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Editorial

Precision medicine in the era of live cell imaging

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Precision medicine is a new frontier for health and medical care combining individual's health status assessment, environmental factors, lifestyle, genetics, pharmacogenomics, population health analytics which determines the populations at risk, their needs for health care and to help deliver the right care to the right people, and big data analytics using artificial intelligence (AI) and machine learning (ML) algorithms which identifies hidden patterns and unknown correlations **[1,2]**. It encompasses customization of healthcare, with clinical decisions, managements, medical practices, or healthcare products being tailored to the individual patient. In this context, a term 'personalized medicine' was used in the recent past but has been done away with because the term could be misinterpreted to imply that treatments and preventions are being developed uniquely for each individual in the population **[3]**.

Precision medicine is one of the most promising approaches in the future for tackling diseases that have so far eluded effective management. Relatively rare genetic or hereditary conditions, degenerative disorders and malignancies have very high morbidity and mortality and are of great socio-economic burden on the families and societies as a whole. Future physicians and healthcare workers will be equipped with detailed electronic health records, genomic testing, big data analytics, and supercomputing in attaining more accurate, precise, proactive and impactful treatment for each individual **[1]**.

Pharmacogenetics is an integral part of the precision medicine which studies the genetic make-up of an individual and how they respond to different drugs thereby developing effective, safe medications and doses that are tailored to variations in an individual's genes **[3]**.

Apart from genetics and data analytics, one important tool in precision medicine is imaging **[4]**. Molecular imaging and live cell imaging are the cutting edge techniques detrimental in the success of precision medicine. Molecular imaging procedures are minimally invasive, safe and cause little pain to the individuals; and comprise of nuclear medicine and radio-pharmacology making use of small quantities of radio-active isotopes **[5]**. Live cell imaging allows observation of cellular processes in real time **[6]**. Ultrasonography is a non-invasive, non-ionizing technique which bypasses the potential radiation hazards of radio-nucleotides used in molecular imaging. Ultrasonic waves easily penetrate most tissues, enabling deep imaging with excellent spatial and temporal resolution (~100 mm and ~1 ms, respectively) but till date has found relatively small role in cellular imaging owing to the lack of appropriate genetically encoded reporters **[7]**. Farhadi et al (2019) devised a technique for live cell imaging using ultrasonography by engineering mammalian acoustic reporter genes from three different microbial species that expresses intracellular air-filled protein nanostructures called gas vesicles, which produce ultrasound contrast. These

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mammalian acoustic reporter genes permit high-resolution imaging of gene expressions in-vivo **[7]**.

There are few challenges ahead for its wider application and utility: 1) the generation of gas vesicles could be toxic to cells, 2) expressing a complex set of interdependent bacterial genes in mammalian cells may require redesigning and refining the technique, 3) identifying endogenous genes of interest in different cells and tissues which can be re-coded for reporter gene expression **[8]**.

Application of acoustic reporter genes coupled with untrasonography in live cell imaging is very promising and opens new avenues in precision medicine.

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