HOSPITAL INFORMATION SYSTEM: ESSENTIAL DATASETS, TO BE USED IN MONGOLIAN HOSPITALS

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A thesis submitted in partial fulfillment of the requirement for the degree of

Master in International Health

by

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Table of Contents

LIST OF TABLES AND FIGURE III

ABBREVIATIONS IV

ACKNOWLEDGEMENTS V

ABSTRACT VI

CHAPTER I. INTRODUCTION 1

CHAPTER II. BACKGROUND INFORMATION 2

2.1 COUNTRY BACKGROUND 2

2.1.1 HMIS IN MONGOLIA 3

2.2 HOSPITAL INFORMATION SYSTEM 6

2.2.1 ESSENTIAL DATASET 7

CHAPTER III. PROBLEM STATEMENT 7

3.1 DESCRIPTION OF THE PROBLEM 7

3.2 PROBLEM ANALYSIS 8

3.3 OBJECTIVES 9

CHAPTER IV. THEORETICAL PERSPECTIVE, AND 9

RESEARCH METHODS 9

4.1 THEORETICAL PERSPECTIVE 9

4.1.1 USEFULNESS OF HEALTH INFORMATION 10
4.1.2 CHOICE OF INDICATORS AND THE RESPECTIVE DATASETS 11

4.2 RESEARCH METHODS 13

4.2.1 NOLAN'S GROWTH MODEL 13

4.3 LIMITATIONS OF THE STUDY 14

CHAPTER V. FINDINGS 14

5.1 HOSPITAL INFORMATION SYSTEMS IN SELECTED COUNTRIES 14

5.2 HIS IN MONGOLIA 18

5.2.1 CURRENT DEVELOPMENT STATUS 18
5.2.2 HIS ADOPTION AT TERTIARY HOSPITALS 19
5.2.3 OBJECTIVES OF TERTIARY HOSPITALS AND USE OF HIS 19
5.2.4 INFORMATION NEEDS 20
5.2.5 CHOICE OF INDICATORS AND THE RESPECTIVE DATASETS 21

CHAPTER VI. DISCUSSION 22

CHAPTER VII. CONCLUSIONS AND RECOMMENDATIONS 26

7.1 CONCLUSIONS 27

7.2 RECOMMENDATIONS 28

REFERENCES: 29

ANNEX 1: ORGANIZATIONAL STRUCTURE OF HEALTH SECTOR, MONGOLIA 33

ANNEX 2: REPORTING FORMS 33

ANNEX 3: INFORMATION SYSTEMS USED IN MONGOLIAN HEALTHCARE 34

ANNEX 4: MAIN HIS APPLICATIONS AT TERTIARY LEVEL HOSPITALS: 35

ANNEX 5: OTHER COMPUTER BASED APPLICATIONS AT TERTIARY HOSPITALS 35

ANNEX 6: NATIONAL INDICATORS THAT ARE USED IN MALAWI 36

ANNEX 7: RESEARCHER'S OBSERVATION OF HIS AT HOSPITAL NO.337

ANNEX 8: PERFORMANCE INDICATORS THAT ARE USED IN HOSPITAL NO.339

List of Tables and Figure

TABLE 1: COMPARISON OF SELECTED INDICATORS OF MONGOLIAN HOSPITALS AND THOSE IN OTHER COUNTRIES 3
TABLE 2: STAGES OF NOLAN'S GROWTH MODEL 13
TABLE 3: SETS OF INDICATORS CORRESPONDING TO DIFFERENT LEVELS OF OBJECTIVE, IN MONGOLIA 20
TABLE 4: DESCRIPTIVE SHEETS OF THE CORE INDICATORS 24

FIGURE 1: HEALTH INFORMATION FLOWCHART, MONGOLIA 5
FIGURE 2: USEFULNESS OF INFORMATION 10
FIGURE 3: FACTORS OF USEFULNESS 11
FIGURE 4: LEVELS IN THE OBJECTIVES HIERARCHY 12

ABBREVIATIONS

CIS	Clinical Information System
CME	Continuing Medical Education
CMEA	Commission of Mutual Economic Assistance
DRG	Diagnostic Related Groups
EDP	Electronic data processing
EHP	Essential Health Package
EMR	Electronic Medical Records
FGP	Family Group Practice
HMIS	Health Management Information System
HMN	Health Metrics Network
HSDP	Health Sector Development Programme
HSMP	Health sector Strategic Master Plan
HIS	Hospital Information System
MPRS	Malawi Poverty Reduction Strategy
NCHD	National Centre for Health Development
NIS	Newly Independent States
NPIHT	National Programme to Improve Health Technology
ICU	Intensive Care Unit
RAP	Resource Allocation and Purchasing
RTDC	Regional Diagnostic and Therapeutic Centre
Sq.km	square kilometres
SWAp	Sector Wide Approach

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ABSTRACT

This research work aims to provide recommendations for designing essential datasets based on relevant performance indicators for tertiary level and specialised hospitals in Mongolia.

A systematic literature review was done to find out what experiences and innovations from the selected countries can be adopted in Hospital Information Systems (HIS) in Mongolia, so as to bypass years of struggles. It employs Nolan's growth model to describe HIS adoption in Mongolia and to generate stage-specific recommendations for further HIS development. An objectives hierarchy framework was used to identify operational and some of higher level objectives that are for tertiary hospitals, thus respective indicators and datasets were proposed to monitor hospital performance towards above objectives. It suggests potential sets of quality indicators and the respective datasets to be adopted in tertiary hospitals.

It is found that computer based HISs in Mongolia are at "expansion or contagion" stage according to Nolan's growth model, and on the way to next stage "formalization or control". This paper also recommends "essential datasets approach" could be a choice of handling current issue – number of parallel projects and initiatives, aiming to develop complete computer based HIS or "paperless hospitals".

Key words: **Hospital Information System, Hospital Performance Indicators, Essential datasets**

CHAPTER I. INTRODUCTION

Information is the foundation for policy making, planning, programming, and accountability. Health information is not an exception, but also provides the foundation for better health. It serves as blood, transporting all the essentials, nutrients to end users to support their functioning, and leaves containing feedbacks from them. Likely, information system is similar to circulatory system in human body. Unfortunately, sound information, and reliable information systems are rarely available in low-income developing countries.

Today, countries face unprecedented demands for reliable and timely health data to support decision making, especially in the context of health sector reform. And a number of international organizations, alliances are now directing its focus on development of national health information systems and of its sub-systems with an aim of helping poorer and transition countries to enhance reliable foundation of its public health sector.

Mongolia is one of the poorer and transition countries of which health system has undergone major reforms since 1990. Mongolian government is now in the process of implementing a new Health Sector Strategic Master Plan (HSMP) 2006-2015. HSMP strategy document, or volume 1, notes development of Health Management Information System and its sub-systems is one of strategic focus of the actions which is under key area of Institutional Development and Management (MoH 2005a, p.10).

It determined 17 policy elements for Mongolian Health Sector based on National Public Health Policy, the health and related laws, the Constitution and various other documents. It emphasizes "*effective use of the evidence-based health information for planning, implementation, monitoring and evaluation in the health sector using a unified health information system*" (MoH 2005a, p.13). A list of 24 strategic actions derived from the 17 policy elements is proposed and the overall outcomes to be achieved by 2015 include increased life expectancy; increased health status of children and women, decreased mortality rates; improved access to safe drinking water and basic sanitation; control of HIV/AIDS; sustainable population growth; reduced household health expenditure, especially among the poor; more effective, efficient and decentralized health system and increased number of client-centred and user-friendly health facilities and institutions.

Use of information and health information system for management, monitoring and evaluation (M&E) purpose is noted in HSMP Monitoring and Evaluation Framework, or volume 3, that the routine M&E benefits as it "…*employs an integrated health management information system (HMIS) in order to obtain the full benefit of the operation of the various stand-alone/individual systems already in place.., employs a standard matrix consisting of strategies, activities, outputs, indicators and means of verification for monitoring and evaluation at all level health organizations, international partners and private sector.., makes use of an appropriate set of indicators for evaluating performance of health institutions*…" (MoH 2005b, p.4).

This research work aims to contribute in evidence based decision making in planning and designing of healthcare information system through generating policy implications. In my study, I aimed to find out what experiences and innovations from the selected countries can be adopted in Hospital Information System (HIS) in Mongolia, so as to bypass years of struggles. It employs Nolan's growth model to describe HIS adoption in Mongolia and to generate stage-specific recommendations for further HIS development. Assumption here is that more comprehensive management data collected on routine basis through computer based HIS monthly or quarterly would improve use of management information at hospital level rather than current management data collected and reported, yearly. It would change

role of hospitals in HMIS as decentralized information users or analyzers from current role as data collectors, decision implementers. It also conveys a key message that Mongolian health information system, in general, is on the way, moving away from "retrospective reporting" and toward very immediate or "concurrent reporting". No longer should information be collected after-the-fact but rather as a by-product of operational systems, in which the information is collected and reported routinely or service and facility based.

Expected results:

- A comparative analysis of hospital performance indicators and the respective datasets used in tertiary level hospitals in selected countries
- A proposed list of indicators for MoH, hospital managers to assess the hospitals' performance and criteria for accreditation that can be extracted from computer based HIS
- Recommendations on determining hospital performance indicators and the respective essential datasets of computer-based HIS applications for management use of information at tertiary level hospital

Intended use of the results

The proposed datasets based on defined hospital performance indicators has an ambition of serving as a basis for datasets of management use in Mongolian tertiary level hospitals after accommodating them in specific hospital settings with recommendations developed by this study. It would also give an insight into current situation of management use of information at hospitals in the selected countries. The possible users are ministry officials, researchers who got interest in similar area, practitioners or HIS software developers.

CHAPTER II. BACKGROUND INFORMATION

2.1 COUNTRY BACKGROUND

Landlocked between China and Russia, Mongolia is situated in Central Asia with a total area of 1,566,500 sq.km. Its population of 2,951,786 (July 2007 est.) starts to grow after some stagnation, during socio-economic crisis due to shift from communist regime into democracy and free market economy. Health indicators are comparable to former soviet or newly independent states (NIS). Economic growth in recent years has brought some positive effects on health, demographic and socio-economic status; however there is growing inequality as well. Inequality, as measured by the Gini coefficient, is 0.33. Human development index (2004) gave Mongolia 0.691 and it is ranked at 116.

Mongolian healthcare is undergoing major reform since making a shift from centralized and hospital based system into decentralized and community based healthcare. Before adoption of democracy and market oriented economy by the new Constitution in 1992, it was one the countries that followed socialist ideology and completely integrated with former Soviet Union and other Eastern European Countries through Commission of Mutual Economic Assistance (CMEA) in all socio-economic and political structure. The health system was organized according to the Semashko model in which the state is responsible for both the financing and delivery of health care. The system emphasized the provision of health services mainly through hospitals, and as a result, Mongolia has inherited a large, inefficient hospital network that provides a low quality of care (World Bank, 2007).

Table 1**:** Comparison of selected indicators of Mongolian hospitals and those in other countries

Country	Hospital Beds Per 1000 population	Hospital Admissions Per 100 population	Average Length of Stay	Physicians per 1000 population	Out-patient Visits Per capita	Public Health Expenditure % GDP
Mongolia	**7.7**	**20.1**	**12.3**	**2.4**	**4**	**4.7**
Ukraine	7.6	18.3	13.4	3.0	10	2.9
Azerbaijan	7.5	4.7	14.9	3.8	1	1.0
Georgia	4.6	4.7	8.3	4.4	1	0.8
Armenia	5.5	5.6	10.4	3.0	2	4.0
Turkey	2.2	7.3	5.4	1.2	2	3.3
United Kingdom	4.1	15.0	7.0	1.8	6	5.8
Norway	3.3	14.7	6.5	4.2	4	7.0
EU Average	4.6	18.75	8.32	3.7	6	6.7
NIS[1] Average	6.8	18.6	13.3	3.8	5	2.9

Source: European observatory, WB/WHO, HSDP (1998 as cited in UB hospital restructuring project, MoH and The World Bank, 2003, p.17)

Mongolian healthcare service is staged into three levels: primary or FGP's, secondary or district level and tertiary level care (annex 1).

> *Tertiary care - is the advanced specialized professional care provided by specialized hospitals, centres, Regional Diagnostic Therapeutic Centres for the whole population (national and regional) including professional and technical advice to all referring organizations.*

As a result of long term health reform, the number of specialized hospitals has been decreasing from 30 to 19 in 1992-2003 (MoH, 2003). And many small, specialized hospitals are still to be closed or merged with larger ones, or even better merged together into networks (World Bank, 2007).

2.1.1 HMIS IN MONGOLIA

Since 1960 in Mongolia had begun systematic collection of health data. The current health information system in Mongolia collects large quantities of data but quite a significant portion of this data is not considered to be of "adequate quality". In its developmental stages, Mongolian Health Management Information System (HMIS) and its components have been supported by both government policy and external donor funding. However, it lacks adequate facilities, human resource and a standard system (MoH 2005b). To address current issues of HMIS in Mongolia, development of Hospital Information System (HIS) has been set as one of top priorities in policy papers such as "Mid-term strategy on ICT development", "National Programme to Improve Health technology" (MoH 2004).

[1] NIS is the Newly Independent States of FSU: Northern Tier includes Poland, Hungary, Czech Republic, Slovakia, Slovenia, Lithuania, Latvia, and Estonia; Southern Tier includes Croatia, Romania, Bulgaria, Albania, Bosnia-Herzegovina, Macedonia, Serbia, Montenegro and Kosovo; European NIS includes Russia, Ukraine, Moldova, Belarus, Georgia, Armenia, Azerbaijan, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan.

National Programme to Improve Health Technology (NPIHT) was approved in 2002, and health technology in Mongolia was noted as being stayed far behind in comparison with international practice, because of inadequate quality control, monitoring subsequently the missing corrective measures and advocacy. The NPIHT was designated to guide comprehensive solution to renewal, maintenance of health technology, its management, information and human resource issues. Its objective is "*to improve the the quality of health services to meet international standards through selective introduction of cost-effective and readily available health promotion, protection, diagnosis, treatment, rehabilitation and information technology*".
The guiding principles are as following:

1. to select and introduce widely used technologies which are specifically efficient, and cost-effective to a certain level of healthcare service
2. to prioritise and introduce efficient technologies, used for reducing main causes of morbidity and mortality of the population
3. to address the issue of health technology as complex, in cohesion with its management, organization and human resource development
4. *to introduce information technology in health information database, integrated network, distance learning, distance diagnosing, and counselling*
5. to re-standardize the practice of diagnostics and treatment to a level of "evidence based medicine"

It offers two main policy arenas, 1) healthcare technologies which are both standards and equipments used in prevention, diagnostics, and treatment, 2) health complementary technologies which are used in health management and organization as well as *information technology* used in health system.

In 2004, ADB technical assistance team did an assessment of HMIS in Mongolia, as part of Health Sector Development II (HSPD II) loan project, subsequently extended into HMIS Development Strategy in 2005. It stated that a number of HIS models have been initiated and adopted by the tertiary level hospitals individually and this has shown hospital managers' commitment to improve HIS. However, it often brings the whole system into problems of interoperability, integrated database due to use of different format and different dataset as they were developed individually. It has also indicated the collection of duplicated and unused data, poor quality assurance system of data as main issues of information generation process.
HMIS Development strategy is founded on principles of HMIS being based on stakeholders' need, wholly standardized and of information generation process being cost-effective. Its mission statement is

> *"HMIS is to contribute to the improvement of health outcomes and client satisfaction by supporting knowledge-based decision making at all levels of health sector capitalizing upon appropriate technology."*

In this strategy paper, a number of sub-systems is targeted to be developed; Public Health Management Information system, Financial Management Information System, Supportive Management Information System, Additional Management Information System. HIS is prioritized and categorized under sub-system Hospital service management information system, along with Electronic Medical Records (EMR).

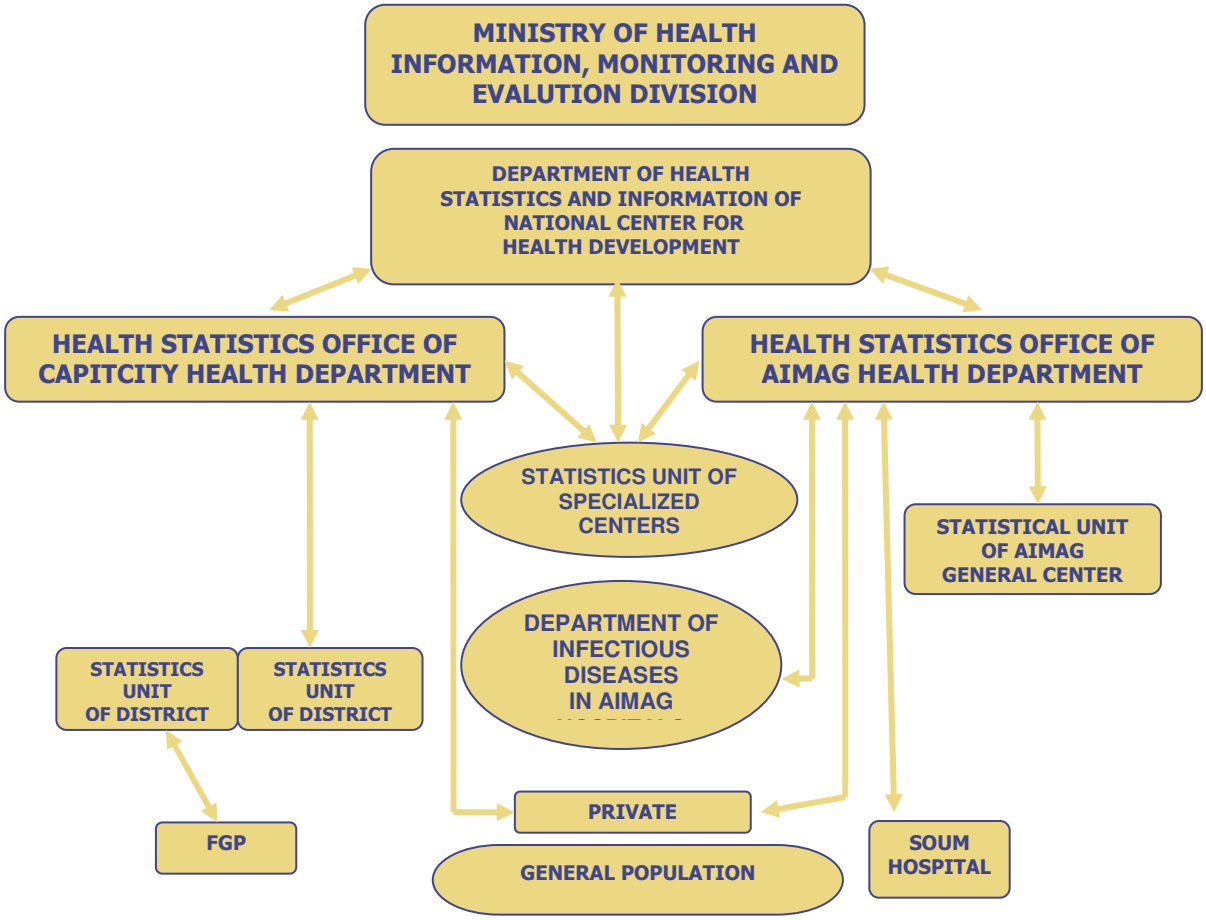
Data collection and indicators
Main activities of improving data quality include revising set of indicators, their definitions and calculation method, defining common requirements and specifications for software for

each level of healthcare service (MoH 2005c). The main categories of data, HIS in Mongolia collects, are identified (WPRO 2006) as inpatient data, outpatient data, and hospital morbidity & mortality. Inpatient and outpatient data is then categorized into (1) resource (input) indicators such as the number of health personnel by type; (2) service utilization indicators such as the average length of hospital stay, or the average number of outpatient visits per doctor; and (3) outcome indicators such as the number of deaths within 24 hours after admission.

Health Information flow

Tertiary or specialised hospitals in Mongolia report to Department of Health Statistics and Information of NCHD and partially to Health statistics office of (Capital) City Health Department or that of Aimag[2] Health Department, depending on if it is specialised hospital in the capital city or Regional Diagnostic and Therapeutic Centre (RDTC) in the country.

Figure 1: Health Information flowchart, Mongolia



Source: Health Management Information System Development Strategy, 2005, MoH.

In Mongolia, specialised hospitals use registry and reporting sheets approved by the Minister's order No.203 (MoH, 2005c). Not being categorized by level of healthcare, registry sheets collects data from family or *soum*[3] hospitals (24 forms), ambulatory polyclinic (28 forms), inpatient section of the hospital (40 forms) and specialised centres (35 forms). But

[2] Administrative unit, comparable to province

[3] Soum – smallest administrative unit in Mongolia

most reporting sheets are designed to report on certain hospital activities and functions (annex 2).
Data collected by registration forms are summarized into reporting forms, and is meant to be used for management, and policy-making. However the registry forms collect and report data only from clinical facilities monthly, whereas reporting forms additionally inclusive of human resource data are sent to Statistics Information Department, National Centre for Health Development on yearly basis. Indicators such as percentage of screening diagnostics, workforce mobility can be analyzed from this report, but financial data is retrieved from registry forms and analyzed as part of health insurance calculation. The fact that management data is reported yearly can be one of the reasons why primary analysis and immediate use of hospital information is not satisfactory at hospitals. Monthly or quarterly collection of management data through HIS on routine basis is assumed to contribute in use of up-to-date information in decision making in hospitals. Process of data collection is described in a country report at WPRO (2006) meeting as following:

> *Data are collected from hospital registration forms and monthly information sheets and then shared through quarterly reports and annual health reports. The monthly reports include data on births, deaths and infectious diseases, in addition to inpatient and outpatient data. The annual report has a much wider coverage since it includes data on: non-communicable diseases; information, education and communication (IEC) activities; HIV/AIDS; TB and other infectious diseases.*

The current activities of HMIS development focus more on EMR and regulations of minimum IT infrastructure requirements. The main stakeholders are MoH, WHO country office, ADB, Luxembourg, Belgium government, private companies and the hospitals. A number of workshops, plenary meetings have been held on EMR, LAN installation at hospitals.

Current challenges
A number of computer based hospital information systems projects have been initiated in parallel, but most of which failed (annex 3). Although Ministry of Health (MoH) promoted Med-Land piloted at Hospital #2 to be adopted in other hospitals, it failed to satisfy end users' requirements. It initially aimed to build a complete computer-based HIS. However, the hospital officials did not accept the HIS developed by MoH with assistance of WHO country office, at all. The task was contracted out to a private ICT company and the result was no use. The main pitfalls were that it was not user-friendly, hardly possible to extract indicators and not comprehensive for hospital functions. At the same time, two other HISs have been developed and piloted at different tertiary hospitals: Hospital #1 (Pyramid) and Hospital #3 (E-hospital). The hospitals applied different approaches to introduce their own HIS; Hospital #2 developed patient information system at first, and expands its function by developing financial information system. While hospital #1 developed at first financial information systems, and then developed patient information systems functions as its subsystem (MoH 2004).

2.2 HOSPITAL INFORMATION SYSTEM

Hospital information system (HIS) is defined in a various ways and often called as clinical information system (CIS). It is commonly defined as a comprehensive information system used to collect, store, process, retrieve, and communicate patient care and administrative information for all hospital-affiliated activities and to satisfy the functional requirements of all authorized users in a hospital (Van Bemmel J.H, Musen M.A. 1999). However, the

contradictory distinction between both terms is that CISs concentrate on patient- and clinical state- related data or Electronic Medical Records (EMR) whereas the HIS keeps track of administrative issues (Wikipedia contributors, 2007). In addition, HIS and EMR are stated separately in priority areas of HMIS strategy paper (MoH, 2005b, p.20) as if they are completely different terms and concepts. The HIS encompasses human (or paper-based) information processing as well as data processing machines. However this study will focus more on electronic or computed based information systems which are used for management purposes in the hospitals.

2.2.1 ESSENTIAL DATASET

Developing an essential dataset provides managers with a clearly defined set of indicators for monitoring & evaluations, clinicians with simple, easily-retrievable data for primary use. An essential data set may be defined as a set of the most important data elements, selected from certain health care service that should be reported by health providers on a routine basis, with the aim of being able to generate indicators that monitor the provision of health services in an integrated manner (Shaw V, 2005. p.632). The minimum data set approach is also noted (WPRO 2006, p27) as a choice of implementation methods for integration of health information system. It is described that national ministry determines minimum reporting requirement for all health facilities and the organizations add indicators or datasets in order to be able to manage their services efficiently. Most indicators are used at all levels; however a few apply to one or more specific levels only. Health centres and hospitals monitor most indicators monthly whereas district and national levels monitor quarterly.

CHAPTER III. PROBLEM STATEMENT

3.1 DESCRIPTION OF THE PROBLEM

In November 2004, the HMIS in Mongolia was reviewed by a team of external consultants. After analyzing the basic data collected from different sources, the team came up with a list of findings that cover all aspects of the HMIS (MoH 2004):

- lack of knowledge and experience of health sector managers in developing and maintaining of IT enabled HMIS;
- *No integrated policy and mechanism of developing, maintaining, monitoring, evaluating, and maintenance of HMIS;*
- No current policy in the MoH regarding “ownership” of intellectual properties which are created by internal staff or through international projects;
- Multiple projects, which are ultimately lead to fragmentation and additional costs;
- *Lack of standards and standardization;*
- *Lack of integration and interoperability;*
- Lack of IT specialists, HMIS experts and user training in both IT and the concepts of information use;
- Technological backwards of most HMIS hardware and communication equipment; Sometimes lack of (computer related) supplies;
- Lack of systematized way to assure maintenance and repair;
- Shortage of budget allocation for implementing and maintaining computerized HMIS in hospitals

Among HMIS sub-components, progress of implementations of standard setting, master planning, management and planning tools are identified to be of 15 and 10 per cent completion respectively (MoH 2004, p.19).
Accordingly, the set of common standards is emphasized as urgently needed to be created and enforced. As first on the list, National Health Data Dictionary (defining the syntax and semantics of each data element to be collected) and a National Health Information Infrastructure (a common network and common data flow) need to be created to enhance inter-operable, integrated information systems. Both terms refer to National Health Datasets and Conceptual Health Information Model respectively, hereinafter.

3.2 PROBLEM ANALYSIS

Based upon aforementioned assessment report and on other documentations (presentations from workshop on LAN installation in tertiary hospitals, assessment reports of IT infrastructure of Dornod RDTC and of Second Hospital by VSO/WHO), main HMIS opportunities and weakness, relevant to information standards, indicators and datasets, are identified to be:

Absence of integrated planning, regulations

- There are 10 parallel systems that are not coordinated centrally by HMIS planning; some are national, some sentinel site-based, and some project- or donor-initiated /annex 3, 4 and 5/
- The health information unit inside MoH is proposed in HSMP to be built for regulation of HMIS, yet not built.

HMIS benefits

- A wide range of information, which covers population health, mother-child health, and services, database of doctors' check up, hospital registration, is collected by a standard system
- National statistical abstracts "Health Indicators" have been published annually
- Standard registry and reporting forms are developed and in use.

HMIS weaknesses

- Poor standardization results in parallel initiatives which are not inter-operable, eventually the misuse of resources
- Data quality and accuracy is not sufficiently assured
- Data processing, information use for management purposes at facility level is insufficient
- Current indicators are mainly output indicators

HMIS main opportunities

- The HSMP has emphasized role of indicators in HMIS in particular, M&E framework in general, presenting opportunity for the HMIS to move from recording and compiling data to analyzing and using those data for planning, management, and evidence-based decision making. In that sense, HSMP may become the impetus for indicator based performance monitoring to become productive.
- Substantial set of indicators were developed, and the essential datasets can be developed on the basis of the current system. Yet, the current set of indicators need to be enriched with performance indicators and be specific to level of healthcare service
- If data are analyzed and used coherently, the HMIS may become a powerful tool for M&E and decision making.

3.3 OBJECTIVES

General objective:
To contribute in performance monitoring for Mongolian tertiary level hospitals

Thesis objective:
To provide recommendations for designing essential datasets based on relevant performance indicators for tertiary level and specialised hospitals in Mongolia.

Research strategies:

- To analyze current health information systems in tertiary hospitals in Mongolia
- To find alternative approaches on performance monitoring systems in literature
- To select an effective and feasible set of indicators for performance monitoring; to describe necessary datasets; to propose an implementation strategy.

Research questions

- What are the information needs of MoH officials and hospital managers specifically on tertiary level hospitals?
- What indicators are formulated for monitoring and evaluation of over-all hospital performance? How can the existing set of indicators be improved to respond better to the information needs?
- How can the approach to determine hospital performance indicators and essential datasets be improved?

CHAPTER IV. THEORETICAL PERSPECTIVE, AND RESEARCH METHODS

4.1 THEORETICAL PERSPECTIVE

Anderson and Aydin (Anderson J.G, Aydin C.E, 2005) discuss three perspectives which view health information system as an exogenous or external force that affects individuals, organization; endogenous as it is designed, implemented and controlled by the managers, clinicians; and more pluralist as it is determined by complex social interactions within the organization. The simplest approach views computer system as an exogenous factor where the participants are viewed as passive or as resistant. Evaluation in this instance focuses usually on technical performance, and can include assessment of impact of the system on specific characteristics of the organization. This theoretical perspective is applied here, only for identifying certain stage of an organization's IS adoption according to Nolan's growth model by investigating the extent of impact of HIS on organization of departments and on task distribution. As this study aims to investigate the appropriateness and management use of the data extracted by the information system, it will engage the one which views the design of information systems as determined by the information needs of stakeholders, as for the theoretical perspective. IS as endogenous as it is shaped by end users' needs, provides appropriate data which is useful for end users' purpose.

The third perspective is much more complex than above two. As this perspective views the system use is determined by complex social interactions such as conflicting objectives, preferences and the work demands within an organization, it is ideal for socio-behavioural studies of introduction of new technologies.

4.1.1 Usefulness of Health Information

One of the main issues in dealing with health information is the usefulness of the information. A cost utility measure of usefulness was defined as following (Figure 2):

Figure 2: Usefulness of information

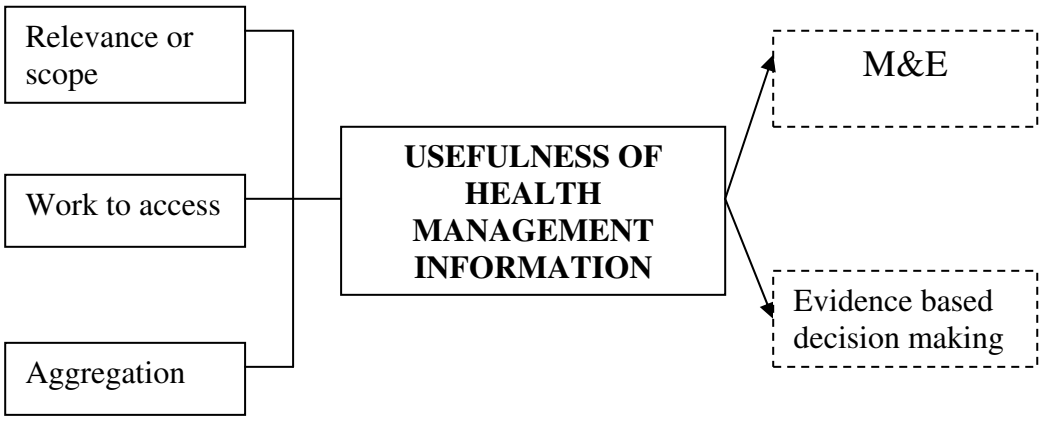
$$\text{Usefulness of Information} = \frac{\text{relevance x validity}}{\text{work}}$$

Source: Slawson 1994 as cited in Karlsson 1997

Where relevance refers to relevance to everyday practice and the type of evidence presented, validity refers to the probability of the information being correct and work is defined as the effort needed to obtain the information.
Analyzing the use of a clinical decision and information support system, which was developed at Linkoping University, Sweden, the researcher (Karlsson 1997) found two main contribution of the system, which are to get patient-specific decision support and Continuing Medical Education (CME). Important determinants of the use of system were relevance, validity and work. Relevance was discussed from two perspectives: (1) the relevance to the current patient case, and (2) the relevance in everyday clinical practice. Validity was discussed in terms of trust and authority, i.e. subjective validity, and how the validity could be assessed. Work was mostly discussed as the amount of time that was needed to find information. Likely, Mangaliso M.P (1995) described usefulness of management information as its determinants are to be scope of information, aggregation and timeliness. As for use of health management information, relevance or the scope of information could be discussed more in facility based service registration and in its continuous management. The rest of the determinants are found to be similar to each other, however work to access, aggregation are chosen for “usefulness of health management information” as work to access is inclusive of effort and time used for retrieving certain information or timeliness, and the aggregated formats of data is more crucial for higher management level, and validity attribute of information decreases as it is more aggregated. The contribution of the management use of information is much wider and hierarchical than clinical use of the information. The limited number of literature specifically on health management information (Campbel et al, 1996) suggests that health management information is used for self-assessment, planning and support/supervision. This paper argues, use of health management information supports monitoring and evaluation (M&E) of health facility performance, along with its management purpose. M&E can be discussed in two perspectives: an outsider’s perspective can be interpreted as audit reports to MoH or information that is in need of MoH or higher officials, whereas an insider’s perspective can be self evaluation reports made by hospital managers and for internal use only. While the management information does include information that is needed for decision making at organizational level so as to decrease environmental uncertainty that may affect organizations performance. Thus the use of health management

information is more complex and more action-oriented in dealing with problems identified by M&E. Accordingly, the contribution of use of health management information is categorized as M&E (both perspective), and evidence-based decision-making in general. Clear distinction between management and decision making is not determined, when management itself comprises of continuous decision making.

Figure 3: Factors of Usefulness



4.1.2 Choice of indicators and the respective datasets

With a simple model of action cycle – planning, implementation and evaluation, the whole health system functions can also be described in stages as objectives, target setting, action plans are developed in planning stage; the actual process of implementing the plan in implementation stage; and summarizing the outcomes with comparison of initial objectives in evaluation stage. Whereas, monitoring could be described as also a review of achieved results, but it is more on-going process along with implementation procedures and excludes assessment of project design, overall outcomes. The M&E activities are seemingly interconnected with the objectives and targets. Working definitions of some terms in this paper are as following:

> *Monitoring* – is the systematic collection of data to provide management, government agencies, donors and other stakeholders with an indication of project progress.
> *Evaluation* – is the systematic and objective assessment of an ongoing or completed project, including its design, implementation, and results. .
> *Targets* – are quantified objectives, set by policy makers, to be attained at a future date.

Both monitoring and evaluation are based on relevant indicators, however the types of indicators can be assigned to each of them as the monitoring activities focus more on operational objectives or targets, and evaluation activities corresponds with tactical objectives as discussed by Casey et al (2004. p.13). There exists, in addition, a number of typologies and levels of indicators (Schirnding, 2002. p.23, MoH 2005a, p.27)

Figure 4: Levels in the Objectives Hierarchy

Source: Casey et al, 2004. p.13

As this paper focuses on performance monitoring at facility level, it will further investigate operational objectives at tertiary hospitals, corresponding indicators and datasets or information needed for monitoring achievements of objectives of the organization. Healthcare objectives, in general, cover:

- Equity and access
- Effectiveness and quality
- Financial sustainability
- Productivity & Efficiency
- Social participation satisfaction

However, there is no source, stating objectives of Mongolian tertiary level healthcare service; this paper argues that there are certain sets of indicators, developed as a result of multi-national initiative, regardless of possible variations among hospitals, countries (WHO 2007). It will be promoted as universal sets of indicators which serve as basis of development of specific sets of indicators for certain healthcare level.

According to MoH definition (MoH 2005a, p.101), indicators are:

> *"…measures for checking on progress towards achieving outcomes. They can be quantitative and/or qualitative, have a timeframe, and may highlight geographical and/or target groups. Indicators should relate to those aspects of care or organisational/management issues which can be altered by staff."*

Thus indicators are needed to

- compare areas or group of people in terms of their health status, so as to help target action where it is most needed (to help allocate resources)
- to monitor and assess the effects of policies or other interventions on health
- to help awareness about health issues across different stakeholder groups (including policy makers, health practitioners, public, media etc)

It can further be devised to meet context specific requirements as well. This paper adopts classification of indicators, discussed in HSMP, so that the findings of current work can be tied to what already exists. These are indicators of MDG; financial indicators; healthcare resources; use of healthcare services; performance indicators; quality indicators; health behaviour and environmental indicators; and demographic & socio-economic background data.

It is also acknowledged that the indicators discussed in HSMP are adopted cautiously because the distinction between performance and quality indicators in HSMP is problematic, as

performance itself is discussed in several aspects (Knowles et al, 1997. p.24) – access, efficiency, equity, sustainability and *quality*. Accordingly, some performance indicators in HSMP such as average length of stay, bed occupancy rate, are identified to be efficiency indicators according to Knowles et al.
Furthermore, quality indicators are discussed in three dimensions: process, outcome and structure and the current study focus on indicators that are potentially used in routine performance monitoring, some of the quality indicators such as presence of different types of quality control mechanisms, health-related behavioral change of the patients are regarded as structural and outcome indicators respectively, thus excluded from the study.

4.2 RESEARCH METHODS

For this desk study, the mixed methods approach is used, and the data collection has been carried out in the Netherlands and in Mongolia. The MeSH terms such as Hospital Information System, Healthcare Planning limited by single terms – basic/essential datasets, performance monitoring, development and developing countries will be used for searching relevant literatures in Pubmed, ScienceDirect as well as in SpringerLink. Data collection in Mongolia involves site visits, collection & review of relevant policy documents, research papers and other relevant publications. The researcher's observations, conversations, informal interviews and personal experiences during times of site visits are also used to draw a comprehensive understanding of HIS situation in Mongolia.

4.2.1 Nolan's Growth Model

Furthermore, one of the most popular models, Nolan's Growth Model (1979 as cited in Van Bemmel J.H, Musen M.A. 1999) is used for determining stages of HIS adoption nationwide in the selected countries. Organizations, in general, follow several stages in their growth toward a situation in which information systems are fully integrated in the organization. The basic growth model of Nolan consists of four phases (Table 2):

Table 2**:** Stages of Nolan's Growth Model

	Stage	**Description**
1	Initiation	Early use of computers by small numbers of users to meet basic organizational needs. Decentralized control and minimal planning.
2	Expansion or contagion	Experimentation with and adoption of computers by many users. Proliferation of applications. Crisis caused by rapid rise in costs
3	Formalization or control	Organizational controls established to contain growth in use and apply cost-effectiveness criteria. Centralization. Control often prevents attainment of potential benefits
4	Maturity or integration	Integration of applications. Controls adjusted. Planning is well established. Alignment of information systems to organization

Source: Van Bemmel J.H, Musen M.A. 1999

Nolan observed that most organizations pass these four stages consecutively, and that the transformation into the formalization and maturity stages especially requires explicit

interventions by the general management of the organization. The growth into maturity often implies a redesign of the entire organizational structure, including the information systems. An in-depth comprehensive view on the use of data by all activities in the organization is then needed to be able to effectively integrate applications. Each of these stages has its distinctive applications, rewards and problems. By identifying which stage the hospitals are in, intrinsic factors to IS/IT use of the organization, current and upcoming advantages or obstacles can be foreseen (can be estimated). It has to be managed in a way which is sensitive to the issues in that stage and with an eye for the issues which will arise in the next.

Nolan's growth model is used in this paper, to identify and to understand the current stage of IS usage in the organization, respective problems. According to Nolan (1979), the problems which arise at each stage and the management techniques to solve them are very similar regardless of variations in the electronic data processing (EDP) installation and the type of company. Not like Nolan's model, McFarlan's (1983) phases of assimilation give more focus on merging "islands" of technologies and on strategic impact of information technology. The further models (Earl 1989, Galliers 1991) focus on organizational maturity for IS planning and management. Earl's model, for example, tries to give more specific direction about what actions an organisation should be taking at each phase. Implications concluded from this model-analysis should reflect on recommendation part, later.

4.3 LIMITATIONS OF THE STUDY

This paper examines and proposes sets of hospital performance indicators; however, it is designated solely for tertiary level hospitals. Limited source of literature on Mongolian HMIS and availability of HIS project documents limit comprehensive description of the problem. Time constraint is another limitation for studying all the indicators but it only allows a study of quality, and clinical effectiveness indicators.

CHAPTER V. FINDINGS

5.1 HOSPITAL INFORMATION SYSTEMS IN SELECTED COUNTRIES

There is a growing number of initiatives, led by Health Metrics Network (HMN) in improving the availability and use of timely and accurate health information at sub-national, national and global level, among low and middle income countries. There is also prevalent tendency to build national health information systems based on open sources, standards, national health information and data models enhanced by the standards developing organizations, such as Health Level 7 (HL7), Canadian Institute for Health Information (CIHI), Australian Institute of Health and Welfare (AIHW) in high income countries (Zhang et al 2007).

The national health information models developed by above mentioned institutes have influenced each other significantly and are meant provide conceptual framework for fundamental structural elements of health information. These would lead systematic development of a framework for the organization of health information and the design of new information systems.

The CIHI launched the Partnership for Health Informatics/Telematics in March 1996. The Partnership aims to enable the creation of a non-redundant, non-conflicting set of health informatics and telematics standards for Canada. It used the Health Level Seven (HL7) Reference Information Model (RIM) as the starting point for its data modelling efforts. The primary reason that the HL7 RIM was chosen as the starting model is that it had already been a de facto standard however the model developed by AIHW was later regarded as more compatible with how the Canadian Health System works than the HL7 RIM (CIHI 2001, p.A-1).

In Canada, all 14 jurisdictions including the federal government, released their reports on 67 comparable indicators in 2002, and on 70 indicators in 2006 (CIHI 2006). Out of these indicators, 13 are on "other programs and services", which represents more service-related performance indicators for more specialised hospital service. Also human resources indicators (2 items), diagnostic and medical equipment indicators (3 items) and catastrophic drug coverage and pharmaceutical management indicator (1 item) are identified to be relevant to hospital performance monitoring regardless of the healthcare level.

Indicators of other programs and services:

1. Wait times for cardiac bypass surgery
2. Wait times for hip replacement surgery
3. Wait times for knee replacement surgery
4. Self-reported wait times for surgery,
5. Self-reported wait times for specialist physician visits,
6. Re-admission rate for acute myocardial infarction (AMI)
7. Re-admission rate for pneumonia
8. 30-day in-hospital acute myocardial infarction (AMI) mortality rate
9. 30-day in-hospital stroke mortality rate
10. 365-day survival rate for acute myocardial infarction (AMI), (age-standardized)
11. 180-day survival rate for stroke,
12. Patient satisfaction with hospital care,
13. Patient perceived quality of hospital care,

The Australian National Health Information Model (NHIM) identified key areas of performance and other indicators as:

- National Health Priority Areas – an indicator framework spanning a broad spectrum of population health and clinical intervention activities
- National Public Health Partnership – a conceptual framework emphasizing interventions targeting determinants
- National Health Performance Framework – indicators of efficiency and effectiveness developed by the National Health Minister's Benchmarking Working Group

Accordingly, the National Health Minister's Benchmarking Working Group (1996) developed the Hospital Performance Indicators that are summarized as following:

Efficiency	Cost per case mix-adjusted separation
	Cost of treatment per outpatient
	Average length of stay for top twenty Australian National-Diagnosis Related Groups (AN-DRGs)
Productivity	User cost of capital (depreciation + opportunity cost) per casemix-adjusted separation
	Ratio of depreciated replacement value to total replacement value
	Total replacement value per casemix-adjusted separation
Quality	Rate of emergency patient readmission within 28 days of separation

	Rates of hospital-acquired infection
	Rate of unplanned return to theatre
	Patient satisfaction
	Proportion of beds accredited by Australian Council on Healthcare Standards (ACHS)
Access	Waiting times for elective surgery
	Accident and emergency waiting times
	Outpatient waiting times
	Variations in intervention rates
	Separations per 1,000 population

However, some indicators are yet to be determined such as indicators of hospital service outcomes, equity of access and physical access, it can serve as a reference set of indicators of hospital performance where healthcare financing with DRG is present.

In Malawi (Chaulagai, 2001), 65 indicators are used for national health monitoring (annex 6). 25 indicators are used for monitoring achievement of 15 performance objectives at tertiary level facilities. It is emphasized here, Ministry of Health and Population, Malawi had used comprehensive approach with the classification of indicators on six performance dimensions (access, equity, quality, effectiveness, efficiency, sustainability), four logical hierarchy of results (input, output, outcome, impact), four service management and delivery levels (community, facility, district, national) and four levels of goals/objectives intended to monitor or evaluate (MDG, MPRS, SWAP, EHP)

Tertiary care indicators monitor achievement of the following objectives:

1. to reduce mortality
2. to increase cure rates
3. to increase the number of specialists
4. to expand number of diagnostic services
5. to increase the types of services offered
6. to improve the use of hospital beds effectively and efficiently
7. to reduce waiting time for specialist clinics and operations
8. to provide practical training for trainee doctors, clinical officers, nurses and other cadres
9. to supervise and offer specialist services to district hospitals
10. to increase the budget from cost sharing gradually
11. to ensure rational use of resources
12. to conduct and coordinate research activities
13. to ensure availability of key drugs at all times
14. to increase users' satisfaction with the services
15. to increase providers' satisfaction with the services

The indicators are as follows:

1. Percentage of patients seen by specialists within 4 weeks of appointment
2. Percentage of operations performed within 7 days of admission
3. Cure rate
4. Reported new cases of confirmed HIV positive cases
5. Inpatient death rate from all causes
6. Direct obstetric death rate in the
15. Percentage of extended management meetings conducted bimonthly
16. Percentage of hospitals supervised in the 4 main areas of speciality
17. Percentage of availability of vehicle for patient-related activities
18. Percentage of students successfully completing practical training in the hospital
19. Percentage of research findings

facility
7. Bed occupancy rate
8. Bed turnover rate
9. Average length of stay
10. Percentage of income from cost sharing
11. Percentage of budget spent in programs
12. Percentage of cumulative drug expenditure to date
13. Availability key essential drugs
14. Availability key medical supplies
incorporated in hospital work plans
20. Percentage of specialists' positions filled
21. Percentage of doctors' positions filled
22. Percentage of nurses' positions filled
23. Percentage of clinical officers' positions filled
24. Percentage of technicians' positions filled
25. Percentage of account and admin personnel positions filled

Another set of indicators developed by WHO, is the Performance Assessment Tool for quality improvement in Hospitals (PATH). PATH indicators are grouped into two sets: A **core set** includes indicators that are relevant to most contexts and represent a low burden of data collection whereas a **tailored set** includes those which are relevant to fewer contexts, or, because of their higher burden of data collection, are suggested if congruent with the organization or country's priorities.

Core Indicators:

Clinical effectiveness & safety	C1 Caesarean section
	C2 Prophylactic antibiotic use
	C3 Mortality
	C4 Readmission
	C5 Day surgery for eight tracers
	C6 Admission after day surgery
	C7 Return to ICU
Efficiency	C8 Length of stay
	C9 Surgical theatre use
Staff orientation & safety	C10 Training expenditure
	C11 Absenteeism
	C12 Excessive working hours
	C13 Needle injuries
	C14 Staff smoking prevalence
Responsive governance	C15 Breastfeeding at discharge
	C16 Health care transitions
Patient centeredness	C17 Patient expectations

Tailored Indicators

Clinical effectiveness & safety	T1 Door to needle time
	T2 Computer tomography scan after stroke
	T3 Acute myocardial infarction patients discharged on aspirin
	T4 Mortality indicators (C3) with more advanced risk adjustment
	T5 Readmission indicators (C4) with more advanced risk adjustment
	T6 Pressure ulcers for stroke and fracture patients
	T7 Rate of hospital acquired infections
Efficiency	T8 Score on Appropriateness Evaluation Protocol

	T9 Costs antibiotics/patients
	T10 Length of stay indicators (C8) case mix adjusted
	T11 Cash flow / debt
	T12 Cost of corporate services / patient day
Staff orientation & safety	T13 % of wages paid on time
	T14 Survey on staff burnout
	T15 % job descriptions with risk assessment
	T16 Staff turnover
	T17 Work related injuries by type
Responsive governance	T18 Audit of discharge preparation
	T19 % discharge letters sent
	T20 Score on Appropriateness Evaluation Protocol for geriatric patients
	T21 Waiting time for day surgery tracers
	T22 Acute myocardial infarction and coronary heart failure with lifestyle counselling
Patient centeredness	T23 Patient survey score on access to care
	T24 Patient survey score on amenities of care

5.2 HIS IN MONGOLIA

5.2.1 Current development status

HSMP Monitoring and Evaluation Framework of Mongolia propose actions to be taken in improvement of monitoring and evaluation of health sector performance, and acknowledge main role of integrated HMIS, and use of indicators in this framework. It emphasizes its necessity to develop indicators at each level of the health system that are adapted from national set of core indicators to better reflect their local situation and to ensure their use at that level (MoH 2005b, p.19). However, it is also acknowledged that there are certain indicators missing to be developed and to be adopted.

H-info is appreciated to be an excellent example of standard system (MoH 2004, p.21) which has been developed since 1994 as a sub-project "ICT introduction to improve health status of rural population" of "Health Sector Development - II", an ADB supported program. It is designed to facilitate health organizations with EDP and reporting applications. It does not facilitate data collection but is designed to process data, collected by formal paper-based sheets. It is now used in all health service organizations for inputting data including that of children under 5, health status of the reproductive aged, morbidity, mortality rates or health indicators (www.icthealth.mn). However, the World Bank (2007) described the status of Mongolian health information systems supervision which is prior to introduction of integrated HMIS in HSMP, as "unsystematic or purely program-driven".

Immature or non-existent professional associations and MoH lost its leading roles to hospitals and ICT companies on hospital information system development. It is evident that policies and strategies have been developed after tertiary hospitals had introduced their HIS applications. MoH tries to catch up and re-formulate its policy on HMIS with technical assistance of HMN. HMN (2006) framework for the development of country health information system identified six levels of data collection ranging from household level to global/regional level. As for facility level, information needs include that of facility management, audits and planning. The quantity of data is assumed to be fairly much.

However, the framework provides guidance on development of national level health information system and on defining national set of core indicators.
In Mongolia, much has been done on EMR, reporting of health indicators or statistical data but defining sets of data that is needed for management, M&E and performance measurement has been unsatisfactory.

5.2.2 HIS adoption at tertiary hospitals

Nolan's growth model is adopted for determining stage of HIS development in Mongolia. Thus, it is used for prediction of how the HIS in Mongolia will evolve over time. Benchmarks were developed for examining both administrative activities and patient management on three dimensions: technological, functional, and integration dimensions.

Technological dimension	computers in place, network installations, users' computer literacy, software development;
Functional dimension	use of computer based HIS, degree of automation of reporting and data processing, use of data for decision making or using other sources of information in parallel;
Integration dimension	possibility of exchange and aggregation of data coming from different sources, uniform indicators which can be analysed, standardisation of information from different places, uniform system in the country or more systems;

From an overall assessment and personal observation (annex 7), it is found that:
Technological dimension – The use of computers in tertiary hospitals is still insufficient, though, significant efforts have recently been made to increase the number of computers, users' computer literacy, installation of servers and local area network (LAN). More than half of the computers in hospitals are Pentium II or earlier models and it is estimated that each computer is per 10-15 doctors and health workers in secondary or tertiary hospitals (MoH 2004, p.9). The computers in hospitals are interconnected through WAN and LAN, most of which have inadequate capacity. It is also common that hospitals have individual LANs in its separate buildings (workshop on LAN installation, 2007).
Functional dimension – Two, independently developed, computer-based HISs are currently used in five tertiary level hospitals. Both HISs were based on existing registry forms and mainly run in ambulatory or outpatient departments. For administrative activities, more financial information systems co-exist in tertiary hospitals. And single universal HR database of civil servants and respective updating system is being developed.
Integration dimension – Sets of indicators which require further improvements have been proposed. More comprehensive and specific indicators to services and level of healthcare are needed to enhance complete analysis based on indicators.

Many features of HIS in Mongolia are at its rapid development stage, experiencing proliferation of applications and parallel initiatives. Hospital investments in IT, computer based information systems are scaling up. But, information and technological standards and organizational control over computer based HIS applications have not yet been established fully. Hence, it is identified that Mongolian HIS development is in the "*expansion or contagion*" stage according to Nolan's growth model.

5.2.3 Objectives of tertiary hospitals and use of HIS

The objectives hierarchy framework (Casey et al, 2004. p.13) is applied to map objectives, indicators and corresponding datasets in Mongolian healthcare (see Table.) However, there are some overlaps in sets of indicators and it is hard to distinguish levels of objectives clearly.

Table 3: Sets of indicators corresponding to different levels of objective, in Mongolia

Level	**Objectives**	**Indicators**	**Respective data sets**
Strategic objectives	MDGs, MoH mission (MoH 2005a, p.9) "…*contribute to poverty alleviation and socio-economic development by ensuring the delivery of quality health care that is equitable, user friendly evidence based and sector-wide, to improve the health status of all the people of Mongolia through efficient targeting and management of resources, especially to the poor and to areas in greatest need*."	/Impact assessment indicators/ Human development index, Human Poverty Index, DALY, QALY, MDG targets, etc	Demographic data , life expectancy, literacy rate, GDP, number of population without sustainable access to an improved water source and children under weight for age etc
Tactical objectives	Objectives listed in Economic Growth Support and Poverty Reduction Strategies (EGSPRS) (MoH 2005a, p.15)	/Evaluation indicators/ Quality and accessibility indicators of Essential and Complementary Package of Services (ECPS) etc	Demographic data, number of infant mortality case, number of soum hospitals with ultrasound, etc.
Operational objectives	Objectives that are listed in Government Action Plan, objectives of Hospital Restructuring (Rationalization) Facility Standards, Targets and work plan of health organizations for the fiscal year	/Monitoring indicators/ Population per doctor, population per hospital bed, cost per hospital bed-day, etc.	Demographic data, number of doctors, hospital bed, etc.

As described in objectives hierarchy framework, objectives at facility level (in this case, tertiary hospital) include those of whole health system, some inter-sector goals, government action plan and facility or service standards. Its objective roots in "well being of the population in catchment area" in which healthcare is only one aspect. The more specialized healthcare is provided, the more specific objectives need to be set. Though, the objectives are broader in a sense in which it conveys way long traces of higher objectives. It denotes specialized hospitals not only focus on specific objectives, but also it contributes in "general" ones.

Objectives of HMIS (MoH 2005c. p.19) cover "…*to foster evidence-based decision-making by ensuring the transparency, availability and user friendliness of health information …to improve the quality and content of health data and information …*t*o enhance information technology infrastructure by automating data registration, collection, transfer, analysis and reporting at all levels of health sector"*

There was no literature found on objectives of either Mongolian tertiary level healthcare or HIS at tertiary hospitals.

5.2.4 Information needs

HSMP Monitoring and Evaluation Framework (MEF) working group identified (MoH 2005b, p.17) main areas that should be taken into account for using information in decision making:

- *performance of the health services*
- impact of policy on health and development

- improved resource utilization
- *rationalisation of the hospital capacity and its utilization*
- improved coordination of external resources
- sector wide management
- *improved quality*
- public private mix

Further it suggests areas of indicators that should be included in national core indicators set:

- Overall development of the health sector
- Increasing financial resources
- *Increasing access and utilisation*
- *Improving quality*
- Improving health outcomes
- Regulating the private sector
- Other country and culture and situation specific areas

The above highlighted areas are identified to be relevant to current objectives of the thesis. Though, existing data collection at tertiary hospitals does not often reflect these areas of information need thoroughly. The routine data collection sheet on clinical performance (annex 8) is cited from a registry book at hospital No.3. It provides data on use of hospital beds, mortality cases, average length of stay, cure rate, misdiagnosing or post-mortem operations, and service utilization of rural residents referred from *aimag* hospitals. It leaves out whole access issue such as waiting times and data on re-admission, return to ICU or surgical theatre, post-surgical complications, survival rates of certain disease cases after discharge which are also quality and clinical performance indicators and to be collected on routine basis.

5.2.5 Choice of indicators and the respective datasets

National health statistical abstract "Health indicators" is published on core health indicators which comprise of 122 (http://www.nchd.mn/index.php). Most of which are output indicators of health status of the population, few are input and performance indicators. There has been effort put on devising healthcare performance indicators as part of HSDP 2. It proposed core-set of performance and quality indicators for National core set (MoH, 2005b. p.43):

1. Average length of stay
2. Bed occupancy rate (%)
3. Bed turn-over rate
4. Referrals to aimag hospitals (%)
5. Referral from aimag hospitals (%)
    a. From FGP
    b. From soum health centre
6. Unit cost by service
7. Contraceptive use by women aged 15-44 (%)
8. Number of abortions per 1000 live births
9. Immunisation coverage in age group 0-1 (%)
10. Persons receiving health education (%)
11. Unplanned re-admission within 14 days of discharge (%)
12. Deliveries attended by qualified health workers (%)
13. Patient satisfaction

Another source of indicators that are used in Mongolian healthcare service is accreditation. It is much of external perspective of performance monitoring and provides data on how purchasers or government's interest is served. Accreditation criteria is devised specifically for

tertiary hospitals (MoH 2004b). Indicators of service quality standards along with Essential indicators of hospital service are as follows:

1. Percentage of morbidity
2. Fatal cases in 8-24 hours of admission
3. Post-surgical complications
4. Percentage of obligatory forensic operations /post-mortem examination/
5. Percentage of unreasonable mis-diagnosis
6. Percentage of results of Intensive Care
7. Treatment and nursing complications
8. Drug expenditure per bed per day
9. Food expenditure per bed per day
10. Specific quality indicators of civil service

The above are compared to national average, whereas the following are assessed case by case:

- Customer satisfaction survey
- Dispute cases with regard to hospital service
- Regularity of clinical and clinic-pathos-anatomical conference
- Approved hospital regulation for transfer of patients
- Presence of citizens' committee on outpatient treatment

CHAPTER VI. DISCUSSION

In chapter 5, findings from Mongolian HIS development, its indicators and corresponding datasets were described with stages of Nolan's growth model and objectives hierarchy framework, respectively. These will be used to guide further discussions of foreseen opportunities and challenges of the system, choice of indicators, and datasets.

Each of stages in Nolan's model has its own distinctive applications, rewards, and problems. Accordingly, each stage has to be managed in a way which is sensitive to the issues in that stage and with an eye for the issues which will arise in the next. It is identified that Mongolian HIS development is in its expansion or contagion stage, however, early signs of next stage "formalization or control" has become evident;

- Investment curves for IT, computer based HIS has started to flatten out in hospitals which adopted it earlier
- The workshops on standardization of EMR, LAN installation in healthcare organizations have been held in order to achieve agreements on uniform system, least requirements for technical features of new purchases, sample contracts with ICT companies
- Considerable political effort and leadership is required to implement unified HMIS, uniform HIS model, basic indicators and minimum datasets.

This paper emphasizes need of adopting essential datasets approach in current stage of HMIS development to manipulate the HIS situation in Mongolia. Accordingly, it suggests an example of devising datasets based on a set of quality indicators and which are to be used for routine monitoring of hospital performance. It starts with a discussion of quality of care, its dimensions and the interconnectedness with other aspects of hospital performance.

Arvedis Donabedian (1980 as cited in Knowles et al 1997) defines quality of care "*as that kind of care which is expected to maximize an inclusive measure of patient welfare, after one has taken account of the balance of expected gains and losses that attend the process of care*

in all its parts". Furthermore, Knowles et al discussed three dimensions of quality of care: process, structure and outcome. However, they have own strengths and purposes of measuring. As it is discussed in theoretical part of this study, outcome measures are more used for purposes of evaluation whereas structural measures for policy formulation. The current choice of indicators is of routine or facility/service based health information that is used for performance monitoring. Thus, it continues with process measures of quality care. Based on theoretical perspectives and the relevant findings, this paper recommends two sets of indicators and datasets which are core performance (quality and clinical effectiveness) indicators for general tertiary hospitals and tailored sets of indicators which are relevant to a limited number of contexts or of more specialized hospitals. Sets of quality and performance indicators proposed for national core indicators were chosen as a basis for further selection of quality and clinical performance indicators of tertiary hospitals. The selection is judged on criteria of usefulness and of feasibility of being collected through computer based system.

Core indicators

1. Cure rate
2. Unplanned re-admission within 30 days of discharge (%)
3. Patient satisfaction
4. Post-operative complications
5. C3 Mortality
6. Inpatient death rate within 8-24 hours of admission
7. Reported new cases of HIV
8. Pressure ulcers for stroke and fracture patients
9. Return to ICU
10. Rate of hospital acquired infections

Tailored indicators

1. Caesarean section
2. Case fatality rate of direct obstetric complications
3. Treatment of pneumonia cases (under 5)
4. Cervical cancer survival rate
5. Colorectal cancer survival rate **etc**

Brief rationale of the choice of the indicators

Cure rate

Cure rate is an important quality indicator except for the fact that it is not universally adoptable because of biological nature of some disease. It is justified because of low burden of data collection and legacy of paper based information systems in hospitals.

Unplanned re-admission within 30 days of discharge (%)

This is defined as percentage of unplanned readmissions. It is an important quality but is difficult to distinguish preventable readmission from readmission due to the natural progress of the history. Furthermore it is difficult to distinguish between readmissions in and from different hospitals. The indicator is proposed as re-admission within 14 days, by HSDP 2.
However, this paper argues 2 week period is not optimal, taking into account that geographically dispersed residents of rural Mongolia, waiting times etc. It is also suggested by PATH as its follow up period is 30 days.

Patient satisfaction

Patient satisfaction on perceived quality of the service is an important indicator in which feedbacks can be collected through any IT enabled means. It is mentioned that patient satisfaction surveys can be variant in purposes and in means of data collection – some focus on outcome indicators, some on real time process measures. This indicator is proposed by HSDP 2.

Post-operative complications
It is the percentage of the complicated cases after surgical operations. It reflects poor patient selection, pre-operative preparations and procedures of the operation. Surgical care is an important service provided by tertiary or specialized hospitals such as neurological, trauma.

Mortality
Strong rationale, death is an outcome that needs to be avoided. Literature demonstrates relationships between process measures and mortality for some conditions and thus this indicator can to some extent be useful to identify quality improvement actions. The indicator is one of accreditation criteria for Mongolian hospitals. Information is easily available.

Inpatient death rate within 8-24 hours of admission
As tertiary or specialized hospitals, they have functions of serving patients referred from secondary level care. The indicator is optimal not only for monitoring quality of service for those referred from lower healthcare level, but also for emergency care (trauma and orthopedic care).

Reported new cases of HIV
This indicator is for monitoring quality diagnostics and treatment at tertiary hospitals. Because of low prevalence of HIV, under-equipped laboratories in lower level hospitals in Mongolia, it is common that new cases of HIV are reported at tertiary hospitals.

Pressure ulcers for stroke and fracture patients
It is an optimal indicator of nursing care at tertiary hospitals. Preventable ulcers of stroke and fracture patients reflect inadequate nursing care. The indicator is proposed in sets of PATH indicators.

Return to ICU
The indicator is generally accepted and a widely used indicator of quality in ICU. It indicates technical quality in the ICU and appropriateness of discharge timing. Readmitted patients have a longer duration of ICU stay and a higher mortality rate than those who are not readmitted. The indicator is proposed in sets of PATH indicators.

Rate of hospital acquired infection
Optimal indicator of clinical procedure being performed in adherence with clinical guidelines and standards which has however some limits. It is also proposed in sets of PATH indicators.

Table 4: Descriptive sheets of the core indicators

Name of Indicator	**Numerator & Denominator**	**Data**		**Analysis**	
		Sources	**Resp. for collection**	**Resp. for data processing**	**Frequency of analysis**

Cure rate	Number of patients cured and discharged home	Personal history, inpatient care notes; Electronic data collection from medical records	Statistician of the hospital	Statistician of the hospital Quality manager	Monthly
	Total number of all discharges	Personal history, inpatient care notes; Electronic data collection from medical records	Statistician of the hospital		
Unplanned re-admission within 30 days of discharge (%)	Number of re-admission within 14 days of discharge	Registry books, Personal history; Electronic data collection from medical records	Statistician of the hospital	Statistician of the hospital Quality manager	Monthly
	Number of total admission during the period	Registry books, Personal history; Electronic data collection from medical records	Statistician of the hospital		
Post-operative complications	Number of post-operative complication cases	Registry books, Personal history; Electronic data collection from medical records	Statistician of the hospital	Statistician of the hospital Quality manager	Monthly
	Total number of operations during the period	Registry books, Personal history; Electronic data collection from medical records	Statistician of the hospital		
Inpatient death rate within 8-24 hours of admission	Number of inpatient death rate within 8-24 hours of admission	Registry books, Personal history; Electronic data collection from medical records	Statistician of the hospital	Statistician of the hospital Quality manager	Monthly
	Number of total admissions during the period	Registry books, Personal history; Electronic data collection from medical records	Statistician of the hospital		
Mortality	In hospital deaths	Registry books, Personal history; Electronic data collection from medical records	Statistician of the hospital	Statistician of the hospital Quality manager	Monthly
	Total number of patients admitted	Registry books, Personal history; Electronic data collection from medical records	Statistician of the hospital		
Patient satisfaction	Perceived quality	Patient survey (possibly web based surveys)	Statistician of the hospital	Statistician of the hospital Quality	Quarterly

	Assessed with scores		Statistician of the hospital	manager	
Pressure ulcers for stroke and fracture patients	Stroke and fracture patients with pressure ulcer	Registry books, Personal history; Electronic data collection from medical records	Statistician of the hospital	Statistician of the hospital Quality manager	Monthly
	Total number of patients with stroke and fracture	Registry books, Personal history; Electronic data collection from medical records	Statistician of the hospital		
Return to ICU	Number of patients returned to ICU < 48 hours	Registry books, Personal history; Electronic data collection from medical records	Statistician of the hospital	Statistician of the hospital Quality manager	Monthly
	All patients discharged from the intensive care unit.	Registry books, Personal history; Electronic data collection from medical records	Statistician of the hospital		
Reported new cases of HIV	Number of new HIV positive cases	Registry books, Personal history; Electronic data collection from medical records	Statistician of the hospital	Statistician of the hospital Quality manager	Monthly
	Total population in the catchment area	Registry books, Personal history; Electronic data collection from medical records	Statistician of the hospital		
Rate of hospital acquired infection	Number of cases of hospital acquired infection	Registry books, Personal history; Electronic data collection from medical records	Statistician of the hospital	Statistician of the hospital Quality manager	Monthly
	Number of patients admitted	Registry books, Personal history; Electronic data collection from medical records	Statistician of the hospital		

Tailored indicators are more specialization-specific indicators, and to be devised on case by case basis. It is, however, recommended to adopt indicators and the respective datasets from suggested sets of indicators by specialized health organizations so that the indicators can serve as for not only monitoring purposes but also for universal use nationwide as well as international comparisons.

CHAPTER VII. CONCLUSIONS AND RECOMMENDATIONS

This chapter concludes the research efforts by presenting the research contributions, further research areas, and recommendations. To begin with, I present the research concluding remarks.

7.1 CONCLUSIONS

This study responds to the need of health information systems reform, particularly in developing and transition countries by addressing problems in the hospital information systems, and presenting the role of indicators and datasets to transform existing information systems into management support systems. The study has fulfilled both problem identification of Mongolian HIS development in its current stage and possible solution of adopting the sets of hospital performance indicators proposed in this study, as for minimal datasets, through assessing the existing systems and reviewing the relevant literatures. However, system reform is a complex, time-consuming and continuous process, in which one should not expect radical changes within one study.
According to the findings discussed in this paper, it was revealed that the data collected by hospital information systems in Mongolia is not optimal enough to support performance monitoring and decision-making. Furthermore, not all hospital facilities and services are covered in performance monitoring domain.

Based on the analysis and discussion of the findings in the previous chapters, the following statements describe crucial factors that affect use of health management information at tertiary hospitals:

- There are several parallel HIS projects which are designed and implemented by tertiary hospitals, private ICT companies and international projects
- The computer based HIS's at tertiary hospitals are not complete yet, but under continuous restructuring according to needs of personnel and facility
- The current computer based HIS's enable routine data collection only from ambulatory or outpatient departments of the hospital, others have paper based data collection and transcribed into computers monthly for reporting
- The health workers perceive information effort as a burden to them because a dual system (paper and computer based) of data collection and reporting exists
- The national core indicators are devised to serve as basis for further development of specific indicators
- The current data collection focus more on health or clinical outcome indicators but less on performance indicators of health facilities
- The data processing and analysis is not adequate at facility level, thus use of information at hospitals, particularly for management purpose is unsatisfactory
- The quality performance indicators at Mongolian hospitals are out of date, less effort has been put on devising up to date indicators
- Indicators proposed by international initiative are not very compatible to Mongolian case, because of legacy information systems which are still existent coherently with computer based systems.

The study has shown that developmental stage of Mongolian HMIS, ongoing process of HIS reform and hospital rationalization offer an opportunity and/or challenge to regulate whole process efficiently and to harmonize national policy, standards with stakeholders' interest. In addition, the study has demonstrated that essential dataset approach could be a choice to handle current issues, and proposed a set of indicators and respective datasets that are adoptable in tertiary level hospitals.

This paper contributes in evidence based decision making by suggesting potential sets of indicators and datasets for performance monitoring and management support. It made a practical contribution with using objectives hierarchy framework in Mongolian HMIS and tries to distinguish operational objectives that are for tertiary hospitals.

Further research works can be done on comprehensive datasets which should be investigated in larger picture or in the complex social interaction perspective, starting from study of culture of computer based HIS, objectives set by local tertiary care providers, competing interests of MoH and/or the purchaser.

7.2 RECOMMENDATIONS

Based on the research findings and personal observation, the following recommendations and considerations were presented to adopt essential datasets approach at policy level, and to design essential datasets and indicators at facility level. Developmental stage shift from expansion or contagion to formalization or control enhance an opportunity to apply precise strategy to implement national integrated HMIS. However, there exist a dozen of tertiary hospitals which are at different stage of HIS adoption, and it also requires case specific action for encouraging them catch up.

Policy considerations

Road map or concrete action plan to implement HMIS strategy should be publicly available so that stakeholders (especially, the international donor organizations) harmonize their actions and would avoid parallel projects. However, the refined national core set of indicators, performance indicators specific to healthcare levels, essential datasets together with other standards still have major role in building common ground for HIS collaboration. It is highly recommended that working groups should be built on devising essential datasets.

Institutional considerations

Potential hindrance is foreseen in adopting uniform HIS in some tertiary level hospitals because of different ministry (such as Ministry of Defence) affiliation. On the other hand, management teams of the hospitals themselves have interest in adopting routine performance monitoring for internal use, which will help the whole reform process. Professional association or legal body, representing tertiary hospitals should be involved in regulation of HIS development and standardization procedures to ensure accountability and successful implementation. Such association or representing organization is expected to bridge the technical and professional knowledge gap between MoH, hospitals and ICT companies, so that more efficient collaboration will be achieved.

Organizational considerations

Organizational change, shift from Soviet legacy hospitals to rationalized hospitals which are managed by managers' team, should be taken into account implementing essential datasets approach. Core performance indicators and essential datasets are appreciated to be helping to monitor progress towards hospital rationalization, also for internal monitoring. Indicators and datasets should also reflect on new health services, IT related functions, units and facilities. Temporary indicators such as percentage of cases reported through computer based system can be adopted to "monitor the monitoring system".

Technical considerations

Routine performance monitoring through computer based HIS require sound computer network, users' computer literacy and willingness. Thus some more workshops, users training and additional budget on implementing management information systems are needed.

Furthermore, management information for decision making should be incorporated with population data in the catchment area as well as the results of prevalence studies for various diseases and conditions like diabetes, obesity and STI/AIDS.

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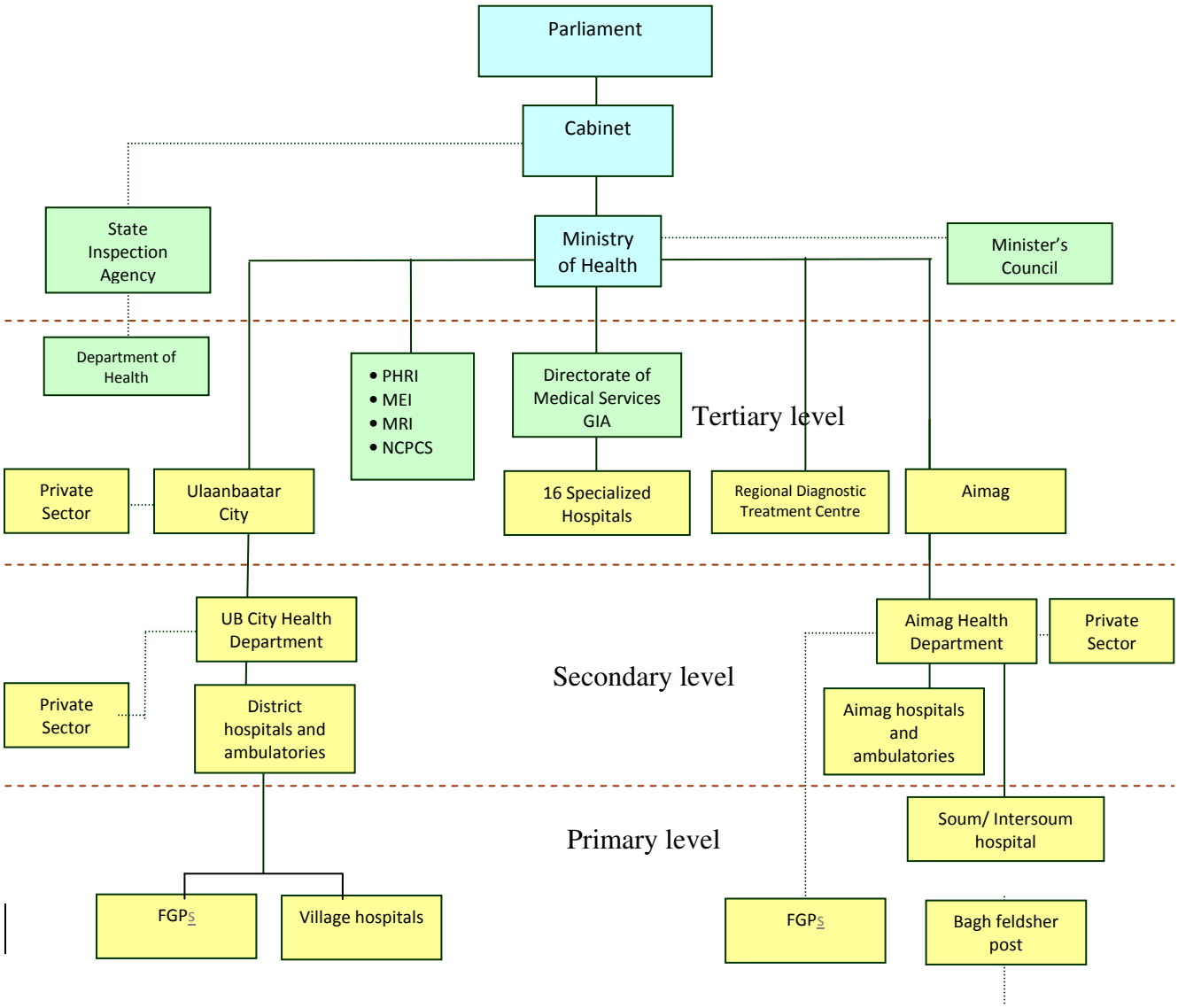
ANNEX 1: Organizational structure of Health sector, Mongolia



Source: MoH 2004c, p.41. Organizational structure of health sector, Mongolia, 2003.

ANNEX 2: Reporting forms

Minister's order No.203, dated on 19.Aug.2005.

1. Reporting sheet for family hospital
2. Reporting sheet for *soum* hospital
3. Reporting sheet for provincial and capital hospitals
4. Reporting sheet for private hospitals
5. Reporting sheet for visit notes, Communicable Disease Research Centre
6. Reporting sheet for visit notes, Centre for TB

7. Reporting sheet for visit notes, Cancer Research Centre
8. Reporting sheet for visit notes, Centre for STI/AIDS
9. Reporting sheet for visit notes, Centre for Psychiatry and Narcology
10. Reporting sheet for forensic hospital
11. Reporting sheet for pathos-anatomy
12. Reporting sheet for Blood Centre
13. Reporting sheet for Centre of Facia-oral health
14. Reporting sheet for training and marketing activities
15. Reporting sheet for health workforce
16. Monthly report of population mortality and morbidity
17. Monthly report of child nutrition
18. Reporting sheet for ambulatory morbidity of the population
19. Reporting sheet for inpatient morbidity of the population
20. Report of population mortality

ANNEX 3: Information systems used in Mongolian healthcare

	Name of the system	**Type of application**	**Status / Site**	**Developed by**	**Year of initiation / supported by**
1	H-info	EMR	In use / National	Gregcity Co.Ltd	1994 / MoH, ADB
2	E-hospital	HIS	In use / Hospital No.1, 3, Cancer Research Centre	Mon-IT Co.Ltd	2004 / Hospital No.3
3	Telemedicine	Distance diagnosing, treatment instructions	In use / Hospital No.3		2003 / Government of Luxembourg
4	Mediface	HIS	In use / Hospital.2, National Centre for Communicable Disease	Starsoft Co.Ltd	2004 / Starsoft Co.Ltd
5	Clinic DB	CIS	Failed / Hospital No.1		
6	Medland	HIS	Failed / 2nd hospital		2002 / WHO
7	Healthcare financial information system project	Financial IS	Failed[4] / 17 hospitals		2000 / TACIS
8	Powersoft	Financial IS	In use / Hospital No.3	Powersoft systems LLC	Powersoft systems LLC
9	Pyramid	Financial IS	In use / Hospital No.1, 2	Interactive Co.Ltd	2000 / Interactive Co.Ltd
10	Currently a project proposal	EPR	Proposed / Dornod RDTC	Proposed to use a Belgium company's software	2007 / Belgium Government

[4] Currently used only in Bayanzurkh district hospital

ANNEX 4: Main HIS applications at tertiary level hospitals:

H-info
It has been developed by Greg City Co.Ltd since 1994 with an aim of resolving difficulties in reporting health data. H-info was developed by the sub-project "ICT introduction to improve health status of rural population" of "Health Sector Development - II", an ADB supported program. It is designed to facilitate health organizations with EDP and reporting applications. It does not facilitate data collection but is designed to process data, collected by formal paper-based sheets. It is now used in all healthcare organizations for inputting health data of respective residents including children under 5, health status of the reproductive aged, morbidity, mortality and doctors' performance.

E-hospital
E-hospital is developed under the project E-hospital which was developed at Hospital No.3 by Mon-IT Co.Ltd since May, 2004. Currently, it is adopted in Hospital No.1, 3 National Cancer Research Centre. It is used in outpatient clinic or advisory polyclinic, laboratories, functional diagnostic units but not used in inpatient clinic.

Mediface
In 2004, Mediface 1.0 was developed by Starsoft Co.Ltd and the second version SmartMediFace 2.0 in which the smart card is integrated under technical cooperation with another national software company Smart Solutions.
General Clinical Hospital No.2 and National Center for Communicable Disease have recently introduced this software for their HIS establishment, for upgrading registry, control of the disease and its database. It uses commonly used standards such as International Classification of Disease, the hospital registry and reporting forms approved by MoH.

ANNEX 5: Other computer based applications at tertiary hospitals

Hospital No.1
Pyramid is a financial accounting application which is being adopted in a particular way in which it is integrated with statistical information and integrated database of the hospital. Advantages of this application are identified (Workshop on EMR, 2007) to be:

- designed in accordance to international accounting standards
- easy to use
- prevention from utilization error
- newer and better versions are developed frequently (Pyramid I-V)
- adopted and used in many organizations

However the only disadvantage is Hospital # 1, 2 in health sector use Pyramid. A clinical information system "Clinic DB" was used, along with Pyramid but replaced by E-hospital, piloted at Hospital #3 since Jan.2006.

Hospital No.2
Since Oct.2002, it started to cooperate with MoH on development of MedLand. MedLand consisted of MedLand-Admin, MedLand-EMR, MedLand-MedLand, MedLand-Statistics, MedLand-Lab. However, it has been replaced by MediFace since 2006. The hospital identified its problem as: current paper-based information system itself is not so sophisticated

that it can be interpreted into computer based system. Accordingly, what to order is unclear. Now, it uses MediFace, Pyramid and H-Info.

Hospital No.3
Third hospital or "Shastin" hospital is a 400-bed tertiary level healthcare service provider with 571 staff including 121 doctors. With 13681 inpatient admissions and 73434 ambulatory visits in 2006, third hospital is one of the three busiest medical centres in Mongolia making it an ideal site for data collection. It is also one of earliest health organizations which introduced information technologies such as HIS package and LAN. Currently, the hospital uses Powersoft for its financial activities such as payroll, financial reports besides E-hospital and H-info.

ANNEX 6: National indicators that are used in Malawi

1 Percentage of pregnant women starting antenatal care during the first trimester	34 Inpatient death rate of diarrhoea
2 Average number of antenatal visits	35 Inpatient death rate of pneumonia
3 Percentage of pregnant women received adequate TT doses	36 Inpatient death rate of malnutrition
4 Percentage of pregnant women received iron supplementation	37 Inpatient death rate of TB
5 Percentage of pregnant women received sulpha pyrimethamine (SP)	38 Direct obstetric death rate in the facility
6 Percentage of deliveries attended by trained health personnel	39 Inpatient death rate of all causes
7 Percentage of deliveries attended by trained traditional birth attendants (TBAs)	40 Availability of vital drugs
8 Percentage of women with obstetric complications treated in obstetric care facility	41 Availability of vaccines
9 Caesarean section rate	42 Availability of essential medical supplies
10 Percentage of women attending first postnatal care within 2 weeks of delivery	43 Availability of categories of foodstuff
11 Percentage of postnatal women who have received Vitamin A supplementation within 2 weeks of delivery	44 Percentage of the households with access to safe drinking water
12 Percentage of women of childbearing age (WCBA) using modern family planning methods (CPR)	45 Percentage of households with san plat latrines
13 Percentage of new family planning acceptors	46 Percentage of availability of vehicles for programme activities
14 Percentage of fully immunised children	47 Percentage of positions of doctors filled
15 Percentage of expected doses of vitamin A given to under 5 children	48 Percentage of positions of nurses filled
16 Percentage of under-weights in the under-fives attending clinic	49 Percentage of positions of clinical officers filled
17 OPD utilisation rate	50 Percentage of positions of medical assistants filled
18 Reported new cases of acute flaccid paralysis (AFP)	51 Percentage of positions of health assistants filled
	52 Percentage of positions of health surveillance assistants (HSAs) filled
	53 Percentage of other recurrent transactions (ORT) budget received
	54 Percentage of budget spent in each subprogramme
	55 Percentage of income from cost sharing

19 Reported new cases of leprosy 20 Reported new cases of neonatal tetanus 21 Reported new cases of measles in under 5 population 22 Reported new cases of sexually transmitted infections (STI) 23 Reported new cases of HIV 24 Volunteer counselling and confidential testing (VCCT) for HIV 25 Reported new cases of clinical malaria 26 Reported new cases of diarrhoea in under 5 population 27 Reported new cases of pneumonia in under 5 population 28 TB cases detection rate 29 TB cure rate 30 Bed occupancy rate 31 Bed turnover rate 32 Average length of stay 33 Inpatient death rate of malaria	56 Percentage of drug and medical supplies expenditure spent at health centres 57 Percentage of cumulative drug expenditure to date 58 Percentage of health centres with functioning communication equipment 59 Percentage of health centres with functioning water supply 60 Percentage of health facilities with functioning medical waste disposal facilities 61 Percentage of active village health committees 62 Percentage of management meetings conducted 63 Percentage of health facilities supervised by Management Team 64 Percentage of completeness of reporting 65 Percentage of timeliness of reporting

ANNEX 7: Researcher's observation of HIS at Hospital No.3

In hospital No.3, "core indicators of hospital performance" is used to monitor selected indicators for all 12 departments, but these are of clinical performance alone. It has been reported monthly since three decades back, however its usefulness is not examined at all. The current report on core indicators is reported in a way in which relevant data collected by registry forms is put in Excel spreadsheet by departments. The whole process is perceived to be duplication of work effort by making it both by hand and electronically. Because the e-hospital is not used in inpatient clinic, they use formal personal history sheets for taking notes of daily checkups. When the patients are discharged, these sheets containing personal information, initial & clinical diagnosis, and the list of drugs & treatments received, are then delivered to statistics unit for data processing as described above.

The data on outpatient clinic or ambulatory service utilization is retrieved from E-hospital. It registers patients at the front-desk, inputting personal information including national ID, health insurance number into the system and here are due fees paid. H-info is used in statistics unit for reporting these data both from inpatient and outpatient departments.

This "dual" system in hospital No.3 is because there is overwhelming tendency among policy-makers to shift current healthcare financing into that of Diagnostic Related Groups (DRG) in which all the registry and reporting sheets shall be re-formalized. IT engineer at hospital No.3 said

> "*…the dataset, E-hospital collects & reports, is founded on formal registry and reporting sheets which approved by Minister's order No.203 in 2005… The new healthcare financing will bring about new regulations, formal sheets, datasets to be reported and so on… That is why the development of datasets, expansion of e-hospital into inpatient services have been suspended…*"

The financial unit uses "Power-soft", a complete financial software package. It consists of subsystems of drug supply/expenditure, salary, real estate, cashier and debit/credit account. Not like statistics unit, financial unit only reports cash inflow/outflow monthly and regular balance statement quarterly and yearly. It does not retrieve expenditures by programmes; by curative/preventive activities; or by certain drug. It is linked to patient information system in ambulatory and gathers financial data (services covered by insurance, user fee).

Organizational change and EDP investment

Computer based HIS applications made distinctive changes in the organization of service; Compared to prior system in which all the technical functions such as registry, liaison with insurance, forwarding respective lab testing was part of duties of doctors and nurses, the new posts, units and subsystems such as registration officer, IT unit, e-pharmacy system have been introduced. Patients, who come to ambulatory to visit a doctor, can now make an appointment by calling or coming and getting registered in person with registration desk. From there, he/she is directed to respective doctor and the personal information including name, national ID number, and health insurance number is sent to the doctor's PC at the same time. The doctor, then, enters check up results, lab test order and refers him/her to inpatient department if necessary. All these data entered at different stages are pooled into database.

In the inpatient departments, daily checkups, treatment and drugs administered are noted on formal sheets. When the patient is discharged, these sheets are sent to statistics unit of the hospital and the necessary data are extracted by filling registry forms manually. The H-info is designed to report the data collected by these registry forms and it does send the data to National Centre for Health Development (NCHD) and MoH. All the formal sheets are archived.

E-hospital, the project developed and administered by the hospital was initially budgeted to be 115 million tugrik[5]. All the doctors and nurses work on local network which connects 150 workstations. For four years of implementation, the investment instalments were about 7 million in 2004, 13 million in 2005, 18 million in 2006 and 4 million in first half of 2007[6]. Furthermore, it is reported that,

> *…The number of cashiers for patient services was reduced dramatically. Now the service fees are paid at registration section. The financial applications brought about better internal control, by enabling inter-connection between financial subsystems and the transactions are registered as service-based…*
>
> /in-depth interview, Hospital staff/

Department of IT has been organized which consists of head of the department, coordinator, software & hardware engineers, and 8 registration officers as total of 15 persons.

[5] Mongolian national currency; 1USD equals 1166 tugrik

[6] Estimated amounts, actual amounts were denied to be reported.

ANNEX 8: Performance indicators that are used in hospital No.3

No. of beds: Department No.

		Jan	Feb	Mar	Qrt 1	Qrt 2	…	Year	First 9 months
Bed day	Planned								
	Actual								
	Percentage								
At the beginning of reporting term									
Admission	Total								
	From rural area								
Discharge	Total								
	From rural area								
Mortality	Total								
	Aged between 0-15								
	Within 24 hrs of admission								
Mortality /case of patients admitted from rural area/	Total								
	Aged between 0-15								
	Within 24 hrs of admission								
By end of the reporting term									
Bed days of patients from rural area									
INDICATORS	Average bed day								
	Bed turnover								
	Percentage of mortality cases								
	Cure rate								
	Bed occupancy rate								
	Bed turnover rate								
	Misdiagnosing								
	Percentage								
	Proven diagnosis								
	Percentage								
	Number of cases undergone post-mortem operations								
	Percentage								
	Number of cases NOT undergone post-mortem operations								
	Percentage								