The use of Decision Analysis and Decision Trees in Paternity Testing in Forensic Medicine

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1. Introduction

Paternity testing is very important in Forensic Medicine and in law. The subject of this study is to identify those tests; blood group systems, Rh systems, M-N types, C-c types, E-e types, S-s types, P blood groups, Kell blood types, Lu types, Duffy types, Kidd types; used in paternity in Forensic Medicine, which are more sensitive and specific. Decision trees for each test are consructed to get the resulting probabilities of cases. Three hundered and fourty eight paternity testing cases were studied, among which 79 cases were identified as being non-fathers, the remainning 269 cases were labeled as being fathers.

2. Materials and Methods

The data is gathered from the records of Ankara University Dept. of Forensic Medicine, which covers paternity testing cases between 1968 to 1989. In our study, 348 cases, each consisting of a father, a mother and a child. were included and for each case the probability of occurence of such an outcome (combinations of the considered 11 test results of the individuals within a case) is calculated for each test. Clinically, if a probability of zero is achived in at least one of the 11 tests, paternity is rejected, otherwise paternity is accepted. In this study, the positivity criteria (cut-off point) is set at different probabilities, ranging from 0.20 to 0.80. We observed that, highest percentage of correct classification were around 0.20 for all of the tests. When 0.20 is taken as the cut-off point, sensitivities and specificities (false positives and false negatives) are calculated for each test.

3. Results

Sensitivities and Specificities and percentage of correct classification (accuracy) of each test for cut-off point 0.20 are given in Table 1. When we applied this decision criteria to our data set, the results are outlined in Table 2. Sensitivity of combined tests is 0.78 and the specificity is 1.00. Although false negative rate (FN=0.22) seems to be rather high, a probability of zero automatically labels the case as non-fathers, with 100% certanity. If the probability of any test is between 0.001 and 0.199, a false negative rate of 0.22 may be misleading. In such a case, we recommend a further test. If all tests result with probabilities greater than 0.20 (positive test result), with 100% certanity, paternity will be detected. (positive predictive value=ppv=1.00).

Table 1. Sensitivty, Specificity, Accuracy Values of 11 Test for cut-off value 0.20

Tests	Accuracy	Sensitivity	Specificty
Blood group	0.72	0.82	0.42
Rh systems	0.77	0.96	0.13
M-n types	0.82	1.00	0.27
C-c types	0.80	1.00	0.22
E-e types	0.79	1.00	0.21
S-s types	0.77	1.00	0.25
P blood group	0.74	1.00	0.14
Kell blood types	0.71	1.00	0.02
Lu types	0.76	1.00	0.23
Duffy types	0.73	1.00	0.08
Kıdd types	0.82	1.00	0.28

Table 2. Combined Test Results for cut-off value 0.20

		Clinic results		
		Nonfather 0	Father 1	Total
Test results	Nonfather, prob. < 0.20 0	79 100 %	59 22 %	138 40 %
	Father, prob. ≥ 0.20 1	0	210 78 %	210 60 %
	Total	79 22 %	269 77 %	348 100 %

Sensitivity = 0.78
Specificity = 1.00
Predictive value positive =1.00
Accuracy = 0.83

In developing countries, expensive tests such as DNA test which is almost 100% accurate, are less frequently used in Forensic Medicine, such a decision criteria may be helpful in reducing costs. We beliewe that this study will offer a solution for paternity testing in Forensic Medicine.

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FRENCH RÉSUMÉ

Le sujet de cet étude, est identifier ces testes desservies en paternite chez la medecine judiciaire.Les arbres de décision pour chque teste sont construits pour les résultats de probabilités des cas.