

Using a Computer Vision-Based System to Read Skin Prick Test Results: A Cost-Consequence Model

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Background

Skin prick tests (SPTs), or intraepidermal tests, are the first diagnostic approach for people with a suspected allergy.

Together with the patient’s clinical history, SPTs allow doctors to draw conclusions on allergies based on the sensitization pattern.

Objective

To investigate the potential cost savings that would accrue to a Swiss University hospital after the adoption of computer vision-based SPTs, *Nexkin DSPT*.

Methods

Cost-consequence model comparing standard manual SPTs and computer-vision aided SPTs.

Patient population consists of individuals who were referred to the allergology department of one of the five University hospitals in Switzerland, *Inselspital Bern*, whose allergology department averages 100 SPTs a week.

1-year time horizon.

Input parameters (*Tables 1 & 2*) are based on literature and expert input.

Methods

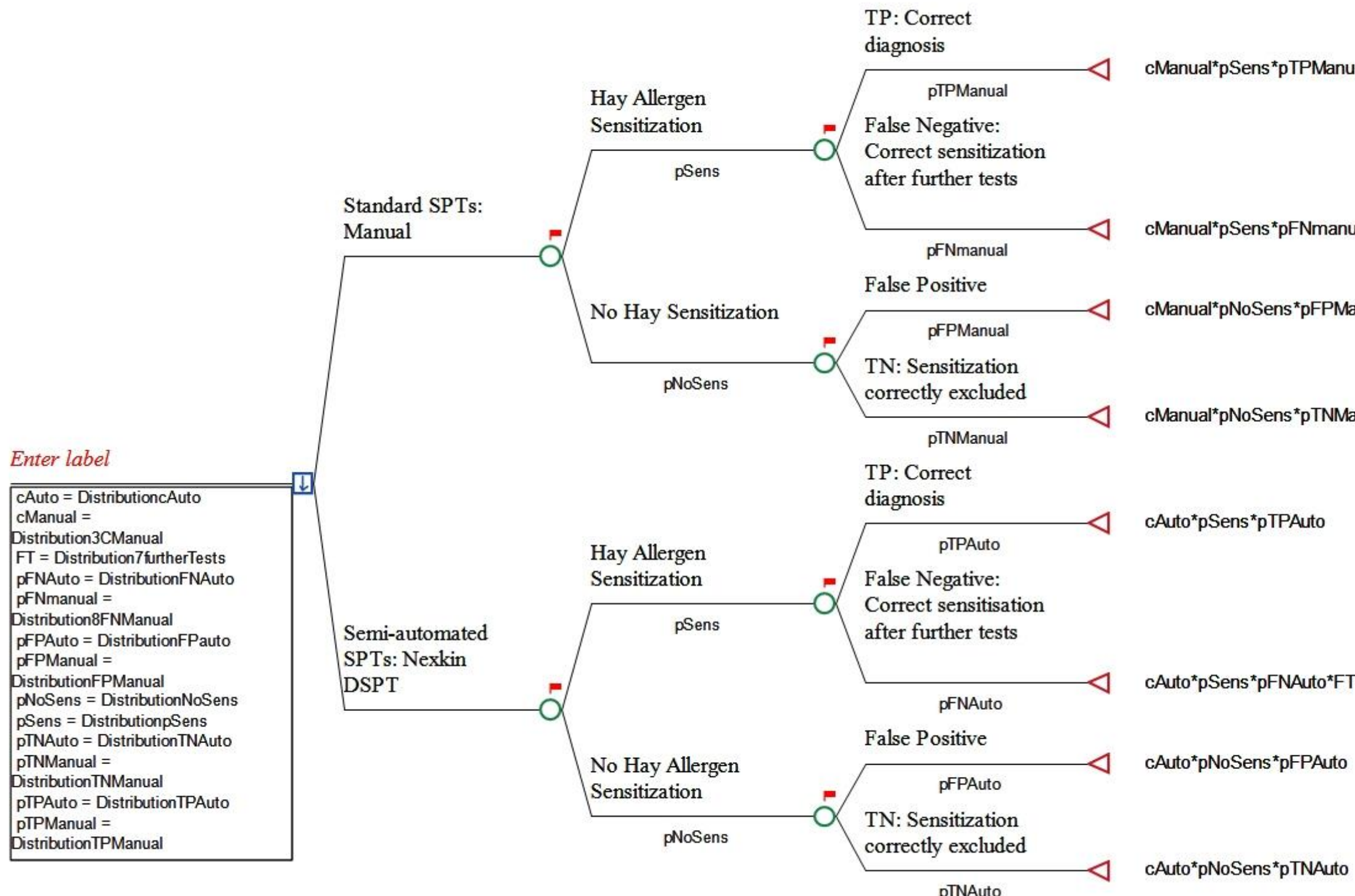


Figure 1: Decision tree; standard SPT practice (Manual) vs. semi-automated SPT, Nexkin DSPT

Parameter	Value	Range (+-20%)	Distribution (mean, SD)	Source
Standard Manual SPT				
Cost of materials (lancet, allergen extracts etc.)	19.41	-	-	Expert
Human resources 5.5 minutes salary	19.96	-	-	Inselspital Human Resources
Total Manual	39.37	[31.5-47.24]	Gamma (39.37, 7.87)	
Nexkin DSPT				
Cost of materials (lancet, allergen extracts etc.)	19.41	-	-	Expert
Human resources: 3 minutes salary	10.89	-	-	Inselspital Human Resources
Cost of device (annual amortization & service fees)	0.42	-	-	Nexkin medical
Total Nexkin DSPT SPT	30.71	[24.6-36.9]	Gamma (30.71,6.14)	
Further tests	2	[1.6-2.4]	Gamma (2, 0.4)	Expert

Table 2: Hospital perspective costs (in CHF) and further test (no of times) parameter information.

Parameter	Count (r)	Sample size (n)	Expected Value (r/n)	Range	Distribution (n, r)
Prevalence (Sensitization)	1061	8357	0.13	[0.13-0.4]	Beta (8357,1061)
Manual: Sensitivity	1485	2289	0.65	[0.64-0.66]	Beta (1485,2289)
Manual: Specificity	9366	9627	0.97	[0.97-0.98]	Beta (9366, 9627)
Nexkin DSPT: Sensitivity	1448	2289	0.63	[0.62-0.64]	Beta (1488, 2289)
Nexkin DSPT: Specificity	9132	9627	0.95	[0.95-0.96]	Beta (9132, 9627)

Table 1: Hay fever probabilities associated with standard manual SPT and Nexkin DSPT.

Results

The difference in average cost is **CHF 7** per skin prick test, **in favour of the computer vision-based skin prick tests**.

Monte Carlo simulation (10000 runs, *Fig. 2*) confirmed our findings.

Sensitivity analyses (*Fig. 3*) demonstrate the robustness of the base case result, with parameters representing the **costs** associated with both the manual and computer vision-based SPTs having the **largest influence** on the incremental cost.

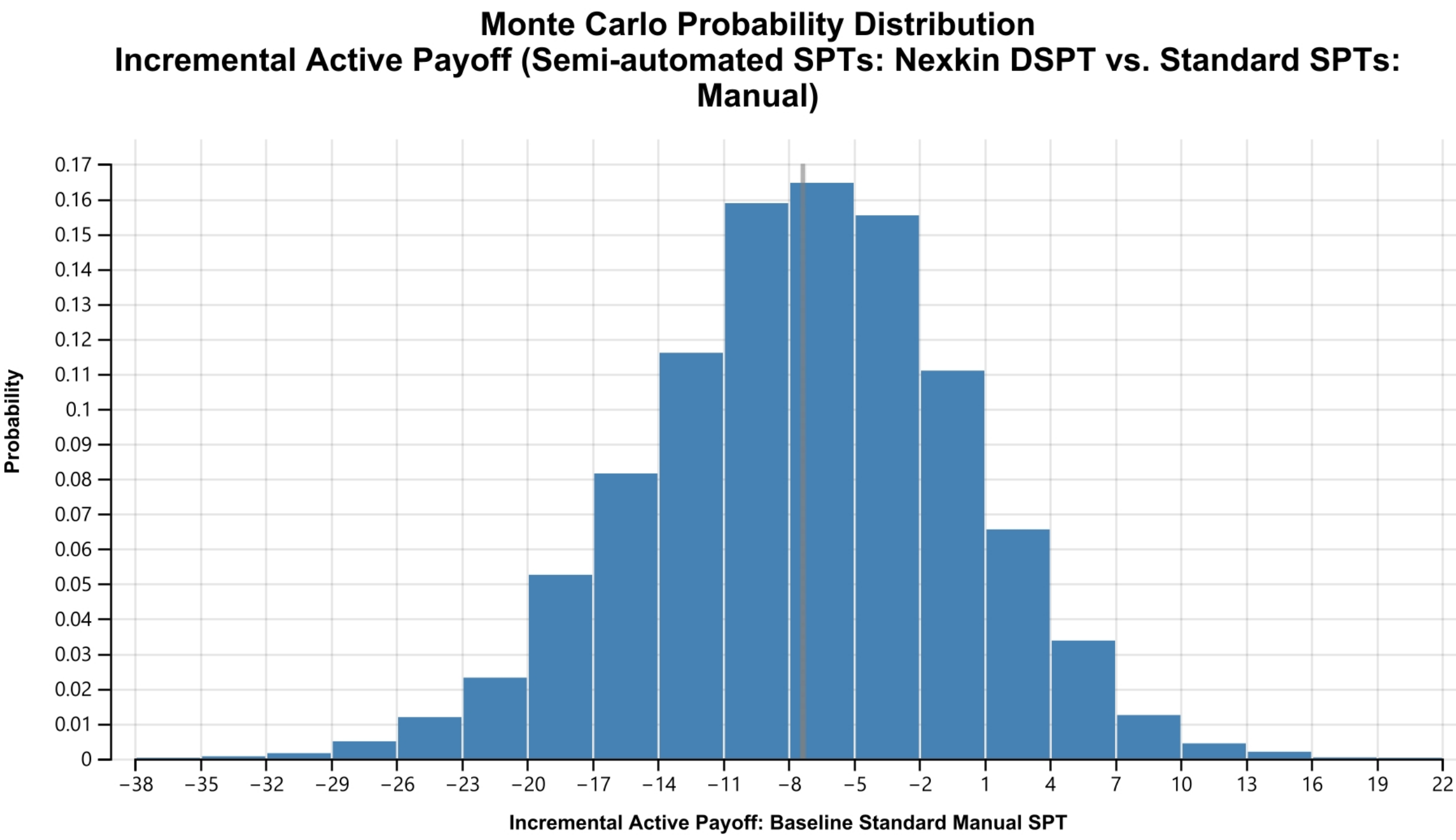


Figure 2: Distribution of Monte Carlo simulation of Incremental cost

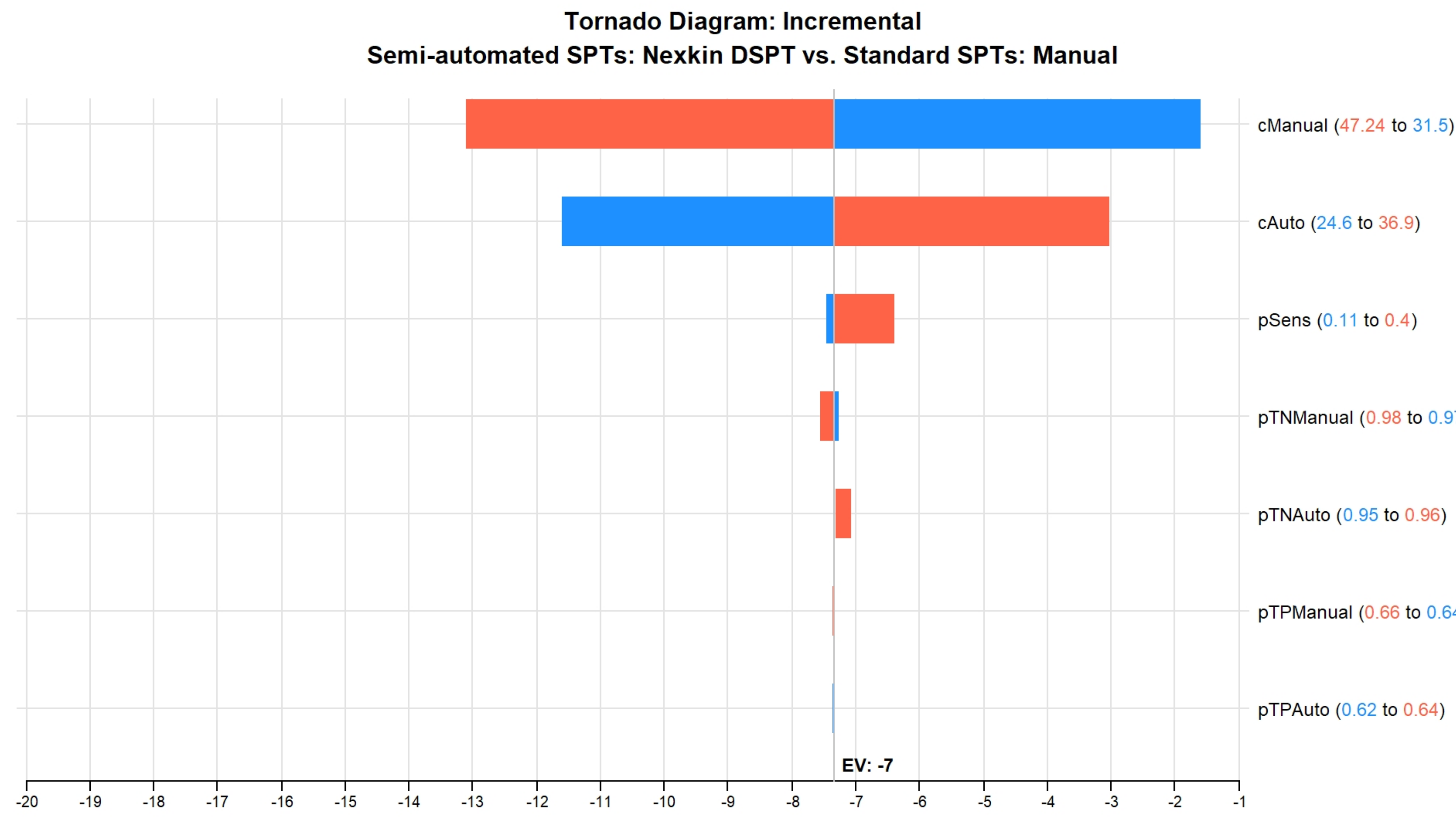


Figure 3: Incremental active payoff tornado chart of base case analysis

Conclusion

Against the backdrop of rising healthcare costs especially in Switzerland, **using computer-aided/automated SPT processes could lead to considerable cost savings**.

Results should be taken with caution because:

- a). This is an early cost-consequence model with limited data and
- b). Our study is based on on hay fever allergy prevalence parameters in Switzerland. Transferability to other forms of allergies and country/hospital settings should be exercised with caution.