**A Tool for Identifying and Analyzing Causes of Readmissions in Internal Medicine Departments at Meir Hospital**

**Project Team:**

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**Project Goal:**

To develop a tool for analyzing and comparing information on hospitalized patients at Meir Hospital and predicting readmissions using neural networks (ML).

**Motivation:**

*Readmissions* are a global problem that hospitals face.

In Israel, 1 in 8 hospitalized patients return for readmission within a month. Readmission to the hospital is a process in which a patient is discharged from the hospital and readmitted within a particular time, which we will define for the project as six months since the previous discharge. Readmission is one of the most expensive treatments in the United States, costing $41.3 billion annually.

**Objectives:**

· synthesize data on hospitalized patients according to the format provided by the hospital, including gender, age, department, length of stay, Etc.

· Development of a program that collects patient data and displays information trends in various graphs according to criteria selected by the user.

· To present the different algorithms for training the model and allow the user to choose the desired algorithm. The available options are Decision trees, K-nearest neighbors, and Logistic regression. We will apply different ML methods to perform classification on readmissions.

· To run a trained model on new data. The user can choose a trained model, load new data, and run the trained model on this data.

· To answer the most important question : whether a certain patient will return to the hospital for readmission.

**Metrics:**

· When there is enough information to train the AI according to the format provided by the hospital - a minimum of 1000 patients.

· It is possible to compare all the criteria by a graph when the number of criteria is limited to 2 for each graph.

· Successful training of a model and saving it according to the user's request.

· When the model can find logical and rational connections according to the type of algorithm chosen.

· Presenting the correlations and conclusions with an explanation and a visual option to see the data on which it is based.

· When the algorithm is able to predict readmissions with at least 80% of success.

**Literature Review:**

Our project deals with data analysis using statistical tools, drawing conclusions, and making hypotheses from the information using a machine learning-based tool.

Our ultimate goal is to provide an ML-based tool that can predict readmissions and focus on risk groups for hospitals.

Using the tool we build, we want to inform the hospital about the probability that a particular patient will return for readmission to an internal medicine department and make hypotheses about the relationship between the different data.

**In Israel:**

According to an article published in November 2022, 1 in 8 hospitalized patients return for readmission within a month. The article reviews a report of the general hospitalization departments over a decade from 2010 to 2020.

One out of eight hospitalized patients (12.5%) returned for readmission, meaning they were discharged from a previous hospitalization within the last month—a decrease from 13.4% in 2019.

Readmissions measure the quality of care in the first hospitalization and may indicate a "miss" in diagnosis, problems with discharge to community clinic follow-up, or trouble in medication administration.

According to the report, in 2020, 1.3 million hospitalizations in Israel lasted for 4.5 million days. More than a quarter of the days of hospitalization (27%) were in the internal medicine departments.

According to an article by the Ministry of Health on the subject of hospitalizations in internal medicine departments in particular, the following data emerges:

**Readmissions: In 2019**, 19% of hospitalizations in internal medicine departments were readmissions within a month and 8% within a week, a relatively stable rate since 2005. The rate increases with age; 23% of hospitalizations of people aged 85+ were readmitted within a month, 21% aged 75-84, 19% aged 55-74, 15% aged 45-54, and 11% aged 15-44. The percentage is higher the longer the length of stay in the baseline hospitalization, 27%-24% for patients who were eight days or more in the baseline hospitalization, compared to 18%-15% for patients who were 2-4 days in the baseline hospitalization.

**Factors Affecting Readmission:**

This section discusses the factors that were found to significantly impact readmission within 30 days, according to a multivariate model that examined the characteristics of hospitalized patients and hospitalization in 2019.

· **Age:** The probability of readmission increases with age.

Patients aged 85 and over have a higher chance of readmission (1.6 times), followed by patients aged 75-84 (1.4 times), 55-74 (1.3 times), and 45-54 (1.2 times) compared to patients aged 15-44.

· **Gender:** Men were found to be 1.06 times more likely to be readmitted than women. This finding suggests that men may be at a higher risk for certain health conditions or complications.

· **Hospitalization in the previous six months:** Increases the chances of readmission by 2.4 times compared to other cases.

· **Urgent admission:** Increases the chances of readmission by 1.9 times compared to elective patients.

· **Length of stay:** The chances of readmission increase with the longer stay in the baseline hospitalization. A stay of 15 days or more increases the chances of readmission by 1.3 within 30 days, a stay of 8-14 days increases the chances by 1.2, and a stay of 2-4 days decreases the chances to 0.8 compared to a stay of 5-7 days in the baseline hospitalization.

· **Day of the week:** Patients discharged on Sunday have a lower chance of readmission (0.94).

· **Month of discharge:** No significant difference was found in monthly readmission rates, except for a 1.07 increase in June compared to May.

· **Hospital size:** Hospitals with 200 or more internal beds have a 1.06 times higher chance of readmission, and hospitals with less than 100 beds have a 1.15 times higher chance of readmission than hospitals with 100-199 beds.

· **Health insurance fund:** Members of Maccabi and Meuhedet have a lower chance (0.9) of readmission than members of Clalit. No significant difference was found for members of Leumit compared to Clalit members.

· **Comorbidities:** Patients with metastatic malignant tumors have a 1.9 times higher chance of readmission, and patients with non-metastatic cancer have a 1.3 times higher chance compared to patients without these diseases.

Patients with liver failure have a 2.2 times higher chance of readmission compared to patients without this disease, and patients with liver disease have a 1.7 times higher odds ratio for readmission. Patients with heart failure or dementia have a 1.4 times higher chance of readmission. Patients with kidney failure or COPD have a 1.3 times higher chance of readmission compared to patients without these diseases. Patients with dementia and diabetic patients with complications have a 1.2 times higher chance of readmission compared to patients without these diseases. Diabetic patients without complications, patients with heart attacks, and patients with peripheral vascular diseases have a 1.1 times higher chance of readmission compared to patients without these diseases.

Considering the direct influence of these diverse factors on readmission rates, they will all be incorporated into the analysis of Meir Hospital's internal medicine departments and the subsequent conclusions drawn.

Specifically, readmissions at Meir Hospital in 2019:

* Fourteen thousand people were hospitalized
* Of those, 14% were hospitalized twice.
* 8% were hospitalized three times.

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**Readmission Rates in the United States:**

The annual cost of readmissions within 30 days is $41.3 billion, with readmission rates ranging from 11.3% to 22.3%.

Readmission is one of the most expensive medical procedures in the US.

The high annual costs indicate inadequate hospital quality and Hinder resources available for other government programs that require attention and erode the industrial competitiveness of the US.

**Preventing Readmissions with Artificial Intelligence:**

The article "Implementation of Artificial Intelligence" discusses a research study on AI tools and how they contribute to hospitals. The tool is designed to reduce readmissions by drawing conclusions about patients, making recommendations to prevent readmission, and focusing on risk groups. The research concludes that the use of artificial intelligence led to a decrease in readmissions.

Hospitals are looking for different strategies to prevent readmissions and try to predict them. One strategy is to identify patients at the highest risk for readmission and focus resources and attention on this risk group.

The article shows that focusing treatment on patients at high risk for readmission can save significant financial costs for hospitals and patients.

Various models are used to predict readmission to the hospital, including:

Logistic regression, Decision trees, and One widely used predictive model is LACE. LACE considers length of stay, comorbidities, and emergency department use to predict 30-day readmission to the hospital.

However, this model has been criticized because it may not apply to specific populations and may provide little added value compared to clinical judgment alone.

Nevertheless, the study results showed a significant decrease in readmission rates from 11.4% to 8.1%.

Many studies have concluded that AI-based models are superior to traditional risk stratification models. **Therefore, our project will use ML algorithms that have proven effective and better suited for this purpose.**

**Competitors:**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| R | MediData | Microsoft BI | Tableau | Polymer | our project | category |
| free | unknown. | 1$-193$ | 75$ | 50$ minimum | free | price |
| none | During installation, there is a representative; after that, it depends on the route. | helpdesk | helpdesk | helpdesk | Telephone assistance | support |
| yes | yes | yes | yes | yes | yes | Displaying statistics |
| no | yes | yes | yes | yes | yes | Use of AI |
| no | yes | no | no | no | yes | Adaptation to the world of medicine |
| no | yes | yes | yes | yes | yes | Generate graphs automatically from the data |
| no | yes | yes | yes | yes | yes | Characterization of relationships between different factors |

**Our Advantage Over Competitors:**

Our main advantage over other competitors is our ability to customize our solution specifically to the needs of Meir Hospital. This includes building functionality and designing the UI according to Meir Hospital's requirements.

We are specifically focused on the healthcare industry, while our competitors in the market are more focused on financial data analysis.

We offer the same services as our competitors but at no cost.

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