



## Prototype Design of Web-Based Drug Inventory Prediction Application Using Multiple Linear Regression Methods at the X District Health Office

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<p><b>Track Record Article</b></p> <p>Accepted: 28 December 2023 Revised: 23 January 2024 Published: 15 February 2024</p> <p><b>How to cite :</b> Putro, E. U., &amp; Trihandini, I. (2024). Prototype Design of Web-Based Drug Inventory Prediction Application Using Multiple Linear Regression Methods at the X District Health Office. <i>Contagion : Scientific Periodical of Public Health and Coastal Health</i>, 6(1), 13–24.</p>	<p style="text-align: center;"><b>Abstract</b></p> <p><i>The need for information systems is currently becoming very important, especially in terms of predicting drug needs in health care facilities, one of which is the health department. The availability of drug inventory prediction applications is expected to help health facility management optimize drug inventory levels so that they can use budgets effectively. The research aims to design an application that can meet the needs and facilitate the process of planning drug needs in health care facilities. This research is highly relevant to the aspects of pharmacy management, pharmacy data analysis, and information systems in the field of health, all of which are important topics in the development of effective and efficient health services. The research method used in this study is a qualitative method using the System Development Life Cycle (SDLC) model approach to develop information systems. The information system developed is a web-based information system that adopts a multiple linear regression system and the use of data mining as an algorithm in predicting drug needs. This is so that the allocation of drug provision budgets can be used effectively. The design of a drug data prediction information system using a linear regression method is intended to facilitate the process of planning drug needs that must be met in healthcare facilities. If this application design is implemented, it will help the management of healthcare facilities to optimize the level of drug inventory. This is because there is already a drug needs selection process that is in accordance with the drug needs condition needed by the hospital formation installation. Suggestions for further research can be developed to obtain information quickly about significant changes in drug needs or the potential risk of stockouts.</i></p> <p><b>Keywords:</b> <i>Data Mining, Drug Procurement, Medicine Needs</i></p>
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## INTRODUCTION

Current health development is focused on digital transformation activities that are expected to use integrated information technology for all health services (Nurlita et al., 2023). One of the indicators of the quality of health services in the field of health and pharmacy is drug management, so drug management is very important to support the quality of services. Drug management begins with the selection, contribution, and procurement process (Cholilah et al., 2021).

Data mining is one of the processes in databases that is used to extract important information from large data sets, also known as Knowledge Discovery in Databases (Putri et al., 2022). Data mining is a process that utilizes statistical science, mathematical calculations, artificial intelligence, machine learning that can extract information through various databases. Data mining is often used in predicting future data (R. Hidayat, 2022).

Based on previous research conducted by Dahlia (2020), it can be concluded that the existence of drug need prediction analysis can help Mataram Auxiliary Health Center to control

and make decisions in providing drug stocks in the future. This will help Pustu Mataram in its efforts to improve the quality of services.

Drug demand prediction can be obtained from previous drug data. By using data mining, these data can be processed and used as a basis for predicting drug demand in the future using the linear regression method (Novita et al., 2022). Linear regression is a method of predicting data by using a straight line to represent the relationship between two or more variables. By using linear regression, drug demand can be predicted so that drug demand can be met (Ghebyla, 2019).

The availability of drugs at the location of health care facilities that meet the needs is one of the health facilities needed by the community. In the era of regional autonomy, local governments have the responsibility to regulate the fulfillment of public drugs, including planning and management (Nurmiwiyati, 2020). The Health Office of X Regency often experiences problems with excess drug stocks and drug shortages. This problem is caused by an imbalance between drug procurement and demand. One of the causes is the uncertainty of drug demand at the time of ordering (Safii & Trydillah, 2019).

The impact of these problems can be that the procurement of drugs is less than the stock or even the demand for drugs is greater than the stock, which results in expired drugs because there is no control in the purchase of drugs, in other words, it is not calculated correctly. If the target in drug procurement is not determined properly, it will only waste a lot of time and costs that could be minimized through a calculation system or prediction of needs in the future (Mai et al., 2022). Other research also mentions that the problem of drug management in hospitals is when the drug condition is out of stock so that it has to make purchases quickly, this happens because there is no estimate of the calculation of the number of drugs needed (Wahyudi et al., 2022).

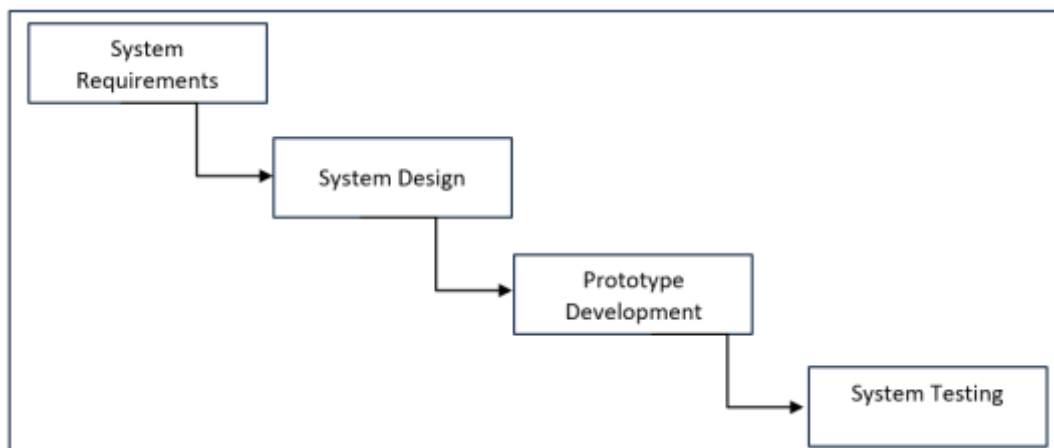
The purpose of this study is to design a prototype application that can predict drug needs using the linear regression method. The benefits of this application are made to estimate the number of drug needs in one period using the consumption method, which means that in the calculation it will use the variables of remaining drug stock, drug usage, and drug needs. The three variables are used as a basis for making predictions using linear regression so that they can generate information on the number of drug needs in the next period.

## **METHODS**

The research type uses a qualitative research design using the System Development Life Cycle method as an approach to develop an application prototype. Data collection was carried

out using observation, literature review, and interviews with relevant parties at the X Regency Health Office. The selection of research subjects was carried out using the purposive sampling method, where the research subjects were people who were selected because of their knowledge and competence. This is because the research subjects are the main informants who can provide information for the development of the application.

The research procedure adopts the stages of the model from the System Development Life Cycle with the Waterfall model approach, as shown in the following flowchart:



*Figure 1. Application Development Stages*

The first stage of system analysis is the initial stage in designing an information system to carry out all system planning and system requirements. At this stage, the researcher conducts a system requirements analysis by collecting relevant data and information to develop the application being built. The analysis of needs is to identify all user needs by identifying business processes and the output design expected by users.

The second stage of system design is carried out with the aim of ensuring smooth operation, overcoming existing problems, and anticipating possible events. The researcher starts to create logical designs, starting with the Data Flow Diagram, Entity Relationship Diagram, Table Relationship Diagram, and data mining.

The third stage of Prototype is a system development method to create a program quickly and gradually for immediate evaluation by users. Prototype development as part of the SDLC software development life cycle and the prototype developed, namely the development of interface design, is considered a very good approach to facilitate the needs between software designers and users (Berhan & Suwarni, 2023).

The fourth stage of system testing is to use black-box testing techniques to test the functionality of the program, such as the application's display, the presence of errors, the

functions available in the application, and the data flow (Hasyim et al., 2020). The use of data mining can improve the accuracy of predictions by finding unknown patterns in collected data. This allows users to find knowledge in database data to identify facts or conclusions based on filtering through data to explore patterns or data anomalies (Zai, 2022).

One of the available data mining approaches is multiple linear regression, which can analyze the relationship between one variable and another variable with the goal of generating an estimate of the average value of the variable that is already known (Rizky et al., 2019). The general equation for multiple linear regression is as follows:

$$Y = a + b_1X_1 + b_2X_2 + \dots + b_nX_n$$

Description:

Y = Dependent variable (response)

X = Independent variable (predictor)

a = Intercept

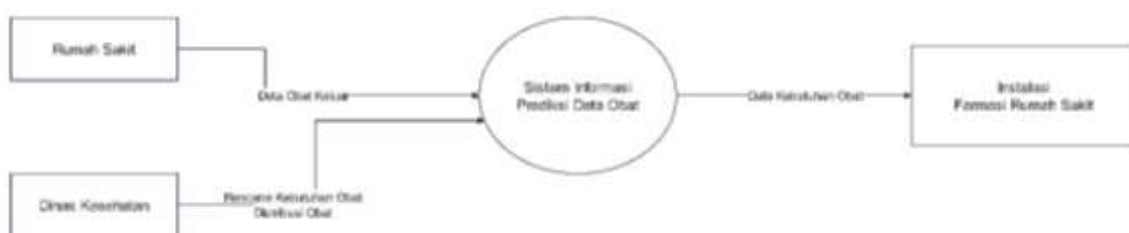
b = Regression coefficient (slope)

## RESULTS

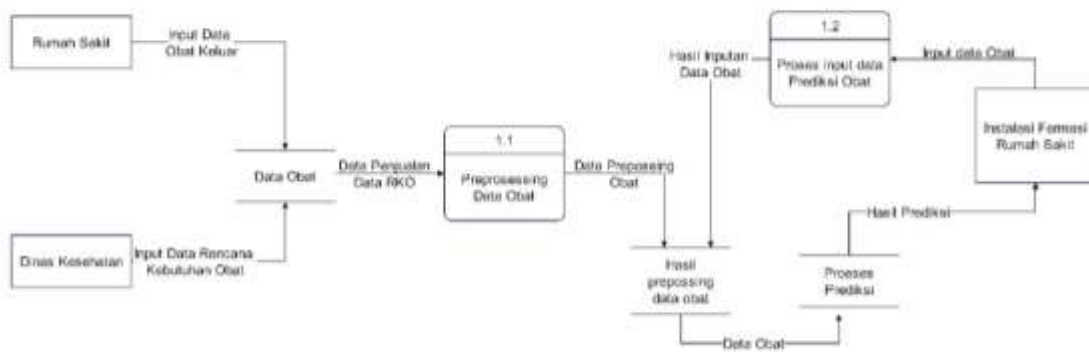
The information system developed is a platform for the implementation of services during the drug procurement process. The system development stages consist of several stages, namely system planning, system analysis, and design, with the following descriptions:

In the system design stage, the framework of the system is prepared, including architectural design, program design, and database design. This structure is made simpler and easier to understand (Wicaksono et al., 2023). The visual representation of the system design can be seen through Data Flow Diagram (DFD), Entity Relationship Diagram (ERD), and Table Relationship Diagram (TRD).

Data Flow Diagram (DFD) is used to present the sources and destinations of data that flow out of the system. It can also be used to depict the processes that are generated in the system.



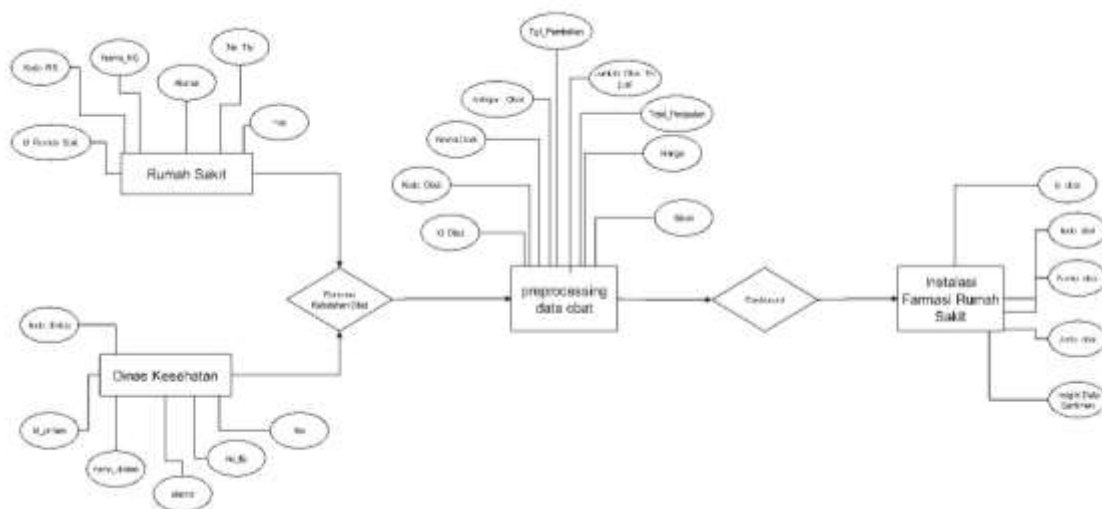
**Figure 2.** Context Diagram (DFD Level 0) of the Drug Data Prediction Information System



**Figure 3.** Data Flow Diagram (DFD) Level 1 of the Drug Data Prediction Information System

Figure 2 provides information about the entities in the Drug Data Prediction Information System. In this system, the source entities are Hospitals and the Health Office, while the destination entity is the Hospital Pharmacy. Figure 3 explains the data flow in the information system, which consists of several processes, namely the process of inputting drug output data, the process of planning drug needs, and the results of drug needs prediction.

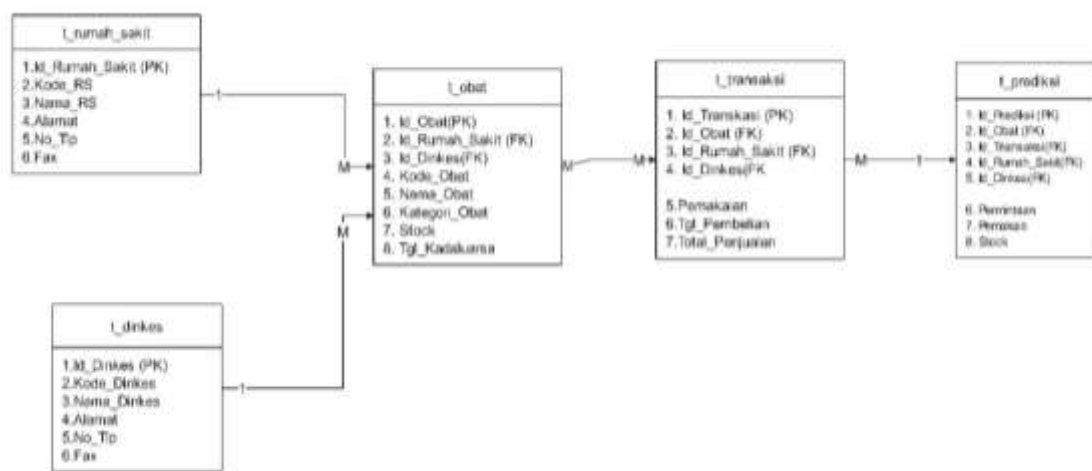
The relationships between entities are depicted in an Entity Relationship Diagram (ERD). It uses symbols or objects that consist of three components: entities, attributes, and relationships. Each symbol is related to each other in a database (Pranatawijaya et al., 2019). ERD relationships show the relationships between two or more entities. There are three types of relationships: one to one, one to many, and many to many (Arie Gunawan, 2023).



**Figure 4.** Entity Relationship Diagram

Figure 4. Provides attribute information for each entity process that occurs in the system. In the entity of hospitals and health offices, there is a one-to-many relationship in the system process. Installation has a one-to-one relationship in the system process.

A relational diagram table is created based on the existing ERD. A relational diagram table shows the relationships between tables in a database visually, as well as the functions that regulate the relationships and operations within the database (I. M. Hidayat & Utomo, 2023). The TRD shows the relationships between tables, namely the primary key table in one table with the foreign key attribute in another table (Trivalni & Eryando, 2023).



**Figure 5.** Table Relationship Diagram (TRD)

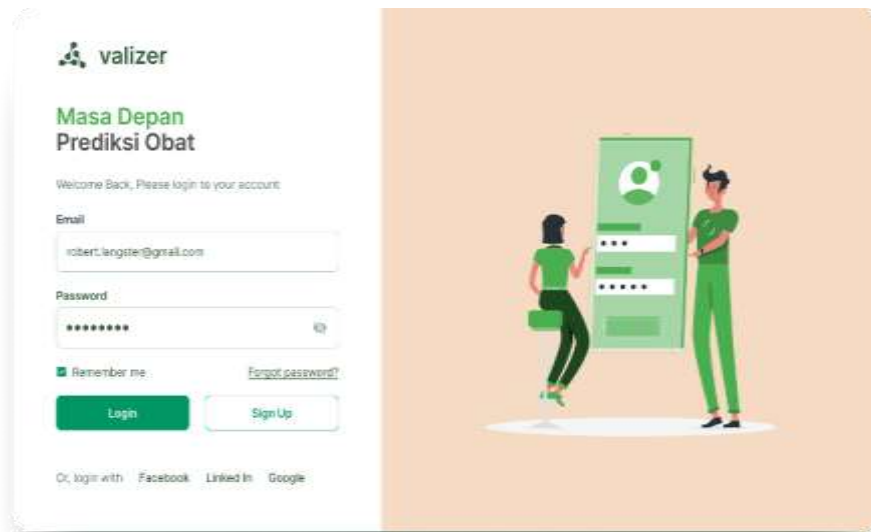
In Figure 5, it explains the relationships between tables in the drug prediction information system database. Some of the databases include hospital tables, health department tables, drug tables, transaction tables, and prediction tables.

## DISCUSSION

In the design phase, system development includes the creation of specifications related to program architecture, interfaces, and supporting elements (Tazkiyah & Arifin, 2022). This design is expressed in the form of wireframes that depict the user interface of the application that will be built within the web page. This can make it easier for users to minimize errors in drug management (Adeo & Muvid, 2023). Drug data processing can be more effective and efficient, resulting in better drug needs planning with a shorter time (Aisah & Suryawati, 2020). Web Application Firewall (WAF) with modsecurity is used in the process of designing web-based security systems. The purpose of implementing this web security system is to understand security concepts on web platforms (Hermawan & Ary, 2020). Interface design involves

determining the structure of the login page, dashboard, and the process of using linear regression methods.

### Login Menu



*Figure 6. Login Menu*

The display in Figure 6 represents the initial interface when users access the application. Each user will log into the system using their respective email and password.

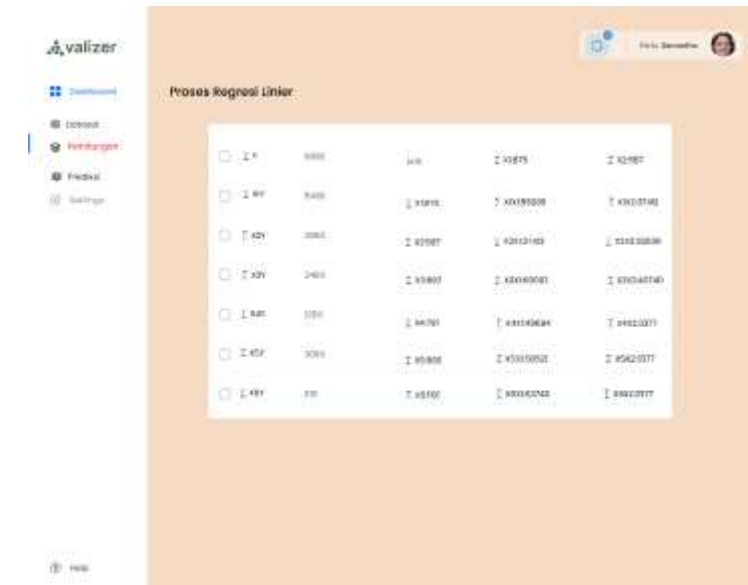
### Dashboard Menu



*Figure 7. Dashboard Menu*

In Figure 7, there is a dashboard view that contains a summary of reports on the needs required by the workforce. These include the total accuracy of drug demand predictions, drug delivery data, and the total predicted costs that are likely to be reduced.

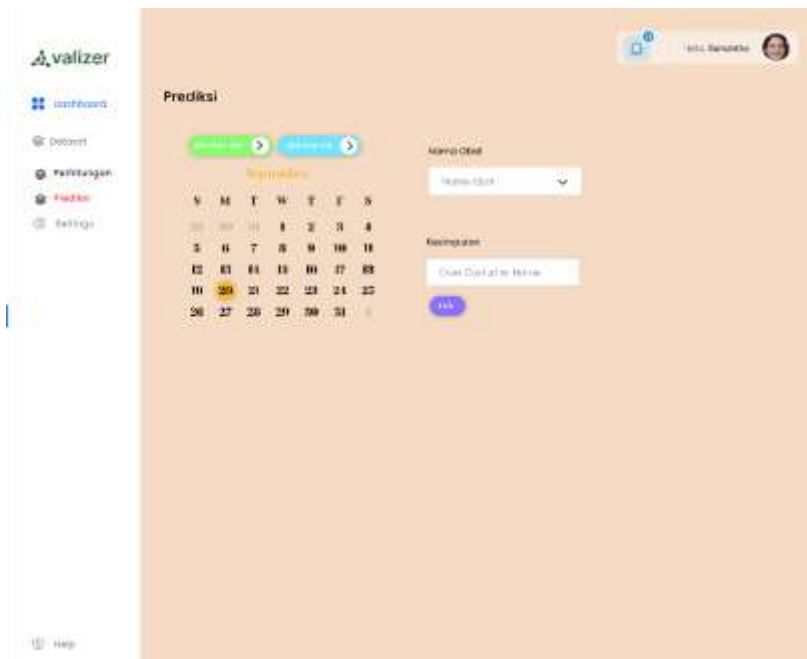
## Calculation Menu



**Figure 8. Calculation Menu**

In Figure 8, this page displays the total number of criteria data that has been previously entered. Additionally, this page has the capability to add, modify, and delete data.

## Prediction Menu



**Figure 9. Prediction Menu**

In Figure 9, this page is a page to display the results of the calculation process and the calculation date. This page also has a function to view the drug needs that will be needed in the future.



Pharmaceutical services in hospitals are an integral part of health care efforts that play an important role in improving the quality of health care for the community. Pharmaceutical services in hospitals must support three functions, namely a center for health-oriented development, and a first-level health service center that includes individual and community health services (*Peraturan Menteri Kesehatan Republik Indonesia Nomor 75 Tahun 2014*, n.d.)

The information system used to record drug sales transactions in a conventional accounting system can make the drug inventory control process less effective, resulting in a slight disruption in the process of predicting the drug inventory that needs to be purchased for the next period (Muttaqin & Srihartini, 2022). This is related to the costs that health facilities, especially primary health care centers (PHCs), must incur in managing drug needs for each planning period. In line with research (Laukati et al., 2022), it was stated that efficient drug management can optimize available funds and ensure the sustainable availability of drugs to meet the health needs of the community seeking treatment at primary health care units.

In addition, the development of the application also helps in optimizing drug availability. The prediction system allows the pharmacy installation to maintain drug stocks at optimal levels by preventing overstocking and shortages. This is supported by research (Eman et al., 2019). on the analysis of drug planning and procurement at the Manado City Sario Health Center, which shows that improper drug planning factors cause drug needs in a health service to be unmet, resulting in shortages or drug waste. This can be seen from research (Agustini et al., 2020) on 88 drug samples, which showed that the drug procurement compliance in October, November, and December 2017 was 56.82%, 54.55%, and 80.68%, respectively.

Therefore, a predictive method approach is needed through a structured process of analyzing the data used. The implementation of a simple linear regression algorithm model can be implemented well, and is able to show new insights for the needs of predicting the condition of drug sales per month in the future for several months. This modeling depends on the drug dispensing data that has been entered in the previous period. In a study conducted by (Baihaqi Wiga M et al., 2019) on the application of simple linear regression to predict the number of patient visits to a hospital based on the type of service and patient age group, it was found that the success rate of the method reached a error value of less than 20%, which indicates an accuracy rate of up to 80%, or could be considered good or very good. This means that the simple linear regression model used to predict the number of patient visits to a hospital is accurate and reliable.

The design process of the drug prediction application is carried out by integrating multiple systems. The purpose of integration is to synchronize data and functions between

various systems. If a system developed with good integration can accelerate decision-making, users can know the amount of needs in each drug needs planning. This will allow hospitals to improve productivity, provide a better experience, and be more adaptable to changes in business needs.

## CONCLUSIONS

The design of a drug data prediction information system using a linear regression method is intended to facilitate the process of planning drug needs that must be met in healthcare facilities. If this application design is implemented, it will help the management of healthcare facilities to optimize the level of drug inventory. This is because there is already a drug needs selection process that is in accordance with the drug needs condition needed by the hospital formation installation. The health office can monitor the budget and avoid budget waste due to expired drugs that have been stored for too long in the drug storage warehouse. Suggestions for further research can be developed to obtain information quickly about significant changes in drug needs or the potential risk of stockouts.

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