Solution 1

1. Biomedical Problem: *Detection of Cancer*
    - One potential source of data relevant to cancer detection is medical imaging, such as mammograms or CT scans.
    - Electronic health records (EHRs) and genomic data can also be valuable sources of data for cancer detection and personalized treatment.
    - Integrating multiple data sources can lead to more accurate and comprehensive cancer detection models.

2. Potential Source of Data: *Cancer Research Databases*
    - Cancer research databases, such as TCGA or ICGC, are valuable sources of diverse molecular data for cancer-related studies.
    - Researchers can leverage this data to explore genetic and molecular signatures associated with different cancer types, identify potential biomarkers, and develop predictive models for cancer diagnosis and prognosis.
    - Working with cancer research databases may require expertise in data preprocessing, integration, and analysis, and collaborations with multiple research institutions may be necessary to access and utilize the data effectively.

Solution 2

Tool/Analysis Technique: Random Forest Classifier

- As a data scientist, one tool or analysis technique that can be applied to the detection of cancer is the Random Forest Classifier.
- The Random Forest algorithm is an ensemble learning method that combines multiple decision trees to make predictions.
- For cancer detection, the Random Forest Classifier can be trained using diverse biomedical data, such as medical imaging features, patient demographics, and clinical data.
- By leveraging this technique, a data scientist can build a predictive model that takes into account multiple variables and identifies patterns indicative of cancer.
- The Random Forest Classifier can handle high-dimensional data, handle missing values, and provide feature importance rankings, allowing for better understanding of the factors contributing to cancer detection.
- With its ability to handle complex data and provide accurate predictions, the Random Forest Classifier can assist in improving cancer detection accuracy and aiding in early intervention and treatment decisions.

Solution 3

Tool/Technique: *Receiver Operating Characteristic (ROC) Curve*

- One tool that a data scientist can use to measure the performance of a cancer detection model, such as a Convolutional Neural Network (CNN) or Random Forest Classifier, is the Receiver Operating Characteristic (ROC) Curve.
- The ROC Curve is a graphical representation of the trade-off between the sensitivity (true positive rate) and specificity (true negative rate) of a binary classifier at different thresholds.
- By plotting the ROC Curve and calculating the Area Under the Curve (AUC), a data scientist can measure the performance of the cancer detection model and compare it to other models or benchmarks.
- A high AUC value indicates that the model has good discriminative power and can distinguish between positive and negative cases effectively.
- The ROC Curve and AUC measure are useful for evaluating the performance of a cancer detection model because they provide an intuitive and quantitative way to assess the model's ability to correctly classify positive and negative cases.
- In addition, the ROC Curve can be used to determine the optimal threshold for making predictions, balancing the trade-off between sensitivity and specificity, depending on the specific needs of the application.

Solution 4

Reason for Unsatisfactory Care: *Lack of Coordination and Communication Among Healthcare Providers*

- Tyler Orion did not find satisfactory care in the normal course of medical practice because she was not receiving coordinated care and her healthcare providers were not communicating effectively with each other.
- She found that her providers were not sharing her medical records and history, which led to redundancy in tests and procedures, and made it difficult for her to manage her own health.

Reasons for Integrated Medical Timeline:

- Tyler Orion believes that her integrated medical timeline on Canvas can be helpful in resolving the coordination and communication problems she experienced in the past.
- By creating a comprehensive and centralized record of her medical history, including information from different healthcare providers and visits, Tyler can have better control and understanding of her own health journey.
- The integrated medical timeline can also help Tyler's healthcare providers to have a more complete picture of her medical history, leading to better coordination and more informed decision-making.
- In addition, Tyler's integrated medical timeline can serve as a valuable resource for future healthcare providers, making it easier to transfer medical records and history and providing continuity of care.

Solution 5

Benefit of Time Series Data: *Better Understanding of Disease Progression and Treatment Response*

- Both Wade Webster and Michael Kurisu discussed the use of longitudinal time series data in healthcare to provide a better understanding of disease progression and treatment response.
- Longitudinal data allows healthcare providers to track changes in a patient's health over time, which can help identify patterns, predict outcomes, and tailor treatment plans.

Challenge of Time Series Data: *Complexity and Variability in Biological Systems*

- One aspect of time series data in biological systems that makes them more challenging to analyze by classical methods is the complexity and variability of biological systems.
- Biological systems are highly dynamic, and factors such as genetics, environment, and lifestyle can all influence disease progression and treatment response, leading to complex and highly variable data.
- This variability can make it difficult to identify patterns and make predictions, especially when using classical statistical methods that assume independence and normality of the data.
- To address this challenge, advanced machine learning methods, such as deep learning and recurrent neural networks, can be used to capture the complex relationships and temporal dependencies in time series data in biological systems.

Solution 6

Design: *A mobile application that integrates patient data from different healthcare providers and creates a visual timeline of medical history.*

- The app would allow patients to input their medical history and synchronize data from different healthcare providers, creating a comprehensive and centralized record of their health journey.
- The visual timeline would help patients understand their medical history and identify patterns, as well as provide a valuable resource for healthcare providers to better coordinate care and make informed decisions.

Opposing Actors: *Healthcare Providers or Institutions*

- Healthcare providers or institutions might oppose this solution because it could disrupt their existing systems and workflows for managing patient data.
- Providers might also be concerned about the security and privacy of patient data, especially if the app is not properly regulated or secure.

- To address these concerns, the app could be designed with strong security and privacy measures and work with healthcare providers to ensure compatibility with existing systems and workflows.