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Introduction

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Why health information systems?

Good management is a prerequisite for increasing the efficiency of health services. The need to do more with less is especially important because the health sector faces ever increasing demands while receiving stagnant or decreasing resources.

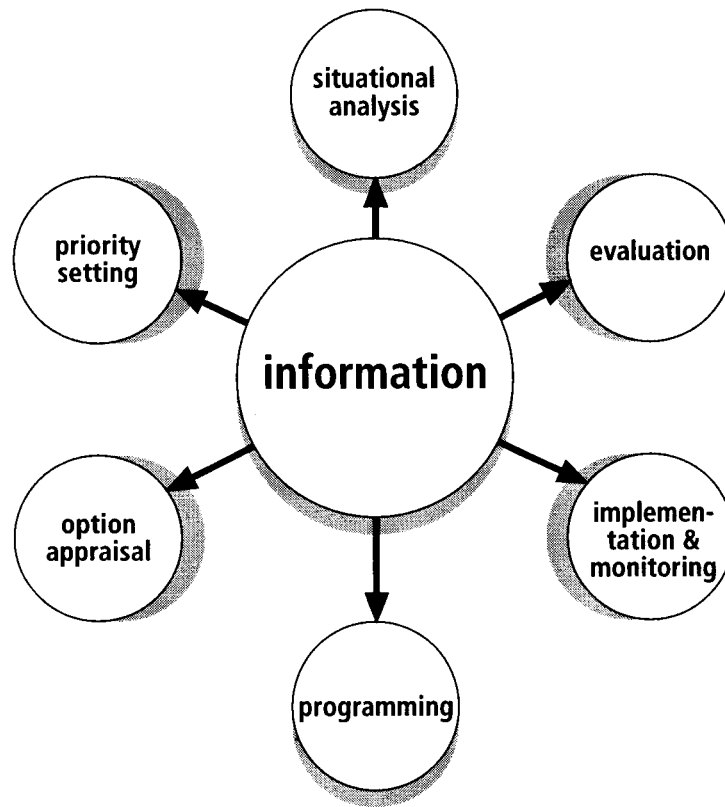
Good management is also a prerequisite for increasing the effectiveness of health services. There is ample evidence that interventions lose a great deal of their theoretical effectiveness, also called efficacy, if they are delivered by poorly run health services (Tanner & Lemgeler, 1993; Tugwell et al., 1985). As an example, the effectiveness of polio vaccines may be diminished by breakdowns of the cold chain, incorrect assessment of the age of the child, failure to follow up on children who do not come for booster shots, and other such flaws. The challenge for health systems is to optimize the management of service delivery in a way that minimizes losses in effectiveness.

The World Health Organization (WHO) has long identified health information systems as critical for achieving health for all by the year 2000 (Mahler, 1986). A report of a WHO meeting (1987) clearly links improved management to improved health information systems: "Of the major obstacles to effective management, information support is the one most frequently cited." Unger and Dujardin (1992) and Lippeveld et al. (1992), recently stressed the need for well-designed routine information systems for ensuring that services are delivered according to standards.

For information to influence management in an optimal way, it has to be used by decision-makers at each point of the management spiral. Examples of these decision points include undertaking situational analysis, setting priorities, or implementing a programmed activity (see Fig. 1). Information is crucial at all management levels of the health services, from the periphery to the centre. It is crucial for patient/client management, for health unit management, as well as for health system planning and management. This means that not only policymakers and managers need to make use of information in decision making but also care providers, including doctors, health technicians, and community health workers. Unless this occurs, the considerable opportunity costs involved in set-up and maintenance of health information systems can be difficult to justify.

Helfenbein et al. (1987) rightly stated that "changing the way information is gathered, processed, and used for decision-making implies changing the way an organization operates". Or as Newbrander and Thomason

Fig. 1 Information support to each step in the management cycle



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Source: modified from Green (1992)

(1988) pointed out in their article on health information systems in Papua New Guinea: “The enhanced development of the health information system has been used as the entry point for the improvement of managerial capabilities in the health system”. Similarly, our hypothesis is that the development of rationally structured routine information systems, closely adapted to the information needs of health services at the district, health centre, and community levels, can potentially contribute to the overall improvement of health service management.

Definitions

A “system” is conveniently defined as any collection of components that work together to achieve a common objective. The objective in the case of a health information system then is to improve health services management through optimal information support. We define “information” as a meaningful collection of facts or data.

While consensus on the definition of “system” and “information” is quickly established, defining the term “health information system” is less obvious. At the outset, health information systems were oriented to collect information on diseases (“surveillance”) and on health service output. While these functions are certainly important, we prefer to start from the definition of information systems as commonly used in industry. Hurtubise (1984) describes them as systems that provide specific

information support to the decision-making process at each level of an organization. The ultimate objective of health information systems is therefore not “to gain information” but “to improve action”. Applied to the health sector, we can now define health information systems as a set of components and procedures organized with the objective of generating information which will improve health care management decisions at all levels of the health system.

The widely used term “health management information system” could be misleading, since it may suggest that there are different information systems for different functions, for example management information systems, epidemiological surveillance systems, and administrative information systems. We consider all these as “subsystems” (see also Chapter 2) of a unified health information system and therefore prefer the latter term.

In summary, health information systems integrate data collection, processing, reporting, and use of the information necessary for improving health service effectiveness and efficiency through better management at all levels of health services.

What is wrong with current health information systems?

Unfortunately, health information systems in most countries are inadequate in providing the needed management support (WHO, 1987; Lippeveld, Foltz & Mahouri, 1992). Most health care providers in developing countries equate information systems with filling endless registers with names and addresses of patients, compiling information on diseases (e.g. sex and age of patients) every week or every month, and sending out reports without adequate feedback. Furthermore, the data received are often not helpful for management decision making because they are incomplete, inaccurate, untimely, obsolete, and unrelated to priority tasks and functions of local health personnel. In other words, information systems tend to be “data-driven” instead of “action-driven” (Sandiford, Annett & Cibulskis, 1992). A large part of the data collected passes to the national level without being analysed and used, and frequently ends up on the dusty shelves of an office in the Ministry of Health (Smith, Hansen & Karim, 1988; Becht, 1986; Frere, 1987; Ho, 1985; Kiaffi, 1988; WHO, 1988a; de Kadt, 1989). Current health information systems are therefore widely seen as management obstacles rather than as tools. The reasons can be summarized in five points:

Irrelevance of the information gathered

According to a WHO Expert Committee (1994), “Many of the data recorded and reported by the health service staff are not needed for the tasks the staff perform”. Data collection tends to focus on disease reporting and only partially addresses management objectives at the health unit level or at the patient/client level. Yet data that are needed are frequently not collected. For example, appropriate indicators to monitor continuity of care of individual patients or clients are rarely included in health information systems.

The common denominator of these two observations is a lack of a consensus between producers and users of data at each level of the health care system regarding the information needed.

Poor quality of data

Data requirements are frequently chosen without taking into account the technical skills of the health workers collecting the data, or the available diagnostic equipment in peripheral health facilities (Nordberg, 1988; Lippeveld, Foltz & Mahouri, 1992; Frere, 1987). For example, at the first level of care, auxiliary health staff without laboratory or X-ray facilities are required to report on diseases such as leishmaniasis, diphtheria, and peptic ulcer. Furthermore, health workers receive little if any training in data collection methods (Murthy & Patel, 1988; Kiaffi, 1988; Nordberg, 1988), and rarely have standardized instructions on how to collect the data (Frere, 1987; Foreit et al., 1988; Jaravaza et al., 1982; WHO, 1994).

Another reason data quality is low is lack of motivation among health services personnel. Since health services supervisors and peripheral health workers rarely receive feedback on the data reported to higher levels (Smith, Hansen & Karim, 1988; de Kadt, 1989; Frere, 1987; Ho, 1985; Mitchell & Cromwell, 1982), they have little incentive to ensure the quality of the collected data and to comply with reporting requirements (Smith, Hansen & Karim, 1988; Frere, 1987; Ho, 1985; Mitchell, 1983; Helfenbein et al., 1987; Stinson, 1983; Murthy & Patel, 1988).

Duplication and waste among parallel health information systems

Historically, national reporting systems, even in developed countries, are rarely the result of a coordinated effort to address information needs of health planners and managers. Often, donor agencies or national programmes within the Ministry of Health developed their own specialized information system (Mitchell & Cromwell, 1982; Lippeveld, Foltz & Mahouri, 1992; Foreit et al., 1988; WHO, 1994), mostly under pressure and with financial assistance from external donor agencies.

Designed as vertically structured "empires", these programmes replaced line managers with programme directors who managed separate categories of personnel, facilitated separate training programmes, and created separate "programme information systems" which tended to focus on one specific disease (e.g. diarrhoea), a specialized service (e.g. "family planning information systems"), or a management subsystem (e.g. "drug management information system") instead of addressing management functions in a comprehensive way. These programme information systems existed side by side and in addition to the general routine health information system, which was considered insufficient and incapable of delivering the data needed for programme management. While these separate systems could indeed provide real information support for programmatic decisions, and the quality of information generated tended to be better than that of the general information system (WHO, 1994), the net result was that routine health information systems became chaotic and bothersome (Ho, 1985; Foreit et al., 1988; Kiaffi, 1988; Murthy & Patel, 1988).

The literature reveals several design and implementation problems. Reporting and transmission within each system is usually designed with minimal involvement of the line managers and providers of the health services (Frere, 1987; Mitchell & Cromwell, 1982; Stinson, 1983). The result is that health workers are drowned in a multitude of reports to be com-

pleted every month (Ho, 1985; Murthy & Patel, 1988; Kiaffi, 1988; Stinson, 1983). Since the data are not cross-referenced among the different systems, health care providers and systems managers spend a considerable amount of time collecting redundant and overlapping information (Smith, Hansen & Karim, 1988; Ho, 1985; Foreit et al., 1988; Rodrigues and Israel, 1995). Furthermore, data transmission does not follow the hierarchical lines of communication, so that reports often do not reach their destination (Frere, 1987; Ho, 1985; Lippeveld, Foltz & Mahouri, 1992). Elimination of duplication and waste requires a unified system rather than better coordination among the existing parallel structures.

Lack of timely reporting and feedback

The process of transmitting, compiling, analysing, and presenting the data is usually so tedious that by the time a report is prepared, the data are frequently obsolete and decisions are often made without any information input. Planners and managers face deadlines and time constraints in their daily decision making. Outdated information, even if of high quality, is of low value to them. Delays in data transmission and lack of feedback at the district level are often caused by the presence of strong vertical programmes. Health facilities report data directly to national programme managers, and line managers at the district level receive outdated feedback reports, if any.

Poor use of information

Despite the evidence that much of the generated data is irrelevant, of poor quality, redundant, or obsolete, there are nonetheless some useful data sets available. Unfortunately, researchers have not adequately evaluated or documented information use, and the prevailing sentiment that information is poorly used is based mainly on anecdotal evidence.

However, a few existing studies do point to some of the culprits. For example, information use was found to be especially weak at the district, health centre, and community levels (Smith, Hansen & Karim, 1988; WHO, 1988b; de Kadt, 1989), given the centralization of many health systems and, hence, health information systems. This raises serious concerns, given the current effort to decentralize decision making and build capacity at the district level.

Dunn (1980) revealed another impediment to ensuring use of information: the difference in “culture” between data people and decision-makers, which is difficult to bridge. Consequently, planning and management staff rely primarily on “gut feelings” to formulate ad hoc decisions rather than seek pertinent data. We will explore the factors that lead to the failure to use information and provide suggestions for solving this problem in Chapter 3.

Efforts to reform health information systems

The chaotic status and inefficiency of most existing information systems in developing countries are linked to the structural weakness of the system and lack of integration in the overall health system. This can be explained by the fact that historically, as in most developed countries, information systems were not intentionally planned to provide management support to the health services in an integrated way. Foltz (1993)

explains: "They differ from country to country depending upon historical accident and the interests of policy makers, administrators and researchers".

The first efforts to systematically collect, analyse, and report data for improved management in developing countries were undertaken by national programme managers of vertically structured "empires", as discussed above. This was due to the fact that foreign assistance to the health sector was typically focused on programmes rather than the entire health system. Since such projects were accountable to their respective donors, information on performance had to be collected. Targeting financial resources on disease control programmes or programmes addressing a group of specific "health problems" was indeed attractive to the donors because the quantifiable success of these programmes justified the use of their funds. This vertical approach to health care delivery, and thus to health information systems, was considered even more justified in the early eighties because of the prevailing "ideology" of selective primary health care (Walsh & Warren, 1979). However, apart from their effect on health information systems, these vertical programmes were undermining the development of a sustainable primary health care-based health infrastructure. In recent years great efforts were made in many countries to integrate the Expanded Programme for Immunization, the Control of Diarrhoeal Disease Programme, onchocerciasis control, and other vertical programmes into existing health structures, thus strengthening them.

The problems with health information systems were not lost on national policymakers and donors. Many countries decided to attack the information problem at its roots and planned for a more integrated approach to improving health information systems. Comprehensive restructuring efforts in countries such as Cameroon (see Sauerborn, 1991; Berg, 1988; Weber, 1989), Chad (see Lippeveld, Foltz & Mahouri, 1992; Unger, 1989), and Pakistan (see Ministry of Health, 1994) concentrated on the routine health information system for first-level care facilities. In Cameroon, health information system restructuring was complementary to an overall reform of the health services, building on a decentralized district health system based on primary health care. In Chad and Pakistan, restructuring of the health information system was done as a separate project.

In other countries, health information systems reform was done using a more gradual approach which consisted of either the reform of subsystems, such as epidemic disease surveillance (e.g. Burkina Faso) or routine services reporting (e.g. Niger). Table 1 gives an illustrative list of countries where national health information systems reform efforts took place recently or are still underway.

The drive for the reform of health information systems coincided with a revolution in information and communications technology. The computer has made its entry even in the most reluctant ministry of health. Doctors and nurses discuss hardware, databases, and spreadsheets. Low-cost powerful microcomputers and modems can efficiently store, process, and transmit enormous amounts of data. "User-friendly" desktop publishing and graphics software permit timely, specific, and action-oriented feedback to managers at different levels of the health services. With this state-of-the-art technology combined with pressure from the computer industry, most recently created or restructured health information

Table 1 *Illustrative list of published reports on national health information systems reform projects*

Country	Reference
Bangladesh	Reynolds, 1988
Burma	Reynolds, 1988
Bolivia	Cardenas, 1992
Cameroon	Sauerborn, 1991; Berg, 1988; Weber, 1989
Chad	Lippeveld, Foltz & Mahouri, 1992; Unger, 1989; Foltz, 1993
Eritrea	Tekle et al., 1995
Ghana	Campbell, Adjei & Heywood, 1996
Nigeria	Lecky, 1991
Niger	Kiaffi, 1988
Pakistan	Ministry of Health, 1994
Papua New Guinea	Campos-Outcalt, 1991
Philippines	Magnani, 1990
Swaziland	Ministry of Health, 1990
Thailand	Reynolds, 1988

systems are computerized to various degrees. But introducing computer technology in the development of improved health information systems is not necessarily the “silver bullet” that solves the efficiency problem of the health services (Sandiford, Annett & Cibulskis, 1992). On the contrary, lack of appropriately trained staff, a hostile climate, and hardware and software maintenance problems sometimes result in the decay and obsolescence of expensive computer equipment.

Review of the literature on health information systems reform

The scientific literature on how to develop appropriate health information systems in support of basic health services is relatively scanty, despite the general consensus that these systems should be restructured. Before 1985, most of the literature on management information systems focused on the use of computer technology rather than organizational aspects of information handling, information systems for large tertiary hospitals rather than basic health services, and survey methodology rather than routine health unit-based information systems. Other publications have underlined the importance of the development of such information systems, but without detailing how they could be developed. One of these publications is the report on an international workshop on management information systems and primary health care organized by the Aga Khan Foundation in Lisbon (Portugal) in 1987 (Wilson et al., 1988), which covers most of the issues cited. Most publications have focused on a single aspect of the development of health management information systems (see Table 2).

Somewhat more comprehensive, the publications of Stinson (1983) and Helfenbein et al. (1987) provide a fair amount of detail on available methodologies and technologies for the development of routine health unit-based information systems in developing countries, but they reached a limited target audience and date from 1983 and 1987, respectively. The Aga Khan Foundation published the Primary Health Care Management Advancement Program series (Wilson & Sapanuchart,

Table 2 *Specific aspects of health information systems development in the literature*

Aspect of health information systems	Reference
Information needs for national health planning	White, 1977; WHO, 1981; WHO, 1994
Disease surveillance systems	Klaucke et al., 1988; Thacker, Parrish & Trowbridge, 1988
Development of computerized data processing systems	Brodman, 1986; Bussell, 1993; Rodrigues & Israel, 1995
Programmatic information systems	Ho, 1985; Newbrander, Carrin & Le Touze, 1994; Pelletier, 1994
Data collection methods	Anker, 1991; Frerichs, 1988; Guhasapir, 1991; Hill, Zlotnik & Trussell 1981; Kielmann, Janovsky & Annett, 1995; Kroeger, 1983; Lanata & Black, 1991; Oranga & Nordberg, 1993; Scrimshaw et al., 1992; Seltzer, 1990; Valadez, 1991
Epidemiological techniques	Vaughan & Morrow, 1995
Community involvement	Husein et al., 1993; O'Neill, 1993; Scott, 1988
Measurement of quality of care and health information systems	Garnick et al., 1994; Roemer & Montoya-Aguilar, 1988
Politics of health information systems reform	Foltz & Foltz, 1991

1993). Conceived as a set of field guides to strengthen the quality and utility of health data organized around nine thematic modules, the Management Advancement Program series helps primary health care managers at the local level to collect and use information for managing the health services under their supervision. Also, more recently, two WHO documents on the development of district-based routine health information systems were published, the first titled *Information support for new public health action at district level* (1994), and the second, by the Pan American Health Organization titled *Conceptual framework and guidelines for the establishment of district-based information systems* (Rodrigues & Israel, 1995). The first document is a report of a WHO Expert Committee, summarizing problems and strategies related to the development of district routine health information systems. The second publication, by Rodrigues and Israel, gives an excellent treatment of the design of district-based health information systems, with a strong emphasis on computer software and hardware.

Scope of the book

This book responds to an urgent need in the public health community to gather in one publication the state of the art of designing and implementing health information systems, particularly in developing countries. It especially addresses the question of how to transform existing information systems into management support systems.

The focus is on routine health unit-based information systems. The rationale behind this approach is based on several conditions which exist in the basic health services in most developing countries. First, the problems of inefficient and chaotic data collection and use of information in peripheral health units as previously described typically apply to routine health unit-based information systems. Many government agencies and

donors tend to “use . . . general and special-purpose surveys to capture data that should be part of routine reporting” (WHO, 1994). But these problems do not solely originate from the methodological attributes of routine information systems. They also reflect poor general management capability of the basic health services. Our hypothesis is that the development of rationally structured routine information systems will also contribute to the overall improvement of the management capability of the basic health services, particularly if a consensus-building design process is used. Second, routine health unit-managed information systems are the only way to generate data for patient and client management decisions. They are especially suited for routine managerial decisions, such as those related to ordering supplies, or supervision of health personnel. Considering the fact that data collection is performed mainly by health care providers as part of their health care tasks, marginal cost is low. Finally, the development of routine health information systems, compared with surveys and other nonroutine methods, has been less well described in the scientific literature.

Most of the analysis and strategies on health information systems development discussed in this book will pertain to government-managed health services because this is the most common health services system in developing countries. Yet one of the roles of the district management team is to coordinate and supervise nongovernment and private health services within the district (WHO, 1988b). We will therefore also discuss in the following chapters means and strategies to involve private sector health care services in health information systems development.

The strength of the book lies in the case material distilled from information systems which the authors have helped to design and maintain. In the last 10 years, the authors have gathered broad and varied experience in the development of health information systems through projects and advisory services in developing countries throughout the world: Bolivia, Burkina Faso, Cameroon, Chad, Costa Rica, the Democratic Republic of the Congo, Eritrea, Malawi, Niger, and Pakistan. Some of these efforts involved overall restructuring of health information systems, such as in Cameroon, Chad, Eritrea, and Pakistan. Other efforts were limited to more specific aspects of health information systems development, such as the introduction of lot quality assurance sampling as a tool to improve quality of care in Costa Rica, the use of geographic information systems in Bolivia, and production of annual feedback reports for district managers in Niger. These experiences, combined with those of the guest authors and the team of the Strengthening Country Information System unit of WHO/Geneva, provide a unique opportunity to bring together in book form lessons learned about the development of health information systems.

The book targets professionals not only in the health sector but also in related sectors involved in planning and managing health services at national and intermediate levels, particularly government health services and of nongovernmental organizations. Our focus on decentralized, district level-operated health services makes it a valuable guidebook for district health managers. The presentation of case studies and the continuous link in the text between concepts presented and actual implementation in the field are intended as a resource for teachers and students in programmes related to planning and managing health services in developing countries, and more specifically to developing health information systems.

Organization of the book

The chapters of the book have been grouped under four parts. The theme of the first part with two chapters is information for decision making. In Chapter 2, we lay the groundwork for health information systems design by providing a health services system framework closely linked to the health information systems restructuring process. Chapter 3 deals with use of information, analysing the reasons information is rarely used by decision-makers and suggesting ways and means to improve its use.

The second part of the book has six chapters examining step by step how health information systems should be structured so that they can provide information useful to decision making at all levels of the health services. Chapter 4 deals with the first step, information needs and indicators and how to define them through consensus building. In Chapter 5, the author proposes a health information system assessment methodology to identify weak elements in the existing health information system and set the agenda for the restructuring process. Chapter 6 contrasts the different routine data collection methods, while Chapter 7 gives an overview of nonroutine data collection tools. Data transmission and processing are the focus of Chapter 8, with particular emphasis on assessing and assuring data quality. Chapter 9 applies these health information systems restructuring principles to population-based community health information systems.

The three chapters of the third part of the book deal with resources and tools required for a well-functioning health information system. Chapter 10 provides a comprehensive view of the health information system resource base: staffing, training, and supervision; procurement and distribution systems of printed supplies; purchase and maintenance of hardware and software; and budgeting for recurrent health information system costs. Chapter 11 analyses the strengths and weaknesses of computer use in health information systems. Chapter 12 highlights one particular computer application: geographic information systems and their potential usefulness in health services planning and management.

Whereas the first three parts of the book provide the principles and technical content of health information systems for decision making, the two chapters of the last part are about the process of health information systems restructuring. Chapter 13 focuses on the politics of change, analysing how different interest groups and contextual factors can influence the design and implementation of new health information systems in a positive or negative way, and proposing health information systems design strategies to deal with these factors. Finally, in Chapter 14, the authors, based on their experience, summarize health information systems development approaches which almost certainly will fail, and those, on the contrary, which will lead most likely to successful health information systems restructuring. The chapter also identifies areas for future research and development experience.

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