

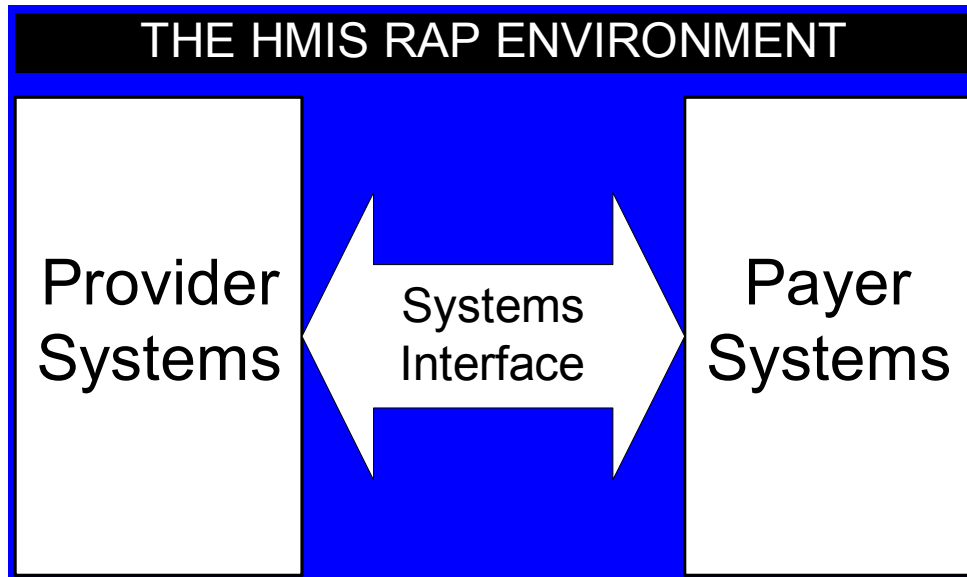
Health Management Information Systems for Resource Allocation and Purchasing in Developing Countries

Dennis J. Streveler and Sheila M. Sherlock

September 2004



**HEALTH MANAGEMENT INFORMATION SYSTEMS FOR RESOURCE
ALLOCATION AND PURCHASING IN DEVELOPING COUNTRIES**



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Health, Nutrition and Population (HNP) Discussion Paper

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Health Management Information Systems for Resource Allocation and Purchasing In Developing Countries

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Paper prepared for the World Bank's Resource Allocation and Purchasing Project

Abstract: The paper begins with the premise that it is not possible to implement an efficient, modern RAP strategy today without the effective use of information technology. The paper then leads the architect through the functionality of the systems components and environment needed to support RAP, pausing to justify them at each step. The paper can be used as a long-term guide through the systems development process as it is not necessary (and likely not possible) to implement all functions at once. The paper's intended audience is those members of a planning and strategy body, working in conjunction with technical experts, who are charged with designing and implementing a RAP strategy in a developing country.

Keywords: resource allocation and purchasing, resource management, health care financing, health management information systems, information systems design.

Disclaimer: The findings, interpretations and conclusions expressed in the paper are entirely those of the authors, and do not represent the views of the World Bank, its Executive Directors, or the countries they represent.

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FOREWORD

Great progress has been made in recent years in securing better access and financial protection against the cost of illness through collective financing of health care. This publication – *Health Management Information Systems for Resource Allocation and Purchasing in Developing Countries* by Dennis Streveler and Sheila Sherlock – is part of a series of Discussions Papers that reviews ways to make public spending on health care more efficient and equitable in developing countries through strategic purchasing and contracting services from non-governmental providers.

Promoting health and confronting disease challenges require action across a range of activities in the health system. This includes improvements in the policymaking and stewardship role of governments, better access to human resources, drugs, medical equipment, and consumables, and a greater engagement of both public and private providers of services.

Managing scarce resources and health care effectively and efficiently is an important part of this story. Experience has shown that, without strategic policies and focused spending mechanisms, the poor and other ordinary people are likely to get left out. The use of purchasing as a tool to enhance public sector performance is well documented in other sectors of the economy. Extension of this experience to the health sector is more recent and lessons learned are now being successfully applied to developing countries.

The shift from hiring staff in the public sector and producing services “in house” from non-governmental providers has been at the center of a lively debate on collective financing of health care during recent years. Its underlying premise is that it is necessary to separate the functions of financing health services from the production process of service delivery to improve public sector accountability and performance.

In this Discussion Paper, Streveler and Sherlock emphasizes the important role that information technology plays during implementation of reforms that involve resource allocation and purchasing of health services. Computers are becoming cheaper, ubiquitous and more easily managed. No country, not even the poorest, can escape this important reality of today’s health care delivery systems. But information technology is not only computers. Telecommunications is also needed. And staff must be trained to operate these new systems. The guide provides an overview of critical issues and approaches related to information technology in resource allocation and purchasing, with special application to the constraints found in countries with lower income levels. Appendix I & II provides an easy tutorial for beginners. More in depth reading for experts is suggested in the bibliography.

Alexander S. Preker

Lead Economist
Editor of the HNP Publication Series

PREFACE

Welcome to this monograph! The purpose of this document is to specifically address the selection of Health Information Management Systems (HMIS) when implementing Resource Allocation and Planning (RAP) processes in nations with developing economies (NDEs). Its intended audience is the motivated technology managers of the world, who are being asked to look for effective ways to implement ever more complex RAP strategies in their home countries, while being given limited budgets to do so.

Though it is recommended that one take the time to read through the entire document once carefully, those having general knowledge of HMIS may wish to use the Table of Contents to reference specific areas of interest.

WHAT IS “RAP”?

The governments of the world are increasingly unable to shoulder alone the burden of ever-rising healthcare costs. RAP (Resource Allocation and Planning) is a way to allow market forces to work by fostering competitive negotiations between the purchasers of services (called “payers” in this document) and the providers of services (called “providers” in this document). RAP is characterized by a strong separation of duties, responsibilities and accountabilities between “payer” and “purchaser” functions and responsibilities.

The choice of Health Management Information System (HMIS) to implement RAP is therefore crucial – it must be “cooperative” (i.e. collaborative through shared information and platforms) and “linked”, yet still operate at “arms length” in order to preserve this crucial separation of responsibilities.

THE PURPOSE OF THIS MONOGRAPH

HMIS play a crucial part in organizing and streamlining RAP processes, especially as they are introduced in lower-income countries. Given the ever-decreasing price of computer technology, there is an opportunity to employ technology in ways previously only possible in higher-income countries and settings. This document is a chronicle of past and present HMIS implementations as they reflect the selection of systems.

Current healthcare systems suffer high costs, fragmentation, decentralized delivery of care, inconsistent or missing longitudinal health records, poor quality control, reporting lapses and gaps in access. Barriers to quality healthcare are economic, chronological, geographic, sociological and psychological in scope. The rapid deployment of HMIS initiatives into nations of developing economies (NDE) healthcare systems will allow for better healthcare at the point and time of need.

The vision of an improved healthcare delivery system in the world includes the provision of greater access by all to a standardized, high quality healthcare funded in the most cost-efficient manner. The benefits to the society include increased access to care, diagnostic accuracy, and productivity. Additional benefits include the ability to promote and measure patient health status, provide earlier interventions, provide community-based continuity of care and improved health education.

The challenge in HMIS is to implement regulations, policies and procedures aimed at standardizing systems. The days of “one-of-a-kind” custom-built systems must end, for they are far too costly and risky to build, too hard to maintain and almost impossible to integrate into larger systems as the need arises. Imperative issues that HMIS must address are licensure, confidentiality, standards and enforcement and payment for services rendered. With the proper policies and procedures, a nation will reap great benefits from HMIS; without substantive control the healthcare systems will writhe in a worsening economic crises.

For over 30 years, there have been research efforts in and applications of telecommunications and information technologies to healthcare. The goal of these technologies has been to improve care and access while reducing costs. Thus, HMIS was born as a combination of innovative and mainstream technologies applied to health services. HMIS may be defined as “the use of electronic information and communications technologies to provide and facilitate healthcare and health related services.”¹

The implementation of HMIS enables and necessitates the re-engineering of processes: the evaluation and possible restructuring of the manner of delivery of clinical, business, financial, diagnostic and educational services. The strategic power of information technologies lies in their ability to revolutionize the way that work is performed with subsequent quantitative and qualitative benefits.²

The urgent need for patient-care-centered information technology is precipitated by rising medical costs, increasing populations, changing patient demographics, the “epidemiological transition”³ and an emphasis on managed care and humanitarian aspirations in improving healthcare world-wide. HMIS offer the ability to replace aging health-related information systems (manual or somewhat automated), while concurrently efficiently accommodating re-engineered health provision and health financing systems. With the application of the business disciplines of functional economic analysis and Return-on-Investment (ROI) calculation; lifecycle costs and payback periods for technology insertion can be determined. However, “soft” benefits (i.e. socio-economic increases and long range population health improvements) are difficult, if not impossible, to definitively quantify beforehand, and nearly as formidable to assign causality and delineate confounding factors in post hoc analysis.

There is increased interest in RAP processes in many countries of the world. Yet, each country has been left to “reinvent the wheel” in describing how HMIS can be employed. No “best practices,” no “how to” manual has (yet) emerged. This project endeavors to make a small step in that direction by sharing some state-of-the-art knowledge and best practices, and to provide developing nations with a standard somewhat “cookbook” approach, which can then be modified as individual circumstances, resources and priorities dictate. Differing social, political, cultural, historical and economic situations will result in different approaches, but this monograph attempts to propose a general framework applicable for most situations.

This monograph ventures to describe aspects of the world’s experience in this area, in a manner meaningful to nations who desire to reproduce the development of best practice systems and to build upon lessons already learned. There are practical, political and professional impediments to attaining quality health service delivery; HMIS offers the potential to improve the situation. The difficulty is often in the proper implementation in disparate conditions and knowing where to start.

THE CONTEXT AND SCOPE OF THIS MONOGRAPH

It is envisioned that this monograph will eventually be one of a series of three that will address the larger context of RAP. The three are:

1. A Prototypical Information Flow to Ideally Implement RAP in NDE Nations
2. Notes on Selection of Information Systems (HMIS) to Implement RAP in (NDE) Nations [*this monograph*]
3. A Survey and Critique of Experience to-date in Implementing Information Systems (HMIS) to Support RAP Functionality in NDE Nations

CHALLENGES WE FACED

It is impossible to cover all material in an effort of this kind. Thus, we must humbly admit our failures and shortcomings in producing this document:

1. This document is necessarily influenced heavily by our own individual experiences designing RAP systems in a variety of countries around the world. It is possible that some excellent examples were missed.
2. The pace of technology continues to quicken, lending “instant obsolescence” to certain of our concepts. It is hoped that this document can be updated from time to time to mitigate this shortcoming.
3. Given that this monograph is envisioned as the second of a three-part series, certain materials, which should properly be contained in the others, are repeated here.

Respectfully submitted,

Dennis J. Streveler, Ph.D.

Sheila M. Sherlock, M.S.

ACKNOWLEDGEMENTS

The authors are grateful to The World Bank for initiating this activity and to the Government of Canada for helping sponsor it.

DEFINITIONS AND ACRONYM LIST

Access to healthcare A measure of the proportion of a population with admittance to appropriate health services. Access may be divided into financial, geographic, and cultural categories. Financial accessibility measures the extent to which people are able to pay for care, usually measured through a community-based willingness and ability to pay survey. Geographical accessibility is a measure of the extent to which services are available and accessible to the population; linked to the healthcare infrastructure and services available. Geographical accessibility also relates to means of transportation and local topography. Cultural accessibility relates to whether access to health services is impeded by cultural traditions and includes gender, religion and ethnic issues. SOURCE: WHO, 2000, as found at <http://www.who.dk/observatory/Glossary/>.

Best Practice An examination of the methods by which optimal outcomes are achieved. Best practice and benchmarking are organizational concepts deployed in the industrial sector and increasingly related to management and administration. A process-oriented concept, it is used to achieve improvements in quality, effectiveness, cost-effectiveness, and productive output within individual agencies or settings over time. SOURCE: USAID, 1999, European Commission, 1999, as found at <http://www.who.dk/observatory/Glossary/>.

Eligibility Checking The ability of the HMIS to verify an individuals coverage; as simple as verifying coverage or as complex as noting amount of coverage, type of insurance, covered services, co-payments, deductibles (totals and remaining balances), etc.

Evidence-based policy A mechanism with which performance measurement and the improvement cycle are monitored periodically and compared across time.

Health Data Clearinghouse Shared information within systems abiding by security and confidentiality issues, which provide maximum benefit to all stakeholders.

Health equity Ensuring that the same quality of health is provided to all, regardless of economic, social, cultural, geographical or other differences; reducing gaps in health outcomes.

Health outcomes (Improved) clinical decisions based upon the best current practice, avoiding both under- and over-utilization of services.

HMIS Health Management Information Systems is using modern computerization, telecommunications and systems techniques to improve health care processes.

Key (performance) objectives Improving health outcomes and responsiveness, economic efficiency, and health equity across social, cultural and economic barriers.

National Health Data Dictionary Defines what information is to be contained in health-related database, how the information will be used, and how the items in the database relate to each other.

National Health Data Model Defines how your nations health data formats fit together to create a healthcare system.

National Health Standards See section “Types of Data Standards” page 10.

Payers Those entities which collect, contract for, and pay for health services from “providers”.

Performance The extent to which the health system is meeting a set of key objectives.

Providers Those individuals and entities involved in the provision of health services. This includes physicians, certain nursing services, and possibly other components such as pharmacies, laboratories, etc.

RAP (Resource Allocation and Purchasing) RAP is a way to allow market forces to work by fostering competitive negotiations between payers and providers.

Service Level Agreements Are fundamental to both providers and payers. They define the terms of engagement and rules that govern the relationship.

Sickness fund: Third-party payer in social health insurance system, covering the community as a whole or sections of the population. Sickness funds are usually quasi-public bodies. Synonyms are “sick funds” and “health insurance funds”. The OECD categorizes sickness funds into “social security funds” if they are imposed or controlled by government units (OECD, 2000b). SOURCE: European Observatory on Health Care Systems, 2001.

ULI See Unit Level Information.

Unit level information Basic information (regarding the healthcare encounter) such as services provided, diagnosis, care provided, etc. Unit level patient information includes name, address, age, past medical history, medications being taken, allergies, etc.

INTRODUCTION

BACKGROUND AND BACKDROP

More and more nations with developing economies (NDEs) are being required to exert greater managerial control over healthcare resource allocation and purchasing (RAP) arrangements between payers and providers. This is accomplished through the combination of improved management capacity, improved budgetary controls (through the introduction of National Health Accounts and other vehicles) and through the installation, utilization and optimization of health management information systems (HMIS).

Income inequity is one of the main drivers of health status in nations,^{4 5} and literacy patterns have been shown to parallel health status.⁶ **Health insurance**, or other forms of national or regional risk-pooling, has emerged as a major means of providing more equitable wealth distribution. Conversely, “Nations or regions that are able to achieve increased prosperity and reasonable equity in the distribution of income have populations that live longer and appear to show small socio-economic gradients in terms of their health status as measured by hard end-points such as death.”⁷

Resource Allocation and Purchasing (RAP) arrangements are being introduced because “while advances in health during the past few decades have been impressive...the share of the world’s population protected against the catastrophic cost of illness has increased significantly during the 20th Century, with global spending on health increasing from 3 percent to 8 percent of global GDP (US\$2.8 trillion) or 4 percent of the GDP of developing countries (US\$250 billion) during this time-period. These achievements in good health against the cost of illness are partly the result of improvements in broader determinants such as economic growth and education, with accompanying improvements in nutrition, access to contraceptives, hygiene, housing, water supplies and sanitation.”⁸ “Poverty is being sick and not being able to see a doctor.”⁹ Generally, there is a wide spread sense of budgetary constraints; however these are not necessarily applied to healthcare expenditures. Between 1985 and 1995, for most developed nations as well as NDEs, health care costs increased far faster than did national wealth.

As has been frequently described,¹⁰ improvements in health are also the result of a better understanding of the causes, prevention, and treatment of diseases, and efforts to improve the performance¹¹ of the organizations and institutions that are used to purchase and deliver care. International experience indicates that the underlying causes of the health problems of the world’s 1.3 billion poor are well known, and that effective and affordable drugs, surgeries and other interventions are available. But, because of weakness in the core functions of health systems and non-strategic resource allocation and purchasing (RAP) arrangements, potentially effective policies and programs often fail to reach needy populations in many low- and middle-income countries.

Today, the core functions of health systems include financing, resource (input) generation, service delivery and stewardship oversight. The financing function includes the collection and pooling of revenues, and the use of these revenues through RAP arrangements with service providers.¹² The resource generation function includes the production, import, export, distribution and retail sale of human resources, knowledge, pharmaceuticals, medical equipment, other consumables and capital. The service delivery function consists of both population-base and personal clinical services provided by the public and private sectors, governments through their stewardship function and the population through political processes. Demand and markets influence these core functions. The stewardship oversight function involves management and monitoring in order to ensure operationalization meets strategic objectives. Stewardship oversight is influenced by demands and markets.

The combined effect of these three functions leads to either good or poor performance in health outcomes, financial protection, and responsiveness to consumer expectations. Given the complex interplay between these factors, the success of reforms in RAP arrangements will be highly dependent upon parallel reforms and changes in other parts of the health system.”¹³

A HEALTH SYSTEM’S CORE FUNCTIONS	
FINANCING	<ul style="list-style-type: none"> Collection of revenues Pooling of revenues and risk Use of revenues <ul style="list-style-type: none"> RAP arrangements with service providers
RESOURCE (INPUT) GENERATION	<ul style="list-style-type: none"> Production of resources (1) Import of resources Export of resources Distribution of resources Retail of resources
SERVICE DELIVERY	<ul style="list-style-type: none"> Population-based services <ul style="list-style-type: none"> Public sector services Private sector services Government (stewardship) services Population dictated services (political processes) Personal clinical services <ul style="list-style-type: none"> Public sector services Private sector services Government (stewardship) services Population dictated services (political processes)
STEWARDSHIP OVERSIGHT	<ul style="list-style-type: none"> Influenced by demands and markets
<p>(1) Resources is defined as human, knowledge, pharmaceuticals, medical equipment, consumables, capital, etc.</p>	

The RAP concept involves the following Core Policy, Organizational and Institutional considerations¹⁴ that must be addressed during development of any HMIS RAP:

Core Policy Considerations:

- Demand (for whom to buy healthcare services?)
- Supply (what healthcare to buy, in which form, and what services to exclude?)
- Prices and incentive regime (at what price and how to pay?)

Core Organizational Considerations:

- Organizational forms (what is the economy of scale and scope, and contractual relationships within the healthcare system, “as-is” and “to-be”?)¹⁵)
- Incentive regime (what is the degree of decision rights, market exposure, financial responsibility, accountability, and coverage of social functions in healthcare, “as-is” and “to-be”?)

- Linkages (what is the degree of vertical and horizontal fragmentation or integration in the healthcare system, “as-is” and “to-be”?)

Core Institutional Considerations:

- Stewardship (who controls strategic and operational decisions?)
- Governance (what are the ownership arrangements?)
- Insurance markets (rules on revenue collection, pooling, and transfer of funds?)
- Factor and product markets (from whom, at what price to buy and how much to buy?)”¹⁶

It is highly recommended that the user of this manual document the “as-is” and “to-be” states for the core considerations listed above in order to be able to chart one’s progress and identify one’s successes.

Finally, we stress that HMIS must always be looked at in context of the bigger picture: The aim of a properly implemented HMIS should be to provide healthcare that is¹⁷:

- Safe – avoiding injuries to patients from the care that is intended to help them.
- Effective – providing services based on scientific knowledge to all who could benefit and refraining from providing services to those not likely to benefit (avoiding underuse and overuse, respectively)
- Patient-centered – providing care that is respectful of and responsive to individual patient preferences, needs and values and ensuring that patient values guide all clinical decisions.
- Timely – reducing waits and sometimes harmful delays for both those who receive and those who give care,
- Efficient – avoiding waste, including waste of equipment, supplies, ideas and energy.
- Equitable – providing care that does not vary in quality because of the personal characteristics such as gender, ethnicity, geographic location, and socio-economic status.”¹⁸

Health services should be evaluated based upon how well they succeed in producing “equitably distributed health outcomes, protecting citizens against impoverishing health expenditures, and helping the poor build self-reliance and break out of social exclusion.”¹⁹ Health services are characterized by a variety of market failures: externalities associated with disease, asymmetric information between professional providers and patients, and the failure of insurance markets.

WHY IS HMIS IMPORTANT FOR RAP?

A principal goal of HMIS is to optimize the health of individual patients and of the population as a whole in an equitable, efficient and effective manner that is acceptable to patients, providers and administrators. There are no information technology “magic bullets”²⁰ – Information Systems (IS) will not single-handedly achieve overarching reforms of service delivery or finance; rather, improvement from the implementation of the HMIS results in incremental changes at all levels of health system. This evolutionary re-iterative change process²¹ is contingent upon systematic measurement of health system performance, in conjunction with evidentiary decision-making processes. Broad measures of population health are confounded by unmanageable factors within the healthcare system, and composite indices of system-specific performance, which are by nature imprecise. To drive change within the system, one must develop accurate and reliable micro- and macro-level data systems. To avoid information overload, performance indicators should be aligned with expensive, complex, and/or high-priority services, especially those unevenly delivered. Performance indicators can also be implemented to measure simple and inexpensive services, if so desired.

Determining the needs and views of all health system users – patients, providers, administrators and policy-makers – is essential to the development of effective HMIS. The establishment of continuous, audience-specific reporting systems is imperative. Additionally, informed consumer choice is not completely effective in driving change at the procedure- or provider-specific level, but may be effective at a macro-level in an environment of competing health plans. Supply-side drivers of change include regulatory frameworks and the alignment of funding with performance. Reforms are ultimately dependent on collaborative action by professionals and administrators aimed at identifying and implementing best practices. With a well-implemented HMIS, the use of health system performance information will ensure that health services reflect the best policies and practices, in addition to community contexts and values.²²

Implementing standards involves changes in infrastructure, social morays, and socio-technical interaction. The struggle is to balance tradeoffs between changes in clinical outcomes and implementing globalized standards of care. To achieve any specific standard of care, there is an associated cost. Accomplishing the correct level of healthcare improvement within your budget and maximizing the healthcare improvement per dollar expended is your goal. One of the most significant issues for healthcare managers when making decisions is the cost of care, including project funds that support care. In order to correctly explore efficient modalities, including HMIS, to improve care, it is vital to understand and anticipate the cost of care consequences. The strategic power of information systems lies in their ability to transform the way that work is performed. HMIS and the Internet are potentially vital enablers in making a qualitative shift in the ability to deliver better care at a reduced cost.²³

The purpose of designing a national HMIS is to provide access to information so that nations can monitor and evaluate health services programs, collect baseline information on health status of the populations served, and then, over time, analyze health outcome trends of their population. This then provides the nation with information about the population and subsets within the population, so as to be able to make changes to program initiatives and to evaluate program change effects.

Perhaps the greatest challenge in designing a health indicator system is the heterogeneity of healthcare stakeholders who include patients, providers, payers and payees.²⁴ Different entities collect and require different information,²⁵ tracking is disparate, and security/confidentiality concerns add complexity to the process. The selection of health indicators, identification of potential data sources and gaps in those sources (which vary widely) dictate to some extent recommendations for hardware and software.

A good health system improves (1) the attainable average level of health (goodness) and (2) the inequities within the system, among and between groups and or individuals (fairness).²⁶ HMIS are “desirable to raise the average level (of health), to reduce the inequality, or both.”²⁷

GOALS OF A PROPERLY IMPLEMENTED HMIS:

- Improved availability of appropriate information for decision-making
- Improved accessibility for all people
- Improved accessibility for all people
- Improved productivity of all health workers
- Improved cost-efficiency
- Improved utilization of health care resources
- Improved quality of care!

Said another way:

1. Patient Management
2. Population Management
3. Disease State Management

GOALS OF A PROPERLY IMPLEMENTED HMIS:

4. Financial Management
5. Resource Management
6. Utilization Management
7. Quality Management

HMIS have the potential to increase or decrease inequality in healthcare provision. It is essential for the Information Technology (IT) professional to realize that IT will not necessarily improve the average level of care. HMIS must be implemented with a proper understanding of the healthcare system and individual payer and provider needs in order to realize potential benefits. While it may be costly to implement HMIS (the capital investment costs and running costs are not small), these costs may well be warranted where they are integrated into better managerial and medical practice; however this is by no means assured.

Initial HMIS benefits are vast for developing countries. Weisbrod²⁸ argues that technology increases healthcare costs, however his studies focus on OECD countries and on extremely advanced interventions. His findings support the contention that the higher costs are offset by better outcomes. Additionally, market level analyses of the value of technology within healthcare are rare. Within the OECD countries, “technology has been included in the risks covered by insurers,... the marginal cost to the patient has been low... Thus, the concern over technology in the present institutional context arises from a) the fact that institutional incentives to make such evaluations are weak, and b) the lack of agreement as to the criteria and methodology to be used in judging whether new technology provides significant benefit to warrant the expenditure.”²⁹ [For more discussion about the overall benefits of HMIS, please see Appendix I.]

RAP needs HMIS to be implemented in the most efficient manner. Modern RAP templates and costing models are far too complex to be done manually in any but the most limited of environments. The main advantage of computing technologies is their ability to systematize the processes of RAP, and to provide transparency of calculations and report generation. Information technology allows all stakeholders to see how resources are purchased and allocated.

This necessarily means that there will need to be computerization in both the (larger) provider-side environments (see Chapter 2) and the payer-side environment(s) (see Chapter 3). In addition, an interface between these two environments (see Chapter 4) is required so that information can pass between the two.

IMPLEMENTING PROVIDER SYSTEMS TO SUPPORT RAP

Provider systems exist in a variety of clinical venues, including hospitals, clinics, polyclinics,³⁰ and general practitioner offices. The priorities of provider systems are to increase operational efficiency within the clinical venue³¹ (in order to reduce costs) and to interface with payer systems. Inter-operability between provider and payer systems is mandatory -- provider systems must “talk to” payer systems.

CURRENT “OLD” PROVIDER SYSTEMS

Ideally, within any healthcare system, all individuals should be afforded: (1) Access: uninterrupted and unhindered access to medically necessary services, (2) Quality: basic quality standards with appropriate monitoring, and (3) Safety: assured levels of services and confidentiality.

To ensure access a healthcare delivery system should provide uninterrupted and unhindered access to medically necessary services. Medical services must be made available to all without regard to age, ethnicity, gender, existing health status, pre-existing conditions, or economic situation. Good systems

include preventive health services and a continuous care system that ensures provision of appropriate care without interruption. Care should be provided in a timely, efficient manner and include ready access to emergency services. Information about services should be readily available to consumers in a form that they can understand. Facilities and services should be available in reasonable proximity to consumers. Additional functionalities such as portability outside the country, referral to specialists, medical tests and rehabilitative services can be made available as needed. A good health delivery system should not include barriers to accessing services such as unduly burdensome or time-delayed pre-authorization requirements, unreasonable restrictions on second opinions, or lengthy appeals processes.

Any healthcare delivery system should, at a minimum, meet basic quality standards, as defined by the host country. Quality of care, consumer satisfaction and cost savings, together, should define the success of a healthcare delivery system. Care should be provided by qualified providers and meet the basic standards of care. Qualified, independent professionals should create mechanisms for regular monitoring of appropriateness and quality of care. Consumer satisfaction with care received is an important determinant in monitoring quality. Health promotion and disease prevention should be an integral part of every care plan. Pressures to control costs should never compromise or adversely affect quality of or appropriateness of care.

A proper healthcare delivery system contains adequate consumer safeguards and protections. Medically necessary care should not be denied solely on the basis of cost. Other factors, such as health status, prognosis, and medical directives should be taken into consideration in making decisions. Care organizations and providers should be subject to independent reviews on a periodic basis, with performance information available to consumers. The healthcare delivery system should ensure complete confidentiality of medical records, requiring consumer consent for disclosure of personal information.

Unfortunately, most of today's Provider Systems are self-contained, stand-alone systems, limited to the venue itself. Where they exist in NDEs, most existing systems have outlived their usefulness and appropriateness. Designed 20 – 30 years ago, when priorities in healthcare focused on much simpler concepts –perhaps collecting some simple statistics for retrospective analysis, they are remnants of a simpler era. In the area of financing and resourcing, they offer few applications – perhaps simple billing, simple accounting and very little more. In all areas, more data visibility, authentication and planning is required.

Several modern trends in the enhanced requirements of these systems are noteworthy:

- Budget control with increasing emphasis on outcomes and performance
- Strengthened capacity for financial management, reporting and accountability
- Quest for new private sources and shared funding
- Greater scope for local financial control and management.

A superior provider system will offer all of these functionalities, while most NDE HMIS-RAP systems will not include these functionalities, they should be considered as potential future additions when designing any HMIS.

THE ULI (UNIT LEVEL INFORMATION) OF PROVIDER SYSTEMS

Provider systems can, and should, afford both business and clinical functionality. Provider business functions include eligibility checking, claims creation and submission, payment processing, contract monitoring and business unit level management information. Additional provider business solutions potentially are central budgetary control, improved financial management and the creation of specific management tools to manage the specific clinical venue in which the system is implemented.

Just as the principal objective of a health system is to improve people's health, the chief objective of the information system is to aid in the delivery of healthcare services by improving both its clinical and operational efficiency.

This monograph discusses the overall functions of a modern provider system, placing particular emphasis on the needs of RAP. In that regard, the first, and perhaps the most important element of a provider system, is standard "unit level" information (ULI) for each and every service provided. Standardization is necessary to enable communication across platforms. Information should be consistently coded and it is imperative that appropriate information be captured. Information capture has an associated cost, as does information not captured.

A concept related to ULI is the Electronic Patient Record (EPR). While a full EPR is out of the question in most developing countries, understanding the very long term implications of an EPR are important. A full discussion of the concept of EPRs is found in section "Implementing Provider Systems to Support RAP, Functionality of Provider Systems" specifically under "Virtual Lifelong Electronic Patient Records (EPR)", page 15. ULI is key when implementing HMIS and should include at a minimum:

For each inpatient stay, the ULI is accumulated in a "stay abstract" (sometimes also referred to variously as a "discharge abstract" or "discharge summary"). Here services performed are enumerated (at some level of roll-up) along with admitting and discharge diagnoses, procedures and stay information (i.e. length of stay, admitting department, department of stay, etc.).

For each outpatient (hospital or clinic) visit, an "encounter record" (or, simply, an "encounter") is the ULI. An individual encounter enumerates the event of a particular patient visiting a particular provider on a particular day. The outpatient ULI should include procedure codes as well as diagnosis codes (see section "Types of Data Standards" on page 10).

TYPES OF PROVIDERS

Providers may be classified according to their clinical function (providers operating in primary health clinics, polyclinics,³² work-based clinics, school-based clinics, hospitals, etc.) Providers may also include certain institutions (the hospital, the community pharmacy, a reference laboratory, etc.) that have contracts with the payer. Alternately, providers may be classified by their for-profit/non-profit market orientation and/or by their manner of ownership (i.e. individual/group, mission/charitable organizations, employer-provided clinics, etc.) Categories of non-profit organizations include religious mission hospitals, health centers, clinics and dispensaries, family planning clinics, community health facilities, community pharmacies and other Non-governmental organizations (NGO) healthcare facilities. For-profit providers include individual and group run clinics and hospitals, privately owned nursing homes, employer provided clinics and pharmacies, and individual pharmacies/chemists, clinic laboratories, stores, shops and traditional practitioners. Among for-profit systems we may make a distinction between those offering modern and traditional treatments.³³

"Sometimes these (healthcare) services are in the public sector and sometimes they are in the private sector. For example, in Zambia, the copper mining and other industries which own and operate their own health facilities are mostly government owned, although their health services often operate independently of the government; ...in Kenya, such employer-based services are most often in the private sector."³⁴

The requirements of HMIS for each of these provider types will be somewhat different depending upon the specific implementation scenario, but not substantially so. These requirements will also vary somewhat depending on the size of the clinical venue. Perhaps the most significant determinant of the

requirements will be the complexity of the contract that a provider has entered into with a payer. Some contracts will require that very detailed information be transmitted to the payer, where in other situations (e.g. global capitation) only very highly summarized information will need to be passed between the two “sides”. However, whether information provided is procedural (clinical), diagnostic or “fee-for” similar functionalities are required (see next section).

FUNCTIONALITY OF PROVIDER SYSTEMS

Without being overly concerned about these variations, this chapter looks at the common functionality required by Provider systems to support RAP.

Eligibility Checking

Eligibility Checking is the ability of the HMIS to verify an individual patient’s benefits and coverage. It can be as simple as verifying (“yes” or “no”) coverage or as complex as noting the amount of coverage, type of insurance, the specific benefits offered, covered services, co-payments, deductibles (totals and remaining balances), additional forms of insurance (coverage), etc.

With the introduction of HMIS, eligibility checking becomes simplified for the provider. Adequate HMIS provide access to information such as coverage and types of insurance, in order to provide appropriate care and/or referrals. Adequate eligibility checking HMIS also allow a provider to foresee and resolve issues with coverage before services are rendered. Costs related to non-covered services and individuals, many of which go unrecovered, can be avoided. Thus, eligibility checking not only yields savings for the providers, but to the health system as a whole.

Obviously, the provider desires to be assured of reimbursement. Eligibility checks may be done through an identification card with or without further eligibility checking. In addition to eligibility, HMIS can provide information regarding co-payment levels, remaining deductibles, types of coverage and services provided, and additional information (such as primary care physicians and whether a referral is needed or not).

There are several ways by which eligibility checking can be done:

1. The first, and most obvious, is through a direct online transaction between the provider system and the payer system. This requires good communication lines, and is by far the most expensive way to implement eligibility checking. It, however, is the “best” (in that it provides the most accurate, up-to-date coverage information). In this scenario, any change in coverage is immediately known.
2. Another way is for the payer to provide periodic lists of eligible patients and their coverage. This can then be loaded into the provider system and referenced by the provider system’s applications.
3. A third way is for the system to “assume” the patient is covered up to a threshold amount, (based on the presentation of an ID card) after which a phone call (or fax?) is required to the payer to provide assurance of further benefits. This is the cheapest to implement, but obviously also the most limited in its functionality. It may however not be the cheapest to operate since the costs of the manual intervention can be high.

In most situations, we recommend option # 2 above. It is the most cost-effective way in most situations, although among the higher-volume providers, option #1 may be feasible and warranted. Option #3 can be used if the other two options prove to be impractical.

Each of these options requires some form of patient identification. In a HMIS implementation at Lyndon B. Johnson Tropical Medical Center (LBJ TMC) in American Samoa,³⁵ employing improved and forced registration, the number of non-residents registering in the system has increased from 1.6 percent to 26 percent. LBJ TMC's current tariff structure is \$5 for residents and \$10 for non-residents. With 167,000 visits in 2002 that means that the improved charge capture could add over \$200,000 to revenue this year.³⁶ The ability to prevent "identity fraud" and to later implement differential charges as opposed to a flat rate provides opportunities to improve charge capture and increase revenue. By eliminating the widespread practice of using other people's hospital ID cards, the LBJ TMC HMIS improved the accuracy of hospital records. Previously, the medical records of a non-resident posing as a resident would be mixed up with those of the resident, posing a safety risk – incorrect medications might be prescribed. Improved record keeping is a major benefit of the system frequently cited by LBJ TMC. Prior to HMIS implementation, records were "loose-leaf" and medications were often missing from the patient chart.

Claims/Encounter Creation and Submission

Within a healthcare system, every "discharge" and "encounter" (visit between patient and healthcare provider) should be documented. This documentation varies in scope and depth and serves various purposes. It also can replace many/most/all of the registries frequently found in manual systems for vertical programs (family planning, disease-specific registries, etc).

Encounter documentation provides an ongoing, but brief proxy for the patient's medical history. It may also serve the purpose of documenting the healthcare provider's work/time record and thus be a proxy for provider productivity as well. The documentation provided for claims submission may be a subset of the clinical patient record created as a result of the encounter.

A "claim form" may be used to pass all (or part) of the "encounter information" to the payer. This "claim form" then becomes a demand for payment (in the case of fee-for-service models) or a record of utilization (in the case of pre-paid or capitation arrangements).

Using HMIS technologies claims encounters creation can be automated. Potentially, the healthcare provider can create an electronic encounter record during (or immediately after) the patient visit. Whether prospective or retrospective, once the encounter information is in the HMIS, it may be submitted electronically or printed and submitted manually to the healthcare payer. It is best if the claims encounter flows directly from the provision of the healthcare delivery, and if the encounter information is "fed back" to the provider(s) who supplied the care. By having the provider be an integral part of the workflow, the highest possible accuracy of information can be obtained.

Any automation within the claims and encounter creation and submission process streamlines provider systems. In manual, outdated systems, the steps for claims and encounter data input and submission may be many-fold. Or worse, it may be divorced completely from the healthcare delivery process, with forms being created separately. This promotes transposition errors and other inaccuracies. The encounter information should, ideally, flow directly from the provision of services. For example, when the patient is admitted, the same patient admission record in the hospital serves as the source of "date of admission", "admitting diagnosis", etc. If one creates such information later, many types of errors and inaccuracies can be (will be!) introduced.

ULI is mandatory for any viable insurance scheme, and efficient and accurate claims encounter creation and submission becomes tantamount. The information must be (1) standardized to the requirements of the payer, (2) submitted in a timely fashion and (3) the system must provide visibility and accountability throughout the payment process. This process may be completely automated (electronic filing) or, in lower volume situations, may take on a quasi-automated format.

Types of Data Standards

Obviously, when one discusses data exchange, there are many layers of standards that must be accounted for. Broadly, for HMIS, there are technical, medical, administrative and policy standards. When implementing RAP, there exists the need to develop standards or to adopt international (or another defined national) standards. The choice is normally dictated by the needs of the system and, to some extent, politics. They may be de facto standards³⁷ for various communities, or officially recognized national or international standards. There are, especially when considered on the global level, many different (competing) standards; this, of course, results in confusion, fragmentation, obsolescence and duplication of efforts.

Technical Standards

There is a plethora of technical architecture standards, protocol³⁸ standards and other mechanisms necessary for exchanging information, internetworking, portability³⁹ and reusability. From the technical standpoint, the main bodies concerned in one way or another with computing standards are the IAB,⁴⁰ ISO,⁴¹ ANSI,⁴² ECMA,⁴³ IEEE,⁴⁴ OSF,⁴⁵ and W3C.⁴⁶

Electronic Data Interchange (EDI) is the computer-to-computer exchange of data in standard formats. In EDI, information is organized according to a specified format set by both parties, allowing a hands-off computer transaction that requires no human intervention or reformatting of information on either end. All information contained in an EDI transaction set is, for the most part, the same as on a conventionally printed document.⁴⁷ EDI offers enhanced efficiency and increased profits through.⁴⁸

- Reduced cycle time
- Better inventory management
- Increased productivity
- Reduced costs
- Improved accuracy
- Improved business relationships
- Enhanced customer service
- Increased sales
- Minimized paper use and storage
- Increased cash flow

EDI standards are developed and maintained by the Accredited Standards Committee (ASC) X12. Today, more than 300,000 organizations use the 300+ EDI transaction sets to conduct business.⁴⁹

XML, or eXtensible Markup Language, is a new, high-powered Web language developed for e-business. Unlike HTML that displays text and images now found on Web pages, XML enables the exchange of structured data over the Web.^{50 51} ASC X12 is working diligently to enhance communications around the world by collaborating on the Electronic Business XML (ebXML) initiative—a worldwide effort to develop a common framework for XML business messages.

Health Level 7 (HL7)⁵² is an information exchange protocol used mainly in medicine. This formatting and protocol standard, developed by <http://www.hl7.org> It is newer than DICOM. DICOM (From Digital Imaging and COMMunications in Medicine) was a standard developed by ACR-NEMA (American College of Radiology - National Electrical Manufacturer's Association) for communications between medical imaging devices. It conforms to the ISO reference model for network communications and incorporates object-oriented design concepts.

Additionally, there are specific standards for medical equipment (ISO standards, engineering (IEEE) standards, etc.). Because such equipment may interface with systems, this should be peripherally considered when developing HMIS.

Medical standards (“External Quality Assessment”)

The Canada Medical Act (R.S.C. 1952, c. 27) establishes the five principles of public health insurance: universality, accessibility, portability, comprehensiveness and public administration. It addresses healthcare performance indicators of timeliness, quality, sustainability, health status and wellness. Within quality indicators, the Canada Medical Act refers to the measurement of quality of health care services across the country, including patient safety, patient satisfaction and health outcomes.

In the United States, the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) establishes medical standards.⁵³ JCAHO standards represent national (US) consensus on quality patient care that reflects changing health care practices and health care delivery trends. “JCAHO's standards address the organization's level of performance in key functional areas, such as patient rights, patient treatment, and infection control, and the standards focus not simply on an organization's ability to provide safe, high quality care, but on its actual performance as well. Standards set forth performance expectations for activities that affect the safety and quality of patient care. If an organization does the right things and does them well, there is a strong likelihood that its patients will experience good outcomes. JCAHO develops its standards in consultation with health care experts, providers, measurement experts, purchasers and consumers.”⁵⁴

Administrative Standards

When implementing HMIS, there is information to be exchanged between systems that is more “administrative” in focus. Mainly, this information relates to diagnoses and procedures. Major diagnostic categories (MDC) {such as Disease classification systems (such as Diagnosis Related Group (DRG)⁵⁵-type systems and International Classification of Diseases (ICD))⁵⁶ for inpatients, Ambulatory Payment Classifications (APC) for outpatients} codify the appropriate disease classification code and translate it into a suitable service, procedure, treatment, equipment and/or billing code(s) (Current Procedural Terminology (CPT)⁵⁷ or other code). There are internationally defined standards, however, as discussed previously, there is more than one classification schema from which to choose.

Policy Standards

Healthcare policy, such as national considerations which relate to the amount of privacy and confidentiality a patient has as it relates with public health considerations,⁵⁸ has been enacted into laws in most developed nations. In the United States, this legislation is known as the United States Health Insurance Portability and Accountability Act of 1996 (HIPAA). HIPAA can serve as a potential guideline for countries wishing to provide Electronic Data interchange (EDI) with regards to delivery and payment of healthcare services and the security and confidentiality of individually identifiable, protected health information. HIPAA is intended to provide 1) improved portability and continuity of coverage and 2) administrative simplification (reducing the costs and inefficiencies through standardization and EDI). However, as a caveat, the intent of the law has yet to be realized within the U.S. and potential imitators should beware. What are measurable are objective results, not legislative intent never enacted. Alternatively, there do exist standards in such countries as Canada,⁵⁹ Australia⁶⁰ and New Zealand, which may serve as the basis of developing a standard for your country

Appointment Scheduling

Automatic appointment servicing alone saves money and streamlines the system. Appointing improves patient convenience, eliminates peaks and valleys from the workload of physicians, and also provides also the early entry point for information to be entered into the ULI. Automatic appointment scheduling can reduce “front-office” costs by reducing manual processes and streamlining scheduling, thus enhancing

profitability. In addition, by streamlining and regulating the workflow, automatic appointment scheduling can enhance provider satisfaction by decreasing work overloads and minimizing workload turbulence.

There are many ways and systems used to appoint including “wave scheduling”, “bulk scheduling” (sometimes called “grouping”) and modified versions of these systems. The algorithms for these appointing regimens can be easily located. A sophisticated patient scheduling system accounts for average appointment times for various visit categories, such as new patients, established patients, follow-ups, emergent visits, referrals and consults. The many benefits of automated appointment-scheduling systems include the ability to view several days and weeks at a time using specific screening criteria and the ability to “block” and designate certain appointment types and times. These features often increase the scheduling staff’s accuracy and efficiency.

Payment Processing

Claims processing results in the receipt of payments (hopefully in an accurate and timely manner!) for either individual services (in a fee-for-service scheme) or a standard capitation amount. Even in the latter case though there are potentially many other payments which can be received including social welfare payments to assist patients who could not pay their co-payment or deductible, payments for excluded services, and the like.

In fee-for-service situations, claims are generated for services performed using a combination of procedure and diagnosis codes. Procedure codes allow payment for specific services rendered, such as a physician encounter, laboratory (i.e. x-ray or blood test) examination or other diagnostic tool. Diagnosis codes allow for charges to be accrued based upon patient illness (severity, etc.). One potential pitfall with diagnosis code billing is that there may be several related or non-related illnesses. Which one (or ones) are coded and thus billed for? Additionally, the physician may not establish a diagnosis until after examination results are reviewed, after several patient visits, etc.

In capitation-based systems, claims are generated based upon a per encounter basis, not necessarily including all diagnosis and procedure codes. While billing is simpler, many of the nuances of proper payment are lost. Likewise, using this stream of input later to retrospectively analyze the health status of the population may be difficult.

Regardless of the nature of the insurance contract, posting payments is an important role of provider systems. Electronic Claim Processing (ECP) can save money by reducing man-hours required of manual entry methods, reducing reject rates, and increasing cash flows (through reduced account receivables and decreased days-in-receivable). ECP can save time for providers, patients, and payers. Fewer resubmissions and quicker processing time will reduce the number of Claims in Suspension (a.k.a. provider Accounts Receivable).

In addition, ECP will decrease billing errors and under-allowances. A study, done for the Texas Orthopedic Association (TOA) by Medical Present Value (MPV), reports an overall under-allowance rate of about 5% percent of annual revenue. This figure may be substantially higher or lower within specific systems. An excellent example of an EPC is Department of Veterans Affairs (DVA’s) Consolidated Co-Payment Processing Center Lockbox (CPCL). This EPC system is “a secure way to automate medical payment processing. Using a Web browser interface, the VA can manage all billings and payments for medical services, make deposits, access online databases, and produce up-to-date reports. Because of increased efficiencies and reduced man-hours, the Lockbox system is expected to save the VA over \$11 million dollars during its first year in operation.”⁶¹

The DVA’s EPC system contains many features, which should be included in basic HMIS provider systems, including:

- “Automated posting of payments to patient accounts
- “Centralized payment collection
- “Automated deposit processing
- “Point-and-click navigation and easy-to-use graphical interface
- “Dynamic report generation

“These functions will establish benefits through:

- “Increased Efficiency (and) eliminated labor-intensive accounts-receivable tasks.
- “Lower costs (and) reduced maintenance costs.
- “Improved ease-of-use which means reduced training for customers and employees.
- “Reduced storage costs associated with maintaining static reports.
- “High volume capabilities...{(having) processed over 4.5 million payments for the Veterans Health Administration in fiscal year 2000.}
- “Extremely low error rates. (In October 1999, DVA error rates were .006%.)”⁶²

This example shows what can be accomplished. Likely, systems implemented in NDEs will not require this degree of complexity, at least in early years of the RAP schemes. But planning now to have a TWO-WAY interchange between provider and payer is highly recommended.

Contract Monitoring

The functions in the information system to perform contract monitoring can be easy, or very complex. -- The more complex the contract itself, the more difficult the monitoring process becomes.

Let’s face it, providers and payers don’t always trust each other. They are generally on “different sides of the table” in contract negotiation. It is also true that, like any free market, providers want to obtain the MOST for their services, and payers wish to pay the LEAST possible. This is normal and natural. (It is the same in a bazaar in Istanbul if one is attempting to buy a fine Turkish carpet!)

We have emphasized several times in this monologue the need for transparency in the contract negotiation process. If either side feels that it is at a disadvantage in the negotiation, the environment will be filled with stress and difficulties. It is imperative that each side is able to monitor how the agreed-upon contract is performing. The provider must know that the contract is fair, and that it is being applied consistently. The payer must be assured that information submitted will be correct, and that there are mechanisms to prevent over- and double-billing.

The provider needs some way to determine whether the current contract terms are favorable, and if there are reasons to attempt to renegotiate part (or all) of the contract at the time of its next re-negotiation. This is important. International experience from Europe to the Pacific indicates that a provider who has poor cost and overhead information in a new insurance environment can easily become financially unstable, or even fail financially, through lack of knowledge about the “performance” of its major contracts.

It is of mutual benefit (to both provider and payer) for the provider to remain financially viable and want to “participate” in the insurance scheme. Without providers participating in the healthcare system, the system does not work. The idea of health insurance is to purchase at the lowest possible price, but not to endanger the providers who are providing cost-effective care.

At the time of the next contract re-negotiation, it may be necessary to strike new deals (changing contract content), revise the contract (making additions or exclusions), adjust maximum risk levels (if financial risk contracts are involved), and change various other facets of the arrangement.

Business-unit Level Management Information

HMIS must support management of resources at the *business-unit level*. Operational managers should view the provider system as helping them to better perform the required management duties, and as an aid in managerial decision-making. An example of how business-unit level information aids in better managerial decisions would be the refiguring of budgets (provided for by a proper Chart of Accounts).

Tracking compensation and payments and consolidating claims to a centralized HMIS increases the accuracy of the data, and saves time and money that would otherwise be spent on manually gathering, tracking, and analyzing this information.

Central Budgetary Control (and Inventory Management)

The importance of sophisticated inventory control tools to track supplies, pharmaceuticals and Durable Medical Equipment (DME) cannot be overemphasized – They are key! Minimal functionalities that any adequate HMIS should provide in the area of central budgetary control are:⁶³

- Tracking the issuance of costly supply items -- from the Directorate of Materials Management (DMM) to the specific patients who received them.
- Tracking the specific provider who ordered an item – allowing the profiling of provider ordering patterns and to flag potential overuse/misuse. This provides some degree of quality control, and allows for the monitoring of compliance with guidelines and protocols for item use.
- Supporting a highly competitive tendering process, in which the purchase of supplies, pharmaceuticals and Durable Medical Equipment (DME) is accomplished at the most competitive prices. (The frequent issuance of mini-Requests for Proposals (RFPs) will help to stimulate a competitive bidding process.)
- Supporting accountability of items as they move through multi-level “stores”,⁶⁴ the central store (DMM), multi-stores at the medical complex, stores at the business-unit level and caches within a ward.⁶⁵

Clinical Functionality

The degree to which the provider’s HMIS will support clinical functions will depend, to a great extent, on the complexity and sophistication of the venue. Generally it is a good idea to implement BOTH financial and clinical functions together, and not wait many years before beginning to think about the clinical functions themselves.

So where to begin? Perhaps the first clinical functions to be automated will provide a way to place “orders” (also called “requisitions” in some parts of the world) for diagnostic services (laboratory, radiology) or for therapeutics (prescription systems, therapies, requests for surgical theater time etc.) Besides placing “orders”, it may be possible to automate the return of some “results” as well, particularly those from the clinical laboratory.

Another area that has significant potential is automating patient referrals (also called “patient transfers”). This process is generally poorly performed in most countries of the world. It is often a huge concern to the MOH and the Minister himself. Providing some way to initiate referrals, and to track them, is an important first step.

Advanced HMIS Functionality

Provider systems can become very sophisticated indeed. The developed countries have spent decades working on them, but even today much needs still to be accomplished. Here is a discussion of some of the future applications that are being contemplated, or at early stages of development. Few are probably appropriate for NDEs at this moment, but it useful to plan for them in the coming years:

Virtual Longitudinal Lifelong Electronic Patient Records [EPR]

This encompasses virtual health records, where no heavy paper files exist and all data is digitized and readily accessible. Generally, these provide a broader snapshot of total health than the physician currently has, due to patient relocation over a lifetime. With customizable queries and rollup screens, the information can be presented in easily accessible, common sense categorical packets for retrieval as necessary. Pertinent information such as medical allergies could alert as needed. These are still a “dream” in the entire world, but will be realized one day.

However some progress is being made in creating a “Health Passport”. The “Health Passport”⁶⁶ is a simplified concept that contains some practical subsets of the EPR possibly including:

- Patient demographics
- Significant allergies
- Health problems
- Current medications
- Recent encounters
- Hospitalizations
- Significant operative and special procedures

The “Health Passport” (sometimes using an optically encoded card, magnetically encoded card, or a “Smart Card”⁶⁷) does involve issues of security, patient confidentiality and security laws and regulations. Proper use involves legislating appropriate safeguards and penalties regarding inappropriate, inadvertent, miscreant, and criminal use of patient data. When treating a patient, the clinicians should be able to easily retrieve relevant information such as health problems, medications, and recent encounters in order to provide appropriate care to the patient. Health Passports make this possible. Clinical Practice Guidelines can then suggest to the clinician appropriate treatments.

Health Passports provide the physician with more complete, accurate and up-to-date information, allowing for the provision of greater continuity of care. Additionally, providers have access to comprehensive patient medical information, regardless of the availability of traditional paper charts, on-line telecommunications links, or scheduled appointments. Medical providers and support staff have immediate access to patient records and potentially the ability to update patient information during the encounter.

Support for Clinical Practice Guidelines

Clinical practice guidelines could be established throughout the medical care system. These technical protocols and procedures could be distributed freely via the web, and help to standardize treatment worldwide. Physicians could access these guidelines during treatment of a patient or for reference. They will provide ways to measure outcomes, reduce variance in practice, and create a way to provide “report cards” to providers.

Telemedicine and Teleconsultation

Telemedicine is “distance medicine”. It comes in many forms and modalities from simple “store-and-forward” techniques (used in teleradiology for example) to sophisticated real-time teleconsultation which

allows a remote physician to consult with a specialist elsewhere, providing education, synergies of collaboration, and the best service for the patient. The consult can be a one-way diagnosis by the specialist, a second opinion, or an ongoing treatment plan coordinated by the host physician. Teleconsultations have been done as simply as through e-mail (asynchronous store and forward technology) or as complexly as through Video teleconferencing (VTC).⁶⁸⁶⁹. Teleconsultation can also be applied to the various medical boards (such as grand rounds, tumor boards, etc.) and other meetings of physicians to discuss specific clinical case data and arrive at diagnosis and treatment.

While initial HMIS implementation in your country will not focus on teleconferencing, an Internet connection is of vast benefit to any HMIS. Teleconsultation eliminates problems caused by lack of available qualified providers, through better resource utilization and efficiencies of scope and scale. Furthermore, Internet accessible HMIS experience direct cost savings, reduced or eliminated travel time and maximized work equivalents. Physicians can access medical conference proceedings, medical resources (libraries, etc.) and CME training online. Moreover, by providing extended services there is a change in overall perception of services provided, both in quantity and quality.

Consultation services could be available for all remote sites that have Internet access, providing the treatment expertise of a major medical center to any hospital (regardless of size or location) at a reasonable cost. The result is faster patient treatment and second opinions in unusual cases.⁷⁰ Such implementation of evaluations will formulate specialized centers of knowledge. Subspecialists can confirm the correct diagnoses and review and recommend state-of-the-art treatment modalities.⁷¹

Provider System Considerations

OBJECTIVES:

- Increase operational efficiency (reduce costs)
- Interface with payer system

FUNCTIONALITIES:

- Patient registration and rostering
- Eligibility checking
- Claims / encounter creation
- Claims / encounter submission
- Appointment scheduling
- Payment processing
- Contract monitoring
- Business unit-level management information
- Central budgetary control
- Inventory management
- Clinical functionality

FUTURE POTENTIAL FUNCTIONALITIES:

- Virtual longitudinal lifelong electronic patient records
- Support for clinical practice guidelines
- Telemedicine and teleconsultation
- Video teleconferencing
- Medical research resources

NOTES ON COSTS AND LIKELY IMPLEMENTATION TIMES

How much should a provider system cost to acquire and implement? This is, of course, a multi-dimensional question with few reliable answers. The answer is often “it depends...” But despite this unsatisfying, if true, answer, we can provide some guidance that is typical of the world’s experience.

For Hospital Information Systems

Hospital information systems, as a rule of thumb, should cost about \$1,000 U.S. per bed to acquire. This then leads us to say that a 100-bed hospital will cost roughly \$100,000 in software and hardware. And a 1,000-bed hospital might well cost \$1 million to acquire.

Besides this investment cost, there is the running cost. A general rule of thumb is that the running costs will be somewhere between 20% and 30% of the capital investment cost **per year**. This includes standard maintenance and technology refresh costs as well as training and other costs associated with running and maintaining the system.

Of course these are imprecise estimates, but they hopefully provide some useful rules of thumb. They are given for the year **2003**. Technology costs continue to decrease, but “people costs” may increase. Thus, please use these guidelines only as rough estimates.

It generally takes 12 to 18 months to implement a full Hospital Information System. There are few examples in the world where it has taken less time, and many examples where it has taken somewhat (or occasionally substantially) longer.

For Clinic Information Systems

Clinic Information Systems should cost somewhere between \$50,000 and \$200,000 depending on the size of clinic and the complexity of its clinical offerings. Clinic information systems generally take between 6 months and 9 months to implement.

IMPLEMENTING PAYER SYSTEMS TO SUPPORT RAP

INTRODUCTION TO HEALTH INSURANCE

There exists a plethora of institutional approaches to budgeting for, and funding, healthcare services. Aggregate indicators of health outcomes (life expectancy, infant mortality) are only weakly related to medical care spending.^{72 73} This weak association reflects the confounding effects of an array of social, environmental and cultural factors that influence health status.⁷⁴ Among these are income distribution,^{75 76} social status,^{77 78} personal and cultural beliefs, dietary habits, exercise behaviors, child raising practices, lifestyles, educational attainment, housing situations, stress levels^{79 80 81} and social support structures.⁸² Noteworthy aspects of these factors are):⁸³

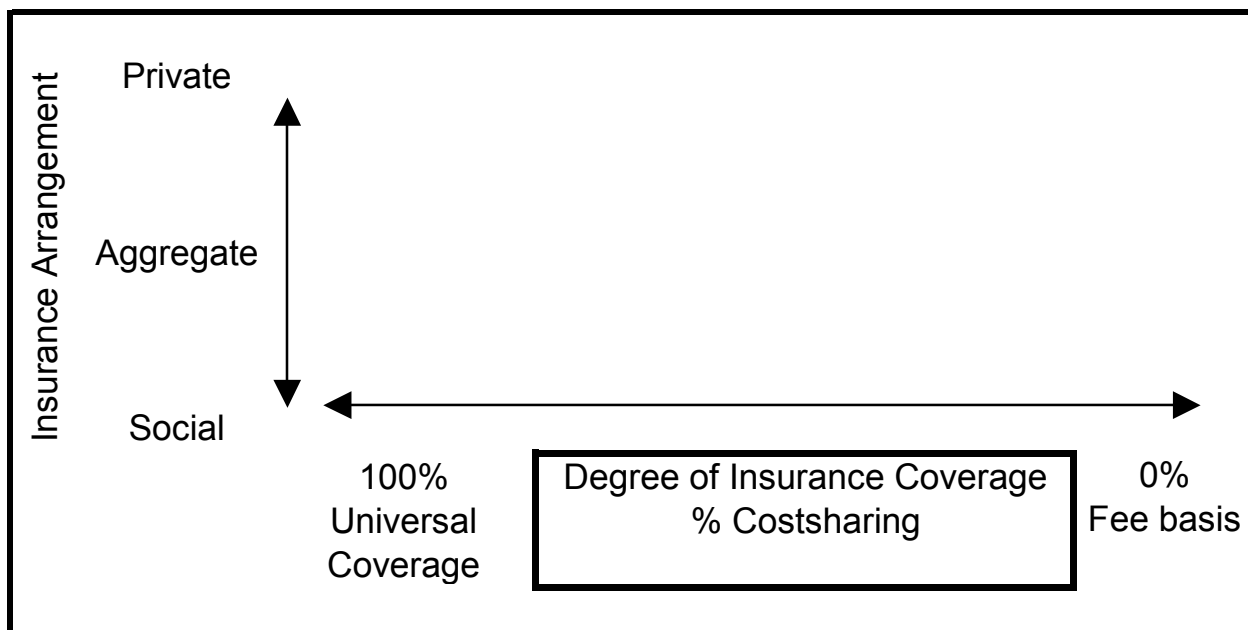
- Life expectancy tends to increase with income, education and occupational class^{84 85}
- Health gradients⁸⁶ persist over time and exist for all major disease classes
- Across countries, health gradients vary
- There is an association between income inequality and life expectancy⁸⁷
- Within lowest income countries or states, there is a small group that manages to achieve high life expectancy in spite of low gross domestic product (GDP).

“Comparisons of aggregate health expenditure across different countries have become popular over the last three decades as they permit a systematic investigation of the impact of different institutional regimes and other explanatory variables. Over the years, several regression analyses based on cross-section and panel data have been used to explain the international differences in health expenditure. A common result of these studies is that aggregate income appears to be the most important factor explaining health expenditure variation between countries. In addition, estimated income elasticity is high (even higher than unity), which indicates that healthcare is a "luxury" good. Additional results indicate, for example, that the use of primary care "gatekeepers" lowers health expenditure and also that the way of remunerating physicians in the ambulatory care sector appears to influence health expenditure; capitation systems tend to lead to lower expenditure than fee-for-service systems. Finally, we also list some issues for the future. We demand more efforts on theory of the macroeconomic analysis of health expenditure, which is underdeveloped at least relative to the macro-econometrics of health expenditure. We also demand more replications based on updated data and methods that seek to unify the many differing results of previous studies.”⁸⁸

Health Insurance Types and Organizational Structures

There are few, if any countries, in the world today in which health care can be entirely self-funding. Rapidly increasing health care costs, have forced a rethinking of how health care will be financed.

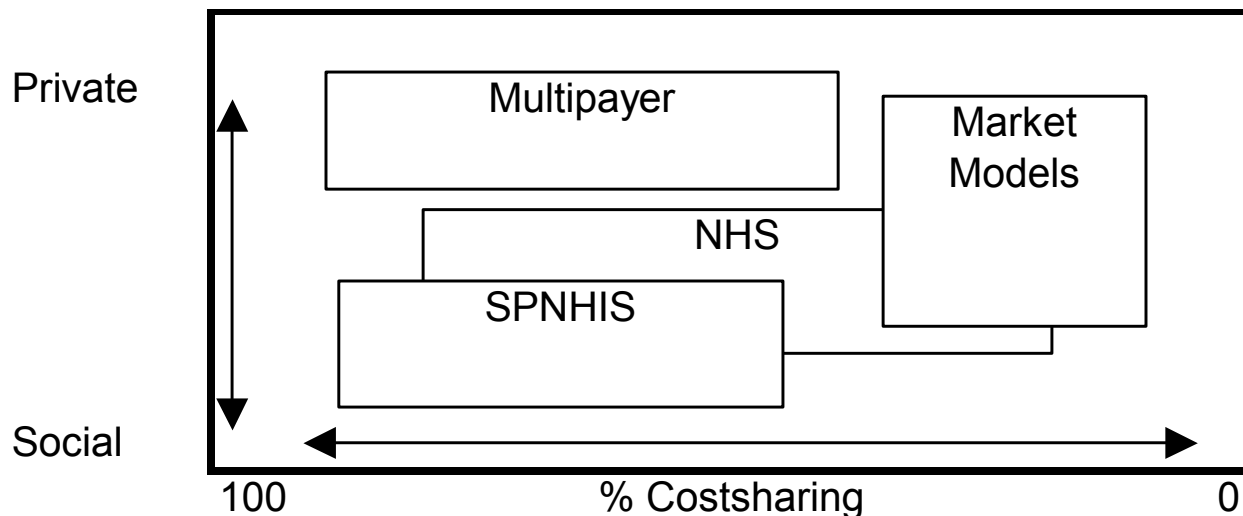
Health insurance has emerged as the typical vehicle to fund health care costs. Health insurance schemes may be categorized by 1) type of insurance arrangement (private, social, and tax or aggregate) and by 2) degree of insurance coverage (with consideration for population coverage and cost sharing). These may be matrixed into a two dimensional space which defines the health insurance schemes of most nations (See Drawing 1).



The Organization for Economic Co-operation and Development (OECD) defines three types of health insurance schemes¹: which we have easily fit into our model:

¹ http://www.pnhp.org/facts/international_health_systems.php.

1. *Single-payer National Health Insurance Systems (SPNHIS), that are publicly administered.* Most physicians are in private practice and hospitals are generally either publicly owned (through county councils or municipalities in the case of the Scandinavian countries), or not-for-profit enterprises, although the model itself does not preclude private ownership of health facilities. Single-payer National Health insurance systems provide universal service for all. OECD countries that operate under this model include Canada, Denmark, Norway, and Sweden.
2. *National Health Service Systems (NHSs)* are systems in which salaried physicians work in predominantly publicly owned and operated hospitals. NHSs consist of publicly owned and accountable hospital and community services funded from central taxation. Hospital doctors and nurses are salaried, and under national terms and conditions of service. NHSs provide universal services for all. OECD countries that operate under this model include Great Britain and Spain.
3. *Multi-payer Health Insurance Systems* (highly regulated, universal, multi-payer health insurance systems a.k.a. all-payer systems) have universal health insurance via sickness funds, which pay physicians and hospitals uniform rates negotiated annually. OECD countries operating under this model include Germany and France (See Drawing 2.)



In addition, there are market models that allow more commercial forces within the healthcare system.

Whatever the type of payer chosen, there must be a strict division of duties, responsibilities and accountabilities between the payer and the provider. For this reason, the question about WHERE the payer should be housed is a major organizational and political question in many countries.

Here are some choices:

Housed within the Ministry of Health.

This is usually a very poor choice, since it immediately violates the separation-of-duties principal discussed earlier. In early stages of RAP it is probably okay for the health insurance agency to be housed in the MOH, but longer term it is definitely not the best choice.

Housed within the Ministry of Social Welfare.

For many of the same reasons discussed above, this organizational arrangement is also problematic.

Housed as an autonomous governmental agency.

This is a better choice, but very difficult to politically control. While it may be free of the vagaries of political control from individual ministries, this method puts the agency in a situation in which it may have little accountability to the legislative bodies or to the people.

Housed as a semi-autonomous governmental agency.

This is a still better choice. In this structure, the agency is given some autonomy to manage its affairs separate from direct interference from (often) battling stakeholders, while still providing accountability. In this structure, usually the head of the agency is appointed (and can be fired by) either the Prime Minister or by the Minister of Health, but otherwise it enjoys considerable autonomy.

Housed as a private agency.

Private health insurance is successful in some countries, and a disaster in others. Privatization of all, or part, of the health insurance scheme should be made in a deliberate fashion as it can dramatically change the complexion of future health care services and spending. In private health insurance schemes, the coverage can be compulsory and universal, or optional and discretionary. In the latter case, there are some examples of countries where private health insurance companies have been able to “cherry pick” the healthiest (and usually wealthiest) patients while allowing the sickest (and usually poorest) patients to remain on public roles. This can dramatically increase the government’s burden if not carefully regulated.

Capitation versus Fee-for-Service Payments

Fee-for-service and capitation refer to different (and to some extent, competing) provider reimbursement methods used in different kinds of health insurance plans. Generally speaking, managed care schemes, such as health maintenance organizations (HMOs) use the capitation method. Indemnity plans, sometimes referred to as traditional insurance, generally use fee-for-service reimbursement. *Fee-for-service* is a scheme in which the healthcare provider is paid a fee based on what services the provider rendered. *Capitation* pays the provider a certain amount of money each month for each of the provider's patients (these patients are sometimes referred to as “rostered” patients) regardless of the amount of care rendered. There are many possible variants, and hybrids, of these two models.

In fee-for-service the provider is reimbursed a share of medical bills incurred by the patient (they pay “the fee for the service,” subject to benefit limitations). The patient is responsible for any deductible (the amount that must be satisfied before the insurance begins to pay benefits), along with co-payments or co-insurance. A co-payment is a set price paid for each medical benefit. Co-insurance is a shared percentage of the cost for medical care. After the patient has satisfied deductibles, co-payments or co-insurance, the payer pays for the rest up to a “cap”. Normally, payers reduce the amount due by comparing the medical cost to the normal charge for a certain procedure or diagnosis in a geographic area. This is called “usual, reasonable and customary” (URC) re-pricing. The payer may choose not to pay more than the URC amount for a procedure. In the United States, the policyholder's share is based on the reduced amount. In the Canadian system, fees are negotiated between the payer (provincial government) and the provider “union” and there is a set fee for each service, with no variation. European systems tend to have rate-setting mechanisms similar to that of the Canadian system.

URC provides some safeguard against physicians who may overcharge for procedures. Under fee-for-service, providers are reimbursed for every eligible procedure they perform. In certain instances, fee-for-service was associated with healthcare providers rendering services which were at times excessive and not needed, subjecting patients to unnecessary risks and raising the cost of medical care but at the same time favoring the provider financially. Additionally, with fee-for-service less attention was given to

determining which treatments produced the better outcomes relative to the costs involved. Societal issues, such as concern for the utilization of scarce resources, were also infrequently evaluated.

Capitation is a scheme in which an insurer pays a healthcare provider a fixed amount per month for each insured member on that provider's roster, regardless of how often, or whether, that member is treated. The amount per member may vary depending on the member's age, gender, or other factors. Additional incentive payments may also be included to encourage physicians to provide services to certain populations, or locate in certain areas. As the provider's "pool" of members grows, capitation may become a better deal as the law of averages begins to take effect, as risk can be effectively shared. Under a capitation plan, a provider may end up providing care beyond that covered by the capitation rate. For this reason, certain "caps" may be placed on what the physician performs, and any additional services might yield additional payments from the payer. *Managed care* is a combination insurance company and healthcare delivery system that covers healthcare costs in return for a premium. Each plan has its own network of providers and a single payer (the managed care entity). Premium costs and co-payments for services received vary between plans and are normally dependent upon the situation (coverage, disease state, etc.) of the enrollee. Managed care is rapidly growing in most developed nations. Like fee-for-service, capitation can also be abused, since the system rewards UNDER-treatment. An ethical argument against capitation is that capitation rewards providers for providing less care and therefore may lead to management that is against the best interests of the patient but favoring the financial advancement of the providers. It can also result in OVER-referral patterns, as providers attempt to "dump" their costlier patients on other risk-bearers.

In the case of a *global capitation* arrangement, providers must bear the cost of ALL treatment, including that to which the patient is referred, and including the cost of visits, tests, treatments, drugs and hospitalizations. What is left over represents the monies the provider can keep for overhead and profit. There also may be incentive payments to those who meet certain utilization targets, and also certain "withholds" which will be paid only after certain quality standards are demonstrated. Because global capitation involves considerable financial risk, some providers are not comfortable under this arrangement. Indeed only relatively large groups of providers should be encouraged to assume this risk.

FUNCTIONALITY OF PAYER SYSTEMS

The information technology needs of the payer are generally more complex than that of providers, and certainly more costly. Systems maintenance cost is also high since these systems are subject to needed updates for legislative and regulatory changes, clinical and organizational changes, and Management Information Systems (MIS) technical changes.⁸⁹

The main functions of payer systems are: registration and eligibility, premium collection, contracting, claims adjudication, support for timely and reconcilable provider payments, utilization management, and, last but not least(!), quality assurance.

Registration and Eligibility

Payers must provide accurate registration and eligibility data to providers. This is not easy, because insurance "rolls" are extremely dynamic and changing.

The registration and eligibility databases must be up to date, accurate, and available to participating providers whenever necessary. Essential data points within these databases include:

- Demographic information, including confirmatory information
- Benefit plan – included coverage, co-payments and options
- Date of eligibility and eligibility end date

- Co-payment information for the variety of goods and services covered
- Referral network(s) to which the patient has access
- Information about unpaid deductibles.
- Premium rate and payment information (depending on the type of system, this may be a set amount per month based on family size and coverage, or an income-based calculation).

If there is more than one payer, it is highly desirable to design a common system and demographic database that supports registration and eligibility for ALL payers. This enormously simplifies the provider systems (and the life of providers!), since they have to access only one site that acts as the “gold standard” for essential eligibility information in a region.

Premium Collection

Once “beneficiaries” are enumerated, either on a per-person or per-family basis, then the payer’s principal responsibility is to collect the premiums for the insurance coverage from patients, (sometimes) employers, and (sometimes) social welfare agencies of governments who pay the premium for those who cannot afford the premium on their own.

In many ways the premium collection function of a modern payer system resembles that of any large enterprises’ accounts receivable system – it must bill, collect, and post revenues. It must track delinquencies (and turn off “eligibility” as appropriate). It must report on its revenue production as part of its accountability to its “members” or stakeholders.

This is not an easy function, and surprisingly the functionality here can be extremely costly. This is because health insurance schemes normally get complex rather quickly (as the scheme gets “tuned” to special needs and interest groups) and also because the underlying accounting principals are related to advanced charts-of-account which require complex posting procedures.

Besides the financial factors, there is always a difficulty in deciding when the beneficiary is so delinquent that his health care benefits must be suspended. This can be an enormously contested decision – without health insurance where can a sick person go for treatment?

Contracting and Contract Management

The three major types of healthcare (insurance) contracts found in the European Union (EU) countries (as an example) are (listed in order of increasing complexity):

1. *Block contracts* which generally outline expectations and agreements between provider and payer
2. *Cost and volume contracts* which specify broad volumes targets, types of case mix and general payment levels
3. *Cost-per-care contracts* that specify payment levels and processes for specific types of care and cases. This method is also called “case-mix” reimbursement in some countries. Specific coding systems for denoting “cases” have also been devised. The prevailing method, used in many countries, uses a code called the DRG (Diagnosis-Related Group).

Contracting must be orderly, accountable, and transparent to ensure an appropriate insurance scheme. It is highly recommended that one avoid the tendency towards ever-increasing contract complexity because it can create conflict and greatly increased administrative and legal costs. On the other hand, suitable safeguards should be included to guard against providers claiming reimbursement for services that are more expensive or complex than are appropriate in the circumstances. For example, rules are often set to determine when a general practitioner can bill a more expensive consultation, rather than a less costly office visit. These safeguards need to be reflected in the claims processing system (see below).

Contract templates should be created that are simple to use and can be replicated among providers. Information Systems should be utilized to track and archive the contracts and due dates, deliverables, etc. Ideally, a contract could be negotiated between provider and payer by merely “filling in the blanks” of a pre-designed template. Any further complexity, exclusions, inclusions, etc. can add enormously to the cost of adjudication of the contract.

Standards for contracting must be agreed upon, including the contract template itself, the claim form(s) if any which are to be used, the rules for submitting claims and other information, and the agreed upon time the payer has to adjudicate the typical claim.

Finally, the contracting module should track these contracts, and provide easily retrievable information about their terms to both payers and providers. It should also provide a reminder as to when the contract is due to be renegotiated.

Claims Adjudication

Some means of adjudicating incoming claims for services against the corresponding contract must be provided. Adjudication simply means deciding whether the claim is valid, and what the reimbursement should be for the claim. The adjudication system can be rather simple doing little more than “counting” utilization, or they can be enormously complex systems with rules-based engines that do highly sophisticated scanning of each incoming claim for appropriateness and deciding on a settlement based on the terms of the applicable contract(s). To simplify adjudication, it is important to have a standard claim form for all claims to be submitted. Adjudication can rarely be fully automated, so some (small) percentage of claims may have to be determined manually, even in the most advanced systems.

It is usual that there be one standard adjudication for claims involving “institutional” fees, and another for professional fees. The specification of these information standards is crucial – these must be “rich” enough to include information needed to run the insurance process, but they must not be so burdensome to the providers as to be costly to produce. Thus it is a delicate balancing act to develop such forms, and they may be paper-based and/or use electronic media.

Even in the case of providers being paid on a capitation basis, many systems require activity reports to be filed, both for financial management and quality assurance purposes. The content of these reports can vary from simply daily logs to individual submissions for each patient encounter. The approach chosen obviously has an impact on both provider and payer hardware and software requirements.

Finally, the use of Major Diagnostic Categories (MDC) and Disease classification systems for provider payments generate additional issues. MDCs include Diagnosis Related Group (DRG)-type systems for inpatients and Ambulatory Payment Classifications (APC) for outpatients. Because the level of compensation is based on clinical factors, there is often a longer time delay between the provision of the service and the submission of the claim. Aside from the normal time lag (resulting from the fact that claims are usually submitted only after patient discharge), the process of determining the appropriate disease classification code (such as the DRG, International Classification of Diseases (ICD)⁹⁰, etc.) and translating it into a suitable service, procedure, treatment, equipment and / or billing code(s), Current Procedural Terminology (CPT)⁹¹ or other code, takes time and requires clinical input, coding expertise and sophisticated information systems.

Once the claim is received, equally sophisticated systems and expertise are needed for the payer to ensure that the coding is clinically consistent, and to guard against “DRG creep” or “up-coding”. These latter terms refer to the tendency of providers to use the coding system to claim more complex (and expensive) DRGs, even for relatively simple and straightforward procedures or cases.

Provider Payments

Timely and reconcilable payments to providers must contain readily identifiable information about the services (in a fee-for-service environment) or periods (in a capitated environment), so that the provider can verify that correct payments were received. The payments must flow in a timely manner, as specified by regulation or law. Payments can be provided via paper checks, or can be via electronic funds transfers (via EDI). In either case, certain supporting documents which allow the provider to reconcile the payments in their accounting systems may be important.

Utilization Management

The payer must have a way of testing the appropriateness of services rendered, their adherence to any quality standards and guidelines, and possibly concurrently intervene in the care of the patient. The latter function, sometimes known as “case management”, is usually reserved for the most complex (and costly) cases, such as severe burns, severe trauma, etc. Payers also use their information systems to review “patterns of practice” across a number of providers (e.g., all general practitioners in a particular geographic area) to identify outliers or those whose billing patterns may be suspect. Where payers cover all inhabitants of a particular geographic area, there is the potential for developing population-based and small-area analyses to determine variations in factors such as surgical interventions, hospitalization rates, complication and death rates, etc. These analyses can then be used in direct discussions with providers, or as an input to future contract negotiations.

Quality Assurance

This is the most difficult and challenging area. It is most desirable to find ways for the computer system to help to “assure quality”. Unfortunately, the world has not ventured far in this area, due partly to its inherent difficulty and partly due to its inherent political sensitivity.

The world has yet to answer the question of whether a physician who does not practice according to accepted standards is being artful or simply a bad physician. Few quality measures are universally agreed to. The ones that are (that children should be vaccinated, that pregnant women should be given proper pre-natal care, that certain screenings should be performed), account for only a very small part of the healthcare delivery services menu.

Payer System Considerations	
HEALTH INSURANCE TYPES	
Type of insurance arrangement	
	Private
	Social
	Tax (aggregate)
Degree of insurance coverage	
	Population coverage
	Cost sharing
	Capitation
	Fee-for-service
HEALTH INSURANCE SYSTEMS	
	Single payer National Health Insurance
	National Health service

Payer System Considerations

Multi-payer Health Insurance

OBJECTIVES

Provide efficient, equitable care

Address escalating health care costs

 Opportunity to create efficiency

 Possibility to create efficiency and eliminate administrative waste and redundancy

Decrease medical errors

Increase patient safety

Improve overall health of the community

FUNCTIONALITIES

Registration and eligibility checking

Premium Collection

Contracting

Claims adjudication

Support for timely and reconcilable provider payments

Utilization management (case management)

Quality assurance

ADDITIONAL POTENTIAL FUNCTIONALITIES

Provide consumer-centric health plans with decision-support services enabled by IT

As your nation develops and refines accepted quality standards, based on clinical guidelines and protocols, it is the duty of the HMIS professional to incorporate them, to the extent possible, in the HMIS. For it is likely that only a computer will be able to track compliance with these standards adequately. In the past, chart audits were used as a type of quality control” but these manual checks are inherently spotty and expensive to perform.

NOTES ON COSTS AND LIKELY IMPLEMENTATION TIMES

So-called “payer-side” systems are expensive. Expect that even a modest one will cost upwards of \$1 million to acquire. These costs are high because often they are one-of-a-kind, or nearly so, and they must incorporate a great number of specific and unique requirements. Payer-side systems are not as standard as provider-side systems are (see previous chapter) and thus their costs are higher.

In countries with a long experience of implementing payer-side systems (e.g. in certain provinces of Canada), the overall investment has been in the \$10’s of millions of dollars over a number of years. Now we must hope that some of their experiences can be leapfrogged, and that the NDEs might benefit from the current state-of-the-art without reinventing it. Thus we might expect the costs today to be much less and declining further as payer systems become better known and there are more models from which to choose. It is because of a lack of standard models (a small step in the direction of a standardized approach is a reason for creating this manual!) that the technical capacity needed to implement payer-side systems is high(er). As noted above, the complexity of the reimbursement and contracting systems, as well as the desired degree of control and level of safeguards, can affect the complexity and cost of the management information systems needed to support them. So, it is important to consider these factors in the

development of the RAP system itself. Essentially, a cost-benefit analysis is needed to determine if the extra investments will pay off in terms of increased effectiveness and/or control of health expenditures.

Like provider-side systems, payer-side systems also have a running cost that is typically 20%-30% of the capital investment cost **per year**.

Typically it takes between 1 and 2 years to implement a moderately complex payer system.

THE INTERFACE BETWEEN PAYER AND PROVIDER SYSTEMS TO SUPPORT RAP

INTRODUCTION

The true art of the HMIS professional is to fashion an appropriate interface between the payer systems and provider systems, such as they are described in this document. It is possible to have the “best” provider system in the world, and the “best” payer system, but, if these two systems do not talk to each other in a reasonable way, the business costs will skyrocket, and dissatisfaction with the systems, on the part of both payer and provider, will mount.

The “art” here is to create a system that allows easy transmission of data between the two sides, without upsetting the delicate political balance of power that exists between the two. Both sides need to be assured that the other cannot pry into its systems, or otherwise have access to data that is going to give it an unfair advantage in negotiations.

In the world, there is ample precedent for such systems in other industries. For example:

- Common airline reservations systems share services among highly competitive carriers.
- Common transactions clearing systems process transactions for highly competitive banking institutions.

But such peaceful co-existence is rarely achieved in the healthcare industry as easily. Thus we must be aware of the political sensitivity of this work.

FUNCTIONALITY OF THE INTERFACE

As a minimum, an appropriately robust interface will allow for:

- Sharing of Patient Eligibility data and Rosters
- Transmission of “Claims” to the payer from the provider in a Standard Format on a timely schedule
- Transmission back of anomalies and Errors found in the claims (“edit errors”)
- Transmission of Payments from the provider to the payer
- Transmission of Quality Assurance data between provider and payer

Provider - Payer System Interface Considerations

FUNCTIONALITIES

Sharing of patient eligibility and rosters
Transmission of claims to the payer from the provider in a standard format on a timely schedule
Transmission back of anomalies and errors in the claims ("edit errors")
Transmission of payments from the provider to the payer
Transmission of Quality Assurance (QA) data between provider and payer

HOW FUNCTIONALITIES ARE ACCOMPLISHED

Data mapping
Through mapping tools

Provider - Payer System Interface Considerations

Interface engines and middleware

Way-station or clearinghouse

Central data repository (CDR)

Cached

Routed ("switch")

Standards

US - HL7

EU - HISA

NOTES ON IMPLEMENTATION

The implementation of an appropriate interface requires a combination of data mapping skills and networking skills.

DATA MAPPING

Ideally, all interchange formats would be completely “standardized” and thus no data mapping would be required, but this is very infrequently the case. For reasons which are not completely clear, there will likely be some data mapping needed, as both payer and provider become “creative” in their game playing.

Appropriate mapping tools, and possibly interface engines and middleware, are frequently required to return the modified data into something that resembles a “standard” form. Standards in the USA such as HL-7 (Health Level 7) and those in the EU, such as the HISA (Health Information Systems Architecture) standard might help create some standardization. Frequently even these international standards are still not bulletproof.

A national level standardization body may also be needed to take existing international standards and determine which ones are going to be applied nationally, and how. This body could be an independent organization (NGO), a branch of the Ministry of Health, or somewhere in-between. It is often useful to have healthcare providers, Ministry, insurers, and HMIS provider representation on such a body, to ensure that the resulting standards are acceptable to all parties. Once standards are agreed upon and widely accepted, only those systems compliant with the standards should be acquired. By allowing all compliant systems to be marketed, this approach allows the maximum level of competition between HMIS providers, and also relieves the Ministry of Health and/or the insurer(s) of the responsibility for specifying/providing a unitary solution for healthcare providers. It also ensures that provider and payer systems will be able to talk to each other, and to other providers as appropriate.

NETWORKING AND TELECOMMUNICATIONS

The exact communications protocols to be used (Electronic Data Interchange [EDI], web-based interfaces, offline media, etc.) will depend largely on the availability and cost of each option. With the ubiquity of the Internet today in most countries of the world, a data communications protocol using XML (extensible markup language) might be the best choice. However, EDI is still the most common means to move financial data around the world; it is well known and secure. In the most remote of locations, the mailing of diskettes (please make a copy before mailing!) or other media may be the only practical method.

A HEALTH DATA CLEARINGHOUSE?

There still remains the question of HOW the data is going to be moved between provider and payer, and whether there will be a way-station (a “clearinghouse”) between the two.

Rather than utilizing point-to-point transmission of data between parties, it might be more effective to implement a “star network” where all communications flow through, and are routed from, a single point. Such a “clearinghouse” can potentially save considerable communications costs and hassles since each party needs only to transmit to a single point.

If the data is stored at the central point, it becomes a Central Data Repository, which can become an enormous asset to a country – it allows the analysis of health data collected in a single format and accessible at a single site.

While in theory this is a good idea, in some countries where it has been tried (including many in Eastern Europe) the political unease that such “centralized” data access provides has caused some stakeholders to be uncomfortable.

The data need not be stored at the central site, but merely cached and routed (a “switch”) in which case the political hurdles are somewhat lower. However, even this can be the cause of some concern among competing interests because there is the perceived opportunity for abuse and misuse of the data as they flow through the single point. Therefore, when setting out to implement a “star network” it is important not only to look at its technical feasibility (it is usually always technically feasible) but also at the political realities of the myriad stakeholders involved.

We do not know of a country which has successfully implemented a “star network” for its health care data storage. More realistically data will need to be stored by both provider and payer agencies, as it is these data, and their accompanying analyses, which provides the basis for fair, well-informed and spirited negotiations between the two. As there is organizational separation between the two interest groups, perhaps that separation also must be institutionalized in how it collects, analyzes and archives data. We will continue to look for good examples of the “star network” model however, since the potential simplicity and cost-savings could be enormous.

CONCLUDING REMARKS

HMIS offer the ability to standardize the quality of care provided; streamline business processes related to operations and finances, and to establish some clinical practice guidelines for evaluation and diagnosis. In implementing, operating, and maintaining any HMIS project, the following issues may affect the ability to realize the maximum potential benefits. These factors have inherent risks and benefits to them, and they require proactive managerial attention. They include:

Disparate Systems: There are multitudinous disparate systems that exist today, and even if compatibility is a key issue during implementation of the HMIS, incompatibility and interoperability issues are a result of the size and complexity of the system. A larger (systems) perspective is required to analyze and resolve these issues as they occur, and clear standards may be needed.

Ease of Access: HMIS enable specialists easy access to clinical history and other important information.⁹² It can enhance the coordination of care, but creates issues of support and security.

End-User Acceptance: Not all systems developed have been able to meet end-user criteria and many have resulted in less-than-optimal usage. There are systems, organizational, and individual reasons for this. Organizational culture, workload balance, process fit, product fit, and service orientation affect end usage. Individual variations are outside the scope of this analysis, and are better treated as an upper management issue. It should be noted that a limited amount of individual variations do not affect overall system performance, as they are statistically irrelevant. The key is to ensure that, to the extent possible, data

collection is integrated into clinical processes and workflows, and provides added value, rather than being additional, after-the-fact work, that adds no benefit to clinical decision-making.

Knowledge Base: HMIS should provide increased contact between specialists and multidisciplinary experts that should directly result in increased knowledge. It is an economical means of educational opportunities, but should not displace proper education. As our human knowledge base exponentially grows, realized issues of support for the system become evident.⁹³

Management Overconfidence: Management should be aware of the tendency to overstate or overemphasize achievements while understating problems. It is, however equally detrimental to view the system too pessimistically and make purely financial decisions without accounting for qualitative benefits. It is important to present unbiased objective costs and benefits, both quantitative and qualitative in nature.

Remote Site Coverage: Consultation services could be available for all remote sites that have Internet access. This provides treatment expertise of a major medical center to any hospital—regardless of size or location, at a reasonable cost. This could result in faster patient treatment time and allows second opinions in unusual cases.⁹⁴ However, coverage that is over encompassing may introduce unexpected management and workload problems.

Security and Confidentiality Issues: Transmission of patient data over the Internet and storage on microcomputers accessible from the Internet involves inherent risks. There are many different options available to insure security and privacy of patient data but no system is completely failsafe.

Systems Reliability: The evolving field of HMIS continues to have issues with system standards, configurations, integration, and compatibility. Even in the most reliable of systems, entropic affects are impossible to completely eliminate. Occasionally, what a user experiences as a lack of system reliability is in fact a result of the failure of the human component. Our inability or unwillingness to communicate regarding issues of system downs and slows can be frustrating. Once again, communication is quintessential to avoid confusion, frustration and failures.

Sustainability: Finally, the single biggest threat to your success in implementing HMIS in RAP is a lack of planning for the system's long-term sustainability. We have seen many systems efforts fail for lack of proper planning. Systems are, in some sense, "living ideas" which need constant attention. HMIS projects are never really "finished". HMIS capital costs are never fully amortized. HMIS running costs must be appropriately managed. HMIS capacity building efforts, and retraining efforts, must continue indefinitely.

Even with all these caveats and warnings, YES, HMIS in RAP is worth it! In fact there is really no other way to implement a modern RAP protocol in your country. As one cannot run a modern airline, a modern bank, or a modern commercial enterprise today without computerization, so it is not possible to implement a smooth, equitable and accessible health care system in the world without computerization – and RAP is an integral part of the health care system today.

Potential HMIS Pitfalls:
Disparate, Poorly integrated Systems
Poor Ease of Access
Lack of End-User Acceptance
Incomplete Knowledge Base
Management Overconfidence
Poor Remote Site Coverage
Security and Confidentiality Issues
Poor Systems Reliability
Lack of Sustainability!

A Personal Footnote

The authors appreciate that HMIS development is a long and difficult project. Some of the examples in this monograph are from countries that have spent many years (even decades!) working on this topic. Perhaps you will be able to avoid some of the delays and pitfalls that colleagues around the world have experienced through thoroughly examining the overall context in which you are working. Perhaps you will be able to “leapfrog” in some areas. Perhaps you will be able to avoid the high failure rate of such projects by knowing what works and what hasn’t worked elsewhere. The authors wish you God-speed in implementing HMIS in your RAP applications in your country! We hope that this text has been useful to you, and we invite your comments and questions.

APPENDIX I: A PRIMER ON THE BENEFITS OF HMIS

In this section we provide an overall Primer on the benefits of HMIS. While the focus of this monograph is the relationship between RAP and HMIS, we thought it was important to put this all in a bigger strategic context. Not all the capabilities implied in the section below are relevant to HMIS efforts in NDEs today. But they will be in a few years. A long-term view to implementing “the big picture” will be helpful in optimizing investments in HMIS and focusing on those benefits that are particularly important to you in your country.

Progress towards achieving the goal of high quality efficient healthcare for all depends on a large number of factors. HMIS have the potential to improve healthcare quality and sustainability by contributing to quality measures; ensuring efficient and effective use of resources; and giving early warning of population health indicators and the effects of health initiatives. A useful practical service is the documentation of exemplary (best) practices and their possible transmission worldwide. Policy makers, administrators and managers have been under continuing pressure to improve financial management for which advances in information technology have been of considerable value, to reduce unit costs, and to bring about a closer relationship between expenditures and outcomes. Disclosure and reporting procedures have improved. There has been greater awareness of healthcare costs in both public and official venues.- Long established features of traditionally decentralized locally controlled systems are being replaced by highly centralized systems in an effort to reduce costs. . Four important principles have been enunciated. First, that there should be transparency; second that there is public accountability; third, that there is an obligation to direct public funds to the ends and purposes of declared public policy; and fourth, that there should be integrity and efficiency in the use of funds .

Best Practices that should be incorporated into every HMIS include:

- *Emphasis on Industry Best Practices (IBP)*. This will ensure high quality, efficient, and reliable HMIS services at competitive Returns on Investment (ROIs) throughout the system.
- *Total Information Assurance (TIA)*. This will assure the protection, integrity, and security of data. It is of critical importance that all data and applications are stored on secure servers in a secure environment, and protected using intrusion detection systems and other security safeguards. Certified security professionals should manage security operations and independent government and private organizations should regularly review the security program. Backup versions of all data must be securely maintained off-site, and disaster recovery protocols should be tested annually to ensure they work in practice.
- *Disaster recovery plans and scheduled audits*. Disaster recovery plans provide for business continuity both in terms of equipment and human resources in the vent of a disaster.
- *Customer Relationship Management (CRM)*. CRM ensures proper project management, system architecture, and coordinated deliverables.
- *Performance Based Service Level Agreements (SLAs)*. Having SLAs based on performance allows the healthcare system to monitor outcomes and ensure success.

As systems grow and integrate, the larger system benefits through economies of scale and scope, resulting from an expanded customer base and shared platforms. In this manner the system ensures controlled costs and continually renewable business solutions, quality, and added value.

HMIS benefits may be categorized as either operational (business-specific) or functional (medical/clinical) related. Operational improvements create increases in efficiencies and therefore reduce costs. The improved base information available to all stakeholders for their planning, delivery, and financing tasks can enhance cost efficiency within the healthcare system while preserving quality.

Clinical improvements accrue from providing additional assistance and are either financial or non-financial. The basic improvements to the clinical environment include: integration among healthcare providers (or decrease in fragmentation among healthcare providers), highly developed clinical applications to aid in the clinical decision-making process, shortcuts that provide access to essential health data with proper security, shortcuts to access eligibility data with proper security, disease surveillance, epidemiological profiling, and ad hoc reporting for clinical research purposes.

All quantifiable gains may be analyzed through a specific or incremental ROI analysis once applicable performance metrics have been determined and measured. Increased efficiencies due to affects on service providers, patients and their families, and administrative/business teams may be matrixed into the operational and functional factors. Operational efficiencies to the service providers are realized through better balance of the workload and the reduction of the quantity and skill mix for providers in any one area.

Functional gains may be realized through teleconsults which provide the ability to maintain skills of specialized providers in high traffic areas, and to extend these specialties into unserved and underserved areas at a relatively nominal cost. There is reduced travel time for the provider and/or the patient. With the decreased analysis time and diminished provider travel time, provider productive time is maximized. This productivity translates into better utilization of medical professionals.

Operational efficiency increases at the administration/business levels are actualized through the increased speed and efficiency of a less paper-dependent system. This speed and efficiency creates better use of staff-hours at the point-of-care as well as in administration. The ability to instantly access patient data greatly reduces the need for extensive manual patient check-in and record retrieval services. The entering of billing codes directly from data input into the patient care component reduces the potential for billing and misrepresentation errors.

Enhancements in technical efficiency include reduced research time through provider access to technical links and research tools. Rapid transmission of patient data allows easier access for providers to patient data and medical information. This access diminishes the potential for errors such as missed drug interactions or relying on incomplete subjective patient-provided information. In addition, assistance in diagnosis through increased availability of “second opinions” is medically relevant. Technology insertion leads to both decreased per patient costs due to increased accuracy of diagnoses and reduced patient episodes of care. Moreover, more efficient patient appointments provide additional economic benefits. Finally, there is an increase in customer satisfaction due to eliminated travel and wait time that can minimize stress to patient and family. These stressors alone could impair the patient’s state of wellness!

The potential payback for conversion to and implementation of HMIS is substantial. It is inevitable that functional economic analyses will demonstrate positive ROIs for correct HMIS implementations. Failure to document clear benefits is attributable to poorly constructed research or incorrect critiques. HMIS is the most cost-effective method of increasing efficiency, taking advantage of economies of scale, and improving patient and provider satisfaction while enhancing the quality and improving access to medical services. A reasonable estimation of the actual benefits, and a clear plan for actually extracting the benefits (and deciding which ones not to extract), is also needed. For example, it may not be possible to extract productivity gains of 15 percent in a small department of 3 people, but this should be possible in a department of 20 people. However, management may feel that even in the 20-person department, the existing workload and stress level is such that extracting the full 15 percent savings may not be a reasonable expectation. A clear benefit-extraction strategy can both provide a more credible estimate of the actual payback, and mitigate some of the employee stress resulting from uncertainty around job

changes that will occur when the system is implemented. This, in turn, could lead to greater acceptance of the system and smoother implementation.

Additional clinical benefits occur through the standardization of access to care, whereby access to sub-specialists as needed throughout society's economic levels may be improved. We achieve improvements in the quality of care through a reduction in errors through peer review, improved training, accountability, visibility, quality synergies of networked providers, quality increases from better educated providers, and visibility in system alerts to sub-standard care. Standardization of care is achieved through clinical practice guidelines (standardized and readily accessible to providers) and standards readily acceptable to patients (empower the people). Clinical applications reduce barriers to care, providing greater access to specialists and sub-specialists and allowing us to "overcome the tyranny of time and geography".⁹⁵ They allow increased security of personal information held in systems, providing greater compliance with medically accepted standards of care and regulations.

Decreases in the cost of care can also be realized through decreased errors. The reduction of medical errors decreases costs of adverse reactions, eliminates repeat (redo or redundant) tests, missed diagnoses, and misdiagnosis (through the use of clinical practice guidelines) and recovers opportunity-lost costs. The cost reductions to the system resulting from improved outcomes can be substantial, but may be difficult to document.

With little standardization and relatively few safeguards in comparison to the manufacturing sector⁹⁶, it comes as no surprise that, in the U.S., adverse drug reactions alone cause more injuries and have greater associated costs than airplane and automobile crashes.⁹⁷ Technology insertion allows the re-engineering of the process through streamlining, standardization, and automation (such as checks and balances to prevent drug interactions and allergies). Use of medication Order Entry Systems (OES) using data on patient diagnoses, current medications, and history of drug interactions or allergies results in reduced prescribing errors and adverse events.^{98 99 100} The automation of ambulatory and clinical care data (e.g. encounters, procedures, ancillary tests) provides a rich source of information for improvement in processes and procedures.¹⁰¹

HMIS offer increased access to services across spatial (geographic and time) and resource (financial and human) barriers. It also furnishes healthcare providers instant access to comprehensive treatment information at the point of care. Your country will realize reduced delays in obtaining information to initiate treatment, alerts, contraindications, reminders, enhanced monitoring, and tailored instructions. HMIS allow for more informed decisions regarding treatment modalities through integrated knowledge sources. Clinical practice guidelines provide the primary care physician (PCP) with specific guidelines, protocols and clinical modalities and allow easy patient tracking. Also, within the system, information exists which will supplement quality improvements and allow contribution to cutting edge research and clinical trials. Increased provider outcome visibility provides performance tracking and physician monitoring.

HMIS insertion into business medical applications realizes improved access to information, standardization of information, improved informational quality and content, decreased cost of business, and increased security. The improvements in information access include easy retrieval of billing codes (diagnosis and procedure codes) and billing prices, as well as clear and complete roll up financial reports. If the system is developed correctly, information generated through queries provides relevant statistics. Increased financial visibility allows for effortless performance tracking and increased visibility of mispricing, billing errors and fraud. With the addition of HMIS into medicine, the requirement for a standard coding system (a standard cost system, based on treatment and a hospital-specific pricing factor) becomes paramount. Improved quality of information provides less mistakes, more visibility in system

operations (preventing mischarging and intentional fraud), better accounting and tracking of costs, better reportability, increased audibility, and decreased cost of business. The streamlined information systems, including electronic transactions, reduce errors, manpower requirements and the cost of business goods, whether or not we achieve “paperlessness”. Reduced administrative costs include reductions in redundant data entry, improved risk management, and reduced malpractice premiums. Also, the technology allows increased security of personal information held in systems and other safety and security improvements.

A 1993 US study showed that 17% of healthcare budgets were administrative costs¹⁰² due to paper inefficiencies, different formats and customization of “standardized” formats. The American healthcare system has an opportunity to save \$3.1 billion annually,¹⁰³ how much can your nation save?

One of the lesser-cited HMIS benefits is the availability of increasingly reliable, inexpensive population statistics. Health trend tracking is of utmost importance in identifying emerging health concerns and trends and for monitoring overall national health. With patient-focused national information technology, it is possible to provide sanitized population health statistics. Population based research statistics (devoid of individual data), provide epidemiological controls through greater visibility. Combined with an overarching customizable query capability, HMIS provide public domain statistics and trend analyses. HMIS also afford greater visibility of drug utilization, visibility of drug interactions, visibility of providers (alerts the system to substandard practices for re-education or removal) and visibility for providers to possibly discover better methods of care.

Statistical demographic queries in a national database provide the ability to aggregate and analyze data, to perform practice pattern analysis, to develop practice guidelines, and to conduct longitudinal studies. To your nation, HMIS will provide increased population trend visibility for halting epidemics and developing health trends. Lastly, policy makers will have accurate health trend data on which to base resource allocation decisions.

Overall benefits of HMIS include:

Increased Access to Care: The use of HMIS and the Internet allows for faster evaluations, which directly relates to the number of diagnoses and evaluations per time. Also, in most illnesses, the impact of early diagnosis and treatment on survival rates and treatment costs cannot be denied. Early diagnosis and early treatment creates better health outcomes at reduced direct costs to the healthcare system.

Better Resource Utilization: Telediagnostic features allow for better utilization of physicians and related hospital staff; thereby expediting diagnoses. Potential effects include greater satisfaction of providers, patients and their families, and possible increased retention rates of staff.

Increased Diagnostic Accuracy: Diagnosis accuracy is always a huge concern for the medical community; therefore, the telediagnostic phase of a HMIS project is considered a primary benefit. It is easier for PCP’s to get expeditious diagnoses, for doctors to get second opinions and for educators to correctly train our next generation of physicians. This greater access to specialists helps ensure more patients will get the appropriate level of care and therefore be treated correctly, the first time. This leads to additional benefits, proper planning for patient treatment plans, wellness programs, better long term results, and better/less use of medications and treatment modalities; all with the resulting reduced costs.

Greater Visibility and Tracking: HMIS allow for greater visibility and tracking of patient health information, provider quality information, population trends, and business transactions. Closer patient monitoring results in decisions at earlier disease states and earlier interventions, with less associated costs and fewer hospitalizations. Tracking physician diagnostic accuracy can reduce malpractice claims and

related medical errors; furthermore population trend tracking more rapidly resolves epidemic and health issues. The physician who can identify the connection between angiosarcoma and previous employment in a vinyl chloride plant is exceptional,¹⁰⁴ however a system containing sufficient, appropriate information will automatically notice even miniscule correlation.

Increased Productivity of the Health System: HMIS allow for the routing of consults to a specialty hospital rather than to a general network hospital or provider. At sites where specialists are not utilized to capacity, the health system can eventually shift the workload to improve utilization. This would allow for better utilization of physicians at remote sites, with the potential for primary care providers providing the needed care with guidance and evaluations from the specialists.

Increased Ability to Enhance and Measure Health and Fitness of Patients: By improving access to tele-evaluations in a timely manner, the technology enables the early coordination and treatment of learning disabilities and associated health conditions, thus improving the health status of patients.

Increase Economic Productivity: The provision of adequate healthcare services to the citizens will provide a healthier, happier citizenship. In addition, any efficient system will reduce stress and therefore better serve your nation.

Improved Utilization of Health System Staffing Model: The opportunity to better use specialist care by consulting to remote clinics and the ability to fill unproductive downtime is a possible HMIS benefit. Depending upon the magnitude and span of the final project, a reduction in the size and skill mix of the health system-staffing model is probable. Improved access may result in shortened or avoided hospital stays, and a marked increase in health status of the patient and family.¹⁰⁵

Increased Ability to Promote and Measure Patient (Citizen) Satisfaction: HMIS enable collaboration between physicians, patients, and ancillary professionals with access to specialists and improved access to information. This collaboration will improve provider satisfaction and lead to improved retention rates and enhanced patient care. The improved information directly relates to considerable improvements in the quality of care and patient satisfaction.

Provision of Earlier Intervention: The importance of early intervention in evaluation and treatment cannot be stressed enough. Normally, the initial patient presentation is in a primary care setting. Referral to a specialist adds a time delay, a stress factor to the patient and the potential that the patient will not return. HMIS provide the distant primary care site with the ability to quickly route clinical information and to access specialty consultations. Patients, providers, and the system capitalize on the benefits of early intervention while the health system maintains quality of care and clinical efficiency. This efficiency minimizes the disruptions to the patient life cycle and maximizes the efficacy of treatment. The technology, implemented locally, can be transferred to remote sites. Factors such as geographic isolation can inhibit the continuity of care as well as delay, and even prevent, the specialty care that is required to treat a condition.

Provision of Community-Based Care: Patients want high-quality care within their local communities. Their daily duties may already include additional stressors related to their illness; therefore reduced travel time and related stresses associated with many referrals are especially value added. The perception of a responsive, clinically based system could alleviate frustration. Support groups and protected chat rooms may serve to create a virtual community of individuals with like issues, where they feel comfortable to discuss problems and find solutions.

Provision of Greater Continuity of Care: HMIS also provide greater continuity of care. By allowing local practitioners to access medical consults, they become a partner with both the patient, for whom they are ultimately responsible, and with the distant specialist as they collaborate on the problem and develop a professional relationship. The provision of community-based, continuous care has been reported as a positive experience for all involved.

Provision of Medical Education: The application of HMIS will promote education and distance learning within the medical community. Technology can be used to link medical school lectures to medical students who are training at rural clinical sites, linking sites for grand rounds and case presentations. HMIS have the potential to allow regional, national, and international forums to meet and discuss research, treatments, and medical trends. Internet access further expands the availability of medical education with on-line learning being offered on many sites often including the availability of CME/Continuing Education Credits (CEs).

Adoption Concerns: It can be hard to determine the true costs of HMIS deployment. Considerable complications exist in evaluating HMIS' often-elusive results. The rapidly evolving information technology field imperils evaluations due to its penchant for transience and "instant" obsolescence. The intricacies of the network topology and convoluted financing arrangements used for technology insertion create an accounting morass, even if properly documented. The size and complexity of needed telecommunications efforts alone may daunt managers and evaluators until they become comfortable with the systems. The diversity of available HMIS technologies may distract individuals from identifying practical, affordable, and sustainable ways to achieve defined quality, access, and cost objectives.

HMIS requires significant levels of cooperation and collaboration – often beyond the norm in our industry. Negative attitudes and reluctance to participate due to cultural and professional differences can impede substantive evaluations and comparisons. Medical productivity is difficult to assess, and the assessment must necessarily address many qualitative issues. Additionally, the insertion of information technology into medicine affects many internal business processes. Overall success depends on end-user acceptance and internal verification and validation.

In part or in whole, provider acceptance is subject to the proper communication of system requirements, benefits and limitations, ease of accessibility, reliability, internal perceived costs-benefits, workload factors, and to the HMIS' perceived educational and research value.

APPENDIX II: CURRENT TRENDS IN MIS

DECREASING COSTS OF TECHNOLOGY

The mid-1990s spawned widespread use of telecommunications portals and technology innovations, which subsequently stimulated growth rate of affordable telecommunications bandwidth. Because computers operate at different performance rates and at assorted costs, computation can be purchased in multiple ways. Price/performance ratios directly establish marketability. We can characterize a computer as a function of price, performance, interoperability, and time of introduction into the commodity market. The necessity of using a common software base allows for dynamic computing, and end user investments dwarf that of the manufacturers.

Financial restrictions to HMIS have recently diminished as telecommunications vendors have passed to consumers price reductions, lowering the relative costs of initial investments. However, telecommunications cost decreases are not uniform, and vary greatly due to tariffs, telecommunication policies, and monopolies in various countries. Another factor affecting investment costs is the acceptance of such applications as store-and-forward methodology. This pragmatic, cost effective method has gained clinical acceptance. Most HMIS projects involve using technology to reduce barriers to healthcare for local or remote populations. Despite the varied results of e-Health project financial analyses, the vast majority of studies cite documented gains in access to care and improvement in health outcomes through the leveraging of expert consulting specialists to remote locations. Halvorsen¹⁰⁶ suggests that HMISs be justified on equity and quality-of-care grounds. However we analyze it, there are definite tradeoffs involved among cost-benefit, quality of care, and access to care outcomes. The use of PCs, Internet connections and already available software is relatively cost efficient when compared to other options for configuration. The cost of off the shelf software is significantly less than tailor made programs, and may create fewer obstacles to interconnectivity in the future. Cost savings of HMIS projects are not always obvious or immediate, and due diligence must be followed when analyzing savings.

While rapidly evolving technology permits new designs to be more cost-effective, there must be backward (in time) compatibility in order to build on and preserve and leverage the user's and manufacturer's investment. This allows flexibility and compatibility along time. Thus, technology provides basic improvements with each new generation, and most new designs provide increased performance at constant price.

Advances in technology translate into three design styles and a fourth option:¹⁰⁷

1. Use the newer technology to build a cheaper system with the same performance.
2. Hold the price constant and use the technological improvement to get an increase in performance.
3. Push the design to the limits of the new technology, thereby increasing both performance and price.
4. Find a drastically new structure using the computer as a basic archetype (e.g., calculators) such that the design can be considered revolutionary rather than evolutionary.¹⁰⁸

Improvements in memory technology are the principal force driving the rise of the minicomputer and the fall of technology costs. Mainframes are expensive, massive and archaic; the minicomputer is readily available, and more recently, extremely interoperable. Memory is the most basic component of a computer, and it is utilized throughout the design. In addition to obvious uses as main program and data memory, and as file storage devices (disks and tapes), memory is also located within the central processor in the form of registers, state indicators, control, and buffer storage between the central processor and main (primary) memory. In input/output (I/O) devices, there are buffers and staging areas. Memory can

be substituted for nearly all logic by substituting table lookup for computation. Constantly increasing bit density has been the most dramatic cost reducing effect on memory and thus minicomputer developments. Bipolar read-write or random-access memory (RAM)¹⁰⁹ chips have advanced as follows.

Approximate year available	Bits of memory
1970	16
1977	4096
1990	1,000,000
1998	64,000,000
2003	1,000,000,000

Cost reductions have paralleled bit density increases. A consequence of high density RAM technology is that cache memories are now extensively used in mid- and upper-range minicomputers. Bipolar ROM¹¹⁰ densities have led RAM densities by about a year.¹¹¹

Today, information and communications technologies, such as the Internet, are commonplace, user friendly, and widely accepted in the developed world. In order to maintain a relative balance of power, it is imperative that the digital divide be closed, and NDE-nations must be brought up to speed with communications technologies. The Internet is becoming a vehicle for the delivery of medical care, and many industry analysts believe it will become a major factor over the next decade. Telecommunications has already been used to efficiently bring medical services directly to the point of need in many areas. HMIS functional business benefits are unparalleled. By providing direct links between general practitioners and major medical centers, HMIS also provides clinical educational opportunities.

INCREASING COST OF SUPPORT

As technology becomes more complex, ubiquitous and inexpensive to produce, the cost of support for the technology increases. Technology refresh rates mandate skilled subject matter experts in continuous learning environments. Cyclic retraining for newer technologies mandates loss of direct labor manpower hours. Additionally, the constant variations wrought by changes and amplifications in technology dictate highly skilled subject matter experts who typically are in low supply and high demand. Thus, competitive pay rates are required. Moreover, such high-priced staff may be less willing to retrain on their own time, and or with their own funds, mandating higher levels of essential employee training and staff development costs to the employer.

EMPHASIS ON SUSTAINABILITY

HMIS require integrated, consolidated, and high performance solutions. There are structural and institutional difficulties in moving towards providing comprehensive and integrated Healthcare services. Partnerships between providers and payers are an absolute necessity in order to create functional HMIS that alleviate systemic problems while providing superior coverage with limited resources. All systems must provide the basis for broad based and equitable delivery of Healthcare Services. Therefore, short-term actions should build sustainable and equitable HMIS that support social development. Integrated solutions may include a comprehensive data continuance portfolio to help ensure high availability, consolidated solutions that maximize utilization of existing storage resources, and high-performance solutions to increase efficiency and productivity. Long-term investment protection is imperative and simplicity for easy deployment and management is necessary. Additional costs in the venue of training, education, and support are necessary to maximize the value of your HMIS assets and drive costs down.

RELIABILITY

Reliability is the ability of a system or unit to perform a required function (continue to operate) under stated conditions for a specified period of time. From a consumer's perspective, a system is reliable if it

operates properly each time he wishes to use it. This operational reliability may be more aptly defined as availability: the system is available and fit for use whenever required. A highly available system need not be highly reliable, although this situation is ideal. An examination of how reliability is assessed provides a basis for understanding the relationship between reliability and availability.

Each assembly, subassembly, device, or component within a system has its own inherent reliability, often expressed as a mean-time-between-failures (MTBF). The inherent reliability of a system is a function of the sum of the non-reliabilities (failure rates) of all components in the system. Consider an integrated circuit (IC) that has an MTBF of 1000 hours. If this device is placed into a circuit that also contains an LED with an MTBF of 1000 hours, the reliability of the circuit is not additive. To determine the MTBF of the circuit, we convert the MTBF of each component into its corresponding failure rate (the reciprocal of its MTBF): $1/1000 = 0.001$. Then take the reciprocal of the sum (0.002) to produce the MTBF of the system (circuit): $= 1/0.002 = 500$ hours. This methodology applies to all serial systems: the input of one element depends on the output of another, and the failure of any device will produce a failure of the entire system.

Intuitively, the more material that is added to a serial system, the lower the resultant MTBF, or the higher the failure rate, will be. This premise is the basis for seeking alternate design approaches, such as fault tolerance, fault resilience, or redundancy, which try to keep a system operational even in the event of a hardware failure. Another issue is that MTBF represents machine operational hours, not calendar time. Exacerbating these issues is the fact that the reliability of a unit changes with time.¹¹² The most common means to sustain a failure without a loss of usability (increased availability) is to increase reliability (reducing the failure rate of the system) through the use of redundant components with switchover at failure. This also allows load sharing during normal operation.

HMIS is about making healthcare products and services accessible, user-friendly and readily available to the general populous. No system is foolproof, however technology affords us the opportunity to create self-maintaining infinite resource-driven databases. The functional stability of the resultant system after the telecommunications overhaul is only as good as the constituent parts. With proper communication and appropriate policies and procedures we have the capacity to revolutionize the health sector. While the technology has the capacity to eliminate economic and social disparities in healthcare, implementation is what mandates the final results.

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- ¹² Providers are those individuals and entities involved in the provision of health services, for fee (either money, or other credit (capitation, etc.)).
- ¹³ RAP Concept Note
- ¹⁴ <http://www.ulb.ac.be/ceese/meta/sustvl.html>
- ¹⁵ “As-is” documents the current state of the system and “to-be” documents the desired end-states as determined by the key stakeholders. For more information on defining and documenting these states the reader is referred to the Electronic College of Process Innovation, a free online resource at <http://www.defenselink.mil/c3i/bpr/bprcd/mhome.htm>.
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- ²⁹ World Health Report, 2000, <http://www.who.int/whr/2001/archives/2000/en/pdf/chapter3.pdf> (accessed 7/18/02), pg 13-14.
- ³⁰ A polyclinic is a clinic or hospital treating diseases of many sorts (Merriam Webster Online, <http://www.m-w.com/>).
- ³¹ Mainly achieved through integrating workflow management.
- ³² A polyclinic offers expert medical treatment both general and specialized as well as possibly psychiatric, dental and other “non-medical” specialties.
- ³³ Hursh-Cesar, Gerald, “Summary of Country Studies: Private Providers’ Contributions to Public Health in Four African Countries” Conference: Private and Non-government Providers: Partners for Public Health in Africa, Nov 28 – Dec 1, 1994.
- ³⁴ Ibid.
- ³⁵ http://www.pacifichui.org/projects/disp_proj.cfm?proj_id=77.
- ³⁶ $26\% - 1.6\% = 24.4\% \times 167,000 \times \$5 = \$204,000$
- ³⁷ In effect, but not formally recognized, ratified or sanctioned (especially as by a standards board such as the ANSI (American National Standards Institute)). SOURCE: Ibid.
- ³⁸ A set of formal rules describing how to transmit data, especially across a network. Low level protocols define the electrical and physical standards to be observed, bit- and byte-ordering and the transmission and error detection and correction of the bit stream. High level protocols deal with the data formatting, including the syntax of messages, the terminal to computer dialogue, character sets, sequencing of messages etc. Many protocols are defined by Requests for Proposals (RFCs) or by the Open Source Initiative (OSI). SOURCE: Free On-line Dictionary of Computing (FOLDOC) at <http://foldoc.doc.ic.ac.uk/foldoc/index.html>.
- ³⁹ The ease with which a piece of software can be converted to run on a new platform and/or compile with a new compiler. SOURCE: FOLDOC.
- ⁴⁰ “The Internet Architecture Board (IAB) is the technical body that oversees the development of the Internet suite of protocols. It has two task forces: the Internet Engineering Task Force (IETF) and the Internet Research Task Force (IRTF) The IETF is a large, open international community of network designers, operators, vendors and researchers whose purpose is to coordinate the operation, management and evolution of the Internet and to resolve short- and mid-range protocol and architectural issues. It is a major source of proposals for protocol standards which are submitted to the Internet Architecture Board (IAB) for final approval. The IETF meets three times a year and extensive minutes are included in the IETF Proceedings. The IETF Secretariat, run by The Corporation for National Research Initiatives with funding from the US government, maintains an index of Internet-Drafts whereas RFCs are maintained by The Internet Architecture Board. The IRTF is chartered by the Internet Architecture Board to consider long-term Internet issues from a theoretical point of view. It has Research Groups, similar to Internet Engineering Task Force Working Groups, which are each tasked to discuss different

research topics. Multi-cast audio/video conferencing and privacy enhanced mail are samples of IRTF output.”
SOURCE: Ibid.

⁴¹ “ISO” is not actually an acronym for anything. However, the organization is a voluntary, non-treaty organization founded in 1946, responsible for creating international standards in many areas, including computers and communications. Its members are the national standards organizations of 89 countries, including the American National Standards Institute. ISO produced the Open System Interconnect (OSI) seven layer model which explains network architecture. SOURCE: Ibid.

⁴² The United States government body responsible for approving US standards in many areas, including computers and communications. SOURCE: Ibid.

⁴³ Formerly European Computer Manufacturers Association) An industry association founded in 1961 and dedicated to the standardization of information and communication systems. ECMA edits standards and technical reports. SOURCE: Ibid.

⁴⁴ “The world's largest technical professional society, based in the USA. Founded in 1884 by a handful of practitioners of the new electrical engineering discipline, today's Institute has more than 320,000 members who participate in its activities in 147 countries. The IEEE sponsors technical conferences, symposia and local meetings worldwide, publishes nearly 25% of the world's technical papers in electrical, electronics and computer engineering and computer science, provides educational programs for its members and promotes standardization. Areas covered include aerospace, computers and communications, biomedical technology, electric power and consumer electronics.” SOURCE: Ibid.

⁴⁵ The Open Software Foundation (OSF) is “a foundation created by nine computer vendors, (Apollo, DEC, Hewlett-Packard, IBM, Bull, Nixdorf, Philips, Siemens and Hitachi) to promote "Open Computing". It is planned that common operating systems and interfaces, based on developments of Unix and the X Window System will be forthcoming for a wide range of different hardware architectures. OSF announced the release of the industry's first open operating system - OSF/1 on 23 October 1990.” SOURCE: Ibid.

⁴⁶ The World Wide Web Consortium (W3C) develops interoperable technologies (specifications, guidelines, software, and tools) for technical aspects of Information Technology Systems. SOURCE: Ibid.

⁴⁷ <http://www.firstsource-furniture.com/edi/page007.htm>.

⁴⁸ http://www-1.ibm.com/mediumbusiness/services/igs_retail.jsp.

⁴⁹ <http://www.geocities.com/WallStreet/Floor/5815/>.

⁵⁰ <http://www.xml.com/>.

⁵¹ http://www.viradix.com/what_is_xml.html.

⁵² <http://www.hl7.org/>.

⁵³ For more information see <http://www.jcaho.org/index.htm>.

⁵⁴ <http://www.jcaho.org/index.htm>.

⁵⁵ The United States federal government enacted legislation in 1983 that established billing categories and the prospective payment system (Grohar-Murray & DiCroce, 1997). The first diagnostic related groups (DRG) were defined by the Social Security Amendments of 1983, Law HR-1900 (PL 98-21), Prospective Payment for Medicare Inpatient Hospital Services (Gerchufsky, 1996). Diagnostic related groups (DRG) are a system of categorizing patients based on the primary and secondary diagnoses, primary and secondary procedures, age, and length of stay. The categories established a uniform cost for each category. DRGs set a maximum amount that would be paid for the care of Medicare patients. Hospitals and health care providers were given a real incentive to keep health care costs down since they would experience a profit only if their costs are less than the amount indicated by the DRG category (Grohar-Murray & DiCroce, 1997). SOURCE: <http://www.pittstate.edu/artsc/diagnosproced.htm>.

⁵⁶ The International Classification of Diseases (current version ICD-10) classifies diseases and injuries. Conditions are grouped in a way that was felt to be most suitable for general epidemiological purposes and the evaluation of health care. ICD is a system developed collaboratively between the World Health Organization (WHO) and 10 international centers so that the medical terms reported by physicians, medical examiners, and coroners on death certificates can be grouped together for statistical purposes. The purpose of the ICD and of WHO sponsorship is

to promote international comparability in the collection, classification, processing, and presentation of mortality statistics. Revisions of the ICD are implemented periodically so that the classification reflects advances in medical science. Since 1900, the ICD has been modified about once every 10 years, except for the 20-year interval between the last two revisions, ICD-9 and ICD-10. Effective with deaths occurring in 1999, the United States replaced ICD-9, in use for deaths from 1979 to 1998, with ICD-10. Publications showing mortality data coded under ICD-10 will differ substantially from those under ICD-9 because of changes in coding rules, changes in category names and ICD numbers, and changes in the tabulation lists used to group mortality data. This source of this footnote, along with a review the history of ICD, highlighted major changes in ICD-10, and a discussion of the statistical impact the revision will have on mortality analysis may be found at <http://www.cdphe.state.co.us/hs/Briefs/icd10brief.pdf>.

⁵⁷ Current Procedural Terminology (CPT) is a uniform coding system for health care procedures that was developed by the American Medical Association (AMA). Third-party payers have adopted the coding system that is used when submitting claims for health care. The CPT system originated in 1966 and is revised annually based on changes in medical practices and updates in technology. The Department of CPT Editorial Research and Development within the AMA adds, modifies, and deletes CPT codes as needed. The CPT Editorial Panel meets four times a year to review proposed changes. That 16-member panel is supported by an Advisory Committee, which represents over 90 medical specialty and professional health organizations. The most recently published codes are in CPT 2002 (American Medical Association, 2002). SOURCE: <http://www.pittstate.edu/artsc/diagnosproced.htm>.

⁵⁸ For instance, if an individual presents to a physician with a communicable disease, of which disclosure may have negative effects on his public life, is this individual afforded confidentiality at the risk of the public commons? Societies balance utilitarianism (John Stuart Mills, “The greatest good for the greatest number”) against individual freedoms.

⁵⁹ The Canadian HIPAA equivalents are the *Privacy Act*, which governs the personal information practices of Canadian (Federal) government institutions, and the *Personal Information Protection and Electronic Documents Act*, which does the same for the Canadian private sector.

⁶⁰ The Australian equivalents to HIPAA are the Information Privacy Act 2000 and the Health Records Act 2001.

⁶¹ DVA Payment Processing Center, online at <http://www.aac.va.gov/ccpc.htm> (accessed 7/22/02).

⁶² Ibid.

⁶³ Bahrain: Implementing Private Health Insurance, Chapter 5.

⁶⁴ Definition of a “store” is any holding place where a significant quantity of items exists.

⁶⁵ Bahrain, op cit.

⁶⁶ Ibid.

⁶⁷ Many countries with national healthcare systems are evaluating or deploying smart card technology to reduce the costs associated with delivering services. The largest operating system is one in Germany with over 80 million cards. Please forward links to other healthcare projects to the SCIA web master. In France, the government set up a project called “Sésam Vitale”. This project is expected to deploy over 10 million smart cards.

⁶⁸ VTC is a teleconference that includes video communications. In other words, a two-way electronic communications system that permits two or more people in different locations to engage in the equivalent of face-to-face communication through the use of audio and video communications technologies.

⁶⁹ MDTV (Mountaineer Doctor Television) is a two-way interactive audio and videoconference using ISDN PRI and BRI digital telephone lines for transmission. SOURCE: Testimony to the Subcommittee on Science, Technology and Space of the Senate Committee on Commerce, Science and Transportation, Sept 15, 1999 Presented by Dr James Brick, Chairman Department of Medicine, Robert C Byrd Health Science Center, Morgantown, West Virginia. “Mountaineer Doctor Television MDTV”.

⁷⁰ Stitt, Judith A, “A System of TeleOncology at the University of Wisconsin Hospital and Clinics and Regional Oncology Affiliate Institutions,” *University of Wisconsin Medical Journal*, Jan 98.

⁷¹ “University of Iowa Hospitals and Clinics Department of Radiology, An Introduction to Teleradiology,” UIHC Office of Public Information, Publications Division, 1995.

- ⁷² World Bank, 1993, World Bank Development Report, 1993 Washington, International Bank for Reconstruction and Development.
- ⁷³ World Health Report, op cit.
- ⁷⁴ Porter, M. The Competitive Advantage of Nations. NY: The Free Press, 1990.
- ⁷⁵ Wilkinson, R., 1992, "Income Distribution and Life Expectancy", British Medical Journal, 304 (Jan 18).
- ⁷⁶ Phillips, K. The Politics of Rich and NDE. NY: The Free Press, 1990.
- ⁷⁷ Marmot, M, 1986, "Social inequities in mortality: the social environment", in Wilkinson R.G. (ed.), Class and Health: Research and Longitudinal Data, London, Tavistock Press.
- ⁷⁸ Power, C. O. Manor and J. Fox. Health and Class: The Early Years. London: Chapman& Hall, 1991.
- ⁷⁹ Dantzer, R. and K. Kelley, 1989, "Stress and Immunity: an integrated view of relationships between the brain and the immune system", Life Sciences, 44.
- ⁸⁰ Moyers, W. Healing and the Mind. NY: Doubleday, 1993.
- ⁸¹ Mustard, J and J.Frank. The Determinants of Health. The Canadian Institute for Advanced Research, Population Health Publication #5, Aug 1991. Toronto: CIAR, 1991.
- ⁸² Bunker, J., D. Gomby and B. Kehrer, 1989, Pathways to Health: The Role of Social Factors, Menlo Park, CA, The Henry J Kaiser Family Foundation.
- ⁸³ World Health Report, 2000, op cit.
- ⁸⁴ United Nations, 1982, Levels and Trends in Mortality Since 1950, New York: United Nations.
- ⁸⁵ We now have a better understanding of the brain and biological pathways that influence how diseases develop and are expressed that is helping us to understand factors causing income and social class differences in health. These difference show up as gradients in which individuals in lower socio-economic levels show elevated incidences of negative health outcomes. (Source: Keating, D, "The National Longitudinal Survey of Children and Youth: An Essential Element for Building a Learning Society in Canada", Ontario Institute for Studies in Education of the University of Toronto and CIAR, online at
- ⁸⁶ Positive relation between health and other factors
- ⁸⁷ Wilkinson, R., op cit.
- ⁸⁸ Gerdtham, U-G., Jonsson, B., 2000, International Comparisons of Health Expenditure: Theory, Data and Econometric Analysis, in Newhouse, JP., Cuyler, AJ., (eds.) Handbook on Health Economics, North Holland/Elsevier, (NOTE: Text is no longer available online, was accessed on 2002-07-18 at <http://www.elsevier.nl/hes/books/17/1a/001/171a001.htm>).
- ⁸⁹ Bahrain, op cit.
- ⁹⁰ The International Classification of Diseases (current version ICD-10) classifies diseases and injuries. Conditions are grouped in a way that was felt to be most suitable for general epidemiological purposes and the evaluation of health care. ICD is a system developed collaboratively between the World Health Organization (WHO) and 10 international centers so that the medical terms reported by physicians, medical examiners, and coroners on death certificates can be grouped together for statistical purposes. The purpose of the ICD and of WHO sponsorship is to promote international comparability in the collection, classification, processing, and presentation of mortality statistics. Revisions of the ICD are implemented periodically so that the classification reflects advances in medical science. Since 1900, the ICD has been modified about once every 10 years, except for the 20-year interval between the last two revisions, ICD-9 and ICD-10. Effective with deaths occurring in 1999, the United States replaced ICD-9, in use for deaths from 1979 to 1998, with ICD-10. Publications showing mortality data coded under ICD-10 will differ substantially from those under ICD-9 because of changes in coding rules, changes in category names and ICD numbers, and changes in the tabulation lists used to group mortality data. This source of this footnote, along with a review the history of ICD, highlighted major changes in ICD-10, and a discussion of the statistical impact the revision will have on mortality analysis may be found at <http://www.cdphe.state.co.us/hs/Briefs/icd10brief.pdf>.

- ⁹¹ Current Procedural Terminology (CPT) is a uniform coding system for health care procedures that was developed by the American Medical Association (AMA). Third-party payers have adopted the coding system that is used when submitting claims for health care. The CPT system originated in 1966 and is revised annually based on changes in medical practices and updates in technology. The Department of CPT Editorial Research and Development within the AMA adds, modifies, and deletes CPT codes as needed. The CPT Editorial Panel meets four times a year to review proposed changes. That 16-member panel is supported by an Advisory Committee, which represents over 90 medical specialty and professional health organizations. The most recently published codes are in CPT 2002 (American Medical Association, 2002). SOURCE: <http://www.pittstate.edu/artsc/diagnosproced.htm>.
- ⁹² Agency for Healthcare Policy and Research, Statement paper 1997: <http://www.ahcpr.gov/>.
- ⁹³ It has been projected that by the year 2010 we will be doubling man's knowledge base every 35 days. Issues of supporting, documenting, archiving, retrieving and managing this become notably significant.
- ⁹⁴ Stitt, Judith A, op cit.
- ⁹⁵ Anthony Gelish, 1999.
- ⁹⁶ Bates, David W. "Using Information Technology to reduce rates of medication errors in hospitals" *BMJ*, 320:788-91.
- ⁹⁷ Ibid.
- ⁹⁸ Ibid.
- ⁹⁹ Kohn et al., "To Err is Human: Building a Safer Health System," Committee on Quality Healthcare in America, 1999.
- ¹⁰⁰ Leapfrog Group, 2000. "Leapfrog Patient Standards: The Potential Benefit of Universal Adoption." Online at <http://www.leapfroggroup.org> (Accessed July 12, 2001).
- ¹⁰¹ IOM, op cit.
- ¹⁰² Baker, Dixie, "HIPAA Administrative Simplification: Business Challenges and Opportunities." Feb 11, 2000.
- ¹⁰³ Ibid.
- ¹⁰⁴ Rocket, Ian R.H., "Population and Health: An Introduction to Epidemiology," 2nd ed. Population Bulletin, vol 54 no 4, Washington, D.C.: Population Reference Bureau, Dec 1999.
- ¹⁰⁵ Hilsenrath, Peter E. and Smith, Wilbur et al., "Analysis of the Cost-Effectiveness of PACS," *American Journal of Radiology*, January 1991, p. 177.
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- ¹⁰⁷ Bell, C. Gordon, Mudge, J Craig and McNamara, John, Computer Engineering: A DEC View of Hardware Systems Design, available online at http://research.microsoft.com/users/Gbell/Computer_Engineering/00000007.htm. (accessed 2002-07-12 on http://www.ulib.org/weRoot/Books/Saving_Bell_Books/Computer_Engineering/contents.html).
- ¹⁰⁸ "The influence of technology on the computers that are built and taken to the market place is so strong that the four generations of computers have been named after the technology of their components: vacuum-tubes, transistors, integrated circuits (multiple transistors packaged together), and large-scale integrated (LSI) circuits. Each electronic technology has its own set of characteristics, including cost, speed, heat dissipation, packing density, and reliability, all of which the designer must balance. These factors combine to limit the applicability of any one technology; typically, one technology is used until either a limit is reached or another technology supersedes it." (direct quote Bell, et al.)
- ¹⁰⁹ RAM, previously "direct-access memory", is a "data storage device for which the order of access to different locations does not affect the speed of access. This is in contrast to, say, a magnetic disk, magnetic tape or a mercury delay line where it is very much quicker to access data sequentially because accessing a non-sequential location requires physical movement of the storage medium rather than just electronic switching. The most common form of RAM in use today is built from semiconductor integrated circuits, which can be either static (SRAM) or dynamic (DRAM). In the 1970s magnetic core memory was used. RAM is still referred to as core by

some old-timers. The term "RAM" has gained the additional meaning of read-write. Most kinds of semiconductor read-only memory (ROM) are actually "random access" in the above sense but are never referred to as RAM. Furthermore, memory referred to as RAM can usually be read and written equally quickly (approximately), in contrast to the various kinds of programmable read-only memory. Finally, RAM is usually volatile though non-volatile random-access memory is also used. Interestingly, some DRAM devices are not truly random access because various kinds of "page mode" or "column mode" mean that sequential access is faster than random access." SOURCE: Free Online Dictionary of Computing, <http://foldoc.doc.ic.ac.uk/foldoc/index.html>.

¹¹⁰ Read-Only Memory (ROM) is a type of data storage device manufactured with fixed contents. Generally, the term may represent any storage system whose contents cannot be altered; however, the term is most often applied to semiconductor integrated circuit memories, of which there are several types, and CD-ROM. ROM is inherently non-volatile storage - it retains its contents even when the power is switched off, in contrast to RAM. ROM is often used to hold programs for embedded systems since these usually have a fixed purpose. ROM is also used for storage of the lowest level bootstrap software (firmware) in a computer. SOURCE: Free Online Dictionary of Computing, <http://foldoc.doc.ic.ac.uk/foldoc/index.html>.

¹¹¹ Bell, C, op cit.)

¹¹² The following equation, which forms the basis of nearly every reliability function, indicates that the reliability of an electrical unit exponentially decreases through time:

$$R = e^{-(t/MTBF)}$$

where

R = the probability that the unit will be fit for use

e = the natural log

t = the time under consideration

MTBF = the reciprocal of the failure rate



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