Health Administration in the Computer Age

MURRAY GRANT, M.D., D.P.H.

A COMPUTER-BASED management system makes it possible to control and direct the efforts of complex and often far-flung health activities. An administrator needs information that will enable him to render judgments, to be able to testify before legislative bodies, to have an understanding of the resources and programs of his agency, and to enable him to evaluate the direction in which his agency is moving. In 1962, when I became the director of the District of Columbia Department of Public Health, we had no such readily available information, and it was evident that an early priority needed to be placed on its development. For example, it took 9 months to complete a list of employees by organizational entity.

Six years ago the health department had approximately 4,000 employees to operate numerous programs and two large hospitals. Yet with few exceptions much of its statistical service data, all patient records, all management reports—just about everything in the department—was tabulated manually.

At D.C. General Hospital, a 1,500-bed municipal hospital and one of the 10 largest in the country, patients were being billed manually; in fact, the volume of work was such that few bills were actually being mailed to patients and collections were small. The accounting staff of the hospital was unable to keep up with the load.

Dr. Grant is director of public health, District of Columbia Department of Public Health. This paper is based on an address to the IBM Executive School in Data Processing for Health Program Administrators, Poughkeepsie, N.Y., September 17, 1968.

Why Automation Was Needed

The District of Columbia Department of Public Health is unlike any other because it can be considered, at the same time, a city, a State and, in some ways, even a Federal health agency. The 550 members of Congress have a voice in its operations as does the President and his advisers, as well as did the three-member Board of Commissioners that formerly headed the city government.

With a budget of nearly $40 million in 1962, the department operated something like 100 different clinics in the city and administered many other health services—medical care, environmental health, school health, an extensive crippled children's program, and mental health and mental retardation activities.

The staff of the department was scattered, some being located not only in the District of Columbia but also in Maryland and Virginia. In the intervening years, the department has grown, and it now has a budget of $85 million and a staff of 6,500.

The budget is a complicated line item document, going into minute detail, and when I first took office it was extremely difficult to secure pertinent information concerning it. I was not able to determine readily what our balance was for the remainder of that fiscal year, and cer-

tainly any attempt at determining the current balance would have required a long, tedious, manual operation by many people.

When an inventory is made manually, it is difficult to obtain inventory records rapidly enough to be certain that there are adequate supplies of drugs and equipment items in stock. On one occasion, several members of Congress stated that drugs were supposed to have been stolen from D.C. General Hospital.

How was it possible to maintain control over the $1 million worth of drugs budgeted for annually when only through a long manual inventory could we determine what drugs were on the shelves? No mechanism had been developed to compare drugs purchased with those dispensed and those remaining in stock.

This difficulty applied to hundreds of other supply and equipment items in the department. We had no list of these items; we could obtain one only by having staff go through the entire department and list each item individually.

Another difficulty was the way records were kept. Patients who came to one clinic and later went to another or to a hospital had records made out at each location. There was no effective way of checking to see if a patient was known at another clinic, and records were often duplicated. For example, at D.C. General Hospital, the record made by the social worker who determined eligibility for services was separate from the patient's other records, and records were not cross referenced.

Converting to Computer Operation

One of the advantages of a computer is the additional control it gives over records and production. In general, the larger the staff, the more problems. In government, where Civil Service requirements must be adhered to and where removal of incompetent personnel is so complicated that the tendency is to shy away from it, it is not easy to recruit and retain the best qualified staff. This tendency to keep unqualified persons is certainly true of clerical staff. Clerks are responsible for acquiring and recording the data upon which administrators ultimately rely, and it becomes obvious that the less reliance placed upon this source and the more placed upon machinery that has the ability to provide a check on itself, the better. These are some of the reasons that the speed, efficiency, and accuracy of the computer seemed so attractive to us.

In 1964 when we began computer operations, we selected patient billing at D.C. General Hospital. If patients who could afford to pay could be billed for the services they had received, the monetary value of the automatic data-processing system would be obvious, and this savings was the basis on which we initially justified this program to the Congress.

Early in 1964 we employed a man with more than 20 years experience in automatic data processing to administer this program. After 3 years of hard learning, we discovered that some real personnel changes were needed to acquire the kind of data needed. My only previous experience with machine operation had been with electrical accounting machinery. It is difficult for a health-oriented person with little background and no training in these complex machines to know whether the person they are training will be able to do the job.

A contract operation. Originally faced with the decision whether to hire our own personnel or contract for this service, we decided that the contract method was most feasible for us and proceeded in this direction. Shortly thereafter, it became apparent that we needed a few of our own programers and systems analysts. Subsequently we hired seven of these but continued leasing computer time. We carefully considered the type of equipment we wanted to work toward by listing all activities that could be programed, and we designed the applications on the most advanced technology possible so as to capitalize on subsequent technological advances in equipment.

The next system automated, after the billing department at D.C. General Hospital, was the biostatistical reporting system. Almost every clinic and activity within the department was compiling information which was then keypunched and placed on electrical accounting equipment. The keypunching and coding were voluminous and needed the services of a large number of employees.

Putting biostatistical information on a computer would eliminate a number of electrical accounting machines and reduce the number of employees required to process this information.

Not only were we successful in doing this, but these employees were trained as programers, thereby providing additional inhouse capability. Some of the existing machinery was eliminated, and the money was spent to rent additional computer time.

We have also placed the personnel records on the computer, and having this information readily available has been an extremely useful management tool. Today, the computer is capable of delivering an updated personnel roster each week. I now have at my fingertips information on each of the 6,500 departmental employees. I can also tell at a glance how many vacancies exist and can obtain data on any employee being considered for possible promotion or as an applicant for a newly established position.

We have listed all supply and equipment items including drugs on the computer. I am able to receive immediate information from the supply manager as to the amount and location of a particular drug that is in stock.

A few weeks ago an irate physician telephoned to complain that a health department pharmacy had not had a particular drug in stock for several weeks. Six years ago it would have been impossible to get information concerning the supply of this drug. A few weeks ago, however, the supply manager could tell me within 3 or 4 minutes that there had been a slip-up in communications between pharmacies, that there was an adequate supply of the drug on hand, and that a supply would be transferred immediately to the pharmacy that lacked it.

In the near future we expect to have all the financial information needed to operate the department on the computer. We hope to be able to obtain a balance at any time and within a few minutes information on how the money is allocated. This type of information is not readily available now.

Leasing a computer. By 1965, other District Government departments had begun computer applications, and there was a SHARE computer operation among the departments. We had a choice of terminating the health department's contracts and leasing a computer or of joining the SHARE computer operation. We decided against the SHARE operation because the department's long range goal was to have online capability and, with the number of programs we anticipated putting on the computer, we believed it would be difficult to achieve our goal without our own computer. We decided to lease one computer and, on January 1, 1968, we leased an IBM 360-30.

In setting up the computer program, we contacted other governmental agencies which had developed programs somewhat similar to those upon which we have been working, and every effort has been made to tailor the department's program to theirs so that their program could be adopted in toto without expensive changes.

We have a computer operations staff, have control of the operating schedule, and have complete flexibility. Health department programs require all the prime time on the computer, an average of 400 hours per month. Computer rental time now costs $168,000 a year, but we have managed to save almost $50,000 by leasing time to other District agencies on a reimbursable basis.

Thirty-three persons are employed in the automatic data-processing section. Nine were transferred from positions that were no longer needed elsewhere in the department. Twenty-four positions are new, and their total annual cost of approximately $240,000 must be considered a part of the cost of the automatic data-processing system. In addition, a considerable number of clerks throughout the department have become flexowriter operators, and there was no additional cost other than for training them.

We find it necessary to watch closely applications for computer time; programs that produce information that does not add to the department's capability to do its job are discouraged. Decisions concerning computer applications are made only by top management. The application must pay for itself in monetary reward, in information needed in decision-making processes, or to accomplish some function more accurately, expeditiously, or effectively. We do not want to spend $5,000 to collect 10 cents worth of information.

Other Automated Operations

We have other automated operations in the department that may not be as sophisticated as the computer, but they are valuable to us.

Among them are AutoAnalyzers, information on addressograph plates for filling out forms for patients, and electrical accounting equipment.

We are currently automating the locating and delivery of birth certificates in the vital records division. Generally in August or early September there was a long line of persons waiting at the municipal center for copies of birth certificates for schools. It usually took the staff about 10 minutes to locate any certificate by manual search.

Often a birth certificate was hard to find because the information given was sketchy. We are now using a coded microfilm system; we imprint a code on the microfilmed birth certificate so that it can be retrieved automatically upon the keying-in of that code. We key-in some nine separate pieces of information and can search one roll of microfilm containing some 1,500 certificates in approximately 25 seconds. A document can be located automatically and a copy of any record printed in less than 1 minute, even though scant information is given concerning the birth.

This automated system will take approximately 6 months to become operational, because there are more than 1 million birth certificates to microfilm. We are confident, however, that there will be enough savings in manpower to make the system economical when the conversion is complete, in addition to being able to provide much better service to the public.

Computer Uses in Several Programs

Medicaid. When title XIX establishing the Medicaid program was passed 3 years ago, we began to review the implications of this law to determine what effect participation in it would have on the residents of the District of Columbia and upon health department operations.

Several States, such as New York and Maryland, had entered the program quite early. We studied their operations for policies which appeared successful and in order to avoid the pitfalls they had encountered.

The administrative problems in Medicaid were twofold. First, the forms that physicians and other vendors of services had to fill out were numerous and lengthy, requiring a considerable amount of the vendor's time to prepare. Physicians, particularly, objected to spending so much time on what appeared to be nonessential paperwork. Second, payments to vendors were often delayed. Sometimes more than 90 days elapsed after submission of a bill before payment.

We have insisted that the plan for the District of Columbia insure that Medicaid payments would be prompt and paperwork kept to a minimum. To achieve these objectives, each vendor is given an imprinter by the health department which contains certain identifying vendor information, and each person eligible for Medicaid is issued a plastic identification plate. When the patient is treated, all the physician or a member of his staff has to do is make one stroke of the imprinter. The physician then checks the coded diagnosis and treatment points listed on the form.

The form constitutes a bill which is sent to the data processing section. An optical scanner reads the information and places it on magnetic tape. This tape is then used as computer input and will record the transaction on the records required for Medicaid.

The computer matches this data with tables on known relative value scales and tables of drug costs to compute the costs of services. Once costs have been determined, the computer may make out checks to the individual vendor for his services. This system has been designed so that payment for any given service can be made within 48 hours if necessary.

One of the major difficulties in developing this program was condensing large amounts of information concerning services and illnesses diagnosed in a form usable by the computer. We decided, however, that expeditious processing of these bills required optical scanning rather than manual handling, and the system was built around the scanner. The requirements of the scanner dictated how much information we could collect on each bill, the design of all forms to be used in the system, the amount of coding required, and that the printing would meet the fine tolerance the scanner requires.

We bill the Federal Government for services we provide through our health department facilities. Had we not begun 6 years ago to automate the billing system at D.C. General Hospi-

tal, there would have been a substantial further delay in establishing a Medicaid program for the District of Columbia.

Clinical laboratory data acquisition. The laboratory at D.C. General Hospital performs approximately 1 million tests each year. Reporting of results is often slow, and sometimes reports are lost. To improve service in the laboratories, we decided to implement the Youngstown hospital laboratory program. This program uses the IBM 1080 data-acquisition system, which records instrument readings and associated control data on punchcards or paper tape. The test data on the cards can then be read into any general purpose computer for final processing and reporting.

When this system is completed we expect to have improved control in the laboratory, there should be a reduction in the number of errors, and we should be able to handle a heavier workload. Automated equipment purchased last year for our central laboratory enabled the laboratory in 1 year to increase the number of chemistry tests from 300,000 to 768,000.

We expect to be able to process laboratory reports faster and more accurately. The number of specimens lost will be reduced and tracing time will be almost eliminated. Further, with this system in effect, laboratory technologists should have more time to do nonroutine tests and to develop new procedures and methodologies. Machine-retrievable test results and patient admission data should be more readily available, which will encourage research that contributes to better patient care and better use of laboratory resources.

Milk control program. With the computer, we maintain a master file of some 1,500 farms authorized to ship milk into the District of Columbia. With this file we can maintain suspense dates on each farm for the required annual tuberculin tests and semiannual inspections. A bacterial record is maintained for each farm and, as test results are received, they are added to the farm's bacterial record. If the results exceed the regulatory limits, the bacterial record is automatically printed for those farms that do not meet the standards. This record alerts the inspector to give increased attention to these farms. Also, applications for renewal of dairy farm permits are processed automatically, and permits are issued upon approval of the completed application.

Immunization program. We computerized a portion of our immunization program in January 1968. Each live birth in the District of Columbia is recorded, and when the baby is 2 weeks old, a letter is sent to the parents urging that immunization be started. With the letter is enclosed a duplicate copy of the birth certificate and a request that the parents make any corrections or changes and return it to the vital records division for completion of the birth records. When the infant is 3 months old, a questionnaire is sent to the parents to check on the child's immunizations. If no reply has been received at 4 months, three additional monthly letters are sent.

Tuberculosis control. A register is maintained on the computer of all diagnosed cases of tuberculosis and persons under treatment at home. Periodic reports give the status and characteristics of both previously known and newly reported cases. These reports include information to determine the outstanding characteristics of the occurrence of tuberculosis in the community and to evaluate the effectiveness of control methods. In addition, the computer generates a list of patients requiring special follow-ups and patients with incomplete diagnoses.

Cancer registry. A cancer registry is maintained, showing newly reported cases according to diagnosis, method of diagnosis, and patient characteristics. Although we collect this data for use in decision making, additional information is available to the researcher, the statistician, and the epidemiologist.

Comments

In the past 5 years or so during which we have established and developed an automatic data-processing system within the District of Columbia Department of Public Health, we have learned to rely upon the computer to relay necessary information in a short time. It would be difficult to return to manual operations, long periods of waiting for required information, and the feeling that the information you receive may not be accurate.

The problems in health agencies are proliferating and becoming more complex and more difficult for one person or even a group to man-

age. Adoption of a computer-based management system makes it possible to control and direct the efforts of some of these complex and often farflung health activities. In patient handling and treatment it is apparent that computers have only begun to make their contribution. It seems evident that knowledge gained through the use of computers and their value in patient monitoring may well revolutionize the practice of medicine.

Reducing Radiation Doses

Patient radiation doses resulting from administration of radioactive iodine in thyroid gland function tests may be reduced to one ten-thousandth of current levels by means of a new detection system developed by the Bureau of Radiological Health, Public Health Service.

The system combines ultrasensitive and accurate techniques for detecting thyroid gland uptake of radioactive iodine with methods for using iodine-123 which is lower in energy than the conventionally used iodine-131. About half the dose reduction results from the use of iodine-123.

The Bureau has developed a method for producing highly pure iodine-123 through decay of cyclotron-produced xenon-123. The xenon-123 generator can be shipped directly without laborious chemical separation, having maximum iodine-123 content upon receipt by the user. Furthermore, elimination of most of the iodine-124 contamination found in presently available iodine-123 increases shelf life and permits use of very high spatial resolution collimators or lenses.

Greater availability of iodine-123 would encourage its use not only in thyroid function tests, but in scanning the gland for possible abnormal morphology. In the latter application, iodine-123 would significantly reduce patient radiation exposure.

A recent study supported by the Bureau has shown that radioactive iodine is administered for thyroid function tests in about 445,000 Americans every year. More than 150,000 annually receive radioactive iodine for thyroid scanning. Many of the patients receiving radioactive iodine are children, a group for which dose reduction is particularly important because of extra sensitivity to radiation exposure.

The new system for detecting thyroid uptake of radioactive iodine was developed by a team of scientists headed by Dr. Henry N. Wellman, chief of the Radiological Health Bureau's Nuclear Medicine Section in Cincinnati, Ohio. The new iodine-123 production process was developed by Dr. Vincent J. Sodd of the Nuclear Medicine Section in conjunction with Dr. James Blue of the National Aeronautics and Space Administration's Lewis Research Center in Cleveland. An application for a patent on the process has been filed by the Space Administration.

The radioiodine detection system provides ultrasensitivity and increases accuracy through a correction factor which compensates for the depth of the thyroid gland in the neck of the patient. The correction factor is based on the linear relationship between the depth of the thyroid and a ratio reflecting the proportion between the amount of radiation which penetrates the neck and the amount which is scattered through neck tissues. The deeper the thyroid, the more radiation is scattered.

The detection technique utilizes double sodium iodide crystals which function as scintillation probes in detecting radioactivity. In the conventional measurement technique, the detector is held 10 inches from the neck to compensate for the lack of depth correction. In the new method, however, the detector is placed directly against the neck, thereby greatly increasing measurement sensitivity. The depth correction factor permits more accurate interpretation of the radioactivity count.