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Application of a prescription drugs database in medical informatics: Construction of this database as a search system for similar and comparable drugs

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Abstract

Objective : Information of similar and comparable drugs can provide high-use on from both a clinical perspective, and from the perspective of medical cost and insurance when examining and assessing a change from original to generic drugs in deciding what drug to adopt, or proposing an alternative drug to a physician at times when there are concerns over the use of a particular prescription drug. Searching for relevant publications, however, requires a considerable amount of time and the process itself is relatively incomplete and renders it unsuitable for use as a cross-section search. Classification by the Japan Standard Commodity Classification Number (commonly referred to as the Therapeutic Classification Number) also involves drugs with the same therapeutic value which are classified together, such as the calcium antagonist nicardipine hydrochloride covering the hydrochloride hypertension drug number 214 and nifedipine covering the vasodilator 217. This means that many drugs are simply lumped together and classified as "Other" in many classifications, resulting in an insufficient and incomplete search being carried out. It is with this in mind that we set out to construct a database of similar and comparable drugs in the hope that incorporating the latest information technology into a database system would provide a search capability that was both rapid and comprehensive.

Methods : The basic information of approximately 18,000 Japanese prescription drugs, such as individual drug codes, product names, product specification and drug prices were collated, organized, and then identified as being a generic drug or not. Taking all of the drug package inserts, including the combination drugs, we then extracted 3,647 different active components. Active components that expressed similar properties were then grouped together with other similar components, and their basic information was assessed. After constructing a hierarchical structure to categorize similar and comparable drugs thought to be necessary from the clinical aspect, the drugs were catagorized based on their therapeutic value identifiable by a therapeutic category number, and the active component was defined accordingly. For this database we added several additional components, such as databases for indication, side effects, and identification data for various drugs. This allowed creation of a search system with the following three functions: 1) a search function for similar and alternative drugs; 2) a search capability for drugs by therapeutic value name; and 3) a check for overlapping therapeutic effect.

Results : The finished search system allows users to conduct a search using various criteria, including the drug's brand name, generic name, identification data, and therapeutic value. The search criteria can also be applied to allow users to enter filters such as [Search all], [Uniform component], [Uniform format], and [Uniform standards] to narrow their search field. Users can further narrow their search field by applying additional criteria, such as their relevant drug having any indication or side effects. The subsequent drug names that are generated by a search can then be examined in a convenient list format, a comparative chart of indication, and information regarding package inserts. Users of this system can take advantage of the system's multi-faceted perspective, using the full scope of its digital system.

Conclusion : Our recently developed search system that can quickly and comprehensively collates information regarding similar and comparable drugs. Here we report on the examination of a database that considers drugs from the perspective of identification data, indication, and side effects. In the future we hope to connect this database to other similar systems, adding further drug classification and categories, and further expand the system's application, such as being part of a hospital information system, where it can be utilized even more efficiently. To fully realize such a useful database, however, will require clinical demonstration of this system.

Key words: Medical informatics, Drug information system, Drug database, Comparable drug, Similar drug

Introduction

The increasing specialization and advancement of medical treatment has also seen an increasing requirement for appropriate drug information in order to further develop and apply the most appropriate medical treatment. The main providers of such drug information—pharmacists—need to fully understand the characteristics of each drug they provide and understand the efficacy of each item from every possible perspective; also they need to systematically regulate their use, as well as keep up-to-date with all of the latest research and developments in the field.

Recently, however, the volume of information available to such providers in printed form has expanded with the increasingly high volume of digital information available on the Internet[1)], and therefore, the processes of obtaining

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and organizing the relevant drug information require both increasing time and effort.

Any attempt to provide prompt and constant drug information requires the introduction of information technology. Using this technology and then incorporating any subsequently acquired information into a database allows for improved efficiency in keeping information up-to-date, a more comprehensive search function, and the potential for multi-faceted use. This has resulted in a variety of database systems incorporating drug information being tested from a variety of different angles.

These databases can provide high-use information on similar and comparable drugs from both a clinical perspective, and from the perspective of medical cost and insurance when examining and assessing a change from original to generic drugs in deciding what drug to adopt, or proposing an alternative drug to a physician at times when there are concerns over the use of a particular prescription drug.

Currently, however, this kind of information is at the stage where it is only maintained in analogue form, such as in document or written format. Even if such information is available in digital format it is only in the form of a drug information system using a Japan Standard Commodity Classification Number (commonly referred to as the Therapeutic Classification Number), or only certain elements of the drug information are available so that the relevant drug's therapeutic value is not fully covered by the subsequent search.

Any search system based on this written material is restricted by its very nature to actual documents and written information, and to be used successfully it requires a significant amount of time to be invested in any search. This is despite the fact that any search of this kind will not be fully inclusive and is generally unsuitable for use as a comprehensive search system. A further issue is that classification by Therapeutic Classification Number also involves drugs with the same therapeutic value being classified together, such as the calcium antagonist nicardipine hydrochloride covering the hydrochloride hypertension drug number 214[2] and nifedipine covering the vasodilator 217[2]. This means that many drugs are simply lumped together and classified as "Other," in many classifications, resulting in an insufficient and incomplete search being carried out.

Further compounding these issues are problems resulting from the potential for the search result to be affected by both knowledge and experience of the user. Taking these factors into consideration,we set out to construct a database of similar and comparable drugs in attempt to resolve these issues.

Methods

1. Extraction of active component

In this study 3,647 different active components were extracted from the package inserts of approximately 18,000 Japanese prescription drugs, including drugs used in internal medicine, external application, and injection drugs. These included all applicable drugs, whether single agent or compound agent drugs, and it was confirmed whether the extracted component was a single agent or a compound agent and the results were recorded in graph form.

From this we found that even with drugs that had similar active components, the active components as listed on the package insert were actually different. One example could be seen in the vitamin B6 complex, which includes vitamin B6, pyridoxine hydrochloric acid, pyridoxine hydrochloride, pyridoxal calcium phosphate, pyridoxal phosphate, pyridoxal, and pyridoxine. This means that any active components that are regarded as similar can be grouped together and collated (Fig.1).

There were also a number of overlapping entries in this system in terms of the same components being found in multiple groups, such as pyridoxine hydrochloric acid and pyridoxine hydrochloride being in same group with the same hydrochloric group, and pyridoxal calcium phosphate and pyridoxal phosphate being in same group with the same phosphate group. The ultimate aim of this kind of treatment and organization is to produce a database that can be maintained more efficiently and used in a multifunctional way.

2. Basic information and association

After collating the basic information of individual drugs, which comprised such items as the Japan Standard Commodity Classification number issued by the Ministry of Health, Labour and Welfare's Health Insurance Bureau[2]; a 12-digit individual drug code, generic name, brand name, product standards, National Health Insurance Price and name of manufacturer and retailer, the 12-digit code was then used to create a basic information master site after adding information on whether a particular product was generic or not.

This basic master site could then be linked to the database for active components (Fig.2).

Fig.1 Extraction of active component and grouping

group of active component code	active component code	active component name
026820	026820	vitaminB6
026820	026830	pyridoxal
026820	011260	pyridoxine
026820	107930	pyridoxine hydrochloric acid
026820	015470	pyridoxal phosphate
026820	015480	pyridoxal calcium phosphate
026820	018050	pyridoxine hydrochloride

Fig.2 Link of basic master and active component

JSCC No.	12-digit individual drug code	generic name	generic drug or not	brand name	product standards	NHI price (yen)	manufacturer and retailer name	active component name
872649	2649854N1025	glycyrrhizinate and dexamethasone combination creme	generic drug	Eurich creme	0.05%1g	29.70	Nippon Chemiphar	glycyrrhizinate
								dexamethasone
								pyridoxine
873179	3179504A1116	thiamine disulfide、vitaminB6 and vitaminB12 combination injection solution		Neolamin-3B	10mL1ampule	126.00	Nipponkayaku	thiamine disulfide
								pyridoxine hydrochloride
								hydroxocobalamin acetate

3. Systemization of classification of similar and comparable drugs

Based on each drug's therapeutic value linked to the Japan Standard Commodity Classification Number (the Therapeutic Classification Number), the drugs were then classified into similar and comparable drugs, which is important for clinical use.

For a member of the cephalosporin group of antibiotics, in the large category of beta-lactam it is necessary to classify information from the first generation cephalosporin to fourth generation. The large category of minerals and sugars among adrenal cortex hormones can be classified by their being strong or weak. The number of levels of information necessary for classifying drugs into groups by drug action, however, is different, and depends upon the intended use of the drug. This may lead to information that is actually displayed differently by the system. In an attempt to resolve these problems we planned on developing a database that had a classification scheme based on 5 different levels. The classifications based on the system's hierarchical structure are primarily centered on the relevant drug's pharmacological action and an element of the classification also includes its chemical structure (Fig.3). From this classification the active component of the drug can then be extracted and distributed and a database of similar and comparable drugs created. Furthermore, when considering an audit of prescriptions of similar and comparable drugs for the same patient, then this database is equipped with supplemental data that records drugs with similar therapeutic values to ensure that these are not administered concurrently, so that the system can take variable factors into account, such as the opinions and circumstances of different medical institutions, rather than having just one overall, general viewpoint.

Results

1. System environment

1) Database build environment: The database was built using Microsoft Access 2000.

2) System build: Constructed using Microsoft Visual Basic 6.0 and operating check performed using Windows 2000 and Windows XP.

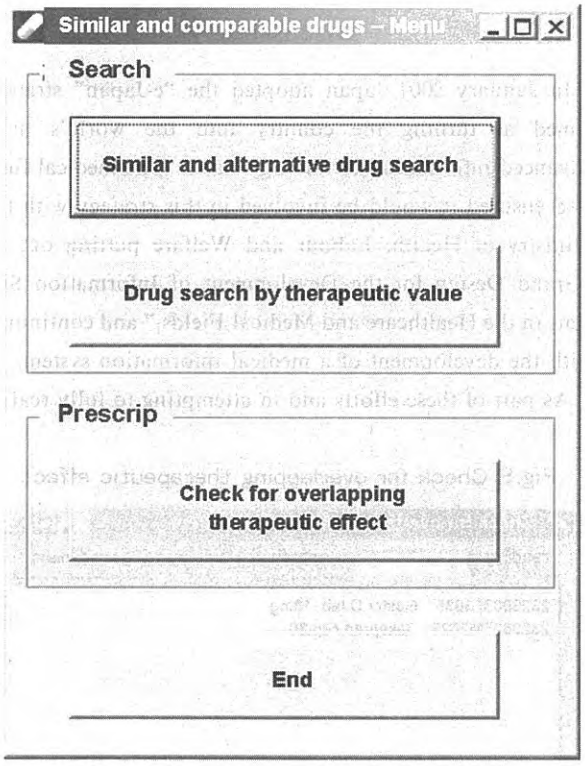
2. System configuration

The system was constructed based on the three core functions of [Similar and alternative drug search]; [Drug search by therapeutic value]; and [Check for overlapping therapeutic effect] (Fig.4). In order to use this as a system that can actually be sustainable in a clinical setting, outside of its use as a database of similar and comparable drugs, it was incorporated with an [Identification information database], [Indication database], and [Side-effect

Fig.3 Database structure of classification of similar and comparable drugs

tree①	tree②	tree③	tree④	tree⑤	active component name
antibiotic	beta-lactam antibiotic	carbapenem antibiotic			Panipenem
antibiotic	beta-lactam antibiotic	carbapenem antibiotic			Meropenem
antibiotic	beta-lactam antibiotic	carbapenem antibiotic			Biapenem
antibiotic	beta-lactam antibiotic	carbapenem antibiotic			Doripenem
antibiotic	beta-lactam antibiotic	carbapenem antibiotic			Imipenem
antibiotic	beta-lactam antibiotic	cephem antibiotic	oxacephem antibiotic		Flomoxef sodium
antibiotic	beta-lactam antibiotic	cephem antibiotic	oxacephem antibiotic		Latamoxef sodium
antibiotic	beta-lactam antibiotic	cephem antibiotic	cephamycin antibiotic	2nd generation	Cefmetazole sodium
antibiotic	beta-lactam antibiotic	cephem antibiotic	cephamycin antibiotic	3rd generation	Cefbuperazone sodium
antibiotic	beta-lactam antibiotic	cephem antibiotic	cephamycin antibiotic	3rd generation	Cefminox sodium
antibiotic	beta-lactam antibiotic	cephem antibiotic	cephalosporin antibiotic	1st generation	Cefaclor
antibiotic	beta-lactam antibiotic	cephem antibiotic	cephalosporin antibiotic	1st generation	Cefazolin sodium
antibiotic	beta-lactam antibiotic	cephem antibiotic	cephalosporin antibiotic	4th generation	Cefepime dihydrochloride
antibiotic	beta-lactam antibiotic	cephem antibiotic	cephalosporin antibiotic	4th generation	Cefozopran hydrochloride
antibiotic	beta-lactam antibiotic	cephem antibiotic	cephalosporin antibiotic	4th generation	Cefpirome sulfate

Fig.4 Menu of system



database] maintained by a private company, Data Index Co., Ltd, Japan.

All of the search functions are equipped with the ability to view package insert information using Portable Document Format file or text file.

1) Similar and alternative drug search

This function can be used in a variety of situations, from seeking a physician's opinion on changing to a more suitable medication to match the patient's condition, to determining whether or not to switch from an original drug to a generic version with the same indicators.

The search process for an appropriate alternative drug involves establishing a relevant method for inputting a product name and generic name search, as well as providing for a search function that allows searches based on any letters or numbers found on the drug or its packaging (Fig. 5).

Setting up the search criteria for an alternative drug involves adding a function that allows the user to select the relevant indication from the display list of indications possessed by the drug being searched, as well as examining any defined side effects. Furthermore, in addition to other functions such as providing for the type of drug and specifications, the system also displays the search results in a list format that shows whether the drug is generic or not, as well as displaying comparative information for indication (Fig. 6).

2) Drug search by therapeutic value

This particular function serves the role of a digital dictionary in the search for similar and comparable drugs. This function's digital features allows the user to simply enter the particular therapeutic category they wish to search for in the form of a character string and any drugs sharing the same classification and effect as the relevant character string will then be displayed in a tree structure. This means that each drug that is listed can then be viewed as a complete list. One example can be seen in a patient entering an allergy to penicillin antibiotics into the search criteria, which allows for any search to filter out any drugs, regardless of generic or product name, that contain penicillin-related antibiotics in generating a prescription for the user (Fig.7).

Fig.5 Picture of similar and alternative drug search

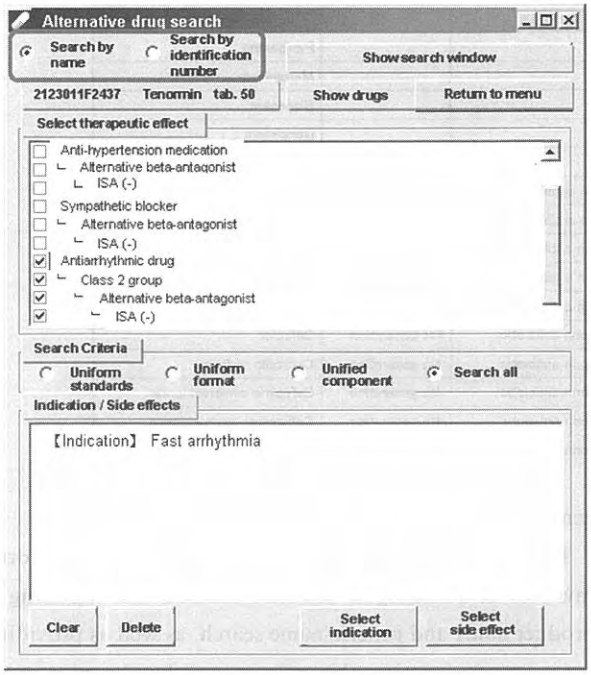


Fig.6 Displaying comparative information for indication

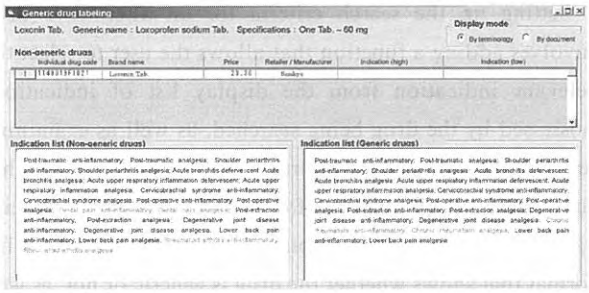
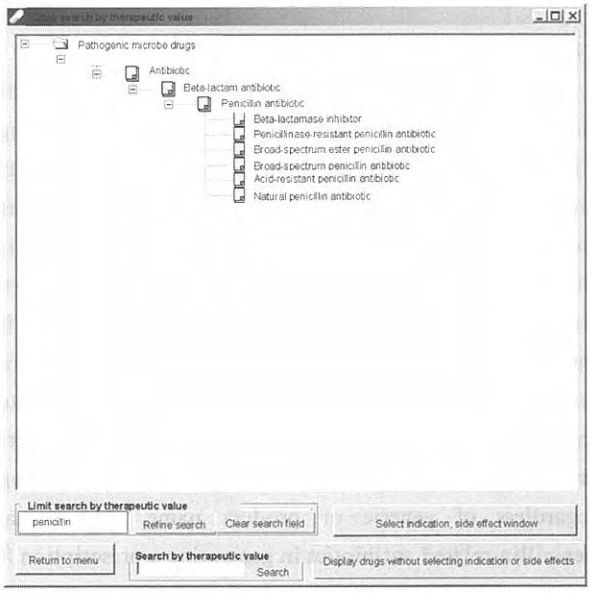


Fig.7 Drug search by therapeutic value



3) Check for overlapping therapeutic effect

With the aim of effecting medication that has been developed with efficacy and safety in mind, this system uses similar and comparable drugs data and supporting data on the Hospital Information System in the automated auditing of whether the generated prescription has any similar and comparable drugs within it. In the event of the system audit developing an error, then each of the relevant drugs will have their therapeutic values displayed (Fig.8).

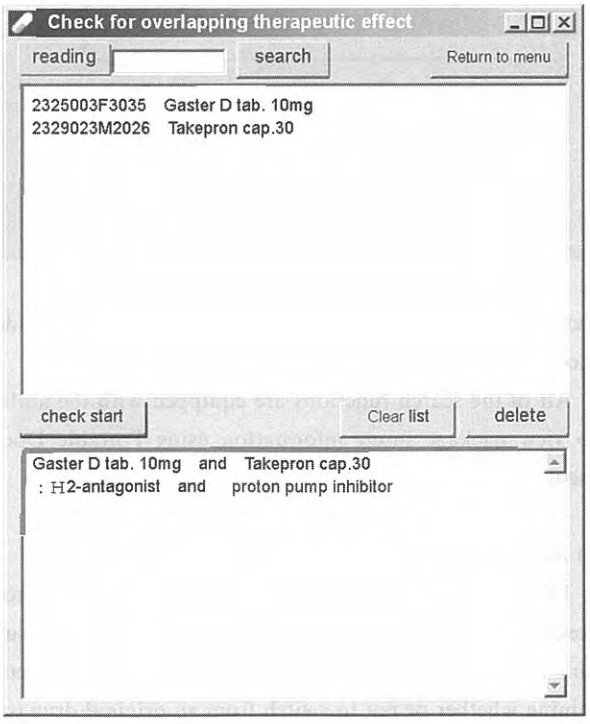
This function, apart from operating as an effective method to prevent any problems arising from drug therapy such as any side effects from an overlapping administration of drugs with the same therapeutic values, also has the potential to be used from a medical expenses perspective in ensuring that any drug is not being overused.

Discussion

In January 2001 Japan adopted the "e-Japan" strategy aimed at turning the country into the world's most advanced information technology state. The medical field also ensured it would be involved in this strategy with the Ministry of Health, Labour and Welfare putting out its "Grand Design for the Development of Information Systems in the Healthcare and Medical Fields," and continuing with the development of a medical information system.

As part of these efforts and in attempting to fully realize

Fig.8 Check for overlapping therapeutic effect



drug information software, the independent administrative agency the Pharmaceutical and Medical Devices Agency maintains a website (http://www.info.pmda.go.jp/)[1] providing public access to package insert information, pharmaceutical manufacturers, drug wholesalers, and publishing companies to meet the needs of physicians, pharmacists and other related medical industry professionals in the form of working towards the creation of a database for a wide variety of drug information.

This attempt to create this database has allowed for the provision of increased drug information in a timely and relatively simple way. This has also resulted, however, in considerable effort being required to maintain all of this information and in attempting to collate all of this scattered information much room remains for improving and refining this system. The database of similar and comparable drugs that we report here, as a result of only updating the database for drugs made commercially available that consist of new active components, means that the latest information can be updated quickly and the focus can be placed on efficiency and continuity. The use of this system also allows for pharmacists to supply patients with drug information that they may not personally be aware of due to a lack of experience or knowledge.

Here, we added this database of similar and comparable drugs that combines indication, side effects, and identification information. By connecting this with other databases and adding further classifications, we think it is possible to use the combined system for other uses, such as a digital chart or as a digital drug history for patients as part of an overall hospital information system, which allows for the enhanced use of the system. Seen in this light we hope to consider these issues when using the system to establish its use in the clinical setting.

Conclusion

The provision of basic drug information is essential for physicians to provide prescriptions based on safety and efficacy, and prescriptions that take into account both appropriate treatment and medical expenses.

It is also important, however, to ensure that only accurate information is being obtained from the overwhelming amount of drug information currently available, and to this end the use of information technology by pharmacists to supplement their knowledge and experience is unavoidable. The database for similar and comparable drugs that we constructed and report here has the potential to be a valuable tool that can contribute to the field of "information healthcare," and can also be regarded as a valuable tool for use in the clinical setting by combining both human ability and IT-based skills.

References

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