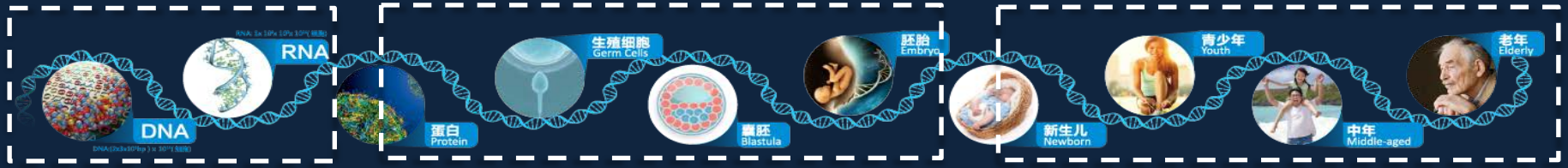
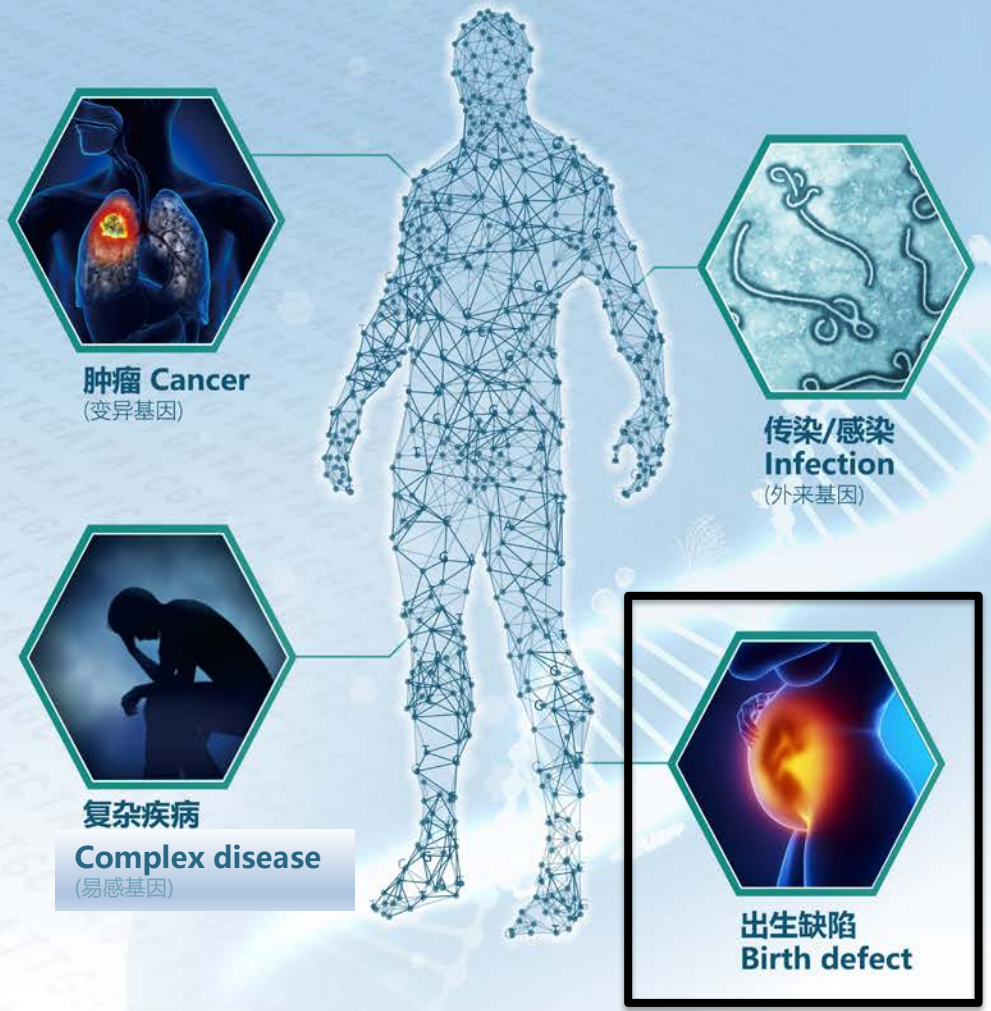
Personalized Medicine Benefits To Healthcare System And Society - the Chinese Perspective

Grover Yu PhD
BGI, China

Precision VS Evidence-Based



Genome	Transcriptome	Proteome	Metobolome	Immunome	Physiology、Imaging、Exposure
DNA/RNA Sequencers		MS/MRI，diagnostics（bio-chem, Immune）			Physiological, Wearable devices, CT, Ultrasonography
		PET-MRI / PET-CT， MRI			

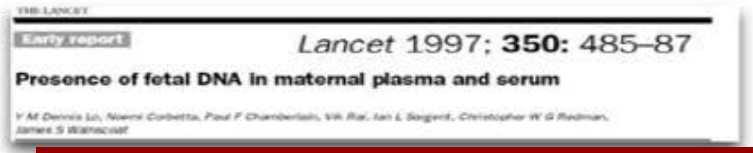


The basis of health is encoded in genes

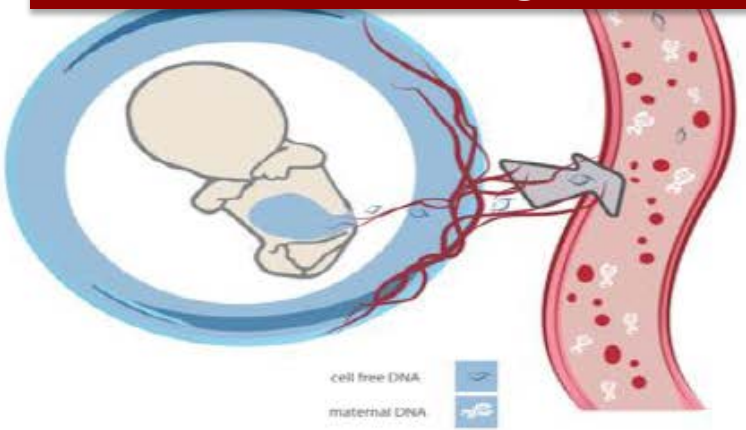
Technology	Accessible and Reliable
Cost	Affordable
Population	Scalable and Sustainable
Data	Manageable

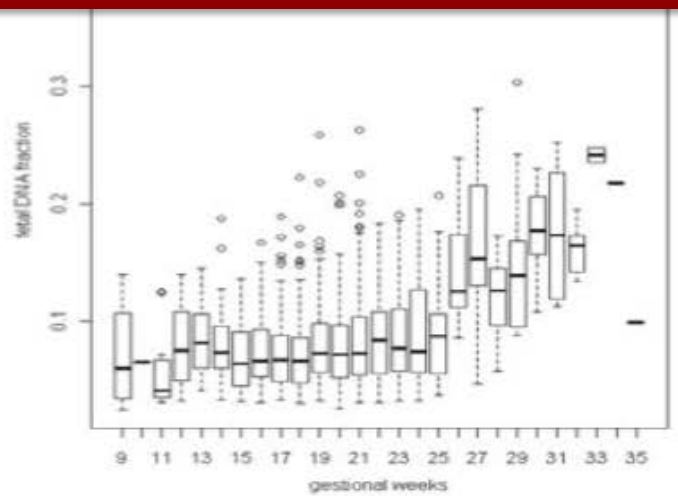
Technology Accessible

Circulating cell free DNA (ccfDNA) in maternal blood



To detect Trisomy 21, 18 and 13 non-invasively with high sensitivity and specificity using ccfDNA in maternal blood





Technology Reliable

China is the first country in the world that has specific regulation on NIPT

In order to standardize domestic NIPT market and avoid abuse of new technology. CFDA suspended NIPT in 2014 nationally and required CFDA approval from any provider that intends to perform NIPT.

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BGI got the first CFDA certificate in six months thanks to CFDA’ s **novel registration process** for supporting implementation of new reliable technology.

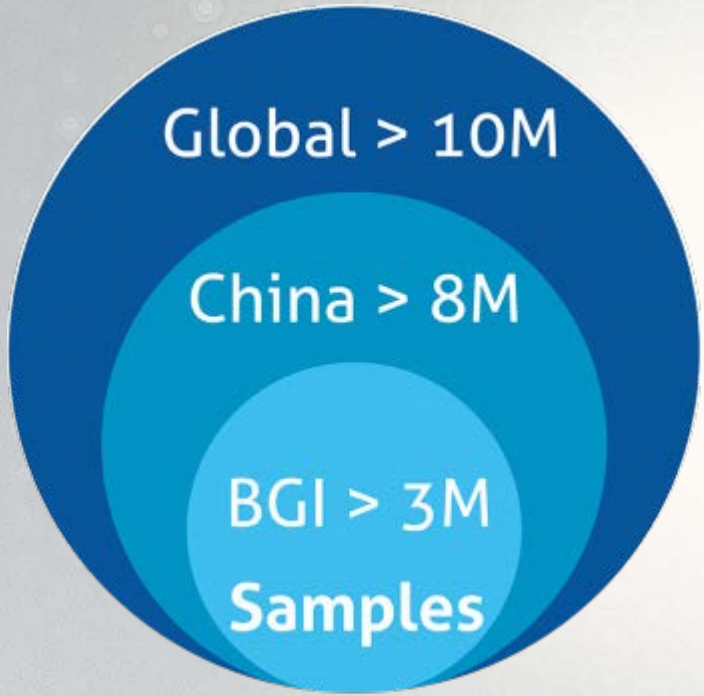
Technology reliable

According to the global assessment of NIPT on New England Journal of Medicine 2015,

NIFTY from BGI enjoys honor of the Best Performance Lab.

Lab(Test Name)		%	True positive	False positive
Sequenom (MateniT21, SafeT21)	121	44%	98(81%)	23(19%)
Ariosa (Harmony)	25	9%	18(72%)	7(28%)
Natera (Panorama)	40	14%	32(80%)	8(20%)
Ilumina (Verif)	44	16%	35(80%)	9(20%)
BGI (NIFTY)	**47**	**17%**	**41(87%)**	**6(13%)**
Integrated Genetics (Informaseq)	1	<1%	0	1(100%)
Total	278	95%	224	54
unknown	16	5%		
Tota1	294			

Cheung S W, Patel A, Leung T Y. Accurate description of DNA-based noninvasive prenatal screening. New England Journal of Medicine, 2015, 372(17)



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Japan	$1000
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Europe	$723
Malaysia	$450
China Average	$308

Technology reliable

ULTRASOUND in Obstetrics & Gynecology

isuog

Original Paper | Free Access

Non-invasive prenatal testing for trisomies 21, 18 and 13: clinical experience from 146 958 pregnancies

Correction(s) for this article

H. Zhang, Y. Gao, F. Jiang, M. Fu, Y. Yuan, Y. Guo, Z. Zhu, M. Lin, Q. Liu, Z. Tian, H. Zhang, F. Chen, T. K. Lau, L. Zhao, X. Yi, Y. Yin, W. Wang

First published: 19 January 2015 | https://doi.org/10.1002/uog.14792

Affordable and Scalable

Shenzhen Model: Government allowance+ Maternity Insurance

- 2013 ： incorporating government allowance as the special suppport for biological development; **$90/person**
- 2013: incorporating social medical insurance; **$60/person**
- 2017:the first city incorporating NIFTY into city public health budget, supporting **$40/person** from finance plus **$80/person** from social medical insurance. The **coverage** of NIPT in Shenzhen is more than **80%** and we expect the number will go up to **90%** in 2018


广东省物价局
广东省卫生厅文件
广东省人力资源和社会保障厅

粤价〔2011〕276号

关于胎儿21-三体综合征基因检测筛查列入省医疗服务价格项目的通知

各地级以上市物价局、卫生局、人力资源社会保障局（社会保障局）、深圳市发展改革委、市场监管局、卫生与人口计生委、人力资源社会保障局、佛山市顺德区发展规划和统计局、卫生与人口计生局、人力资源社会保障局、中央、军队、武警、省属驻穗医疗机构：

为适应医疗技术发展，满足群众就医需要，现将“胎儿21-三体综合征基因检测筛查”（250700010-2）项目列入我省医疗服务价格项目，试行两年，指导价为1705元/次；并对原唐氏综合征筛查项目（250700010）进行修订。具体内容如下，请遵照执行。


广东省卫生厅

粤卫函〔2013〕53号

关于同意深圳华大基因临床检验中心开展胎儿染色体非整倍体无创基因检测等技术的批复

深圳华大基因临床检验中心：

根据你们的申请，经我厅第三方医疗技术审核机构审核，你中心具备开展胎儿染色体非整倍体无创基因检测、人乳头病毒基因分型检测和耳聋基因分型检测等3项技术的能力。根据《医疗技术临床应用管理办法》，经研究，同意你中心开展胎儿染色体非整倍体无创基因检测、人乳头病毒基因分型检测和耳聋基因分型检测等3项技术。以上技术应用于胎儿先天性缺陷和遗传性疾病产前诊断的（包括相应筛查），请按卫生部《产前诊断技术管理办法》（卫生部令2002年第33号）等有关规定办理，并按照《医疗技术临床应用管理办法》规定，加强相关技术的临床应用管理，保障医疗质量和医疗安全。

此复。


市政府办公会议纪要

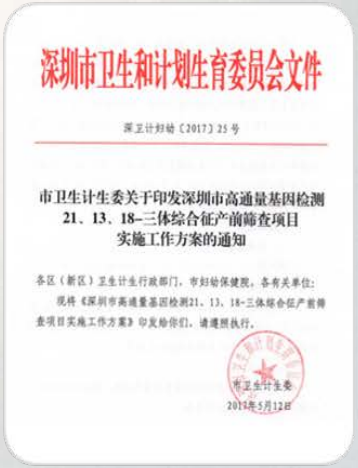
〔63〕

深圳市人民政府办公厅　　2013年2月20日

关于研究支持深圳华大基因临床检验中心开展基因检测技术应用第二阶段试点的会议纪要

1月28日上午，唐杰副市长主持召开会议，听取了深圳华大基因临床检验中心（以下简称华大基因）开展胎儿染色体非整倍体无创基因检测（以下简称无创产前基因检测）等技术的情况汇报，研究了相关问题，并就下一阶段工作进行了部署。纪要如下：

会议认为，2011年7月至2012年10月，华大基因与我市多家医院合作，共完成7132例孕妇样本检测，检出72例染色体非整倍体胎儿，通过核型分析验证，两者符合率为100%，考虑到


深圳市卫生和计划生育委员会文件

深卫计妇幼〔2017〕25号

市卫生计生委关于印发深圳市高通量基因检测21、13、18-三体综合征产前筛查项目实施工作方案的通知

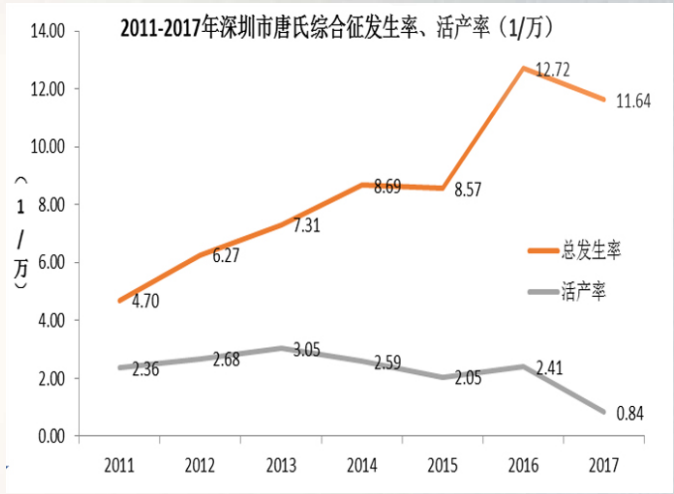
各区（新区）卫生计生行政部门，市妇幼保健院，各有关单位：

现将《深圳市高通量基因检测21、13、18-三体综合征产前筛查项目实施工作方案》印发给你们，请遵照执行。

市卫生计生委
2017年5月12日

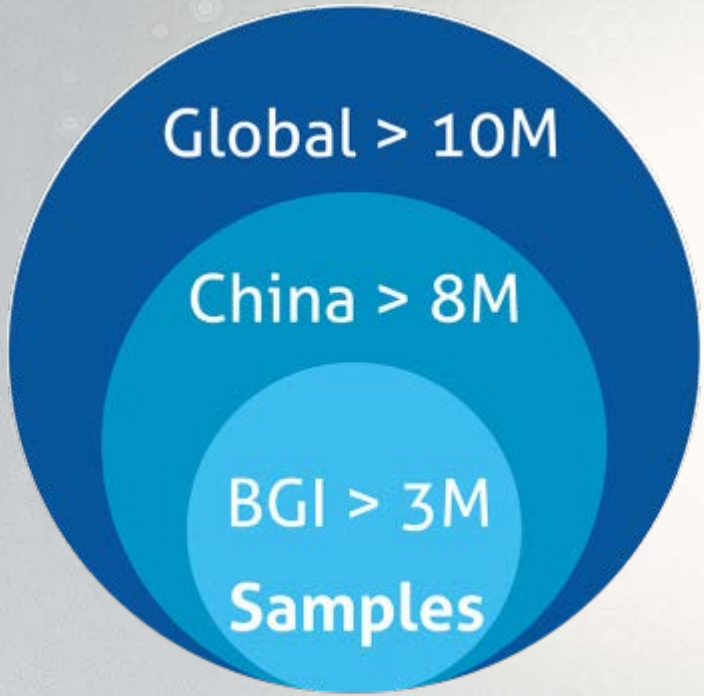
The live birth rate of baby with Down syndrome has been greatly decreased.

年份	出生数	唐氏病例数			总发生率 (1/万)	活产率 (1/万)
		活产数	终止妊娠数(或死胎死产数)	总例数		
2011	182956	43	43	86	4.70	2.36
2012	213729	57	77	134	6.27	2.68
2013	207841	63	89	152	7.31	3.05
2014	205990	53	126	179	8.69	2.59
2015	211262	43	138	181	8.57	2.05
2016	213024	51	220	271	12.72	2.41
2017	240481	20	260	280	11.64	0.84
合计	1475283	330	953	1283	8.70	2.25



——With the advocation of two child policy in family and increasing maternal age, Down syndrome occurring rate has obviously increased, but with effective intervention, the live birth rate of baby with Down syndrome has been greatly decreased from 2.36/10K in 2011 to 0.84/10K in 2017.

Affordable NIPT in China



Country / Region	Price
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Europe	$723
Malaysia	$450
China Average	$308
Shenzhen	**$0** paid by social medical insurance

This model is adjustable and applicable in one way or another.

Up to date, BGI has developed the model for more than 20 provinces in China, making personalized medicine accessible, reliable , affordable, scalable, sustainable

3.4M NIPT genetic tests in China accomplished by BGI

Lower Pass, Bigger Data

A data set of ***140K+ samples***

(the biggest data research

ever)on Chinese population is

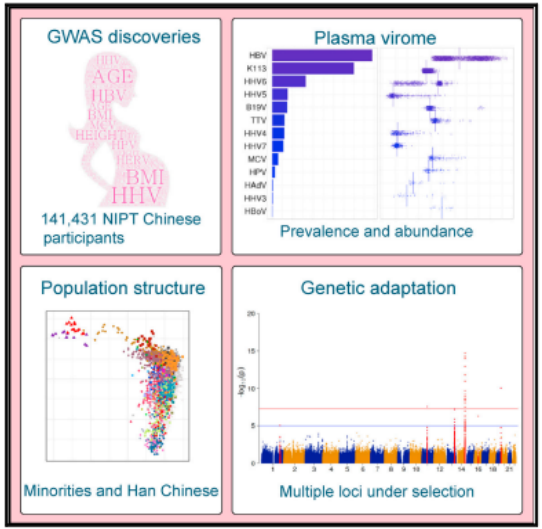
published on ***Cell*** on Oct 4, 2018.

Article

Cell

Genomic Analyses from Non-invasive Prenatal Testing Reveal Genetic Associations, Patterns of Viral Infections, and Chinese Population History

Graphical Abstract



Authors

Siyang Liu, Shujia Huang, Fang Chen, ..., Xin Jin, Rasmus Nielsen, Xun Xu

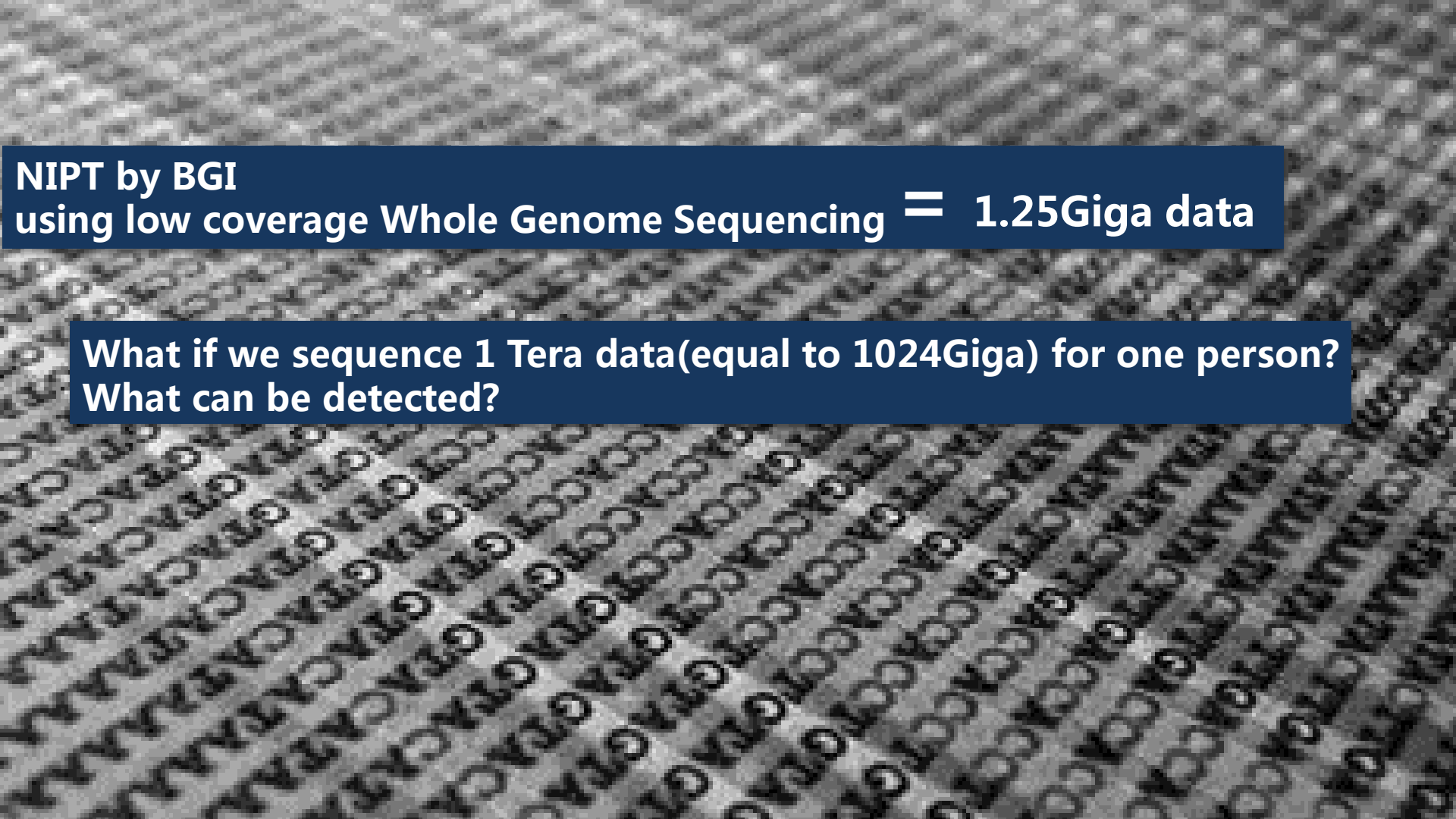
Correspondence

wangjian@genomics.cn (J.W.), albrecht@binf.ku.dk (A.A.), jinxin@genomics.cn (X.J.), rasmus_nielsen@berkeley.edu (R.N.), xuxun@genomics.cn (X.X.)

In Brief

Large-scale analysis of genome sequences from non-invasive prenatal testing in Chinese women yields insights into phenotypic trait associations, viral infection patterns, and population history.

What is more?

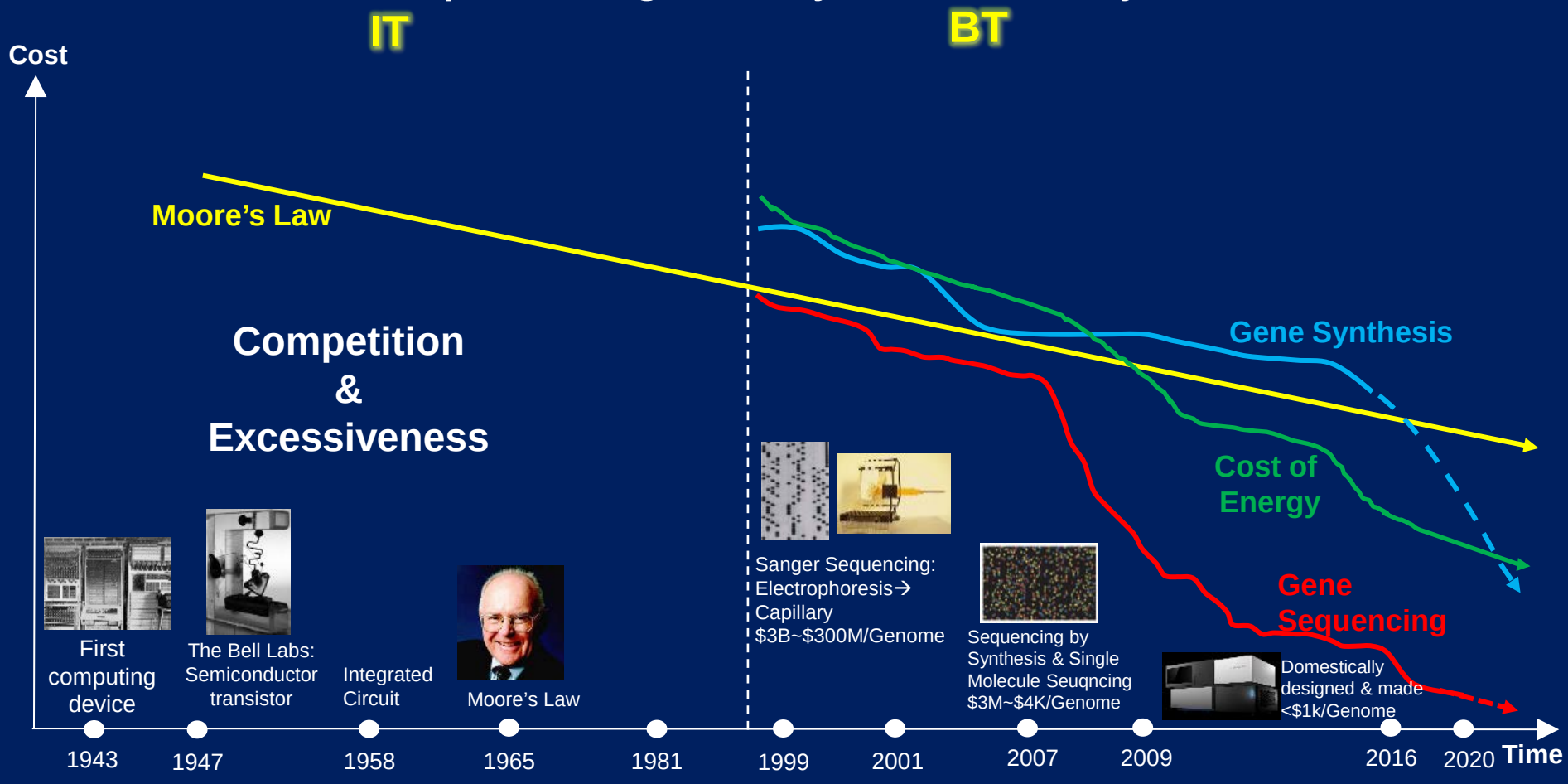

NIPT by BGI
using low coverage Whole Genome Sequencing = 1.25Giga data
What if we sequence 1 Tera data(equal to 1024Giga) for one person?
What can be detected?

From limited known to reality, more than 90% of birth defects can be detected

	Fertility products Data	10^7	10^8	10^9(Giga)	10^{10}	10^{11}	10^{12} (Tera)	Application
Biomarker Detection	Thalassemia gene test 301	$4x10^7$ (50x,0.2M,PE100)						Gene screening of thalassemia test 301 mutations
	NIFTY®Basic		$2.1x10^8$ (0.1x,6M,SE35)					Abnormal chromosome number+9 kinds of CNV
	NIFTY®Pro 1.0/2.0		$8.75x10^8$ (0.3x,25M,SE35)					Abnormal chromosome number+88 kinds of CNV
	ChromosomeSeq-5M		$3.5x10^8$ (0.1x,10M,SE35)					5M above CNV abnormalities
	ChromosomeSeq-5M			$1.225x10^9$ (0.4x,35M,SE35)				100k above CNV abnormalities
	PGS		$3.5x10^8$ (0.1x,10M,SE35)					Abnormal chromosome number and 4M above CNV abnormalities
	PGD			$4x10^9$ (200x,20M,PE100)				34 monogenetic disease PGD
	Carriers screening-100 kinds of disease		$6.0x10^8$ (200x,3M,PE100)					Screening of 100 single-gene disease carriers
	Deafness 127 genes detection			$1.5x10^9$ (100x,7.5M,PE100)				127 deafness gene detection
	Deafness 22 genes detection (159 mutations)		$5x10^8$ (1000x,2.5M,PE100)					22 deafness genes detection with 159 mutations
	WES				$1.5x10^{10}$ (80x,75M,PE100)			Monogenetic disease detection
Fetal Genome	WGS				$9x10^{10}$ (30x,450M,PE100)			The real status of the fetus (abnormal chromosome number, CNV, monogenic disease, mitochondrial disease, etc.)
Maternal and infant genomes	WGS (Pregnant women blood plasma)					3x1011 (100x,1.5G,PE100)		The real status of maternal and fetal double genomes (mother gene component type and fetal chromosomal abnormalities, including parental balanced translocation)
Maternal and infant genomes + Transhistology +nutrition	The fetus and pregnant women WGS + mass spectrometry + image + nutrition						1x1012	Both Maternal and Infant Genome Real Status + Health Guidance

What makes Shenzhen model so successful?

Rate of Gene Sequencing and Synthesis: Beyond Moore's Law



Cutting edge sequencing technology and Sequencing tool

Government’s guidance and policy support

广东省物价局
广东省卫生厅 文件
广东省人力资源和社会保障厅

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关于胎儿21-三体综合征基因检测筛查列入省医疗服务价格项目的通知

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深圳华大基因临床检验中心：

根据你们的申请，经我厅第三方医疗技术审核机构审核，你中心具备开展胎儿染色体非整倍体无创基因检测、人乳头病毒基因分型检测和耳聋基因分型检测等3项技术的能力。根据《医疗技术临床应用管理办法》，经研究，同意你中心开展胎儿染色体非整倍体无创基因检测、人乳头病毒基因分型检测和耳聋基因分型检测等3项技术。以上技术应用于胎儿先天性缺陷和遗传性疾病产前诊断的（包括相应筛查），请按卫生部《产前诊断技术管理办法》（卫生部令2002年第33号）等有关规定办理，并按照《医疗技术临床应用管理办法》规定，加强相关技术的临床应用管理，保障医疗质量和医疗安全。

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（63）

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市卫生计生委
2017年5月12日

Thanks