High Resolution Paternity Testing

How Accuracy is Influenced by the Number of Genetic Markers Examined

Genetic Markers

DNA test results often decide the outcome of a paternity case. All paternity test results and conclusions are founded in statistics and probabilities. The greater the number of genetic markers examined the greater the strength of the genetic evidence and hence the final result. Industry wide, paternity tests can be generated using as few as four (4) markers, to as many as sixteen (16) markers, with the latest high resolution technology. The 16 marker technology can achieve a probability of identity of 1 in 40 quintillion, or 1 in 40,000,000,000,000,000,000.

Definitions

DNA paternity test results are typically expressed by three sets of numbers, the paternity index (PI), the combined paternity index (CPI) and the probability of paternity (W).

Paternity Index (PI)
Paternity index or likelihood ratio is the statistic that summarizes all of the information provided by the genetic testing and is defined as the probability that some event will occur under a particular set of assumptions divided by the probability that the same event will occur under a different set of mutually exclusive assumptions. For example, in the case of paternity, the primary assumption is that the results for an individual genetic marker support the assumption that the tested man is the true biological father rather than an untested randomly selected unrelated man.

Combined Paternity Index (CPI)
The combined paternity index is determined by multiplying the paternity index values for each genetic marker tested. The value can range from 0 to infinity. Values less than 1 are indicative of non-paternity or non-kinship and if less than 0.001, exclusion of paternity. A value of one is neutral and does not provide evidence either way. Values greater than 1 suggests the tested man is the father. The greater the CPI value, the stronger the genetic evidence. Most states accept a CPI of 100 or greater as the standard to establish paternity.

Probability of Paternity (W)
The probability of paternity is an expression of the strength of one's belief in the hypothesis that the tested man is the father, based on all evidence in the case, including nongenetic evidence.

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The Effect of the Number of Genetic Markers Examined and the Combined Paternity Index

#	Genetic Marker	Child		Alleged Father		Mother		Paternity Index (PI)	Combined Paternity Index (CPI)
1	D8S1179	12	13	13		12		5.74	6
2	D21S11	28	31.2	28		28	31.2	6.4	37
3	D7S820	8	11	8	9	8	11	1.1	40
4	CSF1PO	10	13	12	13	10		5.89	238
5	D3S1358	15	17	15	17	15	17	1.65	393
6	TH01	6	9.3	6	9	6	9.3	2.67	1,049
7	D13S317	8	12	8	11	11	12	2.11	2,212
8	D16S539	9	11	11	12	9	12	1.62	3,584
9	D2S1338	17		17	25	16	17	6.59	23,620
10	D19S433	14	16.2	13	14	13	16.2	2.11	49,838
11	vWA	14	18	18		14		5.6	279,093
12	TPOX	8		8		8		1.87	521,903
13	D18S51	15	17	12	17	14	15	4.67	2,437,288
14	D5S818	11	14	12	14	11	12	22	53,620,343
15	FGA	21	25	21		25		7.72	413,949,047
16	AMEL	X		X	Y	X		1	413,949,047

Relationship between CPI, Probability of Paternity and Population Frequencies

Combined Paternity Index (CPI)	Probability of Paternity (W)	Number of Individuals in the Population that Could Contribute the Same Genetic Profile	
20	95%	1 in 20	5%
35	97%	1 in 35	2.9%
50	98%	1 in 50	2%
100	99%	1 in 100	1%
1,000	99.9%	1 in 1,000	0.1%
10,000	99.99%	1 in 10,000	0.01%
100,000	99.999%	1 in 100,000	0.001%
1,000,000	99.9999%	1 in 1,000,000	0.0001%
10,000,000	99.99999%	1 in 10,000,000	0.00001%
100,000,000	99.999999%	1 in 100,000,000	0.000001%

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