PERSONALIZED MEDICINE *IS IT THE WAY FORWARD IN HEALTH CARE?*

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- **OUTLINE**

  - BACKGROUND
  - POTENTIAL APPLICATIONS
  - CONCERNS & OPPORTUNITIES
  - EDUCATION
  - TRACE METALS
  - HALOTHERAPY

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- Medical Model Proposing Customization of Health Care
- All medical decisions directed to the patient
- Term first used context of genetics & genetic information
- As all medical decisions target the patient, PM involves the use of technology to enhance the personalization of the patient

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- **BACKGROUND**
- Traditional clinical diagnosis focuses on patient's clinical signs and symptoms, medical & family history & clinical laboratory data
- This is a reactive approach treatment/medication starts after symptoms appear
- Advances in genetics (Human Genome Project) have advanced our understanding of the impact of genetics on human disease

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- **POTENTIAL APPLICATIONS**
- Improves understanding of role of genes in normal human development & physiology
- Identifies single nucleotide polymorphisms (SNPs)
- SNPs account for genetic variability between individuals
- Allows use of genome-wide association studies (GWAS) to examine genetic variation & risk for many common diseases

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- Impact on medications - pharmaceuticals
- Developed based upon empiric observations
- Examples, antibiotics developed to inhibit growth of microbes
- Drugs for high blood pressure designed to act on pathways involved in hypertension
- Medications for high cholesterol target absorption & metabolism of cholesterol
- Drugs for diabetes target improving insulin release & use by tissues

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- **Pharmacogenetics**
  - Advances in molecular biology & genetics = molecular medicine
  - Created "companion diagnostics" = proteins, genes & specific mutations are assayed in a patient creating specialized individual treatments
  - Doing so stratifies disease status in patients
  - Allows for proper medications & dosages
  - Allows for detecting risk factors
  - Allows for prevention strategies

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- **Pharmacogenetics (pharmacogenomics)**
  - Field of study examines impact of genetic variation & drug responses via biomarkers
  - Aims to optimizing proper drug therapy @ dosage for patients – increasing efficacy & safety
  - Other benefits – by monitoring biomarkers - reduces time, cost & failure rates in clinical trials in developing new medications
  - Increases opportunities to develop novel therapeutics
  - *Example* – genotyping variants of Cytochrome P450 involved in metabolism of warfarin (Coumadin)

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- **Proteomics**
  - Analysis & characterization of proteins encoded by the human genome – *may* have impact on human disease
  - DNA provides the *blueprint*, proteins *do* the work
  - Functions of the cell controlled by signal transduction mechanisms – cell growth, differentiation, movement/localization & death
  - All functions acted upon by proteins, enzymatic activity
  - Diseases, genetic influence (mutations), information processed through action of proteins

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- **Proteomics**
  - Development of pharmaceuticals has been targeted to address faulty proteins not the altered genes
- **Pharmacometabolomics**
  - Because pharmaceutical efficacy is directly related to their metabolism by the body, knowing how effective drug metabolites are utilized by the body in any patient can be useful in predicting therapeutic responses to any pharmaceutical being considered for use

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- **Oncology – Cancer Management**
  - Tumors classified based upon anatomy & pathology
  - Includes examination of cellular markers in tumors (HER2/NEU) in breast cancer
  - New molecular testing methods (biomarkers) to identify altered genes & proteins related to tumors
  - Improved diagnosis & improved therapeutics
  - Cancer genetics – identification of altered genes related to increased predisposition to certain cancers
  - Familial cancers account for up to 10% of all cancers

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- **Personalized Management of Cancer**
  - **Testing for *BCRA1* & *BCRA2* mutations for heredity breast-ovarian cancers**
  - **Minimal residual disease (MRD) identifying tumor markers to quantify residual presence of tumor tissue**
  - **Targeted therapy used to pinpoint therapeutics to specific molecular pathway in diseased tissue**
    - **Herceptin (trastuzumab) for women with breast cancer where HER2 protein is overexpressed**
    - **Tyrosine kinase inhibitors (imatinib/Gleevac) in CML where BCR-ABL fusion gene is overexpressed (95% cases)**

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- **Customized Pharmaceutical Products**
  - Compound pharmacy – oral medications
  - Less common service available through local pharmacies "polypills" can be obtained via Mail-Order
  - Hospital pharmacies still combine meds for i.v. use
  - New using "laser-jet" technology. Each compound dissolved in a solvent
  - As long as prescribed medication/dosage is within patient's profile, customized product does not require FDA approval

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- **NOTABLE CONCERNS & OPPORTUNITIES**
  - **Barriers to genetic testing – what is done with the information? Employers & insurance companies**
  - **2008 President Bush signed "Genetic Information Nondiscrimination Act"**
  - **New molecular diagnostic tests may provide for clinicians opportunity to more effectively diagnose & monitor patient disease status**
  - **Theranostics – developing personalized meds for patients taking into account optimal patient response & resistance profile - *Little evidence to date therapies being developed***

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- **Cost vs benefit?**
  - Initial costs for new diagnostic tests & individualized therapies may be increased VS
  - Use of PM meds may decrease care costs over time
  - Insurance coverage? Based upon actuarial stats using large populations; PM use based upon very small populations, thereby lower actuarial estimates – less attractive over short-term, should increase over-time
  - For health care providers, use of PM should improve health care delivery through more precise diagnostics & effective therapies leading to better patient outcomes

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- **Education**
  - Increasing number of universities are increasing focus on PM through their medical schools
  - Sub-specialties in PM being developed at Duke, Harvard & Mt. Sinai
  - New medical school focused on approaching medical education trough PM being developed in Arizona through a partnership between ASU & Translational Genomics Research Institute (TGen)
  - In Connecticut, Helix Health first privatized clinical medical practice in operation focused on PM. Teaching medical residents on the use of PM

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- **TRACE ELEMENTS – USE IN PM?**
- **Iron, copper, iodine, manganese, selenium, zinc, chrome, cobalt, fluorine, lithium, nickel and silicon are the most important ones – ESSENTIAL for normal physiological function(s)**
- **Not produced by the body**
- **When documented to be deficient (diet) must be replaced & body storage replenished**

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- **HALOTHERAPY**
  - Therapeutic use known by the Greeks & Romans
  - Mid 19th century salt mine workers in Germany & Poland evidence less respiratory alignments
  - Exposure of salt air (calcium, magnesium & sodium) as a therapeutic to treat a variety of respiratory diseases including asthma, bronchitis & cystic fibrosis
  - Individualized treatments in a confined area, historically in caves now in designed treatment spaces with use of halogenerators or salt lamps to aerosolize rock salt into ionized particles

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THANK YOU FOR YOUR ATTENTION