EDITORIAL

Personalised Medicine - Bespoke Healthcare is the Latest Trend

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Personalised medicine is one of the most rapidly expanding and arguably the most exciting paradigm in medicine. It promises dramatic reductions in healthcare expenditure in conjunction with greater efficacy and safety of therapies that are tailored to the individual needs of each patient. It involves molecular profiling of patients with subsequent tailoring of treatments to offer timely, targeted prevention of disease. The completion of the Human Genome Project (HGP) 12 years ago catalysed much of the genetic profiling utilised in personalised medicine today[1]. Although it was thought that once the human genome was sequenced, we would find 'the gene' causing each disease, it is now acknowledged that many genetic and environmental factors often synergistically cause disease.

It is hoped that future identification of susceptibility variants with significant disease associations will allow for the appraisal of individual disease risk. Encouragingly, genome-wide association studies (GWAS) have linked numerous polymorphic DNA sequence variants to many common diseases[2]. Moreover, advances in next generation sequencing following on from the HGP contribute greatly to translational research in genomics. Specifically, panels of genes and biomarkers are being catalogued, facilitating the individualisation of modern medical interventions. Molecular markers for genetic profiles will guide targeted treatment while genetic loci for disease susceptibility will determine those who would benefit from prophylactic intervention[3].

Personalised Medicine and Cancer

Current cancer treatment involves surgery, chemotherapy and radiotherapy depending on the type, site and stage of the tumour. Nonetheless, not all patients with the same type or stage of tumour will respond to the standard treatment regimen. This disparate response is due to genetic heterogeneity. Consequently, the input of personalised medicine in cancer prevention, diagnosis and treatment is imperative as it has the potential to negate such disparity. Molecular diagnostic and pharmacogenetic intervention in cancer allows for the specific targeting of genes or proteins which are essential for cancer growth and survival. Personalised medicine allows for the stratification of cancer patients into low- and high-risk groups according to specific genetic signatures and thus directs therapeutic interventions appropriately[4]. In breast cancer, molecular diagnostic tools such as MammaPrintTM (70-gene prognostic signature of breast cancer) can determine treatment protocol[5]. Cusumano and colleagues[6] found that MammaPrintTM classification (low- vs. high-risk) influenced adjuvant chemotherapy recommendations and decreased inter-institutional and international variation in adjuvant treatment guidance for patients.

Holistic Healthcare

There is much debate as to whether or not personalised medicine is a more patient-centric paradigm. Notably, personalised medicine utilises a combination of individual genetic, clinical, familial, and demographic variables to inform decision making on disease prognosis, prevention, diagnosis and treatment[7]. The integration of these variables, forming models of disease prognosis and progression is arguably more holistic than any other medical field to date. Personalised medicine is attempting to form a 'picture' of the patient which assimilates factors from their genes to their lifestyle and everything in between. This is no mean feat.

Personalised medicine heralds the new era of proactive healthcare which endeavours to predict and prevent disease. This is in stark contrast to the reactive, one-size-fits-all medical model where patients with the same disease are given the same drugs at the same dose. The benefits of a proactive approach as exemplified by BRCA1 and BRCA2 gene detection include regular mammography, chemoprevention and prophylactic surgery thus minimising or eliminating disease risk[8]. The shortcomings of a reactive approach include increased adverse side effects, poor adherence, and trial-and-error prescribing with accompanying cost implications. Thus by using targeted therapies, personalised medicine aims to minimise adverse effects while maximising therapeutic benefit, getting ever closer to Paul Ehrlich's "magic bullet"[9].

Ivacaftor Controversy

The individualisation of healthcare has in some cases incurred substantial costs. For instance, the drug Ivacaftor (KalydecoTM) was developed as a targeted therapy for a subset of cystic fibrosis (CF) patients with a rare, functional G551D mutation in the cystic fibrosis transmembrane conductance regulator (CFTR) protein[10]. While Ivacaftor offers substantial benefits to this subgroup of patients it incurs an equally substantial cost to the Irish Exchequer. An estimated 121 patients benefitted from Ivacaftor in 2013, nevertheless it cost the Exchequer in excess of €28 million in that year alone[11]. In a socialised healthcare system such as Ireland's this creates an ethical dilemma in terms of fair allocation of resources in the context of a finite budget. While products of pharmacogenetics such as Ivacaftor have remarkable potential, future endeavours in personalised medicine will no doubt spark many more such debates.

Conclusion

Personalised medicine is arguably a more patient-centric and holistic paradigm in healthcare, bringing with it the potential for great innovation and abundant benefits for patients into the future. By tailoring interventions therapeutic effectiveness will increase, while adverse effects and misdirected expenditure will decrease, thus heralding more effective and cheaper healthcare[1]. As molecular markers and genetic signatures are akin to a unique disease fingerprint treatments will be tailored according to the needs of the patient. With these weapons in its armoury, personalised medicine can generate pathway-directed genetic patient profiles which for example, could curtail exposure to costly therapies in poor-responders[3].

Notably, personalised medicine may lead to ethical quandaries in which fair allocation of resources must balance individual patient benefits. Reassuringly, the costs of high-throughput genotyping and DNA sequencing are continually decreasing while there is an ever increasing volume of genetic data being deciphered to amass genetic patient profiles[3]. In sum, it appears that personalised medicine has the capacity to shape the future of healthcare and offer much hope and innovation for the benefit of patients. There is however, much work that remains to be done if patients are to reap the potentially immense advantages of such practices.

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