

## Project Proposal

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### **Problem Statement**

This project seeks to explore the impact of mergers and acquisitions (M&A) announcements on the stock prices of healthcare industry companies, focusing on how different types of M&A activities—such as smooth acquisitions versus hostile takeovers—affect shareholder confidence and subsequent stock performance. M&A events are pivotal moments for companies, often reflecting strategic growth or consolidation efforts; however, they bring varying levels of market reaction and can significantly alter a company's perceived value and stability. Understanding the market response to M&A announcements can help investors, corporate stakeholders, and analysts better anticipate stock movements and manage risk in healthcare investments.

### **Background**

The healthcare industry is characterized by a high frequency of mergers and acquisitions due to its competitive nature and the pressures of advancing medical technology, rising healthcare costs, and evolving regulatory environments. Stakeholders, including investors, board members, and healthcare consumers, are affected by the financial stability and growth of these companies. M&A activity can yield significant changes in stock prices, offering either lucrative opportunities or risks for investors, depending on the nature of the acquisition. For instance, smooth acquisitions may enhance confidence in a company's stability and growth trajectory, whereas hostile takeovers or leveraged buyouts can cause market hesitancy and lead to negative stock reactions. A better understanding of these market dynamics can aid in more informed investment decisions, especially in a sector as vital and volatile as healthcare.

Improving predictive insights on M&A-related stock performance can benefit both institutional and individual investors, guiding strategies that align with potential gains or risks. However, the ethical implications of M&A in healthcare must also be considered, as not all acquisitions are equally beneficial to stakeholders, especially in cases of hostile takeovers where tensions may arise among employees, management, and shareholders. Ethical concerns also include market transparency and the potential for biases in data, such as over-representation of larger firms or underestimation of M&A events' broader impact on industry dynamics. This study, therefore, aims to contribute meaningful insights into the relationship between M&A events and stock performance, enhancing understanding in a way that respects the complexities and ethical dimensions of healthcare mergers and acquisitions.

### **Introduction to our Data**

Our analysis utilizes stock data from eight leading pharmaceutical companies—Pfizer, Johnson & Johnson, Sanofi, Biogen, Takeda, Novartis, AbbVie, and AstraZeneca—focusing on periods surrounding their recent merger and acquisition (M&A) events. For each company, we gathered daily stock closing prices covering three months before and one month after the initial M&A announcement date. This targeted time frame allows us to examine immediate market reactions, particularly fluctuations in stock value, which may reflect investor sentiment and perceived value generated by each acquisition.

The data was sourced from Yahoo Finance, a widely used platform that provides financial data and market information. Yahoo Finance's stock data is publicly accessible, though recent changes now require a Yahoo Finance Gold subscription to download historical stock data in CSV format. Due to this limitation, we manually collected the data through a custom

web-scraping method, ensuring we obtained accurate stock prices without compromising any privacy or ethical guidelines, as this data is openly available to the public.

While our dataset is both legally and ethically clear, some limitations and potential biases may arise from our choice to concentrate data collection around specific M&A dates. By focusing on a limited window surrounding each acquisition, we intentionally excluded broader market conditions that may influence stock trends over longer periods. This timeframe, however, is relevant for our project's focus on short-term investor responses rather than long-term performance impacts.

Each M&A event involved companies seeking to enhance their portfolios across various medical fields—ranging from Pfizer's expansion into oncology with its acquisition of Seagen to Biogen's venture into rare disease treatments through its purchase of Reata Pharmaceuticals. Given the diverse strategic motivations and areas of focus among these acquisitions, our dataset offers a unique lens to understand how M&A activities in the healthcare sector impact stock performance in the immediate aftermath of these announcements.

### **Data Science Approaches**

To investigate the impact of mergers and acquisitions on stock prices in the healthcare industry, we will utilize a combination of regression and classification techniques. Our primary algorithm will be linear regression, employed to examine the relationship between M&A announcements and stock price changes over time. This approach allows us to assess whether there is a significant change in stock value following the public announcement, as well as to quantify the influence of merger type on price fluctuations.

Additionally, we plan to use multiple regression analysis to incorporate a range of factors, such as market sentiment and specific characteristics of the M&A event (e.g., hostile takeover, smooth acquisition), to identify which factors most significantly drive stock price changes. By including these variables, we aim to improve the accuracy and robustness of our model, offering a more comprehensive view of M&A effects.

Beyond regression, we will implement classification algorithms to categorize M&A events based on anticipated stock performance, such as positive or negative price movements, in response to various M&A characteristics. These classifications will help us determine if specific types of M&A events are predictive of distinct market responses. For example, we might use logistic regression or support vector machines to classify events as likely to lead to positive or negative stock performance, depending on identified features like merger type, industry segment, or market size. Together, these data science techniques will help us test our hypothesis and provide a nuanced analysis of M&A impacts on stock performance in the healthcare sector.

## **Results and Conclusions**

Our analysis of the impact of mergers and acquisitions (M&A) on the stock prices of healthcare companies revealed distinct market reactions based on the nature of the M&A event. In general, stock prices tended to decline following M&A announcements. This trend may be attributed to market perceptions of overpayment, increased debt burdens, or uncertainty about the integration process. These findings highlight the nuanced differences in investor reactions depending on whether the M&A event was a smooth acquisition or a hostile takeover.

Smooth acquisitions demonstrated a relatively minor negative impact on stock prices, as evidenced by a regression coefficient of -0.0035 and an intercept of 0.0983. This suggests that

investors view these transactions as less risky and more strategically beneficial in the long term, likely due to their collaborative nature and smoother integration process. In contrast, hostile takeovers exhibited a more pronounced negative impact, with a regression coefficient of -0.0122 and an intercept of 0.2905. The greater negative reaction to hostile takeovers aligns with the perception of heightened risks, stemming from potential conflicts among stakeholders and challenges in achieving synergy post-acquisition.

When analyzing the combined data, the overall regression coefficients of -0.0078 and -0.0643, with an intercept of 0.2266, indicate that hostile takeovers significantly drive the observed negative trend in stock performance. This stronger negative coefficient for hostile takeovers underscores their disproportionate influence on the aggregated results. These findings emphasize the importance of distinguishing between different types of M&A events when assessing their impact on stock prices. While smooth acquisitions elicit moderate investor responses, hostile takeovers generate greater market volatility and more substantial negative reactions.

Understanding these differences can help investors and corporate stakeholders anticipate market trends and develop strategies to mitigate risks associated with M&A activities.

## **Future Work**

Building on our findings, several avenues for future research could further explore the dynamics of M&A events and their market impacts. One promising direction is to extend the analysis to examine the long-term effects of M&A events on stock performance, spanning several years post-announcement. Such an approach would provide a broader perspective on whether initial reactions persist, stabilize, or reverse over time.

Another potential area of exploration involves comparing the healthcare industry's M&A impacts with those in other sectors, such as technology or finance, to determine whether certain industries exhibit unique patterns in market response. Additionally, integrating qualitative data, such as sentiment analysis of news articles, social media posts, and earnings call transcripts, could enhance our understanding of how public perception influences stock price reactions. Advanced modeling techniques, such as random forests or neural networks, may also be employed to identify nonlinear relationships and improve the predictive accuracy of stock performance following M&A announcements.

Lastly, investigating the broader implications of M&A activities on non-financial outcomes, such as patient care quality and healthcare accessibility, would provide a more comprehensive understanding of their societal impact. Addressing these areas in future research would deepen our understanding of the complex factors driving market reactions to M&A events and aid investors, policymakers, and corporate decision-makers in navigating these critical business activities.