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Role of Biomarkers in Molecular and Disease Diagnostics

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Abstract: *A biomarker is a variable which is biologically monitored and sometimes studied more as an indication of natural biological mechanisms, pathogenic activities, or therapeutic reactions. Biomarkers are beneficial in the detection and grading of disease seriousness in laboratory as well as clinical settings. The first step in the creation of the biomarker system is to explore a viable target. There are two categories of. biomarkers: biomarkers of exposure for detection of risk, and biomarkers of disease employed in disease progression, diagnosis, and surveillance. The principles of biomarkers in disease have been applied to the detection, screening, diagnosis, treatment and checking of cancer. However, more targeted therapies have now been developed that can be directed to kill cancer cells only, while sparing healthy cells. By understanding the relation amongst the biological processes and clinical outcomes, we can increase, expand, and further elaborate our ways of treatment of diseases by using biomarkers.*

Key Words: Biomarker, Surrogate Endpoint, DNA Biomarkers, RNA Biomarkers, Protein Biomarkers, Predictive Biomarkers, Diagnostic and Prognostic Biomarker

Introduction to Biomarkers

In the post-genomic age, to scan the whole genome biomarkers have been available, but traditional methods to the exploration of biomarkers are unlikely to achieve results with the advanced technologies. It is a concern of system biology to seek clinically effective biomarkers with sensitivity and specificity similar to cystoscopy.

Biomarkers can bridge the gap between simple basic and late-stage clinical studies, and even help reduce that gap. Both pharmaceutical firms and research companies are spending more money to bring them into the field. While hoping, these efforts to carry out. pharmacogenomic research in both pre-clinical and clinical stages will raise the possibility of discovering potential drugs. ("An Introduction to Biomarkers", 2021)

Biomarkers are beneficial in the detection and grading of disease seriousness in laboratory as well as clinical settings. They may provide viability, reactivity, and metabolic details for the Various phases of drug discovery and used with therapy to keep producing commercial tests that actually helps in choosing patient or drug dosage (personalized. Medicine).

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What is Biomarker?

Joint project on chemical safety, the International Program on Chemical Safety, led by the World. Health. Organization and in collaboration with the United. Nations and the International Labor. Organization defined a biomarker as.

"Any substance, structure, or process that can be measured in the body or its products and influence or predict the incidence of outcome or disease."

A biomarker is a variable which is biologically monitored and sometimes studied more as an indication of natural biological mechanisms, pathogenic activities, or therapeutic reactions.

Example of biomarkers involves anything from the heartbeat and blood pressure to simple chemistries and more complicated blood and other tissue examinations in the laboratory.

Neuroscientists also depended on biomarkers to guide in diagnosing and curing nervous system disorders, and to explore their origin. (Strimbu & Tavel, 2010)

In clinical setting, the use of medical signs has a long history and Biomarkers are merely the most objective and quantifiable medical signs to be determined precisely by recent medical sciences. Biomarker may function as clinical endpoint, surrogate endpoint or even both; Anything which helps to classify a disease can act as a biomarker regardless of whether it is a metabolite, a transition in biological composition or a characteristic. (Ellenberg & Hamilton, 1989)

Table 1. Different uses of Biomarkers

Biomarker as Clinical Endpoint	Biomarker as Surrogate Endpoint
Clinical. Endpoint is defined as a quality that reflects the patient's feeling, functioning or ability to survive.	Surrogate. Endpoint is described as a biomarker being expected for predicting clinical benefits (or risks or losses) rely on epidemiological, medical, pathophysiological, or other empirical facts. (Wittes, Lakatos & Probstfield, 1989)
Validated Surrogate Endpoint	Correlated Clinical Outcome
Systolic Blood Pressure	Occurrence of Stroke
Low Density Lipoprotein Cholesterol (LDL) level	Occurrence of Heart attack

Common Technologies used in Biomarker Discovery

The generation of biomarkers has acted as predictor of disease progress and reaction to therapeutic treatment. The first step in the creation of the biomarker system is to explore a viable target. Nonetheless, many approaches can be used to distinguish possible biomarker targets. In fact, research has evolved exponentially over the years, encouraging the knowledge, and understanding of cellular processes. (PMC, 2021)

These involve:

- mRNAs (transcriptomes),
- proteins (proteomes),
- genetic and structural differences (genomics),
- metabolites (metabolomics)

Genomic and proteomic advancements had also led to an increasing number of possible DNA, RNA and protein biomarkers being tested.

DNA Biomarkers

Genomic techniques rely on a study of the genes that could be associated with in therapeutic response. Such techniques often examine the gene activity that are crucial to understand

whether the individual is at risk of contracting a disease. (Reyzer et al., 2004)

Gene expression imaging allows scientists to analyze and quantify gene function in the disease population and disease phases. Mutations in pro-cancer genes, gene-suppressing tumors, and mismatch-repair genes has important part as DNA biomarkers.

RNA Biomarkers

Dynamic genomic output as RNA molecules reflects the impression of the cell's physiological. status. In fact, genetic background of the molecular pathway liable for disease development and drug tolerance disclosed by improvements in RNA sequencing.

In case of cancerous cells, dysregulating transcriptional functions is at the key of tumor growth and development so it can be employed for screening and predicting disease early in clinical practice.

Protein Biomarkers

Protein profiling plays a significant part in trying to understand the physiology of an individual. The aim of proteomics is to detect protein modifications linked to disease progression, such as cancer. The proteomics technique is often valuable for the identification of serum markers in the blood and can be effective in the detection of severity and symptoms of the disease. (Califf, 2018)

Types of Biomarkers

There are two categories of. biomarkers: biomarkers of exposure for detection of risk, and biomarkers of disease employed in disease progression, diagnosis, and surveillance.

There are many different types of biomarkers based on their usefulness.

Diagnostics Biomarker

A diagnostic biomarker recognizes or indicates the existence of a disease or disorder of concern or distinguishes a patient with a subtype of the disease. When we progress through the age of precision medicine, this type of biomarker may improve immensely. Such biomarkers are applied to recognize individuals with disorder, but also for classification of the disease.

Predictive Biomarker

A predictive biomarker is characterized by the observation that a person or group of individuals more likely to encounter a favorable or unfavorable impact from exposure to either a drug or environmental factor, predicted by prevalence or modification in the biomarker.

Prognostics Biomarker

A prognostic biomarker is preferred in persons with an illness of interest to predict the sources of a clinical event, disease prevalence or disease proliferation.

Development Pathways

The discovery. stage needs excellent quality., clearly distinguished samples which are taken from either humans or model organisms. When we discover a promising lead, the nearness of biomarkers needs to be affirmed in various samples. Then following stage is to build up a clinically valuable assay (mostly in serum. or urine) and approve on the off chance that it can recognize built up sickness. The clinical utility of biomarkers is set up in a review longitudinal examination and imminent report lastly to decide if biomarkers screening technique can decrease the chance of infection. The last stage regularly not acknowledged is the commercial advancement of assay by industry. (Pepe et al., 2001)

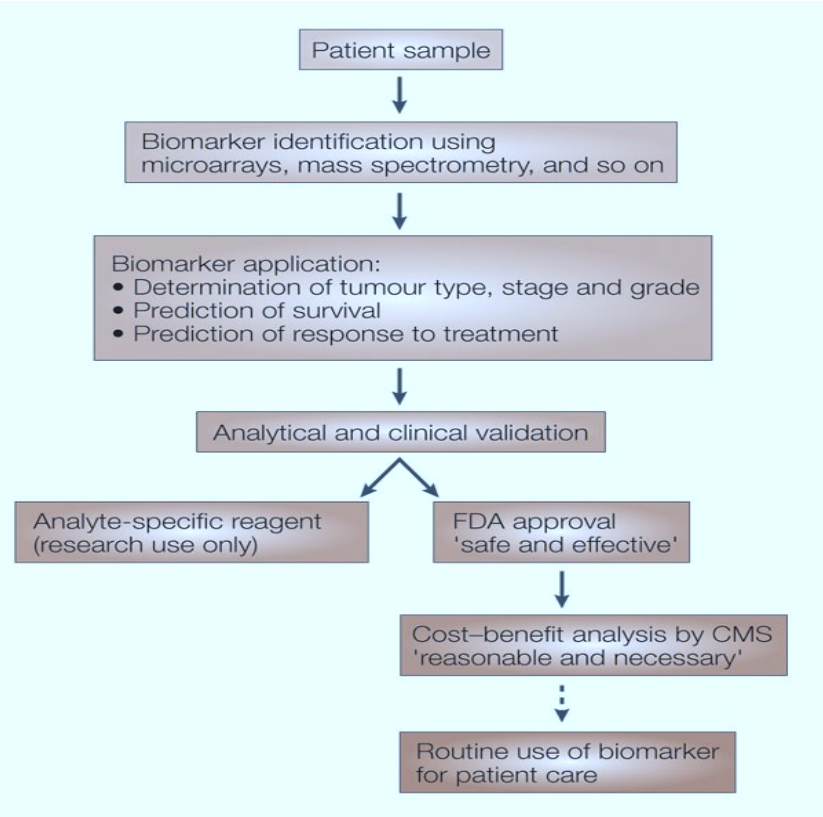

Figure 1: Development Pathways

Target Selection

The process involves drug development, improvement, and its approval. It starts with a target protein that may be DNA, RNA, or any protein that causes infection. Biomarker revelation normally begins with the examination of countless analytes as well as its test on a modest number of tests or people, with progressive heightening of the evidence of idea to a last examination of a more modest number of analytes as well as tests in numerous samples or people. Keeping up a record of the preparing and treatment of all biospecimens—as it were, their provenance — is significant over the span of examination; this record is especially significant for labile analytes, the convergences of which lessen with progressive freeze–thaw cycles. Likewise, the assortment and treatment everything being equal, and the presentation of all tests ought to be led in a uniform way. The optimal requirements. and tolerance to environmental variation are established. on a case-by-case basis, as shown by a study of traditional clinical chemistry and hormones which require different tubes and varying handling conditions; in general., analyte stability, particularly for the proteins improves the shorter processing times and cooler temperatures (4°C) can minimize proteolysis.. Various techniques can be used for biomarker discovery like proteomics, genomics, measurement of RNA and various imaging technologies.

Lead Identification

After developing an assay, it is followed by target approval and is a target technique for screening putative mixes to decide collaboration as well as alteration of the objective. After a measure is set up, the subsequent stage is to discover intensifies that effectively connect with

the target. From a pool of possible intensifies, a couple of selected leads that exhibit a connection between concoction structure and target-based movement in a biochemical or cell-based measure are produced. The way toward moving from target recognition to lead generation is regularly done completely without model organisms. Various compounds, for instance, can be created through functional, biochemical, and cell or cytotoxicity measures. High-throughput screening through a huge compound library can distinguish different compounds. In drug discovery. A standard single-analyte immunoassay is ordinarily performed with a plate-based ELISA. Including a couple of antibodies to distinguish an antigen or another marker of intrigue. With multiplexing, that equivalent response happens in corresponding with numerous different responses, regularly utilizing dots as a substrate to append the antibodies and antigens.

Analytical Validation

The systematic approval period of biomarker improvement is described by examination of the exhibition measurements of the biomarker to guarantee that. the test is solid, reproducible and is of sufficient affectability and explicitness for the proposed use. The primary regions of test approval are they must be selective, accurate, precise, sensitive, reproducible, and stable.

Clinical Validation

Capability is an evaluated evidentiary procedure that joins a biomarker to natural and clinical end points. Critically, capability (clinical approval) ought to be recognized from the previously mentioned scientific approval .Four general degrees of capability have been proposed based fair and square of proof gave that a biomarker is fit for a specific use — investigation (for speculation producing research), exhibition (biomarker connected to clinical results), characterization.(biomarker reproducibly connected to clinical results) also, surrogacy. (biomarker can fill in for a clinical end point). Animal models are frequently utilized first to limit the quantity of leads to a couple of up-and-comers that can continue into clinical preliminaries. The lead compound(s) is tried in model organisms for its pharmacological and toxicological properties. After a lead compound is created, it experiences further testing to enhance physicochemical and pharmacological properties, particularly strength and selectivity. Streamlining is a detailed procedure that can be expensive and requires time. When streamlining is finished, first-in-human testing can start with a Phase IA clinical preliminary in which a solitary portion of the medication is given to solid volunteers. This is trailed by Phase Ib preliminaries, which comprise of various raising dosages to build up wellbeing, consistent state pharmacokinetics, and most extreme endured portion. There is expanding utilization of Phase Ib preliminaries to give proof of viability so as to build up evidence of idea (POC). A regular POC clinical preliminary is a little controlled investigation directed at less than 4 locales with under 100 subjects/patients. (Mayeux, 2004)

Usage

The usage of biomarkers for clinical applications is reliant on their clinical. utility which is set up by assessment of biomarkers execution with regards to explicit methods, for example, determination of disease and organizing, assurance of the requirement for infection treatment, choice of a treatment, treatment monitoring and dosage adjustment. as well as illness anticipation .In this manner, in spite of the fact that formal capability isn't required for a biomarker to have clinical utility, capability enormously encourages the utilization of biomarkers in sedate advancement preliminaries and is required when a biomarker is proposed to be utilized as an end point in a preliminary proposed to help the administrative endorsement of a medication.

Role of Biomarkers in Clinical Medicine

Biomarkers are very useful to predict and confirm the target binding, to evaluate

mechanism. of action of. a drug, its pharmacokinetics., toxicity., and monitors the. disease status., stratify. patients, and determine. treatment. efficacy in clinical. trials. It determines whether drug binds with its receptor, site of distribution, and suitable dose.

Biomarkers. have been employed largely for treating various diseases in clinical practices. With the advancement in genomics and molecular biology biomarkers have reached to a new level.

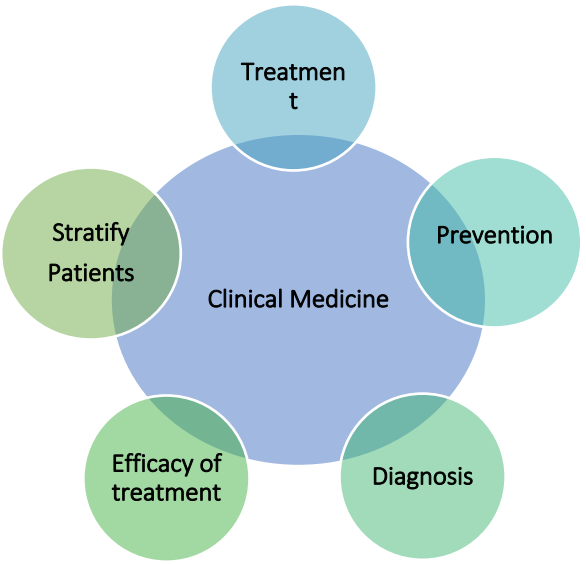

Figure 2: Clinical Medicine

Biomarkers are used to indicate various biological processes and comparison of normal process and abnormal body functions. Clinical medicine includes how to prevent a disease, diagnosis of a disease and treatment of that disease. Biomarkers play a vital role in covering all these aspects.

In clinical medicine, there are various types of biomarkers which are employed, and they are as follow:

Exposure Biomarker

Exposure biomarker includes any chemical/ metabolite that is exogenous in nature. It may be due to result of interaction between any target cell and xenobiotic compound. Particular biomarker of exposure indicates the presence of certain xenobiotic agent in some body tissue and fluids as well as products of excretory system.

For example, the lead concentration in blood can be used as marker that indicates exposure to lead. Similarly, the level of cotinine in saliva is used as biomarker to show the consumption of cigarette by an individual.

Effect Biomarker

Biomarker of effect is a measure of change or fluctuation in an endogenic factor that results in a disease due to being vulnerable to any factor that is exogenous in nature.

Those mutations which occur due to exposure to various carcinogens can act as effect biomarkers. The fluctuation in pulmonary rate acts as biomarker of exposure after an individual exposure to smoke of tobacco.

Susceptibility Biomarker

Susceptibility biomarkers are indicators of those factors that affect response to the

environmental factors. These markers indicate genetic variations among individuals which show the extent of susceptibility of individuals to any environmental factor.

For example, skin cancer is likely related to sun burn in excess but not every individual develops skin cancer even if exposed to same amount of sunburn.

In clinical medicine, there are two aspects of biomarkers of exposure and susceptibility. The first aspect indicates the exposure that is hazardous and results in negative impacts on human body. The second aspects deal with exposure to treatment that results in positive healthy impacts in human body leading to improved condition and recovery of patient. In clinical medicine, the first aspect deals with the prevention of disease and diagnosis while second aspect deals with the treatment of disease and recovery.

Clinical trials

Clinical trial is a kind of research that deals with the studies involving a certain test or treatment which is given to people and evaluating that how safe that treatment or test could be. When it becomes evident that treatment is safe and accurate then it becomes a standard treatment.

Clinical trials fall into four phases.

Phase 1: It deals with the selection of dosage of drug and possible toxicities that can result by drug.

Phase 2: It deals with efficacy of drug that how much effective it can be and leading to testing at phase 3.

Phase 3: It involves comparison of new method of treatment and already existing treatment. If new one gives better results, then it is adopted as gold standard to cure problems.

Phase 4: It is carried out when a drug has been approved. It deals with collecting the information about the possible side effects, degree of safety and the associated risks as well as benefits in long term. (Tomer, 2021)

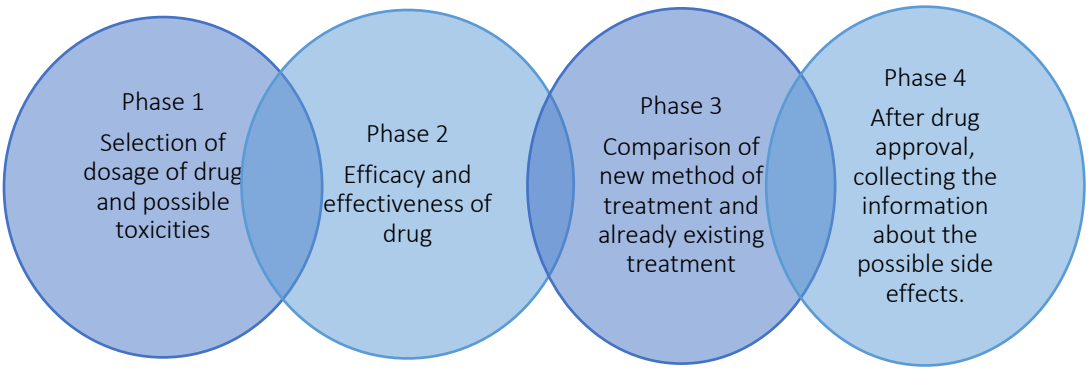

Figure 3: Phases of Clinical Trials

Classes of Biomarkers used in Clinical Trials

In clinical trials, the biomarkers which have been used fall into two categories:

- Safety biomarkers
- Efficacy biomarkers

Safety Biomarkers

Safety biomarkers are those biomarkers that are measured before and after exposure to any drug or environmental factor to indicate the possibility of a disease along with the level of toxicity as a side effect. For clinical and testing purposes, those safety biomarkers should be used to monitor various functions of important organs that are commonly used in lab and are monitored constantly. Therefore, in clinical trials selection of appropriate test should be done

carefully and based on profile of compound and toxicity related data.

Safety biomarkers are further divided as follow:

- Biomarkers for liver safety
- Renal safety biomarkers
- Biomarkers of hematology safety
- Bone safety biomarkers
- Biomarkers for basic metabolic safety

Biomarkers for liver Safety

These biomarkers indicate liver state and its response to various drugs and detecting the level of toxicity that can be caused it. For example, to evaluate the level of toxicity in liver, bilirubin, and aminotransferase act as safety biomarker. GGT (Glutamyl Transpeptidase) acts as biomarker for liver cholestatic injury.

Renal Safety Biomarkers

Kidney is a vital organ for the excretion of toxic substances and various biomarkers are used to indicate healthy and pathological state of kidney. For example, *KIM 1* (kidney injury molecule 1) is one of the most qualified biomarkers for renal safety. Cystatin .C is an important biomarker for kidney and its very low level is present in urine of a healthy person.

Biomarkers of Hematology Safety

These biomarkers act as indicators of change in count of components of blood. Bone marrow is the main target for cytotoxic agents which cause change in blood components. The most important safety index includes the complete count of blood which include an individual total hemoglobin count, total count of red blood cells, total count of white blood cells, and average volume of red cells in total hemoglobin etc.

Bone Safety Biomarkers

Bone is the major connective tissue that undergoes continuous remodeling process in which various components are degraded by bone dissolving cells and new tissues are built by bone forming cells. Calcium and Phosphate level in serum act as biomarkers of safety in bone.

Biomarkers for Basic Metabolic Safety

Metabolism constitutes total reactions occurring in biological systems and a certain level of many compounds constitute the normal metabolism. There are certain compounds or metabolites which distinguish normal metabolic state from abnormal one which include Glucose level in blood,

Cholesterol level, Level of Triglycerides

Efficacy Biomarkers

The biomarkers which are used to indicate the level of effectiveness of a given treatment or prescribed drug according to the disease. The higher level of positivity indicates higher level of efficacy of drug.

Efficacy biomarkers are further categorized as follow:

- Surrogate biomarkers
- Predictive biomarkers
- Pharmacodynamics biomarkers
- Prognostic biomarkers

Surrogate Biomarkers

A surrogate biomarker is an indicator employed in laboratory for clinical trials to monitor a response of drug. It can be used to evaluate the benefits as well as harms associated with a drug. They demonstrate that how a patient feels after exposure to a drug and considered as alternative of clinical endpoint for example, Blood pressure in stroke is considered a surrogate marker. Cholesterol is also a surrogate marker. (Brotman & Prince, 1988)

Predictive Biomarkers

The biomarkers which provide information about the effect of a therapeutic treatment. They predict the effectives of a drug that whether it will work or not for a particular purpose. These biomarkers classify the patients into groups of respondents and non-respondents based on response to a drug.

Predictive Biomarkers and Personalized Medicine

As predictive biomarkers predict the suitability of a treatment, by utilizing this information the treatment can be designed according to the genetic make- up of an individual. This concept is called

"Personalized Medicine"

Predictive biomarkers as genomic biomarkers describe the relationship between exposure of drug and variation in response of individuals to the drug. Based on this response further dosage given is specific to the genotype.

Prognostic Biomarkers

Prognostic biomarker provides information about tumor specific tissues and predict the risk of a disease without providing treatment or therapy. It is measured prior to the treatment and identifies tumor related characteristics, changes in methylation pattern of DNA, proliferation of cancer cells that are associated with severe outcomes.

A population which tests positive for a given marker has more chances of long-term survival than the population which is negative for a given biomarker. These biomarkers aid in the selection of patients which seriously need therapy. For example, in the disease Acute Myeloma Leukemia, abnormalities in cytogenetic factors act as prognostic biomarkers to categorize the patients according to risk. In cardiovascular incidents, CRP acts as a prognostic biomarker.

Pharmacodynamic Biomarker

Pharmacodynamic biomarkers are indicators of the response of an individual who has been given a drug or treatment. They act as indicators for monitoring the effect of drug on the target in an individual. They provide information about the change in biochemical pathways when a drug reaches the target. These biomarkers determine the level of dose which is effective for a person and schedule of a dose.

For example, the blood pressure acts as pharmacodynamics biomarker to evaluate the response of a person suffering from hypertension when exposed to blood pressure lowering drugs. The level of cholesterol in blood also serve as pharmacodynamics biomarker when patient response to the lipid lowering drug is checked.

Thus all these kinds of biomarkers are used in clinical trials on the basis of which treatment is given to the patient and if these trials become successful then on the basis of results obtained from these biomarkers, those treatments are adopted as gold standard treatment and used in clinical medicine.

Features of an ideal Biomarker

There are some features of an ideal biomarker that make it specific for checking the condition of disease. It should have the following characteristics:

- It is cost effective
- Inexpensive
- Consistent across ethnic groups and gender.
- It should be non-invasive.
- They have accessible sources, such as blood.
- It allows early identification and there is no overlapping in values between healthy and diseased person.
- It should be helpful in reducing the death from cancer.
- It gives reproducible results and for screening purpose multiplexing is possible.
- It should be consistently validated in multiple populations of Alzheimer's disease patients.
- Accuracy in reflecting total disease burden.
- Minimal patient discomfort and reasonable expense should be associated with collection to enable serial studies to monitor disease progression.

- It should be validated in clinical trials and predict the onset of cognitive symptoms.

Features of an Ideal Biomarker for Kidney Toxicity

- It should be demonstrative after active damage and ought to be early visible.
- It ought to be delicate, but it should also connect with the seriousness of harm.
- In the case of the kidney, it should be available in the peripheral tissue, for example, it should be easily measured in blood.
- In tissue it should be stable and after some time has passed it can be easily measured for example, after a necropsy performed or a biopsy has been taken.
- It should be connected to a known mechanism. Through statistical analysis of gene expression many current biomarkers are identified.
- It should be able to localize harm. For example, it should pinpoint the specific range of the kidney that has been harmed instead of indicating the kidney toxicity.

Advantages and Disadvantages of Biomarkers

Advantages	Disadvantages
Precision of measurement	Timing is critical
Objective assessment	Robustness of analysis techniques used in clinical trials
Validity and Reliability can be setup	Ethical responsibility
Less biased than questionnaires	Normal range difficult to establish
There is Homogeneity of disease	Laboratory errors
Disease mechanism often studied	Lack in biomarkers characterization/validation strategies

Uses /Applications of Biomarkers

- They can be easily measured.
- They can measure the Normal biological processes that occur in the body (heart rate, blood pressure, temperature)
- They also measure the disease processes in the body (disease stage).

Role of Biomarkers in Personalized Medicine

They will allow the early identification of disease to facilitate optimization of therapy. They will play a crucial role in combination of diagnosis with therapeutics. This is a crucial aspect of personalized medicine.

Role of Biomarkers in Risk Assessment

They can be utilized to access earlier exposure, to distinguish changes and impacts that happen inside the organism. They can assess underlying susceptibility of an organism. They are important tools for understanding the extent and nature of human exposure and hazard from natural toxicants and pollutants.

Role of Biomarkers in cell Biology and Genetics

In cell biology, a biomarker could be a molecule that permit the detection and isolation of a specific cell type.

For example, the protein Oct-4 is utilized as a biomarker that recognize the embryonic stem cells.

In genetics, a biomarker may be a DNA sequence that causes disease or is related with susceptibility to disease. They can be utilized to make genetic maps of whatever organism is being studied.

Use of Biomarkers as Health and Disease Predictors

They are utilized to anticipate serious illnesses, for example, diabetes and cardiovascular disease. Each individual biomarker shows whether there is infection or health state and can be combined to provide a detailed picture of how a person healthy is and whether a diagnosis needs to be made.

Role of Biomarkers in Cancer Detection

The principles of biomarkers in disease have been applied to the detection, screening, diagnosis, treatment and checking of cancer. Anti-cancer drugs were those agents that killed both cancer cells and healthy cells. However, more targeted therapies have now been developed that can be directed to kill cancer cells only, while sparing healthy cells. (Paone, Phillip Waalkes, Robinson Baker & Shaper, 1980).

The assessment of a typical biomarker in cancer helps in the improvement of therapies that can target the biomarker. This may minimize the chance of harmfulness and check the cost of treatment.

Role of Biomarkers in Medicine Development

Basically, there are two main amins of using biomarkers in medicines development are as:

Improving the Processes of Medicines Development

Clinical trials seek to measure responses of patients to a treatment. Biomarkers can give an alternative way of measuring the result, If it is not possible to measure the response directly (they serve as surrogate endpoints). (Kraus, 2021)

Tailoring Treatment to Individuals

Biomarker research helps to improve how well able to anticipate a person's chance of infection. How an infection might progress once it is identified, and how an individual will react to a medicine. This will enable safe and more effective treatment choice.

Organization of a Program in Protein Biomarker Discovery

"Cancer" has been picked up as an example of organization of program in protein biomarker discovery which is generally combined into three fundamental and core components that are, Informatics, Reagents, and the assessment of technology. Further adding in its development, each of the afore mentioned components will support via resources and services provided, the plethora of organized projects, satellite projects, surrounding the pilot projects, cancer sites and biomarker mines.

Cancer Site Teams

The teams for the cancer sites generally demonstrate and include members and group of investigators that are committed and fully devoted for the discovery of biomarker at cancer sites that is colon, lung, breast, and prostate. The different amount of teams working, would have clinicians that have been provided with access and reach to the tissues of human at that specific site, certain scientists and researchers working in collaboration on mouse models and few other researchers skilled enough for; mass spectrometry, enrichment methods, preparation of antibodies, informatics and fractionation of proteins. (Karachaliou & Rosell, 2015)

Biomarker Mines

The components of biomarker mines generally include single or few investigators or mini groups that are committed for finding and optimizing the techniques for discovery in biomarkers. The methods for optimization occur in specific classes or categories of

biomarkers that is Secreted proteins or cell surface proteins. For optimizing and finding out the methods for biochemical fractionations, bioinformatics, workup of tissue and biomarker analysis demands special attention to be carried out which mostly lacks in case of cancer site teams where people are more devoted for discovering and finding out the biomarkers for a cancer specific site. ("Committee on A Framework for Developing a New Taxonomy of Disease | The National Academies Press", 2021)

Informatics Platform

The informatics platform and core usually contain tool for enabling laboratories which can further communicate and compare data efficiently. The Informatics core generally makes a format of standard data that can then compare and facilitate the comparisons of different platforms. Eventually, the core for the candidate markers would assemble and further curate data sources.

Reagents Core

Reagent Core generally contains and organizes devices and tools for discovery of biomarkers, further it maintains performance data, request forms, characterizations, and virtual databases of all the reagents. Reagents that we are talking about includes human, mouse and mice tissues and their plasmas', bodily fluids, protein and peptide combinations for analysis, some standard reagents that are developed by investigators and finally for candidate enrichment we would require antibodies. The reagents that are required would be based on their quality and performance which will then be transferred to other core satellites and facilities.

Challenges and Improvements

The improvement related to the discovery of protein biomarker is possible but the separation and identification of protein, protein biomarker, within therapies and diagnostics remains one of the key limitations that needs to be addressed properly so that we can flourish easily. The improvements accompanied with technology would be evident in the upcoming years which will greatly contribute to the process of discovery. These improvements within technology can be evident in protein quantitation, its fractionation, arrays, detection, mass spectrometry and other procedures and methodologies accompanied and related to discovery process.

In support with the improvements in technology for biomarker discovery, the technology assessment core needs to develop certain well-equipped laboratories that contain appropriate protocols and techniques. At first, the technology assessment core would use the reference and standardized plasma so that current technologies can be compared in each individual step of the discovery of biomarker. Further then, the best suited and high-performance based technologies could be integrated so that new technologies can be developed and tested. The usage of optimized and integrated platforms and core for the identification of biomarkers would be done using mouse models.

Conclusion

As we have talked about biomarkers, ways of production and its techniques, advantages and disadvantages, challenges, and improvements to be made in its discovery. So, concluding our article, we would like to say that biomarkers must play a huge role in the process of drug development and biomedical research. By understanding the relation amongst the biological processes and clinical outcomes, we can increase, expand, and further elaborate our ways of treatment of diseases by using biomarkers. During 1980, the use of biological markers as surrogate outcomes was mostly used for the treatment of heart and cancer diseases. Ever since then it is highly used and discussed. The Food and Drug Administration (FDA) has fully supported and welcomed the progress being made in biomarker for the treatment of diseases and tends to support new research on potential new biomarkers.

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