

Day 2 - NACB LMPG 2004: Evidence Based Practice for POCT

- This draft laboratory medicine practice guideline (LMPG) will present scientific evidence that relates point-of-care testing (POCT) to patient outcomes, grade the evidence, and make recommendations based on the strength of the evidence supporting implementation of POCT.

Fundamental Challenge

“Perhaps the greatest challenge to laboratory medicine is the suggestion that diagnostic tests are not perceived to have a major impact on patient outcomes.”

– Christopher P. Price, Ph.D.
Clinical Chemistry
August 2000

Current Laboratory Medicine Activities

– Evaluating Patient Outcomes

- NACB LMPG: Outcomes in POCT – draft presented in Los Angeles at AACCC Annual Meeting 2004
- Proposed Guidelines for Studies to Evaluate Patient Outcomes - NCCLS (HS6-P)
- Textbooks: Evidence-Based POCT Outcomes – Christopher Price, Ph.D., & Robert Christenson, Ph.D., Jim Nichols, Ph.D., and Gerry Kost, M.D., Ph.D.

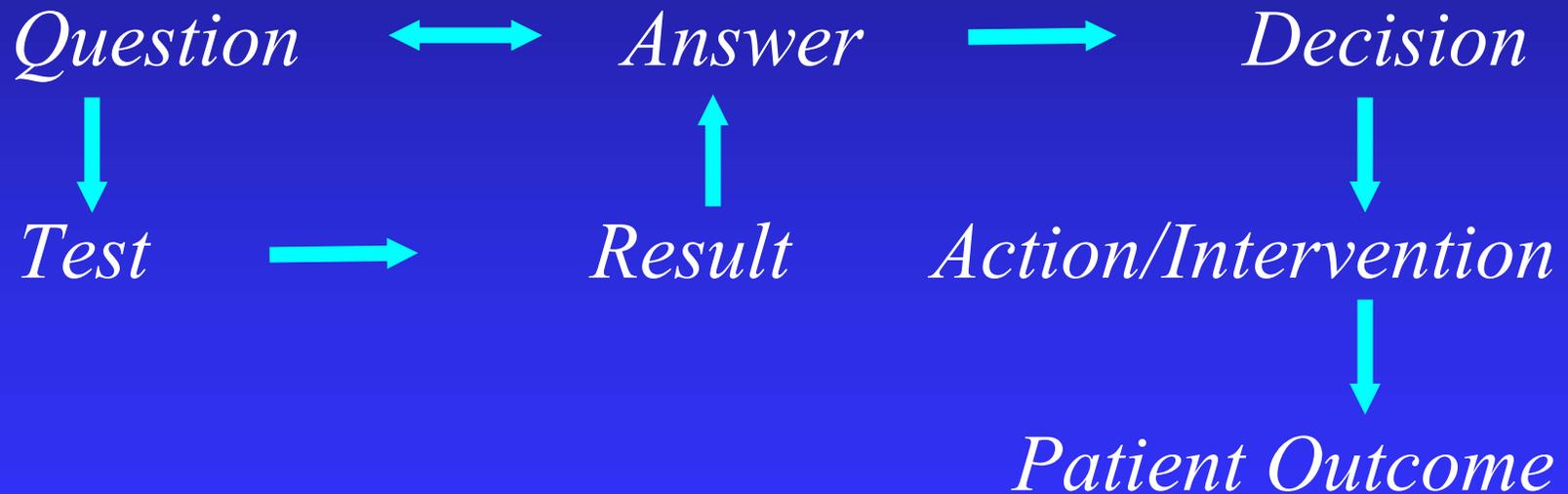
A Laboratory Medicine View

“While clinicians can argue the need for faster turnaround time of results, decreased sample requirements, and convenience to patient care, there is little in the peer-reviewed literature that actually demonstrates improved patient outcomes as a direct result of implementing POCT.”

- Preface, J.H. Nichols, 2003

Clinical Decision-Making

(Christopher P. Price. Keynote address at Monterey Conference,
POCT – Delivering Clinical Outcomes, 2002)



The Clinical Medicine View

- Based on experience, most clinicians know their patients' outcomes have improved with faster therapeutic turnaround times (TTAT).
- Clinicians and laboratorians need to work together to institute appropriate, accurate, reliable, and precise POCT.
- Biases must be dropped for the sake of the patient.

The Clinical Medicine View (cont.)

- Peer-reviewed articles reporting improved clinical outcomes, after the intervention of POCT, have not been available to any significant degree except in contexts of glucose and coumadin monitoring.
- Clinicians need to continue to perform the clinical studies and create the literature to prove POCT improves patient, operational, and economic outcomes.

Impact of Outcomes Studies

If study results reveal improvement in outcomes with POCT in specific settings, the results ...

- Will create evidence for administrative healthcare decision-makers (e.g., risk managers, cost-benefit analyzers, laboratory, clinical departments), showing economic or operational benefit and patient morbidity and/or mortality reduction with POCT relative to the usual method

Impact of Outcomes Studies (cont.)

- Will define the best way(s) to introduce POCT to deliver these improved outcomes
- Will lead to practical patient care guidelines and protocols that will lead to these improved patient outcomes, resulting in POCT being the “Standard of Care” in specific clinical settings

Protocol: Systematic Review on POCT

Definition

- Point-of-care testing (POCT) is clinical laboratory testing conducted close to the site of patient care, typically by patients or clinical personnel whose primary training is not in the clinical laboratory sciences. POCT refers to any testing performed outside of the traditional, core or central laboratory.

Protocol: Systematic Review (cont.)

Objective

- The objective was to systematically review and synthesize the available evidence on the effectiveness of point-of-care testing (POCT) with a specific focus on outcomes: (1) patient/health; (2) operational/management; or (3) economic.

Protocol: Systematic Review (cont.)

- 1) Formulate the clinical questions
- 2) Database search strategies
- 3) Study selection criteria
- 4) Systematic review
 - ◆ Abstract review
 - ◆ Full text review
 - ◆ Systematic review
 - ◆ Determine the final recommendation

Protocol: Systematic Review (cont.)

Recommendation Grid

(see next slide for definitions)

	Net Benefit			
Weight of Evidence	Substantial	Moderate	Small	Zero/Negative
Good	A	B	C	D
Fair	B	B	C	D

Poor = I

Protocol: Systematic Review (cont.)

■ Standard Recommendation Language

A - We strongly recommend that clinicians routinely provide POCT. (We found good evidence that POCT improves important clinical outcomes and conclude that benefits substantially outweigh harms)

B - We recommend that clinicians routinely provide POCT. (We found at least fair evidence that POCT improves important clinical outcomes and conclude that benefits outweigh harms)

C - We make no recommendation for or against routinely providing POCT. (We found at least fair evidence that POCT can improve health outcomes but conclude that the balance of the benefits and harms is too close to justify a general recommendation)

D - We recommend against routinely providing POCT. (We found at least fair evidence that POCT is ineffective or that harms outweigh clinical benefits)

I - We conclude that the evidence is insufficient to recommend for or against routinely providing POCT (Evidence that POCT is effective is lacking, or poor quality, or conflicting and the balance of benefits and harms cannot be determined.)

Today's Focus Groups & Speakers

- Critical Care – Greg Shipp, M.D.
- Drug Testing – Ian Watson, Ph.D.
- Occult Blood – Kent Lewandrowski, M.D.
- Infectious Disease – Robert Sautter, Ph.D.
- Renal – William Clarke, Ph.D.
- Reproduction – Ann Gronowski, Ph.D.

Critical Care Recommendations

- Arterial Blood Gases – John Toffaletti, Ph.D.
- Glucose, Lactate, and Mg – Terry Shirey, Ph.D.
- Cooximetry – Niels Fogh-Andersen, M.D.
- Electrolytes – Paul D’Orazio, Ph.D.
- Ionized Calcium – Anthony Okorodudu, Ph.D.
- Hematocrit/Hemoglobin* – Greg Shipp, M.D.

* To be completed

Critical Care Focus Group (cont.)

- Definition of “Critical Care Setting” –
 - ◆ Any clinical setting in which patients are managed who have major organ dysfunction, severe trauma, major surgical wounds, general anesthesia, severe sepsis, or other high acuity disorder that requires life-sustaining care.
- This setting includes: ICUs, surgical suites, emergency departments, transport systems, chest pain units, trauma units, and stroke units.

Critical Care Focus Group (cont.)

- One of the most important characteristics of critical care settings is the potential for rapid (secs to mins) and clinically significant changes in a patient's status that require prompt intervention
- Some biochemical markers (if available in time) can be thought of as “vital signs” that give evidence that a patient's physiology is becoming unstable

Critical Care Focus Group (cont.)

Arterial Blood Gases (35 articles)

Intensive Care Unit –

- A major concern of ICUs is the maintenance of tissue oxygenation, ventilation, and normal acid-base status. Because life-threatening changes in these parameters can occur suddenly, rapid results are often needed for effective monitoring and treatment in the ICU.
- However, current modes of POC testing may not be optimal for ICU use.
- Although blood gas testing was a small part of the testing evaluated, one report describes the process, the economics, the attitudes, and the clinical and economic benefits of implementing POC testing in a large medical center that previously had a variety of STAT-type laboratories.
- Blood gas testing has been mentioned as the most-often needed POC test in the ICU. The advantages of POCT were decreased therapeutic TAT, fewer errors, and reduced blood loss. There is much less evidence for earlier diagnosis, decreased LOS in ICUs, decreased costs or decreased mortality.

Critical Care Focus Group (cont.)

ABG Recommendation #1 –

ICUs serve a wide-variety of patients and represent a challenge for offering POC blood gas testing. Evaluation of pulmonary function has been performed with rapid blood gas testing, available near the patient, for many years. For patients on ventilators, the blood gas results are the primary means to assess whether ventilation is stable or requires adjustment. Some reports suggest that POC blood gas testing had clinical benefits in patients on ventilators. We found fair evidence that POCT may lead to a small to moderate improvement in clinical outcomes and, therefore, clinicians should consider POCT. (Weight of Evidence = Fair; Net Benefit = Small to Moderate; Recommendation = B/C)

Critical Care Focus Group (cont.)

Emergency Department –

- A review of 99 articles published between 1985 and 2001 on overall POC testing in the ED reported that: 1. POC technology appears to be reliable in an ED setting; 2. cost and connectivity are difficult but important issues for greater acceptance of POCT in the ED; 3. ultimately, improved patient care must be evaluated to offset the costs of POC testing.
- For patients admitted to the ED, POC blood gas testing allowed a decision to be made an average of 21 minutes earlier compared to central laboratory testing.
- Another report similarly noted that, while electrolytes and BUN did not influence initial management of major trauma, Hb, glucose, blood gases and lactate occasionally helped reduce morbidity or save resources.
- Because blood gas results could help to triage such patients from those who are more stable, it was concluded that ABG analysis should be performed on all blunt trauma patients who meet even minimal severity criteria.

Critical Care Focus Group (cont.)

ABG Recommendation #2 –

The ED presents an area where rapid assessment of the patient can have major advantages. Because patients are often evaluated and treated with little or no prior information about medical history, rapid results may not only allow faster diagnosis and treatment, but can improve ED efficiency by proper triage of many patients. The studies suggest that POC blood gas testing reduced the turnaround time to obtain results and there is some evidence that POC blood gas testing improved clinical outcomes. We found at least fair evidence that POCT improves important clinical outcomes and conclude that benefits outweigh harms. We recommend that clinicians routinely provide POCT. (Weight of Evidence = Fair; Net Benefit = Substantial; Recommendation = B)

Critical Care Focus Group (cont.)

Cardiac Surgery –

- During cardiac surgery, blood gas and hemoglobin measurements are often used to calculate O_2 consumption and CO_2 production, with blood lactate measured to evaluate the presence of ischemia.
- In pediatric cardiac surgery, indwelling monitors are often not practical. Therefore, blood gas and other test results often provide the only means to monitor the patient. Rapid blood gas results were noted to allow better control of cerebral blood flow and oxygen delivery in infants during cardiac surgery. Another report makes a strong case for rapid blood gas results during operations in neonates with congenital heart defects, during which ventilator adjustments are critical for optimal patient care.

Critical Care Focus Group (cont.)

ABG Recommendation #3 –

Blood gas monitoring has become a standard of care, during cardiac surgery with CPB. In routine use, blood gas results are used to adjust ventilator settings, with additional tests ordered as needed. While stat-type laboratories may be able to offer blood gas results with acceptable turnaround times, analysis of blood gas specimens within the operating room (at the POC) can provide improved outcomes. We found at least fair evidence that POCT improves important clinical outcomes and conclude that benefits outweigh harms. We recommend that clinicians routinely provide POCT. (Weight of Evidence = Fair; Net Benefit = Substantial; Recommendation = B)

Critical Care Focus Group (cont.)

ECMO –

- A previous report emphasizing the use of lactate also mentioned the value of blood gas testing in assessing the patient on ECMO.
- There was limited evidence for the use of POC ABGs during ECMO.

Critical Care Focus Group (cont.)

ABG Recommendation #4 –

Standard practice in ECMO patients requires rapid blood gas and other tests to be available for proper assessment of the patient. While in-dwelling sensors may provide the fastest results, current models are not sufficiently reliable for routine use. Either POC testing or rapid results from a stat-type laboratory located near to the patient may be satisfactory, depending on the location of the laboratory. We found fair evidence that POCT may lead to a small to moderate improvement in clinical outcomes and, therefore, clinicians should consider POCT. (Weight of Evidence = Fair; Net Benefit = Small to Moderate; Recommendation = B/C)

Critical Care Focus Group (cont.)

Glucose (30 articles)

- Four observations have been documented in the literature as important rationales for time-critical testing of glucose (i.e., POCT): 1) glucose levels may not be known at times when rapid therapeutic options (i.e., glucose or insulin infusions) can influence clinical outcomes; 2) glucose levels may change rapidly and dramatically in critically ill patients; 3) there are time-dependent risks associated with hypoglycemia, ranging from symptoms of neuroglycopenia (e.g., headache, confusion, blurred vision, dizziness, and epigastric discomfort) to seizures, loss of consciousness, irreversible damage, and even death; and 4) there are also time-dependent risks associated with hyperglycemia including irreversible/ischemic brain damage, nosocomial infections, polyneuropathy, and mortality.

Critical Care Focus Group (cont.)

Glucose Recommendation #1 –

Any location (ED, OR, ICU) that cares for critically ill patients that may be significantly hypo- or hyper- glycemc, or whose glycemc status may be changing rapidly, may better serve their patients by having POC glucose testing. We recommend that clinicians routinely provide accurate and precise POCT for glucose in these critical care settings. (Weight of Evidence = Fair; Net Benefit = Substantial; Recommendation = B)

Critical Care Focus Group (cont.)

Lactate (34 articles)

- To interpret lactate requires two key pieces of information: 1) an understanding of the clinical circumstance leading to the increase in lactate (e.g., late septic shock, exercise, liver compromise), and 2) the length of time that lactate has been elevated (which requires serial lactate analyses to give an estimate of accumulated oxygen debt).

Critical Care Focus Group (cont.)

Lactate Recommendation #1 –

Any location handling critically ill patients whose lactate levels may be elevated can better serve their patients by having POC lactate testing including:

- in the ED, patients presenting with acute abdomen, acute myocardial infarction, asthma, cardiac arrest, cyanide poisoning, intracranial pressure, pulmonary embolism, occult illness, shock, need for transfusion, and trauma may benefit;
- in the OR, patients with congenital heart surgery, intracranial pressure, liver transplant, shock, high-risk surgery (vascular, abdominal), thoracoabdominal aortic aneurysm, and transfusion may benefit; and
- in the ICU, patients include those with acute myocardial infarction, anemia of prematurity, circulatory shock, cyanide poisoning, ECMO, heart surgery, intracranial pressure, liver transplant, high-risk surgery (abdominal, vascular), pulmonary embolism, transfusion, and burns may benefit.

We recommend that clinicians routinely provide accurate and precise POCT for lactate in these critical care settings. (Weight of Evidence = Fair; Net Benefit = Substantial; Recommendation = B)

Critical Care Focus Group (cont.)

Magnesium (60 articles)

- Magnesium has POC testing value in cardiovascular and oxidative stress/inflammatory settings.
- Mg is a cofactor in > 325 enzymatic reactions, including virtually all of the reactions involved in energy exchange.
- Mg is important to conduction and contraction and, therefore, to cardiac rhythm, cardiac output, and blood pressure.
- Mg is a regulating factor in hemodynamics, vascular tone, reperfusion injury, platelet aggregation, and the inflammatory response

Critical Care Focus Group (cont.)

Magnesium Recommendation #1 –

Any location handling critically ill patients with cardiovascular symptoms, or where reperfusion injury or an inflammatory response exists, may benefit from POC magnesium measurements to guide magnesium therapy. This includes patients experiencing electrolyte imbalances, being treated with inotropes (digoxin) and antiarrhythmic drugs, experiencing hypoxia, or receiving i.v. magnesium therapy:

- in the ED, patients presenting with ischemic heart disease (including AMI), arrhythmia, asthma, cardiac arrest, cerebral vascular tension/vasospasm, coagulation problems, coronary vasospasm, digitalis toxicity, electrolyte imbalances from diuretics, adverse drug reactions (nitrates and ACE inhibitors), head ache, head trauma, heart failure, hypotension, infarct, preeclampsia/eclampsia, seizures, sepsis, and stroke may benefit;
- in the OR, patients presenting with arrhythmia, experiencing clotting problems, coronary vasospasm, cerebral vasospasm, head trauma/surgery, heart surgery, liver transplant, and stroke may benefit; and
- in the ICU, patients presenting with ischemic heart disease (including AMI), arrhythmia, cardiac arrest, cardiogenic shock, cerebral vascular tension/vasospasm, clotting, coronary vasospasm, cramps, digitalis toxicity, diuretic therapy, drug therapy (nitrates and ACE inhibitors), head trauma/surgery, heart failure, heart surgery, hypotension, infarct, liver transplant, neonates from mothers receiving Mg therapy, pain, seizures, sepsis, shock, and stroke may benefit.

We recommend that clinicians routinely provide accurate and precise POCT for magnesium in these critical care settings. (Weight of Evidence = Fair; Net Benefit = Substantial; Recommendation = B).

Critical Care Focus Group (cont.)

Cooximetry (6 articles)

- The applications of oxygen saturation by cooximetry do not require POCT. Pulse oximetry is preferred for POCT of oxygen saturation, rather than oxygen saturation by cooximetry.
- The diagnosis of carbon monoxide (CO) poisoning requires that the physician suspects the condition and orders a determination of HbCO. Two studies demonstrate the benefit of screening of patients presenting with flu-like symptoms or headache for CO poisoning.
- A correct and timely diagnosis of occult CO poisoning in this setting requires easy access to POCT.
- Early detection of benzocaine-induced methemoglobinemia is necessary for timely intervention, and it can best be achieved with POCT.
- MetHb may be significantly higher in patients with sepsis. However, MetHb does not correlate with clinical markers or severity of illness. Sepsis is potentially lethal and must be diagnosed early. Whether POCT of MetHb by cooximetry may be useful as an early marker of sepsis is still open to question.

Critical Care Focus Group (cont.)

Cooximetry Recommendation #1 –

We conclude that the evidence is insufficient to recommend for or against routinely providing POCT of oxygen saturation by cooximetry. Evidence that POCT of oxygen saturation by cooximetry is effective is lacking. (Weight of Evidence = Poor; Net Benefit = Small; Recommendation = I)

Cooximetry Recommendation #2 –

We recommend that clinicians routinely provide POCT of HbCO by cooximetry to screen patients with flu-like symptoms or headache in the emergency department for occult CO poisoning, particularly in communities where combustion is used for heating during the heating season. We found at least fair evidence that POCT of HbCO by cooximetry will lead to a correct and timely diagnosis of CO poisoning in patients, who otherwise would have been missed. (Weight of Evidence = Fair; Net Benefit = Substantial; Recommendation = B)

Critical Care Focus Group (cont.)

Cooximetry Recommendation #3 –

We recommend that clinicians routinely provide POCT of MetHb by cooximetry to patients receiving benzocaine during intubation and endoscopy/bronchoscopy. We found at least fair evidence that POCT of MetHb by cooximetry will lead to a timely diagnosis and allow timely intervention of methemoglobinemia in patients, who receive benzocaine. (Weight of Evidence = Fair; Net Benefit = Moderate; Recommendation = B)

Cooximetry Recommendation #4 –

We make no recommendation for or against routinely providing POCT of MetHb by cooximetry to detect and monitor sepsis in ICU. We found at least fair evidence that POCT of MetHb by cooximetry may suggest sepsis. This could lead to earlier intervention and thereby improve the outcome of patients with sepsis. We conclude that more studies are needed. (Weight of Evidence = Fair; Net Benefit = Small; Recommendation = C)

Critical Care Focus Group (cont.)

Electrolytes (10 articles)

- Several studies have shown that therapeutic TAT is clearly decreased when POCT is used for measurement of electrolytes in the **ED**, leading to faster decisions on patient management.
- There was no clear evidence that outcomes such as length of stay in the **ED** or in the hospital, or patient mortality are improved when POCT is used for initial ED screening.
- Therapeutic TAT is shortened when POCT for electrolytes is used for screening of trauma patients in the **ED**, however, it is not clear that changes in patient management or outcomes result. One exception is measurement of K^+ , where there is some indirect evidence that availability of K^+ results in a time urgent manner (preoperatively) would improve patient outcomes.
- No change in patient treatment in the ED resulted from measurement of electrolytes (Na^+ , K^+) using POCT during **air transport** to the ED.
- There is no correlation between reduced TAT for electrolyte results in the **ICU** and improved patient outcomes.
- An important advantage of using POCT in the **ICU** and **ED trauma** is the ability to conduct analysis using small sample volumes.

Critical Care Focus Group (cont.)

Electrolytes Recommendation #1 –

For screening of ambulant patients in the emergency department, we recommend that clinicians routinely provide POCT for the measurement of electrolytes. There is fair evidence that the benefits outweigh harms. (Weight of Evidence = Fair; Net Benefit = Moderate; Recommendation = B)

Electrolytes Recommendation #2 –

For screening of trauma patients in the emergency department, we recommend that clinicians routinely provide POCT for the measurement of electrolytes. There is fair evidence that the benefits outweigh harms. (Weight of Evidence = Fair; Net Benefit = Moderate; Recommendation = B)

Critical Care Focus Group (cont.)

Electrolytes Recommendation #3 –

We make no recommendation for or against routinely providing POCT for measurement of electrolytes during patient transport to the emergency department by air. Although no harm results, there is lack of evidence that patient outcomes are improved. (Weight of Evidence = Fair; Net Benefit = Small; Recommendation = C)

Electrolytes Recommendation #4 –

We make no recommendation for or against routinely providing POCT for measurement of electrolytes in the adult ICU setting. Although no harm results, there is lack of evidence that patient outcomes are improved. (Weight of Evidence = Fair; Net Benefit = Small; Recommendation = C)

Critical Care Focus Group (cont.)

Ionized Calcium (9 articles)

- Cardiac arrest patients require prompt evaluation of ionized calcium (and other electrolytes) for proper interpretation and prompt initiation of therapy.
- The significance of rapid (within 5 mins) ionized calcium measurement was stressed in the literature for patients undergoing cardiopulmonary bypass and liver transplant surgeries. These patients require prompt evaluation of ionized calcium and other electrolytes for proper interpretation and prompt initiation of therapy.
- In a comprehensive review of criteria for POCT instrument evaluation, test menus, analysis times, and performance criteria, the literature indicated that in the critical care setting, ionized calcium measurement is obligatory because of the well-documented impact of ionized calcium on vital functions such as conduction and contraction of muscle cells.
- Specific examples cited included impact of ionized calcium for critically ill individuals with sepsis, hypocalcemia crisis, hypotension, heart failure, hyperkalemic dysrhythmia, and electromechanical dissociation.
- In another article, the significance of rapid ionized calcium measurement was stressed for shock burns, electrolytes imbalance patients, and those patients receiving blood transfusion. These patients require prompt initiation of therapy.

Critical Care Focus Group (cont.)

Ionized Calcium Recommendation #1 –

Any location (ED, OR, ICU) that cares for critically ill patients that may be significantly hypo- or hyper- calcemic, or whose ionized calcium status may be changing rapidly, may better serve their patients by having POC ionized calcium testing. We recommend that clinicians routinely provide accurate and precise POCT for ionized calcium in these critical care settings. (Weight of Evidence = Fair; Net Benefit = Moderate; Recommendation = B).