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PERSONALIZED MEDICINE WITH TECHNOLOGY

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Abstract

Modern problems need modern solutions. The same is the case with medication, earlier patients were treated with the symptoms they felt, and later they were treated with a diagnosis performed with the result of a series of tests, but now we aid patients considering their genetic profile. Personalized medicine shifts the "one size fits all" approach to "personalizing the medicine". This is done efficiently and precisely with the assistance of technologies like AI and Big data. AI is implemented in numerous ways to personalize medicine. This paper highlights the types of data collected, how is this data managed, and mainly the interpretation of this data. In addition, it also puts forward the history of personalized medicine.

Keywords:
Personalized medicine, AI, Machine learning, Big Data, Precision Medicine.

Introduction:

Personalized medicine is the use of the genetic profile of the patient for appropriate medication and aids in the perfect amount of dosage. In the process of collecting and storing the humongous amount of data from the patient's input, big data technology is used. Big data is a massive and complex set of data that is considerably large to be interpreted by a human or be handled by the daily use database software. Artificial intelligence (AI) in use for personalized medicine is for pulling out trends and patterns from complex datasets, giving you very valuable insights to work on. In the case of personalized medicine, big data is like an ocean and AI is like a ship to navigate through it.

Theory:

History of personalized medicine

On April 16, 1999, a brief article was published namely "New Era of Personalized Medicine: Targeting Drugs for Each Unique Genetic Profile," by The Wall Street Journal and this was the first time when people knew what personalized medicine was. This idea was made more realistic and brought to life at the start of the 21st century with the aid of the Human Genome Project. The project created a link between health and the genetic makeup of a person, enabling doctors to perform the genetic mapping. The mapping displayed that it's only 0.9% that make individuals different, and also proved why different people react to medication differently. This also showed a need for personalized medicine to tailor to the needs of different beings in a personalized way.

What are the different types of data collected?

Routinely accumulated patient information and inputs have a rising volume with time. The largest volume is the imaging data as it covers gigapixel images of tissues and organisms at subcellular resolution, and metadata and quantitative measurements. This data also includes structured (e.g. ICD codes) and unstructured (e.g. symptoms descriptions) content of electronic health records, which were originally made to convey patient information among clinicians. In addition, whole-genome sequencing (WGS) and whole-exome sequencing (WEX)are even stored. With the introduction of fitness bands and sensors, data generated for wearable devices and lifestyle tracking mobile apps is becoming an increasingly relevant big data type in Personalized Medicine nowadays.

How is the data managed?

Biomedical datasets display unique features, like highly distributed acquisition, format heterogeneity, and content sensitivity. To address this," General Data Protection Regulation (EU)" 2016/679 has developed a framework for ethical and anonymous data processing, and this has a notable impact on the research. Patients' anonymity is maintained with the use of Blockchain-based cryptographic techniques. Moreover, cloud computing is in action to deliver software and storage solutions, enabling stakeholders to use resources 'on demand' to foster reproducibility. To be effective, biomedical data should be Findable, Accessible, Interoperable, and Reusable. For the biomedical datasets to be managed and stored, high-performance computing (HPC) is used. Supercomputers are a need of age for handling complex problems with data tasks. Input/output advancement plays a significant role in facilitating efficient big data handling.

How are Biomedical datasets analyzed and interpreted?

Biomedical big data takes into account ensembles of complementary information retrieved from a combination of sources, which is referred to as multi-view data. These data can be examined with integrative workflows. Machine learning methods are efficiently employed for integrative solutions for the data to explain an event or predict an outcome. Biological datasets certainly put forward some structure of patterns, like a group of genes performing identical functions, and a common approach to these datasets is Sparse Group LASSO (Least Absolute Shrinkage and Selection Operator). A stock of highly precise and flexible neural network-based machine learning techniques that in the last few years have been successfully applied to domain-specific applications. Deep learning is particularly applied in the classification of medical images and videos, often in combination with the processing of Electronic health records. The enormous size of aggregated biomedical data displays different levels of data dimensionalities, sample sizes, sources, and formats. Certainly, small datasets with fewer samples, and class imbalance, represent substantial problems typical in many areas of biomedicine. Data augmentation, which is creating negative examples, and transfer learning, which is repurposing features of established models are used to address the problem. Modern machine learning techniques such as weak supervision are used to automatically generate data labels to be used for deep learning model training. A series of new technological advancements inspired by neuroscience and established on natural language processing and computational linguistics are referred to as cognitive computing. This type of computing pursuits a dynamic process of observation, interpretation, evaluation, and decision.

What are the limitations of AI?

Careful testing needs to be performed on health care products rooted in AI. This is motivated due to varying results observed with the use of some AI in health care products, for example, IBM's Watson treatment decision support system. A need for level best testing is because if the systems are trained on partial and incomplete datasets, they will indeed give misleading results. In addition, in basket trials, if drugs don't match the patient profile scheme better than traditional healthcare then the scheme can be questioned. It could be that the medicine is ineffective or some portion is inadequate to make the whole matching scheme ineffective. In contrast, even if the medicine works, but does not match the profile perfectly which may give abnormal results, and still questions can be raised. Moreover, AI-based technologies like deep learning and neural network-based algorithms, give dependable predictions if enough training datasets are used. Even though the predictions are reliable, it's hard to understand the link between input and output. Thus, the 'Black Box' problem in the context of AI can be problematic as it evokes a sense of fear and lowers the confidence in relying on these modern technologies.

Conclusion

A shift towards personalized medicine is positively transforming the medical field. The usage of modern-day technologies is helping clinicians and researchers understand living beings to their molecular level with preserving their individuality and uniqueness. Currently, an enormous amount of multi-omics, imaging, medical devices, and EHR data are available from large-scale cohorts and population studies, revealing subtle differences in human genetics. Cutting-edge machine learning techniques like deep learning and platforms for cognitive computing are tool case for the upcoming data-driven analysis in biomedical big data. Technological advancement in the field will surely provide us with medicines with greater precision and help humans survive a pleasant life.

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