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Bio&Med Search – A Platform to Help Health Professionals about Pharmacogenetics

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Abstract

Bio&Med Search is an online platform that allows to get data from different databases; it permits the collection of information about genetic research, namely genetic variants and drug side effects associated with genetic variability. Based on the concept of pharmacogenetics people respond differently to medicines according to their genes' variants. Nowadays, health professionals should be more and more aware of the origin of several drug severe side effects.

This proposed web platform will allow the improvement and better prescription practices by health professionals, from physicians to pharmaceuticals. With Bio&Med Search, it will be possible to access scientific information and data about genetic variants associated to certain diseases and drugs, to better suggest and adjust the patient's medication according to its diagnostic and chemical composition of drugs and may suggest genetic tests. In this way, the error of prescription of drugs decreases and the quality of life of the patient may be improved, avoiding already described side effects. It will be possible to compare studies and literature associated to each drug, chemical composition, gene, gene variants and diseases.

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1. Introduction

Recently, there is a growing importance of pharmacogenetics; the study of how genes affect the way certain people respond to different medications [1]. Healthcare professionals can cooperate to avoid predictable side effects of drugs based on the advances in genetic research as well as in technology.

In this paper, we present the Bio&Med Search, a web platform that could be a helpful tool for health professionals. Bio&Med Search was designed to allow access to information that may contribute to better medical prescriptions because it will give insights and data about diseases, genetic variants as well as about drugs. With this platform it will be possible to prescribe the medication that will work better to certain disease without risk of adverse effects.

In many cases, a person's response to a given medication is determined by his or her genetic inheritance [1]. On this basis, the platform will allow easier and faster finding out medical prescription. It helps to select which drug can be advised and what will be its' best dosage in order to prevent side effects of medication recommended for certain disorders. By studying the links between genetics and medicine through pharmacogenetics, physicians can accurately predict what kind of reaction an individual, or even an entire group of people, is likely to have when taking certain medication [1].

With this web platform is intended to beyond database analysis and information access, the recommendation of genetic tests based on the search result.

1.1. Pharmacogenomics and pharmacogenetics

In scientific literature the concepts of *pharmacogenomics* and *pharmacogenetics* are similar. For some authors, Pharmacogenetics, also called pharmacogenomics, is the study of how genes affect the body's response to certain medicines. Genes are parts of DNA passed down from the parents. They carry information that determines the individual unique traits, such as height and eye colour. The genes can also affect how safe and effective a particular drug can be for a determinate individual, in a certain health condition [2].

To others, the concept of Pharmacogenetics has been defined as the study of variability in drug response due to heritage. More recently, with the fashion for adding the suffix 'omics' to areas of research, the term 'pharmacogenomics' has been introduced and became popular. While the former term is largely used in relation to genes determining drug metabolism, the latter concept is broader based term that encompasses all genome that may determine drug response. The distinction, however, is arbitrary and both terms can be used interchangeably [3].

In the context of Bio&Med Search, the concept *pharmacogenetics* will be used as part of the emerging field of precision and personalised medicine. Health and healthcare are evolving and shifting from the traditional "one size fits all" approach to medicine providing a more individualized plan that will give each patient the best possible chance in the fight against disease with the help of more accurately designed and effective medications [1] [4].

According to this, Bio&Med Search can be a useful tool for health professionals to advice the best solution to each patient, applying individualized medical's prescription instead of traditional medicine.

1.2. Health problems and pharmacogenomics

According to some studies and research, adverse drug reactions are a public health problem causing a significant number of hospitalizations, increased length of hospital stay or even contribute to mortality, with a prevalence of 1.5% to 15% and 0.4% to 2% of these cases are very serious [3]. Destenaves and Thomas describe that 30% of schizophrenic patients do not respond to standard antipsychotic treatment and that interferon- β is only effective in one third of cases of multiple sclerosis [5]. Due to these and other case study of variations, the pharmaceutical industry is forced to withdraw 4% of the drugs that are released on the market after some time of sale to the public, due to unexpected adverse drug reactions (ADR), a disastrous situation for the industry responsible [6]. According to Allen Roses, the

percentage of anomalous responses may range from 25%, for example, when antitumor chemotherapeutic agents are being used and 90% in the case of analgesics such as aspirin [7].

It is known that knowledge of the genetic profile of the patient may have a positive predictive value for toxicity or adverse reactions, providing benefits to the clinician in the selection of drug or drug dose, minimizing complications in the patient, thus reducing the number of patients cases of adverse drug reactions [8]. This way, pharmacogenetics helps on healthcare practice.

1.3. Motivation for the platform

Sometimes untoward reactions to drugs can be the cause of disorders or even mortality. The potential of this web platform with connection to pharmacogenetics' data is the support to personalized medicine based on the patient's disease, genetic characteristics and his reaction to chemical composition of drugs.

Once there are several databases and data to relate, sometimes, for the ones who recommend and prescribe medicines, it can be time consuming to get reliable information. So, our goal is to collect as many sources as possible of diseases, genes, variants, drugs, chemicals, literature, and transform the data into information, in a single platform. The proposed platform was designed to be used by health professionals contributing to advice patients in order to have better results in their health with none or minimal side effects. It could be a challenge in medicine.

In the following section we describe que Bio&Med Search platform.

2. Platform project

To accomplish the project of Bio&Med Search web platform development was performed a search to identify the technologies to be used. The development is still ongoing, and this is part of a final degree project with the objective of being used by health professionals, helping to avoid bad consequences of medicines prescription.

2.1. Databases

There are several scientific databases available for academic purposes, as well as a lot of information associated with them (Table 1). Our challenge is to filter the necessary information from databases, relate them and transform data into valuable information. Within this reasoning, we decided to explore the following databases based on the credibility, access and data meaning, in order to develop this project:

Table 1 Databases used for Bio&Med Search platform.

Database name	Description
PharmGKB	Is a pharmacogenomics knowledge resource that encompasses clinical information including clinical guidelines and drug labels, potentially clinically actionable gene-drug associations and genotype-phenotype relationships. PharmGKB collects, curates and disseminates knowledge about the impact of human genetic variation on drug responses [9].
Drug Bank	Is a blended bioinformatics and cheminformatics resource that combines detailed drug (i.e. chemical, pharmacological and pharmaceutical) data with comprehensive drug target (i.e. sequence, structure, and pathway) information [10].
NCBI- National Center for Biotechnology Information	Is one of the world's premier Websites for biomedical and bioinformatics research. Based within the National Library of Medicine at the National Institutes of Health, USA, the NCBI hosts many databases used by biomedical and research professionals [11].

The only database that was possible to download and use in this project was PharmGKB's database due to access control and format file issues. From PharmGBK's database were selected tables with correlation to disease, genes, genetic, variants and chemicals. For example, from the "Genes" table it is possible to identify the Name, Symbol, Alternate Names, between others, and relate it to other tables, such as, Variants and Clinical Variations.

2.2. Technologies used

In order to develop Bio&Med Search web platform, it was used Laravel and Vue Framework as well as SQL language.

Laravel is a powerful framework with many packages and resources to easily structure and create web pages. On the other hand, Vue is an open community JavaScript framework which has many custom components to develop the frontend of the website. With this large data sources and in order to transform data into information we are using SQL queries to extract data and cross in tables.

2.3. Logotype and Platform prototypes

The first step was the definition of the name, description and design of the logotype (Figure 1). Among several models, it was chosen for the designation for the platform the model represented in Figure 2.

At this moment, it is possible to consult all the Drugs, Chemicals, Variants and Genes contained on the Database, search for the name or ID of each one and view the details of the selected item.



Figure 1 –Web platform logotype.

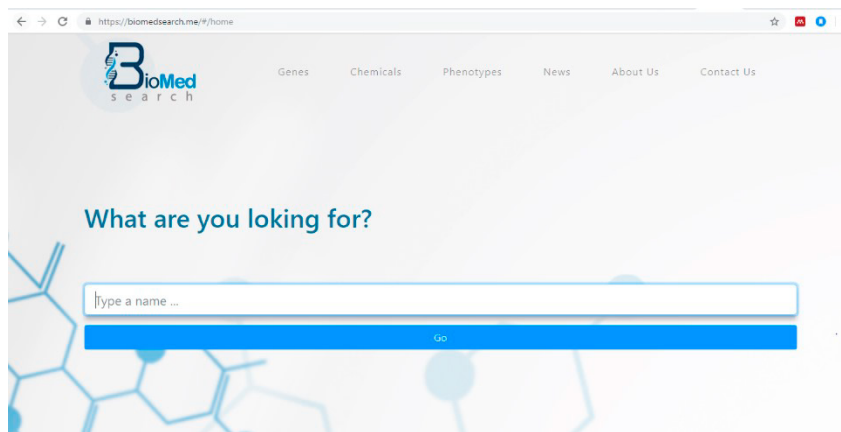


Figure 2 - Bio&Med Search platform.

The platform has a heading with the logotype and menu, followed by the search section and description. It will present the updated numbers of data available in the platform and corresponding sources. There will be a feed of recent news in the research area and, in the footer, the platform developers' information.

2.4. Description of Bio&Med Search

This web platform has an auto-complete functionality on the main page as you can see on the Figure 3. It allows the user to start inserting characters in the search bar by a word, and the searching line will auto-complete with suggestions.

After select an option from the auto-complete search bar, the user will be redirected to the details of the selected item. The user can also access only a Chemicals/Phenotypes/Genes data and filter the results immediately as you can see in the Figure 4. Each page presents information columns and an action column allowing actions to see details.

It is also available a News tab where the user can search for recent news related with pharmacogenetics concept or with any other word inserted by the user. In case of questions or suggestions the user can also contact the development team on the form contact page.

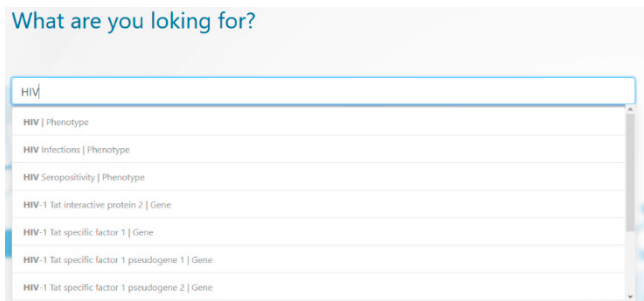


Figure 3 – Autocomplete functionality on the main page

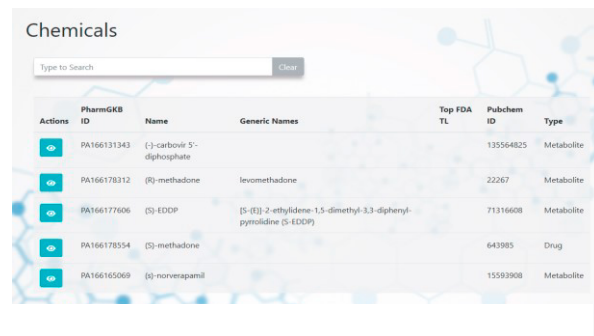


Figure 4 – Chemicals page

3. Platform Assessment Tests

The Bio&Med Search platform have been tested for accessibility, usability, certificate (SSL) in order to ensure quality and user satisfaction.

3.1. Accessibility Tests

Accessibility tests can be configured as a rigorous set of data applied to a web page or mobile application to determine whether or not they are used by persons with any limitations or disabilities. These were carried out through the online platform <http://www.acessibilidade.gov.pt>, in the ACCESS Unit of FCT - Foundation for Science and Technology, IP. It can thus be concluded that the classification index of our site is good, but it is not more difficult to access with the same physical limitations.

3.2. Usability Testing

In order to test the usability of this platform in real context, it was decided to create a form with questions to direct to potential users with area of formation related with Health.

This file was planted with a stack on Google forms and is divided into two parts, one for the platform characterization and the second part with a personal characterization: set of closed questions. The issues related to the platform are to validate the present Case Study with relevance to the user, thus being the questions addressed to the Genes, Chemicals, Phenotypes and finally News.

The form was answered by 20 users, 52.6% of whom are between 25 and 35 years of age, and of diverse professional / study areas: Health, Linguistics, Engineering, Management; administration and art.

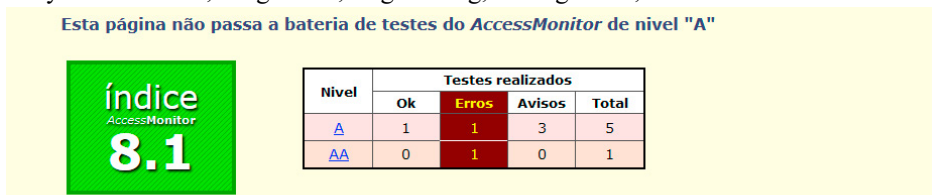


Figure 5 – Bio&Med Search platform accessibility assessment.

Analyzing the results, it can be concluded that half the users who tested the platform accessed the platform using computer (50%), while the rest used the Android smartphone (40%) and the smartphone iOS (10%). Access to the platform was achieved by 95% of users. With this we can conclude that the responsiveness of this platform is an important characteristic, since half of the users used a mobile phone to access the platform and they did it successfully. It can also be said that this platform is responsive, since the platform can be used successfully in all browsers Chrome (70%), followed by Firefox (15%), Safari (10%) and Microsoft Explorer (5%).

Access to the pages of each category had an average success rate of 82.4%. And the filter option in each of them was well achieved by 73.7% of users.

The last question of the questionnaire required the suggestion of possible improvements in the platform that were taken into account. Most users reported that there is a long waiting time to load the data and they do not have request status information. In this way, we added a spinner to each table that is hidden each time it is fully populated.

Finally, it is concluded that the Bio&Med Search platform was successful in the usability tests taking into account the usability tests.

3.3. Certificate Testing (SSL)

The SSL configuration assessment represents a set of protocol and cryptographic tests and handshake simulation, in order to evaluate if the site is safe for the exchange of data between the client and the server, thus creating a signal of confidence to the user. These tests were done through <https://www.ssllabs.com/ssltest>.

We can thus conclude that the Bio&Med Search platform has been certified with an "A" level of classification, it is a classification that generates confidence to the user by protecting their data.

4. Conclusion and future work

In this paper we describe the Bio&Med Search platform. Pharmacogenetics is a promising field of study and in this perspective, the Bio&Med Search is an innovation which is in an initial state of development and available since the beginning for testing purposes on <https://biomedsearch.me>. Currently Bio&Med Search can show information contained in tables and cross references. It was also tested the platform with a case of study about HIV (Human Immunodeficiency Virus) to validate the website functionalities. Other tests such as accessibility resulted an 8.1 score and for SSL configuration assessment, the Bio&Med Search got an "A" classification.

In the near future Bio&Med Search will be improved in several levels such as an upgrade of search functionalities, reducing the response time, importing new Databases sources and adjust the platform for a better user experience. Now, with Bio&Med Search, we can search, compare chemicals, genes and phenotypes and relate each other in order to make better decisions about medical prescription.

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