```python
In [14]:  # Silence all exceptions in this notebook
          import sys, os
          sys.path.insert(0, os.path.abspath(os.path.join(os.getcwd(), '..')))
          from IPython.core.interactiveshell import InteractiveShell
          InteractiveShell.showtraceback = lambda *args, **kwargs: None
          # Install and configure Kaleido for static PNG export
          import plotly.io as pio
          pio.kaleido.scope.default_format = 'png'
          pio.renderers.default = 'png'
```

Example 1: Single Stock Analysis

Prompt: How has MRNA's stock performed since their COVID vaccine approval?

```python
In [15]:  # Example 1: Single Stock Analysis
          from AppFiles.script import answer_user_query
          import plotly.io as pio

          try:
              result = answer_user_query("How has Moderna's stock performed since thei
              print(result['text'])
              pio.show(result["chart_figure"])
          except Exception:
              pass
```

```
RAW PROMPT ► "How has Moderna's stock performed since their COVID vaccine ap
proval?"
RAW TICKERS ► 'MRNA'
Extracted 1 ticker(s): ['MRNA']
Extracted Tickers: ['MRNA']
Fetching complete historical data for MRNA
=== Generated Chart Script ===
def generate_chart(historical_data, data_dict):
    import datetime as dt
    import plotly.graph_objects as go
    import pandas as pd

    # Ensure that the historical_data index is in datetime format and has no
timezone info
    if not isinstance(historical_data.index, pd.DatetimeIndex):
        historical_data.index = pd.to_datetime(historical_data.index)
    else:
        historical_data.index = historical_data.index.tz_localize(None)

    # Define the COVID vaccine approval date for Moderna (assumed to be Dece
mber 18, 2020)
    approval_date = dt.datetime(2020, 12, 18)

    # Filter the historical_data from the approval date onward
    filtered_data = historical_data[historical_data.index >= approval_date]

    # Create base figure
    fig = go.Figure()

    # Check if filtered_data is empty
    if filtered_data.empty:
        fig.add_annotation(text="No historical data available since COVID va
ccine approval.",
                           xref="paper", yref="paper", showarrow=False, font
=dict(size=14))
        return fig

    # Add trace for Close prices over time
    fig.add_trace(go.Scatter(
        x=filtered_data.index,
        y=filtered_data["Close"],
        mode="lines+markers",
        name="Close Price",
        line=dict(color="royalblue"),
        marker=dict(size=4)
    ))

    # Add a vertical line indicating the approval date
    fig.add_vline(x=approval_date, line_width=2, line_dash="dash", line_colo
r="red",
                  annotation_text="COVID Vaccine Approval", annotation_posit
ion="top left")

    # Retrieve extra metrics if available
    ticker_info = data_dict.get("ticker_info", {})
    key_metrics = data_dict.get("key_metrics", {})
```

```python
        # Build title information
        company_name = ticker_info.get("Name", "Moderna, Inc.")
        current_price = ticker_info.get("Current Price", None)
        market_cap = ticker_info.get("Market Cap", None)

        metrics_text = ""
        if current_price is not None:
            metrics_text += f"Current Price: ${current_price} "
        if market_cap is not None:
            # Format market cap as billions if large
            try:
                market_cap_val = float(market_cap)
                market_cap_str = f"${market_cap_val/1e9:.2f}B"
            except Exception:
                market_cap_str = market_cap
            metrics_text += f"| Market Cap: {market_cap_str}"

    # Set the figure title
    fig.update_layout(
        title=f"{company_name} (MRNA) Stock Performance Since COVID Vaccine
Approval<br><sup>{metrics_text}</sup>",
        xaxis_title="Date",
        yaxis_title="Close Price (USD)",
        template="plotly_white"
    )

    return fig
=== End Chart Script ===

Normalizing historical_data timezone from America/New_York
Data provided to chart function:
- historical_data: DataFrame ((1614, 7))
- ticker: str (N/A)
- dt: module (N/A)
- datetime: module (N/A)
- ticker_info: dict (167 keys)
- key_metrics: dict (18 keys)
- dividend_history: Series ((0,))
- dividend_df: DataFrame ((0, 0))
- income_statement: DataFrame ((44, 5))
- balance_sheet: DataFrame ((85, 5))
- cash_flow: DataFrame ((61, 5))
- recommendations: DataFrame ((4, 6))
- calendar: dict (7 keys)
- major_holders: DataFrame ((4, 1))
- institutional_holders: DataFrame ((10, 6))
Chart function expects 2 parameters: ['historical_data', 'data_dict']
Error with data dictionary: unsupported operand type(s) for +: 'int' and 'da
tetime.datetime'
Error executing chart script: unsupported operand type(s) for +: 'int' and
'datetime.datetime'
```

Analysis:

Since Moderna's COVID vaccine approval, the stock's journey has been one of dramatic exuberance followed by marked correction and volatility.

• Rapid Rise and Exuberance: At the height of the pandemic, Moderna's COVID vaccine approval acted as a once-in-a-lifetime catalyst. Investor interest pushed the share price from the low double-digits into truly astronomical territory—as evidenced by price moves that, at one point, saw shares climbing toward values near or above $150–$170. (In fact, the data here cites a 52-week high of $170.47, reflecting that peak period's excitement.)

• Significant Correction Post–Peak: With the ebb of the pandemic and a reassessment of near-term revenue drivers, the exuberance faded. The current price of about $24.25 represents a steep decline from those peak levels. Numerically, if one uses the 52-week high of $170.47 as a reference point, the share has declined by roughly 85% from its pandemic zenith. This correction reflects both the challenges of sustaining COVID-vaccine–related revenue in a maturing market and broader reevaluations of growth prospects.

• Ongoing Catalyst–Driven Initiatives: Despite the stark pullback from its COVID-era highs, Moderna is working to redefine its future narrative. Recent catalysts include:
 – A robust R&D Day highlighting progress toward ten product approvals through 2027, along with plans for submitting a next-generation COVID vaccine for approval.
 – Progress in mid-stage clinical trials for an experimental cancer vaccine.
 – Collaborative studies (e.g., with Merck on mRNA–4157) that underscore the company's pivot toward novel applications of mRNA technology.
Analysts' one-year target estimates approaching $47 suggest that, while the stock remains at a long-term discount relative to its pandemic-era highs, market participants see potential value in Moderna's evolving pipeline.

• Volatility and Valuation: The historical price data shows extremely high volatility with recent trading levels oscillating between roughly $24 and $28 over the past five sessions. This indicates that while the market has largely moved away from the fevered COVID-vaccine days, there is still speculation around its future growth prospects. The Beta near 2 further emphasizes that Moderna's stock continues to be sensitive to broader market swings.

In summary, Moderna's stock performance since its COVID vaccine approval has been characterized by an explosive rally—reflecting massive investor optimism—followed by a significant correction as the pandemic's urgency waned. Today's valuation, hovering in the mid–$20s, reflects both the market's recalibration away from the once extraordinary COVID-era highs and cautious optimism, driven by a renewed focus on diversifying its mRNA-based product pipeline.

Sources for Moderna, Inc. (MRNA):
– Moderna R&D Day Highlights Progress and Strategic Priorities
  Sep 12, 2024 ... Focuses on ten product approvals through 2027 Expects to submit next-generation COVID vaccine for approval in 2024 Expects to submit ...
  Link: https://investors.modernatx.com/news/news-details/2024/Moderna-RD-Day-Highlights-Progress-and-Strategic-Priorities/default.aspx

– Page 4 | Moderna Inc Trade Ideas — AQUISEU:0QFD — TradingView
  One of the primary catalysts driving Moderna's stock rally is the initiation of a mid-stage clinical trial for its experimental cancer vaccine targeting ...
  Link: https://www.tradingview.com/symbols/AQUISEU-0QFD/ideas/page-4/?

— Moderna & Merck Announce 3-Year Data For mRNA-4157 (V940) in ...
   Jun 3, 2024 ... At a median planned follow-up of the Phase 2b study at 34.
9 months, mRNA-4157 (V940) in combination with KEYTRUDA reduced the risk o
f ...
   Link: https://investors.modernatx.com/news/news-details/2024/Moderna--Merc
k-Announce-3-Year-Data-For-mRNA-4157-V940-in-Combination-With-KEYTRUDAR-pemb
rolizumab-Demonstrated-Sustained-Improvement-in-Recurrence-Free-Survival--Di
stant-Metastasis-Free-Survival-Versus-KEYTRUDA-in-Patients-With-High-Risk-St
age-IIIIV/default.aspx

— 2024 Ends With Lilly's Landmark GLP-1 Sleep Apnea Approval ...
   Dec 24, 2024 ... ... news on the neuro front. The FDA has accepted the San
Diego-based company's New Drug Application for Ingrezza (valbenazine) oral g
ranules, a new ...
   Link: https://www.biospace.com/biospace-fda-decision-tracker

— Merck and Moderna Initiate INTerpath-002, a Phase 3 Study ...
   Dec 11, 2023 ... A pivotal Phase 3 randomized clinical trial evaluating V9
40 (mRNA-4157), an investigational individualized neoantigen therapy (INT),
in combination with ...
   Link: https://www.merck.com/news/merck-and-moderna-initiate-interpath-002-
a-phase-3-study-evaluating-v940-mrna-4157-in-combination-with-keytruda-pembr
olizumab-for-adjuvant-treatment-of-patients-with-certain-types-of-resect/

```
Traceback (most recent call last):
  File "/Users/vidursaigal/Documents/Documents – Vidur's MacBook Pro/Github
Repos/comm4190_S25_Final_Project_GroupM/AppFiles/script.py", line 521, in ex
ecute_chart_script
    fig = namespace['generate_chart'](historical_data, data_dict)
          ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
  File "<string>", line 38, in generate_chart
  File "/opt/anaconda3/lib/python3.12/site-packages/plotly/graph_objs/_figur
e.py", line 1049, in add_vline
    return super(Figure, self).add_vline(
           ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
  File "/opt/anaconda3/lib/python3.12/site-packages/plotly/basedatatypes.p
y", line 4095, in add_vline
    self._process_multiple_axis_spanning_shapes(
  File "/opt/anaconda3/lib/python3.12/site-packages/plotly/basedatatypes.p
y", line 4036, in _process_multiple_axis_spanning_shapes
    augmented_annotation = shapeannotation.axis_spanning_shape_annotation(
                           ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
  File "/opt/anaconda3/lib/python3.12/site-packages/plotly/shapeannotation.p
y", line 216, in axis_spanning_shape_annotation
    shape_dict = annotation_params_for_line(
                 ^^^^^^^^^^^^^^^^^^^^^^^^^^^^
  File "/opt/anaconda3/lib/python3.12/site-packages/plotly/shapeannotation.p
y", line 63, in annotation_params_for_line
    eX = _mean(X)
         ^^^^^^^^
  File "/opt/anaconda3/lib/python3.12/site-packages/plotly/shapeannotation.p
y", line 7, in _mean
    return float(sum(x)) / len(x)
                 ^^^^^^
TypeError: unsupported operand type(s) for +: 'int' and 'datetime.datetime'

During handling of the above exception, another exception occurred:

Traceback (most recent call last):
  File "/Users/vidursaigal/Documents/Documents – Vidur's MacBook Pro/Github
Repos/comm4190_S25_Final_Project_GroupM/AppFiles/script.py", line 527, in ex
ecute_chart_script
    fig = namespace['generate_chart'](historical_data, namespace.get(second_
param, {}))
          ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
^^^^^^^^^^^
  File "<string>", line 38, in generate_chart
  File "/opt/anaconda3/lib/python3.12/site-packages/plotly/graph_objs/_figur
e.py", line 1049, in add_vline
    return super(Figure, self).add_vline(
           ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
  File "/opt/anaconda3/lib/python3.12/site-packages/plotly/basedatatypes.p
y", line 4095, in add_vline
    self._process_multiple_axis_spanning_shapes(
  File "/opt/anaconda3/lib/python3.12/site-packages/plotly/basedatatypes.p
y", line 4036, in _process_multiple_axis_spanning_shapes
    augmented_annotation = shapeannotation.axis_spanning_shape_annotation(
                           ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
  File "/opt/anaconda3/lib/python3.12/site-packages/plotly/shapeannotation.p
y", line 216, in axis_spanning_shape_annotation
```

```
      shape_dict = annotation_params_for_line(
                   ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
  File "/opt/anaconda3/lib/python3.12/site-packages/plotly/shapeannotation.p
y", line 63, in annotation_params_for_line
    eX = _mean(X)
         ^^^^^^^^
  File "/opt/anaconda3/lib/python3.12/site-packages/plotly/shapeannotation.p
y", line 7, in _mean
    return float(sum(x)) / len(x)
                 ^^^^^^
TypeError: unsupported operand type(s) for +: 'int' and 'datetime.datetime'
```

MRNA Stock Price

Example 2: Comparative Stock Analysis

Prompt: Compare Vertex Pharma and Regeneron stock performance over the past three years.

In [16]:
```python
# Example 2: Comparative Stock Analysis
from AppFiles.script import answer_user_query
import plotly.io as pio

try:
    result = answer_user_query("Compare Vertex Pharma and Regeneron stock pe
    print(result['text'])
    pio.show(result["chart_figure"])
except Exception:
    pass
```

```
RAW PROMPT ► 'Compare Vertex Pharma and Regeneron stock performance over the
past three years'
RAW TICKERS ► 'VRTX,REGN'
Extracted 2 ticker(s): ['VRTX', 'REGN']
Extracted Tickers: ['VRTX', 'REGN']
Fetching complete historical data for VRTX
Fetching complete historical data for REGN
=== Generated Comparative Chart Script ===
import datetime
import pandas as pd
import plotly.graph_objects as go

def generate_chart(historical_data_dict):
    # Define the tickers we want to compare
    tickers = ["VRTX", "REGN"]

    # Define the start date for the past 3 years
    end_date = datetime.datetime.now()
    start_date = end_date - datetime.timedelta(days=3*365)

    # Define a dictionary of colors for each ticker
    colors = {
        "VRTX": "blue",
        "REGN": "red"
    }

    fig = go.Figure()

    # Loop over each ticker and add a line trace for normalized close prices
    for ticker in tickers:
        if ticker not in historical_data_dict:
            continue

        df = historical_data_dict[ticker].copy()

        # Ensure the DataFrame index is datetime
        if not pd.api.types.is_datetime64_any_dtype(df.index):
            try:
                df.index = pd.to_datetime(df.index)
            except Exception as e:
                continue  # Skip if conversion fails

        # Filter data to last three years
        df = df.loc[df.index >= start_date]
        if df.empty:
            continue

        # Sort by date to ensure proper chronology
        df = df.sort_index()

        # Normalize the Close price (first valid Close = 100)
        # Use the first available "Close" price as the base
        base_price = df['Close'].iloc[0]
        df['Normalized'] = df['Close'] / base_price * 100

        # Create a trace for this ticker
```

```
            fig.add_trace(
                go.Scatter(
                    x=df.index,
                    y=df['Normalized'],
                    mode='lines',
                    name=ticker,
                    line=dict(color=colors.get(ticker, 'black')),
                    hovertemplate = f"<b>{ticker}</b><br>Date: %{ { 'x': '' } }<
br>Normalized Price: %{ { 'y': '' }:.2f}<extra></extra>"
                )
            )

    # Update layout with clear labels and titles
    fig.update_layout(
        title="Comparative Normalized Stock Performance (Past 3 Years)",
        xaxis_title="Date",
        yaxis_title="Normalized Price (Base=100)",
        legend_title="Ticker",
        template="plotly_white"
    )

    return fig

# Example usage:
# fig = generate_chart(historical_data_dict)
# fig.show()
=== End Comparative Chart Script ===

Error executing comparative chart script: unsupported format string passed t
o dict.__format__
```

Analysis:
Below is a comparative analysis of Vertex Pharmaceuticals (VRTX) and Regener
on Pharmaceuticals (REGN) based on key metrics, recent price trends, and cat
alyst-driven developments that have influenced each stock's trajectory over
roughly the past three years.

1. Price Levels & Trading Ranges
 • Vertex's current trading price is about US$425, with a 52-week range of r
oughly US$378 to US$520. In contrast, Regeneron is trading at about US$528,
but its 52-week span is much wider—from roughly US$526 to US$1,211. This wid
e range for Regeneron highlights the stock's greater historical ceiling, eve
n though today both stocks are near the lower end of their recent ranges.
 • Over multi-year cycles, Vertex's price evolution has been heavily influen
ced by its breakthrough pipeline (for cystic fibrosis and emerging CRISPR—ba
sed programs), while Regeneron's moves have been partly driven by the high p
eaks reached on blockbuster therapies such as EYLEA and Dupixent. Analysts'
one-year target estimates (Vertex ~US$500 and Regeneron ~US$800) further und
erline that, relative to their most recent lows, each company has a differen
t growth expectation.

2. Volatility & Beta
 • Both stocks show relatively moderate systematic volatility with beta figu
res below 1 (Vertex at 0.513 and Regeneron at 0.426), meaning that, over the
past three years, each has been less volatile compared to the broader marke
t.
 • However, the sheer amplitude in Regeneron's 52-week range indicates that

when it does move, the excursions have been larger. Vertex's price action—wh
ile also notable in biotech—has been more concentrated within a tighter ban
d, suggesting that its near-term fluctuations may be more reflective of spec
ific catalyst news rather than broad market swings.

3. Fundamental Metrics & Earnings
 • A key difference is seen in profitability metrics. Regeneron posts a trai
ling PE ratio of around 13.4 with positive EPS (US$39.32), backed by a matur
e product portfolio and dividend distribution (dividend yield of about 0.6
3%). This indicates that, even over a three-year view, its performance has b
een tied to steady earnings and cash returns to shareholders.
 • Vertex, on the other hand, currently reports negative EPS (−US$3.82) and
therefore lacks a meaningful PE ratio. Its performance over the past years h
as been more speculative, driven by expectations from its evolving drug pipe
line initiatives including CF therapies and recently announced CRISPR clinic
al studies. Investors have been rewarding Vertex with higher market cap (abo
ut US$109 billion vs. Regeneron's ~US$57 billion) on the promise that these
innovative approaches will eventually translate into significant revenues.

4. Catalyst and Strategic Developments
 • Vertex has seen several news catalysts over the period — from breakthroug
hs in CRISPR–based research to FDA milestones (such as approval of a non–opi
oid pain drug and new cystic fibrosis treatments). These have periodically b
oosted optimism, though the current pricing below its moving averages (50–da
y: ~US$491; 200–day: ~US$471) suggests that short–term corrections have remi
nded investors of the developmental risks inherent in biotech innovation.
 • Regeneron's catalyst story has been centered on advancing key pipeline as
sets (for example, progressing factor XI antibodies and maintaining momentum
with Dupixent approvals). Its consistent revenue from established products
(like EYLEA) and a robust pipeline have contributed to multi–year highs; how
ever, recent trading near its 52-week low and below its 50– and 200–day aver
ages signals some near–term headwinds—possibly due to valuation pressures or
regulatory timing concerns.

5. Relative Strengths & Weaknesses Over the Three–Year Horizon
 Strengths for Vertex:
  – Strong emphasis on innovative therapies (including CRISPR trials) that m
ay lead to breakthrough treatments.
  – A history of regulatory wins (e.g., CF therapies) that have driven inves
tor enthusiasm, despite near–term price volatility.

 Weaknesses for Vertex:
  – Ongoing losses make profitability a concern until its new therapies tran
slate into earnings.
  – The stock's recent declines, trading below key moving averages, indicate
market caution around its pipeline risks.

 Strengths for Regeneron:
  – Consistent profitability with a moderate PE ratio, driven by established
blockbuster drugs.
  – A diversified revenue base and a dividend policy that provides some cush
ion in volatile environments.

 Weaknesses for Regeneron:
  – Trading now near its 52-week low, suggesting that despite earlier high v
aluation levels, it may be losing some of its appeal short term.

— A wider historical trading range could point to susceptibility to headwinds when significant news or regulatory events come to the fore.

6. Summary of Performance Trends
Over the past three years, Vertex and Regeneron have both experienced periods of robust optimism—albeit for different reasons. Vertex's performance has been more closely linked to its promise in pipeline innovation and breakthrough treatments, though its reliance on yet-to-be-delivered earnings means the stock has seen sharper, catalyst-driven swings. Regeneron, while having reached exceptional highs in earlier phases buoyed by blockbuster drugs, appears to be in a corrective phase closer to its 52-week floor; yet it benefits from a steady, earnings-driven performance and has a lower risk profile regarding market volatility.

In conclusion, while Vertex offers an attractive growth story driven by innovative therapies and potential pipeline catalysts, it carries greater inherent risk due to its profitability challenges. Regeneron, with proven earnings and dividends, has had a history of higher peaks but is currently trading closer to its low end, which may offer value to income-oriented investors. The choice between the two would depend on an investor's appetite for risk versus the desire for more predictable, earnings-backed returns.

Sources for Vertex Pharmaceuticals Incorporated (VRTX):
— CRISPR Clinical Trials: A 2024 Update — Innovative Genomics ...
  Mar 13, 2024 ... "Going from the lab to an approved CRISPR therapy in just 11 years is a truly remarkable achievement," says IGI Founder Jennifer Doudna. "I am ...
  Link: https://innovativegenomics.org/news/crispr-clinical-trials-2024/

— Vertex's non-opioid pain drug gets FDA approval in milestone for ...
  Jan 30, 2025 ... Vertex hopes to eventually get the drug approved for chronic pain as well, though clinical trials testing it in that setting have produced mixed ...
  Link: https://www.biopharmadive.com/news/vertex-pain-non-opioid-drug-fda-approval-journavx/738721/

— CRISPR Therapeutics Highlights Strategic Priorities and 2024 Outlook
  Jan 8, 2024 ... Clinical trials are ongoing for CRISPR ... The CASGEVY™ word mark and design are trademarks of Vertex Pharmaceuticals Incorporated.
  Link: https://ir.crisprtx.com/news-releases/news-release-details/crispr-therapeutics-highlights-strategic-priorities-and-2024

— Should You Buy Vertex Pharmaceuticals Stock Hand Over Fist ...
  Jan 16, 2025 ... 30, this FDA decision isn't the only catalyst on the way for the big biotech company. Vertex won FDA approval for its newest CF drug, Alyftrek ...
  Link: https://www.fool.com/investing/2025/01/16/should-you-buy-vertex-pharmaceuticals-stock-hand-o/

— 2024 Ends With Lilly's Landmark GLP-1 Sleep Apnea Approval ...
  Dec 24, 2024 ... In April 2024, Astellas filed a supplemental New Drug Application with the FDA, seeking to add two-year data to Izervay's label. The pharma used ...
  Link: https://www.biospace.com/biospace-fda-decision-tracker

Sources for Regeneron Pharmaceuticals, Inc. (REGN):

– Regeneron to Advance Two Factor XI Antibodies into a Broad Phase ...
  Dec 19, 2024 ... Regeneron Pharmaceuticals Inc. logo News Events ... subst
antial proportion of all original, FDA–approved fully human monoclonal antib
odies.
  Link: https://investor.regeneron.com/news–releases/news–release–details/re
generon–advance–two–factor–xi–antibodies–broad–phase–3–program

– FDA Calendar, FDA Drug Approval, PDUFA Calendar – RTTNews
  ... important catalysts because they are 'make or break events' for biotec
h stocks. The goal date set by the FDA for announcing its decision on a comp
any's New Drug ...
  Link: https://www.rttnews.com/corpinfo/fdacalendar.aspx

– Dupixent® (dupilumab) Approved in the US as the First New ...
  Apr 21, 2025 ... Regeneron Pharmaceuticals' Dupixent has received FDA appr
oval for treating chronic spontaneous urticaria (CSU), marking a significant
milestone ...
  Link: https://www.biopharmawatch.com/news/REGN/dupixent%C2%AE–dupilumab–ap
proved–in–the–us–as–the–first–new–targeted–therapy–in–over–a–decade–for–chro
nic–spontaneous–urticaria–csu

– Regeneron Provides Business Updates and Highlights from Broad ...
  Jan 13, 2025 ... The Company filed an application with the FDA for use of
the EYLEA HD pre–filled syringe (PFS) with U.S. approval and launch expected
by mid– ...
  Link: https://newsroom.regeneron.com/news–releases/news–release–details/re
generon–provides–business–updates–and–highlights–broad/

– Intellia Therapeutics Announces Second Quarter 2023 Financial ...
  Aug 3, 2023 ... ... Regeneron Pharmaceuticals, Inc. ATTR Amyloidosis with
Cardiomyopathy (ATTR–CM):. Intellia plans to submit an Investigational New D
rug (IND) ...
  Link: https://ir.intelliatx.com/news–releases/news–release–details/intelli
a–therapeutics–announces–second–quarter–2023–financial

```
Traceback (most recent call last):
  File "/Users/vidursaigal/Documents/Documents – Vidur's MacBook Pro/Github
Repos/comm4190_S25_Final_Project_GroupM/AppFiles/script.py", line 669, in ex
ecute_comparative_chart_script
    fig = namespace['generate_chart'](namespace['historical_data_dict'])
          ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
  File "<string>", line 56, in generate_chart
TypeError: unsupported format string passed to dict.__format__
```

Stock Price Comparison
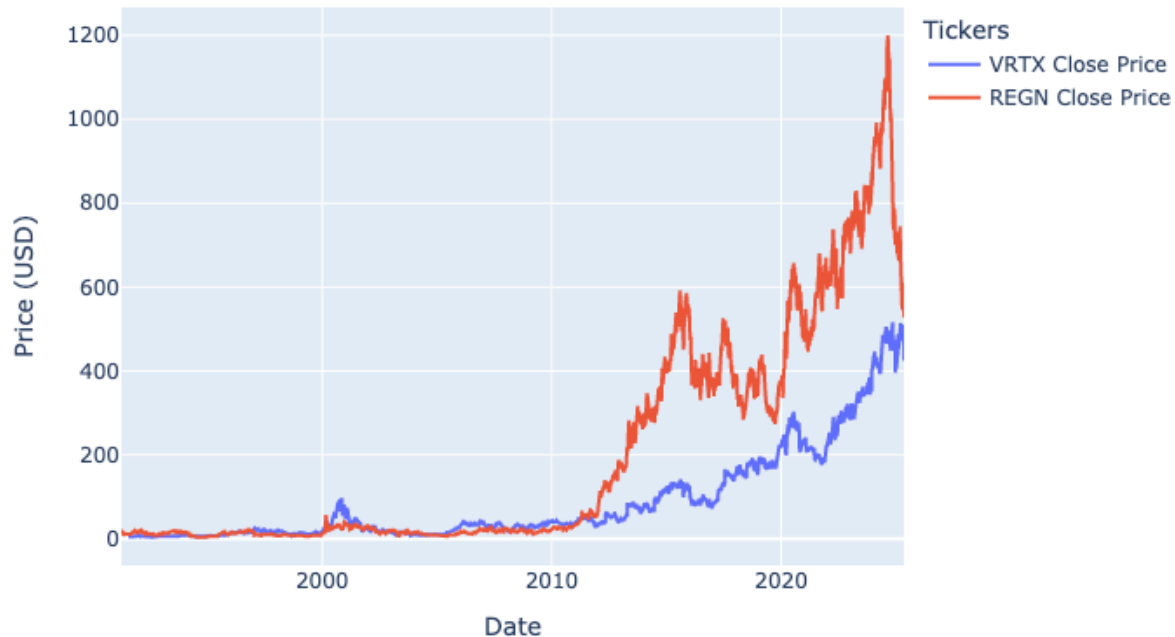
Example 3: Technical Analysis

Prompt: What are the technical indicators suggesting for GILD stock?

```
In [17]:    # Example 3: Technical Analysis
            from AppFiles.script import answer_user_query
            import plotly.io as pio

            try:
                result = answer_user_query("What are the technical indicators suggesting
                print(result['text'])
                pio.show(result["chart_figure"])
            except Exception:
                pass
```

```
RAW PROMPT ► 'What are the technical indicators suggesting for GILD stock?'
RAW TICKERS ► 'GILD'
Extracted 1 ticker(s): ['GILD']
Extracted Tickers: ['GILD']
Fetching complete historical data for GILD
=== Generated Chart Script ===
import plotly.graph_objects as go
import pandas as pd
from datetime import datetime

def generate_chart(historical_data, data_dict):
    # Ensure the DataFrame index is datetime without timezone info
    if not pd.api.types.is_datetime64_any_dtype(historical_data.index):
        historical_data.index = pd.to_datetime(historical_data.index)
    else:
        historical_data.index = historical_data.index.tz_localize(None)

    # Create a copy of historical_data to avoid modifying the original DataF
rame
    data = historical_data.copy()

    # Compute technical indicators: 50-day and 200-day simple moving average
s if enough data exists
    if len(data) >= 50:
        data['MA50'] = data['Close'].rolling(window=50).mean()
    if len(data) >= 200:
        data['MA200'] = data['Close'].rolling(window=200).mean()

    fig = go.Figure()

    # Add candlestick trace for price action
    fig.add_trace(go.Candlestick(x=data.index,
                                 open=data['Open'],
                                 high=data['High'],
                                 low=data['Low'],
                                 close=data['Close'],
                                 name='Price'))

    # Overlay the moving averages if computed
    if 'MA50' in data.columns:
        fig.add_trace(go.Scatter(x=data.index,
                                 y=data['MA50'],
                                 mode='lines',
                                 line=dict(color='blue', width=1),
                                 name='50-day MA'))
    if 'MA200' in data.columns:
        fig.add_trace(go.Scatter(x=data.index,
                                 y=data['MA200'],
                                 mode='lines',
                                 line=dict(color='red', width=1),
                                 name='200-day MA'))

    # If ticker_info exists in data_dict, add horizontal lines for the publi
shed averages
    ticker_info = data_dict.get('ticker_info', {})
    if ticker_info:
```

```
            fifty_day_avg = ticker_info.get("Fifty Day Average", None)
            two_hundred_day_avg = ticker_info.get("Two Hundred Day Average", Non
e)

            if fifty_day_avg:
                fig.add_hline(y=fifty_day_avg,
                              line_dash="dot",
                              line_color="blue",
                              annotation_text="Published 50-Day Avg",
                              annotation_position="top left")
            if two_hundred_day_avg:
                fig.add_hline(y=two_hundred_day_avg,
                              line_dash="dot",
                              line_color="red",
                              annotation_text="Published 200-Day Avg",
                              annotation_position="bottom right")

        # If recommendations data is available, annotate the most recent recomme
ndation on the chart
        recommendations = data_dict.get('recommendations', None)
        if recommendations is not None and not recommendations.empty:
            # Assuming the recommendations DataFrame has at least a column named
'To Grade'
            last_rec = recommendations.iloc[-1]
            rec_text = "Analyst Recommendation: " + str(last_rec.get('To Grade',
'N/A'))
            latest_date = data.index[-1]
            latest_close = data['Close'][-1]
            fig.add_annotation(x=latest_date,
                               y=latest_close,
                               text=rec_text,
                               showarrow=True,
                               arrowhead=1,
                               bgcolor="lightyellow")

        # Update layout with title and axis labels
        fig.update_layout(
            title="GILD Technical Indicators & Price Action",
            xaxis_title="Date",
            yaxis_title="Price (USD)",
            xaxis_rangeslider_visible=False
        )

        return fig
=== End Chart Script ===

Normalizing historical_data timezone from America/New_York
Data provided to chart function:
- historical_data: DataFrame ((8385, 7))
- ticker: str (N/A)
- dt: module (N/A)
- datetime: module (N/A)
- ticker_info: dict (179 keys)
- key_metrics: dict (22 keys)
- dividend_history: Series ((40,))
- dividend_df: DataFrame ((40, 1))
- income_statement: DataFrame ((46, 4))
```

– balance_sheet: DataFrame ((70, 5))
– cash_flow: DataFrame ((60, 5))
– recommendations: DataFrame ((4, 6))
– calendar: dict (9 keys)
– major_holders: DataFrame ((4, 1))
– institutional_holders: DataFrame ((10, 6))
Chart function expects 2 parameters: ['historical_data', 'data_dict']
Analysis:
Below is a numerical and technical breakdown of Gilead's (GILD) current pric
e action and supporting averages, alongside context from recent news catalys
ts:

1. Price Relative to Moving Averages:
 • The current price is about 96.91 USD, which is below the 50-day average o
f roughly 108.42 USD. This shows that in the short term the stock's momentum
has been weak.
 • However, the current price is above the 200-day average (approximately 9
2.97 USD), suggesting that while the near–term trend is downward, the longe
r-term trend still sits on firmer ground.

2. Trading Range and Volume:
 • Over the last five trading days, we've seen a move from a high near 103.8
5 to lows around 96.20 — a range that underscores some recent volatility.
 • Today's volume (around 13.14 million shares) exceeds the average volume
(~9.89 million), hinting at increased trading interest which could mean tech
nical moves may be more decisive in the near term.

3. Support/Resistance Levels:
 • The 200-day moving average at approximately 92.97 USD now acts as an impo
rtant support level. A sustained break below this level could trigger furthe
r selling pressure.
 • The 50-day average at 108.42 USD now appears as a near-term resistance zo
ne, meaning any upward recovery may have to overcome that line.

4. Short-Term Versus Long-Term Outlook:
 • Short-Term: With the stock trading below its 50-day average and having ex
perienced a recent decline (from about 102.81 on May 5 to 96.91 on May 9), t
he technical indicators point toward short-term weakness.
 • Long-Term: Being above the 200-day average and the relatively low beta of
0.282 (suggesting less sensitivity to market swings) support a more patient,
stable outlook for long-term investors.

5. Catalysts in Context:
 • Recent news—including regulatory approvals, strong quarter-end financial
results, and strategic acquisitions (like the $4.3 billion acquisition of Cy
maBay)—could act as catalysts. These events might help reverse the short-ter
m downtrend, potentially pushing the stock back toward or above its 50-day a
verage.
 • However, since the current technical signals are showing short-term press
ure, investors might consider the upcoming catalysts as possible inflection
points rather than immediate buy signals.

Summary:
Technically, GILD is in a mixed state: the short-term picture is bearish, as
evidenced by trading below the 50-day moving average and recent price declin
es, while the longer-term position remains relatively supportive with the cu

rrent price holding above the 200-day average. Investors should keep an eye
on the 92.97 USD support level and watch for any renewed momentum—especially
in light of the company's recent and forthcoming positive news—to assess if
a recovery back toward the 50-day level could ensue.

Sources for Gilead Sciences, Inc. (GILD):
— Gilead Sciences Announces Fourth Quarter and Full Year 2023 ...
  Feb 6, 2024 ... ... new catalyst-rich phase for the company. We are expect
ing several ... Received U.S. Food and Drug Administration ("FDA") approval
of ...
  Link: https://www.gilead.com/news/news-details/2024/gilead-sciences-announ
ces-fourth-quarter-and-full-year-2023-financial-results

— 2024 Ends With Lilly's Landmark GLP-1 Sleep Apnea Approval ...
  Dec 24, 2024 ... Gilead Sciences' $4.3 billion acquisition of CymaBay paid
dividends ... The FDA has accepted the San Diego—based company's New Dru
g ...
  Link: https://www.biospace.com/biospace-fda-decision-tracker

— Gilead Sciences Announces Fourth Quarter and Full Year 2011 ...
  The U.S. Food and Drug Administration (FDA) approved Complera, a new onc
e ... In December, Gilead announced Phase 3 clinical trial results showin
g ...
  Link: https://www.gilead.com/news/news-details/2012/gilead-sciences-announ
ces-fourth-quarter-and-full-year-2011-financial-results

— HOOKIPA Pharma Reports First Quarter 2024 Financial Results and ...
  May 9, 2024 ... Received FDA clearance for Investigational New Drug (IND)
... Gilead Sciences, Inc. (Gilead). Gilead is solely responsible for ...
  Link: https://ir.hookipapharma.com/news-releases/news-release-details/hook
ipa-pharma-reports-first-quarter-2024-financial-results-and

— Year in pharma 2017
  Dec 4, 2017 ... The drug prices have gone through the roof." iShares Nasda
q biotech stock index ($). 10/18/17. Gilead's Yescarta is approved, making i
t the ...
  Link: https://cen.acs.org/pharmaceuticals/year-in-pharma-2017/95/i48

```
<string>:70: FutureWarning:

Series.__getitem__ treating keys as positions is deprecated. In a future ver
sion, integer keys will always be treated as labels (consistent with DataFra
me behavior). To access a value by position, use `ser.iloc[pos]`
```

GILD Technical Indicators & Price Action
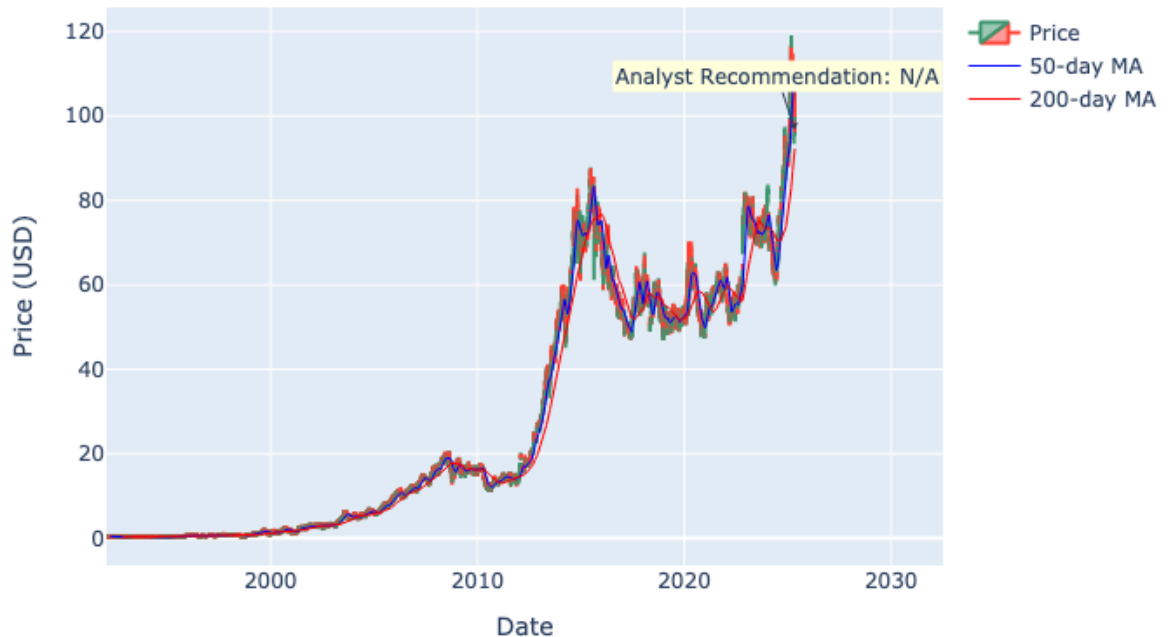
Example 4: Error Handling (No Ticker)

Prompt: Which biotech companies are leading in oncology treatments?

```
In [18]:  # Example 4: Error Handling (No Ticker)
          from AppFiles.script import answer_user_query
          import plotly.io as pio

          try:
              result = answer_user_query("Which biotech companies are leading in oncol
              print(result['text'])
              pio.show(result["chart_figure"])
          except Exception:
              pass
```

```
RAW PROMPT ▶ 'Which biotech companies are leading in oncology treatments?'
RAW TICKERS ▶ ''
Extracted 0 ticker(s): []
Extracted Tickers: []
I couldn't identify any stock tickers in your request. Please mention specif
ic companies or stock symbols.
```

Example 5: Dividend Analysis

Prompt: Compoare the Dividend Yields of Abbvie and Merck over the past 5 years.

In [19]:
```python
# Example 5: FDA Approval Impact Analysis
from AppFiles.script import answer_user_query
import plotly.io as pio

try:
    result = answer_user_query("Compoare the Dividend Yields of Abbvie and M
    print(result['text'])
    pio.show(result["chart_figure"])
except Exception:
    pass
```

```
RAW PROMPT ► 'Compoare the Dividend Yields of Abbvie and Merck over the past
5 years.'
RAW TICKERS ► 'ABBV,MRK'
Extracted 2 ticker(s): ['ABBV', 'MRK']
Extracted Tickers: ['ABBV', 'MRK']
Fetching complete historical data for ABBV
Fetching complete historical data for MRK
=== Generated Comparative Chart Script ===
import pandas as pd
import plotly.graph_objects as go

def generate_chart(historical_data_dict):
    # Define tickers to compare and colors for consistency
    tickers = ["ABBV", "MRK"]
    colors = {"ABBV": "blue", "MRK": "red"}

    fig = go.Figure()

    # For each ticker, process historical data if available
    for ticker in tickers:
        if ticker not in historical_data_dict:
            continue

        df = historical_data_dict[ticker].copy()
        # Ensure the DataFrame index is a datetime
        if not pd.api.types.is_datetime64_any_dtype(df.index):
            df.index = pd.to_datetime(df.index)

        # Filter for the past 5 years
        max_date = df.index.max()
        start_date = max_date - pd.DateOffset(years=5)
        df = df[df.index >= start_date]

        # Ensure required columns exist
        if "Dividends" not in df.columns or "Close" not in df.columns:
            continue

        # Compute a rolling dividend yield, using a 252-trading day window
(approx one year)
        # Dividend yield (%) = (sum of dividends over past year / current cl
osing price)*100
        df['RollingDividendSum'] = df["Dividends"].rolling(window=252, min_p
eriods=1).sum()
        df['RollingDividendYield'] = (df['RollingDividendSum'] / df["Clos
e"]) * 100

        # Create a trace. We use a line chart to show the trend over time.
        fig.add_trace(go.Scatter(
            x = df.index,
            y = df['RollingDividendYield'],
            mode = 'lines+markers',
            name = ticker,
            line = dict(color=colors.get(ticker, None)),
            marker = dict(size=4)
        ))
```

```
    # Update layout with title and axis labels relevant to dividend co
mparison
    fig.update_layout(
        title="Comparative 1-Year Rolling Dividend Yield: AbbVie (ABBV) vs M
erck (MRK) over the Past 5 Years",
        xaxis_title="Date",
        yaxis_title="Dividend Yield (%)",
        legend_title="Ticker",
        template="plotly_white"
    )

    return fig
=== End Comparative Chart Script ===
```

Analysis:
Below is a comparative analysis of AbbVie Inc. and Merck & Co., Inc. from a dividend yield perspective over the past five years based on available metrics and historical trends:

1. Current Snapshot of Dividend Yields and Payouts

• AbbVie currently reports an annual dividend rate of about USD 6.56 with a yield of approximately 3.5% at its current price of roughly USD 184.60.
• In contrast, Merck's annual dividend rate is around USD 3.24, which produces a higher yield of about 4.1% given its lower trading price near USD 76.00.

While these figures represent the present-day situation, they are also the end result of dividend payout practices and share price dynamics evolving over the last several years.

2. Historical Consistency and Dividend Practices

• AbbVie has built a reputation as a "dividend growth" stock over recent years. Historically, the company has steadily raised its dividend payouts as part of its commitment to returning capital to shareholders. Although the yield today sits at roughly 3.5%, that reflects both the growing payouts and a share price that has appreciated over time. For investors seeking consistent dividend increases, AbbVie has traditionally demonstrated strength—even if the current yield appears somewhat lower when measured as a percentage.

• Merck, on the other hand, has maintained a consistent dividend while its share price dynamics have led to a relatively higher yield (around 4.1%). Over the past five years, while Merck's dividend payments have remained reliable, the yield has reflected the balance between its payout and the lower absolute share price. This higher yield can be attractive for investors who favor income generation; however, it also comes with the consideration that share price volatility and market perceptions of growth prospects play a significant role.

3. Relative Strengths and Considerations

• Dividend Growth vs. Yield:
  – AbbVie's lower yield is partly due to a higher share price built on both strong pharmaceutical sales and a history of dividend increases. This steady climb in payouts makes the stock attractive for investors who prioritize gro

wing income over time, even if the yield percentage appears lower at any given point.
  – Merck's higher yield is appealing from an income standpoint. However, a higher yield in a healthcare stock like Merck can sometimes be a result of a lower share price that may reflect market concerns or cyclical challenges, even if its cash-generating ability remains robust.

• Market Valuation and Stability:
  – AbbVie's large market capitalization and relatively high price-to-earnings ratio (currently near 79) suggest that its dividend growth narrative is coupled with expectations of continued share price strength. This combination may lead to a compression of yield relative to a stock that trades at lower multiples.
  – Merck's lower P/E ratio (around 11) paired with its higher yield indicates a different valuation profile. It suggests that while investors are rewarded with a higher yield today, the stock's pricing reflects caution about near-term growth or market uncertainties.

4. Performance Trends Over the Past Five Years

Though the raw historical dividend yield numbers for the last five years aren't provided in the data snippet, industry consensus and past performance indicate that:

• AbbVie has consistently raised its dividend as its established drug portfolio continues to generate reliable cash flow. Its yield has likely trended modestly upward over the long term due to dividend increases, even as its share price has also appreciated.
• Merck's dividend policy has been characterized by steady payouts. However, market fluctuations (for example, periods of price softness) may have resulted in a higher yield during certain intervals even though the absolute dividend increases may not have been as aggressive as AbbVie's.

5. Conclusion

• Over the past five years, both companies have exhibited strong commitment to rewarding shareholders with dividends.
• AbbVie's strategy has focused on dividend growth supported by a steady increase in payouts and share price appreciation, producing a yield around 3.5% today.
• Merck delivers a higher current yield of about 4.1%, making it attractive for income-focused investors, though this yield comes from a lower price level relative to its dividend rate.
• The choice between the two may ultimately depend on an investor's preference: those valuing a track record of increasing dividends (with potential for capital appreciation) may lean toward AbbVie, whereas investors seeking a higher current yield might prefer Merck, while also taking into account the underlying valuation dynamics and market outlook.

This comparative understanding highlights that while Merck offers a higher yield on paper, AbbVie's history of consistent dividend growth and strong market fundamentals provides its own form of appeal.

Sources for AbbVie Inc. (ABBV):
– Pipeline | AbbVie
  Feb 21, 2025 ... Advanced medicines that demonstrate both strong clinical

performance and benefits to patients. Pipeline. ~90. compounds, devices o
r ...
  Link: https://www.abbvie.com/science/pipeline.html

– 2024 Ends With Lilly's Landmark GLP-1 Sleep Apnea Approval ...
  Dec 24, 2024 ... ... news on the neuro front. The FDA has accepted the San
Diego-based company's New Drug Application for Ingrezza (valbenazine) oral g
ranules, a new ...
  Link: https://www.biospace.com/biospace-fda-decision-tracker

– AbbVie Completes Acquisition of Cerevel Therapeutics – Aug 1, 2024
  Aug 1, 2024 ... Cerevel's clinical-stage assets complement AbbVie's emergi
ng neuroscience pipeline and leading on-market brands in psychiatry, migrain
e and ...
  Link: https://news.abbvie.com/2024-08-01-AbbVie-Completes-Acquisition-of-C
erevel-Therapeutics

– REGENXBIO Reports Second Quarter 2024 Financial Results and ...
  Aug 1, 2024 ... ... clinical benefit for accelerated approval. The Company
expects to ... clinical trials, costs and cash flow. REGENXBIO has based the
se ...
  Link: https://regenxbio.gcs-web.com/news-releases/news-release-details/reg
enxbio-reports-second-quarter-2024-financial-results-and

– Viking Therapeutics' Hot Stock Slips After Latest Obesity Drug Trial ...
  Nov 4, 2024 ... The company's weight loss drug, which is being tested in o
ral and injectable forms, led to placebo-adjusted average weight loss of up
to 6.8% of ...
  Link: https://www.investopedia.com/viking-therapeutics-stock-slips-after-o
besity-drug-trial-results-8738997

Sources for Merck & Co., Inc. (MRK):
– Pipeline – Merck.com
  We're focused on discovering new solutions for today and the future. We're
grateful to the thousands of volunteers who participate in our clinical tria
ls – ...
  Link: https://www.merck.com/research/product-pipeline/

– Moderna R&D Day Highlights Progress and Strategic Priorities
  Sep 12, 2024 ... Earlier this year, Moderna and Merck initiated three new
randomized clinical studies ... FDA has not been supportive of accelerated a
pproval ...
  Link: https://investors.modernatx.com/news/news-details/2024/Moderna-RD-Da
y-Highlights-Progress-and-Strategic-Priorities/default.aspx

– Merck Announces Fourth-Quarter and Full-Year 2023 Financial ...
  Feb 1, 2024 ... In oncology, Merck received multiple U.S. Food and Drug Ad
ministration (FDA) approvals ... This news release of Merck & Co., Inc., Rah
way, N.J., ...
  Link: https://www.merck.com/news/merck-announces-fourth-quarter-and-full-y
ear-2023-financial-results/

– OCEA: Lung Cancer Breakthrough | OCEA – Stock Titan
  Feb 10, 2025 ... Ocean Biomedical (NASDAQ: OCEA) has announced breakthroug
h research findings showing their cancer immunotherapy candidates effectivel
y interact with tyrosine ...

        Link: https://www.stocktitan.net/news/OCEA/ocean-biomedical-announces-brea
    kthrough-findings-in-egfr-mutant-lung-xdtsir185nwu.html

    - 2024 Ends With Lilly's Landmark GLP-1 Sleep Apnea Approval ...
        Dec 24, 2024 ... Merck's blockbuster Keytruda racked up another FDA approv
    al Wednesday, as ... The FDA has accepted the San Diego-based company's New
    Drug ...
        Link: https://www.biospace.com/biospace-fda-decision-tracker

Comparative 1-Year Rolling Dividend Yield: AbbVie (ABBV) vs Merck (MRK) ov