# I. INTRODUCTION

1.1. Problem Background

Digitalization of healthcare provides new possibilities to improve healthcare services. A problem that can occur in healthcare is limited physical contact between patients and healthcare providers, which can prolong the diagnosis process. Patients have to rely on healthcare providers, such as primary care physicians, to determine which medical specialty is most suitable to treat their condition. The delayed diagnosis can result in missed opportunities for intervention. Contact between patients and healthcare providers can be hindered due to various situations. For example, during the COVID-19 pandemic, it was harder for patients to meet healthcare providers (Lee et al., 2021). Such situations can also happen to patients who live in remote or impoverished areas. Digital tools, like chatbots, can be utilized to assist healthcare providers and patients.

Various institutions have incorporated chatbots into their system. Companies often use chatbots to improve engagement with their consumers while reducing the cost of customer service (Rossmann et al., 2020). Besides that, chatbots can perform automated tasks, it can handle booking, ordering, or giving recommendations. More importantly, it can run 24 hours a day. This feature can be very useful, especially in the medical field where time is an important factor in saving someone's life.

Healthcare call centers hold an important role as they are often the first to deal with patients. Telephone access in primary care has been associated with patient satisfaction. Griffith et al. (2019) conducted research on the relationship between ASA to patient satisfaction. They found that ASA was inversely associated with the way patients perceive the ability to access urgent care and book appointments on time.

Based on the study by Chuang et al. (2022), call center understaffing prevents optimal telephone access. Other than the limited number of staff, the support calls can also be repetitive. Chatbots can improve access and timeliness to care (Palanica et al., 2019). Clinics or hospitals' call centers can focus more on dealing with urgent cases while the basic queries or FAQs can be handled by the chatbot. The survey by Palanica et al. (2019) also shows that 78% of physicians believe that chatbot is most beneficial for scheduling appointments. By incorporating a chatbot, appointment booking can be done more efficiently and with less possibility for human error. This would also reduce the workload of hospitals' staff as scheduling and managing appointments can be time-consuming work. This way healthcare call centers don't get overwhelmed easily.

In this study, an ANN model was developed to classify medical specialty. This study is part of the AI Chatbot project for Lira Medika Hospital. The current chatbot prototype can be accessed at https://htc.i3l.ac.id/bot. In this prototype, the patient ID can be inserted into the link. For example, the link would be https://htc.i3l.ac.id/bot?patient_id=1638 for patient ID 1638 (Figure 5). The menu consisted of 7 features. These features can be chosen by typing the corresponding number. One of the features of this chatbot is the medical specialty recommendation tool that would suggest medical specialty to patients based on their symptoms and comorbidities. In the chatbot prototype, this feature can be accessed by choosing "Deteksi penyakit anda".
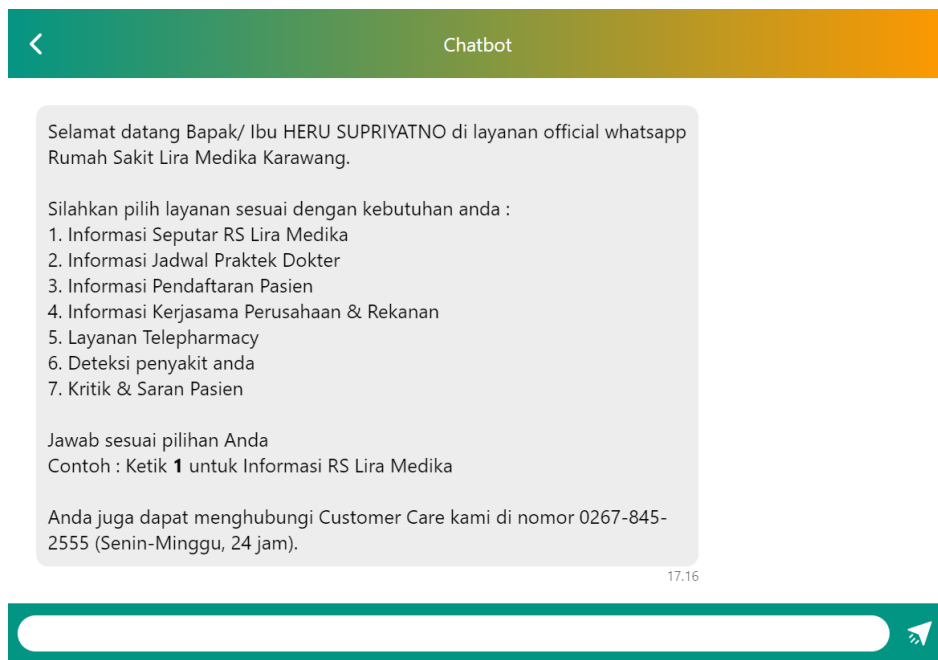
Figure 1. Prototype of the chatbot for Lira Medika hospital, using patient ID 1638.

ANN is one of the most popular AI methods in medical applications (Jiang et al., 2017). It has been applied for studies such as classification, prediction, and diagnosis (Shahid et al., 2019). This method is popular as it can process a large amount of data, is less likely to overlook important information, and reduces diagnosis time (Amato et al., 2013). Ann has been applied to diagnose various diseases such as diabetes, Alzheimer's disease, and heart disease (Lim et al., 2021; Olatubosun et al., 2015; N. Wang et al., 2019). Besides diagnosis, ANN has also been used to help decision-making in healthcare management (Hanafizadeh et al., 2010; Purwanto et al., 2012).

Even though ANN is often applied for large datasets, some studies suggest that ANN can also be suitable for small datasets. In one study, an ANN model was created to predict material defects with 487 data (Feng et al., 2019). There's also the ANN-based dengue predictive model that reaches high accuracy, sensitivity, and specificity, and was trained with

a small dataset (Silitonga et al., 2021). In another study, a model trained with 116 data achieved an accuracy of 82% without signs of overfitting (Olson et al., 2018).

This study focused on one class of ANN, which is MLP—a fully connected feed-forward class that use backpropagation during training. For the development of medical specialty recommendation feature, a small dataset with 111 data points was used to train the model. LOOCV was also conducted to estimate the performance of the model. The performance of the model was assessed using four metrics: confusion matrix, precision, recall, and F1-score.

1.2. Research Objective

- Create a classification model that can be implemented in the chatbot. This MLP model would take the symptoms and comorbidities and give a medical specialty recommendation as the result.

1.3. Scope of research

- Obtain data dan build the dataset for the model
- Develop the MLP model that can classify the data
- Test the performance of the model