THE STORAGE AND RETRIEVAL OF PHYSIOLOGICAL AND MEDICAL DATA IN A MODERN HOSPITAL

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Abstract

As an introduction this paper considers some of the problems in data handling in a modern hospital. Next, the needs of the users of the data are considered. The principle area of interest is indicated as that hospital function dealing with the storage and retrieval of the clinical record after the patient's hospitalization. The types of terms used in medicine are examined and two currently used schemes for the indexing of diseases are described. Next a storage and retrieval system that permits the medical researcher to examine or browse through clinical records or abstracts of the records is described. The paper concludes with observations on the need for applied research and system development to acquire pilot systems for the storage and retrieval of physiological data.

Introduction

Problems of Data Handling in the Hospital

Clinical records inherently defy logical control. In addition to sheer volume, the following are typical complications:

1. "Summaries" of hospital stays often contain lengthy "soft" literary descriptions that are difficult to abstract and "harden." Medical and surgical entries in "Progress Notes," often lack the parameters necessary to describe many complications.

2. Concrete detail may not be available for the physician's or nurse's first encounter with the unusual situation.

3. Soft literary comments are considered necessary to supplement hard parametric values.

4. Only detailed research for an extended period over the range of the many diseases and almost infinite number of disease combinations will yield a pattern of knowledge such as employed by an experienced doctor when he examines a clinical record.

Two Assumptions Regarding the Storage and Retrieval of Clinical Data

1. If a general solution exists for storage and retrieval problems, this general solution will be found most readily by applying the hard practical techniques used to solve storage and retrieval problems for particular systems.

   General techniques, common characteristics, laws of behavior, and formules will emerge from the solutions of the problems of different systems. In some respects, each system will be unique, as determined by the nature of the data to be handled and the needs of the user. The common problems will be solved by deduction; esoteric and inductive reasoning may only serve to fog the issues.

2. If existing concepts on automatic abstracting, indexing, pattern recognition, parsing of sentence structure, translation from physiological language to a mathematical logical language, teaching machines, heuristic programming, etc., are collected and ordered, a storage and retrieval system will then exist for the management of data in the clinical record.

It is possible to assemble such a system and it should be attempted soon. This paper will suggest a broad configuration omitting details that only can be acquired through extensive research. Hopefully, this description will prompt other researchers to collect, refine, and integrate existing concepts, and from this, evolve an effective storage and retrieval system for medical and physiological data.

Consideration of the Needs of the User of Physiological Data

"Real Time" Data Storage in the Clinical Chart

The capability of storing data in "real time" as it is received asynchronously from the varied hospital services (wards, clinics, laboratories, x-ray, conferences, operating room, etc.) and then retrieving part or all of it when requested by users, clearly, will aid in satisfactorily caring for patients. An experiment is in progress, conducted by a joint team of researchers from the Veterans Administration and the System Development Corporation of Santa Monica, to demonstrate this capability in a simulated hospital ward environment, using an IBM 1401 with RAMAC. The project will handle those forms found in most hospital clinical records as suggested by the Joint Commission on Accreditation of Hospitals.
Storage of the Clinical Record After Hospitalization

Access to records stored after the patient’s discharge is a major need (and is the main interest of this paper). According to Huffman, the Medical Record Library (MRL) function is to provide medical records containing sufficient data to verify the diagnosis and treatment and document the results for all patients treated in the hospital. These records should be readily available for:

1. The patient, as busy physicians cannot remember the details of all their cases; also, if the patient is readmitted, accurate records save time and effort.

2. The hospital, to review the competency of their staff and the results of treatment, and to compile statistics; also, for medicolegal purposes.

3. The physician, to review his cases and consultations, and to treat patients who do not recall previous illnesses and hospitalizations; also, for medicolegal purposes.

4. Medical research and teaching, since many observations can only be made clinically.

The Storage and Retrieval of Documents Written in the Medical and Surgical Field

The field of medical documentation is burdened by the problem of how to store documents so that they can be recalled readily. To solve the problem concisely, the computer must be "taught" the language of "physiology." Hans Selye and Miklos Nadasdi in their book on a "Symbolic Shorthand System" discuss the possible adaption of their system to electronic machines, and state, "Perhaps the mechanical memories of the future will not take this particular form, but whatever we use, punch-card systems, electronic machines, or any other physical aid to classification, the first problem is to create a simple, mnemonic language, which can easily be fed into such machines." 3

Although it was originally designed for processing documents on stress and endocrinology, the "Symbolic Shorthand" technique appears to be directly adaptable to a library system for all types of medical documents. Consideration is given to the possibilities of generating an abstract of the clinical record, and of generating an index based on the abstract. This can be compared to the techniques used at Western Reserve for document storage.

Some Concepts of the Size of the Medical and Physiological Language

A computer system that can communicate and handle storage and retrieval problems using medical and physiological data must be programmed to recognize the terms and words of medicine and physiology.

Medicine is a science which is concerned with the abilities of recognizing, preventing, curing, and alleviating diseases and their causes. Surgery is considered a medical science that manually corrects, aids deformities and defects, and repairs injuries and is, therefore, a sub-category of this definition of medicine.

Physiology is a science dealing with the functions of organs and physical parts during life. By way of contrast, "physiology" is dynamic, and "anatomy," static.

A cursory examination reveals the large size of the task of developing descriptor terms for the data encompassed by these sciences. Skeptics may weigh "Stedman's Medical Dictionary" 4 or merely leaf through its 1556 pages of definitions.

A Smaller Manageable Area for Examination

The immense field of medical terminology may be bounded somewhat by selecting a subclassification of the entire science, specifically, endocrinology. Endocrinology deals with the glands and their secretions. It is further concerned with the movement of those glandular secretions that pass directly into the blood or lymph. In addition, the science is interested in the activation of cells of other parts of the body by organic substances called autacoids. An example of an autacoid is the hormone thyroxine, produced by the thyroid gland, which considerably influences growth.

Why was endocrinology selected? After attending conferences, visiting wards, examining the data in the charts of the patients, and discussing the question with various doctors, it appears that endocrinology involves a larger volume of objective data than other services and would benefit most directly from computer handling.

Much work has already been accomplished to firm these data and, therefore, facilitate this study.

To reduce the problem to a level suitable for this paper, one small area of the entire subject of endocrinology was selected, namely, the Hypophysis. A study of this gland, though quite complex, is easily bounded, and appears to afford hard and finite data. The following material is presented to indicate how large the terminology and indexing problem is for a single gland.

The Hypophysis is the pituitary body. It consists of two lobes and is located at the base of the brain in a depression of the sphenoid (wedge shaped) bone called the pituitary fossa. The smaller posterior lobe is developed from and attached to the brain by the infundibulum, the name given to the stalk attachment of the hypophysis. The larger anterior lobe is developed from the buccal cavity, the cavity of the mouth. (See Figure 1.)
DIAGRAM OF THE HYPOPHYSIS


FIGURE 1
The foregoing serves to introduce the wide range of data used to describe this gland and its functions. Hans Selye in his "Symbolic Shorthand System," conceived of the following eight major categories.

1. Actions upon the hypophysis. The following types of actions are viewed as interventions upon the gland and its system:
   a) Extirpation, complete removal of the gland
   b) Partial extirpation
   c) Exposure to ionization or x-rays
   d) Activation, excitation, or depression of gland by drugs, medication, etc.

2. Morphology. The features, form, and structure of the organism are covered by the following two subjects:
   a) Anatomy--the structure and parts of the gland.
   b) Histology--the minute structure of the tissues. For example, the posterior lobe is composed of neuroglia-like cells (like the brain cells). These spindle-shaped cells are known as piticytes. These cells are filled with a clear homogeneous material known as hyaline bodies, also Hering's bodies. This smaller lobe also consists of connective tissue, blood vessels, and numerous nerve fibers. The larger anterior lobe consists of cords of cells which are separated by very small channels, microscopic vessels. There are three types of cells in this lobe, chromatophores which do not stain easily, acidophils which stain with acid dyes, and basophils which stain with basic dyes.

3. Chemistry. The general chemistry of the structure of the gland is divided into two sections.
   a) Organic compounds of the gland
   b) Chemistry of the hormones, including such terms as:
      . Trade names
      . Extraction
      . Synthesis
      . Chemical activation and inactivation
      . Preservation, etc.

4. Humoral Physiology. This classification deals with the functions of the blood and lymph ducts in relation to functions of the gland:
   a) Mechanism of secretion, including pathways and flow
   b) Mechanism of action
   c) Metabolism of the hormones, their fate in the body
   d) Utilization of the hormones for the performance of their functions in the body.

5. Pharmacology. This deals with the drugs used in treating the hypophysis, and includes such items as:
   a) Application
   b) Dosage, effect data between dosage and results
   c) Relationships between chemical and pharmacologic effects
   d) Sensitization and desensitization
   e) Pharmacological resistance
   f) Immunity and allergy
   g) Toxic effects

6. Hypophyseal Hormones. This subject deals with the secretions of the gland:
   a) Crude hypophyseal extracts
   b) Crude anterior lobe extracts
   c) Adrenocorticotrophic hormone
   d) Somatotrophic hormone
   e) Gonadotrophic hormone in general
      . Follicle stimulating hormone
      . Luteinizing hormone
      . Luteotropic hormone
   f) Thyrotrophic hormone, TSH
   g) Crude middle lobe extracts
   h) Melanophorotropic hormone, intermedi
   i) Other middle lobe hormones
   j) Posterior lobe extracts
   k) Vasopressin, antidiuretic hormone
   l) Oxytocin
   m) Other posterior lobe hormones.

More terminology must be introduced to understand the functions of some of these pituitary glands.
hormones. The smaller posterior lobe furnishes a secretion that stimulates contraction of unstriped muscular tissue; raises blood pressure; and is oxytocic (hastens childbirth), antidiuretic (decreases the secretion and discharge of urine), and melanophore (control of skin pigmentation) dispersing. The larger anterior lobe furnishes a gonadotrophic hormone (affecting the sex glands), thyrotrophic hormone (affecting the development and activity of the thyroid), and an adrenocortrophic hormone (abbreviated as ACTa, influencing the growth and activity of the adrenal cortex); prolactin (stimulating the secretion of milk); and generally contributes to growth promotion. Ketogenic (producing acetone bodies in the blood), diabetogenic (causing diabetes), and insulin-antagonizing effects are obtained by injection of the extracts of this anterior lobe.

7. Pathology of Hypophysis. This classification deals with the condition of the gland or fluid produced by disease, and considers such items as:
   a) Aplasia--the congenital absence of an organ.
   b) Hyperplasia--the increase in tissue elements such that the bulk of the organ is increased, excluding tumor formations.
   c) Hypoplasia--the defective development of an organ.
   d) Accessory glands.
   e) Hemorrhages and other vascular lesions.
   f) Any other malformations.
   g) Inflamations.
   h) Tumors.

8. Diseases of the Hypophysis. Diseases of this gland are defined as any malady, ailment, or maladjustment that causes a condition in which bodily health is impaired. Classifications include:
   a) Diseases with underactive pituitary, either lobe.
   b) Diseases with overactive pituitary, either lobe.
   c) Tumors of the hypophysis.
   d) Injuries and operations.
   e) Others.

As an examination of the broad classifications of diseases used in a system for the storage and retrieval of documents dealing with studies of stress and endocrinology, the following diseases of the hypophysis are listed:

- Hypopituitarism in general
- Simmonds disease
- Sheehan's syndrome
- Hypophoseal dwarfism
- Hypophoseal infantilism
- Hyperpituitarism in general
- Acromegaly
- Cushing's syndrome
- Berardinelli's syndrome
- Diabetes insipidus
- Antidiabetes insipidus
- Inflammation of the hypophysis
- Non-endocrine hypophoseal tumors
- Cranio-pharyngioma

A Look at Two Coding Schemes that are Currently Used to Index Hospital Records

Two well developed schemes exist for classifying diseases and for assigning number codes to identify the diseases. The classification and coding are described for the pituitary gland. The first system is that listed in the ICDA, "International Classification of Diseases, Adopted for Indexing of Hospital Records." The second is the SN, the "Standard Nomenclature of Diseases and Operations," published for the American Medical Association.

Description of Diseases of the Hypophysis as Listed in the ICDA

The International Classification creates a "separate title or code number in the classification only when a separation is warranted because of the frequency of its occurrence." This system is based therefore on the frequency with which diseases occur and is a statistical model of public health information. If the user of this index requested data that occurred most frequently, then this system might satisfy his needs. The medical research worker, however, is not always interested in data primarily because of its frequency of occurrence (for example the common cold).

The ICDA states, "For hospital indexing purposes, the most efficient classification system is one which permits the location of a maximum number of pertinent records with the review of the least number of records." ICDA adherence to its own definition of efficiency is covered in a study reported in the Journal of the American Association.
of Medical Librarians, which contrasts this indexing system with the SN.

In Appendix I some disease symptoms and terms are described to clarify the classifications; however, these descriptions do not appear in the International Classification. The major category dealing with diseases of the endocrine system is Number III: Allergic, Endocrine System, Metabolic and Nutritional Diseases. The next lower level of classification is Diseases of Other Endocrine Glands (270-277). Under sub-class 272 are most of the items that are of interest to this paper. For a more complete treatment of indexing in the ICDA refer to Appendix I.

Description of Diseases of the Hypophysis as Listed in the Standard Nomenclature

The technique of indexing in the SN is more highly ordered than in the ICDA and would appear to lend itself more readily to automatic programming.

In general, the plan of the SN is to code the disease as a two part index. The first part indicates topographically the system of the body that is infected; the second indicates the etiology, the cause of the disease. Refer to Appendix 2 for an example of the SN applied to diseases and operations of the hypophysis gland.

Appendices 1 and 2 suggest the complicated thesaurus that must be considered for any data retrieval system. A set of terms as advocated by Dr. Mortimer Taube, or descriptors as promoted by Calvin Mooers, would be extensive even for so limited an area of the human body as the pituitary gland. An extrapolation to the complete body and its systems shows the enormity of the complete storage and retrieval problem. Perhaps, retrieval systems should be specialized and deal only with individual medical areas in the beginning.

A "Storage and Retrieval" System Description

The system illustrated in Figure 2 was evolved by synthesizing a number of independent concepts. Many of these concepts will require considerable development and study before firm operational techniques may be recommended; however, rudimentary and perhaps even somewhat crude methods are available presently to set up a prototype system.

"In the majority of cases, the problem is not that our existing technology is insufficiently advanced to provide the mechanisms we need for effective handling. In short, the practical problem we face in this area is the proper selection and application of the systems and equipment now available to us, and to do this properly we must understand clearly the elements of our own individual working environment."

The purpose of this proposed system is to provide high-speed storage and retrieval for the user of medical data. The part of the system that abstracts the clinical record for indexing and storage also abstracts the users' request. The system compares the request with stored information and then displays the matched abstract, indirectly asking if it is what the user desired. The user then either accepts what is offered or modifies his request. This inter-communication between the system and the user permits the retrieval of a single abstract, several abstracts, a solitary clinical record, selected parts of a record, selected parts of several clinical records, or several complete clinical records.

The presentation that follows covers three areas:

1. The Movement of Data in Processing of Clinical Charts for Storage.
2. The Movement of Data in Retrieving Abstracts and Charts.
3. Communications of the User with the System.

The Movement of Data in Processing of Clinical Charts for Storage

This concept is illustrated in Figures 2a and 2b. Figure 2a is the legend for the flow diagram; the flow of the data in processing the clinical charts as they come from the ward is shown in Figure 2b. The clinical charts (input data) are shown entering the system at the base of the diagram.

Read-in of Clinical Charts of Discharged Patients to be Abstracted. Clinical charts are entered into the system to be abstracted (line A of Figure 2a) by the Automatic Abstractor and classified by the Index Classifier. In the early stages of system development the process would be manual; however, efforts should be extended to computerize this function. The efforts of Zellig S. Harris and others to parse the English sentence indicate a possibility of selecting key words in the doctor's summary of the clinical record and automatically abstracting them. The abstracts would be indexed according to the primary disease as coded by the standard nomenclature with next level storage indicated by secondary illnesses. Further and deeper indexing should now be made by abstracting the clinical chart. The resulting abstract used as an index will retain a level of storage and retrieval far beyond the capabilities of modern medical record libraries, particularly for research purposes. The system will also allow for browsing by the user. An existing manual system is the Symbolic Shorthand System of Hans Selye.

Read-in of Clinical Charts to be Reduced. The read-in of clinical records of discharged patients for reduction to micro-image is handled at the same time that the clinical chart is being abstracted and indexed. Line B indicates the movement of the chart to the micro-image producer. Several devices exist for this function including
The following flow of data is presented to indicate how the system retrieves data for the user.

Read-in of Text of Request. The input of the user is indicated by line 1 (Figure 2b), and represents "n" possible iterations of user requests as he modifies them to retrieve the clinical data he wants.

Storage of Abstract Classification and Index for Retrieval of Abstract. Line 2 indicates the movement of the system to the nearest abstract to the request and Abstract Index Matcher. This movement is made for the National Science Foundation, and in a course on Information Storage and Retrieval.10 Dr. Robert M. Hayes presented a mathematical model in which an abstract matrix was used to indicate the relevance between documents.

"Of particular mathematical interest is the fact that powers of the association matrix provide a method for determination of its eigenvalues and thus represent an approximation to the method of eigen-analysis and factor analysis."

This technique suggests that an abstracted request can be treated as a vector and multiplied by the association matrix some "n" times to obtain an approximation to an "eigen" vector, thereby processing the original request to obtain a close fit to the stored file of documents. This matching technique affords the requester considerable freedom in formulating his request, using key words as a basis. A researcher could draw as many relevant cases from the stored data as he desired in either direction in the file from the closest match.

Storage of Abstract in Appropriate Classification as Determined by Automatic Abstraction. Line C leads to a storage of abstracts. The first level of classification or index is made by use of the SN number of the primary diagnosis, and then by the SN number of the secondary diagnosis. The next level would be stored as the coded abstract itself, possibly as a dynamic file of "agents" acting on "targets". Associated with each filed abstract would be a stored serial index to retrieve in part or completely the clinical charts of interest.

Output of Abstracts. The abstracts requested will move the index, illustrated on line 6, to activate output of abstracts. This feedback technique is similar to automated teaching practices and permits communication between the system and the user.

Output of Abstracts. The abstracts requested will move the index, illustrated on line 6, to activate output of the abstracts from storage as per the user's request.

Entry of Request Using Hospital Serial Number. At this point, the user will determine which clinical records or forms or parts of records he desires. For example, the researcher may only be interested in the laboratory reports, or the medications used for a certain classification of diseases. Selectively using the serial indices and guides to specific parts of the charts the user inserts a request (as illustrated by line 8).
**COMMUNICATIONS OF THE USER WITH THE SYSTEM**

1. Written requests for retrieval of clinical data stored in discharged patients' charts.
2. Image of abstract data with closest match to request for examination by requestor.
3. Activation switches to retrieve abstracts in classification which agrees with request.
4. Printout of abstracts of clinical records in classification that matches request.
5. Keyboard for insertion of serial number to request whole or that part of clinical record which is desired. Insertion will also indicate method of output.
6. Display output of selected parts of data as indicated in retrieval request.
7. Hard copy output of selected clinical data on printer.

**MOVEMENT OF DATA IN PROCESSING OF CLINICAL CHARTS FOR STORAGE**

A. Read-in of clinical records of discharged patients to be abstracted.
B. Read-in of clinical records of discharged patients to be reduced to micro images.
C. Storage of abstract classification and index for retrieval of abstract.
D. Storage of abstract in appropriate classification as determined by automatic abstraction.
E. Transfer to storage of complete charts. Charts are now stored in agreement with hospital serial index. Data are now micro-miniaturized.

**MOVEMENT OF DATA IN RETRIEVING ABSTRACTS AND CHARTS**

1. Read-in of text of request describing the type and number of clinical charts desired to be retrieved.
2. Request index as generated by automatic abstractor.
3. Temporary storage of index generated for this request.
4. Abstract index with closest match to request index.
5. Activation switch indicating agreement of requestor with match.
6. Index used to activate output of abstracts in this classification for examination.
7. Output of abstracts with hospital serial number to be used to retrieve charts as desired.
8. Entry of request using hospital serial number for retrieval of complete records or parts of charts as desired.
9. Output of charts or selected parts as requested.

**FIGURE 2a.**

LEGEND FOR INFORMATION STORAGE AND RETRIEVAL SYSTEM SHOWN IN FIGURE 2b
Output. The output as indicated by line 9 can be of two types: a display of individual bits of data for visual examination, such as a display of the doctor's orders which had been given for a patient; or a printout of partial or complete clinical records that had been stored as micro images.

Communicating with the System

This section briefly describes the inputs (requests) from the user and outputs (retrieved data) to the user.

Written Requests. For retrieval of the data stored in the clinical charts of discharged patients, the user will write (typewrite) an input (I) to the system using an SN number and a written description of his request. The request may be dictated by various requirements such as the need of data to defend the hospital against malpractice suits, the retrieval of records for statistics to support research endeavors, the gathering of figures for hospital management to compile accreditation reports, etc.

Image of Abstract Data with Closest Match. This output (II) from the system makes it possible for the researcher to see the abstract that is the closest match to his request. If the abstract does not meet the needs of the requestor, he can reframe his request and the system will display a new matched abstract.

Activation Switches. This input (III) provides the requestor with the capability of retrieving as many abstracts as he may wish to look at. These abstracts are stored in the immediate environment of the abstract that best fit the user's request. This satisfies two needs of the user: the desire to browse through the file, and the need to retrieve a quantity of abstracts to obtain additional material to support research and teaching projects. By switch insertion the user will indicate to the system how much material he wishes to examine, and what type of output (soft visual-display or hard printed-copy) he desires.

Printout of Abstracts. The retrieval system will supply the output (IV) in the form of a printout of the abstracts the user requested. The storage location of the abstracts has been supplied by the matching techniques and the storage plan. No provision would be made to exceed the boundaries of the SN classification in supplying the quantity of abstracts desired.

Keyboard. After examining the abstracts and deciding that the complete clinical charts or parts of the charts are necessary, the requestor will key into the system the serial number in the abstract, the format number for the part or complete clinical record, and the method of output desired. This input (V) directly addresses the micro-image storage system and provides by switch-insertion the serial index to retrieve the required data.

Display Output. The system can display a visual-type image of individual pages of the clinical chart (Output VI). This capability will enable the research worker to examine a part of a clinical chart directly if the data in the abstract were insufficiently detailed.

Hard Copy Output. The printed output (VII) supplies the user with a "hard copy" of the retrieved clinical chart, or section of the chart exactly as it was stored when transmitted from the ward.

Conclusion

Economic considerations of this system configuration appear quite extensive; however, this configuration is suggested for the purpose of demonstrating and developing the feasibility of such systems. Simplification of functions and equipment should lead to practical operational concepts.

The level of retrieval for research, the rapidly expanding field of medical knowledge, the mounting heap of clinical charts in hospital storage vaults, and the increasing demands upon the hospitals because of our rapidly growing population indicate a need for increased research and development on storage and retrieval systems.

This paper concludes with a series of observations drawn from "Proceedings of the San Jose Conference on Health Information Retrieval, 1959."12

"1. Health and medical information is the essential requisite for effective care of individual patients and one of the essential needs for sound research but its volume and complexity has become so great that it can no longer be effectively stored, codified, retrieved and transmitted by conventional methods.

"2. The problems and needs of health information retrieval are of critical importance to all professional disciplines related to health, to all agencies concerned with health, rehabilitation, welfare and correction. These problems and needs are nation-wide in scope.

"3. The technology of information storage and retrieval is already in a state of development where it may be applied to this problem.

"4. To accomplish this objective, intensive studies are necessary in order to define precisely the information retrieval requirements of health and medical practice and research.

"5. The benefits to the individual and social health of man to be derived by successfully doing so are considered to be very great and it is therefore recommended by the conference that the development of definitive studies directed toward solution of this problem be encouraged by every means possible."
The following listing is in the format of the ICDA. Comments and descriptions not a part of the ICDA are placed in parentheses.

272. DISEASES OF PITUITARY GLAND

272.0 Anterior pituitary hyperfunction

(The diseases in this general group are due to over-activity of the anterior lobe of the hypophysis.)

Includes: Acromegaly (also known as Marie's disease. This disease has the following symptoms: enlargement of head and face, hands and feet, and thorax. This growth is due to excessive secretion of the acidophil cells of the anterior lobe.)

hyperpituitarism (A condition, which is marked by acromegaly as described above and hypertrichosis, which is the abnormal growth of hair such as on the face of women or on the back in both men and women.)

hypophyseal gigantism

premature puberty

(At this point, the ICDA, to prevent hospital personnel from making mistakes when using this coding index, lists three diseases that should not be listed under 272.0.)

Excludes: Basophilic adenoma (277.0)

Cushing's syndrome (277.0)

pituitary basophilism (277.0)

(To show how much is excluded, a description of Cushing's syndrome in Stedman's Medical Dictionary lists the following group of symptoms for these diseases: abnormal carbohydrate metabolism; obesity of head, neck, and trunk; decalcification of the bones; and increased blood pressure. It has been suggested that the syndrome points to the presence of a basophil adenoma of the hypophysis cerebri, pituitary basophilia. This describes a pituitary tumor made up of basophil cells.

Now the listing proceeds with the next classification of pituitary diseases.)

272.1 Anterior pituitary hypofunction

(Hypofunction is the opposite of hyperfunction. Instead of overactive the anterior lobe is underactive.)

Includes: adiposogenital dystrophy (This is a disease of the type of Froehlich's syndrome. The condition is caused by a deficiency of the anterior lobe and often combined with a deficiency of the posterior lobe. Symptoms of the disease are: increase in fat, loss of sexual power, atrophy of the external genitals, and loss of hair.)

dwarfism (of several types)

hypophyseal

Loraine type

(Idiopathic infantilism)

pituitary

Froehlich's syndrome

hypopituitarism

(juvenile)

pituitary

cachexia

dwarfism

infantilism

obesity

Simond's disease

(This disease is marked by premature aging, rapid atrophy of the genital organs with repression of secondary sexual characteristics, and loss of hair. Disease is usually noted in young women due to atrophy or diminished functioning of hypophysis.)

(Again to prevent errors the ICDA advises against the inclusion of the following diseases.)
Excludes: dwarfism:
   achondroplastic (758.0)
   (occasioned before birth)
   congenital (277.0)
   NOS (277.1)
   pancretic (587.0)
   dwarfism and infantilism (277.1)
   infantilism NOS (277.9)

(Then the ICDA goes on to the next listing.)

272.2 Chromophobe adenoma, pituitary
   (A tumor in the chromophobe cells of the anterior lobe.)

272.9 Other and Unspecified
   Includes: abscess
   adenoma NOS (tumor)
   cyst
   diabetes insipidus
   (A disease characterized by the excretion of large amounts of pale urine of low specific gravity, and caused by a deficiency in the antidiuretic action of the gland.)
   Dyspituitarism
   (A complex of symptoms due to either excessive or deficient pituitary action.)
   eosinophilic adenoma
   (A tumor of the chromaphil cells of the anterior lobe associated with gigantism and acromegaly.)

(This concludes diseases of the pituitary in the ICDA, however, to be complete, classification 277 must also be considered.)

277.0 Pituitary basophilism
   Includes: basophilic adenoma
   Cushing's syndrome
   (also under major classification II dealing with neoplasms the ICDA lists data of importance.)
Appendix 2

The SN Index

The material below will illustrate the coding of the SN by showing how it is applied to coding diseases and operations of the hypophysis. Figure 3 shows the word structure of this index. The broadest classifications are made topographically by systems of the body. System 8 is the class dealing with the Endocrine system. The Endocrine system classification is divided into 9 categories, each coded by a two-digit number as follows:

- 80 Endocrine System
- 81 Thyroid Gland
- 82 Parathyroid Glands
- 83 Thymus Gland
- 84 Pituitary Gland
- 85 Pineal Gland
- 86 Adrenal Glands
- 87 Pancreas
- 88 Gonads
- 89 Carotid Gland

Classification 84, the Pituitary Gland, has 6 subdivisions coded as follows:

- 840 Pituitary gland, generally
- 841 Anterior lobe
- 842 Posterior lobe
- 843 Pars intermedia
- 844 Pituitary stalk
- 845 Cranio-buccal (Rathke's) pouch

Subsequent digits, separated from the topographical classification by a dash, define the etiological classification (the causes of the disease). The first digit after the dash indicates the cause. For example, in the case of the pituitary gland, the causes are listed as follows:

- 0 Diseases Due to Prenatal Influence
- 1 Diseases Due to Infection with Lower Organism
- 4 Diseases Due to Trauma or Physical Agent
- 50 Diseases Due to Circulatory Disturbance
- 6 Diseases Due to or Consisting of Static Mechanical Abnormality
- 7 Diseases Due to Disorder of Metabolism, Growth or Nutrition
- 8 New Growths
- 9 Diseases Due to Unknown or Uncertain Cause with the Structural Reaction Manifest
- X Diseases Due to Unknown or Uncertain Cause with the Functional Reaction Alone Manifest
- Y Diseases Due to Cause not Determinable in the Particular Case.

As this paper is more interested in the plan and logic of the classification than the entire list of diseases, all diseases are not presented; however, as most troubles of the pituitary gland are due to over and under activity an examination of the scheme of - 7, Disorder of Metabolism, is presented.

- 77 and - 78 Disturbances of Specific Endocrine Organs or Hormones
- 776 Pituitary gland, anterior lobe, increased or perverted function
- 777 Pituitary gland, anterior lobe, decreased function
- 778 Pituitary gland, posterior lobe, increased or perverted function
- 779 Pituitary gland, posterior lobe, decreased function.

By this scheme, the classification of diseases due to metabolic disturbance is as follows:

- 7 Diseases due to Disorder of Metabolism, Growth or Nutrition
  - 841 - 776 Anterior pituitary hyperfunction
  - 841 - 7761 Hypophyseal gigantism
  - 841 - 7762 Acromegaly
  - 841 - 7763 Pituitary basophilism
  - 841 - 7764 Premature puberty
  - 841 - 777 Anterior pituitary hypofunction
  - 841 - 7771 Pituitary dwarfism
  - 841 - 7772 Juvenile Hypopituitarism
"CHROMOPHOBANE CARCINOMA OF PITUITARY GLAND"
For Diseases of Hypophysis

"HYPOPHYSECTOMY"
For Operations on Hypophysis

FIGURE 3.
EXAMPLE OF STRUCTURE OF WORD CODES
THE STORAGE AND RETRIEVAL OF PHYSIOLOGICAL AND MEDICAL DATA IN A MODERN HOSPITAL

841 - 7773 Hypopituitar cachexia
841 - 7774 Sex infantilism
841 - 7775 Sex infantilism with obesity
841 - 7776 Dwarfism and infantilism
842-779 Diabetes insipidus due to unknown cause

Under the classification - 8 for NEW GROWTHS a letter, A through I, may be added to specify the Malignancy Code for the growth.

"A" Benign - no premalignant significance

For example:
841 - 809.lA Adenoma of pituitary gland

Coding for Operations. For coding surgery of the pituitary gland, the following plan is used. See Figure 3.

- 0 Incision (to cut open)

8. - 01 Exploration of endocrine gland (The periods are to be filled-in with digits to indicate the site. For example 841 - 01 is an exploration of the anterior lobe.)

- 1 Excision (to open and remove, cutout)

820 - 1. Parathyroidectomy
830 - 1. Thymectomy
84. - 1. Hypophysectomy (The first period is to be filled-in to indicate the site. For example, 842 - 1. is the removal of the posterior lobe.)

850 - 1. Pinealectomy
860 - 1. Adrenalectomy (The final period is to be filled-in with a 2 or 3 to indicate complete or partial. For example, 841 - 13 is the partial removal of the anterior lobe.)

811 - 11 Local excision of lesion of endocrine gland (Periods are replaced by digits to indicate the exact part of the hypophysis.)
811 - 16 Biopsy of endocrine gland

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