has contributed significantly to the efficiency of the search algorithm.

Atom-by-atom searching is done on-line utilizing a Honeywell H-6080 computer and a terminal. On-line searching has enabled us to alter queries, based on initial results, and research the same file without being dependent on turn-around time. On the other hand, should the search file contain more than 5000 WLN's, the search can be done in a batch environment. The average search, which includes bit and string screening, matrix generation, and atom-by-atom searching, consumes approximately 10 min of processing time.

Since, for our purpose, it is not important to analyze polymers, chelates, and inorganics, the system rejects these classes of compounds. Procedures for processing WLN's which contain nonconsecutive locants have been worked out and await implementation into the system.

At present, research continues with the aim of extending the capability, increasing the efficiency, and utilizing the programs to solve related problems. The use of the internal file of over 120000 WLN's has given us an excellent testing ground for our programs, which took approximately 2.5 man-years to develop. The economics of utilizing the programs on the ICRS file of approximately 1.5 million structures are also being examined.

ACKNOWLEDGMENT

We wish to acknowledge Mrs. Olga Z. Buchko for her efforts in the preparation of this paper.

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Investigation of the Index Structure of Drugdoc and Ringdoc†

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Received March 15, 1976

Drugdoc, a computerized information retrieval system, is part of the Excerpta Medica Automated Storage and Retrieval Program of Biomedical Information which provides data from about 280000 biomedical research papers per year taken from about 3500 medical journals. The Drugdoc input comprises drug-related information selected from the total data base, augmented by similar information gathered from 200 journals pertaining to pharmaceutical science, a total of 50000 reports per year.

In 1974, a study committee[1] published a comparative study on the input data base, system construction, and characteristics of the Drug Literature Index and Adverse Reactions Titles which can be regarded as the hard copy of Drugdoc.

Ringdoc, a drug information system run on a membership basis, provides 40000 abstracts yearly of articles taken from about 360 drug-related core journals and is published as an abstract journal and microfilm. Also, for retrieval purposes, index cards and punched cards or magnetic tapes are provided.

Smith et al.[2] and Ashmole et al.[3] have reported comparative studies on the retrieval ratio and cost effectiveness of Excerpta Medica, Ringdoc, and other systems. The Drugdoc Study Committee[4] also reported a comparative study of Drugdoc and Ringdoc from the coverage of both systems in 14 drug-related biomedical journals and on the output and distribution of subject areas according to importance to the drug propranolol.

This paper presents the results of a comparative study on the coding and consequential index structure between Drugdoc and Ringdoc on three drugs to ascertain the difference in selection of original articles between the two systems.

RETRIEVAL PROCEDURE

(1) From the Drugdoc S.D.I. output and Ringdoc abstracts of 1974, articles appearing in both systems and related to either of three drugs, the antidepressant Nortriptyline, the β-adrenergic blocking agent Propranolol, and the antibiotic Erythromycin, were selected. From these 60 articles, one article for each drug in the fields of microbiology or pharmacology, therapeutics, and toxicology was further selected, for a total of nine articles. The bibliographies of these are shown in Table I. The Drugdoc S.D.I. output and the Ringdoc abstract for one of the articles are shown in Tables II and III.

(2) In Drugdoc, three types of descriptors are used for coding pertinent material, Preferred Term, Secondary Indexing Term, and Item Index, these being listed in the computer output of Drugdoc. As the Item Index is a numeral code, in this paper it is converted to its related word.

The descriptors in Ringdoc are Index Term, Free Term, Thematic Group Code, and S.D.I. Profile Code, which together make up the Codeless Scanning heading for the abstract. The Codeless Scanning heading for the abstract in Table III is the first seven lines above the journal citation, the Index Terms being underlined, the Thematic Group Code's letters to the left of the heading, and the S.D.I. Profile Code given in Roman numerals.

The weekly output of Ringdoc includes a Free Term Index, comprising the more important free terms for manual retrieval. In this paper Free Term designates free terms in this index

† It should be stated that in Ringdoc there are two coding systems, which are coded independently by different groups of coders and are both available for information retrieval. One is the Ringcode system which is a fragmentation code originally developed for the punched card and the other the Codeless Scanning system explained in this paper. The author has deliberately ignored the former system in this study in order to compare Drugdoc and Ringdoc on an identical basis.

This paper was presented at the 10th National Convention for the Study on Information and Documentation, Japan Information Center for Science and Technology (in Japanese), Oct 15, 1974 (Tokyo, Japan).

Table I. List of Articles

```
E-1 :  Maness,M.J., Sparling, P.F.,
    Multiple Antibiotic Resistance due to a Single Mutation in Neisseria
    gonorrheae.
        J. Infect. Dis. 128 321 - 30  (1973)
          *Drugdoc No. 074078994      *Ringdoc No. 35952 N

E-2 :  Bach, M.C., Monaco,A.P., et al
    Pulmonary Nocardiasis : Therapy with Minocycline and with Erythromycin
    plus Ampicillin.
        J. Amer. Med. Ass. 244 1378 - 81  (1973)
          *Drugdoc No. 073210329      *Ringdoc No. 25366 N

E-3 :  Oliver, L.E., Iser,J.H., et al
    "Biliary Colic" and Ilosone.
        Med. J. Aust. 1 1148 - 50 (1973)
          *Drugdoc No. 074035359      *Ringdoc No. 23887 N

N-1 :  Hamberger,B., Tuck,J.R.,
    Effect of Tricyclic Antidepressants on the Uptake of Nortriptyline and
    5-Hydroxytryptamine by Rat Brain Slice Incubated in Buffer or Human
    Plasma.
        Eur. J. Clin. Pharmacol. 5 229 - 35  (1973)
          *Drugdoc No. 073189813      *Ringdoc No. 20922 N

N-2 :  Silverman, G., Braithwaite,R.A.,
    Benzodiazepines and Tricyclic Antidepressant Plsama Levels.
        Brit. Med. J. III [5870] 18 - 20  (1973)
          *Drugdoc No. 074005404      *Ringdoc No. 27136 N

N-3 :  Asberg,M., Germanis,M.,
    Ophthalmological Effects of Nortriptyline - Relationship to Plasma level.
        Pharmacology 7 349 - 56 (1972)
          *Drugdoc No. 073097868      *Ringdoc No. 04938 N

P-1 :  Levy,J.V.,
    Effect of Propranolol on Hemodynamic Responses to Isosorbide dinitrate in
    Anesthetized Dogs.
        Arch. Int. Pharmacodyn. 191 155 - 61 (1971)
          *Drugdoc No. 071189250      *Ringdoc No. 24117 L

P-2 :  Simca.A., Bonham Carter, R.E.,
    Paroxysmal Atrial Tachycardia in Infants and Children.
        Lancet I [7704] 832 - 33  (1971)
          *Drugdoc No. 071155665      *Ringdoc No. 17562 L

P-3 :  Frohlich,E.D.,
    Beta Adrenergic Blockade in the Circulatory Regulation of Hyperkinetic
    states.
        Amer. J. Cardiol. 27 195 - 99  (1971)
          *Drugdoc No. 071117391      *Ringdoc No. 14767 L
```

Table II. Drugdoc Output

```
           IC                          QN :   123        DATE: 1974   (15)
ENTRNR     Ø7321Ø329
ITEMID      15Ø   16Ø   181   184
CLASSN     5.2.9
           5.2.9.1.
           5.2.13.4
           5.3.11.
           5.3.22.
           15.1.9.
           15.3.4.
           28.25.5.
           37.11.1.
           37.11.1.3.
           37.11.1.5.
           37.11.1.7.
           37.11.1.9.
           39.
PREFTERMS
     2144    AMPICILLIN
     3ØØ1  ANTILYMPHOCYTE SERUM
     3899  ASPERGILLUS FUMIGATUS
     8521  CEREBROSPINAL FLUID
    1441Ø  DRUG INTERACTION
    16Ø23  ERYTHROMYCIN
    19451  GLOMERULONEPHRITIS
    22Ø51  HOMOGRAFT
    23243  IMMUNOSUPRESSION
    25814  KIDNEY GRAFT
    25922  KIDNEY TRANSPLANTATION
    283Ø5  LUNG NOCARDIOSIS
    3Ø879  MINOCYCLINE
    33387  NOCARDIA ASTEROIDES
    334Ø6  NOCARDIOSIS
    45623  SPUTUM
    46642  SULAMETHOXAZOLE
    48383  THORAX RADIOGRAPHY
    49779  TRIMETHOPRIM
    59834  DRUG SENSITIVITY
    729Ø3  DRUG MIXTURE
   124994  DRUG EFFICACY
   185976  COTRIMOXAZOLE
SECTRM      $AALPEN, $AAMCILL, $APOLYCILLIN, $AMINOCIN
            $AILOTYCIN, $AE MYCIN, $APRINCIPEN, $ATOTACILLIN

ENGTLE      PULMONARY NOCARDIOSIS.  THERAPY WITH MINOCYCLINE AND WITH
           ERYTHROMYCIN PLUS AMPICILLIN -
AUTHOR      BACH M.C., MONACO A.P., AND FINLAND M.
ADRAUT      - CHANNING MEM. LAB. HARVARD MED. UNIT. HARVARD MED. SCH.
           BOSTON, MASS. -
JOURNL      J. AMER. MED. ASS.
PUBLYR      1973
BIBREF      224/1Ø (1378 - 1381)
CODENC      JAMAAUSC
LANGGE      ENGL
CONORG      USA
SECNUM      15,5,14,4,37
```

Table III. Ringdoc Abstract

129/205 25366N

M 'sulfa-drug' trisulfapyrimidine 'ampicillin' 'erythromycin'
T sulfadiazine 'tetracycline' minocycline 'antiseptic' 'guanidine'
E trimethoprim + sulfamethoxazole unsuccessful treatment of 'infection.fungus' nocardiosis following 'immunology' immunosuppression with 'mercaptopurine' azathioprine 'prednisone' 'corticosteroid' methylprednisolone 'ALS'-globulin kidney 'transplantation' exitus 2 cases /VI/ /X/ /XI/ /XX/ /XXI/

J.Am.Med.Assoc. 224, No.10, 1378-81 /1973/

Bach M C, Monaco A P, Finland M /Boston,Mass.,USA/

Pulmonary Nocardiosis. Therapy With Minocycline and With Erythromycin Plus Ampicillin.

Two cases of pulmonary nocardiosis unresponsive to sulfa-drugs were treated with minocycline (Minocin) and with erythromycin (E-mycin, Erythrocin, Ilotycin) plus ampicillin (Alpen etc).

Case-1

A 33-yr old man with chronic glomerulonephritis received a cadaveric kidney transplant. Immunosuppressive drugs included azathioprine (Imuran), prednisone, horse ALG. For signs of acute rejection he received high-dosage prednisone on day-4. 4 Mth later he required re-treatment for rejection, and 3 wk thereafter sputum yielded Nocardia asteroides. He received trisulfapyrimidines, but showed signs of sensitivity confirmed on challenge with trisulfapyramide. The Nocardia was shown to be susceptible to ampicillin and erythromycin, but not sulfadiazine The man then received ampicillin 1 g and erythromycin estolate 3 g/day, and sputum was cleared of Nocardia and nodular lung infiltrates disappeared. 10 Wk later the Nocardia re-appeared and was successfully re-treated, but Asp. fumigatus was cultured from sputum and Pseudomonas from urinary tract requiring nephrectomy for suspected renal abscess. Despite i.v. amphotericin B, the fungal infection spread to lung and meninges and the patient died. At autopsy there was no Nocardia in the lungs.

Case-2

A 42-yr man received a cadaveric kidney transplant, then immunosuppressive drugs as in Case-1. 5 Wk later he received methylprednisolone 500 mg/day for 5 days i.v. for rejection signs. He was later admitted for dyspnea, and Nocardia asteroides was shown in sputum. Treatment included sulfadiazine, trisulfapyrimidines, trimethoprim-sulfamethoxazole, but the Nocardia was not cleared. Meantime amphotericin B was given for Asp. fumigatus in sputum.

The Nocardia was shown to be sensitive to minocycline which was then given at dosage 400 mg/day raised to 600 mg/day. Signs and symptoms improved. Minocycline was stopped because of suspected hepatotoxicity, the Nocardia infection recurred and the minocycline 600 mg/day again completely cleared the sputum. The man later died in hemorrhagic shock. Blood was positive for Bacteroides fragilis, but there was neither Aspergillus nor Nocardia in the lungs.

7 Fig. 12 Ref. T37/TNM/WJA

818 Harrison Ave., Boston, 02118, (M F)

Table IV. Sample of Descriptor List

ERY - 2

Bach,M.C., Monaco,A.P., Finland,M.,
Pulmonary Nocardiosis : Therapy with Minocycline and Erythromycin plus Ampicillin.
J. Amer. Med. Ass. 244 [10] 1378 - 81 (1973)

DRUG	Drugdoc	Prefterm	Ampicillin, Cotrimexazole, Erythromycin, Minocycline, Sulfamethoxazole, Trimethoprim, Drug efficacy, Drug interaction, Drug mixture, Drug sensitivity
		Sec.term	Alpen, Amicill, E-Mycin, Ilotycin, Minocin, Polycillin, Principen, Totacillin
	[18]	Itemindx	- - -
	Ringdoc	Indxterm	Ampicillin, Antiseptic, Corticosteroid, Erythromycin, Guanidine, Mercaptopurine, Prednisone, Sulfa-drug, Tetracycline,
		Freeterm	Azathiopurine, Globulin, Methylprednisone, Minocycline, Sulfadiazine, Sulfamethoxazole, Trimethoprim,
	[19]	Codlsscn	*Antibiotics, *Chemotherapeutics,*Corticosteroisa,
BIO.MED.	Drugdoc	Prefterm	Antilymphocyte serum, Aspergillus fungatus, Cerebrospinal fluid, Glomerulonephritis, Homograft, Immunosuppression, Kidney graft, Kidney transplantation, Lung Nocardiosis, Nocardiosis, Nocardia asteroided, Sputum, Thorax radiography,
		Sec.term	- - -
	[17]	Itemindx	Clinical study, Intramuscular administration, Oral administration, Treatment.
	Ringdoc	Indxterm	ALS., Immunology, Infection- fungus, Transplantation,
		Freeterm	- - -
	[13]	Codlsscn	*Endocrinology, *Immunology, Immunosuppression, *Infection, Kidney, *Microbiology, Nocardiosis, *Therapeutics, Treatment,
OTHER	Drugdoc	Prefterm	- - -
		Sec.term	- - -
	[0]	Itemindx	- - -
	Ringdoc	Indxterm	- - -
		Freeterm	- - -
	[0]	Codlsscn	- - -

Authors Key Terms in article : Ampicillin, Erythromycin, Minocycline[Tetracycline], Nocardiosis, Kidney, Transplantation, Immunology, Infection, Azathiopurine, Prednison, ALS-globulin, Synergism.

and all other words are termed Codeless Scanning. Also the Thematic Group and S.D.I. Profile have been converted to words and identified with an asterisk.

(3) The descriptors of the nine articles were divided into three classes:

Drug related: Descriptors related to drug name, biopharmacy, galenics, and physicochemistry.

Biomedicine related: Descriptors for microbiology, physiology, pathology, disease, and therapy.

Others: Descriptors of methods and measurements, animals, age and sex difference, and human and company names.

Table V. Hierarchical Relationship and Synonyms in Drug Names

	Drugdoc		Ringdoc	
	Pref. term	2nd. indx. term	Indexterm	Free term index
Chemotherapeutics				
Erythromycin	Erythromycin	E-Mycin Erythrocin Ilotycin	Erythromycin	- - -
	Erythromycin-estolate	Ilosone	- - -	Ilosone
Ampicillin	Ampicillin	Alpen Amcill Polycillin Principen Totacillin	Ampicillin	- - -
Chloramphenicol	Chloramphenicol	- - -	Chloramphenicol	- - -
Psychotropic agents				
Nortriptyline	Nortriptyline	Sensaval	Dibenzocyclo-heptadiene	Nortriptyline Sensaval
Imipramine	Imipramine	Tofranil	Imipramine	Tofranil
Amitriptyline	Amitriptyline	- - -	Amitriptyline	- - -
Cardiovascular agents				
Digoxin	Digitalis	- - -	Digitalis	Digoxin
Isosorbide dinitrate	Isosorbide dinitrate	- - -	N-ester	Isosorbide dinitrate
Propranolol	Propranolol	- - -	Propranolol	- - -

Table VI. Multifacet Coding of Drugs in Ringdoc

Free term	Index term	
Drug name	Principal action	Chemical structure
Azathiopurine	Immunology	Mercaptopurine
Chlordiazepoxide	Psychosedative	Benzodiazepine
Isosorbide dinitrate	Cardiant	N-ester
Nortriptyline	Psychostimulant	Dibenzocyclo-heptadiene
Spectinomycin	Antibiotic	Dioxane

Table VII. Hierarchical Relationship and Synonyms for Biomedical Descriptors

	Drugdoc		Ringdoc	
	Pref. term	2nd. indx term	Indx. term	Freeterm indx.
Bacteria				
Aspergillus or A. fumigatus	Aspergillus fumigatus	- - -	- - -	- - -
Nocardia or N. asteroides	Nocardia asteroides	- - -	- - -	- - -
Neisseria gonorrheae	Neiseria gonorrheae	- - -	Bact[erium]	Neiseria gonorrheae
Disease, etc.				
Abdominal pain	Abdominal pain	- - -	- - -	Abdominal pain [Codlsscn]
Biliary colic	Biliary colic	- - -	Bile duct & Lithiasis	- - -
Hypersensitivity	Hypersensitivity & Adverse drug reaction	- - -	Allergy & Side effect	*Allergy & Side effect [Codlsscn]
Nocardiosis	Nocardiosis & Lung nocardiosis	- - -	Infection.fungus	Nocardiosis & Infection [Codlsscn]
Paroxysmal heart atrium tachicardia	Heart arrhythmia & Paroxysmal	- - -	Arrhythmia	Tachicardia & *Paroxysmal atrial [Tachicardia] [Codlsscn]
Therapy & Method				
Electrocardiography	Electrocadiography	- - -	[electro]Cardiography	- - -
Renal homo transplantation	Homograft & Kidney graft & Kidney transplantation	- - -	Transplantation	*Kidney [Codlsscn]
Basic bioactivity, etc.				
Arterial blood pressure	Blood pressure	- - -	Hemodynamics	Blood pressure
Cerebral cortex	Brain cortex	- - -	Brain	*Cerebral cortex
Plasma level	Plasma	*Blood value [Itemindx]	Plasma	*Blood plasma or *Conc[entration] [Codlsscn]

A sample of the descriptor list is shown in Table IV.

(4) The nine articles were read from the standpoint of drug information retrieval, and words related to the evaluated drugs were selected by the author as Key Terms. A sample of our Key Term list is shown in the lower part of Table IV. These Key Terms were compared with descriptors of both systems, and the tautology and semantic relationship were evaluated.

RESULTS

(1) The synonym relationship and hierarchy of the drug-related descriptors are shown in Table V.

Table VIII. Distribution of Descriptors According to Field

			Pharm. Sci. Total		Therapy Total		Side effect Total		Sum total	
	Drugdoc	Ringdoc	D.D.	R.D.	D.D.	R.D.	D.D.	R.D.	D.D.	R.D.
Drug descriptors	Prefterm	Indxterm	31	23	23	20	13	4	67	47
	Sec.term	Freeterm	4	9	8	13	2	3	14	25
	Itemindx	Codlsscn	1	13	1	7	2	4	4	24
	Sub-total		36	45	32	40	17	11	85	96
Bio-med. descriptors	Prefterm	Indxterm	15	5	20	8	21	10	56	23
	Sec.term	Freeterm	3	3	0	2	1	3	4	8
	Itemindx	Codlsscn	4	13	9	19	3	20	16	52
	Sub-total		22	21	29	29	25	33	76	83
Other descriptors	Prefterm	Indxterm	1	0	1	3	1	1	3	4
	Sec.term	Freeterm	7	7	2	0	2	1	11	8
	Itemindx	Codlsscn	6	3	1	2	0	1	7	6
	Sub-total		14	10	4	5	3	3	21	18
Total			72	76	65	74	45	47	182	197

Table IX. Distribution of Descriptors According to Drugs

			Erythrom. papers Total		Nortriptyl. papers Total		Propranolol papers Total		Sum total	
	Drugdoc	Ringdoc	D.D.	R.D.	D.D.	R.D.	D.D.	R.D.	D.D.	R.D.
Drug descriptors	Prefterm	Indxterm	21	21	33	19	13	7	67	47
	Sec.term	Freeterm	9	12	5	10	0	3	14	25
	Itemindx	Codlsscn	2	10	2	14	0	0	4	24
	Sub-total		32	43	40	43	13	10	85	96
Bio-med. descriptors	Prefterm	Indxterm	26	12	11	4	19	7	56	23
	Sec.term	Freeterm	3	1	0	0	1	6	4	7
	Itemindx	Codlsscn	7	21	5	13	4	18	16	52
	Sub-total		36	34	16	17	24	31	76	82
Other descriptors	Prefterm	Indxterm	0	0	1	1	2	3	3	4
	Sec.term	Freeterm	0	5	7	3	4	0	11	8
	Itemindx	Codlsscn	0	0	4	2	3	4	7	6
	Sub-total		0	5	12	6	9	7	21	18
Total			68	82	68	66	46	48	182	196

Table X. The Ratio of Key Term to Descriptor According to Fields (Key Term/Descriptor)

		Pherm. Sci. (E-1,N-1,P-1)	Therapy (E-2,N-2,P-2)	Side effect (E-3,N-3,P-3)	Sum total
Drug	Drugdoc	18/36(50%)	15/32(47%)	6/17(35%)	39/ 85(46%)
	Ringdoc	21/45(47%)	25/40(63%)	5/11(45%)	51/ 96(53%)
Bio-med.	Drugdoc	13/22(59%)	8/29(28%)	14/25(56%)	35/ 76(46%)
	Ringdoc	12/21(57%)	12/29(41%)	14/33(42%)	38/ 83(46%)
Others	Drugdoc	3/14(21%)	2/ 4(50%)	0/ 3(0%)	5/ 21(24%)
	Ringdoc	2/10(20%)	3/ 5(60%)	0/ 3(0%)	5/ 18(28%)
Total	Drugdoc	34/72(47%)	25/65(38%)	20/45(44%)	79/182(43%)
	Ringdoc	35/76(46%)	40/74(54%)	19/47(40%)	94/197(48%)

Table XI. The Ratio of Key Term to Descriptor According to Drugs (Key Term/Descriptor)

		Antibiotic Erythromycin	Antidepressant Nortriptyline	Cardiovascula. Propranolol	Sum total
Drug	Drugdoc	15/32(47%)	16/40(40%)	8/13(62%)	39/ 85(46%)
	Ringdoc	25/43(58%)	19/43(44%)	7/10(70%)	51/ 96(53%)
Bio-med.	Drugdoc	15/36(42%)	10/16(63%)	10/24(42%)	35/ 76(46%)
	Ringdoc	19/34(56%)	6/18(33%)	13/31(42%)	38/ 83(46%)
Others	Drugdoc	0/ 0(0%)	2/12(17%)	3/ 9(33%)	5/ 21(24%)
	Ringdoc	0/ 5(0%)	1/ 6(17%)	4/ 7(57%)	5/ 18(28%)
Total	Drugdoc	30/68(44%)	28/68(41%)	21/46(46%)	79/182(43%)
	Ringdoc	44/82(54%)	26/67(39%)	24/48(50%)	94/197(48%)

In Ringdoc, drugs which are not Index Terms themselves are classified by two Index Terms, one for the chemical structure and the other for the main drug action given in the abstract as shown in Table VI. There is no such biphasic coding system in Drugdoc.

(2) To evaluate the depth of concept correspondence of each descriptor, the biomedical descriptors were classified according to their relation to microbiology, disease, therapy, and basic bioactivity. The synonym relationship and hierarchy of biomedical descriptors are shown in Table VII.

(3) Table VIII shows the distribution of the descriptors according to class when the nine articles are grouped according to field of drug activity. Table IX shows the distribution when the articles are grouped according to type of drug. The characteristics and quantitative deviation of descriptors were evaluated from Tables VIII and IX.

(4) To evaluate both systems from the standpoint of drug information retrieval, the ratio of correspondence of descriptors to Key Terms selected by the author was also examined. Tables X and XI show the ratio and distribution when the articles are grouped according to field of drug action and type of drug.

DISCUSSION

For the information scientist in industry, information on pharmacodynamics, pharmacokinetics, therapeutic efficacy, and side effects are of most interest when tracing the research and development of a new drug. According to their selection rules, both Drugdoc and Ringdoc should cover all information in this category. However, the report of the Drugdoc Study Committee showed a difference in the output of the two systems that could not be explained by only quantitative differences in the number of journals that are covered. Therefore, the author selected three drugs of different types and examined the difference in index structure of the two systems.

(1) Correlation between Descriptors. When the contents of an article are evaluated from only a list of descriptors, it is desirable that the relation between terms and their role be made clear by codes which show the respective Link and Role. From this viewpoint, theoretically in Drugdoc the Preferred Term and Secondary Term show the subject matter of the paper, the Item Index shows the object of medication and procedures, and the Classification shows the principal action of the drug. However in the computer printout, presumably to facilitate machine retrieval, the related descriptors are not grouped but in alphabetical or numerical order.

Therefore no clear correlation can be seen between the drug and therapeutic or side effect. If the title is not self-explanatory, then each descriptor can be given only the same weight and so the original paper must be referred to in order to discover the correct correlation between a drug name and an effect.

In Drugdoc it is evident that drug descriptors are selected from the standpoint of complete coverage and not from weight of drug evaluation in the article. Thus in the case of drug reevaluation, as required by the Ministry of Public Welfare in Japan and Food and Drug Administration in the U.S.A., where comprehensiveness takes precedence, Drugdoc will give a large selection of papers, but for general information retrieval it will give a lot of noise.

In Ringdoc the Index Terms and Free Terms in the Codeless Scanning Heading are arranged in the form of a telegraphic style abstract, and thus correlation between descriptors can be grasped readily. However, Ringdoc indexing lacks the comprehensiveness of Drugdoc.

(2) Hierarchical and Synonymous Character. The hierarchical and synonymous character of the descriptors in both systems differ according to whether they are drug descriptors or biomedical terms. The thesaurus used for controlling technical terms in Drugdoc is MALIMET, which is also the thesaurus for the Excerpta Medica total data system. This contains 170 000 Preferred Terms and 300 000 synonyms, and it indicates the relation of synonyms by USE and FOR. Its structure is not hierarchical, but owing to the international character of Excerpta Medica shows the synonymous character among the variety of existing drug names, disease names, and anatomical terms. As shown in Table V the generic name and common name of drugs are classified as Preferred Terms and the trade names treated as Secondary Terms. However, even when the trade name is used in the article it is not always listed as a descriptor. Biological terms and their synonyms are treated at the same hierarchical level as Preferred Terms and according to the range of the present study no synonym was found as a Secondary Term. For cerebral cortex the Preferred Term is "brain cortex", but for renal homotransplantation three terms, "homograft", "kidney graft", and "kidney transplantation", are all listed as Preferred Terms.

In Ringdoc the Thesaurus contains about 1300 Index Terms and 14 000 Free Terms. The relationship between Index Terms is shown in the Index Term Definition Booklet as related Index Terms and by SEE or ALSO in the Thesaurus. The relationship between Index Terms and Free Terms is shown by USE for synonyms and CLASSIFY for hierarchical relations. Thus synonyms are all grouped under one Index Term.

Terms such as nortriptyline and digoxine are treated as Free Terms and the upper level concept "dibenzocycloheptadiene" and "digitalis" used as the respective Index Term.

However, when drug names that should be treated as lower level concepts, and thus Free Terms, become important and are frequently used as search terms, they are raised to the level of Index Terms; for example, ampicillin, erythromycin, and propranolol are Index Terms. In such cases the Index Term showing the hierarchical relationship is no longer used, but frequently the S.D.I. Profile Code will suffice to show this relation as in the case of antibiotics or cardiovascular drugs where the code is VI or IX, respectively. This hierarchical relationship is also seen in biological terms with Neisseria gonorrheae and nocardiosis being used as Free Terms with the Index Terms "bact(erium)" and "infect. fungus" showing the upper level concept. However, in the range of this paper the term renal homotransplantation was classified only under the Index Term "transplantation" and the organ was not shown as a Free Term.

In other words, for drug-related terms in Drugdoc there is no hierarchical relationship and the generic name or common name is used as the Preferred Term, and the synonymous trade names are treated as Secondary Terms. Whereas in Ringdoc the generic names of important drugs are used as Index Terms with the trade names following as Free Terms, and in the case of less important drugs where the generic names are treated as Free Terms, these are preceded by two Index Terms, one showing the basic chemical structure and the other the main pharmacological action mentioned in the paper. This biphasic coding system, which is characteristic of Ringdoc, is most useful for the retrieval of all derivatives of a basic parent structure, or for retrieval of drugs which have the same principal action regardless of the structure. Thus Ringdoc shows more variation and depth for drug descriptors.

As for biomedical terms, the Drugdoc classification includes many lower level concepts as Preferred Terms and a broad selection of terms showing site of action, disease name, activity, and tissue or organ, whereas in Ringdoc a broad upper level concept Index Term is generally used. Thus the editorial policy of Drugdoc can be said to emphasize the medical field.

(3) Distribution of Descriptors in Pharmaceutical and Biomedical Field. According to Table VIII, the distribution of descriptors for activity in the biomedical section shows Ringdoc to have selected a slightly larger number of total terms, but when comparing the main descriptors which are Index Terms and Preferred Terms, Drugdoc shows a higher selection ratio of 56:23. As stated before this is due to the fact that Drugdoc includes a large number of medical synonyms and so from the variety of descriptors in the biomedical field Drugdoc is superior to Ringdoc. Also when articles pertaining to side effects are examined individually in the paper Erythromycin-3, Drugdoc gives two side effect symptoms whereas Ringdoc gives only the main side effect which is the theme of the paper. In Nortriptyline-3, Drugdoc gives four descriptors on site of occurrence and state of side effects whereas Ringdoc gives two descriptors, one the symptom and one the state of side effect. Thus with regard to these two articles, the system that selects descriptors pertaining to subject matter of side effects as comparatively detailed as it does in the case of medical descriptors is Drugdoc. In Propranolol-3 the main subject is pathological mechanism of hyperkinetics and, with regard to side effects which are mentioned in the selection on treatment at the end of the paper, neither system takes the matter up substantially, and only in Ringdoc are the

Index Term "side effect" and in Codeless Scanning "contraindication" used.

As both Drugdoc and Ringdoc are known as drug-oriented information systems, it is thought that the same attitude toward selection of descriptors should be taken for selection of descriptors for side effects. When the descriptors are examined according to drug class, as shown in Table IX, Ringdoc has selected slightly more descriptors for erythromycin and propranolol, but in comparing the number of Preferred Terms and Index Terms in the drug and biomedicine sections, Drugdoc shows a higher ratio of selection for all three drugs.

(4) Ratio of Correspondence between Key Terms and Descriptors. In examining the ratio of correspondence between the Key Terms selected by the author and descriptors of both systems, for the field of drug activity in Drugdoc the ratio was highest for pharmaceutical science and lowest for therapy.

A similar tendency is seen in the report by the Drugdoc Study Committee on article selection rates in five areas. In the case of Ringdoc the ratio was highest for therapeutic papers. When examining the ratio according to type of drug, in Drugdoc the ratio was slightly higher for propranolol and slightly lower for nortriptyline and in Ringdoc highest for erythromycin and lowest for nortriptyline. In general, the ratio of correspondence was higher in Ringdoc.

CONCLUSION

From this comparative study on Drugdoc and Ringdoc, the following conclusions were reached.

Both Drugdoc and Ringdoc use major descriptors (Preferred Term vs. Index Term) and minor descriptors (Secondary Indexing Term vs. Free Term) for coding various relevant material of the article, and alphanumerical codes (Item Index vs. Thematic Group and Profile Code) to show the profile, experimental methods, and objective of the article.

With regard to tendency in selection of descriptors, in Ringdoc a hierarchical relation exists between the major and minor descriptors for drugs, either an upper level concept or a lower level concept which is considered important for retrieval being used for major, and lower level concepts being used for minor descriptors. Also it shows the relation between synonyms and uses multifacet indexing. On the other hand, for coding in the biomedical field, Drugdoc shows objectiveness in expression of its major descriptors, lists the synonyms, and shows comprehensive coverage. This presumably is due to the fact that the Excerpta Medica Foundation, which has had much experience in editing medical abstracts, puts this knowledge to good use in its treatment of the confusing divergency of medical terms.

As for the attitude in selection of descriptors from the original article, as the objective of Drugdoc is the wide stratum of users in the medical and pharmaceutical fields, the terminology of these fields is comprehensively adapted as descriptors by use of the MALIMET, whereas in Ringdoc descriptors pertaining to the activity and character of the drug which is the objective of the article are selected. This reflects an editorial policy inclined slightly toward the pharmaceutical field as its objective is the pharmaceutical industry. This point can also be observed from the abstract. In Drugdoc weight is placed on the author's abstract or the conclusion, whereas in Ringdoc the basic rule is a third person abstract which emphasizes objective elucidation of the whole article.

In other words, although in both systems medical drug related information is the objective, the characteristic of each system is based on the background of its birth.

SUMMARY

A comparative study was performed on the index structure of Drugdoc and Ringdoc based on the output of both systems on the same nine articles. In both systems major and secondary indexing terms are used as descriptors for biomedical and pharmaceutical context, and alphanumeric codes for showing the concept and viewpoint of the article.

Ringdoc is superior in coding of drugs and pharmaceutical information as its descriptors have hierarchical relations, multifacet coding is performed, and synonyms are selected. Medical term related descriptors are more abundant in Drugdoc, including synonyms and analogous words, but no hierarchy is seen. Ringdoc selectively chooses descriptors related to the main theme of the article, whereas Drugdoc chooses descriptors comprehensively throughout the article.

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