1 THEORETICAL PART

* 1. Introduction

Today, in the field of pharmaceutical and medical services, there is a lot of scientific and economic data for the general presentation of these areas. Since the project solves the problems of these areas, various solutions and analysis of already existing problems must be translated in order for the project to be able to meet the requirements of public and market demand. And also, the need to analyze already existing software solutions in order to obtain the necessary information about the existing order of things that have developed in the development of projects with a similar or similar topic. However, it is possible to create new solutions, which can increase the demand for the project and add some uniqueness to it over other solutions. Following these criteria, the development team compiled an analysis and review of all literature related to the project topic, as well as a comparison of existing software solutions.

* 1. Literature inspection of problem
     1. Introduction

There are many scientific works related to the field of pharmaceuticals and medicine. It contains a lot of data related to problems in society, as well as examples of how to solve these problems. Therefore, applying these scientific works, the development team will have an idea of various problems and the ability to add their own solutions and internalize these solutions to the project.

1.2.2 “FARSAR” review

First is a “FARSAR” study **[n]** in Russian cities. This study examines the problem and prevalence of self-medication among various age groups of the adult population in Russian cities and their attitude to self-medication. The study was conducted in the form of a survey of the population of cities.

Self-medication is spreading in modern society due to the dissemination of information via the Internet and the media. Self-medication in case of simple situations like headache, heartburn or heartburn may be warranted. But in the case of clinical symptoms and chronic diseases, it can be uncontrolled, inappropriate use of drugs and neglect or incorrect treatment can lead to major health problems. However, self-medication all plays an important role in health care because as knowledge increases in the population, it becomes a necessity in some cases.

In result, 3798 respondents were interviewed, among whom women predominated - 65.8%. 35.9% of respondents were under the age of 25, 37.9% - 25-55 years old and 26.2% - over 55 years old. Self-medication rates averaged 63.1%, and of these, 2/3 were partially or completely successful. OTC drugs use was 62.1%, non-steroidal anti-inflammatory drugs were 34.2% and herbal remedies were 24.9%. Gastrointestinal problems were common reasons for self-medication was tract, headache, preventive taking drugs, acute respiratory viral infections and pains of various localization. The majority of respondents studied information about drugs independently, using sources such as the Internet and the media, and the percentage of people who took into account the advice and recommendations of doctors is 0.8%.

This indicates that self-medication is common in the population of Russia and also possibly in the population of most CIS countries. Therefore, in order to lessen the harmful effects of self-medication in population, the project tries to provide the most truthful information that is available in the public.

1.2.3 “Analysis of Drug Name Confusion in Medicine Labels” review

Second is a study “Analysis of Drug Name Confusion in Medicine Labels” **[n]** done by Vincent Huff and Dan Nathan-Roberts from San Jose State University, California, USA.

Purpose of the research is to study the problem of labeling and names due to confusion and misunderstanding in some names and also the problems of the human errors that increase the misunderstanding as well as possible methods and solutions to this problem.

According to statistics by the Institute of Medical Health in 2000 reported that at minimum 44,000 to upwards of 98,000 Americans die each year in hospitals from medical errors each year. The widespread use of prescription drugs in the United States has grown from people using one or more drugs to using five or more drugs. In 2010 about 2.6 billion drugs prescribed in the US and it will only increase. In 2001 the Joint Commission on Accreditation of Healthcare Organizations estimated that 10,000 patients were suffered each year due to drug label name confusion.

This is one of the reason why it is necessary to increase the fight against human errors and pay special attention to this on the part of health care. For instance, if a person uses 2 or more drugs and one of them is not correctly prescribed, then this can lead to health complications or even death. Usually people do not pay attention to which prescribed drugs they are using. Because of this, many patients do not know how to handle situations when an error occurs. Healthcare professionals do not have appropriate protocols to prevent and inform patients about an error that can lead to death. There are many ways these errors appear. For example, it may be a misspelled drug name or the name was written in a very incomprehensible handwriting. Furthermore, different medicines may have the same name, which may lead to the fact that the patient, instead of taking painkillers, takes psychotropic drugs. The error mitigation must be a priority for healthcare. Reducing the number and impact of errors can save both industry money and patient health.

On December 5, 2014 a 65-year-old woman named Loretta Macpherson passed away due to the fact that she confused the names of the drugs. She underwent brain surgery and was prescribed the wrong medication by the hospital staff. Instead of Zarotin which is an anticonvulsant medication, she took Zemuron which is a paralyzing muscle relaxant, which led to the mixed up of drugs. This is a good example of how a small misspelling of a drug can be fatal. Because of this, the hospital suffered losses in money and her family members also lost her. This problem did not arise simply because one person made a mistake in choosing two drugs. The main reason is that the current hospital system allows this to happen.

As noted above, drug naming problems are a very dangerous thing, as they can lead to fatal outcomes. However, it is possible to mitigate this problem. From the research, the development team decided to pick up the idea that the name is very important not to be confused. Therefore, the project will rely on the accuracy of the spelling of the names of drugs and also enables the medical staff from hospitals to use our site as links to certain drugs in order to reduce the possible occurrence of errors in the spelling of drugs and, if possible, show additional information about the drug to the patient.

1.2.4 “Health information behavior of rare disease patients: seeking, finding and sharing health information” review

Third is a study “Health information behavior of rare disease patients: seeking, finding and sharing health information” **[n]** by Snjezana Stanarevic Katavic from Croatia, University of Osijek.

The aim of study is to describe distinctive aspects of health information behavior of rare disease patients and specific challenges they face when seeking health information. The methods of study is conducting semi-structured interviews among fifteen respondents that suffering from three different rare diseases.

The prevalence of information technology has made health information and drugs more accessible. However, there are groups of people with rare diseases who find it difficult to find information about their diseases and the drugs for them. Rare diseases are diseases where the number of patients does not exceed 5 patients out of 10,000 in Europe and 5% of patients out of 6,250 in the United States.

Lack of medical knowledge is a common problem. However, patients with rare diseases are more likely to seek and value non-medical advice used in everyday life. Patients need an independent search for medical information, as the information received from medical staff was often insufficient. Patients in search of the necessary information faced the difficulty of the search for more accurate and useful information. Pauer et al. found that the quality of information on rare drugs on the internet is rather poor. However, the support groups had very valuable information. Rare disease information retrieval analysis is showing increasing interest in clinical research and people want to supplement and exchange information with healthcare providers to make it easier for patients to search.

The study results revealed a lot of things about finding information about rare diseases.

First, the highest search intensity was after getting the diagnosis.

Second, the problem is to find more specific information related to the disease, since most of the information was generalized and scarce in detail. Lack of information about the condition of the disease in everyday life.

Third, the ability to find new information is not easy, since possible sources containing information can be found in specialized medical sources to which ordinary people do not have access. There is also the problem of finding information in Croatian.

Last, difficulty in finding drugs and lack of information from doctors. Moreover, much of the information was not available in Croatian and there was no description of side effects and drug interactions.

To sum up, this information from the study was useful in order to clarify the situation with people suffering from rare diseases and the problem of finding information about diseases and drugs. Moreover, it shows the problem of inaccessibility of information on the example of the Croatian language, thus the team would like to provide all kinds of information in different languages, such as Kazakh, Russian, and English for a complete understanding in Kazakhstan.

1.2.5 “The use of internet and social media for drug information services in pharmacies in Yogyakarta province: a study if Asthma care” review

Fourth is a study “The use of internet and social media for drug information services” done by Fajar Ira Juwita, Aris Widayati and Enade Perdana Istyastono from Universitas Sanata Dharma, Yogyakarta, Indonesia.

The aim of the study is to investigate pharmacists' perceptions of using the internet to provide drug information services and deliver these services to asthma patients. The research method was interviews with confirmed professional judgment.

ICT use has risen rapidly. The development of ICT has led to the emergence of e-health, which is also rapidly developing. Furthermore, this affected pharmaceutics where ICT is mainly used in the procurement and storage of drugs and this is called e-pharmacy. Therefore ICT can improve patient adherence to the correct regimen. For example, Canada used social media to connect patients with each other with the help of a healthcare professional as a guide.

For people with chronic conditions, the internet can improve their quality of life. People with chronic illnesses require special attention and treatment, they generally take more than two drugs during long-term treatment. Therefore, the Internet can be used to monitor the use of medicines by patients. Asthma is an increasing chronic disease in Indonesia, but the use of ICT in the treatment of the disease has been rare.

As a result of the interview, many themes emerged.

First theme, the capabilities of pharmaceuticals using the Internet to maintain services. All respondents answered that they use social networks, especially WhatsApp, Instagram and Facebook communicate with patients. In addition, they also use them to find and improve knowledge by finding specific information from other pharmaceuticals in other countries.

Second theme difficult in transformation of roles of pharmacists in e-pharmacy. Some respondents say that patients are more likely to search for information on the Internet than to turn to professional pharmaceuticals, however, they consider this a disadvantage, since information on the Internet can be unreliable and can also lead to big delusions. Moreover, they noted that the pharmacist is obliged to ensure that information on the Internet must be accurate and up-to-date.

Third topic is the relevance of regulation in e-pharmacy. The majority of respondents stated that online pharmacies sell not only over-the-counter drugs, but also prescription drugs, which is an example of the lack of supervision of authorized persons to control drug sales. And the fact that the regulation of such pharmacies is a necessity.

Fourth theme is related to ICT improvement. The respondents who worked at the Primary Health Center said that the main obstacles to the introduction of ICT and the Internet are unstable Internet connections and suboptimal work of services. Additionally, many rural areas are not connected to the internet.

Fifth theme about contribution of pharmacist in on people’s e-health literacy. The respondents argue that pharmacists can increase the literacy of people using the internet and social media. They expect that by using the Internet, the patient will become easier to treat and increase knowledge about drugs.

To conclude, this study allowed the team to look at the situation of the prevalence of ICT in other countries as well as the problems and possible benefits of Internet interconnection for pharmacists and their patients. The team believes that the project can partially provide information for patients and pharmaceuticals who need drugs, especially for people with chronic diseases. In addition, this work pushed the team to implement a system into the project that will show the location of drugs in local pharmacies, which will help increase user satisfaction.

1.2.6 “How Do Patients Expect Apps to Provide Drug Information?” review

Fifth is a study “How Do Patients Expect Apps to Provide Drug Information?” done by Anton Grube, Tobias Dehling, Ali Sunyaev from University of Kassel, Germany.

Patients seek information about drugs from a variety of sources. And one of them is mobile apps. When using mobile applications, patients experience a lack of functionality that is more useful than that provided by healthcare professionals.

This study identified 33 features that patients expect to see in mobile apps. Patients are more interested in personalizing the information provided by applications. The current situation in health information systems shows an attachment to big data. The generalization of patients' personal information leads to a decrease in the display of the personal needs of patients. However, healthcare is shifting more towards personalization and patient-centeredness rather than generalization of all information. Patients' lack of adherence to treatment results in increased treatment rates, increased disease rates and poor treatment outcomes. Patients may refuse or forget to take medications altogether. To prevent this, actively remind the patient of the medication regimen and provide more information about the medication. This is critical to the success of the treatment.

The development of mobile technologies is increasing the personalization of information for patients. The availability of information has led to a decrease in non-adherence to medication. For example, this information can be transmitted both through databases and by text messages or reminders. But at the same time, application requirements are based on the expectations of healthcare professionals. Therefore, it affects developers who develop applications based on these requirements. But this leads to the fact that patients are not satisfied with the information that mobile applications provide them with, as well as the presence of unnecessary functionality.

As a result, the research has brought out 33 features that can help increase usability for patients and also show developers what functionality should be in their applications. These functions are divided into four groups: information provision features, graphical user interface features, search and sort features and features providing additional functionality:

1. Check drugs for adverse drug reactions;
2. Well-arranged presentation of drug information;
3. Search drugs by name;
4. Display dosage information based on other factors than age;
5. Simple user interface design;
6. Provide information whether a drug unit can be split;
7. Display dosage information for a drug in different units;
8. Compare two or more drugs;
9. Search drugs by application area/medical condition;
10. Provide information on drugs which may be taken to alleviate side effects;
11. Provide information on how to enhance the effect of a taken drug;
12. Filter and search for side-effects;
13. Provide information if a drug can be dissolved in a fluid;
14. Filter search results by users' personal characteristics;
15. Provide the possibility to store drugs users are taking;
16. Provide a tutorial on how to use the application;
17. Provide information how a drug acts in your body;
18. Provide the ability to store users' personal information;
19. Search drugs by active ingredient;
20. Allow users to comment on their experiences with a drug;
21. Provide additional information for the technical terms or abbreviations;
22. Provide functionality to identify drugs;
23. Provide information on follow-up drugs;
24. Provide functionality to print out selected information;
25. List all other drugs with same active ingredient as currently displayed drugs;
26. Search drugs by a unique local identifier;
27. Filter for requirement of prescription;
28. List all other drugs for the same application area/medical condition as currently displayed drugs;
29. Integrate images/pictograms to illustrate drug information;
30. Search drugs by company/manufacturer;
31. Provide image of drug package;
32. Provide information on homespun remedies;
33. Customizable user interface.

The first five functions are essential, as without them it is impossible to create an adequate application for patients. The sixth to twenty-seventh functions are functions that patients would like to have as they increase the usability and personalization of information. And functions from twenty-eighth to thirty-third are convenient features that would be nice to have in an application, but still they are not so important to most users.

To sum up, this research is very useful information for developers who are developing applications related to information about the drugs. This will make it possible to make a more user-oriented web application, which will undoubtedly increase its need and demand. The development team will rely on this information to provide specifications for the project being developed.

1.2.7 Conclusion

In conclusion, most of the information from these scientific papers and studies has proven useful to the development team. Moreover, it has determined the direction in which web applications will be developed, as well as determine which functions will be in demand for users.

1.3 Market analysis

After analyzing various literature and scientific papers on the chosen topic and the problems around it, was conducted an analysis of the market and already developed solutions for a topic similar to the project.

Following the research "MAIN TENDENCIES OF THE GLOBAL PHARMACEUTICAL MARKET" **[n]**, the pharmaceutical market is a dynamic and fast developing market, especially in developing countries. This is due to the rapid increase in the range of different drugs. Between 2013 and 2017, the market volume increased by 2-6% every year. The chart below shows the market size for each inhabited continent and Japan.

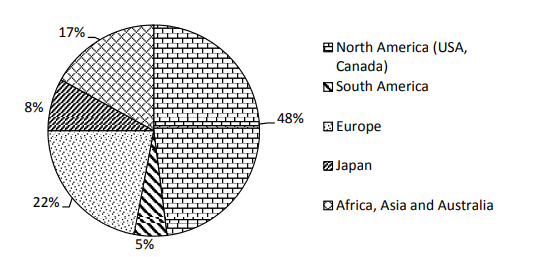


Figure 1.1 Drug sales in the World Pharmaceutical Market

As we can see, North America has the largest volume of market is 48%, second is Europe with 22% of market, third is Africa, Asia and Australia together with 17% of market, Japan with 8% and South America with 5% of market. North America is largest because 25 million people in this region suffers from diabetes and 80 million in prediabetes stage. Europe is second due to the spreading of infections in 28 countries, with 76% of local transmission of infection.

The main threat in the pharmaceutical market is the expiration of many patented drugs and can lead to a so-called "patent cliff", which means that patented drugs with large market sales after patent expiration can drastically reduce overall market profits.

As noted above, we can see that pharmaceutical market has a large volume, especially in North America and Europe, which makes it an important market for modern society and the need for it will remain for a long time.

1.4 Analysis and comparison of existing software solutions

MedElement is a project aimed at improving the quality of medical services for the population through various online services. The project includes a reference dictionary of drugs by which we will evaluate it.

Functionality. When visiting the directory, we see the main page on which there is an input field for searching for a medicine by name, as well as a filter by one parameter, which includes four options. Also on the same page, there is a tab ATX classification, which contains the Anatomical-therapeutic-chemical classification by application such as cardiovascular system, dermatology, etc. The description of the medicine itself contains all the information about the medicine, as well as the field where you can send stuck files about the medicine to your email.

Availability of information. The information about a medicine contains information that is standard for it, such as Side effects, composition, manufacturer, etc. One useful thing about information accessibility is switching the language from Russian to Kazakh and vice versa. The approximate purchase price per unit of drug is also indicated.

2.2 Vidal [4].

Vidal is a reference guide to drug information for workers in healthcare services. It is a stand-alone dictionary site.

Functionality. This site has a search engine that includes such parameters as name, alphabet, ATX, Nosology index, clinical and pharmacological index, disease, manufacture, pharmacotherapeutic groups. In addition, the site has registration for specialists and login.

Availability of information. Information about a medicine has an advanced form and has such things as the shape of the packaging and the type of pill, the clinical and pharmaceutical group, etc. The site has only Russian language support.

2.3 Drug.com [5].

Drugs.com is a drug dictionary site aimed at providing accurate information about medicines for medical personnel in the United States. It also have a mobile application associated with the site.

Functionality. The site has a very sophisticated search engine for various categories. Search categories are divided into four main ones: by drugs, by side effects, by disease and condition, and by pill.

Drug search has a split search by drug name and alphabetical order.

Pill search has search by parameters as printed number, color and shape of pill.

Side effect search has search by effect name and alphabet order list of side effects.

Disease search has a split search by disease name and alphabetical order.

Site has authentication system where user can register and login to system. User profile has elements as add illness or allergy that is change the filter on searching drug. Furthermore, user profile has reminder of which pill you need to consume and in which time. In addition, site has drug interaction where you can input the drugs and system will show that the drug components will mixed which lead to poisoning.

Availability of information. Drug information has advanced drug description; it has a lot of parameters and regulations. Site only provide English language.

Table 1 Comparison of projects

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Name | Different languages | Searching | Login | User profile | Drug information | Shop | Product in other shops |
| drugs.com | - | +++ | + | +++ | +++ | - | - |
| vidal.ru | - | + | + | - | ++ | - | - |
| MedElement | + | + | + | + | ++ | - | - |

2 SOFTWARE DESIGN PART

2.1 Introduction

1.2 Formation of requirements

In this subsection, we look at main requirements of our project: what is our project is and what functionality is needed to implement during development.

“Online drug dictionary” is a web application that shows information about various drugs from database. Online drug dictionary has main three sections such as:

1. Drug section where user searching and see the details of drugs.
2. Side effects section where user searching and see the details of side effects.
3. Diseases section where user searching and see the details of side effects.

Online drug dictionary functionality list:

1. Drug section:

1. Site has authorization system where user can login and register;
2. User can add in profile his information such as user address, user sickness and allergies;
3. Site has searching engine that capable searching by: drug name in alphabetic order, drug by text in name and description;
4. Searching engine is filter drugs by user allergies and it capable to search some drugs by using its alternative or local names;
5. Drugs details consist titles of drugs, description, side effects, diseases, age and pregnant restrictions, dosage, acceptance restrictions; shows related or familiar drug by drug group, drug disease propose and drug category; shows the presence of drugs in certain shop and shop that second part of web application(online drug store);

2. Side effects section:

1. Site has searching engine that capable searching by: side effect name in alphabetic order, side effect by text in name and description;
2. Side effect details consist title of side effect, description, list of drugs contain this side effect;

3. Diseases section:

1. Site has searching engine that capable searching by: side effect name in alphabetic order, drug by text in name and description.
2. Disease details consist title of side effect, description, list of drugs contain this disease, category, related diseases by category;

Target users:

The target user is people who need information about various medications, those people who can get sick or take drugs for preventive action. Also, project help both experienced doctors and novice specialists in the medical field. After all, it is not possible to keep information about all drugs in your head.

1.3 Risks

Risks are one of the strongest reasons for the failure of many projects. Risks are potential problems that can arise during development, implementation, and use. Risks vary from projecting risks to business risks, but the main ones for us are predictable and unpredictable risks. Predictable risks are risks that we can detect early and we can reduce the likelihood of their occurrence. Unpredictable risks can no longer be detected earlier and therefore they can only be solved during the very appearance.

To highlight many of the risks that may appear during the development of our project, an Excel table was compiled on which the risks, their characteristics and possible solutions were indicated. Each risk has its own level of importance and difficulty of elimination, techniques for mitigation, and whether the risk can be reduced or not.

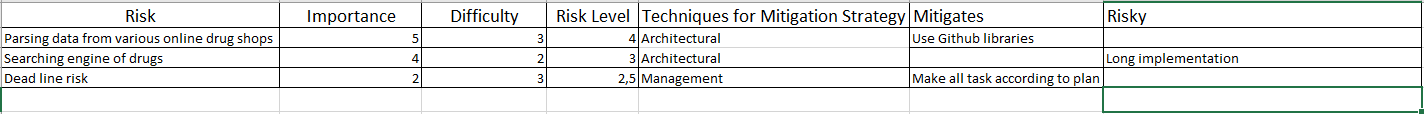


Figure 1.1 Risks analysis

1.4 Choice of software development life cycle

Software development life cycle are business methods and standards used to plan, develop and implement software using various techniques. Usually, the stages of the life cycle are divided into six to eight parts: planning, requirements, design, build, document, test, deploy and maintain. Table below shows the examples of life cycles, and their advantages and disadvantages.

Table 1.1 Life cycle comparisons

|  |  |  |  |
| --- | --- | --- | --- |
| Model | Description | Advantages | Disadvantages |
| Waterfall | A model where all stages of development go one after the other and there is no way to back. | 1. Easy to understand and well documented;  2. Can be easy to planned;  3. Good for small projects. | 1. Hard to go back in last stages. |
| V Model | A model in which each stage has a corresponding testing. | 1. Good for small projects;  2. Good quality control. | 1. Hard to go back in last stages. |
| Iterative | A model in which the development and specification of a program is done in part and supplemented during development. | 1. Create high-level design of application before building the product.  2. Good track of defects. | 1. Good for big projects. |
| Prototype | A model where we create working software with limited functionality and test with the end user. | 1. Quick feedback.  2. Good for online systems.  3. Quick implementation of functional software. | 1. Incomplete application may not be used in a full-fledged project. |
| Spiral | Model which similar to waterfall model but has a very high emphasis on risk analysis. | 1. Better risk management. | 1. Complex management.  2. Large documentation. |

According to table 1.1, team of development decided to take waterfall model, because it is good documented which help us to work out the system even before the start of implementation and it will be easy to plan.

1.5 Use case diagram

To show how our users interact with our system and what functionality is available to a certain type of user, we made a use case diagram. The diagram has elements such as actors who are users of the system or third-party systems, ovals represent the use cases of actors and box represents bounds of system and lines from actors to use case represents the relation.

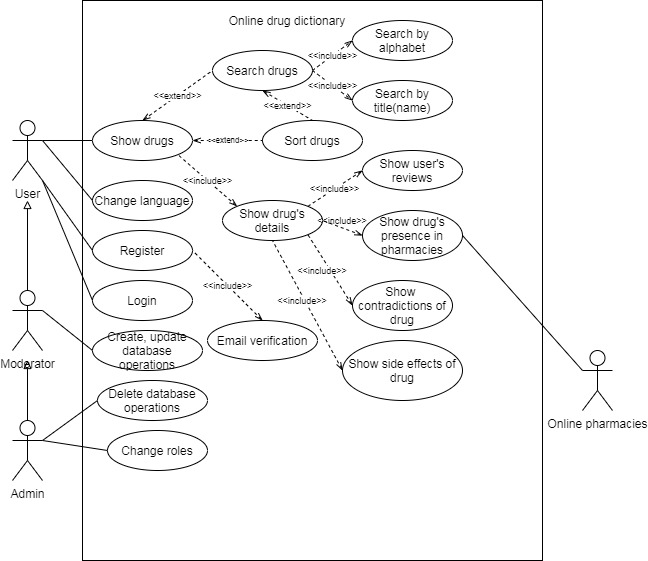


Figure 1.2 Use case diagram

1.6 Calendar plan

In this section, we have created a plan that can still be finalized over time. However, the main criteria and processes for developing our project have already been highlighted at this stage. We made a plan following the SMART concept. S stands for specific which means what goals we need to reach. M stands for measurable, for example, we measure speed of page loading that shows quality of our code. A stands for achievable which means that the goals we need to reach is adequate and we can handle them. R stands for relevant, it needs because tasks in our project should be fully usable in our project. T stands for time-based what considered as starts and deadline time of our tasks. Below is our timetable with marking who will do what work. Our team is made up of software developers, so it is easy for us to assign all team members to the same task.

Figure 1.3 Calendar plan

1.7 Database design

Now, let's take a look at the initial design of the database for the project. Firstly, an entity relationship diagram was developed that shows the relationship between tables. The database has been compiled so that it can support multiple languages, which is one of the requirements for our project.

ER-diagram elements: PK – primary key, FK – foreign key, “Crow feet” – many relation, empty line – one relation.

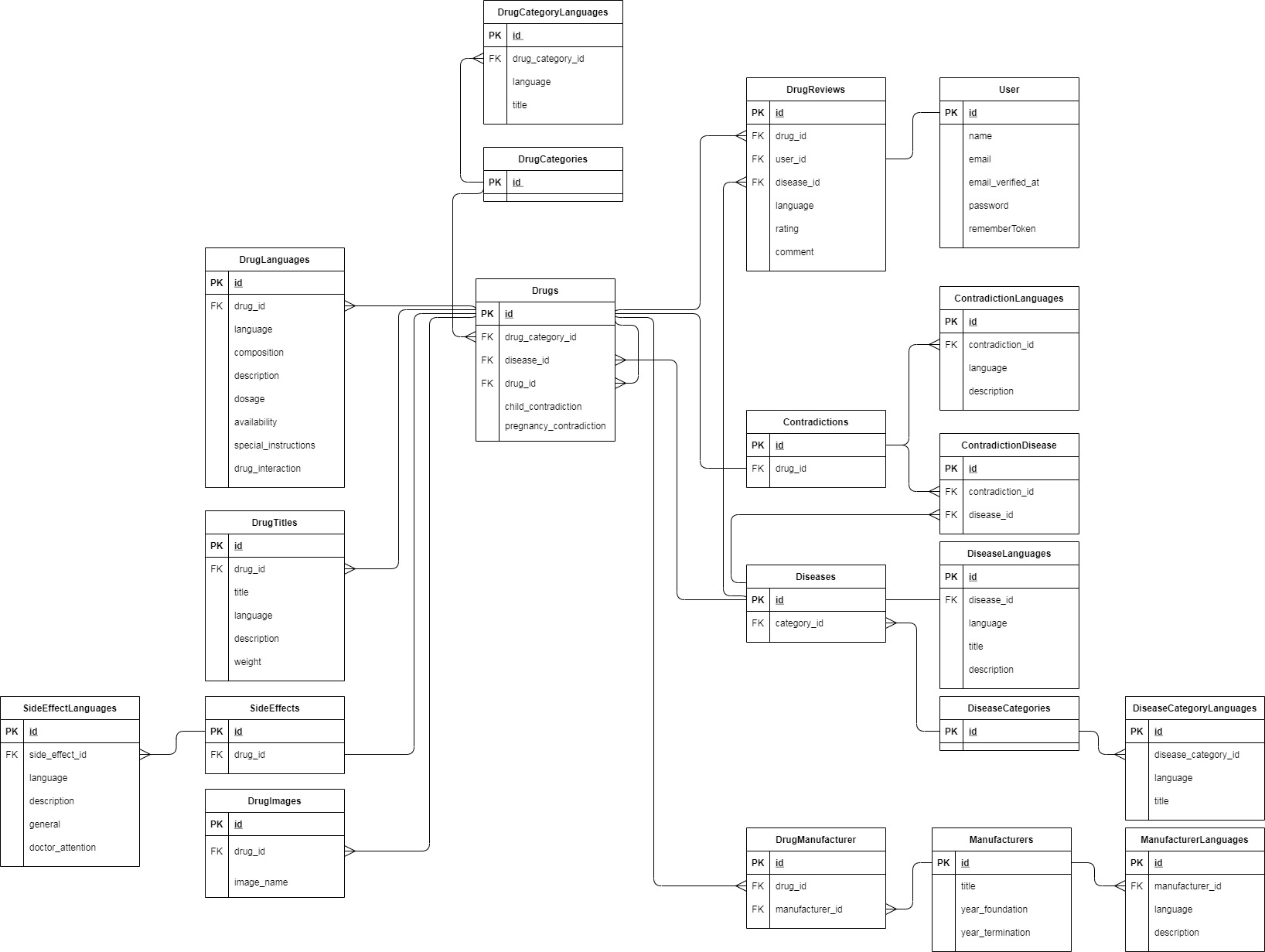


Figure 1.4 ER-diagram.