance from DANIDA (Danish International Development Agency) and the government, the mobile eye surgical units were started in India. Though it increased the number of surgeries and access to care, post-surgical outcome was low on many occasions and there were incidents of severe to irreversible adverse effects where causality was established and was found to be compromised in clinical processes. For example, in an eye camp in Khurja, Uttar Pradesh by Lions Club, 108 patients were operated, 88 among them being cases of cataract. Out of these 88, it was found that 84 patients' eyes were irreversibly damaged due to post-operative intra-ocular infection. The reason for this infection was found to be normal saline used during

surgery. Subsequent to this and similar incidents, mobile eye camps were banned by the Uttar Pradesh High Court and the Supreme Court of India stating the necessity of maintaining aseptic and sterile conditions where any ophthalmic surgery or any other surgery is to be conducted.

But in 2009, Sankara Nethralaya received the permission from MoHFW, Government of India, to carry out the pilot study on utility, safety and feasibility of the mobile eye surgical units, since the design and process mapping in a MESU-based approach were at par with fixed hospitals where adequate infection/adverse event prevention protocols were followed.

The clinical effectiveness of MESU could be measured using indicators, like sight restoration rate, absence of adverse event/loss of vision, reduced operation failure, lack of improvement in vision after surgery and post-operative morbidity. These indicators were captured using patient records from a pilot period of 3 months. There was no major adverse event observed; however, it was noted that 466 out of 486 were lost to follow up for the 3rd post-operative check-up, although rate of follow-up till the 2nd follow-up visit were good (85%) suggesting that cure from the illness/condition could be most probable cause for the drop in the 3rd visit.

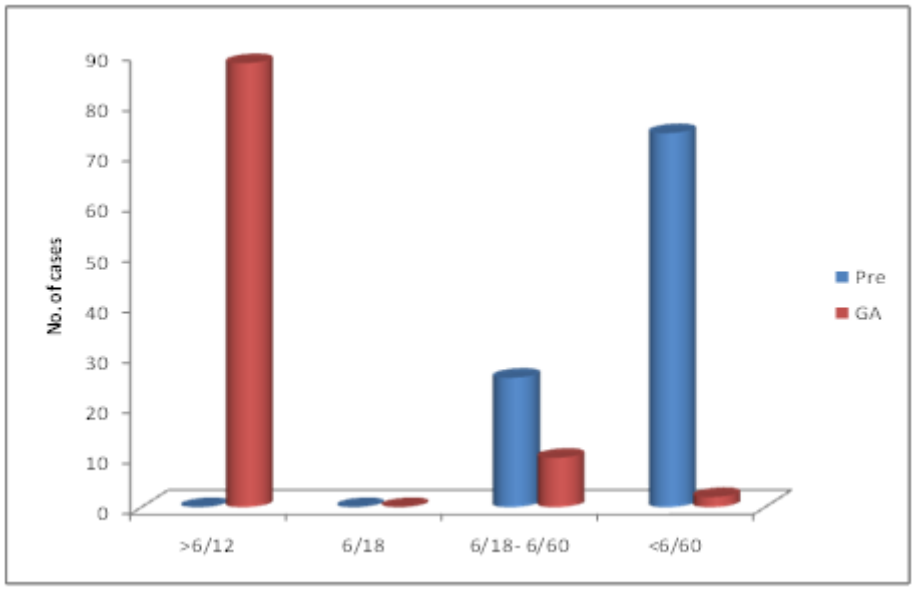

Figure 23: The pre-surgery and post-surgery vision mapping for MESU patients

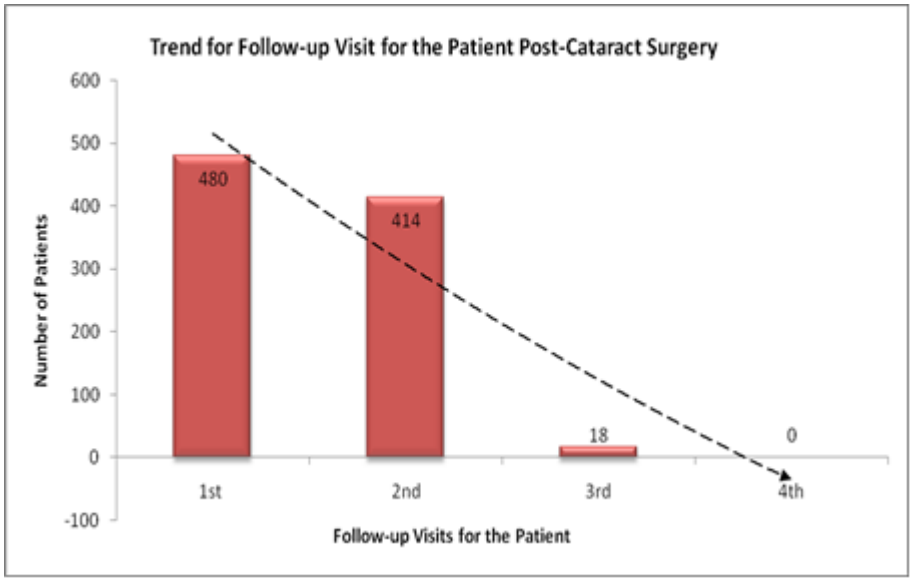

Figure 24: Trend of follow-up visit for the patient post-cataract surgery

1.10 HEALTH SYSTEMS INTEGRATION MODEL

National Programme for Control of Blindness (NPCB), launched with the goal of reducing the prevalence of blindness from 1.4% in 1974, to 0.3% by the year 2020 by developing eye care infrastructure, trained human resources, improving accessibility and quality of eye care services, acquired appreciable levels of success. As per the survey of 2007, level of prevalence of blindness had come down to 1.0%.

Cataract is the dominant cause of blindness as it accounts for nearly two third of the blind population. The purpose of cataract surgery is to restore vision of the affected person through the provision of a package of services that can enable the person to gain sight and return to his normal life. Refractive errors, childhood blindness, glaucoma, diabetic retinopathy, low vision, ocular injury, age-related macular degeneration, retinopathy of prematurity (ROP) and corneal blindness are other important causes of blindness.

The Eleventh (11th) Five Year (2007-12) Plan aimed at making NPCB address issues leading to blindness in a comprehensive manner i.e. management of diabetic retinopathy, glaucoma, squint, keratoplasty, ROP, low vision etc. in addition to cataract, refractive errors and other on- going schemes of Tenth Five Year Plan of program. NPCB has been able to deliver effective and efficient eye care services through successful Public Private Partnership (PPP) as well. The focus of NPCB is specifically targeted towards providing services in rural/tribal and other difficult areas. In addition to on-going schemes that cover eye surgical care, financial assistance for schemes have been revised and new central/state government

sponsored health insurance schemes have been introduced that cover cataract surgery in empanelled land based hospitals.

MESU in the pilot phases itself conducted 486 surgeries over a 3-month period which proves it to be a suitable model suiting the scheme requirements, both for independent functioning as well as up-scaling, although functional sustainability needs to be checked for a much larger time period, for which Ministry of Health and Family Welfare has given its consent for its continued operations.

It is important to look at what proportion of cataract surgeries actually lead to a decrease in blind people (presenting vision < 20/200 in the better eye) after surgery compared to their pre- operative status. Monitoring sight restoration rate is very important for planning at the national level. This is important because the *Vision 2020: the Right to Sight* approach is targeted towards the bilaterally blind. Surgeries on people who have a presenting vision better than 20/200, surgeries on the second eye, and surgeries on the unilaterally blind would not help in restoring vision - though they have a role in preventing future blindness, and should not be accounted for when monitoring progress towards the goal of elimination of avoidable blindness due to cataract. For the immediate future when a significant proportion of the 50+ are blind, the first priority should be given to restoring vision to those already blind. Therefore, it would be more meaningful to monitor sight restoration in addition to CSR/million population and CSR/million 50+ population to monitor progress towards Vision 2020. Recent evidence in India suggests that the visual outcomes after cataract surgery are not very good in some regions wherein the operated people continue to remain blind after surgery. Poor visual outcome has been reported in 15-25% of eyes following cataract surgery. A study in southern India reported poor or very poor visual outcome after cataract surgery in 51.9% of the operated eyes. Another study in northern India showed that one-third of the eyes which had a preoperative vision of less than 20/200 continued to have vision less than 20/200 with best correction after cataract surgery. A study in Mysore, India, demonstrated that more than one-third was blind in the operated eye. Improving the quality of surgery is a major input that needs to be emphasized now that the quantity of surgery has been increased. This along with improved SRR will be more effective in eliminating cataract blindness.

The success rate with MESU is better than the best described or published rate in any single mobile eye surgical program. Cataract surgery, which can be performed at relatively low cost and can result in lasting reversal of vision loss, is among the most highly cost-

effective interventions, when the surgery done uses the appropriate method and among populations with relatively high prevalence, so that facilities and personnel are used efficiently. According to a report, the cost-effectiveness of ECCE surgery is estimated at about $60 per disability adjusted life year (DALY) in the South and East Asia region which includes India. This is however valid for hospital based settings. MESU, as analysed in part–1 of the report, has a cost per DALYs averted at Rs. 5,068.22 (International dollars 316.76); Rs4,328.79 (International dollars 270.55 excluding capital costs which may vary depending on the support of partners) and Rs.1,368.17 (International dollars 85.51 excluding all fixed costs) given that international dollar is adjusted as Rs.16/I$.

1.11 ESTIMATES AND STRATEGY FOR A MODEL UP-SCALED PROJECT

MESU project, if considered to be part of a State Health Plan, could have three phases. Lessons on functioning and utilization learnt from initial phases could also be incorporated into subsequent ones. Given that Tamil Nadu has 32 districts, they could be grouped into three clusters so that MESU working in Cluster-1 could shift base to the 2nd and then to the 3rd cluster in subsequent years, thereby reducing infrastructural costs.

Total cases with one MESU posted at each of the 10 pilot districts performing cataract surgeries at the rate done in pilot phase (approx. 3,000 per annum) would lead to:

3,000 x 10 districts x 1 year = 30,000 cases

Phase – II with 10 districts in 2nd year = 30,000 cases

Phases- III with 12 districts in 3rd year = 30,000 cases

Given that the cataract surgery target for Tamil Nadu is 418,400 and what has been achieved is 158,385, it could be assumed that even at its best utilization, only 50% of the work load of cataract (approximately 200,000 cases of cataract) can be shared by fixed land based hospitals. MESU in a phased manner could handle the rest 50% of cataract cases (approximately 200,000 cases of cataract over 5-6 years) at an average of 30,000 cases per year. The other 50% of cataract, especially from urban areas, would continue to be treated in hospital settings. In case the need exists due to any increase in epidemiology or population health statistics, a fourth and fifth stage could be planned or phase-I, II or III could be expanded to cover more districts instead of only ten, which would require additional MESU infrastructure.

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Direct Healthcare Cost										
Fixed Cost	4596000	4733880	4875896	5022173	5172838	5328024	5487864	5652500	5822075	5996738
Variable Cost	8872179	9479923	10129298	10823155	11564541	12356712	13203147	14107562	15073930	16106494
Capital Cost (Depreciation)	2325500	1940650	1620733	1354567	1132937	948240	794200	665626	558227	468449
Non-Direct Healthcare Cost										
Food Expenses on Patient	145800	155787	166459	177861	190045	203063	216972	231835	247716	264684
Total Cost	**15939479**	**16310240**	**16792385**	**17377756**	**18060361**	**18836039**	**19702183**	**20657523**	**21701948**	**22836365**
Expected Number of Surgeries per Year	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000
Cost per Surgery	5313	5437	5597	5793	6020	6279	6567	6886	7234	7612
DALYs Averted per Person	**1.0483**	**1.0483**	**1.0483**	**1.0483**	**1.0483**	**1.0483**	**1.0483**	**1.0483**	**1.0483**	**1.0483**
Cost per DALY Averted	**5068.22**	**5186.11**	**5339.42**	**5525.55**	**5742.59**	**5989.23**	**6264.64**	**6568.41**	**6900.50**	**7261.21**
Cost per DALY Averted in 1$	**316.76**									

Table 9: Analysis of cost-effectivenes of MESU for cataract surgery over a period of 10 years

Note

- DALYs averted per person is calculated based on discussion paper on Cost effectiveness of Disease Intervention in India by Resource for Future by Chow, Darley and Laxminarayan.
- Fixed costs are inflated using average inflation rate for past 10 years; human resource costs were increased by 3% per annum.
- Depreciation is calculated at 20% for equipment and 15% for vehicles (capital goods).
- Expected number of surgeries was estimated on the basis of surgeries performed during pilot project.

1.11.1 Budget Outlay

Phase- I:

Total cost incurred at Net Present Value of money in 1st year = Rs.15,939,479 (Rs.1.59 crores) Total cost incurred in 10 districts in phase– I = Rs.15.93 crores/annum

Phase- II:

Total cost incurred at Net Present Value of money in 2nd year = Rs.14,369,590 = Rs.1.436 crores

Total cost incurred in 10 districts in phase–II= Rs.14.36 crores/annum

Phase- III:

Total cost incurred at Net Present Value of money in 3rd year= Rs.15,171,653 = Rs.1.517 crores

Total cost incurred in 10 districts in phase– III= Rs.15.17 crores/annum

Total State health budget for 2012-13 = Rs.5,569.28 crores.

Percentage of budget allocation required to have MESU functional within Tamil Nadu over three years phased program= Rs.(15.93 + 14.36 + 15.17 crores) = **Rs.45.46 crores.**

Total program cost in 1st year = 0.29 % of state health budget.

Total cost incurred at Net Present Value of money in 3 years for the entire state of Tamil Nadu which could eliminate 50% of the expected cataract cases= Rs.45.46 crores.

With only 3% increase in the outlay of state annual health budget every year, **total program cost for all the three phases = Rs.45.46 crores/(5,569.28 + 5,736.36 + 5,908.45) crores = 0.26 % of state health budget over three years**.

1.11.2 Country Estimates and Policy

Using age-specific data for those aged 50+ years it was observed that prevalence of blindness at different age cohorts (above 50 years) reduced over three decades with a peak in 1989. Projections show that among those aged 50+ years, the quantum of cataract surgery would double (3.38 million in 2001 to 7.63 million in 2020) and cataract surgical rate would increase from 24,025/million 50+ in 2001 to 27,817/million 50+ in 2020. Though the prevalence of cataract blindness would decrease, the absolute number of cataract blind would increase from 7.75 million in 2001 to 8.25 million in 2020 due to a substantial increase in the population of people above 50 years of age in India over this period (Murthy G, Gupta SK, John N, 2008).

Total cases of cataract expected till 2020 = 82.52 lakhs

Total cases of cataract expected till 2015 = 78.28 lakhs

Total cataract load per annum for next 3 years (2013-2015) = 78.28 lakhs

Total cataract load per annum (country wide) = 26.06 lakhs

Considering that a maximum of 50% of these cases could be reached and treated in an outreach program, total case-load on MESU project = 13.04 lakhs/annum= 2,032 cases/district/annum.

MESU capacity (throughput) = 3,000 cases.

NPCB–MESU model could be a modest strategy for achieving goals of Vision 2020. If the program could be rolled out as a part of NPCB in 8-10 phases, each targeting 60-64 districts, more than 640 districts in India could be covered over the next 8 years, and India would achieve its pre-determined target of Vision 2020.

Total cost incurred at Net Present Value of money in phase-I (1st year - 64 districts)

= Rs.15,171,653 x 64 = Rs.1.517 crores x 64 districts = Rs. 97.088 crores

Total planned outlay in 2012-13 for health= Rs.30,477 crores

Percentage of annual budget required towards MESU as part of NPCB = 0.32% of annual health budget. **With 0.32% of annual health budget every year on MESU cataract project, an aim to treat 50% of all cataract induced blindness cases would be a landmark achievement for the country and Vision 2020.**

1.12 OPERATIONAL PLAN

- MESU could be attached to each district hospital for proper upkeep. This would facilitate its recognition even under proposed Clinical Establishment Act, since as an independent unit it is not covered under the Act. Registration via the Act will help promote its institutional credibility and its utilization as a part of the program would be seen as performance of the district hospitals and district health action plans.
- Cost effectiveness estimates suggest that it is desirable to have it performed under USD60 (equivalent to Rs. 3,000). However, keeping in mind that an outreach program (surgical) would be costlier than hospital based settings, due to capital cost multiplication factor (investment for provisioning scores of satellite hospitals/vehicles instead of a single stationary hospital), the average price of MESU based cataract of Rs. 5,068.22 is acceptable, given that the average cost of a cataract surgery in fixed land based hospital is Rs. 8,000 to Rs.35,000 in private hospitals. The cost incurred by the population in reaching the stationary hospital, the expenses of boarding and lodging in a town/city, the opportunity cost of time for the patient attendant - all these remain excluded in the surgery cost in a stationary hospital based system which is covered in MESU Costing. In an outreach program, these costs are transferred to the provider, which adds to the actual cost of treatment. If societal costs were to be added to the cost of cataract surgery in a hospital setting, it would perhaps be much more than the cost of same surgery in MESU model.
- The burden of disease of cataract in rapidly rising in the aged population due to increasing life expectancy, hence a timely intervention of an MESU/outreach program mode will reduce the burden of surgical load on Indian public hospitals and will sharply decline the out of pocket expenditure made by the rural population in seeking such surgical care.

1.13 CONCLUSION

Cataract could be one of the most inexpensive health care packages yet giving a life time of benefit after a surgical intervention. Since there remains no costs attached to prolonged medications and re-surgeries (re-occurrence rate being very small), and the surgical procedure remains time-tested and safe, it is an option to include this in healthcare packages – whether under a national blindness control program or under central/state government sponsored health insurance schemes. Many such schemes already include this as an intervention. However, using a medico-technological innovation like MESU would enhance its reach, yet keep it under the umbrella of fiscal space provided for under such publicly funded schemes. It also remains an option of choice for not-for-profit organizations that engage in ophthalmic care, as MESU comes with its ability to draw various financial incentives provided for such activities under the NPCB schematic layouts. The 12th Five Year Plan also envisages the option of not-for-profit public private partnership as a method of healthcare delivery. MESU stands as a functional option ready for being up-scaled under all these programmatic innovations and as an important component of the nation's strategy to achieve the goals envisaged under Vision 2020.

CASE STUDY

To Understand the Usability of m-Health among the IT Professionals of Chennai and their Health-Seeking Behaviour

3.1 OBJECTIVE

To study the prevalence of occupational diseases and the use of m-Health for IT professionals

3.2 SPECIFIC OBJECTIVE

- To understand the prevalence of occupational diseases in IT professionals.
- To assess the knowledge level of professionals regarding m-Health.
- To understand the health-seeking behaviour of IT professionals.
- To understand the level of using IT technologies for their health.

3.3 INTRODUCTION

India's IT Industry has seen a phenomenal growth in the last few years. The software sector in India has grown at double the rate of US sector. According to a 2008, McKinsey- National Association of Software and Service Companies (NASSCOM) report, the IT industry in India is growing at the rate of 35% per year and has increased the employment rate of the people. According to a report there are 916 IT providers registered with NASSCOM all over India. With this growing number more and more people are taking up this job which in turn increases the competition among them which leads to occupational stress among them. Occupational stress is associated with increases in negative work-related outcomes, such as job dissatisfaction, ill-health, absenteeism, higher turnover and lower productivity. The negative effects of occupational stress include impaired performance or a reduction in productivity, diminishing levels of customer service, health problems, absenteeism, turnover, industrial accidents, alcohol and drug use and purposefully destructive behaviours. Apart from this, it also leads to occupational health problems among the individual such as musculo-skeletal problems, stress, vision problem etc.

With this changing scenario, internet can be of great help and can be used as a mechanism to transform medical care. It can be used to disseminate information about health and healthcare, enhance communication and facilitate a wide range of interactions between patients and the healthcare delivery system thus improving the health of the people. But confidentiality of personal information about the patient and the misinformation of the patient will be an issue. M-health can be a solution for it. According to a 2012 report, there are around 27million smartphone users in urban India and the number is still increasing.

The purpose of this study is to find a solution to make people aware of the occupational stress and diseases at an early stage.

3.4 REVIEW OF LITERATURE

A study done among 200 IT professionals in the NCR to evaluate the computer related health problems and role of ergonomic factors revealed that there was approximately 93% of computer related morbidity in the subjects. The visual problems were noticed in 76 percent and musculo-skeletal in 77.5 percent. Furthermore, 35 percent faced stress. About 81.3 percent subjects had inadequate lighting and 76.3 percent were not using antiglare glasses/lenses because of what they suffered from considerable visual problem. About 80.2 percent of the total 152 subjects did not have the monitor at correct distance reported with visual discomfort. The subjects with improper ergonomics were higher in number for complaining musculoskeletal disorders.

According to another study done in Goa, it was found that the problem of visual fatigue and musculo-skeletal disorders are the highest among this working group.

According to a report, the Internet can prove to be an important tool with the potential to improve information dissemination and for the betterment of health care delivery and outcomes. Madon et al (2007) argued that information and communication technologies provide an immense potential to support the effective gathering and analysing of health data.

There are currently over three billion mobile phones in the world and there are more than twice as many in the poorer compared to the richer countries (Heeks and Jagun 2007). Mobile telephony started with the upper strata of society, but it has quickly reached a much larger section of the population. With more than a billion subscribers, mobile phones are the most readily available new ICT in the emerging South. Mobiles have been adopted in India and throughout the developing world more rapidly than any other communication technology in history (Castells et al., 2007). Indeed, mobile phone users in developing nations now account for 58 percent of the world's 3+ billion mobile phone users (United Nations Conference on Trade and Development, 2007).

The present study is undertaken to understand the usability of m-health among the IT professionals of Chennai, so as to understand their health-seeking behavior and to make them aware of the occupational diseases caused because of this profession.

3.5 METHODOLOGY

3.5.1 Sample:

- 100 IT professionals candidates were selected working in companies were selected as study participants.
- Taken the first 50 responses only.
- All samples were taken based on convenient sampling.
- Primary data was collected.

3.5.2 Tools:

- Survey was conducted with the help of a questionnaire.
- Consists of 21 questions.
- Data was coded and analyzed using SPSS and Microsoft Excel tool.

3.6 ANALYSIS

A total of 50 participants gave their response for this survey. The age distributions of the respondents are shown below:

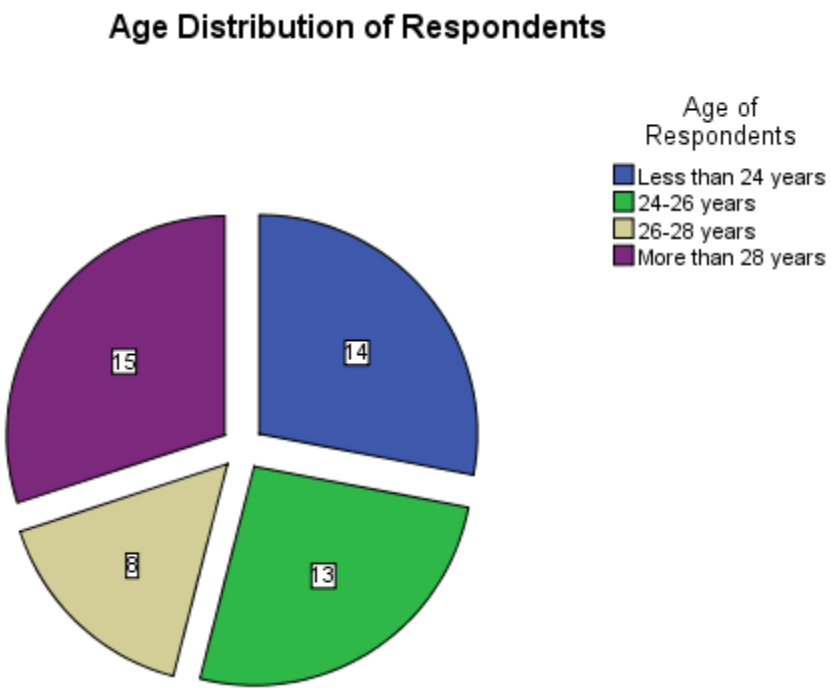

Figure 25: Age Distribution of Respondents

Most of the people, around 28 of them lies in the age group of 21-26 years. Their distribution of working in this field is as below:

Age of Respondents * Years of working in IT Field Crosstabulation					
Count					
		Years of working in IT Field			Total
		0-5years	5-10years	More than 10years	
Age of Respondents	Less than 24 years	14	0	0	14
	24-26 years	9	3	1	13
	26-28 years	5	2	1	8
	More than 28 years	7	3	5	15
Total		35	8	7	50

Various types of occupational diseases were found to be prevalent in these people such as obesity, muscular pain, heart disease, anxiety or stress, depression, insomnia, lower back pain, neck pain and vision problem. Out of these vision problem is the most common. Obesity is found to be equally distributed in all age group but looking closely at the graph we can see that most of the problems are common in the age group of 24-26years.

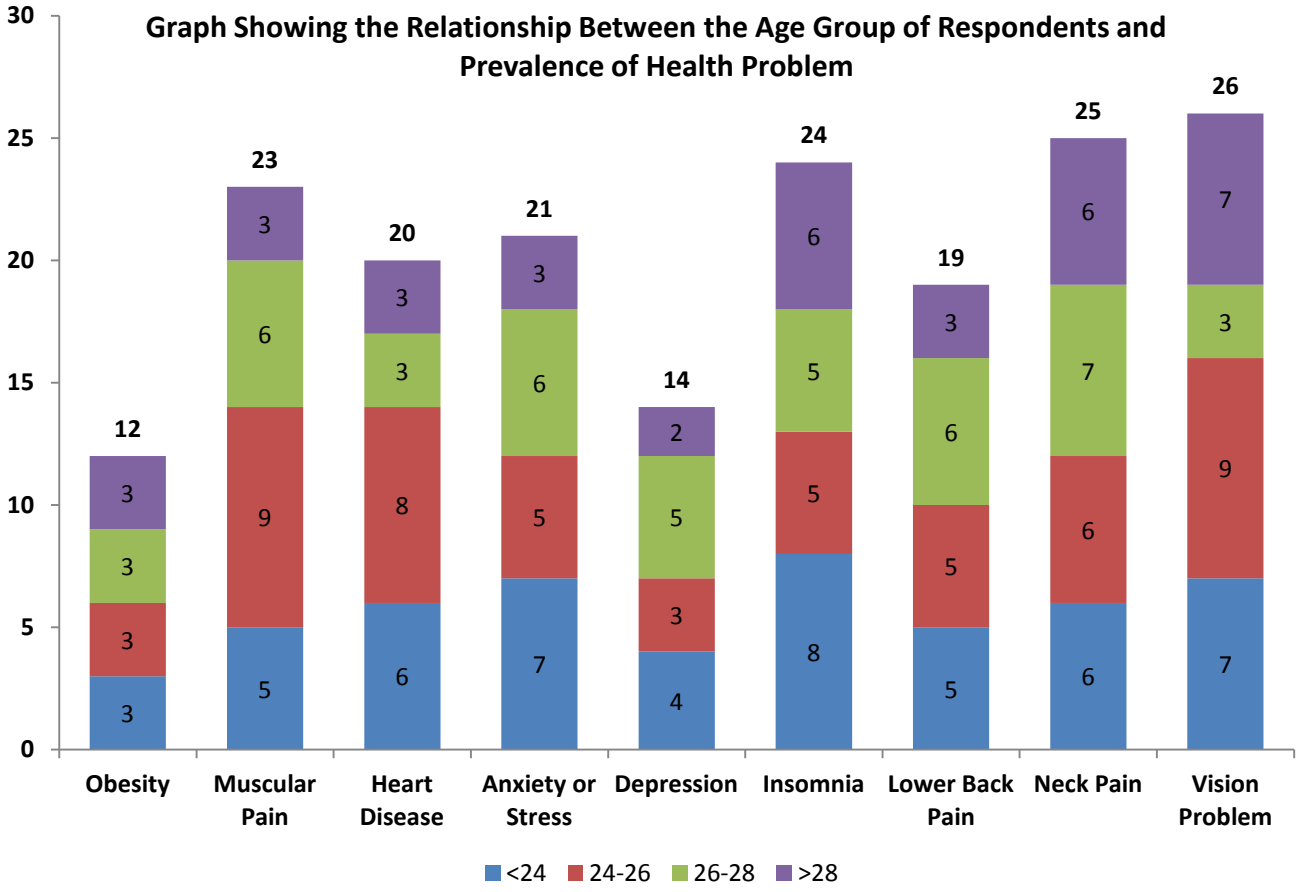

Figure 26: Graph showing the relationship between the age group of respondents and prevalence of health problem

Regarding people's perception for health problem it was observed that education plays an important role because in all the categories of Diploma, Graduate and Post-Graduate participants answered that the most important reason for health problem is their lifestyle followed by their biogenic reasons rather than socio-economic or religious factors.

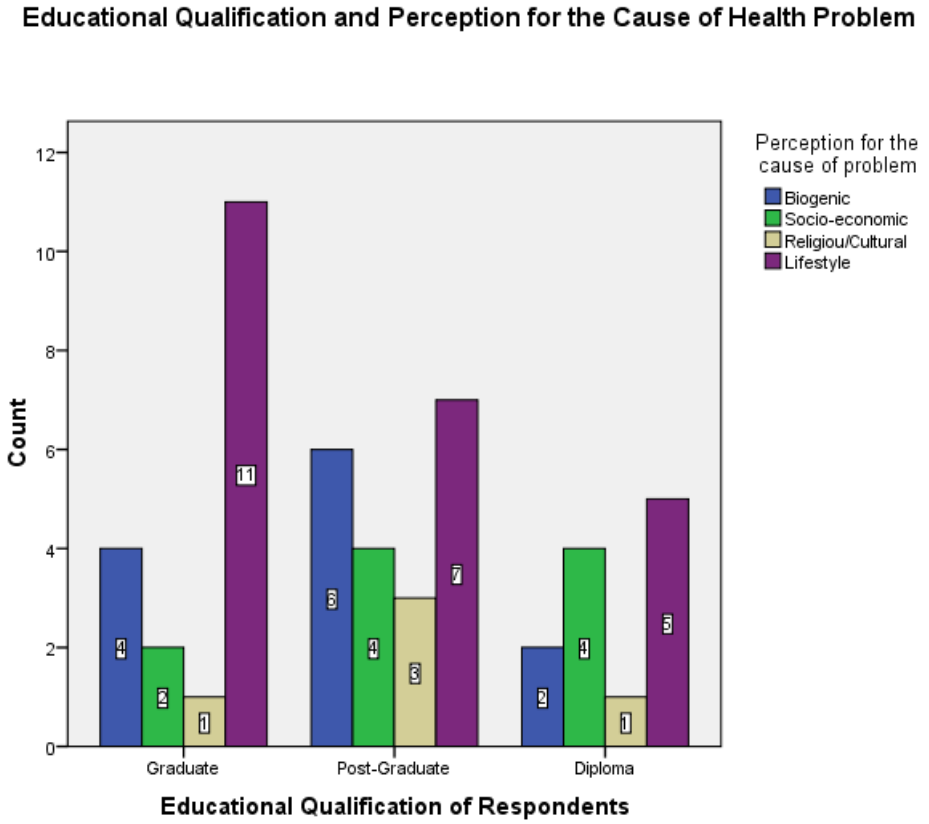

Figure 27: Relationship between educational qualification and perception for the cause of health problem

When asked about their responses, 29 of them said that they ignore the problem or wait for the condition to improve when they are sick. Education does not play any role in this regard.

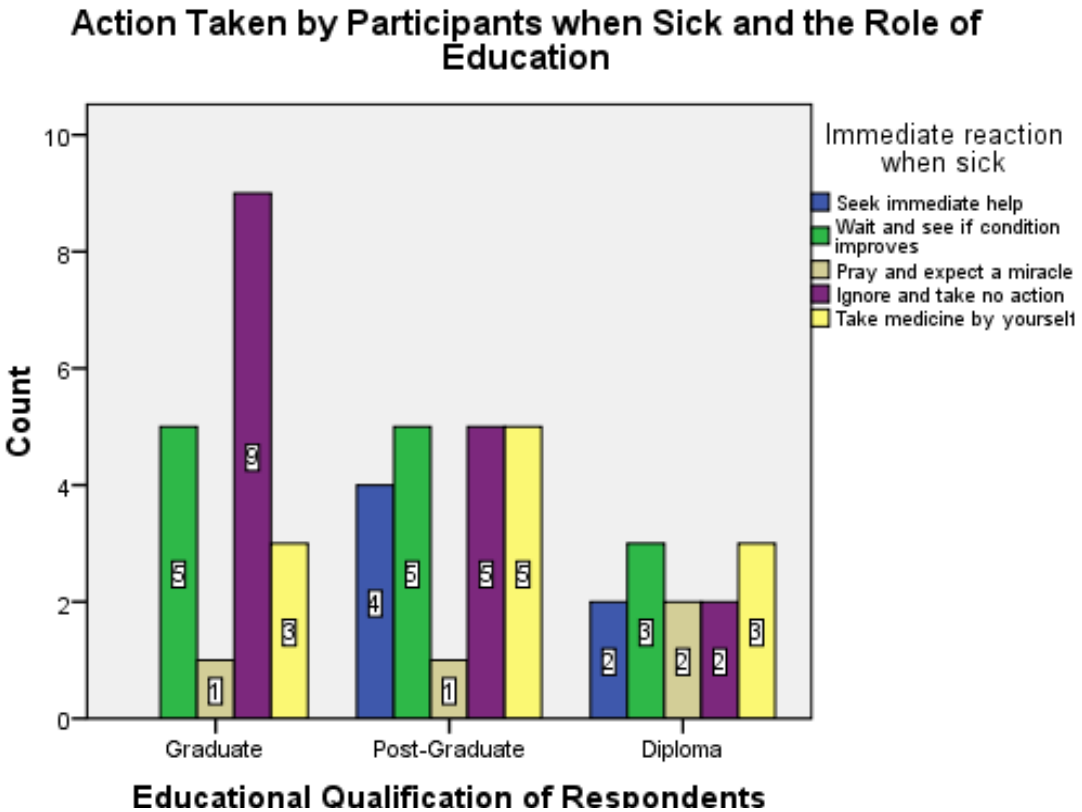

Figure 28: Role of education and the action taken by respondents when sick

Also education does not play any role for people to visit a doctor when ill as 10 of the post-graduate participants said that they go for checkup only when they are unable to perform with normal duties while for the other two group this number is 7 for graduates and 6 for Diploma holders.

Apart from this, out of the 50 participants, 35 of them have a smartphone and for these 35 people the most important feature for their phone is the sound clarity and the next being memory capacity and ease of use.

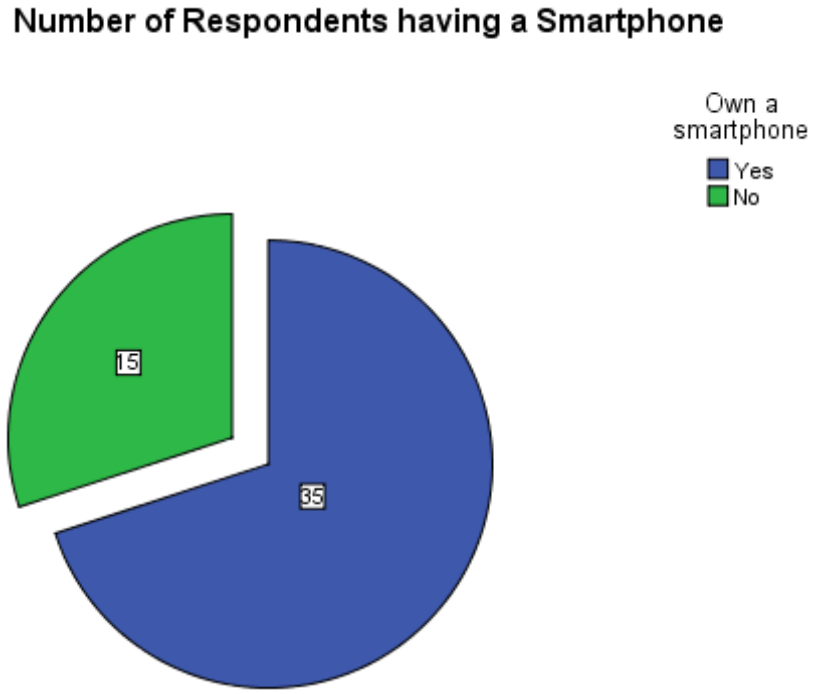

Figure 29: Graph showing the number of respondents having smartphone

Own a smartphone * Features of smartphone that attracts Crosstabulation						
Count						
		Features of smartphone that attracts				Total
		Ease of use	Sound clarity	Software version	Memory Capacity	
Own a smartphone	Yes	9	12	4	10	35
Total		9	12	4	10	35

Table 10: Crosstabulation of having a smartphone and the feature that attract respondents to buy a smartphone

Out of the 50 respondents only 15 of the people are aware of m-health programs while the rest 25 have not heard about this and of those 15 people, 10 of them have a smartphone while the rest 5 don't have a smartphone but still are aware of m-health.

Own a smartphone * Awareness about Mhealth Crosstabulation				
Count				
		Awareness about Mhealth		Total
		Yes	No	
Own a smartphone	Yes	10	25	35
	No	5	10	15
Total		15	35	50

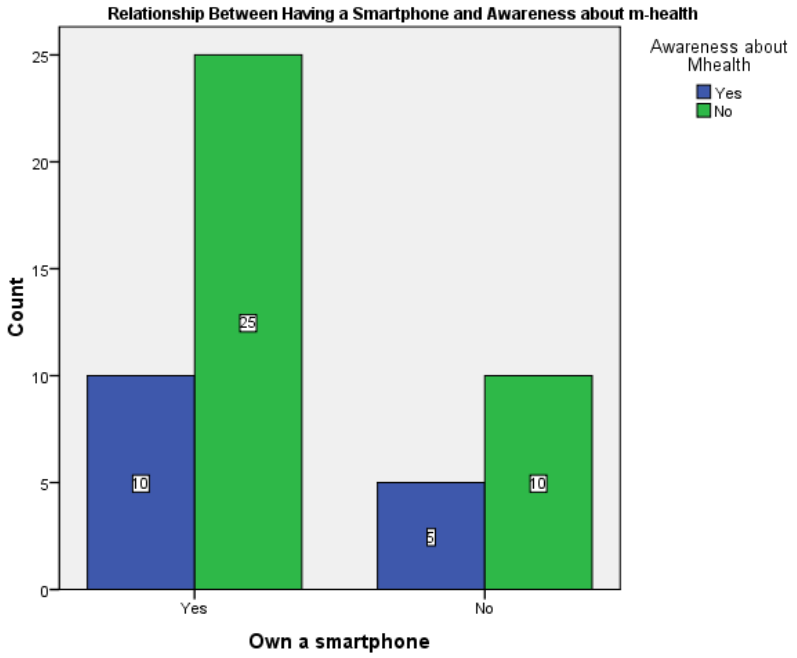

Figure 30: Relationship between having a smartphone and awareness about m-health

For the 15 participants, m-health acts as a means to gain knowledge about their health condition and the rest think it as a tool for emergency help and sometimes to check their health statistics such as BMI, BP etc.

Own a smartphone * Understanding of Mhealth Crosstabulation					
Count					
		Understanding of Mhealth			Total
		1	2	3	
Own a smartphone	Yes	4	2	4	10
	No	4	1	0	5
Total		8	3	4	15

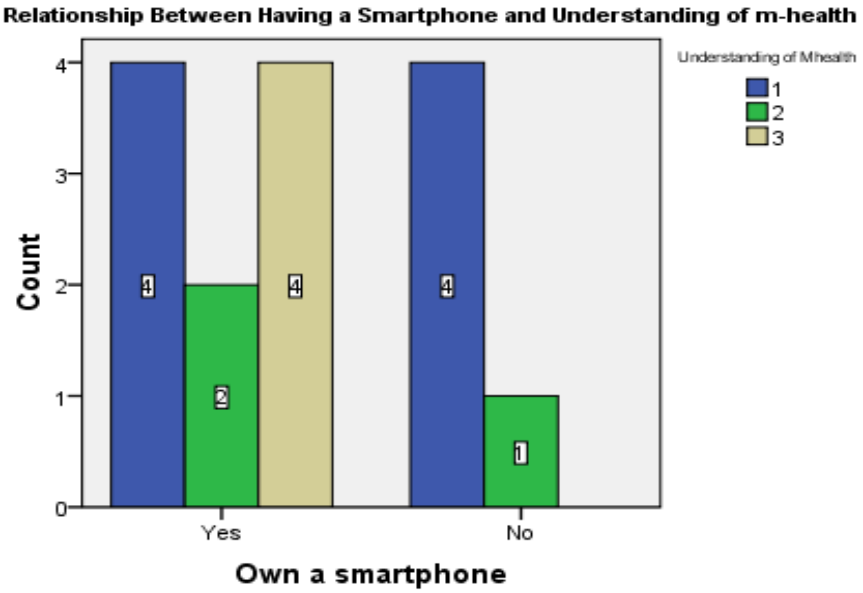

Figure 31: Understanding of m-health among the respondents

When asked whether people would like to receive health information on their phone, 35 of the participants answered with yes. The most preferred way to receive health information on their phone is the SMS service and games. Participants who don't have a smartphone still wished to receive health information on their phone in any of the three forms but the highest being SMS service.

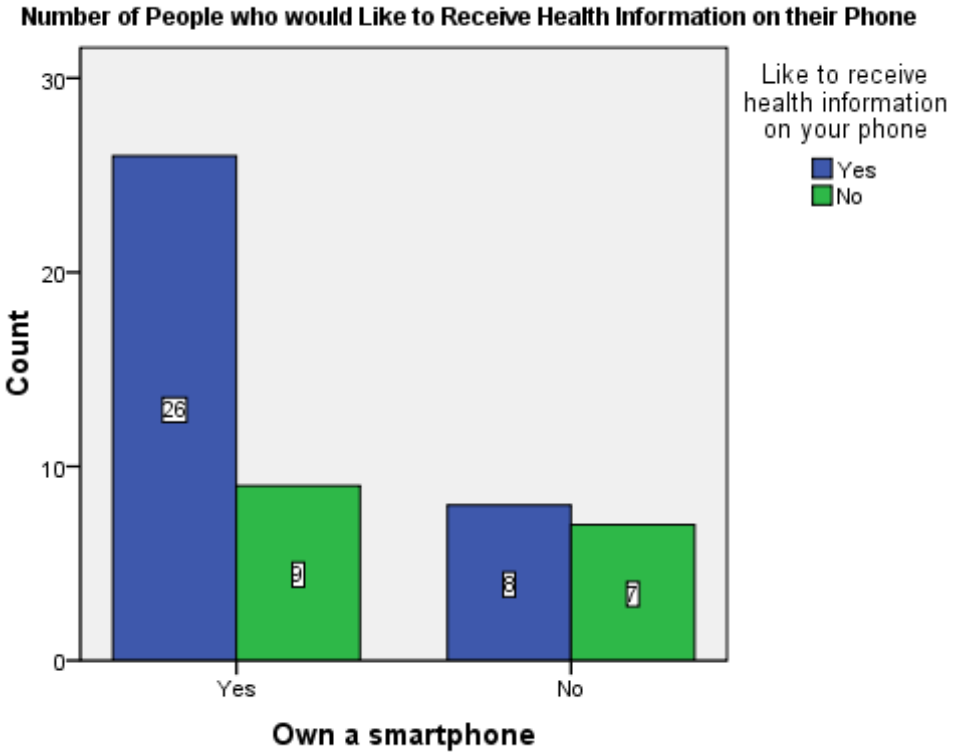

Figure 32: Respondents who like to receive health information on their phone

Own a smartphone * Mode to receive health information Crosstabulation							
Count							
		Mode to receive health information					Total
		SMS	Songs	Games	Through various medical apps	Any other form	
Own a smartphone	Yes	11	5	11	6	2	35
	No	7	4	4	0	0	15
Total		18	9	15	6	2	50

Table 11: Crosstabulation of mode to receive health information and having a smartphone

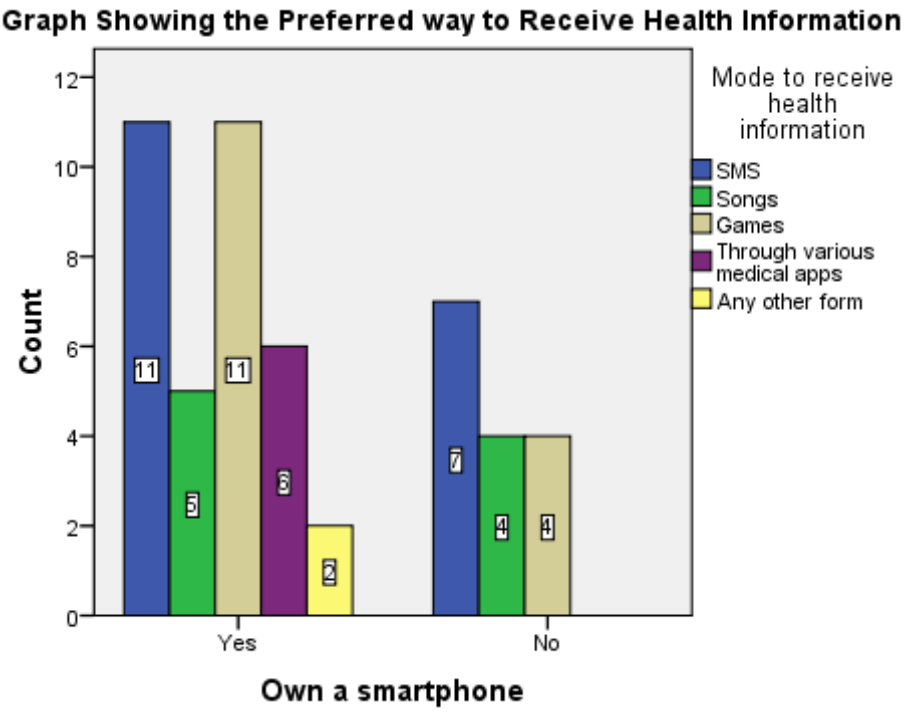

Figure 33: Preferred way to receive health information on the phone by the respondents

3.6 CONCLUSION

With this survey it was found that

- People working in IT sector are more prone to have occupational diseases in one form or other the highest being the vision problem.
- The most common disease found in all age group of people is obesity.
- Education plays an important role as people now believe that the main reason behind their problem is due to either their own lifestyle or it's biogenic.
- The health problem starts as soon as people join IT sector because of the work pressure to achieve their project targets, pressure from their seniors and to compete with their colleagues.
- These people go for health checkup as and when problem occurs rather than going for regular checkups.
- Most of the participants ignore their problem or take a medicine by themselves which increases their problem rather than going for a medical treatment which is opted only after they are unable to do their normal chores.
- Most of these people have a smartphone and sound clarity is the important criteria for them to buy a smartphone.
- Awareness about m-health is very less among these people.
- Those who are aware of m-health use it as a tool to gain knowledge about various health conditions.

3.8 RECOMMENDATIONS

- Companies can organize campaigns by experts to create awareness among their employees for m-health.
- Health education can be given to them through songs, games and animation.
- Micro level awareness can also be created by sending these people email, SMS, radio messages in the form of song jingles.
- m-health can be used as a tool for these people as most of them have a samrtphone and are ready to receive health information in the form of SMS or songs or games.
- People would like to receive health related information on their phone mostly in the form of SMS or Games.

ANNEXURE

Annexure I

To Understand the Usability of m-Health among the IT Professionals of Chennai and their Health-Seeking Behaviour

1. Age
   a) Less than 24years b) 24-26years c) 26-28years
   d) More than 28years
2. Educational Qualification
   a) Graduate b) Post-Graduate c) Diploma
3. Marital status
   a) Yes b) No
4. Designation……
5. For how long you have been working in this field?
   a) 0-5years b) 5-10years c) 10-15years d) >15years
6. What are your working hours?
   a) 8-9hours b) 9-10hours c) >10hours
7. Do you have any of the health problems:
   a) Obesity
   b) Muscular Pain
   c) Heart Disease
   d) Bacterial Infection
   e) Anxiety or stress
   f) Depressions
   g) Insomnia
   h) Lower Back Pain
   i) Neck and Eye Pain
   j) Vision Problem
8. Since how long the health problem is prevailing?
   a) Less than 2years b) 2-4years c) More than 4years
9. If yes, what is your perception about the cause of the problem?
   a) Biogenic
   b) Socio-economic
   c) Religious/Cultural
   d) Lifestyle
10. How often you go for a health checkup?
    a) Every six months b) Once in a year c) As and when health problem occurs
11. What is your immediate reaction when you are sick/ill?
    a) Seek immediate help b) Wait and see if condition improves
    c) Pray and expect a miracle d) Ignore or take no action
    e) Take medicine by yourself
12. If ill, what prompts you to go for health checkup?
    a) Physical Signs
    b) Inability to cope with normal responsibilities

c) Advice by another person

13. What is your first point of contact for your health problem?
    a) Nearby medical store b) Private Hospital c) Government Hospital
    d) Do not consult a doctor and take medicine by your own
    e) Home remedy
14. When ill, the decision to visit a doctor is self-initiated?
    a) Yes b) No
15. Do you have a smart phone?
    a) Yes b) No
16. What features of smart phone attracts you to buy it?
    a) Ease of use
    b) Sound Clarity
    c) Software Version
    d) Memory Capacity
17. Are you aware of m-health (mobile health)?
    a) Yes b) No
    If yes, what do you understand by it?
    ……
    ……..……
    ……..
18. Would you like to receive any health information on your phone?
    a) Yes b) No
19. If yes, in which way you would like to receive health information?
    k) SMS
    l) Through song
    m) Games
    n) Through various medical apps
    o) Any other form
20. Are you aware of m-health programs in India or abroad?
    a) Yes b) No
21. Have you used this application?
    a) Yes b) No
    If yes, which application you have used and for what purpose?
    …….....
    …….....

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