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CONTENTS

		PAGE
OPENING ADDRESS ON THE OCCASION OF MEDIS'72	TARO NAKAYAMA, M.D.	1
HOSPITAL AUTOMATION IN JAPAN	RYOSEI KASHIDA, M.D.	5
MANAGING OF MEDICAL RECORDS AUTOMATION	BALDWIN G. LAMSON, M.D.	6
OUT-PATIENT SURVEY AND TRAFFIC SIMULATION STUDY IN A GENERAL HOSPITAL	TOSHIYUKI FURUKAWA, M.D. HIROSHI ABE, M.D.	13
AUTOMATIC ELECTROCARDIOGRAPHIC INTERPRETATION SYSTEM	EIICHI KIMURA, M.D.	20
COMPUTER USE IN CCU/ICU	YUTAKA NOMURA, M.D.	23
PROBLEMS ON COMPUTER DIAGNOSTIC SYSTEM OF PHONOCARDIOGRAMS	ETSURO SHIMOJI, M.D. SHOZO YOSHIMURA, M.D.	29
PRESENT STATUS AND FUTURE PROBLEMS OF REGIONAL MEDICAL INFORMATION SYSTEMS	MASAMITSU OOSHIMA, M.D.	33
L'INFORMATIQUE MEDICO-HOSPITALIERE EN FRANCE	M. LAUDET, M.D.	37
THE USE OF INFORMATION IN THE NATIONAL HEALTH SERVICE	R.G. ROWE, M.D.	55
EXPERIMENTAL MODEL OF REGIONAL MEDICAL DATA BANK AT NISHI-KU, YOKOHAMA	SHIGEKOTO KAIHARA, M.D.	63
REGIONAL MEDICAL PLAN IN THE MIDDLE WESTERN (KINKI) REGION OF JAPAN	AKINA HIRAKAWA, M.D.	67
MSS, A CENTRALLY PLANNED DECENTRALIZED MEDICAL INFORMATION SYSTEM IN SWEDEN	*W. SCHNEIDER, M.D.	
DESIGN OF HEALTH CARE SYSTEM FOR REMOTE AND DOCTORLESS AREA	TAKASHI TAKAHASHI, Ph.D. KAZUO MIYAWAKI, Ph.D.	68
PROBLEMS REGARDING CONTRIBUTION OF JAPAN MEDICAL ASSOCIATION TO REGIONAL MEDICAL PLAN	MASATERU FUJISAWA, M.D.	76
LECTURE MEDICARE SYSTEM IN JAPAN	TADASHI TAKIZAWA	83
LECTURE THE PLANNING OF EQUIPMENTAL DEVELOPMENT IN MEDICAL SYSTEM IN JAPAN	TERUAKI MIZUNOUE	86
THE PRESENT AND FUTURE PROBLEMS OF AMHTS IN JAPAN	YOSHISUKE IWAI, Ph.D.	90
APPRAISAL OF AMHTS IN PRACTICAL OPERATION	TORU IWATSUKA, M.D.	97
EVALUATION OF AMHT SYSTEM AND HARDWARE FROM ENGINEERING VIEWPOINT	MASAO SAITO, Ph.D.	103
REGIONAL HEALTH-EXAMINATION CENTER	TOSHIO UTSUNOMIYA, Ph.D.	110

PAGE

SOME PROBLEMS ON MEDICAL INFORMATION SYSTEM IN JAPAN — KAZUHIKO ATSUMI, M.D. ······114

THE MEDICAL SYSTEM HANNOVER (MSH) AND REGIONAL SYSTEMS IN GERMANY — PETER L. REICHERTZ, M.D.··127

REGIONAL HEALTH INFORMATION SYSTEM — M.R. ALDERSON, M.D. ············154

TOWARDS MEDICAL DATA BANK IN A HOSPITAL AND IN A COMMUNITY — AKIRA SASAKI, M.D. ·············167

MEDICAL INFORMATION SYSTEM AND A PLAN FOR REGIONALIZATION OF A HOSPITAL SPECIALIZED IN CARDIOVASCULAR DISEASES — ATSUAKI GUNJI, M.D. ···········179

MEDICAL DATA BANK AND CODING SYSTEM — MITSUHARU OKAJIMA, M.D.·····187

ON-LINE COMPUTER DIAGNOSIS AND TREATMENT THROUGH MAC SYSTEM — HIROSHI INADA, Ph.D., HIROSHI ABE, M.D. ··········191

COMPUTER APPLICATIONS OF INFORMATION RETRIEVAL AND MEDICAL INSTRUCTION TECHNOLOGY — IWAO FUJIMASA, M.D. ············198

APPLICATION FOR MEDICINE IN DATA COMMUNICATION SYSTEM — SUMIO TAKAHASHI ··················209

CLOSING ADDRESS — TSUNEO YOSHIDA, M.D. ·········217

* Remarks:

The papers of professor W. Schneider listed here will be at the end because of it's late arrival for his sickness.

THE MEDICAL SYSTEM HANNOVER (MSH) AND REGIONAL SYSTEMS IN GERMANY

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During this part of the conference regional systems have been discussed. I cannot report about regional systems in my country, because there are none, as far as comprehensive and integrated regional systems are concerned. Many concepts are being developed by state authorities, professional organizations, insurance companies, and even trade unions (11). Several projects are in the implementation phase.

The Federal Republic of Germany is a federation of states with autonomy in cultural, police, and health affairs. Slowly, coordination of planning between states overcomes the inherent constraints for a comprehensive health care delivery system.

Berlin (1, 35) and several states have started long-term plans for regional activities. The activities have to be observed and will - without any doubt - be worth special attention.

Instead of talking about these projects I would like to share with you some of my experience in designing and implementing a hospital system attempting an integrated approach. I consider a hospital approach to be a valid one even for regional systems. At least, I think this is the case as long as the terms 'regional' as well as 'information systems' are not yet clearly defined or used with varying definitions. An extension of such a system towards the integration of several hospitals as well as other health care delivery elements might be considered more feasible than creating new structures. I also think that hospitals present the necessary basis for exploration and testing of what a medical system really implies.

In addition, some general analysis may be in order in this context. A few remarks about federal research and development plans will be added

Hospital computing has become quite common in different application areas in our country. The number of computers installed in hospitals compares closely to the list given by Dr. Kashida. Other hospitals are somehow connected to data processing, without using their own hardware. But approaches to integrated systems are only to be found in a few places. There will be more within the next three years. Several projects have started or are in the implementation phase. The most well-known examples are to be found at the moment in Tübingen, Munich, Kiel, Berling, Göttingen, Wiesbaden (7) and Hannover (21,22,24,26).

But before going into detail about the activities with regard to the Medical System Hannover (MSH), I would like to make a few generalized remarks about information systems in medicine.

Medicine may be regarded as a cybernetic circle (Fig. 1) between
- signal generation

- signal apperception
- data interpretation
- information recognition and
- action

which again causes signals to be produced. In the medical environment, information systems are expected to address themselves to all these areas. The user expects more support for decision and action than the name 'information system' might lead one to believe. All these qualities lie within the activities to which medical information science addresses itself, namely (22,23,26):

- data acquisition
- information validation
- information management
- information evaluation and
- system flow control

within the medical environment. If some of the expected functions of medical information systems are listed, it becomes clear that not only the tasks of storage and retrieval of information are expected (26):

- data collection
- communication
- documentation
- information interpretation
- information presentation
- information derivation
- quality control
- optimization of functions and
- general administrative and management services

The term 'system' has been used quite a few times. Systems are defined as (23):

- conceptional sets of interdependent units.

When tasks within these systems are to be solved by computer systems, this term implies (23,26):

- one or more procedures consisting of manual, semi-computerized and computerized modules of varying extent to perform (repetitively) specific tasks or complexes of tasks.

The hospital has been defined as an important and integral part of health care delivery systems. Hospitals may differ greatly as to their specific medical tasks, but three main functional areas may be recognized (Fig.2;23,26):

- hospital management
- patient management
- medical science and tasks.

As shown in Figure 2, regional tasks will emerge and increase in importance together with the great importance of prophylactic aspects in medicine. As already pointed out, not only management of information is expected, but also problem management. Inherent is a request for decision support. Generally applicable information management systems are not possible due to the varying complexity and diversity of underlying objectives. But modules are conceivable from which systems may be composed according to the specific need of the hospital in question.

Fig. 3 delineates a possible concept for these modules. Different functions within different areas may be performed by the same module. This is particularly true for applications within the patient management area and in the area of medical science and tasks. Fig. 3 (26) shows the same main areas as indicated by Fig. 2. The term 'ancillary system' is used for a number of functions in the area of medical science and tasks. As 'ancillary systems' may be defined (21,26):

- systems which support directly the physicians' activities dealing with the patient.

Under this category fall:

- special inquiry systems
- decision support systems
- interpretation aids (discipline oriented, problem oriented)
- problem management systems
- (for instance balance calculations, flow rates, heart and lung diagnostics, simulation systems, etc.)
- aid in specific research projects (data acquisition, grouping, documentation, and analysis)

Fig. 3 attempts to show some of the data flow and tries to indicate some of the principal ways of information processing. The different areas (Fig. 2,3) are closely linked together by the central functions of communication, integration, and system flow control. Within this central circle the computer has to perform and can make its specific contribution.

Regional models may be developed from the same concept. This will be especially possible when it has been successfully tested and performs well. From operating hospital systems planning data may be obtained and the question of medical record linkage may be studied. Fig. 4 shows a systematized concept for regional systems based upon the modules developed in hospital systems.

When designing and implementing medical information systems, the problem of medical information will be recognized and the relativity of the underlying data. The relevance of information changes according to the definition of the problem. Redundancy of today may be valid information of tomorrow. Medical data are subject to different interpretation procedures, in other words, compression of data is difficult and sometimes impossible, since the principle of selection will not remain constant. The same set of data may be subjected to different interpretation procedures for which the redundant sets of data are not identical. The characteristics of a successful information system is to allow for the capability to present the same data according to different information hyperplanes. Some of the most common selection principles, f.i. are type, source, time and/or problem.

In dealing with these tasks we may distinguish three levels of techniques:

- non-qualifying information handling
- qualifying information processing

- information derivation
  (analysis, synthesis, decision, evaluation)
- dynamic systems modelling.

The first two qualities are inherently expected from information systems. Non-qualifying information handling means the retrieval and reproduction of data according to the same principle of grouping under which the original input has been collected. Moderate reordering is naturally possible. Qualifying information processing means reordering and grouping will take place and information will be collected either horizontally or longitudinally according to ordering principles like - as mentioned above - time, source, problem, discipline, etc. The process of obtaining new information or extraction of information from data is called information derivation. The technique of system simulation is specific to computer systems and has still to be explored to a broader extent. The system under scrutiny is modeled to a higher or lesser degree of complexity, so that the actual process can be reevaluated with different parameters and, when an adequate simulation of the reaction of the system has been achieved, further behavior may be predicted, f.i. as a reaction to therapy or in regard to the natural course of a condition or a disease.

After these introductory definitions, the Medical System Hannover should be briefly described. It is a system within a teaching hospital and designed with the ultimate goal of integrating all information flow within a hospital for requirements of all hospital areas as defined in Fig. 2. (24).

The Medical School Hannover is new both in concept and in building. The traditional German medical school had separate buildings for the various disciplines. The Medical School Hannover combines like medical schools in the Anglosaxon countries, all major disciplines in one hospital building, and concentrates the basic sciences in common research complexes. It has been attempted to combine advantageous aspects of both traditions.

The first construction works were started in 1966 (Fig. 5), and the first in-patient was admitted on July 19, 1971. In the meantime most of the clinical services were operating in a city-owned hospital. Detail planning for electronic data processing started late in October 1969 when the financial preparatory work had been done. The computer was installed in August 1970 and less than a year was available to prepare the beginning of operations. Computerized admissions were done from the very beginning when the hospital was opened to the public in July 1971, with an initial bed capacity of 100. The present capacity is about 600 beds and the increase can be seen on Fig. 5 with a continuous growth rate. The capacity of the main hospital building is projected to 1160 beds, and the increase rate will show when this capacity will be reached approximately. The whole capacity of the Medical School Hannover is projected to be 2000 beds with a few additional facilities on and off the campus. There are at the moment about 250 out-patients and the projected capacity is some 660 to 800 per day.

For the medical information system, an IBM /360-67 was chosen and installed. For laboratory work, two IBM 1130 were chosen. Nuclear medicine is processing szintigrams with a CDC 1700 and, for research purposes, there are various smaller PDP computers on campus, as well as a sigma 2 for ECG processing and an AEG Telefunken TR 86 for EEG analysis.

The hardware is described schematically in Fig. 6.

In Fig. 3 the main tasks of an information system were shown in the inner control circle as being

- integration
- communication.

It has been stated that the computer may take over some of these tasks. An integral tool for the integration is the data base and the communication task can be done by on-line tele-processing.

We choose the concept of a virtual machine because in a medical school we also have to provide time-sharing services for both our scientific development within our own department as well as for basic sciences. It is somehow satisfactory that the concept we choose in '69 and which - at that time - was at least unusual, has become the main philosophy of IBM's new products.

Fig. 7 shows the software hierarchy which we developed. We have chosen the concept of virtual machines with a hypervisor control program allowing independent virtual machines to be run. Several of them are time-sharing machines and the hospital system is processed on a huge virtual OS-MFT-II system with more than two megabytes of virtual core. (The real system has 512 K core). Under this MFT-II system, HASP controls the different partitions and, in one partition, a teleprocessing system is operated that has been developed in the Baylor College of Medicine and has been adapted to our specific needs including interfacing with the data base software which is DL/1, more commonly known as the data base part of IMS (Information Management System, IBM). The IMS data sets may be accessed both from our tele-processing system as well as from batch partitions.

A schematized concept of our data bank is shown in Fig. 8. The different data bases are linked together by logical pointers and pointer information in a summary file where all necessary information is stored to allow the programs to access the patients data in a user-transparent way. This 'summary file' contains all information about where patient information is to be found. An emergency summary file links emergency numbers to a valid identification number as soon as it is derived from the personal data of the patient.

The medical information resides in 2 data bases, one of them being 'CONPAT', in which essential information is kept on-line as long as possible to function as a content summary. The second data base contains the actual patient data with detail information. It is kept online for the actual treatment. These data will be put on tapes as treatment units in such a way that they may be reloaded into the active data base for on-line retrieval or be subject to searches and evaluations. In addition, we have sets of different accounting files and files for statistic and administrative purposes. The whole data base may be accessed either by name, by identification number, or birthdate. The name need not be given in full detail, generic searches (comparing only a specified number of leading characters) may be done and the selected patient may then be further specified. Transactions can be done both from cathode-ray type terminals (at the moment 32, 20 more on order) or from typewriter terminals which are, however, mostly used for hardcopy output.

Fig. 9 shows the structure of the content summary file as it stands today. Extensions are possible and new segments may be added. The medical information is stored in form of diagnoses (with specifications and additions), problem descriptions, and problem epicrises as part of the data and not as the governing principle of information storage). The content summary contains also risk facts (like allergy against certain drugs, diabetes, chronic treatment). Furthermore, some basic personal and administrative data are included.

The software uses a hierarchical key structure which lends itself to logical searches and combinations of searches (28, 30).

Basis of this information system is the admission and discharge dialogue. The patient enters the system through an admission procedure which is done physically centrally in the main admission area or logically centrally from any scope. Up to 72 questions with the branching according to the answers of the patients are asked by the system, answered by the patient and entered by the admission clerk. These clerks had no prior experience with electronic data processing equipment when we started the operation. The admission procedure takes about 10 minutes and, as a result, an aluminum foil is immediately produced as well as some other material which accompanies the patient to the ward including some stickers with his name to be used for various purposes. (5,6). The aluminum foil (Fig. 10) shows the basic information of the patient and his identification coded in a binary form so it becomes machine readable when transcribed to an optical reader form by small hand-operated transcription units as well known from credit cards. In the middle part of Fig. 10 an optical reader form for menu ordering is shown, to which the patient information has been transcribed. As a result of this information, cards are punched for each meal and patient, and are fed into an automatic tray control line, where the patients' tray proceeds according to this information and where lamps indicate to the employees what ingredients and what amount has to be put on the tray to compose the diet of the patient.

Menu ordering can also be done from the terminals. Fig. 11 demonstrates a sequence of data entry and -display showing the names of the patients on a ward, their dietary description and the changing of one diet, the change being requested to take effect at noon of the day.

In order to preserve originality, these figures describing actual systems are in German. Most of them show actual patient data. Patients' names will therefore be blanked out or otherwise made unreadable. For demonstration purposes, no frames from cathode-ray tubes have been photographed. Working from a typewriter terminal, more questions may be put together to one figure. The users' answers are always circled.

The identification number used in our system can be seen in Fig. 11. The first 6 digits consist of the patient's day of birth, month and year. It could be observed that these numbers can be remembered more easily and are less difficult to enter when the periods are inserted as people are used to in birthdates. The following 2 digits are a 00-99 code for the first two letters of the patient's birthname. The code has been developed from telephone books of the major cities in order to approach equal distribution. The next digit indicates the sex (and the century) of the patient and the last digit is reserved for those cases where "ID -twins" are encountered, i.e., where the first 9 digits of two patients are the same. In this case, the 10th digit will be incremented by 1. A Federal civic number will be introduced during the next 1-2 years. It is similar and our data bases are projected to work with those numbers as soon as they are available.

The data base may be accessed both by the display as well as by off-line systems. Fig. 12 gives an example of an access to the data bank. Here only a part of the name (Her...) is given. From the displayed patients the correct individual is chosen, and then chronic risk facts, in this case, continuous treatment with digitalis are indicated, and the diagnoses of the former treatment (hemiparesis, respiratory insufficiency, arteriosclerosis) are displayed.

At the moment, we have roughtly 33,000 patients and screening and retrieval procedures can be done with this data base. Also, the admission procedures yield interesting data and bases for planning activities. The graphic of the total number of beds occupied (5) shows seasonal fluctuations, for example during Christmas and New Year, Easter and Pentecost (Fig. 13; see also Fig. 5). Since there are no increased activities immediately following these dips it is save to assume that admissions can be planned to a certain degree. The reason why admission rates should be influenced can be seen when the admission rates are examined (Fig. 13). Very high peaks can be seen on Monday with low discharge rates and small admission rates and high frequencies of patients discharged towards the end of the week. This means that during the peak period either the hospital is overutilized or that it is underutilized during the remaining days of the week because these peak loads trigger similar peak activities in other service areas, although some smoothing may be assumed in certain phase shifts. A look at the admission during one day shows a disadvantageous distribution. 50% of all patients area admitted during the first two hours in the morning after the hospital has been opened to the public. By monitoring admission and discharge, data are obtained about the average stay of a patient within the hospital and the average stay of patients on individual ward's and the average stay of patients according to their diagnoses. When plotting the number of patients against the days they stay in the hospital, a peak is seen after two days and eight days (discharge of patients after having been admitted for some kind of emergency, seven-day cycle as described above). Secondary peaks are to be seen with intervals of one week. At the moment, the average stay is twelve days.

The data base lends itself to seaches of all kinds. These can be done either off-line or on-line. As an example, the age distribution of all patients is shown in Fig. 15. Deep dips indicate the years of World

War I and the age group that presumedly was killed during World War II. Fig. 16 gives, as another example, the age distribution of all patients with coronary infraction. Additional qualifiers can of course be used when performing the search, such as searching only for female patients or for combinations of diseases. The age distribution of female patients with coronary infractions, f.i., shows a slightly later onset with a maximum in the age group between 65 and 70. However, 8,3% of all female patients of the age group between 75-80 had the findings of coronary infraction whereas only 1,8% of the female patients between 60 and 65 were admitted for that reason. 18,6% of all patients with coronary infractions were females between the age of 65 and 70, whereas 0,43% of all patients admitted were women with coronary infractions and between the age of 65 and 70. These results can be retrieved in form of plots as shown in Fig. 15 and 16. Naturally, in the same way, combinations of diseases, diagnoses and combinations with additional qualifiers (as shown above for the parameter age) may be retrieved.

Many other applications have been developed in the areas of hospital management, patient management and ancillary systems. A few examples shall be given.

Automated history acquisition is done either by optical reader form or using extensive branching techniques. The basic system is the Clinical Decision Support System (15,16) adapted to our tele-processing environment and for which the data base research has been done during the last two years (13,14,15,16). Fig. 17 shows two extracts from the on-line questionnaire. The part has been chosen at random. Fig. 18 gives an abstract of the history printed out by the system.

For the reserach with diagnostic models two basic concepts have been chosen. A deterministic model (14,15,18) approaches the diagnostic procedure with the attempt to add explanations of possible causes to the diagnostic classification and therapeutic action. At the same time, additional information may be requested when needed. (Fig. 19).

A probabilistic model (ODARS; 12,19,32) follows a checklist of symptoms and calculates the probability of the differential diagnosis on the basis of the Bayesian theorem (3).

Cytology reporting is done on-line in pathology (34). The texts are entered on a CRT terminal, checked against former reports of the same patient and eventually categorized by free-text analysis procedures (27). Reports are printed and a protocol book is kept.

Naturally, not all applications can be mentioned in this context. Some of them are described elsewhere (5,6,8,9,10, 21,22,24,26,28,29,30), but new ones are continuously added to the system.

To conclude just a few words about a possible regional application of our problem. This will be both possible when linking hospitals together with one or more functions as well as in the form of applications of models to specific tasks. A possible concept is shown in Fig.4. The main charges of the computer applications are here also communication and coordination. It is easy to see that f.i., ancillary systems may be used both for regional systems and as general data base structures for special inquiry systems as well as general information systems.

Under this aspect, also the integration of medical practice has to be seen. The general practitioner may be reached either by off-line systems (with body transportation of source documents or on-line bulk transmission) or tele-processing concepts (Fig. 21).

Our own plans are to start with the linkage of our system to other systems in West Germany or possibly West Berlin. But these plans have not yet reached the stage of realization.

As mentioned previously, in West Germany several hospital models are developed. As far as on-line operations are concerned, the MSH shows the greatest amount of operational facilities. Administrative models are used in about 10-15 hospitals with varying degree. Community and church owned hospitals are developing or using common administrative procedures all over the country. The City of Berlin is trying to advance a regional integrated model encompassing community hospitals, regional authorities, and general practitioners on a long-term basis (35).

It is my opinion that the patient himself has to be made an active part of the system, especially when screening and long-term health care delivery procedures are intended. Nsturally, also the patient's physician has to be part of this active communication and information cycle.

The Federal Government is sponsoring research and development activities to roughly 10 to 15% of a projected DM 2.5 billion research and development plan dedicated to electronic data processing projects (2,4,31). Amongst these projects are several medium-sized hospitals and one larger comphrehensive model (31). Insurance companies and professional organizations consider and develop their own projects. Research activities (33) are also directed towards electronic processing of medical information.

The near future will see several approaches. Some of them will succeed, some will fail on our way coping with the problem of today with the methods and the technology of tomorrow.

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Fig. 1

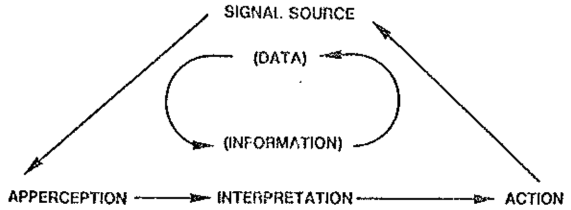

Fig. 2

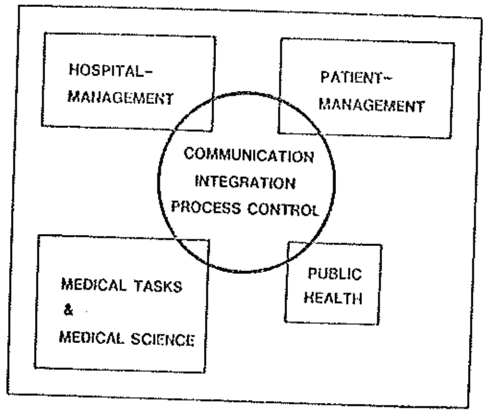

Fig. 3

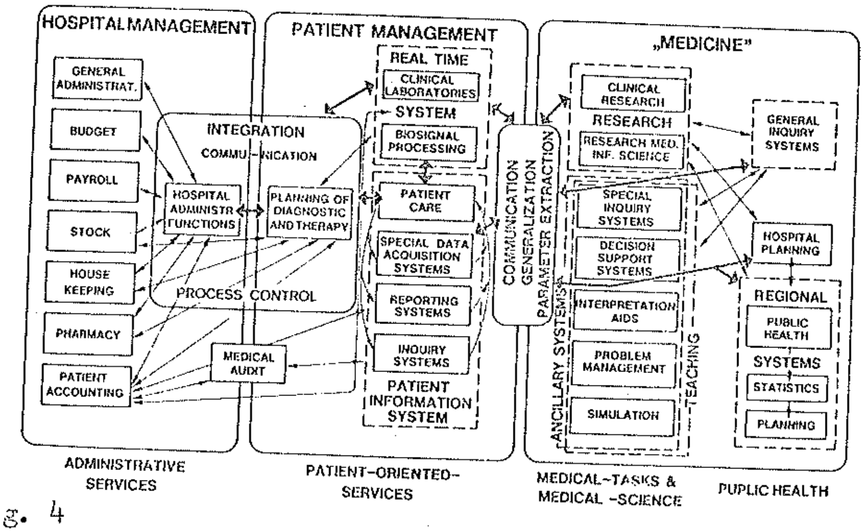

Fig. 4

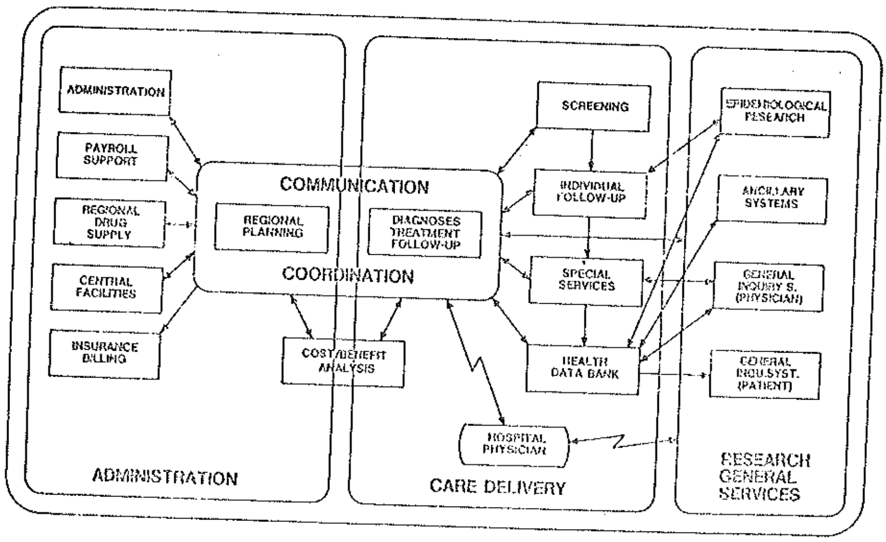

Fig. 5

MEDICAL SCHOOL HANNOVER

DATE: SEPT. 1972	
BEGINNING CONSTRUCTION	MAY 1958
BEGINNING OF DETAILED EDP PLANNING	OCTOBER 1969
INSTALLATION OF COMPUTER	
FIRST PHASE	AUGUST 1970
FIRST IN-PATIENT	JULY 19, 1971
BED CAPACITY JULY 1971	100 BEDS
PRESENT CAPACITY	539 BEDS
INCREASE OF IN-PATIENTS	(UP TO JULY 72, MAX.438)
CAPACITY OF MAIN HOSPITAL	
BUILDING	1130 BEDS
PROJECTED TOTAL CAPACITY M.S.H.	2000 BEDS
OUTPATIENT ADMISSIONS	~250/DAY
PROJECTED CAPACITY	600-800/DAY

Fig. 6

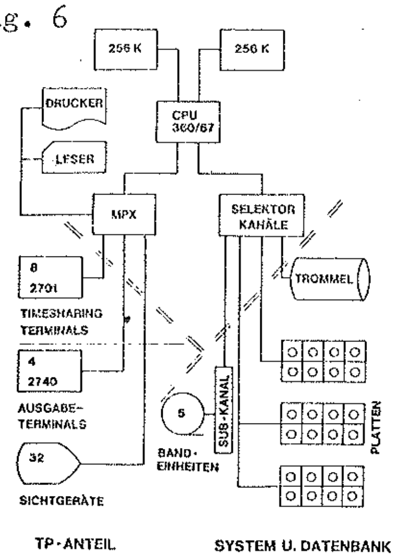

Fig. 7

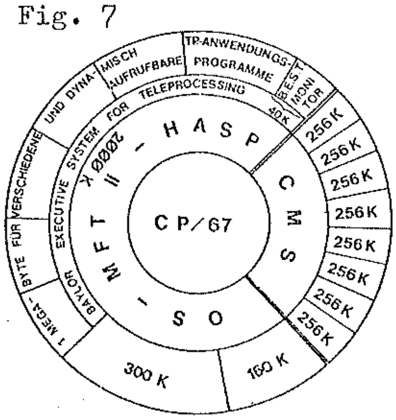

Fig. 8

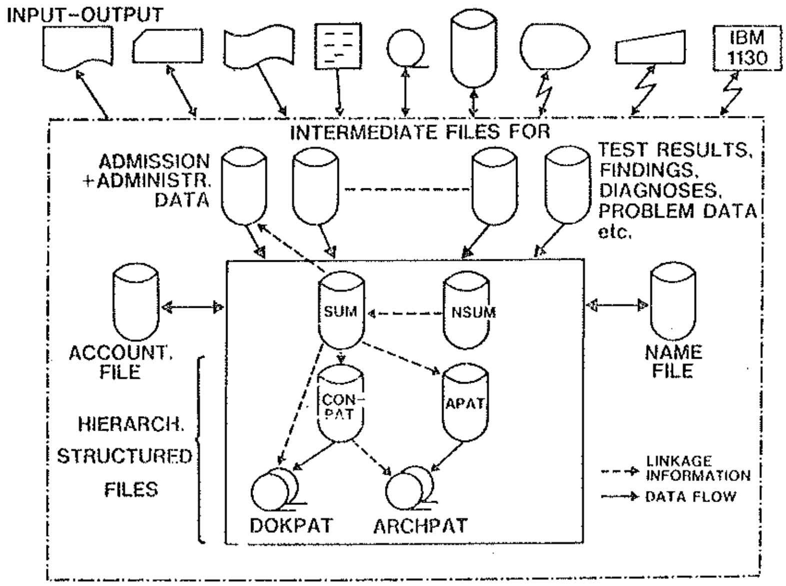

Fig. 9

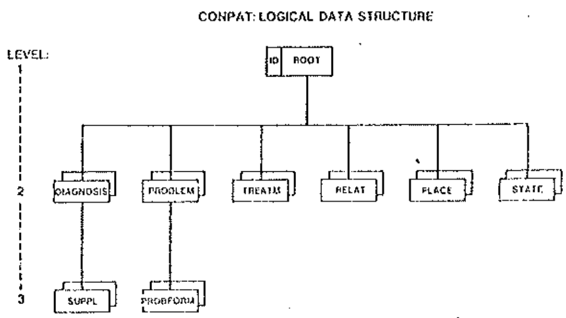

Fig. 10

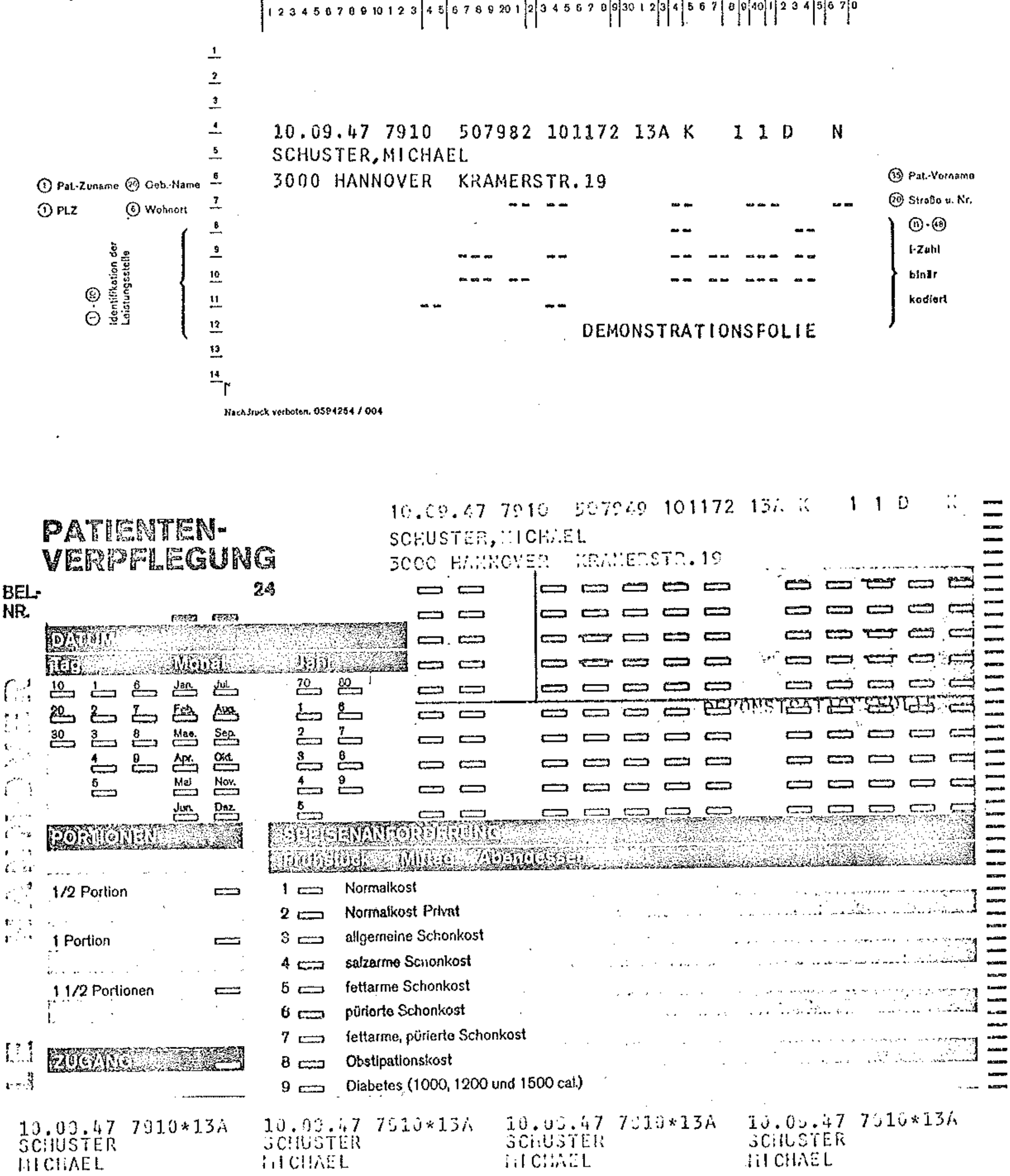
I Zahl
Aufn.-Nr.
Aufn. Datum
Stat.
TK
10.09.47 7910 507982 101172 13A K 1 1 D N
SCHUSTER,MICHAEL
3000 HANNOVER KRAMERSTR.19
① Pat.-Zuname ⑳ Geb.-Name
① PLZ ⑥ Wohnort
①-⑮ Identifikation der Leistungsstelle
㉟ Pat.-Vorname
⑳ Straße u. Nr.
⑪-㊽
I-Zahl
binär
kodiert
DEMONSTRATIONSFOLIE
Nachdruck verboten. 0594254 / 004
PATIENTEN-
VERPFLEGUNG
BEL-
NR.
24
DATUM
Tag
Monat
Jahr
PORTIONEN
1/2 Portion
1 Portion
1 1/2 Portionen
ZUGANG
SPEISENANFORDERUNG
Frühstück Mittag Abendessen
1 Normalkost
2 Normalkost Privat
3 allgemeine Schonkost
4 salzarme Schonkost
5 fettarme Schonkost
6 pürierte Schonkost
7 fettarme, pürierte Schonkost
8 Obstipationskost
9 Diabetes (1000, 1200 und 1500 cal.)
SCHUSTER
MICHAEL

Fig. 11

**** PATSTAT ****

INFORMATIONSSYSTEM FUER DIE PATIENTENVERPFLEGUNG.
BITTE GEBEN SIE IHR KENNWORT FUER DIE BENUTZUNG DES SYSTEMS AN:
(DAS PROGRAMM HAT EINBLICK IN PATIENTENDATEN,WIDERRECHTLICHE
BENUTZUNG IST STRAFBAR)

PROGRAMMIERUNG UND SYSTEMDESIGN: G.ENDERLEIN, E.SCHIEL, R.ENGELBRECHT
¢d: 9
*** SCHLUESSELWORT WIRD GEPRUEFT ***
LIEBER BENUTZER REICHERTZ
BITTE GEBEN SIE DIE STATIONSBEZEICHNUNG EIN:¢21b

LISTE DER PATIENTEN DER STATION 21B				K	P	K	P	K	P
1	RU ,RICHARD	07.05.09	7010	1	1	1	1	1	1
2	MA INGEBORG	12.01.26	1920	4	1	4	1	4	1
3	DE ILLI	17.04.10	1210	1	1	1	1	1	1
4	SC ,WILHELM	22.02.10	7610	0	3	0	3	0	3
5	EG Z	06.06.01	1510	3	1	3	1	3	1
6	RI KLARA	17.07.00	6820	9	2	9	2	9	2
7	ZI N,ALOIS	24.05.06	9810	3	1	3	1	3	1
8	MA TTO	13.04.09	5310	3	1	3	1	3	1
9	SC ,FRIEDRICH	28.02.12	7710	3	1	3	1	3	1
10	KNU ALBERT	10.04.38	4210	1	1	1	1	1	1
11	NOW IDA	18.01.04	5920	9	2	9	2	9	2
12	NEN IGARD	27.01.27	8920	3	1	3	1	3	1
13	PAA TER	30.10.03	6110	3	1	3	1	3	1
14	POH HANNES	28.07.11	6310	1	1	1	1	1	1
15	PRO A	05.09.01	6420	3	1	3	1	3	1
16	MEY HARD	21.03.12	5510	10	0	10	0	10	0
17	HAGI RITZ	15.04.10	2610	5	1	5	1	5	1
18	HASI FRIEDRICH	13.01.97	2710	6	1	6	1	6	1

ENDE DER LISTE,BITTE NEUE EINGABE¢ae,8

AENDERUNG FUER MA TO
ZEITPUNKT
1 ZUM FRUEHSTUECK
2 ZUM MITTAG
3 ZUM ABENDESSEN
PORTIONSGROESSE
0 KLEINE PORTION
1 NORMALE PORTION
2 GROSSE PORTION
KOSTFORM (NACH SCHLUESSEL)
¢2,2,11

IST ALLES RICHTIG ? (JA/NEIN)
STATION: 21B
STAND FUER MA TTO 13.04.09 5310

FUER DEN 05.11.72	KOSTFORM	PORTION
FRUEHSTUECK	3	1
MITTAG	11	2
ABEND	11	2¢

Fig. 13

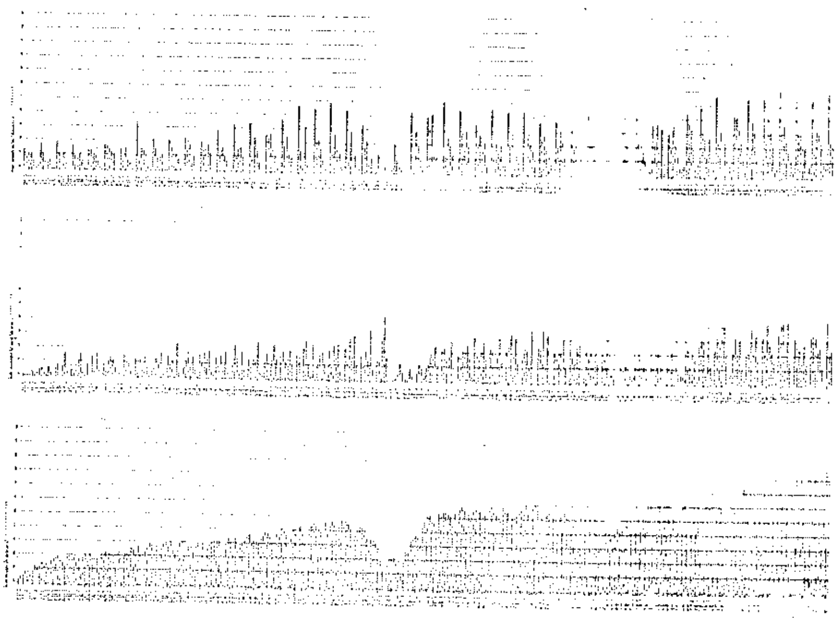

Fig. 14

M E D I Z I N I S C H E H O C H S C H U L E H A N N O V E R
AUFENTHALTSDAUER DER PATIENTEN. STAND:18.10.72

000 100 200 300 400 500 600 700 800

1	164
2	625
3	378
4	307
5	380
6	343
7	315
8	790
9	422
10	471
11	304
12	305
13	268
14	235
15	315
16	273
17	214
18	191
19	129
20	122
21	123
22	159
23	120
24	90
25	82
26	77
27	52
28	67
29	79
30	73
31	59
32	47
33	40
34	30
35	35
36	38
37	34
38	29
39	27
40	29
41	23
42	19

Fig. 15

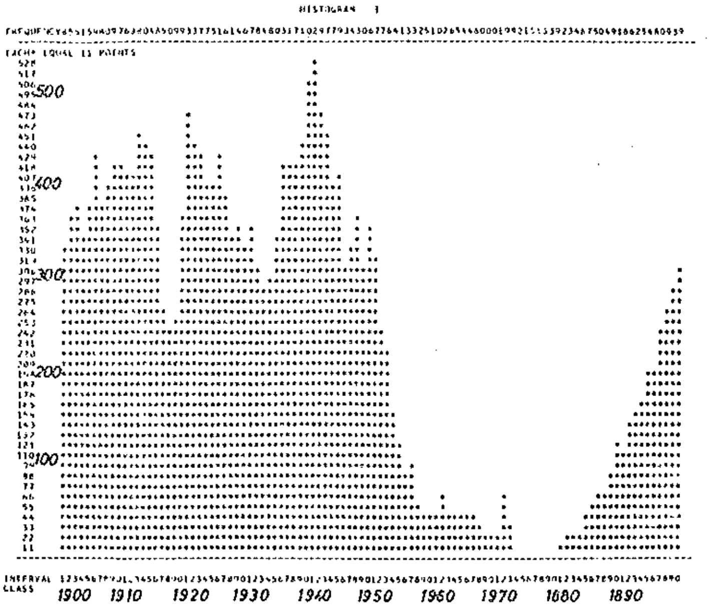
500
400
300
200
100
1900 1910 1920 1930 1940 1950 1960 1970 1880 1890

Fig. 16

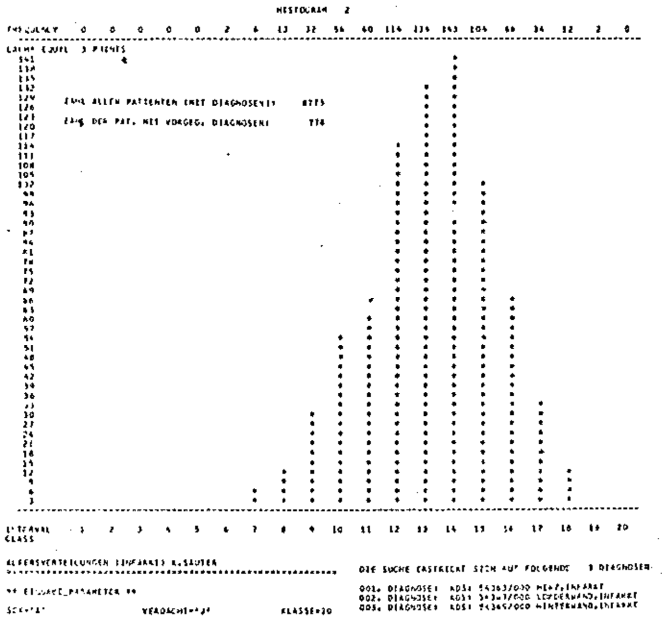
INTERVAL CLASS
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

Fig. 17

```
*** CDSS *** BENUTZER NR:        1** KRANKENGESCHICHTE WIRD EROEFFNET **
        ********* CDSS  MSH *********
        *****************************
    PROJEKTLEITUNG: J. MOEHR
    O/S - BEST VERSION: P.L. REICHERTZ
    MED.-DATENBASIS:
    ANAMNESE: J. MOEHR, G. HOLTHOFF, R. SCHWARZROCK
    K.M.-ZYTOLOGIE: J. ODRIZOLA, H. PAPE


   MIT DEN FOLGENDEN FRAGEN MOECHTEN WIR ERFAHREN, WELCHE BESCHWERDEN UND
   KRANKHEITEN SIE GEGENWAERTIG HABEN ODER FRUEHER EINMAL HATTEN. VERSUCHEN
   SIE SICH BITTE, SO GUT ES GEHT, ZU ERINNERN.  ¢
    BITTE <UMBLAETTERN> (/V)¢/v

   LITTEN SIE
 1 FRUEHER EINMAL (VOR MEHR ALS 6 MONATEN) UNTER KOPFSCHMERZEN, JETZT ABER
   NICHT MEHR?
 2 INNERHALB DER LETZTEN 6 MONATE (EGAL OB  SCHON SEIT LAENGERER ODER ERST
   SEIT LETZTER ZEIT) UNTER KOPFSCHMERZEN?
            JEWEILS 'J' ODER 'N'
 12¢¢nj

   WELCHE MEDIKAMENTE WIRKEN ERLEICHTERND?
 1 SCHON LEICHTE SCHMERZMITTEL (Z.B. ASPIRIN, SPALTTABLETTEN)?
 2 ERST STAERKERE SCHMERZMITTEL?
            J, N, ZAHL(EN) OD./V
 12¢¢2

 1 HABEN SIE OFT SCHWINDELGEFUEHL ODER SCHWINDELANFAELLE?
 2 HATTEN SIE JEMALS WAHNVORSTELLUNGEN ODER KRAEMPFE?
            J, N, ZAHL(EN) OD./V
 12¢¢2

   FRAGEN ZU HUSTENBESCHWERDEN
 1 HABEN SIE OEFTER HUSTEN?
            JEWEILS 'J' ODER 'N'
 1¢¢j

   BITTE TEILEN SIE UNS GENAUERES UEBER IHREN HUSTEN MIT.
 1 HABEN SIE SEIT LAENGER ALS 4 WOCHEN HUSTEN?
 2 HABEN SIE AUSWURF BEIM HUSTEN?
 3 PFEIFT ODER BRUMMT ES BEIM HUSTEN IM BRUSTKORB?
            J, N, ZAHL(EN) OD./V
 123¢¢123

   LEIDEN SIE UNTER ATEMNOT
 1 ODER KURZATMIGKEIT?
            JEWEILS 'J' ODER 'N'
 1¢¢j

   HABEN SIE NUR ATEMNOT,
 1 WENN SIE GANZ FLACH LIEGEN?
 2 WACHEN SIE NACHTS MANCHMAL DURCH ATEMNOT AUF?
            JEWEILS 'J' ODER 'N'
 12¢¢jj
```

Fig. 18

KURZANAMNESE

***,
TESTPATIENT, MARTHA, 378
****
I-ZAHL 8
GESCHLECHT WEIBLICH
ALTER 56

.

GRUENDE FUER VORSTELLUNG IN DIESER KLINIK:
SPEZIALUNTERSUCHUNG
.

.

FAMILIENANAMNESE

CATARACT
DIABETES
HERZINFARKT
RHEUMATISCHE HERZERKRANKUNGEN
HOHER BLUTDRUCK
GALLENSTEINE
.

EIGENANAMNESE
****
FRUEHERE KRANKHEITEN UNFAELLE USW.

FRAKTUREN : DES SCHAEDELS
PAT. HATTE UNFALLVERLETZUNG

OPERATION (EN) : AN TONSILLEN ODER ADENOIDEN

KLEINERE EINGRIFFE

FRUEHERE ERKRANKUNGEN:
MILCHSCHORF
SCHARLACH
DIABETES
MUMPS

THORAXBEREICH:

HUSTEN, -SEIT LAENGER ALS 4 WOCHEN, ASSOZIIERT MIT AUSWURF, VERBUNDEN MIT PFEIFEN UND BRUMMEN IM BRUSTKORB
ATEMBESCHWERDEN
LUFTNOT, LUFNOT BEIM FLACHEN LIEGEN, LUFTNOT NACHTS, VERBUNDEN MIT ENGEGEFUEHL UND TODESANGST
.
HERZGERAEUSCHE VOM ARZT FRUEHER FESTGESTELLT
HERZSCHMERZEN (ANGINA PECTORIS) : TRETEN AUCH UNABHAENGIG VON AEUSSEREN UMSTAENDEN JEDERZEIT AUF
FRUEHERE HERZERKRANKUNGEN:
RHEUMATISCHES FIEBER FRUEHER VOM ARZT DIAGNOSTIZIERT
EKG-FRUEHERE UNTERSUCHUNGSERGEBNISSE, ALS UNNORMAL BEZEICHNET

Fig. 19

```
    BLUTGASANALYSEN INTERPRETATION
     BITTE <UMBLAETTERN> (/V)¢/v

    BITTE GEBEN SIE DIE PERSONALDATEN AN:
1   ZUNAME       TESTPATIENT
2   VORNAME      PAUL
3   STATION      21B
4   ALTER        54

1   PO2                     63.2
2   PH                      7.312
3   PCO2                    29.1
4   BE                      -8
5   KOERPERGEW. (KG.)       78.5

    BEKOMMT DER PATIENT SAUERSTOFF ODER
1   WIRD ER BEATMET?
              J, N, ZAHL(EN) OD./V
 1¢ n
BITTE WARTEN; INTERNE BERECHNUNGEN
    HYPOXIE UND SCHWERE METABOLISCHE AZIDOSE TEILWEISE RESPIRATORISCH
    KOMPENSIERT ODER METABOLISCHE UEBERKOMPENSIERTE RESPIRATORISCHE ALKALOSE.
     BITTE <UMBLAETTERN> (/V)¢/v

    ALS URSACHE DER HYPOXIE OHNE GLEICHZEITIGE HYPERKAPNIE KOMMEN INFRAGE:
    VERTEILUNGSSTOERUNG UND/ODER ERHOEHTES INTRAPULMONALES SHUNTVOLUMEN
    DIFFUSIONSSTOERUNG
    THERAPIEVORSCHLAG: BEHANDLUNG DES GRUNDLEIDENS
    O2-GABE, EVTL. BEATMUNG
     BITTE <UMBLAETTERN> (/V)¢/v

    DIE HYPOKAPNIE IST ALS AUSDRUCK DER RESPIRATORISCHEN KOMPENSATION EINER
    METABOLISCHEN AZIDOSE ANZUSEHEN.
     BITTE <UMBLAETTERN> (/V)¢/v
    DAS GERINGE AUSMASS DER ACIDOSE MACHT KEINE AKTIVEN KORREKTURMASSNAHMEN
    NOETIG. DENNOCH SOLLTEN BEI DER BEHANDLUNG FOLGENDE MOEGLICHEN URSACHEN
    EINER ACIDOSE BERUECKSICHTIGT WERDEN:

    AKUTES NIERENVERSAGEN
    DIABETES MELLITUS
    KREISLAUFVERSAGEN
    SELTENE STOFFWECHSELSTOERUNGEN
    RENALE KOMPENSATION EINER RESPIRATORISCHEN ALKALOSE
    IATROGENE UEBERKOMPENSATION EINER METABOLISCHEN ALKALOSE
    GABE VON CARBOANHYDRASEHEMMERN
```

Fig. 20

```
A    PRIMAERE KNOCHENTUMOREN - LODWICK
B    EINTEILUNG DER PRIMAEREN TUMOREN MIT KNOCHENZER-
     STOERUNG
C    PRIMAERE KNOPCHENTUMOREN OHNE KNOCHENZERSTOERUNG
     EINTEILUNG NACH MALIGNITAETSGRAD
D    PRIMAERE KNOCHENTUMOREN MIT VERKNOECHERTEM RAND
     OHNE KNOCHENZERSTOERUNG,MALIGNITAETSGRAD
E    HERZKRANKHEITEN (TEMPLTEON,LEHR,SIMMONS)
F    SOLITAERE RUNDSCHATTEN DER LUNGE  (TEMPLETON)
G    MAGENULZERA  (WILSON, TEMPLETON, LODWICK)
H    SCHILDDRUESENERKRANKUNGEN  (WILLIAMS,FITTGERALD/
     REICHERTZ,WINKLER)
I    AKUTES ABDOMEN BEI KINDERN     ** TEST  **
KRANKHEITSKATEGORIE MIT KODEBUCHSTABEN AUSWAEHLEN.
OPTIONEN : Ø : ZURUECK ZU RADIATE; Y: NAECHSTE
TABELLE; 1: ZURUECK ZUR ERSTEN TABELLE; # STOP 'ODARS'
E

ALTER                                      GESCHLECHT
A 3 MONATE ODER WENIGER                    K MAENNLICH
B 4 MONATE BIS 5 JAHRE                     L WEIBLICH
C UEBER 5 JAHRE BIS 2Ø
D UEBER 2Ø BIS 45
BITTE MIT DEM KODEBUCHSTABEN ANTWORTEN; KEINE
INFORMATION : Ø, ENDE : Z
CL

ZYANOSE                                    HERZGROESSE
A JA                                       K NORMAL
B NEIN                                     L GROSS 1 +
M GROSS 2 +
N GROSS 3 +
BITTE MIT DEM KODEBUCHSTABEN ANTWORTEN; KEINE
INFORMATION : Ø, ENDE : Z
BL

ZYANOSE                                    HERZGROESSE
A JA                                       K NORMAL
B NEIN                                     L GROSS 1 +
                                           M GROSS 2 +
                                           N GROSS 3 +
BITTE MIT DEM KODEBUCHSTABEN ANTWORTEN; KEINE
INFORMATION : Ø, ENDE : Z
BL

LINKER VENTRIKEL                          RECHTER VENTR.
A NORMAL                                   K NORMAL
B GROSS 1 +                                L GROSS 1 +
C GROSS 2 +                                M GROSS 2 +
D GROSS 3 +                                N GROSS 3 +
BITTE MIT DEM KODEBUCHSTABEN ANTWORTEN; KEINE
INFORMATION : Ø, ENDE : Z
BLZ
OFFENER DUCTUS ARTERIOSUS (BOTALLI)                 34
RHEUMATISCHER KLAPPENFEHLER                         27
FALLOT'SCHE TETRALOGIE                              22
VENTRIKELSEPTUMDEFEKT                                7
AORTENKLAPPENSTENOSE                                 2
MYOPERICARDIALE ERKRANKUNG                           1
PULMONALKLAPPENSTENOSE                               1

DIAGN. IN GEWUENSCHTER KATEGORIE. FORTS.: UMSCH.U.EIN-
GABE.OPTIONEN :Y FUER LEVEL-DISPLAY,Ø: ZURUECK ZU
RADIATE, A: SPEICHERUNG DER DATEN DES PAT.
```

Fig.9: Logical structure of the content summary data base "CONPAT". Diagnoses may be stored with supplements using different coding systems, an important part is the problem epicrisis (10). Further information about treatment and relatives as well as basic administrative data are kept.

Fig.10: Output of the admission dialogue. The upper part shows the aluminum foil containing basic information about the patient and his binary coded identification number.

The middle part shows how this information can be transcribed on, in this case, an optical reader form for dietary requests. The patient identification is transcribed in such a way that it becomes machine readable. At the same time, the ward address is inserted.

The lower part shows stickers which are used for various purposes. All this is produced immediately upon admission of the patient.

Fig.11: On-line system for dietary requests. The program is accessed via a code word (blanked out). When the ward number is indicated, all patients lying on that ward are listed with their identification number and their dietary status (K: type of diet, P: size of portion). Here the user indicates that he wants to change information about patient No.8. He then indicates that he wants to change the dietary status starting noon of the next day assigning a large portion of diet No.11, which in this case means a low-salt diabetes diet of 1500 calories. When this information is entered, the whole status will be re-displayed and confirmation is requested before the changes are stored away.

Fig.12: Example of access to the main data bank. A generic search for the patient's name is performed by entering the letters Har... Then a list of patients is given, whose names begin with those letters. A patient is selected and now the system displays further treatment periods (when and where here admitted), risk facts (in this case chronic treatment with digitalis), and former diagnoses (in this case hemiparesis, respiratory insufficiency and arteriosclerosis).

Fig.13: Continuous plot of (1) admissions, (2) discharges and (3) total number of beds occupied since the very beginning of operationsin July 1971 to July 1972. The deep dip indicates Christmas, followed by a decrease of the number of beds occupied on Easter, Pentecost, and other holidays.

Fig.14: Plot of the stay of patients in days against the number of patients. Maximum after two and eight days with secondary maxima in intervals of a week.

Fig.15: Distribution of age of all patients. Deep dips between 1914 and around 1930 (see text).

Fig.16: Age distribution of all patients with coronary infarction. Each age class covers 5 years.

Fig.17: History taking by CDSS (13,14,16,17).The system branches according to answers of the user.

Fig.18: Part of history compiled using CDSS. The data may be gathered either on-line (Fig.17) or on optical reader forms.

Fig.19: Interpretation of blood gas analysis using CDSS (14,1: A diagnostic evaluation (hypoxemia,acidosis) is given and possible causes are discussed with possible therapeutical actions.

Fig.20: Diagnostic interpretation of findings using ODARS (12,19,32), here in the area of heart diseases (only parts of the dialogue are shown). The differential diagnosis is given in percent, the evaluation is done using Bayesian theorem.

Fig.21: Concept of a regional system for general practitioners using time-sharing. Central computing facilities provide the services and information may be exchanged between the different participants (radiology examinations, laboratory or other consultations).