



CALIFORNIA STATE SCIENCE FAIR 2016 PROJECT SUMMARY

Name(s) Daniel D. Zhang	Project Number S0539
Project Title Developing a Low Cost Noninvasive Prenatal Diagnosis for Genetic Disorders	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals The object of this study is to develop a low cost, noninvasive prenatal diagnosis using bench-top semiconductor sequencing platform (SSP). SSP can thus replace current expensive diagnosis method such as chromosomal microarray analysis (CMA) for large scale screening of genetic disorders in small clinical setting.</p> <p>Methods/Materials Development of a novel SSP based diagnosis method is composed of three steps. First, SSP detection sensitivity was significantly improved through increased concentration of abnormal DNA and SSP sequencing depth. Second, plasma samples from 1,456 pregnant women were analyzed for estimating fetal DNA concentration based on the size distribution of DNA fragments. Third, SSP of maternal plasma DNA was used to detect fetal subchromosomal abnormalities including gene duplications and deletions, followed by validation through conventional CMA.</p> <p>Results Noninvasive prenatal testing (NIPT) was previously only used to detect genetic disorders that resulted from larger chromosomal abnormalities, such as chromosome 21 duplications that occur in Downs syndrome. With the utilization of SSP, small chromosomal deletions or duplications can be identified such as those found in Cri du Chat syndrome, DiGeorge syndrome and many other genetic disorders. With 3.5 million read sequencing depth, SSP detected 56 of 78 (71.8%) subchromosomal abnormalities confirmed by CMA. With increased sequencing depth up to 10 million reads, sensitivity was improved to 69 of 73 (94.5%). Of 55 false-positive samples, 35 were caused by deletions/ duplications present in maternal DNA, indicating the necessity of a validation test to exclude maternal karyotype abnormalities.</p> <p>Conclusions/Discussion A noninvasive method has been successfully developed for prenatal diagnosis of genetic disorders. The SSP based diagnosis is significantly less expensive than traditional invasive CMA methods. This allows for broader applications in small clinics, making it feasible for early prenatal screening of genetic disorders.</p>	
Summary Statement I have developed a low cost, noninvasive method to replace current costly, invasive procedures for early diagnosis of genetic disorders	
Help Received I designed and performed the experimental tests. I got help from my mentor Professor Kang Zhang from UCSD for understanding of statistical analysis of my data.	