

ASSESSMENT OF MAGNETIC RESONANCE  
IMAGING : UTILIZATION AND FINANCIAL ASPECTS

Mr. Mana Vatakul



A Thesis Submitted in Partial Fulfillment of the Requirements  
for the Degree of Master of Science in Health Economics

Department of Economics

Graduate School

Chulalongkorn University

Academic Year 1998

ISBN: 974-639-528-9

Copyright of Chulalongkorn University

Thesis Title            ASSESSMENT OF MAGNETIC RESONANCE IMAGING:  
                                 UTILIZATION AND FINANCIAL ASPECTS

By                            Mana Vatakul

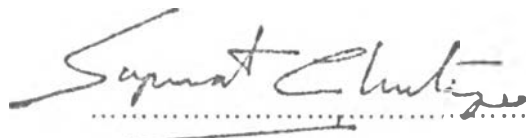
Programme                Health Economics

Thesis Advisor            Phitsanes Jessadachatr,Ph.D.

Thesis Co-Advisor        Viroj Tangcharoensathien,M.D.,Ph.D.

---

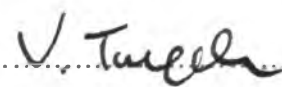
Accepted by the Graduate School, Chulalongkorn University in Partial  
Fulfillment of the Requirements for Master of Science Degree in Health Economics

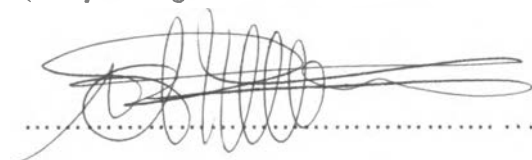
 ..... Dean of Graduate School  
(Prof. Supawat Chutivongse, M.D.)

THESIS COMMITTEE

 ..... Chairman  
(Asst.Prof. Pongsa Pornchaiwiseskul)

.....  ..... Thesis Advior  
(Phitsanes Jessadachatr, Ph.D.)

.....  ..... Thesis Co-Advisor  
(Viroj Tangchareonsathien, M.D..Ph.D.)

.....  ..... Member  
(Raymond C.W. Hutubessy)

# # 5796029 : MAJOR HEALTH ECONOMICS

KEY WORD:

MEDICAL TECHNOLOGY ASSESSMENT / MRI UTILIZATION / FINANCIAL ASPECT OF MRI  
 MANA VATAKUL: ASSESSMENT OF MAGNETIC RESONANCE IMAGING: UTILIZATION AND  
 FINANCIAL ASPECTS. THESIS ADVISOR: PHITSANES JESSADACHATR, Ph.D. THESIS CO-  
 ADVISOR: VIROJ TANGCHAROENSATHIEN, MD, Ph.D. 87pp ISBN 974-639-528-9

This thesis aims to study the situation, utilization and financial aspects of Magnetic Resonance Imaging (MRI) technology in Thailand in order to assess the two most important economics appraisal, efficiency and equity in use the MRI service. Thus it is important to understand the situation, diffusion and utilization of this technology. Because we have bought a high cost but it gave limited benefit on the clinical use of MRI.

In 1998, there are 27 MRIs installed the whole country. (0.45 unit per million population), of which 18 (68%) are in Bangkok, 9 (32%) are in outside Bangkok. Of the total 27 MRIs, 9 MRIs (33%) were owned by public and 18(67%) by private sector. So, There is an inequity of diffusion of MRI and inequity in accessibility to health care service like MRI. The inappropriated diffusion of MRI causes immigration patients from outside Bangkok to use services in Bangkok.

Two MRI units were purposely selected as a case study, classified by public and private. This study aims to collect (a) financial data from MRI's installed to estimate cost of production, cost recovery and break-even output, (b) utilization pattern eg. main application, (c) factors affecting utilization eg. age-sex, resident, payment status(insurance corporate), and monthly income.

The study shows that the major application on clinical use of MRI in both hospitals is on the brain and spine. The financial data of both hospitals show that the cost are more than revenue or the other word, it still less efficiency. They are operating at the level lower than the break-even output.

Moreover, most of cases, 45 % paid from their own pocket 7 % were civil servant who can be fully reimbursed from the Ministry of Finance, 25 % were low income card holders, 18 % were deducted using sliding scale up on the social insurance scheme.

In conclusion the poor and the low income could not access as equal MRI service as the civil servant and the rich people. This clearly reflects unequal treatment for equal needs. Finally, an important implication is that there should be closer collaboration between the public and private sectors.

ภาควิชา.....ECONOMICS.....

สาขาวิชา.....HEALTH ECONOMICS.....

ปีการศึกษา.....1998.....

ลายมือชื่อนิสิต..........

ลายมือชื่ออาจารย์ที่ปรึกษา..... P. Jessadachatr.....

ลายมือชื่ออาจารย์ที่ปรึกษาร่วม..........

## ACKNOWLEDGEMENT

Firstly, I would like to express my sincere to my advisor, Dr. Phitsanes Jessadachatr, who generously advice and suggested me for whole thesis and gratitude to Dr. Viroj Tangcharoensathien, my thesis co - advisor. for him advice which he has always help me from the beginning.

I am grateful to Dr. Somjai Wangsupachart, the chief of MRI Unit in Department of radiology, Chulalongkorn Hospital for providing me the useful information about MRI and thank for staffs at the MRI Unit, Chulalongkorn Hospital especially thanks Mrs. Uraiwan Leksakulchai, who help me facilities during my collected the data at Chulalongkorn Hospital.

I am gratefully to Dr. Wiraiwan Yodsri, the director of MRI diagnostic centre for her information and warmly encouragement and thank to Khun Vipa Suksureemongkol, Department of medicine records and statistics, for the record of the Eastern Seaboard Hospital in Chonburi.

I am also thankful to Mr. Peerapon Plainci, Department of radiation protection, Medical science division, for his supporting the document. My special thanks are due to Assoc. Prof. Waranya Patarasuk, former Director of Center for Health Economics, Chulalongkorn University, for provision my studying in this program.

Finally, I would like to sincerely appreciate the thesis committee members. Assoc. Prof. Pongsa Pornchaiwiseskul and Mr. Raymond C.W. Hutubessy, who gave me specific guidance and kept encouraging me until I completed the thesis.

Mana Vatakul

# TABLE OF CONTENTS

	Page
Abstract .....	iii
Acknowledgment .....	iv
Table of contents .....	v
List of tables .....	vii
List of figures .....	ix
Abbreviations .....	x
Chapter	
1. Introduction .....	1
1.1 Rationale .....	1
1.2 Research questions .....	3
1.3 Objectives of the study .....	3
1.4 Scope of the study .....	4
1.5 Expected benefits of the study .....	4
2. Background .....	5
2.1 Development of medical technology in Thailand .....	5
2.2 MRI technology in Chulalongkorn Hospital .....	12
2.3 MRI technology in Eastern Seaboard Hospital .....	17
3. Literature review .....	20
3.1 Diffusion of medical technology .....	20
3.1.1 Medical technology diffusion in developing countries .....	22
3.1.2 Factors affecting medical technology diffusion .....	26
3.2 Utilization of medical technology .....	27
3.2.1 Concept of medical technology utilization .....	28
3.2.2 Factors affecting medical technology utilization .....	31
3.2.2.1 Under utilization .....	33
3.2.2.2 Over utilization .....	34
3.3 Financing issues for medical technologies .....	37
3.3.1 Health care expenditure for MRI in Thailand .....	39
3.3.2 Prospective reimbursement of MRI technology .....	40
3.3.2.1 Health insurance .....	40
3.3.2.2 Payment mechanism .....	41

4. Research methodology .....	42
4.1 Conceptual framework .....	42
4.2 Method of analysis .....	46
4.3 Data .....	47
5. Discussion of the results .....	48
5.1 Diffusion of MRI .....	48
5.2 Utilization of MRI .....	51
5.2.1 Utilization of MRI in Chulalongkorn Hospital and Eastern Seaboard Hospital .....	54
5.2.2 Factors influence with utilization .....	56
5.2.2.1 Demographic factors .....	57
5.3 Financial aspects of MRI utilization .....	59
5.3.1 Revenue estimation .....	59
5.3.2 Cost estimation .....	60
5.3.3 Financial sustainability .....	64
6. Conclusion and policy implications .....	70
6.1 Summary and conclusion .....	70
6.2 Recommendation .....	72
6.2.1 Specification of MRI .....	72
6.2.2 Clinical effectiveness studies .....	72
6.2.3 Optimal diffusion by regional .....	72
6.2.4 Public and private collaboration .....	72
6.2.5 How to manage the exist MRI ? .....	73
References .....	74
Appendix A : Distribution of MRI in Thailand .....	77
Appendix B : Illustration of MRI in Bangkok .....	78
Appendix C : Illustration of MRI application in Thailand .....	79
Appendix D : Illustration of characteristics of MRI' s patient .....	83
Appendix E : Questionnaires .....	85
Curriculum vitae .....	87

## LIST OF TABLES

vii

Table	Page
2.1 Capacity of Chulalongkorn Hospital .....	13
2.2 Number of personnel in Chulalongkorn Hospital .....	14
2.3 Number of In-Patient and Out-Patient per year .....	14
2.4 Hospital services and special clinics .....	15
2.5 Financial status in department of radiology .....	16
2.6 Capacity of Eastern Seaboard Hospital .....	18
2.7 Personnel members as survey in Diagnostic center .....	18
2.8 Hospital investment .....	18
2.9 Number of services in Eastern Seaboard Hospital .....	19
3.1 Percentage of world's supply of medical technology .....	24
3.2 Number and frequency of MRI scanners .....	25
3.3 Regulations for the use of large- scale medical technology ....	36
3.4 Ratio of CT scanner per million population .....	37
3.5 Important medical devices and their diffusion .....	38
3.6 Health expenditure of import medical instrument .....	39
5.1 MRI diffusion classified by magnetic field strength .....	49
5.2 MRI diffusion classified by regional of Thailand .....	50

Table	Page
5.3 MRI diffusion classified by ownership in Thailand .....	50
5.4 Number of ordering cases classified by service section .....	52
5.5 Number of ordering cases classified by application .....	52
5.6 Number of ordering cases classified by application .....	53
and service time	
5.7 Utilization ratio of MRI in Chulalongkorn Hospital and .....	55
Eastern Seaboard Hospital: 1997	
5.8 Age - sex distribution .....	57
5.9 Patient' s payment mechanism .....	57
5.10 Patient' s residence .....	57
5.11 Patient' s occupation .....	58
5.12 Cost estimates of MRI in Chulalongkorn Hospital .....	61
5.13 Cost estimates of MRI in Eastern Seaboard Hospital .....	61
5.14 Cash flow analysis of MRI in Chulalongkorn Hospital .....	66
5.15 Cash flow analysis of MRI in Eastern Seaboard Hospital .....	67
5.16 Break- even analysis of MRI in Chulalongkorn Hospital .....	68
5.17 Break- even analysis of MRI in Eastern Seaboard Hospital ...	69



## LIST OF FIGURES

Figure	Page
2.1 The direction of superconductive magnets .....	9
2.2 The direction of permanent magnetic .....	11
3.1 Demand for health care technology .....	27
3.2 Underutilization of medical technology .....	33
3.3 Overutilization of medical technology .....	34
3.4 The number of MRI classified by different examination .....	36
4.1 Conceptual framework .....	43

## ABBREVIATIONS

AA	Acute Abdomen	KI	Kidney
AB	Abdomen	KUB	K.U.B
AC	Acromioclavicular	L	Leg
AD	Adrenal gland	LA	Larynx
AN	Ankle	LB	Long Bone
ANG	Angiocardiology	LI	Liver
AOR	Aortography	LS	L-Spine
AR	Arm	LSS	L-S Spine
ART	Arthrography	LYM	Lymphangiography
B	Brain ( tumors, multiple sclerosis, epilepsy, and stroke)	MAM	Mamography
BA	Brachial arteriography	MAN	Mandible
BAS	Barium swallow	MY	Myelography
BE	Barium enema	NA	Nasopharynx
BL	Bladder	NB	Nasal Bone
BR	Breast	NE	Neck
BRO	Bronchography	OC	Oral Cholecyst
C	Chest , ribs	OR	Orbit
CA	Carotid Angiography	PA	Pancrease
CC	Cardiac Cath	PAR	Parotid gland
CHO	Cholangiography	PAT	Patella
CL	Clavicle	PE	Pelvis
CO	Coccyx	PS	Paranasal Sinuses
COM	Common Bile Duct	RE	Renal Angiogram
CS	C-Spine	RP	Retrograde pyelography
CY	Cystography	SA	Sacrum
CYS	Cystourethrography	SAI	Sialography
DAC	Dacryography	SB	Small Bowel
EL	Elbow	SC	Scapula
ESO	Esophagus	SH	Shoulder
F	Foot	SJ	Sacroliac joint
FA	Femoral arteriography	SK	Skull
FE	Femure	SPC	Spinal cord
FIS	Fistulograph	SPL	Spleen
FOR	Forearm	SPN	Splenoportography
GB	Gall Bladder	ST	Sternum
H	Hand	STJ	Sternoclavicular joint
HEA	Head	T	Teeth
HEP	Hepatobiliary	TES	Testis
HJ	Hip joint	THO	Thorax
HT	Heart	THY	Thyroid
HU	Humerus	TL	T-L Spine
HYS	Hysterography	TS	T-Spine
IAC	Internal Acoustic Canal	UGI	Upper G.I.
IVC	I.V.C.	UR	Urethrogram
IVP	I.V.P.	UTE	Uterosalingography
K	Knee	VNO	Venogram
		WR	Wrist
		ZA	Zygomatic Arches