ASCI Journal of Management
Vol. 10 No. 2 (March 1981)

Computer-based Information Systems for Health Administration at State Level

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This paper discusses the use of computer-based information systems for management in health administration. Illustrative examples and sub-systems are derived from the experience in developing such systems for the health directorate in Andhra Pradesh. The discussion is restricted to the computerised systems providing accurate and comprehensive information for the effective decision-making, and for the formulation of policy. Information needs and organisation structures are discussed to the extent necessary. The systems are divided according to the main classifications of the health services; characteristic development efforts in each category are also discussed.

As early as in the 17th century, demographers attempted to estimate the "London population at risk", afflicted by various diseases and plague epidemics, based on the "bills of mortality". Later, several schemes were introduced to process vital statistics. In the present century, computers appeared on the scene and were successfully exploited by industries, not only in improving profitability, efficiency, but also in improving decision-making power. The success of computers kindled, in early 1960s, the expectations of several people that computerised information can be used with equal success in the health care operations to increase efficiency and effectiveness. Computers came to be regarded as a panacea for many of the unsurmountable and complex problems of the health policy and planning. The developed countries used computers increasingly in preventive medicine, public health, epidemiology, hospital care, etc. These efforts produced results, but the success was not as quick and spectacular as expected. Yet, still computers came to be used more and more in preventive medicine and epidemiology, where the major requirements were of data processing and computational. On the other hand, hospital information systems tended to be fragmented and incomplete in spite of the numerous attempts. In 1969, J C Smith wrote: "There does seem to be wide agreement that no one knows just what a hospital information system is — and probably will not know until a complete system is put together in one institution". Little was achieved in management and administration and the use in policy forming was minimal.

The author acknowledges with thanks the help of Mr K Ravindra and Dr S P Yayathi

While computerised information systems were working wonders in the industrialised nations, the task of determining information needs and creating the necessary infrastructure for introducing computers in developing countries continued to be neglected. What with the population explosion, limping socio-economic development, and unclear role of the health services in national planning, the attempts made at information systems — electronic or otherwise — even to date have been quite rudimentary. Only recently, the National Informatics Center, set up by the Government of India, has initiated work to develop information systems for the Ministry of Health and entrusted projects to develop information systems at the State level.

Organisation of Health Services

According to simple definition, the purpose of any information system should be to provide information to the user in such a form that the most informed or rational decisions can be made. This, of course, assumes that the functions, objectives, scope, and role of the organisation are unambiguously known and the types of decisions required can be preconceived. However, the health standards in the developing countries are so much dependent upon the socio-economic development, that often the scope and role of the health organisation remain undefined or imprecise. It is, therefore, worthwhile to study the organisation of health services in the developed nations, their information requirements, achievements in information systems, and compare these with the requirements of the developing countries.

In the US, where free enterprise plays a vital role, the medical practice is largely dominated by the independent specialists. With the advances in modern medicine, clinical examinations based on the equipment methods, play a vital part. Most of the population are enrolled in medical insurance schemes which reimburse the usually very high expenses on hospital charges and surgery. Information systems in hospitals help the doctors in clinical investigation and treatment, by providing medical description of the patients based on the results of the numerous diagnostic examinations and other tests. With a competitive environment similar to industry and business, the information systems also help perform the function of cost analysis and billing. State caters to a few schemes of community medicine and health care of the poor and elderly persons. Britain introduced a National Health Service Scheme in 1948 which covers the health care services of every citizen irrespective of his economic status and geographical location. For medical care, every person is attached to a general practitioner and if need arises, he can go through a network of specialists and hospitals. A lot was expected from the computerised information systems to manage such a gigantic task. Today, information systems and comprehensive databanks are helping in public health planning, preventive medicine, hospital activity analysis, and hospital management. It is expected that in future these systems will play a even more vital role in solving the logistical problems of health care delivery and in policy decisions. In Soviet Union, in keeping with the communist ideology, the medical service is free. A 'clinic' treats outpatients, which has the equipment for diagnosis, and a number of doctors and para-medical personnel. A clinic usually serves a population of about 4,000.

The Indian Scene

In India, health care is largely the responsibility of the State governments. The Central Government allocates the resources

for the national health programmes. The State governments implement and control these programmes. The Health Department of a State Secretariat reviews the progress and assists in formulating policies. The task of planning medical care, disease control, promotional programmes, and deployment of resources is entrusted with the Directorate of Medical and Health Services. Medical care is provided through a network of teaching and specialised hospitals, district and taluq hospitals, and primary health centres.

In the developed countries since the health standards are higher, the information systems necessarily center around better provision of curative health services. Whereas, the health care needs of the developing countries are still intricately dependent upon the socio-economic development. The problems of illhealth are essentially related to the more basic issues of poverty, unemployment, illiteracy, malnutrition, bad housing, and unhygienic environment. Improvement of health is also an element in the socio-economic development, though health services alone cannot achieve it. Planning for better health and its administration involves integrating health policy with the national development and combining the health services with the other health improving activities in the country. For a health administrator, there is a constant need to assess the impact of health services, evaluate the various health programmes, reformulate the health policies and optimise the utilisation of the available resources. Information systems in developing countries should be built around statisfying these requirements of the health administrator.

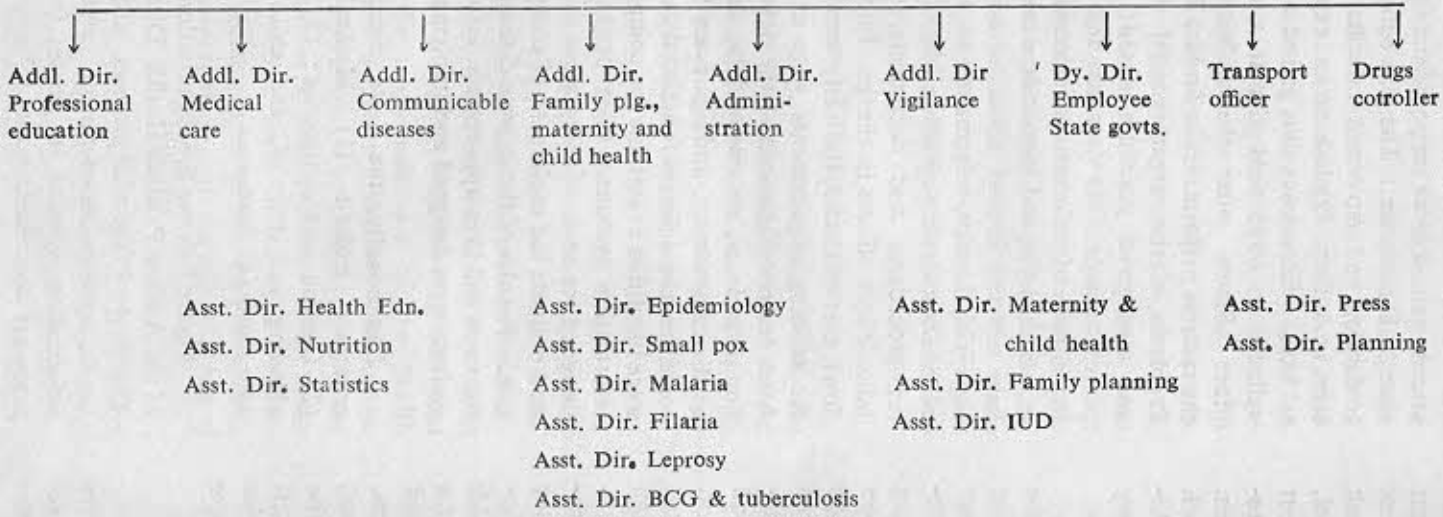
Systems Development

A project team of the Administrative Staff College of India was assigned to develop computer-based information systems for health administration with the assistance of the Electronics Commission, since it had already gained some support from the State Health Directorate. The plan agreed was to develop and implement information systems in Andhra Pradesh on an experimental basis. Experience thus gained would be valuable to implement similar systems in other States after the evaluation of the systems performance in Andhra Pradesh. Problems of the organisational structure and managerial practices existed, but the project team held the view that demonstrating utility of information systems, even in a limited way and in specific areas, would have a greater impact upon the acceptability. With this aim, information requirement of the Directorate were studied by scrutinising procedures and documents, and by interviewing officers in charge. Information flows, cost estimates, the likely benefits, and the training requirements were evaluated. After due considerations to the data collection procedures, volume of data, the user's needs, commitment, and significant benefits, some areas in different functional categories were identified as suitable for computerised information systems. Pilot projects were designed for each of these areas to explore and evaluate the usefulness of computerisation. Results of these were discussed with the users and then appropriate information systems were designed and implemented.

Functionally, the State directorate is organised under : (1) Medical care ; (2) Communicable diseases ; (3) Family planning and material, and child health care ; and (4) Resources.

Figure I shows the organisational chart of the Andhra Pradesh Health Directorate. The results of the pilot projects, information needs, systems development, and typical information systems in these functional areas are described in the following paras.

Fig. 1 : Organisational Chart of Medical & Health Directorate



Medical Care

There are about 700 dispensaries, 400 primary health centers, 220 taluq hospitals, 20 district hospitals, 20 speciality hospitals, and eight teaching hospitals in Andhra Pradesh. Professional education, training and research requirements associated with medicine are usually provided through the teaching hospitals. All cases which require prolonged in-patient care and others facilities, such as operation theatre, surgery, X-ray, etc, are referred to the taluq, district or teaching hospitals. After studying the existing systems and procedures, computerisation was contemplated for in-patient medical care in the large urban hospitals. Before developing an information system, a pilot project was undertaken to study the utilisation patterns of the hospital facilities. Data on in-patient particulars, hospital equipment, staff, major decisions, and population service areas were collected in two largest hospitals covering a time span of ten years. Utilisation was analysed with a view to developing adequate indicators for planning and control.

Planning of medical care requires the knowledge of population health needs and those needs that are tanslated into health demands. This information can be related to the characteristics of the population. In the urban areas these characteristics include the level of industrialisation, urban development, population density, etc, whereas in the rural areas these include the level of education and hygiene, income, remoteness from urban centers, etc. Based on the anticipated changes in the population, it is possible to project the future demands. For instance, the population increase due to expanding industrialisation can be projected in the developing areas of an urban center which suggests the size and locations for the required hospitals. Also, knowledge of met or unmet health demands is useful in planning for the expansion of the medical services. By and large, the health demands are seen to far exceed the available medical care due to paucity of resources. The urban hospitals are usually overcrowded and thus the use of floor beds, in addition to the allocated bed capacity, for in-patient care is very common.

To facilitate the optimal utilisation of the scarce resources it is useful to develop utilisation indicators based on length of stay, occupancy, admissions, etc. These help in comparisons between hospitals and in determining the gaps in the medical services provided. Information so generated would aid in administrative actions and in influencing operational style wherever needed for greater efficiency. For instance, at the individual level, if a docter determines the use of resources for patient care, an analysis of length of stay will provide a guide for the use of the resources at his disposal. An analysis for the hospital and the comparisons between various hospitals would provide useful information for a superintendent of a hospital to enable him evolve administrative strategies to influence individual resource allocations.

At the State Directorate level, the typical decisions relate to the allocation of resources to the various hospitals, constructions of new hospitals, size and locations of new hospitals, student strengths of the medical colleges, expansion of the existing hospitals in terms of increasing the capacity, addition of new services and improvements to the extisting facilities etc. Information required for these decisions can be partially generated from the hospital data and population data.

Based on the results of the pilot study on utilisation patterns and following discussions with the administrators, an outline of

the monitoring system for hospitals was formed. A system was then designed and implemented at the Osmania General Hospital, Hyderbad.

Monitoring System

Monitoring system for a hospital is an information system monitoring the in-patient medical care. It is, however, different from the systems designed to handle medical information for direct use in patient care, which require streamlined procedures, an inhouse computer equipment, and a high degree of sophistication. However, the monitoring system for management requires less sophistication and therefore it is easier to implement and evaluate its utility.

The monitoring system installed at the Osmania General Hospital, Hyderabad, captures summary statistics of the in-patients. It takes the basic information relating to personal data, diagnosis and operation procedures, dates of admission and discharge, ward and unit of stay, residential locality, etc.

Summary information produced at present include diagnostic and operation index for references in routine administration, and to meet the growing demands from physicians for teaching and research. Different classifications by age and disease groups provide the profile of the patient care. Calendars of daily admissions, discharges and occupancy help the superintendent in determining the current workload of the hospital. Statistics on length of stay, occupancy, patients days, admissions, etc, computed under various categories indicate the pattern of utilisation. These can be related to the time consumed in laboratory tests, treatment procedures, physicians' styles, and priorities of patient's admission. Mapping of the service areas of the hospital provides the profile of population being served. These are related to the characteristics of the population. The information flow of the hospital monitoring system is shown in figure 2.

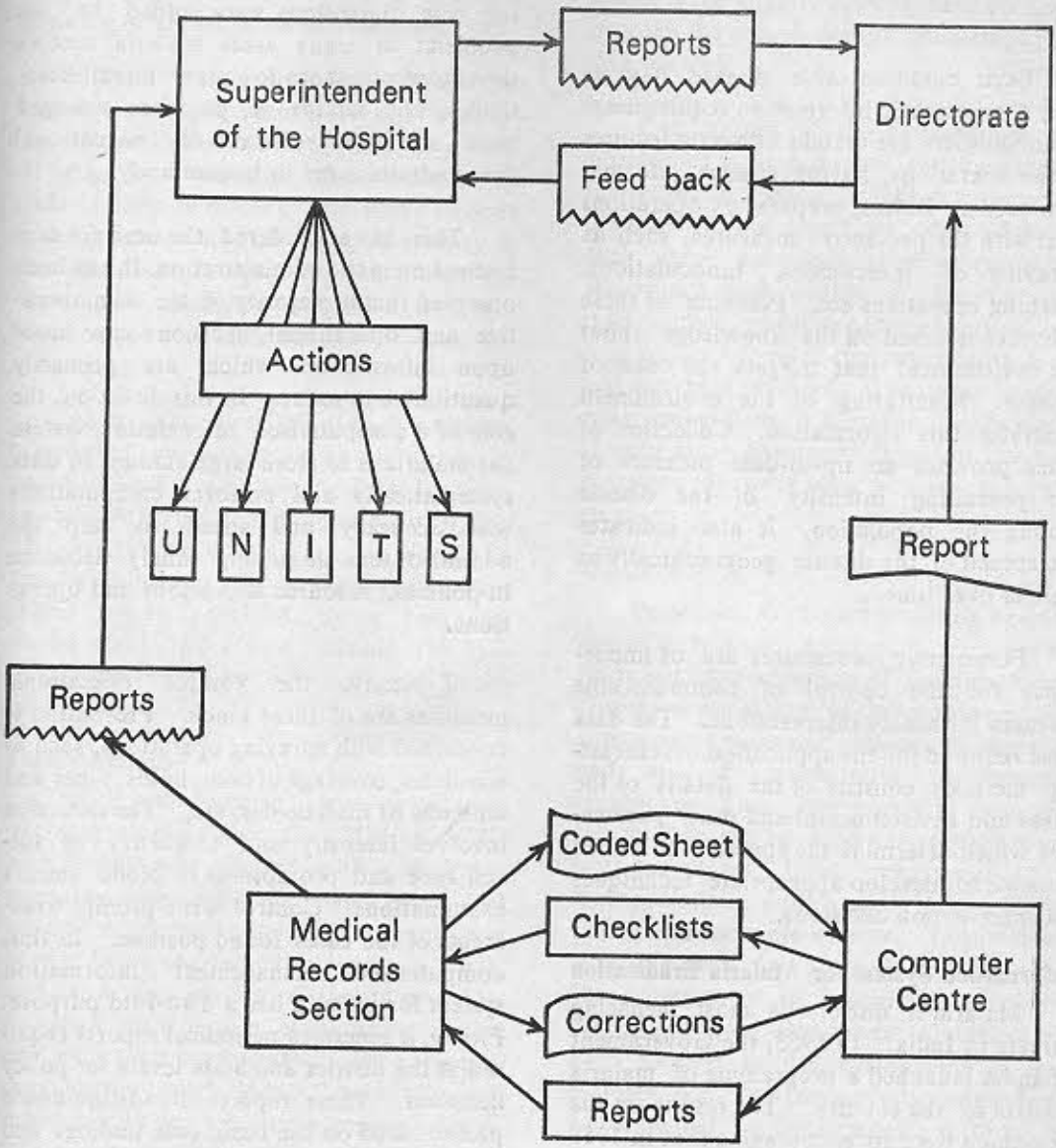
Expansion of the monitoring system is planned in two directions. First, laboratory requisitions can be included to summarise the time analysis of the patient's stay. Second, similar systems are to be installed in other hospitals within the same city and in other major towns. Information generated will then provide the overall perspective useful in planning at the directorate level.

Communicable Diseases

Policy guidelines for the control of communicable diseases are laid down by the respective national bodies. There are national programmes of eradication for malaria, smallpox, tuberculosis, filaria, and leprosy. The implementation and administration of the programmes are entrusted to the respective State governments.

Requirement analysis undertaken for communicable diseases indicated some common characteristic features. A large amount of data are generated in these programmes; however, it is observed that a systematic analysis to identify disease trends and shortfalls in performance at various level is not being carried out. In some instances, there is duplicity of data. There is a lack of epidemiological studies and monitoring of epidemiological parameters. To demonstrate the usefulness of systematic capture of data, a pilot study on spread of malaria was undertaken. A hyper-endemic area consisting of about 50,000 population spread over about 600 villages was selected. Details of the positive cases, blood smear collections, drugs, insecticides, spraying operations, and climate over a period of ten years were coded and analysed, following which elementary

Fig. 2 : Information Flow in Hospital Monitoring System



epidemiological models were developed and their use in the operations was demonstrated.

Each communicable disease has its own characteristic information requirements although there are certain common features in the operations, having similar information needs. In this, preparatory operations deal with the preventive measures, such as spraying of insecticides, innoculations, cleaning operations etc. Planning of these activities is based on the knowledge about the environment that triggers the onset of disease. Monitoring of the environment generates this information. Collection of cases provides an up-to-date measure of the prevailing intensity of the disease among the population. It also indicates the spread of the disease geographically as well as over time.

Forecasting procedures are of importance for the control of communicable diseases for timely interventions. The data base required for the application of forecasting methods consists of the details of the cases and environmental and other parameters which determine the spread. It is then possible to develop appropriate techniques for intervention decisions.

Information System for Malaria Eradication

Malaria is one of the most menacing threats in India. In 1953, the Government of India launched a programme of malaria control in the country. The results in the beginning were so encouraging that in 1958 the programme was converted into a National Malaria Eradication Programme. Within eleven years since the onset of the programme, the incidence was brought down remarkably from 75 million cases to a mere 80,000 cases. But subsequently, malaria seems to have staged a comeback and assumed alarming proportions. In many instances, malaria reappeared where it had been completely eradicated. Disturbing new dimensions were added to the problem; in many areas malaria vectors developed resistance to conventional insecticides, and strains of parasites emerged were seen to be resistant to conventional drugs administered in human body.

This has engendered the need for sophistication in the administration. It has been observed that a majority of the administrative and operational decisions are based upon information which are primarily quantitative in nature. In this direction, the role of a computerised information system for malaria is to store large amount of data systematically and perform computations with accuracy and speed to help the administrators in making timely decisions in policies, resource allocations and operations.

Typically, the routine operational measures are of three kinds. Prevention is concerned with spraying operations, such as schedules, coverage of households, types and amounts of insecticides, etc, The detection involves intensity and frequency of surveillance and promptness in blood smears examinations. Control is the prompt treatments of the cases found positive. In this, computerised management information system for malaria has a two-fold purpose. Firstly, it generates periodical reports required at the district and State levels for policy decisions. These reports include incidence profile based on the basic case findings and the profile of the entomological parameters based upon the field investigation data. As an example, a report on mosquito's resistance to insecticides in different regions can be used in deciding the type and amount of insecticides to be used in those regions. Secondly, the incidence data along with climatological, entomological and epidemio-