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EVALUATION OF THE MEDICAL ECONOMICS AUTOMATION (MEDECA) SYSTEM IN DNIEPROPETROVSK, UKRAINE

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SUMMARY

Josh Coburn, an Abt management information specialist traveled to Dniepropetrovsk Oblast in Ukraine from July 10 to 21, 1995 to evaluate a locally-developed, hospital-based medical information system (MEDECA) and its suitability for use on a larger scale elsewhere in the country. Mr. Coburn discussed the design and application of the system in detail with its developers at the Meshvikov Regional Hospital in Dniepropetrovsk, and studied its operation at the hospital. He also examined a second medical information system being implemented at two other hospitals in the oblast and observed its operation at one of these hospitals—City Hospital No. 2 in Dniepropetrovsk. Finally, he met with officials of a private health insurance company to assess the potential of the MEDECA system in meeting the information needs of private insurers.

This report describes in detail the design, operation, and current status of the two medical information systems. It will be followed by a second document which will analyze Mr. Coburn's findings and provide options and recommendations for strengthening the MEDECA system before its expansion to additional facilities.

BACKGROUND

In addition to technical assistance provided to national initiatives and to intensive demonstration sites (IDSs) in Lviv and Odessa, the Zdrav*Reform* Program (ZRP) will provide assistance to other *oblasts* (regions) in Ukraine where promising reform initiatives are consistent with the goals and objectives of the ZRP. Influenced by innovations originating in Kemerovo, St. Petersburg, and elsewhere during the later stages of the Soviet period, Dniepropetrovsk oblast in the Ukkraine has supported the development of a computerized health care information system —the Medical Economics Automation system (MEDECA)—that is in operation in the Meshvikov Regional Hospital in Dniepropetrovsk, as well as in the rural Synelnikov Regional Hospital. ZRP has identified MEDECA as a potentially important automated information system model that might support health insurance and other reform activities.

The MEDECA system is reported to be an integrated hospital and outpatient information system. It is designed to standardize patient demographic, clinical, and financial information and is intended to serve as a basis for health management, and planning and financing of health services. Because of the potential relevance of this system to health reform efforts at several levels, the Zdrav*Reform* Program conducted an evaluation to assess the characteristics of the MEDECA system and its suitability for use on a larger scale elsewhere. This trip report describes the findings of an initial visit to Dniepropetrovsk for this purpose.

OBJECTIVES

This trip was conducted as part of a Zdrav*Reform* task to support the development of computerized medical information systems for health institutions and agencies (MOH Ukraine Objective 4.2), in order to:

- Promote the establishment of health insurance programs through improved knowledge of costs and resource use (USAID Target A(1));

- Promote market-based reforms, such as self-financing programs through improved knowledge of costs and resource use (USAID Target A(2));

- Promote the reduction of hospital beds and hospital lengths of stay by providing the necessary information to design per capita and per-case payment systems (USAID Targets B(1) and B(2)).

The specific purpose of this task is to perform a comprehensive evaluation of the MEDECA system, a locally-developed, hospital-based medical information system, to determine how to use information collected by the system to estimate the cost of medical services, and to develop recommendations on how the MEDECA system can be improved before its use is expanded to other health facilities.

The specific objectives of this two-week visit were to:

- Study the design of the MEDECA system and the experience to date in facilities where it is being implemented; and

- Develop recommendations on: 1) how MEDECA and the Oblast Health Administration can strengthen the system prior to expanding its use to more facilities, and 2) administrative and policy innovations that can be made possible by MEDECA.

The Zdrav*Reform* Program will conduct a follow-up visit to Ukraine to discuss its findings and recommendations on improving the system with the developers of the MEDECA system, health facilities managers, and USAID, and to assist in the implementation of these recommendations.

ACTIVITIES

Mr. Coburn spent the first week of his visit at the Meshvikov Regional Hospital in Dniepropetrovsk where the MEDECA system was developed and is currently being implemented. During this time, he interviewed the developers of the system extensively, including the head of the development group, Dr. Ludmila Dvorestskaya. He also met with officials of the Dniepropetrovsk Oblast Health Administration, including the Director and Deputy Director to discuss government support for the development and expansion of the system to other health facilities. Mr. Coburn examined the operation of the MEDECA system at the hospital in detail, including the computers, software, and reports and data generated by the system.

During his visit, Mr. Coburn met with other groups and individuals interested in the development of medical information systems, including Dr. Anatoly Alpatov, who had recently joined the Dniepropetrovsk Medical Academy to head up the newly-established Department of Medical Informatics. Through Dr. Alpatov, Mr. Coburn learned of a second information system co-developed

by Dr. Alpatov and currently in operation at the outpatient department of City Hospital No. 2 in Dniepropetrovsk, and in a hospital in the city of Nikopol. He learned of the details of this system and its operation at both hospitals in some detail through Dr. Alpatov and the system's co-developer, Yuri Prokopchuk, also of the Dniepropetrovsk Medical Academy. Mr. Coburn then visited City Hospital No. 2 to observe the operation of this outpatient system. Finally, he and Dr. Anisimov, the Deputy Director of the Oblast Health Administration, met with the president of a private health insurance company in Dniepropetrovsk to assess the information needs of private insurance and the potential for the MEDECA system in meeting these needs.

FINDINGS

The following describes the characteristics and current status of the MEDECA information system and the system in operation at City Hospital No. 2 and Nikopol Hospital. An assessment of these systems will appear in a separate Technical Report, along with recommendations and options on how the systems and be improved and what role USAID can play in this effort.

MEDECA System, Meshvikov Regional Hospital in Dniepropetrovsk

a) Development of the MEDECA System

The MEDECA system was created by a software development and support group that is based at the Meshvikov Regional Hospital in Dniepropetrovsk, and is headed by Ludmilla Nikolaev Dvoretskaya, a mathematician by training who is highly respected in this field. Ms. Dvoretskaya is also well-respected for her role in creating the MEDECA system. The MEDECA system development and support group includes 63 staff and a large number of computers and network equipment.

The original impetus and support for creation of the MEDECA system is said to have come from Dr. Vladimir A. Pavlov, Chief Doctor of the Regional Hospital and, currently, Director of the Dniepropetrovsk Oblast Health Administration. About five years ago, Dr. Pavlov requested that Ms. Dvoretskaya undertake the development of the system. Dr. Pavlov is said to be very interested in costing and cost accounting systems and this interest is reflected in the design of the MEDECA system.

According to Ms. Dvoretskaya, the development of the MEDECA system has been carried out by the medical technologies automation department of the Regional Hospital under a contract with the Health Protection Ministry of Ukraine. Scientific supervisors of the work have included Professor I.A. Logvinenko, head of the Department of Sanitary Hygiene and Health Protection of the Dniepropetrovsk Medical Institute, and Dr. Pavlov. Leading specialists of the Ukraine Health Protection Ministry and regional preventive health organizations have also participated in the MEDECA development program.

The MEDECA system has been under development for approximately four to five years in the Regional Hospital and in use for the past three years. Three years of data are kept on-line.

In addition to ongoing support from the Oblast Health Administration, the MEDECA system group receives support through contracts for the production of specific products and services. For example, Ms. Dvoretskaya indicated that her department has a contract "to develop the infrastructure for social insurance" for Ukraine. This contract between Ms. Dvoretskaya's department and the Oblast Health Administration has several components, including "cost estimation, price setting, and the development of methods of paying hospitals and doctors." In addition to medical service costing tasks, a key component of this system was described as the development of a "passport" for patients containing key identifier and medical information on an electronic card to be kept by the patients. (The passport is describe in more detail in *Section b* below.) The deadline for completion of this contract work is December 1995.

During this technical assistance visit, the MEDECA development group indicated that continued funding for the department and its staff was in doubt. Ms. Dvoretskaya stated that she and other key members of the group had been told by the hospital that they would no longer have jobs as of the first of September. When asked if this was true, the First Deputy of the Dniepropetrovsk District Council, Alexander Sergeivich, stated that as far as he knew this was not the case. The opinion of Dr. Pavlov, the Director of the Oblast Health Administration on the status of the group was not determined. Dr. Anisimov, deputy to Dr. Pavlov, indicated that the group's understanding of the situation was mistaken and that the group could be assured of future support.

b) Goals of the MEDECA System

The objectives of the MEDECA development group's work, according to Ms. Dvoretskaya, are to standardize medical information into a single system or model, that can be used by all facilities and oblasts to determine the costs of services, utilization patterns, and other vital management information. The MEDECA system is being developed as a model for use elsewhere throughout Ukraine. The MEDECA developers have automated data collection and are ready to provide the tools to individual hospitals to collect and report these data. At the same time, Ms. Dvoretskaya stated, they are prepared to receive all information from individual hospitals to create a central oblast data repository and to generate reports based on these data.

Ms. Dvoretskaya explained that the first step in developing the MEDECA system was to automate and standardize the collection of data required by the public health system. Their goal to automate data collection was driven by the desire to consolidate the large number of forms (over 60) that are mandated by the public health statistical system.

The task of consolidating and automating this required information has been accomplished by development of a master data collection form. Ms. Dvoretskaya reviewed a lengthy diagram depicting the array of public health statistical documents required from hospitals and polyclinics. From these documents, common elements were identified across forms and consolidated into a single data collection format. This process reduced the number of elements by 40 percent. Ms. Dvoretskaya's opinion was that these data requirements would not change with the creation of health insurance and other aspects of a market economy.

Ms. Dvoretskaya repeatedly emphasized that the goal of the MEDECA system was to serve as a model for standardizing medical information on patients across hospitals and polyclinics. In the words of the MEDECA system developers, "the system envisages using computer techniques to create a common terminology through standard documents and information for all health service delivery sites, which is a necessary condition for management by economic methods."

An ultimate goal of the system is to collapse relevant medical information into a "passport" for an individual. She explained the goals of the individual patient "passport" to be the following:

- Create a standardized bank of information on the patient.
- Collect standardized information from all levels of the health care system, across hospitals and polyclinics.
- Provide the basis for all doctors throughout Ukraine to have standardized information available on individual patients.

The group is currently at work on development of the "passport" system.

c) Design and Characteristics of the MEDECA System

1) MEDECA Data Collection

The central data collection vehicle for the MEDECA system is a three-page medical record form that is initiated when the patient is registered as an inpatient or outpatient and completed by the attending doctor handling the case. This form contains four main sections: 1) a patient registration section, 2) a medical case history, 3) a consultation record sheet, and 4) a quality of medical service checklist. The fold-out form also serves as the jacket for the patient's medical record for a single admission or outpatient visit, including all additional documentation generated during the admission, such as laboratory test result slips, flow sheets and other clinical documentation, and progress notes, among others. The data contents of the master medical record folder are shown in *Annex A* by section.

Several characteristics of the MEDECA data collection system are noteworthy:

- The MEDECA data collection system is well documented. Each element is described, valid values are listed along with definitions, and formats are provided.
- In general, control over data quality is addressed through training of data entry clerks and by using software edits to identify "illegal" data values. However, data quality edits are of limited value for most types of data.
- Chief doctors are responsible for the accuracy and validity of quality review data used in adjusting physician payment. According to Ms. Dvoretskaya, chief doctors review data quality on all cases. No independent reliability studies are performed. The completeness of

data was not checked. Sergey G. Badogin, Chief Assistant to the Hospital Director, Meshvikov Regional Hospital in Dniepropetrovsk, made a comment during a meeting to the effect that the quality and completeness of medical record data was often poor because doctors have insufficient time to maintain proper records. Ms. Dvoretskaya and Mr. Badogin seemed to disagree on the level of data quality in the MEDECA system.

- As has been observed in Russia and Central Asia, the diagnostic coding standard for Ukraine is ICD-9. This coding system utilizes diagnostic codes only; the ICD-9 system has no companion coding system for procedures. Procedure coding is accomplished using local coding systems. MEDECA staff indicated that where a code was lacking or inadequate, a new code was created to fill the need.

- Data collection redundancy is a central feature of the current MEDECA system due to the centralized design of the system. Primary clinical records (e.g., the patient's medical case history, laboratory and therapeutic examination orders and results) and other key medical records contain common header information that identifies the patient (e.g., address, occupation, date of birth). Because the MEDECA system currently has no on-line patient registration system (the data are only entered one time on the computer and made available to medical departments as needed), registration information on the patient is manually collected multiple times for a single inpatient or outpatient both for the master form and for each ancillary department test order and test report.

  Each clinical transaction (test, treatment, clinical history) form also requires several common data elements regarding the doctor in charge of treating the case, including the doctor's name and "structural subunit" (specialty department). These elements are also manually collected multiple times during an admission or visit. In addition to the problem of data collection redundancy, the potential for errors in patient registration files and other documentation is high.

- "New" patients to the hospital are assigned a patient number. When patients with numbers return for subsequent visits or admissions, they are expected to bring their hospital patient number with them. If patients cannot provide the number, previous hospital records cannot be located. In theory, the MEDECA computer files could be searched for names and other matching criteria. However, the MEDECA system has no computers installed in the registration area and registration and medical record staff have no access to MEDECA files (see below).

2) Design and Information Flows of the MEDECA System

The MEDECA development group is located in an administrative building on the District hospital campus. About 60 people work in the development group, of whom 25 are programmers. The department has 21 computers and all are located in the administrative building housing the department.

The design of the MEDECA hardware and software system is based on the concept of centralized data collection and management. The MEDECA system and its associated data files are located entirely within the department that has been responsible for its development. All system inputs and outputs are performed by the department. Data are stored and accessed entirely within the MEDECA department, and no data repositories exist outside this department. Since no network exists outside the MEDECA department, data users outside the department, including physicians, do not have direct access (through personal computers) to MEDECA data. The MEDECA department prepares reports and provides access to needed data for those outside the department.

Data are collected on hard copy forms (see *Annex A* for a list of elements contained on the master data collection form). Data collection begins with the registration of the patient at one of two points of entry into the hospital: 1) the inpatient registration desk, or 2) the outpatient registration desk. The same form is used for both inpatients and outpatients. Registration is performed manually.

The remaining information on the form, mostly clinical data, is completed by doctors. Completed forms, including other data forms used for the medical record, are sent to the MEDECA department after the patient has been discharged. Data from the completed forms are entered into the computer within the MEDECA department after the patient has been discharged.

As noted above, the District assigns a patient number to "new" patients and expects patients to carry the number with them when they return to the hospital. If a patient cannot produce his or her registration number, a new number is assigned. Since patient registration data are not available on-line where the patient registers, it is not possible to look up the records of previously registered patients.

3) Hardware

Of the 21 IBM-compatible computers in the department, 18 have 286 processors, two have 386 processors, and one has a 486 processor with 8 MB RAM (this machine is "owned" by the accounting department). Other computers in the hospital that are related to, but not networked or directly connected to the MEDECA system include:

- Accounting department: two IBM 486 computers (one located in the MEDECA department); two IBM 286 machines.

- Human resources: one 286 IBM PC.

- Administration/statistical reporting: one IBM 486 computer; three IBM 386 machines (locally networked but not linked with the MEDECA system); two IBM 286 machines.

- Pharmacy/stores: one IBM 286 computer.

In the administrative building housing the MEDECA department, data entry is performed for both inpatient and outpatient records on the second floor using dedicated computers (two for inpatient data entry and one for outpatient data entry).

The inpatient data entry system results in two inpatient databases, one for each of the two computers, each of which contain a portion of the discharge records for the current period. The data files in these computers are separate physical entities (each file has a different filename). Since all of the current data do not exist on one file, searches of these files must be performed using software that reads each file sequentially.

Another data entry location, also within the administrative building, collects data from three ancillary departments (including polyclinic tests and services only): laboratory, ultrasound, and endoscopy. Outpatient data for these three departments are entered into two dedicated IBM 286 PCs that also are not networked with the main MEDECA patient database. These data are used for statistical reporting only.

The department maintains one large local network linking eight computers, including one server (an IBM 386 machine with 280 MB of hard disk storage). This server contains a copy of the MEDECA software and a copy of the inpatient and outpatient databases for three years. The network is contained within the department and its users are system designers and programmers responsible for system development and testing.

Two computers not "owned" by the department are dedicated to statistical reporting for the Oblast. These computers collect summary statistical data from all hospitals in the Oblast and produce reports for the Oblast administration. No patient level information are contained on these computers. These computers are not formally linked to the MEDECA system.

Nearly every PC has its own dedicated dot matrix printer. No laser printers were in use.

4) Software

The MEDECA system is written in Clipper, a DOS-based database package. The department uses one IBM 486 PC with sufficient memory (8 MB) to run Microsoft Windows; this machine is "owned" by the accounting department. Although they have a copy of Windows, this software is not being used for system applications. The department has a copy of Microsoft Access (Windows) but has not used it because they lack documentation (e.g. manuals) for the software. Documentation for Microsoft Windows is also lacking. The department is very interested in Unix but no one has any experience with this operating system.

The limited networks within the department are designed and maintained by department staff. Department staff are not happy with the network because it is slow and unreliable, often causing a loss of data. The network software is "Lantastic."

5) MEDECA System Reports

The MEDECA development department maintains a thick book containing all of the preformatted reports that have been programmed into the MEDECA software. The reports can be grouped into the following categories:

1. Reports for the Ministry of Health, including various types of statistical reports on public health activity;

2. Hospital inpatient statistical activity reports;

3. Outpatient statistical activity reports.

In addition to preformatted reports, a main function of the MEDECA department is to perform special studies. For example, if the chief doctor wants a profile of a doctor's inpatient admissions, an analyst from the MEDECA department will prepare the needed data.

In general, according to Ms. Dvoretskaya, the heads of departments are the main consumers of data generated by the MEDECA system. Costing reports are one type of preformatted reports that are widely used by department heads. Budget variance reports (discussed below) generate considerable demand for special studies due to the need of managers to identify the source of budgetary variances.

d) Key Applications and Uses of the MEDECA System

In addition to the basic tasks of data consolidation and standardization, the major uses of the MEDECA system are to: determine physicians' salaries, which are based partly on their performance; and to estimate medical care costs, both at the department level (i.e. the cost per bed-day for each department), and for specific medical services and procedures. The hospital also plans to incorporating the MEDECA system into an integrated information system for the hospital's newly constructed surgical building. Each of these applications of MEDECA are described in detail below.

1) Setting Doctor Salaries

One of the main applications of the MEDECA system and the one most frequently emphasized is to determine physicians' payment levels, which are based partly on performance, that is, the quality of care that they provide.

The District's 340 doctors are salaried. Base salaries for each individual physician are determined by the Department of Human Resources using a complex formula including the doctor's length of employment, his or her level of training, the amount of extra work he or she performs outside the hospital (e.g., consultations that presumably result in more admissions for the hospital), and other factors.

The MEDECA system contains a complex algorithm designed to calculate the pay of a doctor. At the core of the MEDECA system is a complex method of rating the quality of a physician's work. Based on data collected, the system software automatically adjusts a doctor's base salary upward or downward based on the "quantity and quality of the final result of the treatment multiplied by the qualification level of the individual specialist."

The data for evaluating the quality of physicians' work are provided through "expert" reviews using a special data collection form. Using subjective criteria, reviewers assess the performance of individual doctors in treating an individual case. The chief doctor of the physician's department reviews all cases discharged by the department. In certain cases, the same review is repeated by an expert doctor. The most complicated cases are discussed and reviewed once per month by a group of hospital physicians. A fourth level of review may be provided by the district public health authorities. A fifth level of review is provided for insurance companies, but this level is not currently in use. A doctor's quality performance is calculated automatically on a monthly basis, based on all of the cases he or she has had during the past month.

This quality review system described in outline form by Ms. Dvoretskaya serves as a basis for a peer review system for the hospital. In some cases, problems are identified amd reviewers examine possible reasons for the problems noted. If reasons are found that account for the quality problems, these are noted by the experts, thus making it easier to eliminate the problems.

In addition to quality-based incentives, doctors are paid extra for additional work performed, including working during night shifts and visiting rural and district hospitals. Special studies were conducted with the cooperation of doctors to establish pay differentials for these additional duties. According to Ms. Dvoretskaya, the resulting MEDECA-based physician payment system is apparently well-accepted among physicians and they support its use in adjusting base physician salaries.

2) Costing of Medical Care

The MEDECA group is quite interested in developing methods to determine the cost of treatment. Among the MEDECA group and other hospital administrative staff, there is a widespread perception

that they need to prepare for the advent of a "market economy", which may require learning financial management at the hospital level, and learning how to price their services. In fact, according the Ms. Dvoretskaya, the MEDECA group is currently under contract to the National Ministry of Health to "develop the infrastructure for social insurance". The MEDECA group has a contract, awarded under competitive bidding, to "develop the scientific technical methods for converting the public health system into a medical insurance system". Strategies to achieve this goal were discussed at the national level and it was concluded that "a model" should be developed at one hospital that can be applied across other hospitals. The deadline for completion of this work is the end of December 1995.

The Meshvikov Regional Hospital and the Synelnikov District Hospital are development sites for the costing component of the MEDECA system. The objective of this component is to develop a costing model for the purpose of "cost estimation, price setting, and development of methods of paying hospitals and doctors" that can be replicated elsewhere. One product of this is expected to be the "medical passport" for each individual patient, which has been described above. Ms. Dvoretskaya said they will be able to predict the future work loss of a patient based on his or her medical profile. She expects this to be useful in determining health insurance requirements and rates.

The MEDECA development group has created two parallel, unintegrated systems for costing services: 1) a department-level costing system, and 2) a system to cost specific medical services, including therapeutic and ancillary services. These are both described below.

Department-level Costing

Currently, the department-level costing results in an average cost per bed-day for each hospital department. According to system developers, the objective of the system is to calculate the cost of a bed-day in order to determine the monthly and annual cost of operating the department. The cost of one-bed day is based on the operating costs of each department, and thus varies considerably from one department to the next. The hospital has over 70 departments. Thirty departments are inpatient, and the remainder are outpatient. Using data from the Human Resources Department on staff salaries in each department, salaries are calculated automatically for personnel in each department, including social insurance and other personnel expenses. The sophisticated personnel system also accounts for physician time worked outside the hospital, his or her level of training, and other activities of personnel. Personnel information needed for the costing system is provided on one summary sheet.

Other department costs are added, including business trips, education and training expenses, and related purchased materials.

Other "outside" costs (non-personnel costs requiring outside payment for goods and services purchased) are then added. These costs include electricity, heating, and utilities, which are calculated for the department manually from hospital bills, using a method to apportion costs among departments. Food costs are calculated using a special worksheet that apportions the costs among departments based on the types of food used by different departments. The use of medicines for each department is estimated based on the hospital's total utilization. The costs of departmental repairs

is also added. Equipment costs, other than department-specific equipment, is apportioned based on the overall department budget. All other overhead expenses, including administrative staffing, building costs, laundry, and housekeeping are allocated to department bed-days using a formula whose derivation was not explored by Mr. Coburn.

The departmental average cost per bed-day is estimated by dividing total departmental costs by the number of bed-days consumed by the department. The average cost per bed-day is used to establish the normative cost of each "clinical statistical group"[1] based on the standard length of stay for that group multiplied by the average department cost per bed-day.

Once data requirements are met and all needed data are inputted, the process of calculating final costs is completely automatic. The final outputs of the MEDECA costing system are spreadsheet-like cost tables generated for each department. The cost tables have columns of cost inputs by rows of clinical statistical groups. Cells represent subcosts or final costs for individual disease categories treated by the department. The system has additional features, according to its developers. For example, in addition to the main disease diagnosed, the hospital can determine the cost of a second disease based on secondary diagnoses. This was viewed as one means of calculating a severity-adjusted cost.

In general, the costing system described by MEDECA staff seemed to use a thorough and reasonable approach. A discussion of the mechanics of the current methodology also revealed that MEDECA department staff have a good understanding of the division of costs into fixed and variable components. A Russian-language copy of Alexander Telukov's Tomsk costing methodology was given to Ms. Dvoretskaya. By the next day, the chief economist responsible for the development and maintenance of the MEDICA costing system had read the Telyukov report and was anxious to comment on its relevance to their own efforts. She was quite proud to report that they were already following a methodology that she said was quite similar to the Tomsk model described in the report and she seemed confident that what they were doing in departmental costing represented a sound approach that had been validated by the report.

The costing sheets are used in another computerized analysis that compares actual costs to budgeted costs. This analysis is based on annual and monthly plans (budgets) prepared by each department from projected volume and expected cost data. This analysis generates a variance report that, according to MEDECA group staff, initiates an investigation of reasons for the variance. For example, managers must determine if their original budget estimating process was correct and then proceed to examine other possible explanations for the variance.

Hospital departments use the MEDICA data on standard and actual hospital lengths of stay (LOS), as well as on costs, to monitor physician performance and to create incentives for reducing utilization. MEDECA staff described an incentive-based system that rewards the doctor, the administrator, and ancillary departments if a "profit" is realized based on a comparison of actual LOS

[1] A patient group formed on the basis of clinical and economic data.

to LOS standards. For example, for a given disease category or clinical statistical group, the standard LOS may be 24 days. Around this standard, a high (30 days) and low (18 days) range of LOS is established. According to MEDECA staff, a "profit" is realized if the doctor keeps the patient in the hospital for less than the 24 day standard, but not less than the 18 day lower end of the standard range. According to staff, LOS has decreased in the hospital and the number of beds has been reduced as a result of this system. The "profits", based on the reductions in LOS and estimated bed-day costs saved, are apparently distributed to doctors, administrators, and ancillary departments. No data were shown to the consultant demonstrating the trend in LOS over time.

Costing of Specific Medical Services

Using a methodology similar to that used in department-level costing, the MEDECA department staff have created an unique system to cost individual medical services provided by each ancillary and therapeutic department. This system is unique in that it is based on the equivalent of a "charge master" used in U.S. hospitals to enumerate each billable item used in treating a patient. The hospital's list of billable services has a cost basis as well as a charge (price) basis. The former is based on a departmental costing and cost allocation procedure that is very similar in structure to the departmental costing scheme described above. The pricing system is based on a formula that marks up the cost by a specific percentage for outside customers such as insurance companies. The mark-up factor and its derivation were not examined in detail by Mr. Coburn.

Below is a translated portion of the table of contents of the document describing the costing system for unit of service, including an itemization of individual billable services by department:

1. Budgets of (departmental) subunits according to expenses.
2. Calculation of outside costs of medical procedures by profile of (departmental) subunit.
   - 2.1 Data given in "conditioned" units.
   - 2.2 Budget with overhead expenses.
   - 2.3 Salary with overhead expenses.
3. Calculation of percent of sum of salary without overhead expenses.
4. Calculation of "inside" and "outside" cost by clinical statistical group by structural (departmental) subunits.
   - 4.1 Physiotherapy Department.
   - 4.2 Clinical Diagnostic Laboratory Center.
   - 4.3 Immunologic Laboratory.
   - 4.4 Radiologic Laboratory.
   - 4.5 X-ray Department.
   - 4.6 Special Physical Exercise for Treatment.
   - 4.7 Etcetera...

A table for one component of the costing methodology begins as follows:

Calculation of Inside and Outside Cost of a Medical Service

Name of Item:

132: Exam of alimentary tract
1321: Gastrographia
133: Exam of urinary tract
1331 Detection of volume of urine
35: Analysis of absorption and extraction of radionucleides
3500: Etcetera...

For each examination, test, or medical service, the charge master displays columns of costs that are included in the final cost of the item.

The infrastructure that the hospital has developed to support the costing of specific medical services is impressive. Each department and subdepartment has enumerated all of the individual services they provide to patients. This accomplishment is quite significant for several reasons. Most importantly, it implies that individual departments are focused on the utilization of ancillary health care services, such as laboratory tests, x-rays, special procedures, that are key components of the final cost of an inpatient admission. Having a catalog of these ancillary services, hospital-wide, is a benefit for the future development of the costing system. Equally significant is the fact that the MEDECA department already has pre-coded data entry screens for all of the types of ancillary services and special procedures that the ancillary and therapeutic departments currently provide. Were the hospital to shift to a system of case mix-based budgeting and variance analysis, many of the key components needed to develop such a system are already in place, including the foundation for an ancillary service-based data collection system. Although the department-level and medical service-level costing systems do not appear to be integrated at this time, bringing the two together into a single case mix-driven costing system may be a feasible task due to the existing data infrastructure.

3) Information System for the Hospital's New Surgical Building

The Meshvikov Regional Hospital has recently completed construction of a new surgical building that will consolidate all inpatient surgical beds that are currently located in several older buildings on the hospital campus. The construction stage (Stage I) cost approximately US$10 million, according to Dr. Sergei Gregorovich Badogin, Chief Assistant to the Director of the Surgical Department. Stage II will involve equipping the new building at an estimated cost of between $6 and $7 million. Funds for the construction have been obtained through a Japan/Ukraine fund and a U.S./Ukraine fund. Dr. Badogin stated that the completed and equipped building will be the best of its kind in all of Ukraine.

Ms. Dvoretskaya explained that there is also a plan to develop and install a computer information system for the new surgical building. The Chief Doctor of the Surgical Department has asked Ms.

Dvoretskaya to lead the process to design, select, and install an information system in the new building. According to her, a Steering Committee will oversee this process. She has been asked to select participants for this Steering Committee.

Within a few weeks, a newspaper announcement will be made of a competition among parties interested in participating in the development of the information systems for the surgical building. Ms. Dvoretskaya indicated that her department has been in contact with several companies that are interested in bidding.

Ms. Dvoretskaya explained that the Department wants to participate in the competition but lacks the technical knowledge, experience, and resources to perform some of the key tasks, such as designing and installing the network and selecting the hardware that will be used throughout the system. For this reason, the department wants to "team up" with another company in this competition. Ms. Dvoretskaya believes that her group is best equipped to provide the functional design and software for the system.

It is not clear what the source of funds will be for the proposed information system. The department has developed a design for the system, which is based on the concept of a physician's workstation. The system would incorporate the current MEDECA system and would add to it clinical data obtained from ancillary departments such as laboratories, the radiology suite, diagnostic testing departments, and therapeutic departments. Department programmers have developed a master book of templates for data entry screens for at least 40 ancillary departments and subdepartments that would have computers. These templates have been developed in collaboration with the physicians in charge of the various departments. Relatively little additional work will be required to convert the coded prototype screens into functioning data entry screens that can begin to generate live databases.

A phased plan has been developed for implementing the information system for the surgical building. Phase I will involve transferring the MEDECA system from its current location to the new surgical building and adding on-line registration and ancillary data input and access functions. Inpatient registration for the entire hospital will be relocated to the new surgical building. A central, on-line outpatient registration function will be created and located in the outpatient registration area. On-line ancillary data input and access nodes will be added. In Phase II, the physician's workstation will be created. Terminals anticipated for Phase I only are as follows:

- Inpatient registration: two terminals
- Outpatient registration: seven terminals
- Ancillary department nodes: 40 terminals

In Phase II, an estimated 50 physician workstation terminals are planned.

The current design of the MEDECA system requires that any terminal networked into the system be an IBM personal computer (PC) (486 with at least 8 MB RAM) which will cost approximately US$1,400. The surgical department building plan calls for one or more servers with a fixed disk

storage capacity of 6 gigabytes (six billion bytes). No network wiring has been included in the buildings' construction and the degree of difficulty in wiring the building for a network is not known.

The department has estimated that the entire system for the new surgical building, including Phases I and II, will cost approximately US$350,000.

Dniepropetrovsk Medical Academy

Marina Romana Kabanova, Instructor in the English Language at the Dniepropetrovsk Medical Academy, suggested that the head of the Academy, Lyudmila Vasilyevna Novitskaya-Usenko, M.D., Rector, would be very interested in a meeting to discuss the use of information systems in medical education. Marina was aware that the Rector had asked Dr. Anatoly P. Alpatov to join the Academy to head a newly-created Department of Medical Informatics. Ludmila Dvoretskaya stated that she knew Dr. Alpatov and produced his business card. She said she was also aware that Dr. Alpatov was a member of a national committee that was working on establishing goals and an approach to guide the adoption and use of medical information systems.

The Dniepropetrovsk Medical Academy is the center of medical education in the Oblast. In July, entrance examinations are held in a large auditorium in one of the Academy's several buildings. Dr. Novitskaya-Usenko explained that the Academy has a long, proud history as a center for medical education and research and that it was recognized as one of the leading teaching centers in Ukraine. Dr. Novitskaya-Usenko is an extremely energetic woman, displaying strong enthusiasm for her work and obvious pride in the Academy she leads.

Marina explained that Dr. Novitskaya-Usenko is also a very progressive and creative thinker as evidenced by her decision to ask Dr. Anatoly P. Alpatov, a doctor of technical sciences, to join the Academy to head the new medical informatics department. Dr. Alpatov was a recognized scientist in the Soviet space program, playing a major role in designing orbiting satellites and, most recently, the space shuttle that, according to Dr. Alpatov, was unsuccessful.

At the Academy, Dr. Alpatov has established a modest computer installation that serves as a laboratory for research and for practical applications. For example, the computer team was in the process of finalizing questions on Academy entrance examinations, using the computers to produce the questionnaires as well as to calculate and verify correct answers to the test.

The most important function of the Dniepropetrovsk Medical Academy, however, is in the education of physicians. This role was emphasized by Dr. Novitskaya-Usenko. Dr. Alpatov, in fact, heads a department whose central mission is to apply the computer to all facets of medical education. The Department has over 60 IBM-compatible (Olivetti) personal computers that are used for classroom teaching, research, and examinations. Several classrooms were dedicated to teaching physicians the use of the computer on the theory that this skill will be essential to their practice of medicine and to the provision of high-quality care.

The Academy's medical library has a Gateway 2000 PC with CD-ROM in its main office as well as a similar machine in a reading room of the library where students and practicing physicians consult the Academy's reference library. The Academy has subscribed to the CD-ROM version of the (US) National Academy of Medicine's MedLine and receives CD-ROMs periodically for reference use. This program is currently funded by the George Soros Foundation.

The Director of the Academy's library, Tatiana N. Tikoneliko, has been invited to study at the National Library of Medicine in April 1996 for several weeks to learn about American medical libraries and resources.

The Outpatient Information System at City Hospital No. 2, Dniepropetrovsk; and the Outpatient and Inpatient Information System at the Nikopol Hospital, Nikopol, Dniepropetrovsk Oblast

a) City Hospital No. 2

Dr. Anatoly Petr Alpatov, Head of the Department of Medical Informatics at Dniepropetrovsk Medical Academy, and Yuri A. Prokopchuk, Senior Lecturer at the Dniepropetrovsk Medical Academy, are co-developers of an outpatient health care information system in use at City Hospital No. 2 in Dniepropetrovsk. They also developed a larger outpatient information system that is installed at the Nikopol Hospital, Nikopol City in Dniepropetrovsk Oblast. Dr. Alpatov and Mr. Prokopchuk provided to Mr. Coburn a brief overview of the characteristics of the information system. Mr. Coburn also examined the operation of the system installed at the outpatient department of City Hospital No. 2.

Although an inpatient information system was discussed, it was not observed. Mr. Alpatov said the inpatient system is not nearly as developed as the outpatient system. Both systems operate on local area networks (LANs) connecting multiple computer users. At least in their first stage of development, both systems were designed to serve the needs of doctors rather than of managers. This same outpatient information system is installed at Nikopol Hospital where it is used extensively by doctors.

The outpatient system observed at City Hospital No. 2 uses IBM-compatible PCs linked by twisted pair cable to a Novell network designed around a 120 MB server that houses the database and the applications. The functional programs are written in Clipper, a DOS-based database management system that is commonly used in relatively small-scale database and network applications. In this case, the response time in one user area was nearly instantaneous, but the system was observed past regular hours of operation so it cannot be determined from this experience whether multiple users at peak use periods significantly degrade performance.

The system is designed around the hospital's work processes. Patient registration and data collection associated with this task is conducted on-line in the outpatient registration area. As the patient is interviewed across a counter, the registration clerk enters data directly into the computer to register the patient and schedule his or her visit. A single database design is used, and thus, for any one

patient with an unique registration number, there is only one electronic record of that patient's registration information. The same registration data on a single patient is accessed by all users.

To access a patient's registration record, the patient's name is entered, generating a list of all previously-registered patients with the same name. Name verification is performed by matching several demographic data items if the patient has been previously registered. It did not appear that a unique ID number was used as one of the variables. For previously registered patients, the name of their doctor is obtained.

If the patient was previously registered, verification is performed to make sure the patient is the same. At this point, patient registration information can be updated. For new patients, complete registration information is obtained and entered directly into the computer. The newly-entered information is printed out for new patients, but not for old ones.

The registration system generates a visit authorization slip containing information on the type and purpose of the visit, the date of the visit, and the diagnosis (with a + indicating that this is the initial/admitting diagnosis). The clerk writes in the queue number of the patient. This slip is completed by the doctor who adds information on the treatment offered, the diagnosis, and the number of subsequent visits required to resolve the problem. The doctor also signs the slip, indicating that the visit was completed.

Completed slips are collected and entered into the computer in a room adjacent to the registration and medical records areas. The polyclinic (outpatient department) has about 180 to 200 visits per day or about 50,000 visits per year. The medical record area employs six people to manage the computerized information collected on the slips, not including the registration clerk. Three personal computers are used for data entry.

Doctors may also write text notes regarding the patient's visit, diagnosis, and treatment, which are entered by clerks as text items. These text items become integral parts of the electronic medical record available to other doctors.

The computer system includes a laboratory information component that is designed to record all results for both hospitalized and ambulatory patients. In a room inside the laboratory, data entry clerks (four full-time equivalents) working two shifts enter all laboratory results for patient records. Patient registration information is accessed to verify the identity of the patient against the laboratory slip. Lab results are then entered using a preformatted data entry screen containing appropriate spaces and values for different types of laboratory test results. Abnormal test results are flagged on the original slip and this note is entered into the computer. Test results for inpatients and outpatients are entered into the same database. The lab clerks process approximately 400 laboratory test results per day. The clerks' salaries are based on their data entry productivity.

The primary users of the outpatient information system are doctors treating patients. The primary application in the system is the doctor's automated work station, which is used to obtain lab results, clinical status of the patient, patient histories, and so forth. The outpatient center of the hospital has

few doctor work stations however, due to lack of funds. At this first stage of development, the main applications in active use are patient registration and the collection of laboratory data.

In addition to the outpatient department system described above, City Hospital No. 2 also has computers in the accounting department, the human resources department, the kitchen, and the pharmacy. Mr. Coburn did not observe these systems. The pharmacy computer system was described as collecting information on patient drug use. A senior medical nurse is responsible for entering information on drugs administered to patients.

The Chief Doctor of City Hospital No. 2 said the computer system provides him with the statistics on utilization that he needs for managing the outpatient department. At this stage of development, the outpatient system does not contain a costing component to estimate and track resource use. However, outpatient managers are particularly interested in knowing whether a patient "belongs" to the hospital's catchment area, since the hospital obtains additional funding for inpatients and outpatients who are from outside of the area. The Chief Doctor explained that the hospital is, in effect, competing with other hospitals and outpatient centers for patients. The hospital staff recognize that they must attract patients to their institution.

The Chief Doctor is an enthusiastic supporter of the system, as is the hospital's accountant.

In the hospital inpatient information system, only registration and the collection and recording of laboratory results are in operation. There is no medical record system recording the case history of the patient. The inpatient system awaits further funding for development of additional applications and physician work stations.

b) Nikopol Hospital

The same outpatient system used at City Hospital No. 2 is in operation at Nikopol Hospital in Nikopol City, Dniepropetrovsk oblast. Nikopol City is the site of the Nikopol Metallurgical Raw Materials Plant, one of the most important and profitable companies of its kind in Ukraine. Nokopol Hospital serves two communities: metallurgical plant employees and community residents that are not plant employees. The Nikopol Plant has provided funding to support the development of the computer system for the inpatient and outpatient departments of the hospital, which is linked to the human resources management systems of the plant. The design of the system takes into consideration the information requirements associated with industrial hygiene and epidemiology, such as work loss.

Reflecting the same basic design as the City Hospital No. 2 information system, the Nikopol information system is more fully developed in terms of its applications. Approximately 50 PC work stations are installed, providing doctors direct access to a single patient database. Work stations are connected by a Novell network to a central database on three 486 servers with a combined capacity of over 200 MB. Work stations consist of 286 and 386 personal computers.

The hospital's database contains the same information as that of City Hospital No. 2, as well as a full case history of the patient, including diagnoses, procedures, and other clinical information on the condition of the patient and on the treatment rendered. Each specialist who examines and/or treats the patient has the option of entering data and textual notes into the patient's record. Currently, a single format for such entries is provided to all doctors. Doctors can either enter text or select codes provided on-screen which represent desired entries. Code books are provided and their contents are in the computer. The developers of the system indicated that plans for the future include creation of specialty-specific data and text entry formats.

Physicians retrieve information using structured formats for each type of information, for example, laboratory results, x-ray results, and tomographic results have different display formats.

The system's developers said that key barriers to further development of the system include the difficulty of creating good algorithms for certain specialties, such as obstetrics, as well as current limitations in capturing and storing graphic images. They believe that optical disk storage will be a benefit in the future.

The Nikopol Hospital system has been in operation for one and one-half years. The developers said five full-time equivalent employees were involved in designing and programming the system. Based on their experience, the system development team has acquired many skills and developed significant expertise. The system development team is now involved in a two-year project to develop a computer training system for emergency care. This system will serve students as well as practitioners interested in updating their skills in emergency medicine.

DniepMed Insurance Company

Dr. Anisimov described how the Meshvikov Regional Hospital was attempting to recover costs from non-governmental sources by contracting with private insurance companies. To assess the information needs of private insurance and the potential for the MEDECA system in meeting these needs, Mr. Coburn met with the President and Chief Economist of the private DniepMed Insurance Company. DniepMed has insurance contracts with about 20 local firms, as well as a medical service contract with the Meshvikov Regional Hospital.

The insurance company has been in operation for three months and has a staff of five. DniepMed was created with US$100,000 in capital. Technical assistance was obtained from insurance experts in Moscow. Investors include some of the company's partners. Because of their interest in using the service, some private firms also gave the company some funds for its start-up.

DniepMed charges a fee of about $350 per year per employee. Firms are interested in the insurance program because through it they can purchase a level of care that is otherwise unavailable. For example, the Regional Hospital is not usually available to patients with non-complicated illnesses, since it is a referral institution which treats only the most complex cases. The insurance contract provides the employees of a firm access to the hospital for more routine care. In general, the quality of care at the Meshvikov Regional Hospital is perceived to be the best available. In addition, patients

entering the Regional Hospital are typically asked to bring bedding, medical supplies, and medications. With the insurance contract, however, these "amenities" are provided by the hospital. Employees covered by insurance also receive private nursing, placement in two-bed wards, clean linens at least daily, and they do not have to wait for admission or service. Using its contracting leverage with the hospital, the insurance company also insists on obtaining the services of the best specialists. In addition to inpatient care, the insurance program also contracts with employers to provide family doctors. The company contracts with other hospitals in addition to the Regional Hospital.

The nature of the insurance contract was not clear. Some care was provided on a capitated basis. However, the President of the company stated that many contracts are written on a short-term basis, indicating perhaps that contracts are written on the basis of a need for specific services and the desire of individuals to obtain care from the Regional Hospital.

The President acknowledged the significance of the MEDECA data system for the development of price-based insurance. She was well aware of the characteristics of the system and indicated that the data collected were seen as very beneficial to insurance companies.

FOLLOW UP

Mr. Coburn's analysis of the MEDECA system and recommendations on how the system can be improved both at its present sites and at future sites will appear in a Technical Report which is currently being written. The report will also consider how the information collected by the system can better support quality assurance and payment reforms.

Following the development of the Technical Report, Mr. Coburn will make a second visit to Ukraine to discuss his recommendations and to assist MEDECA development staff in implementing these recommendations.

PERSONS CONTACTED

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Chief Economist, DniepMed Insurance Company, Dniepropetrovsk

Alexander Sergeivich, Deputy Chief of the Dniepropetrovsk District Council

ANNEX A

DATA CONTENTS OF MEDECA MASTER RECORD

"Individual Medical Case History
for District Hospital Inpatient/Outpatient Departments"

Personal Information on the Patient

01. Patient registration number
1. Surname, first name, middle name
2. Sex
3. Date of birth
4. Occupation
5. Place of work or study
6. Disability group
7. Disability type
8. Group of medical observation
9. Residence
    - 01. Street
    - 02. Street number
    - 03. City, town, village
    - 04. Block number
    - 05. Apartment of flat number
10. Name of local medical facility

Referral Source

11. Referring medical facility
12. Name of referring subunit or department
13. Initial diagnosis given by local medical facility
14. Exact date/time of beginning of disease
15. Is patient visit planned or emergency?
16. First admission or second for condition?

Features of the Patient

17. Blood type, RH factor, allergies
18. Place of hospitalization/admission
19. Diagnosis made at reception ward/admitting diagnosis
20. Clinical diagnosis
21. Date clinical diagnosis established
22. Severity of patient's condition

23. Admission and hospital stay: department to which admitted; date and time of admission; place of physical exam of patient; leave days for home
24. Admission and hospital stay: department to which admitted; date and time of admission; place of physical exam of patient; leave days for home
25. Admission and hospital stay: department to which admitted; date and time of admission; place of physical exam of patient; leave days for home
26. Admission and hospital stay: department to which admitted; date and time of admission; place of physical exam of patient; leave days for home
27. Admission and hospital stay: department to which admitted; date and time of admission; place of physical exam of patient; leave days for home

Notes on diagnoses:

- Item 13 is for state statistical purposes
- Diagnosis in item 19 vs. item 20: item 19 is doctor's diagnosis at reception; if 13 differs from 19, a specialist needs to resolve the differences; item 19 is the "admitting" diagnosis.

Final Clinical Diagnosis

28.-32.Unspecified
33. Main diagnosis; number of clinical statistical group; clinical statistical subgroup
34. Additional diagnoses/companion or secondary diagnoses; number of clinical statistical group; clinical statistical subgroup
35. Unspecified
36. Main complications; number of clinical statistical group; clinical statistical subgroup
37.-43.(For each diagnosis listed above) Character of disease/type (acute, chronic)
44. Kind of trauma
45. Type of examination

Result of Hospitalization

46. Result of treatment
47. Result of hospitalization
48. Date and time of discharge
49. If patient continues to be sick: yes/no
50. Number of sick leave permission
51. Sick leave: from date - to date; patient sick himself or leave needed to take care of another sick person
52. Sick leave certificate number
53. Diagnosis made with help of pathological/anatomical department
    01. Main additional complications
    02. Main additional complications
    03. Main additional complications
54. Name of medical institution

55. Cause of death
56. Department

Information On the Physician

57.-61. Names of physicians; number of days of treatment; special; individual; department of physician

Consultations—Medical Procedures Performed

67.-76. Name of medical procedure; code of medical procedure; date of procedure; done in time; name of physician; department of physician

Operations Performed

87.-94. Operation, anesthesia; severity; date and duration of operation; doctor name; department of physician; department; statistical sign

Blood Transfusions of Elements of Blood

107.-114. Medical procedure; quantity; how many times; name of doctor; structural subunit of doctor

Complications

122.-125. Complications (codes: surgical procedure; anesthesia; transformation; post-operative; in process of treatment; after delivery; other); medical/surgical procedure; results of complication; department

CHECKLIST FOR PEER REVIEW EVALUATIONS
OF PHYSICIANS' QUALITY OF CARE FOR
THE INPATIENT AND OUTPATIENT DEPARTMENTS OF MEDICAL SERVICES

Patient Identifiers

1. Patient surname, first name, second name
2. Hospital department
3. Date of hospitalization

Level of Quality of Treatment

4. Were quality of care standards met?
5. Reason why quality of care standards were not met:
   - Error or mistake in diagnosis
   - Untimely diagnosis
   - Operation performed on untimely basis
   - Non-adequate treatment
   - Atypical patient reaction
   - Patient non-compliant with regimen
   - Patient was shifted from one department to another
   - If patient is dead, death occurred before operation was performed
   - Patient died and doctor is at fault
   - Patient died during childbirth and doctor is at fault
6. Meeting of standards for examinations: met; not met with explanation; not met without explanation
7. Meeting of standards for examinations: met; not met with explanation; not met without explanation

Error Index

8. Complications developed because of medical staff
9. Second admission to hospital because of doctor
10. No explanation why LOS is shorter or longer (unexplained deviation)
11. No explanation concerning sending patient to specialists (most senior doctors)—reason not proven by doctor
12. Wrong recommendations by doctor concerning patient's condition
13. No correlation between clinical statistical group and diagnosis made—absence of correlation
14. Mistakes or errors in evaluation indexes
15. Are medical records filled in correctly? (yes/no)

Experts Reviewing Level of Quality and Errors

16.-23.Names of experts reviewing case; dates of reviews