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Short Review Paper

Application of translational bioinformatics in drug interaction research

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Abstract

The application of translational approaches is gaining ground in the drug industry. The utility of the fast appreciation in data volume at all phases of processes involving the discovery of drugs, translational bioinformatics is geared towards addressing some of the key challenges encountered by the industry. Analyzing clinical data an records of patients through computational methods has Indeed influenced the decision-making in many aspects of drug discovery and development, which automatically leads to more effective treatments. Translational bioinformatics research alludes to the multidirectional mix of essential research, understanding focused research, and populace based research with the long haul point of enhancing the health of the general population. In different terms, bioinformatics is the utilization of PC innovation to the administration of biological data, used to assemble, store, dissect and incorporate biological information. This would then be able to be connected to tranquilize disclosure and advancement. Translational bioinformatics is a rising field that spotlights on the application of informatics philosophy to the expanding measure of biomedical and genomic information with a specific end goal to produce learning for clinical applications. For instance, examiners have been occupied with finding noteworthy transformations that can be utilized for the improvement of accuracy solution techniques from a large number of genetic changes or much more in an individual genome. Notwithstanding the difficulties above, there are different points that require quick consideration, for example, information sharing, effective clinical choice and emotional support network and outline, and advancement in the development of particular genes board for quick screening of patients. The interaction of drugs refers to the adjustment of reaction of one medication by another when they are administered with hardly a pause in between. Despite the fact that a moderately new technology, translational bioinformatics (TB) has turned into a major segment of biomedical research in the time of accuracy pharmaceuticals. Advancement of high-throughput advances and electronic health records has caused a change in outlook in both medicinal services and research pertaining to biomedicine. These Novel translational bioinformatics apparatus strategies are required to change over progressively voluminous datasets into significant information.

Keywords: Translational bioinformatics, pharmaceuticals, medication, reaction.

Introduction

Drug interactions (DIs) are one of the major causes of morbidity and mortality, and it leads to increasing cost of health care[1]. Drug interactions are the reasons for over 3% of most admissions in the hospital and nearly 5% of the hospital admission of the elderly[2]. Identifying new medically significant drug interactions is imminent due to the rapid rate at which new drugs are being produced and released into the market[3]. A major reason for the non-specificity drug interactions, leading to adverse drug reactions (ADR) could be attributed to the use of models such as animals in the efficacy prediction and human safety[4]. The inefficient translation of findings from preclinical studies on animals to patients is indeed a major issue in therapeutic areas[5]. Translational research application therefore can lead to a fundamental shift by leveraging data derived by human in overcoming some of the known animal model linked limitations[6,7].

Translational Research

Translational research is the application of discoveries obtained from laboratory researches and preclinical studies with regards to human development[8]. Its application cuts across basic sciences findings to human wellbeing and health, which aims at translating fundamental research findings into medical practice and resultant health outcomes that are meaningful[9,10]. Obtained data from these studies are stored in databases in order to aid the retrieval in cases of subsequent usage[11].

Bioinformatics

Bioinformatics concerns the generation of large quantities of biological information, the visualization, analysis, storage and retrieval[12]. It involves computer technology application in the processing and management of information obtained from biological data[13]. For biological information to be useable, it must undergo basic biological analysis, annotation and

reformatting to be suitable for databases[14]. In summary, the field of bioinformatics is a field of study that utilizes computation in the extraction of knowledge from biological data[15].

Translational Bioinformatics

This refers to the storage, analysis, developmental and interpretive methods used in the optimization and increasingly transforming genomic and biomedical data which are voluminous into proactive, predictive, preventive and participatory health[16]. It is an emerging field in the study of health informatics, biostatistics, statistical genetics and clinical informatics that focuses on the translation of increasing volume of genomic and biomedical data in clinical practice[17]. The knowledge used includes detecting patient's population similarities, biological information interpretation for the suggestion of treatment and the prediction of health results[18].

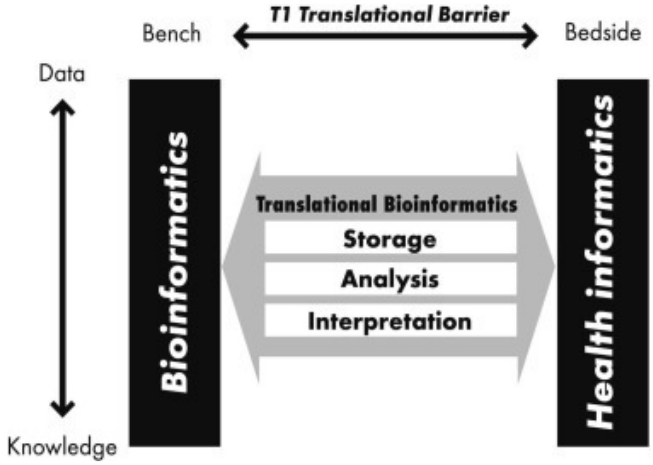

Figure-1: Translational bioinformatics in context (Tenenbaum, 2016)[16].

Drug Interaction

The interaction of drugs occurs when there is interference between a drug and another drug, food, drinks and other chemical agents[19]. This can lead to a change in the way the drug or other chemical agents act in the body and can elicit unexpected side-effects. The modification could either lead to an increased or decreased response in intensity or an abnormal effect[20]. The increasing availability and widespread of complex pharmaceuticals raises the risk of the occurrence of drug interactions[21]. Multiple medication prescription also predisposes to possibilities of increasing drug interactions[22]. Drug interaction is a major cause of negative or undesired reactions related to the administration of drugs which could in some cases lead to death[23].

Types of Drug Interaction

Inhibition of Drug Interaction: An interaction that leads to the inhibition of drug interaction can completely or partially stop a drug from eliciting its effect, thereby reducing the efficacy in patients[24]. Antagonism is a form of inhibition of drug interaction which occurs when a drug possessing a specific action is being deactivated by another drug which has a negating action[25]. Examples include the interactions between barbiturates and amphetamine; naloxoneand morphine; propranolol and adrenaline[26].

Potentiation of Drug Interaction: Potentiating interaction describes a form of interaction which increases the negative or therapeutic actions of a drug after administration to patients[27]. It comprises modification, supra-addition, synergism, pharmacokinetic parameters such as absorption, distribution, metabolism, excretion (ADME), or modifying of the drug action at receptor sites. Synergism, a form of potentiation occurs when the effect of the combination of multiple drugs, with simultaneous action is higher than the addition of individual actions elicited when drugs are administered independently[28]. Examples are: carbidopa and levodopa; trimethoprim and sulfonamide; rifampicin and isoniazid[29].

Mechanism of Drug Interaction

Pharmacokinetic Interaction: Pharmacokinetic interaction is a kind of interaction that affects the process of absorption, distribution, metabolism or excretion of drugs[30].

Pharmacodynamic Interaction: This is an interaction that occurs due to the drug action modification at sites of target by another drug, and this is not dependent on its concentration change. This might lead to increase in reaction (synergism), attenuated response (antagonism), or a response in an abnormal manner[31].

Factors Influencing Drug Interaction

Insufficient Knowledge: This boils down to the low level of comprehension of the pharmacodynamics of the drug coupled with its pharmacokinetics.

Diet related factors: The dietary constitution of what an individual consumes, such as alcoholic drinks may cause an interaction with specific drugs.

Individual Physiology: Age of individuals, their sex and weight abnormalities related to genetics also have an influence on the interaction of drugs.

Disease State Presence: Medical conditions such as liver related diseases, failure of the kidney or an alteration in the enzyme systems might influence drug handling by the body which can elicit drug interaction.

Translational Bioinformatics Research in Drug Interaction (DI)

A wide range of efficient informatics tools have been developed to organize and take full advantage of the deluge of available

information at the molecular level in a range of contexts related to disease states[32]. The application cuts across such diverse areas as classification of diseases, repositioning of drugs, disease biomarkers identification and the generation of models for disease networks, which possesses impacts which are significant to approaches necessary for the development of drugs[33]. Currently, different methods and approaches are utilized in the identification and characterization of these interactions[34]. Mechanisms and parameters of drug interaction downloaded from *in vitro* experiments can be referenced in predicting *in-vivo* changes in the exposure of drugs, however there are limitations because they mostly will not determine the effect of a specific drug interaction on the efficacy of the drug or result into a clinically significant adverse drug reaction (ADR)[35]. Performing large scale drug interactions screening for requires higher throughput strategies, hence, the use of translational bioinformatics technology[36,37].

Translational Bioinformatics Tools for Prediction/ Evaluation of Drug Interactions

Data Mining Approach: Data mining simply refers to the retrieval of the large amount of pharmacokinetic, pharmacophore and pharmacologic information that has to do with drugs that have been stored in databases[38]. Literature and data mining have turned out to be important knowledge discovery tools in biomedical informatics, and are specifically utilized for the generation of hypothesis[39]. For instance, paroxetine and pravastatin were discovered to possess a synergy in their impact on increasing blood glucose after translational bioinformatics analysis. This result was confirmed in three large electronic medical record (EMR) databases[40].

Literature Based Discovery Combination and Electronic Medical Record Assessment

In-vitro and *in-vivo* studies of pharmacology in isolation will be unable to shield the whole spectrum of mechanistic and clinically important drug interaction research[41]. The discovery based on literature approach and validation method based on a large EMR database has largely been employed in predicting new DIs and their associated metabolism enzymes which are CYP-mediated. Clinically, the importance of these interactions is then stored and rated in large databases of electronic medical records[42].

Steps in Translational Bioinformatics Research

Data Storage: A large array of translational bioinformatics data is stored in large databases for scientific uses. For instance, Gene Expression Omnibus (GEO) with a minimum of 183,000 datasets from 7,200 experiments which also on yearly basis doubles or triples. The European Bioinformatics Institute (EBI) has a database related to the GEO called Array Express with above 100,000 datasets from more than 3,000 experiments. In all, translational bioinformatics currently can access over a quarter million samples of microarray[42].

Data Retrieval: Translational bioinformatics utilizes series of methods which includes consolidation of data, data federation, and warehousing of data in the extraction of relevant data from large data sets[44]. The data consolidation approach requires the extraction of data from different sources and these data are brought together in a single database[43]. Contrary to this, the approach of data federation brings together different databases and constantly extracts data, then combines the data for queries. Data warehousing requires the integration of data from different sources into a format which is common to all, and is typically utilized in bioscience exclusively for purposes of decision support[44].

Data Analysis: Numerous software (for instance, Altman's Algorithm) and methods used for data querying currently exist, and the number grows progressively as more studies are being carried out and published in journals of bioinformatics such as BMC Bioinformatics. In order to confirm the best analytical technique, tools like Weka were designed in order to surf through the software array and make selection for the most appropriate technique[45].

Data Integration: Integration of data involves the development of methodologies which utilizes biological information for the clinical setting. Data integration empowers clinicians with tools for accessing data, discovering knowledge, and supporting decision[46]. Data integration also makes use of the abundance of information available in bioinformatics in the improvement of patient health and safety. The utility of decision support systems (DSS) based on translational bioinformatics is an example of data integration, using electronic medical records (EMR) to assist clinicians in their diagnosis[47].

Limitations

Translational bioinformatics in drug interaction has limitations. This is based on the fact that retrieved data may not always be synchronized as it is obtained from series of sources. For instance, Data warehousing sets a single unified platform for the curation of data sets. More input is required in order to breed competency sets within individuals, and to increase interfield visibility will assist in the acceleration of the adoption and increased application of bioinformatics in translational research[35].

Conclusion

Drug interactions have been a major challenge in the pharmaceuticals. It has also become a major source of concern with the increasing rate of release of new drugs into the market and the advent of combination therapies. While *in-vitro* and *in-vivo* studies have not been able to offer enough explanation for many of the unexplained possible drugs effects on the biological system, translational bioinformatics technology can go a long way in helping to predict the interactions of these drugs as well as assessing their clinical significance.

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