Point-of-care testing: where is the evidence? A systematic survey

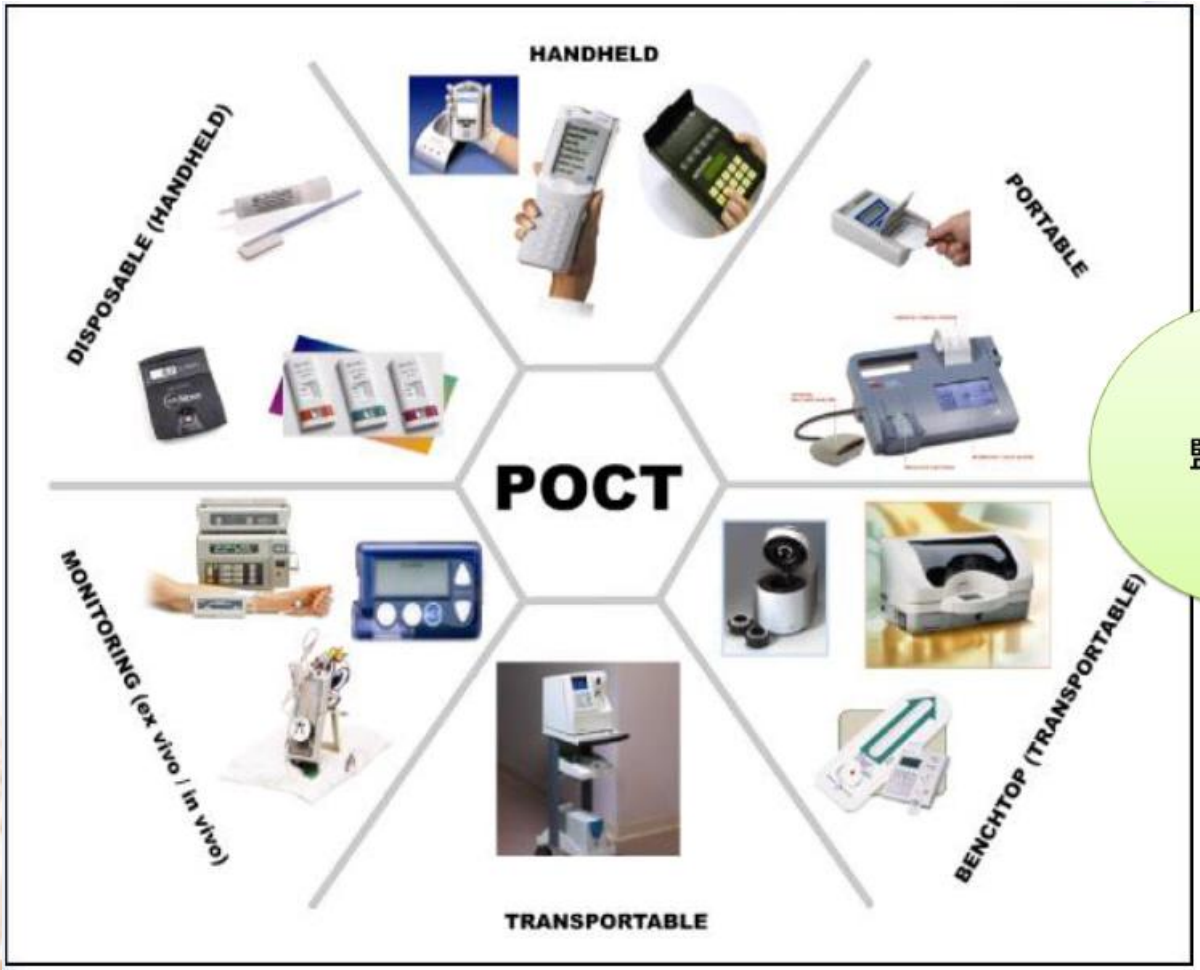
Clin Chem Lab Med 2014; 52(3): 313–324 IF:2.707
Valentina Pecoraro*, Luca Germagnoli and Giuseppe Banfi

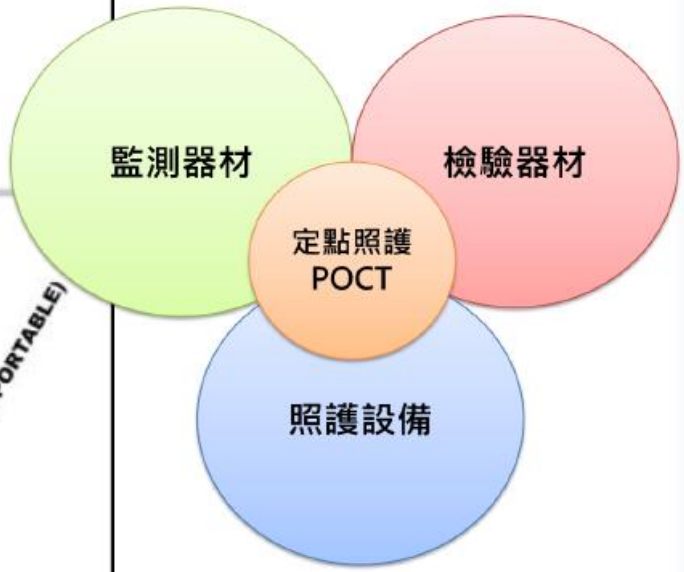
報告人：黃綉茹醫檢師
日期：105年10月25日

Point of Care Testing (床邊檢驗)

- 床邊檢驗是檢驗醫學發展的一種新趨勢，國外對其有多種表述，如床邊檢測（bed side testing）、家庭檢驗（home use testing）、實驗室外檢驗（extralaboratory testing）及醫學診所檢驗（physicians office testing）等，最常用的是POCT，即床邊檢驗。
- POCT寬泛地說是指近病人床旁進行的一種快速檢測分析技術，它能在床旁、病房或中心實驗室之外的其他地方開展。

定點照護範圍





http://cbst.ucdavis.edu/research/poct/point-of-care-technologies-poct-center.html

儀器差異(以血糖機為例)

實驗室

原理:
測量葡萄糖濃度的方法是利用在一定時間內偵測終點反應法。藉由反應時吸光度發生的改變，進而換算出濃度的多寡。機器會自動偵測340 nanomiters吸光度的改變，吸光度的改變直接與葡萄糖的濃度成正比。

化學反應方程式：

$$\text{Glucose} + \text{ATP} \xrightarrow{\text{HK}} \text{Glucose-6-phosphate} + \text{ADP}$$

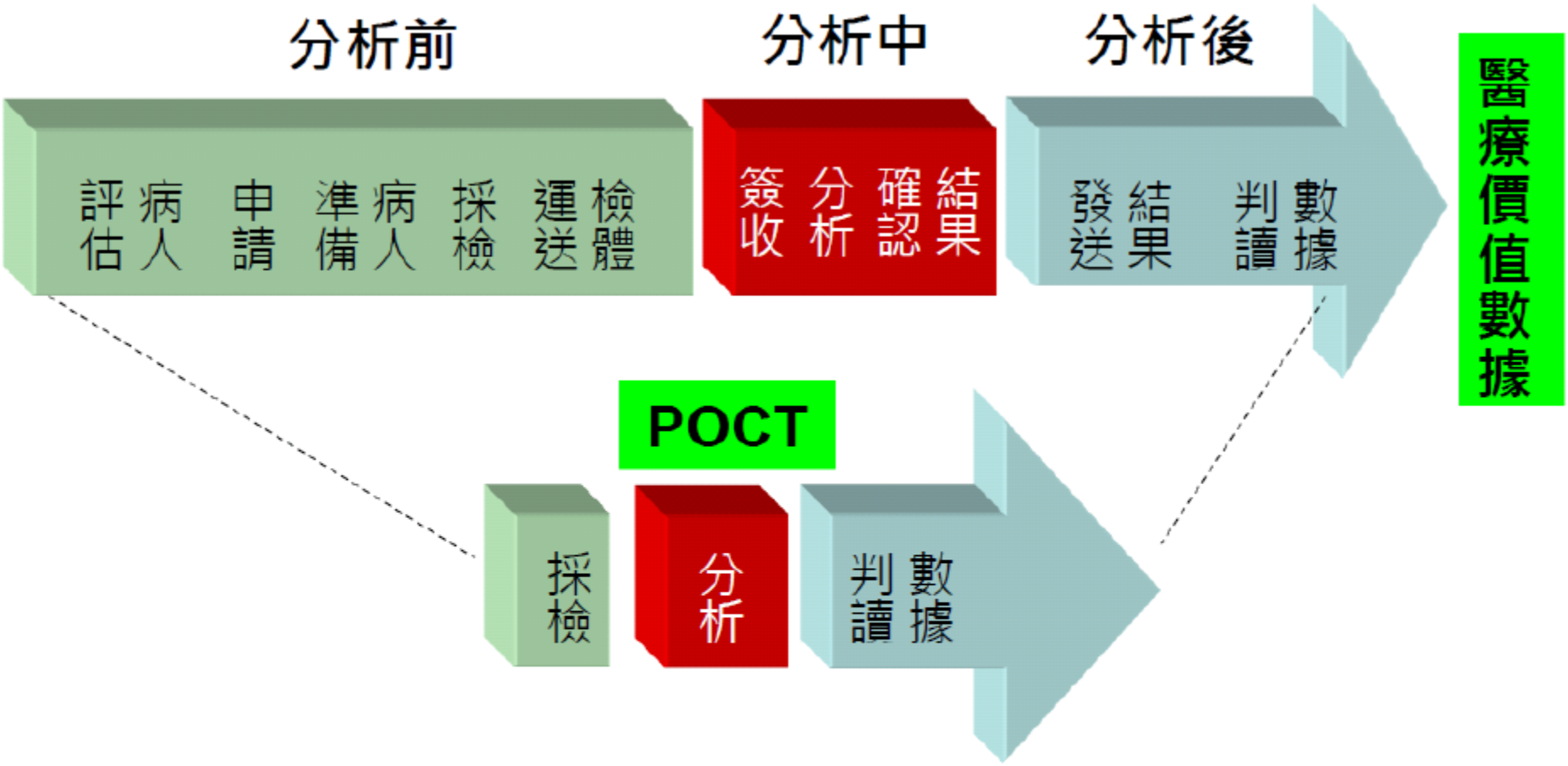
$$\text{Glucose-6-phosphate} + \text{NAD}^+ \xrightarrow{\text{G6PDH}} \text{6-phosphogluconate} + \text{NADH} + \text{H}^+$$

POCT

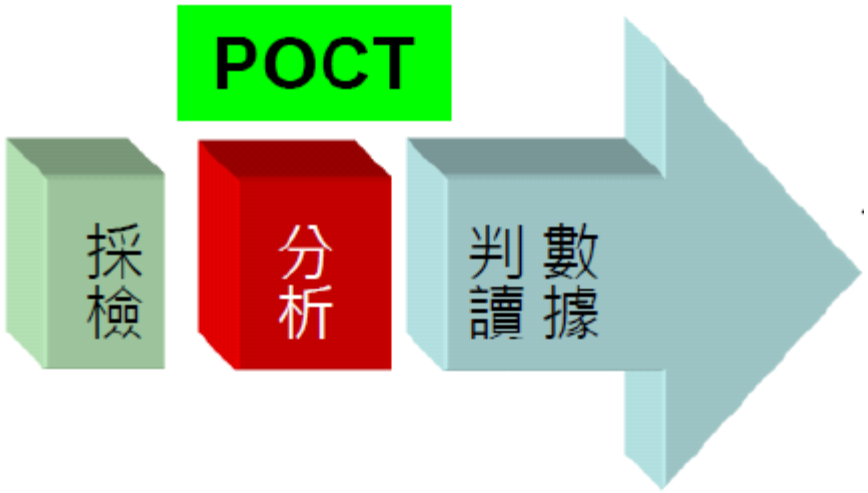
原理:
採用電化學法學(Amperometric electrochemistry) ；當血液中葡萄糖將血糖機試紙上氧化態葡萄糖還原後，借由介質電子的釋出，將電流變化轉換為血糖濃度。

儀器誤差

- **TEa(可容忍分析總誤差)**：個體內生理變異+分析變異的誤差
- **臨床決策區間**（clinical decision interval）：對於臨床上用來判斷是否需要進一步的處置的決策值報告，給予合理的容忍區間。←TEa
  - 例如膽固醇以200mg/dL 作為臨床決策值，實際上臨床治療採用為240mg/dL，所以中間有20%（ =(240-200)/200）為其臨床決策區間



- 安全有效的採檢(實驗室前流程)
- 完整可靠的數據(實驗室中流程)
- 及時正確的判讀(實驗室後流程)



但.....非醫檢專業人員操作

容易產生技術與管理上的問題

Review

Valentina Pecoraro*, Luca Germagnoli and Giuseppe Banfi

Point-of-care testing: where is the evidence? A systematic survey

- doi: 10.1515/cclm-2013-0386.
- Pecoraro V, Germagnoli L, Banfi G.
- Clin Chem Lab Med. 2014 Mar;52(3):313-24.

步驟 1：系統性文獻回顧探討的問題為何？

- POCT是否可取代實驗室檢驗?
  - 調查POCT影響醫療決策與臨床結果的效益的證據

- 問題 (Problem)：POCT是否對clinical outcome有幫助?
- 介入措施 (Intervention)：POCT檢查
- 比較 (Comparison)：實驗室檢查
- 結果 (Outcomes)：醫療決策與臨床結果

本研究探討的POCT項目

- 調查POCT影響醫療決策與臨床結果的效益的證據
- Neonatal bilirubin: 測量新生兒膽紅素是否增加輸血或照光治療?
- PCT (Procalcitonin): 測量PCT前降鈣素是否減少感染發生率和改變抗生素治療?
- PTH (Parathyroid hormone): 術中操作PTH副甲狀腺荷爾蒙是否減少再介入的次數?
- Tn (Troponin): 檢驗Tn心肌酵素是否降低心肌梗塞, 死亡率,和留院天數?
- BGa (Blood gas): 手術與集中治療室中Blood gas血液氣體分析是否降低心血管事件的意外?

步驟 2：系統性文獻回顧的品質如何？(FAITH)

- F - 研究是否找到 (Find) 所有的相關證據？
- A - 文獻是否經過嚴格評讀 (Appraisal)？
- I - 是否只納入 (included) 具良好效度的文章？
- T - 作者是否以表格和圖表「總結」(total up) 試驗結果？
- H - 試驗的結果是否相近 - 異質性 (Heterogeneity)？

Patient important outcomes

- Neonatal bilirubin: 無證據顯示減少輸血或照光治療
- PCT (Procalcitonin): 無證據顯示改變抗生素治療
- PTH (Parathyroid hormone): 只有一篇證明可減少LOS和TAT
- Tn (Troponin): Decrease LOS and TAT about 26 and 56 min
- BGa (Blood gas):無證據顯示減少心血管事件的意外

F - 研究是否找到所有的相關證據？

Database search for published studies

Studies were identified by searching electronic database and scanning reference lists of articles. This search was applied to Medline (1990–May 2012) and adapted for Embase (1990–May 2012) to capture all potentially relevant English language scientific papers. We considered also the reference list of all potential eligible studies. Databases were searched using the following search terms: point of care testing or point-of-care-testing or POC and troponin or bilirubin or procalcitonin or parathyroid hormone or blood gas analyzer.

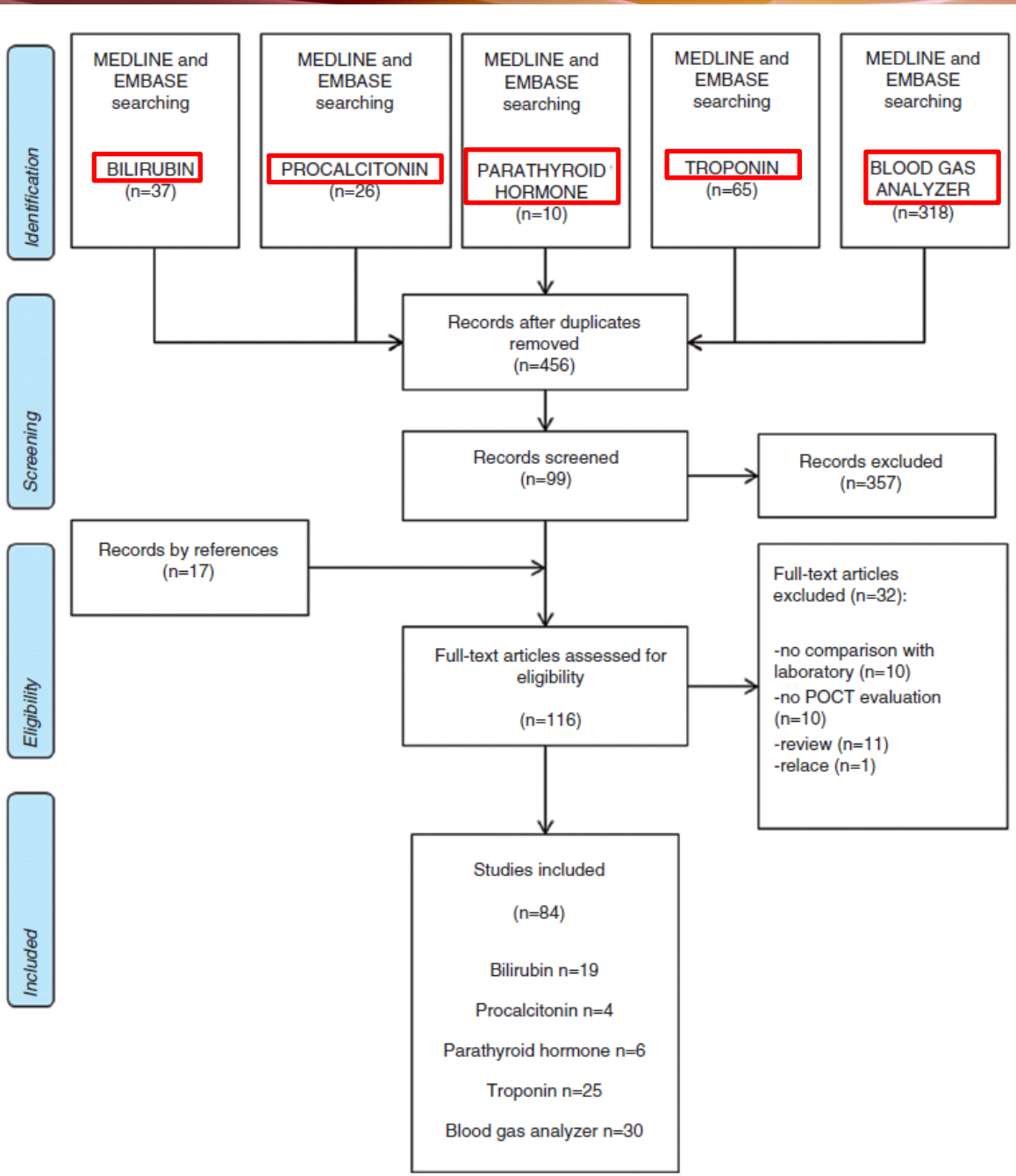


Figure 1 Flow diagram showing the number of record identified, screened, extracted and included in the final analysis.

7 randomized controlled trials (RCTs), 56 prospective studies, 3 retrospective, 1 case series study, 1 before and after study, 16 experimental and cohort studies not better defined

A - 文獻是否經過嚴格評讀？

Phase 2: quality of reporting

We moved from the risk of bias tool of the Cochrane Collaboration. As this instrument was created for evaluating randomized controlled trials (RCTs), we slightly adapted it to non-randomized studies (NRS). As reported in the Cochrane Handbook, risk of bias assessment criteria for these trials is not well established [9, 11].

We decided to assess the risk of bias in the following domains: 1) Study designs, i.e., if the study was retrospective or prospective, awarding a low risk of bias to prospective trials; 2) Outcomes reported, i.e., studies including important patient outcomes, as well as LOS and TAT, were evaluated; 3) Blinding, i.e., the outcomes' assessors were blinded, awarding at low risk of bias; 4) Control of known confounding factors at baseline, i.e., samples were selected ad hoc at the beginning of the study, considering at high risk of bias the trials that performed this method.

Every domain could be classified as 'high' or 'low' risk of bias. If the information reported in the paper was not enough, the domain was defined as 'unclear'. Methodological quality was independently assessed by two authors (VP and LG). Disagreements were resolved by consensus.

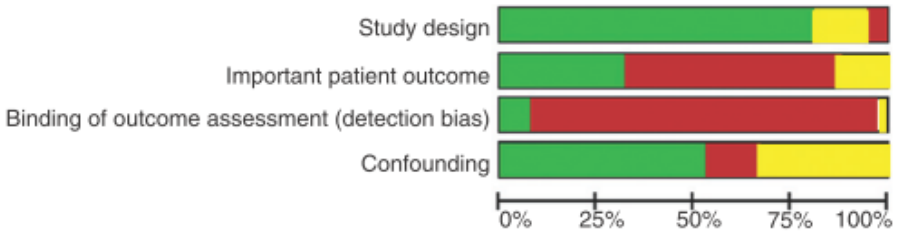


Figure 2 Risk of bias.
Red, high risk of bias; yellow, unknown risk of bias; green, low risk of bias.

I - 是否只納入具良好效度的文章？

Eligibility criteria

Studies were included if they met the following criteria: 1) Studies randomized, quasi-randomized, prospective or retrospective cohort and case-control; 2) Specimens analyzed by POCT and standard laboratory procedure; 3) Comparison of results between POCT and laboratory instruments; and 4) Report of results of at least one relevant outcome.

The term 'quasi-randomized' refers to controlled trials that use inappropriate randomization strategies [9].

We were very 'inclusive' to reach a pragmatic overall picture of the research status in this field.

- 7 RCT
- 56 prospective
- 3 retrospective
- 1 case series and before and after
- 16 experimental and cohort studies

Table 1 Characteristics of studies included.

	Study	Year	Study design	Country	Number of samples	Diagnostic accuracy outcome
Bilirubin	Barko [12]	2006	Prospective	USA	120	SN, SP, PPV, NPV
	Bhutani [13]	2000	Prospective	USA	1788	NR
	Borgard [14]	2006	Prospective	France	473	NR
	Engle [15]	2002	Prospective	USA	404	NR
	Ho [16]	2006	Prospective	China	4689	SN, SP, PPV, NPV
	Kazmierczak [17]	2004	Prospective	USA	Unclear	NR
	Lam [18]	2008	Prospective	China	113	SN, SP
	Maisels [19]	2004	Prospective	USA	849	NR
	Mielsch [20]	2010	Prospective	Germany	240	NR
	Robertson [21]	2002	Prospective	USA	101	NR
	Rolinski [22]	2001	Prospective	Germany	142	NR
	Rubaltelli [23]	2001	Prospective	Italy	NR	NR
	Schmidt [24]	2009	Cohort	USA	94	SN, SP, NPV
	Schumacher [25]	1995	Prospective	USA	NR	NR
	Tan [26]	1996	Prospective	Singapore	540	NR
	Tayaba [27]	1998	Prospective	USA	900	NR
	Wong [28]	2002	Prospective	UK	64	PPV
	Yamanouchi [29]	1980	Prospective	Japan	NR	NR
	Yamauchi [30]	1988	Prospective	Japan	576	NR
Procalcitonin	Bektas [31]	2011	Prospective	Turkey	141	SN,
	Galetto-Lacour [32]	2003	Prospective	Switzerland	99	SN,
	Hesselink [33]	2009	Prospective	Netherlands	101	NR
	Meisner [34]	2000	Prospective	Germany	237	NR
PTH	Agarwal [35]	2001	Prospective	Australia	88	NR
	Chou [36]	2002	Case series	Taiwan	NR	NR
	Garner [37]	1999	Prospective	NC	130	NR
	Johnson [38]	2001	Prospective	USA	104	NR
	Mace [39]	2008	Prospective	UK	20	NR
	Sokoll [40]	2000	Prospective	USA	200	NR
Troponin	Apple [41]	2000	Prospective	USA	1550	SN,
	Apple [42]	2006	Observational retrospective	USA	545	NR
	Birkhahn [43]	2010	Prospective	USA	151	SN,
	Bock [44]	2008	Prospective	USA	5909	PPV,
	Caragher [45]	2002	Prospective	USA	205	SN,
	Collinson [46]	2004	RCT	UK	163	NR
	Cramer [47]	2007	Prospective	Netherlands	358	NR
	Di Serio [48]	2005	Prospective	Italy	105	NR
	Esposito[49]	2011	Randomized parallel group	USA	2000	NR
	Goodacre [50]	2010	RCT	USA	2263	NR
	Hallani [52]	2005	Randomized	Australia	133	SN,
	Heeschen [53]	1999	Prospective	USA	412	NR
	Hindle [54]	2005	Retrospective	Canada	235	NR
	Hjortshoj [55]	2011	Prospective	Denmark	458	SN,
	Lee Lewandrowski [56]	2003	Prospective	USA	369	NR
	Loten [57]	2010	RCT	Australia	912	NR
	Macdonald [58]	2008	Prospective	Australia	100	NR
	McCord [59]	2001	Prospective	USA	1024	SN,
	Muller Bardorff [60]	2000	Prospective	Germany	281	NR
	Ordonez Llanos [61]	2006	Prospective	Spain	1410	NR
	REACTT group [51]	1997	Prospective	USA	721	NR
	Ryan [62]	2009	Randonmized parallel group	USA	2000	NR
	Singer [63]	2008	Before and after	USA	11,266	NR
	Van Domburg [64]	2000	Prospective	Netherlands	1304	NR
	Venge [65]	2010	Prospective	Sweeden	851	SN,

I - 是否只納入具良好效度的文章？

(**Table 1** continued)

	Study	Year	Study design	Country	Number of samples	Diagnostic accuracy outcome
Blood gas	Arora [66]	2011	Prospective	USA	516	SN, SP, PPV, NPV
	Bailey [67]	1998	Prospective	USA	222	NR
	Beneteau Burnat [68]	2004	Experimental	France	20	NR
	Beneteau Burnat [69]	2008	Experimental	France	NR	NR
	Chance [70]	2000	Experimental	USA	NR	NR
	Coplin [71]	1998	Prospective	USA	195	SN, SP
	Dohgomori [72]	2004	Prospective	Japan	27	NR
	Frasca [73]	2011	Prospective	France	471	NR
	Gayat [74]	2001	Prospective	France	200	NR
	Gehring [75]	2002	Experimental	Germany	450	NR
	Grosse [76]	2010	Prospective	Switzerland	NR	NR
	Halpern [77]	1998	Prospective	USA	NR	NR
	Hinkelbein [78]	2008	Prospective	Germany	170	NR
	Jacobs [79]	1993	Experimental	USA	259	NR
	Jain [80]	2009	Cohort	USA	200	NR
	Kilgore [81]	1998	Prospective	USA	NR	NR
	Kulkani [82]	2005	Prospective	Australia	NR	NR
	Leino [83]	2011	RCT	Finland	60	NR
	Lindemans [84]	1999	Experimental	Netherlands	NR	NR
	Ng [85]	2000	Experimental	USA	NR	NR
	Papadea [86]	2002	Experimental	USA	NR	NR
	Petersen [87]	2008	Prospective	USA	114	NR
	Prause [88]	1997	Experimental	Austria	NR	NR
	Schlebush [89]	2001	Experimental	Germany	NR	NR
	Sediame [90]	1999	Experimental	France	92	NR
	Steinfelder Visscher [91]	2006	Prospective	Netherlands	127	NR
	Thomas [92]	2009	Cohort	USA	446	NR
	Walton [93]	2003	Experimental	USA	59	NR
	Wax [94]	2007	Retrospective	USA	NR	NR
	Zaman [95]	2001	experimental	Belgium	20	NR

LR+, positive likelihood ratio; LR-, negative likelihood ratio; NPV, negative predictive value; NR, not reported; PPV, positive predictive value; PTH, parathyroid hormone SN, sensitivity; SP, specificity.

T - 作者是否以表格和圖表「總結」 試驗結果？

Table 2 Number of studies reporting data about important patients' outcome.

	n	TAT	LOS	Mortality	Several bacterial infection	Number of re-intervention	Recurrence of hyperparathyroidism	Major complication
Bilirubin	19	1	0	0	–	–	–	–
PCT	4	0	0	0	2	–	–	0
PTH	6	1	1	0	–	1	1	1
Tn	25	7	8	4	–	–	–	0
BGa	30	1	0	0	–	–	–	0
TOT	84	10	9	4	2	1	1	1

BGa, blood gas analyzer; LOS, lost to follow-up; PCT, procalcitonin; PTH, parathyroid hormone; TAT, turn-around-time; TN, troponin.
n, number of studies included in each group of POC.

H - 試驗的結果是否相近 - 異質性？

→Systematic review only

結　果

- POCT對7%病人有時間效益, 影響14%病人的治療
- 對ER的時間, LOS與死亡率沒有差別
- POCT減少30~60 min的檢驗時間, 使臨床決策所需時間減少
- 只有13%的研究評估重要結果, 但無適當量化
- POCT可能對某些已存在的抱怨有助益, 但仍須更長時間研究經濟與臨床重要性

血糖機可以改善病人的治療時程與結果嗎?


Thank
You