

# 診斷文獻的評讀

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# 診斷工具的特性

- Sensitivity (敏感度)
- Specificity (特異性)
- Positive predictive value (陽性預測值)
- Negative predictive value (陰性預測值)
- Likelihood ratio (相似比)
  - Positive likelihood ratio (陽性相似比)
  - Negative likelihood ratio (陰性相似比)

# Diagnosis 診斷

	有病	沒病
陽性結果	900	100
陰性結果	200	800

敏感度 (**Sensitivity**) – 有目標疾病的病患中，出現陽性檢查結果的比例  
 $900 / (900+200) = 81\%$

特異度 (**Specificity**) – 沒有目標疾病的病患中，其檢查結果為陰性的比例  
 $800 / (800+100) = 88\%$

陽性預測值 (**Positive predictive value**) – 檢查結果為陽性的病人中，有目標疾病的病人比例  
 $900 / (900+100) = 90\%$

陰性預測值 (**Negative predictive value**) – 檢查結果為陰性的病人中，未出現目標疾病的病人比例  
 $800 / (800+200) = 80\%$

# Diagnosis 診斷

	有病	沒病
檢查陽性結果	900	100
檢查陰性結果	200	800

盛行率 **Prevalence** – 某一群體中疾病發生的百分比  
 $(900+200) / (900+100+200+800) = 45\%$

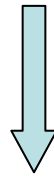
- 陽性預測值與陰性預測值的高或低受疾病盛行率影響
  - 例如：關節痛的病人，以**ANA**篩檢**SLE**，在風濕科門診中可能有很好的陽性預測值反之，在一般門診中陽性預測值可能很差，卻有高陰性預測值
- 
- 敏感度與特異度不受疾病盛行率的影響，但只是對某一檢查的品質做評估，缺乏以病人為中心的實證操作
  - 應用的限制是假設我們已知病人是否有病

# Diagnosis 診斷

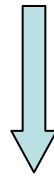
- **Positive Likelihood Ratio (陽性相似比) LR+**
  - True positive rate / False positive rate
  - Sensitivity / ( 1 – Specificity )
  - The amount by which the pretest probability is increased in patients with a positive test
  - LR+  $\geq 4$  valuable, LR+  $\geq 10$  good
- **Negative Likelihood Ratio (陰陽性相似比) LR-**
  - False negative rate / True negative rate
  - ( 1 – Sensitivity) / Specificity
  - The amount by which the pretest probability of disease is reduced in patients with a negative test
  - LR-  $\leq 0.6$  useful, LR-  $\leq 0.1$  good

# 診斷效能的 Bayesian Analysis 貝氏分析

What we thought before + Test information = What we think after



Pretest probability + Likelihood ratios = **Posttest probability**



Pretest odds x Likelihood ratios = Posttest odds

## **Posttest Probability**。

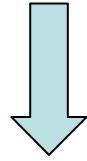
就是在做過該項檢查之後，醫師認為該病患確實罹患該疾病或確實不罹患該疾病的機率。

# Pretest probability

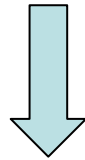
- 由兩要項決定
  - Personal experience：經由history taking, risk factor evaluation後，醫師覺得病人得此病的機會是多少
  - Published data：經由文獻查詢，得知這樣子的病人得此病的機會是多少（盛行率）

首先把 pretest probability 先換算成 pretest odds

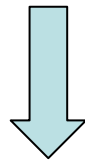
$$\text{Pretest odds} = \text{prevalence} / (1 - \text{prevalence})$$



$$\text{Pretest odds} \times (\text{LR}_1 \times \text{LR}_2 \times \text{LR}_3 \dots \times \text{LR}_n) = \text{Posttest odds}$$



最後再把 posttest odds 換算成 posttest probability 即可



$$\text{Probability} = \text{odds} / (\text{odds} + 1)$$

**Table 3.6** Some post-test probabilities generated by five levels of a diagnostic test result

Likelihood ratio	Post-test probability of the target disorder for different pre-test probabilities					
	Pre-test 5%	Pre-test 10%	Pre-test 20%	Pre-test 30%	Pre-test 50%	Pre-test 70%
Very positive 10	34%	53%	71%	81%	91%	96%
Moderately positive 3	14%	25%	43%	56%	75%	88%
Neutral 1	5%	10%	20%	30%	50%	70%
Moderately negative 0.3	1.5%	3.2%	7%	11%	23%	41%
Extremely negative 0.1	0.5%	1%	2.5%	4%	9%	19%

**Table 3.5** The usefulness of five levels of a diagnostic test result

Diagnostic test result	Serum ferritin (mmol/L)	Target disorder (iron deficiency) present		Target disorder absent		Likelihood ratio	Diagnostic impact
		Number	%	Number	%		
Very positive	< 15	474	59 (474/809)	20	1.1 (20/1770)	52	Rule-in “SpPin”
Moderately positive	15–34	175	22 (175/809)	79	4.5 (79/1770)	4.8	Intermediate high
Neutral	35–64	82	10 (82/809)	171	10 (171/1770)	1	Indeterminate
Moderately negative	65–94	30	3.7 (30/809)	168	9.5 (168/1770)	0.39	Intermediate low
Extremely negative	≥ 95	48	5.9 (48/809)	1332	75 (1332/1770)	0.08	Rule-out “SnNout”
		809	100 (809/809)	1770	100 (1770/1770)		

# Serum Ferritin and IDA

**Table 3.3** Results of a systematic review of serum ferritin as a diagnostic test for iron deficiency anemia<sup>a</sup>

		Target disorder (iron deficiency anemia)		Totals
		Present	Absent	
Diagnostic test result (serum ferritin)	Positive ( $<65$ mmol/L)	731 a	270 b	1001 a+b
	Negative ( $\geq 65$ mmol/L)	78 c	1500 d	1578 c+d
Totals		809 a+c	1770 b+d	2579 a+b+c+d

**Sensitivity =  $a/(a+c) = 731/809 = 90\%$**       **Specificity =  $d/(b+d) = 1500/1770 = 85\%$**

**LR+ =  $sens/(1-spec) = 90\%/15\% = 6$**       **LR- =  $(1-sens)/spec = 10\%/85\% = 0.12$**

**Positive predictive value =  $a/(a+b) = 731/1001 = 73\%$**

**Negative predictive value =  $d/(c+d) = 1500/1578 = 95\%$**

**Prevalence =  $(a+c)/(a+b+c+d) = 809/2579 = 31\%$**

**Pre-test odds =  $prevalence/(1-prevalence) = 31\%/69\% = 0.45$**

**Post-test odds =  $pre-test\ odds \times likelihood\ ratio$**

**Post-test probability =  $post-test\ odds/(post-test\ odds + 1)$**

# Critical Appraisal of Diagnostic Accuracy Study

## “診斷工具”的評析

- **Are the results of the study valid (效度如何) ?**
  - Was the diagnostic test evaluated in a representative spectrum of patients (是否經過具有代表性的病人群測試過) ?
  - Was the reference standard ascertained regardless of the index test result (標準診斷工具做確診時不知道指標診斷工具的結果) ?
  - Was there an independent, blind comparison between the index test and an appropriate gold standard of diagnosis (標準診斷工具與指標診斷工具是在獨立且雙盲的情況下進行比較) ?
- **What were the results (結果是甚麼) ?**
  - Are test characteristics presented (呈現指標診斷工具的特性) ?
- **Can we apply to our patient (可以應用到我的病人嗎) ?**

**Was the diagnostic test evaluated in a representative spectrum of patients**  
**是否經過具有代表性的病人群測試過？**

<b>最理想狀況為何？</b>	<b>何處找到相關訊息？</b>
<p>指標診斷工具最好經過疾病各層面病人的測試，如不同嚴重程度、不同時期</p> <p>最好病人亦能隨機選擇或連續選擇以減少偏差</p>	<p>“研究方法”應說明如何選入病人，是否隨機選擇，病人的來源，是否具有代表性</p>

是

否

不清楚

評論： \_\_\_\_\_

**Was the reference standard ascertained regardless of the index test result**  
**標準診斷工具做確診時不知道指標診斷工具的結果？**

<b>最理想狀況為何？</b>	<b>何處找到相關訊息？</b>
<p>理想的情況是所有病人都應接受標準診斷工具及指標診斷工具的檢驗</p> <p>若標準診斷工具是侵入性或昂貴檢查時，則可以選擇指標診斷工具檢查結果陰性者為之或經一段適當時間的追蹤以確定是陰性結果</p>	<p>“研究方法”應說明標準診斷工具是否用於測試所有病人，或是用其他取代方法</p>

是

否

不清楚

評論： \_\_\_\_\_

**Was there an independent, blind comparison between the index test and an appropriate gold standard of diagnosis**

標準診斷工具與指標診斷工具是在獨立且雙盲的情況下進行比較？

最理想狀況為何？	何處找到相關訊息？
<p>標準診斷工具的選擇是否恰當，有時候單一診斷工具無法做確定診斷，必需結合其他工具以確定疾病的存在</p> <p>標準診斷工具與指標診斷工具是獨立分開執行且是雙盲的</p> <p>檢查結果的判讀者並不知道另一項檢查的結果為何</p>	<p>“研究方法”應敘述所選用的標準診斷工具為何，必要時應做背景資料的搜尋，看所選擇的工具是否恰當</p> <p>“研究方法”中亦應闡明兩種檢查由誰執行，如何進行，是否獨立雙盲</p>

是

否

不清楚

評論： \_\_\_\_\_

## Are test characteristics presented 呈現指標診斷工具的特性？

診斷工具的研究，結果常以兩種方式呈現：

- 檢驗或檢查的準確度
  - Sensitivity (敏感度)  $S_n$
  - Specificity (特異度)  $S_p$
- 檢驗或檢查在某一群體的預測值
  - Positive predictive value (陽性預測值) PPV
  - Negative predictive value (陰性預測值) NPV

1000 個懷疑有失智症的老人，進行指標檢驗及標準檢驗測試，此一群體失智症的盛行率為**25%**。指標檢驗及標準檢驗測試結果皆為陽性者**240**人，兩種檢驗結果皆為陰性者**600**人

		標準檢驗		
		陽性	陰性	
指標檢驗	陽性	240	150	390
	陰性	10	600	610
		250	750	1000

25% 盛行率

## 標準檢驗

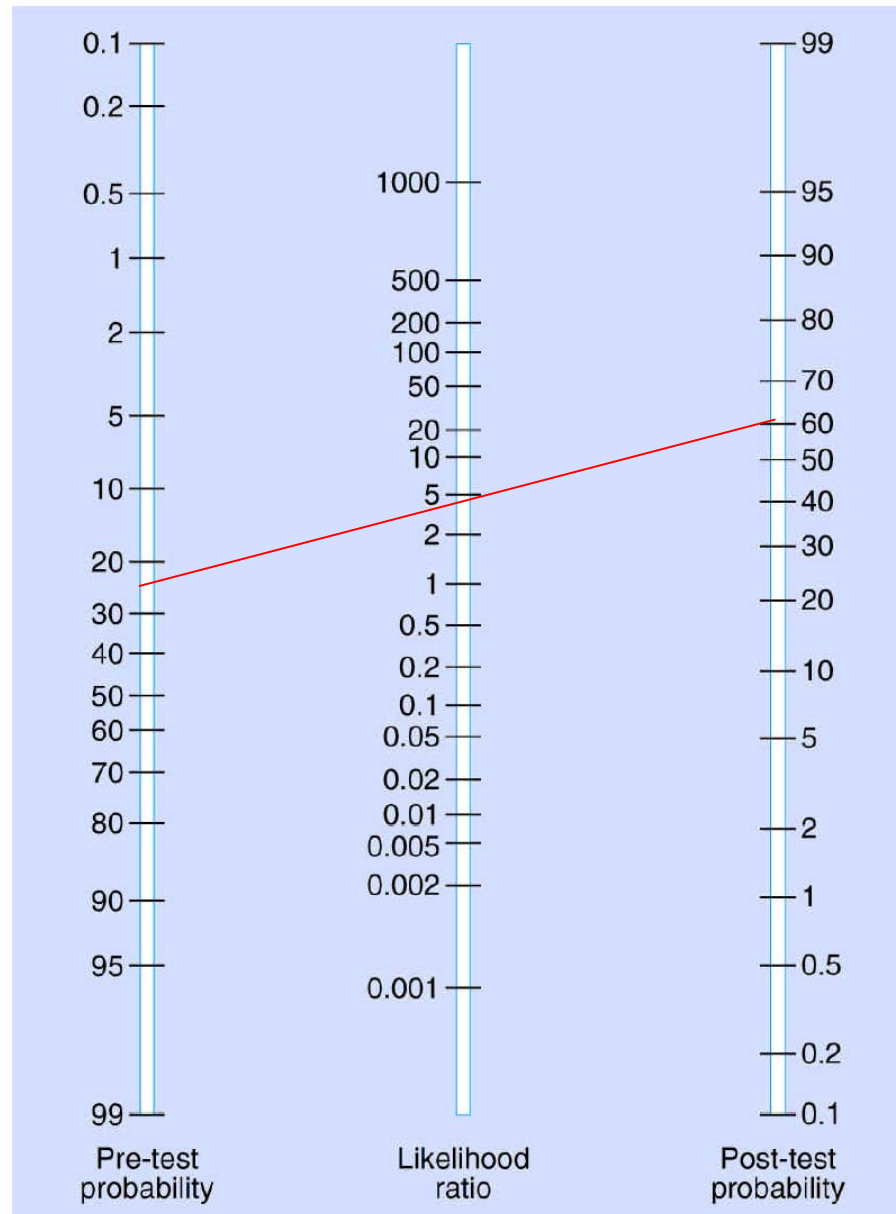
		陽性	陰性	
指標檢驗	陽性	<b>240</b>	<b>150</b>	<b>390</b>
	陰性	<b>10</b>	<b>600</b>	<b>610</b>
		<b>250</b>	<b>750</b>	<b>1000</b>

呈現方式	代表的意義
<b>Sensitivity = 240 / 250 = 0.96 (96%)</b>	敏感度代表檢驗能偵測到疾病的能力。敏感度高的工具較不會遺漏有罹病的人 有 <b>10個(4%)</b> 失智的病人沒有被檢查出來。若要辨識出有病的人是相當好的工具
<b>Specificity = 600 / 750 = 0.80 (80%)</b>	特異度代表檢驗能辨識沒有疾病的能力。特異度高的工具較不會誤認病人罹病 <b>150人(20%)</b> 沒有失智症被誤認有病。若要辨識出沒有病的人則只算是中上的工具
<b>PPV = 240 / 390 = 0.62 (62%)</b>	檢驗或檢查在某一群體的預測值。受檢驗的準確度(特別是特異度)及疾病的盛行率影響 <b>390位陽性結果中，真正有失智症的是62%</b>
<b>NPV = 600 / 610 = 0.98 (98%)</b>	檢驗或檢查在某一群體的預測值。受檢驗的準確度及疾病的盛行率影響 <b>610位陰性結果中，98%沒有失智症</b>

# Test Characteristics

- **LR+ = Sensitivity / (1-specificity)**
  - $0.96 / (1 - 0.8) = 4.8$
- **LR- = (1-sensitivity) / specificity**
  - $(1 - 0.96) / 0.8 = 0.05$
- **Pre-test odds = prevalence / (1 - prevalence)**
  - $0.25 / 0.75 = 0.3333$
- **Post-test odds = pre-test odds X likelihood ratio**
  - $0.3333 \times 4.8 = 1.5998$
- **Post-test probability = post-test odds/(post-test odds + 1)**
  - $1.5998 / (1.5998 + 1) = 0.6154$

# The Likelihood Nomogram



# Can we apply the results to our patient ?

(可以應用到我的病人嗎)

- Patients

- Are your patients similar enough that the prevalence of the disease in the study population is similar to that in your patients ?
- Is the severity of the disease in the test population similar to patients you are likely to see?

- Benefits

- Are there risks associated with the tests?
- Are these outweighed by the danger of an undiagnosed disease ?