

ROC curves

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Overview

- * Introduction
- * Definitions of sensitivity & specificity
- * ROC curve
 - * Comparing diagnostic tests
 - * Choosing a cut-off point

Introduction

- * Receiver operating characteristic (ROC) curve
- * First used for analysis of radar signals following the Japanese attack on Pearl Harbor in 1941



How accurate is T4 as a test of hypothyroidism?

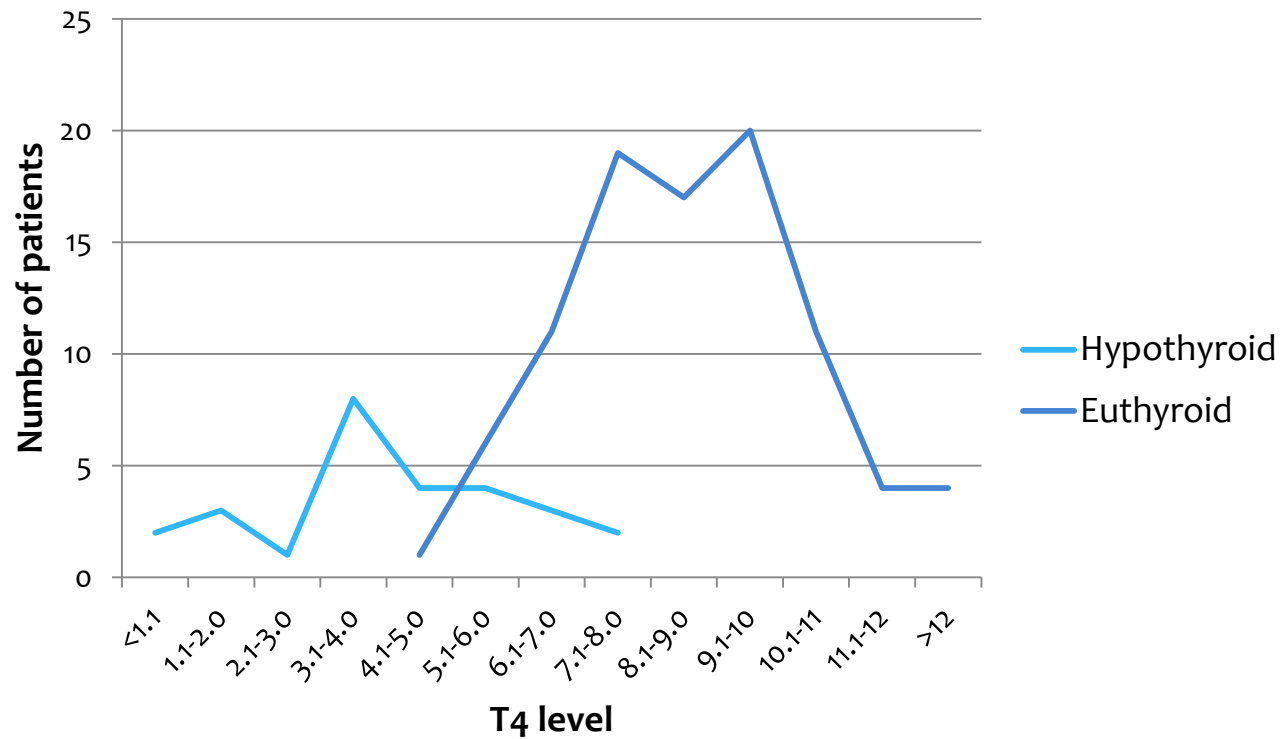
Goldstein & Mushlin, (1987) *Journal of General Internal Medicine*, 2: 20-24.

- * 120 patients were investigated for hypothyroidism
- * TSH levels were used to define if they had it or not
- * 27 had it, 93 didn't
- * T4 levels taken to see if they agreed with the diagnosis made by TSH levels
- * ROC curves were used to analyse the results

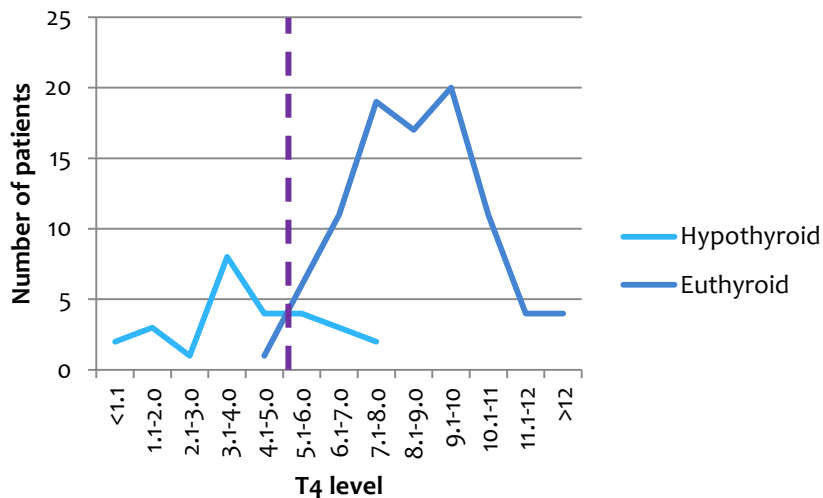
Definitions

- * Sensitivity is the proportion of patients *with* disease who test positive
- * Specificity is the proportion of patients *without* disease who test negative

Results of T4 study



Cut-off: T4 level of 5

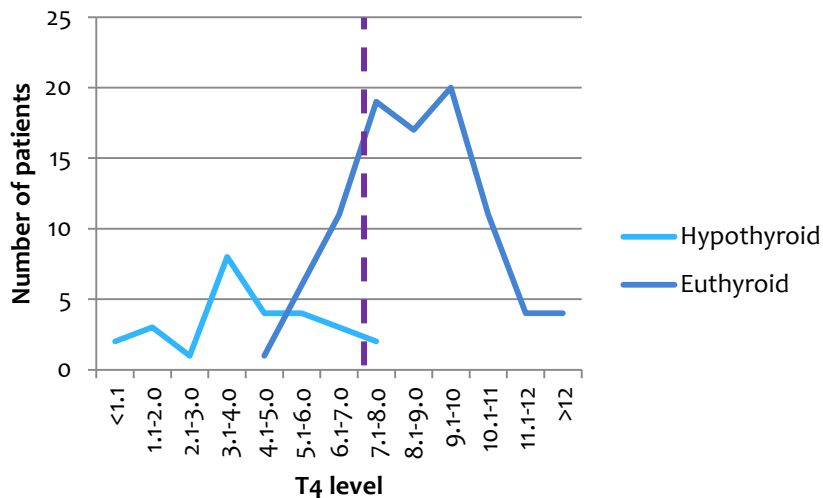


T4 value	Hypothyroid	Euthyroid
<5	18	1
>5	9	92

$$\text{Sensitivity} = \frac{18}{18 + 9} = 0.666666667$$

$$\text{Specificity} = \frac{92}{1 + 92} = 0.989247312$$

Cut-off: T4 level of 7

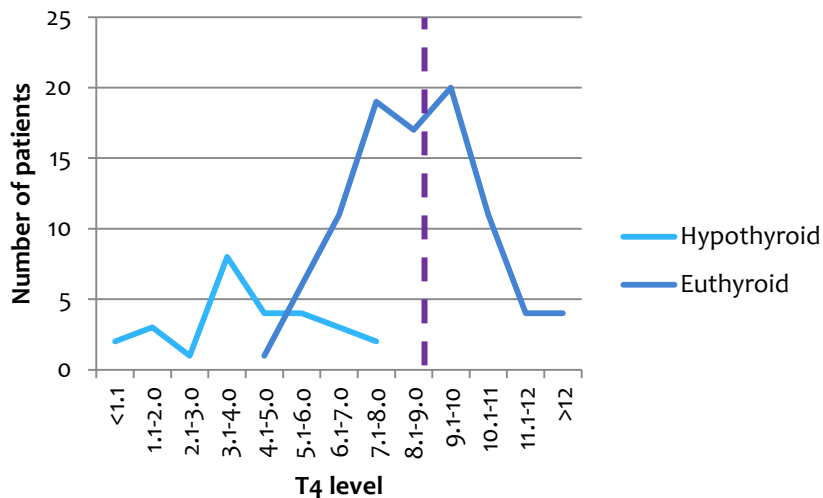


T4 value	Hypothyroid	Euthyroid
<7	25	18
>7	2	75

Sensitivity = 0.925925926

Specificity = 0.806451613

Cut-off: T4 level of 9



T4 value	Hypothyroid	Euthyroid
<9	27	54
>9	0	39

Sensitivity = 1.00000000

Specificity = 0.580645161

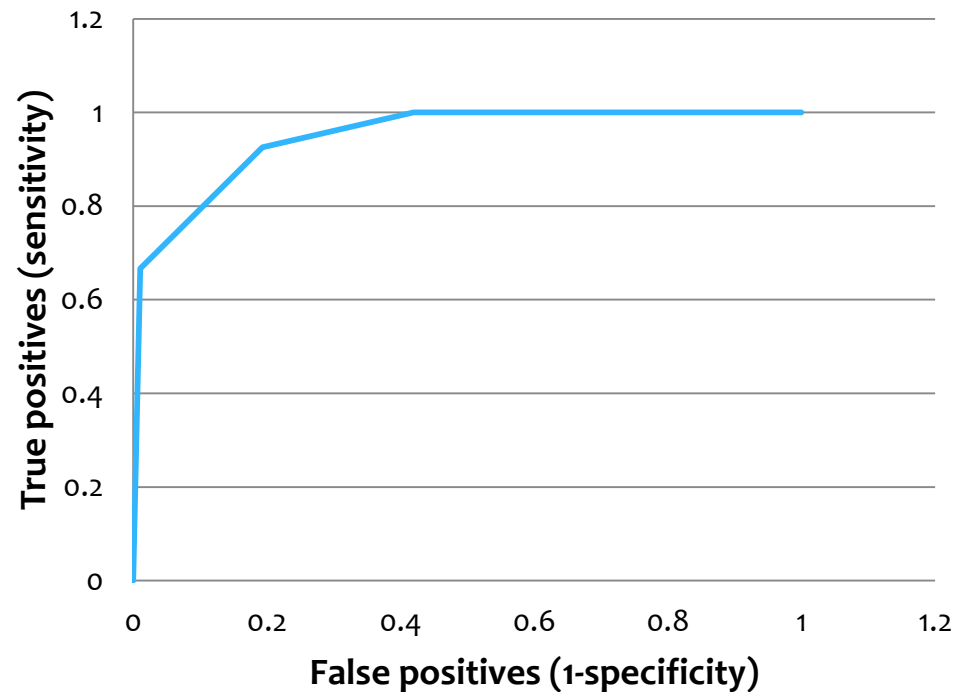
Cut-off summary

- * As the cutoff point is increased:
 - * Sensitivity increases
 - * Specificity decreases

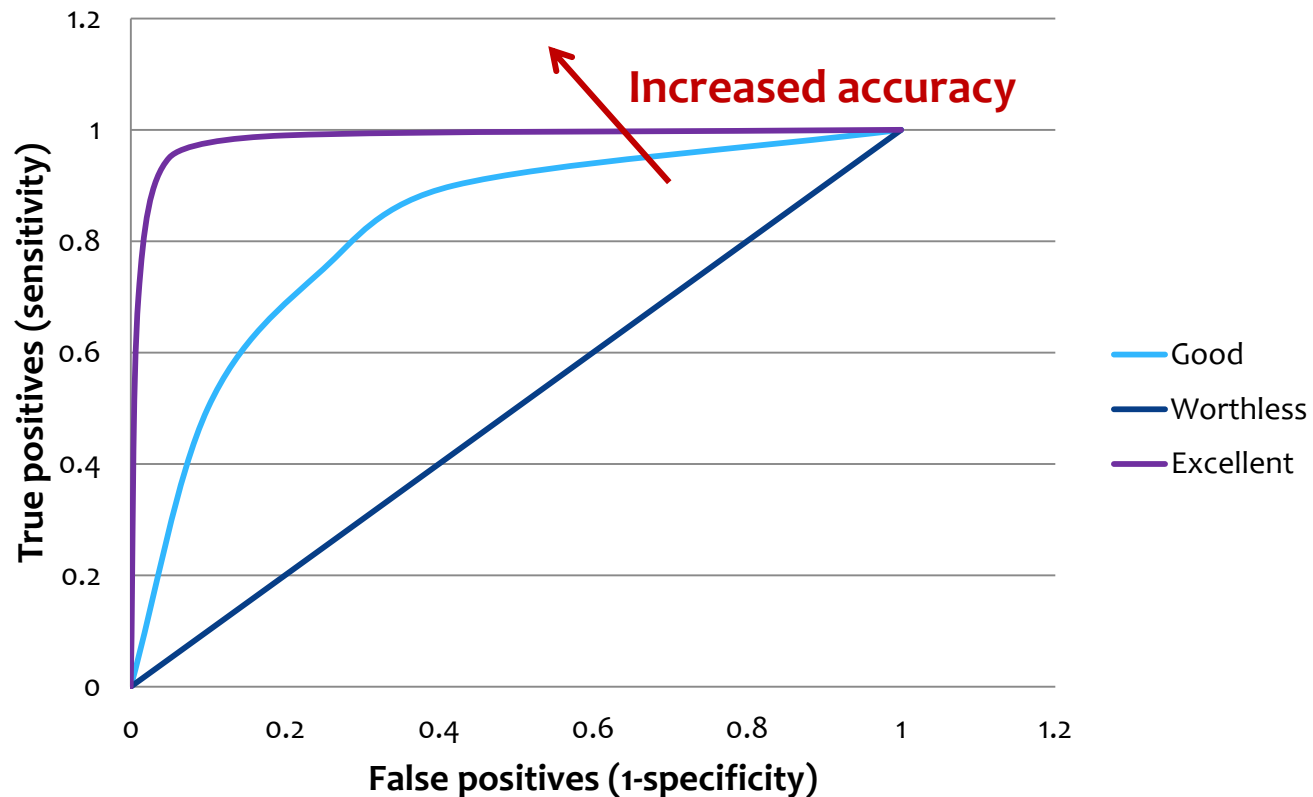
T4 cutoff point	Sensitivity	Specificity
5	0.666666667	0.989247312
7	0.925925926	0.806451613
9	1.000000000	0.580645161

ROC curve

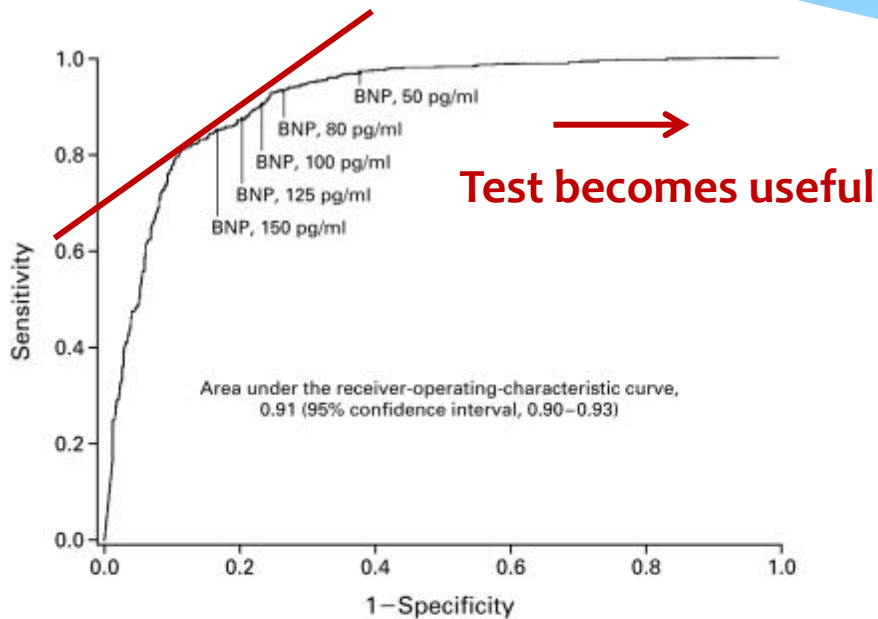
T4 cut-off point	True positives (Sensitivity)	False positives (1-Specificity)
5	0.666666667	0.010752688
7	0.925925926	0.193548387
9	1.00000000	0.419354839



Comparing ROC curves for different diagnostic tests



Choosing a cut-off point



BNP pg/ml	SENSITIVITY	SPECIFICITY	POSITIVE PREDICTIVE VALUE	NEGATIVE PREDICTIVE VALUE	ACCURACY
	(95 percent confidence interval)				
50	97 (96–98)	62 (59–66)	71 (68–74)	96 (94–97)	79
80	93 (91–95)	74 (70–77)	77 (75–80)	92 (89–94)	83
100	90 (88–92)	76 (73–79)	79 (76–81)	89 (87–91)	83
125	87 (85–90)	79 (76–82)	80 (78–83)	87 (84–89)	83
150	85 (82–88)	83 (80–85)	83 (80–85)	85 (83–88)	84

Summary

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 - * Comparing diagnostic tests
 - * Choosing a cut-off point