

Utility of Point-of-Care Testing for Critically Ill Adults

Craig M. Lilly, M.D.
Professor of Medicine, Anesthesiology, and Surgery
University of Massachusetts Medical School

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... the art and science of critical care medicine

Potential Financial Conflicts of Interest

- The presenters have accepted nothing of value from any commercial entity with regard to the content of this presentation.



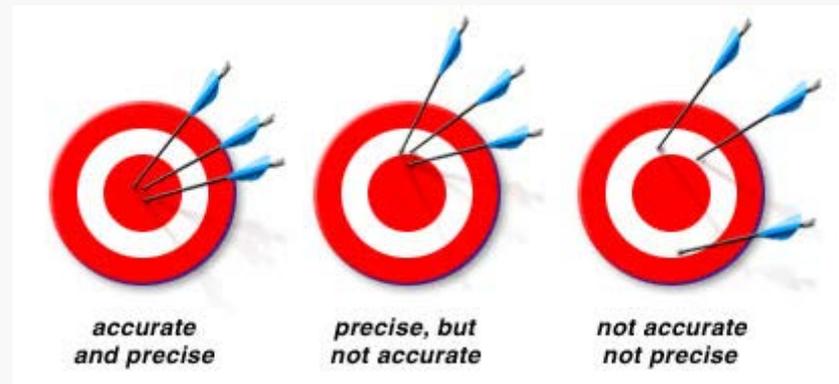
Objectives

1. To understand the qualities that drive the use of POCT by clinicians.
2. To be able to identify areas where tests that are in development can bring value.
3. To be able to articulate the value proposition that drives the clinical uptake of point of care tests.



Characteristics of a POCT with wide and rapid uptake

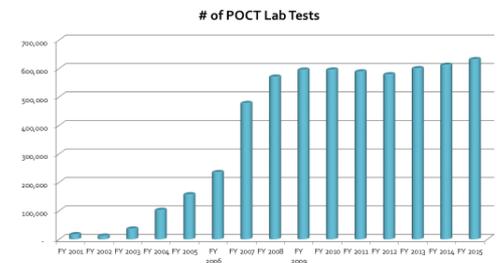
- 1. Use of the test reduces laboratory or bedside direct costs**
- 2. Clinicians perceive the useful test as accurate, precise, and reliable**
- 3. The test is integrated into the electronic health record and provider order sets**



The value proposition for POCT

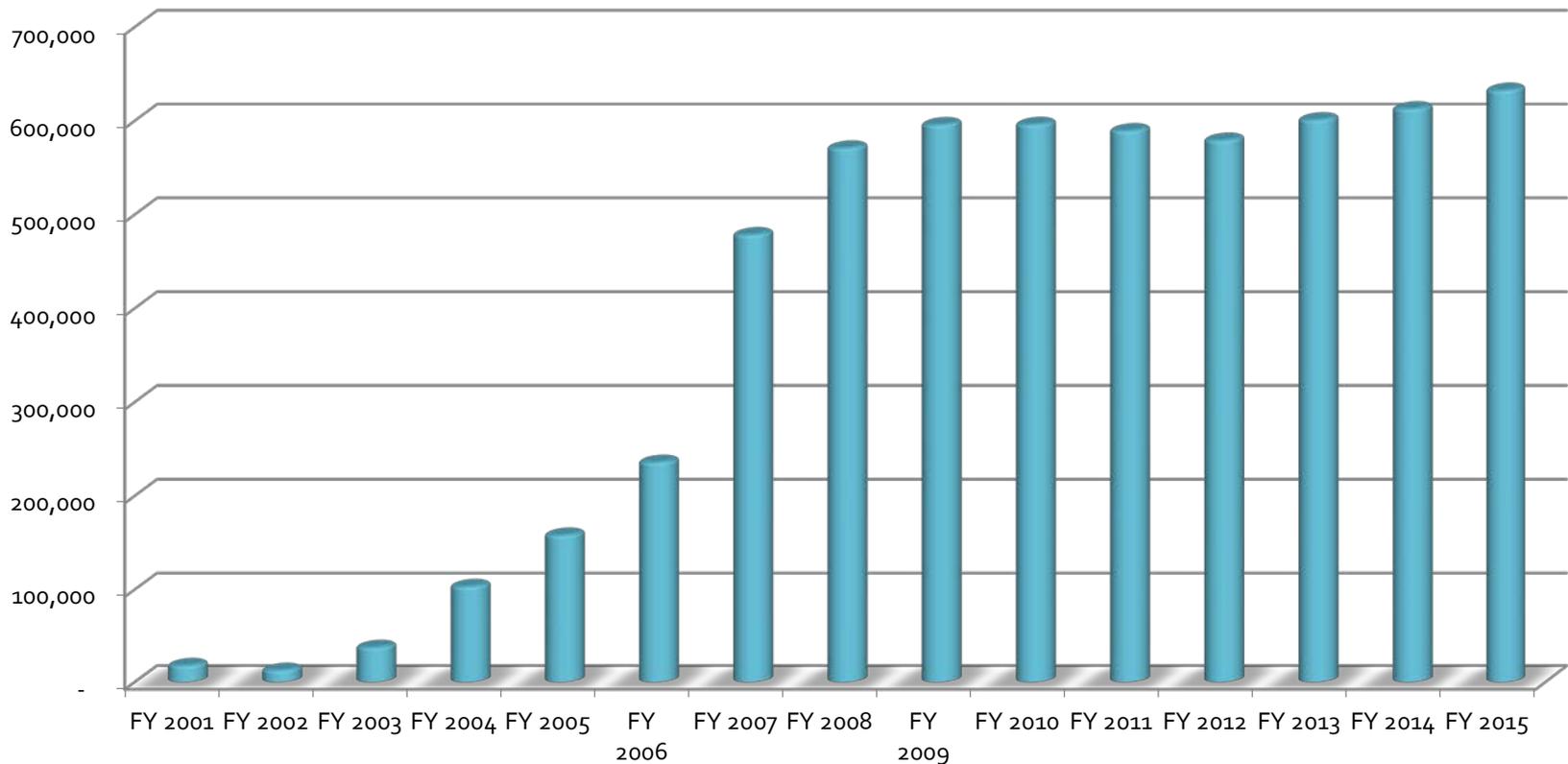
- 1. Reduction of labor costs by making clinical staff workflow more efficient or increasing staff retention**
- 2. Avoided costs related to delayed or missed intervention and readmission**
- 3. Quality of care: earlier recognition of the extent of injury or serious disease**

POCT Lab test Utilization at UMass Memorial Medical Center



POCT Lab test Utilization at UMass Memorial Medical Center

of POCT Lab Tests



POCT Clinical Adoption Characteristics

Why did it take 6 years?

- 1. Pilot projects conducted**
- 2. Creation of clinical standard operating procedures**
- 3. Device training of bedside personnel**
- 4. Building staff confidence that POCT is accurate and reliable**
- 5. Interfacing of results into the medical record**
- 6. Incorporation into clinical order sets**

“Simplicity is the perquisite for reliability”
Edsger Dijkstra



Which POCT tests are in routine clinical use today?

Blood glucose testing

Lactate

Electrolyte panels

Arterial Blood Gas testing

Coagulation studies (PT/INR, ACT)

Hemoglobin A1c

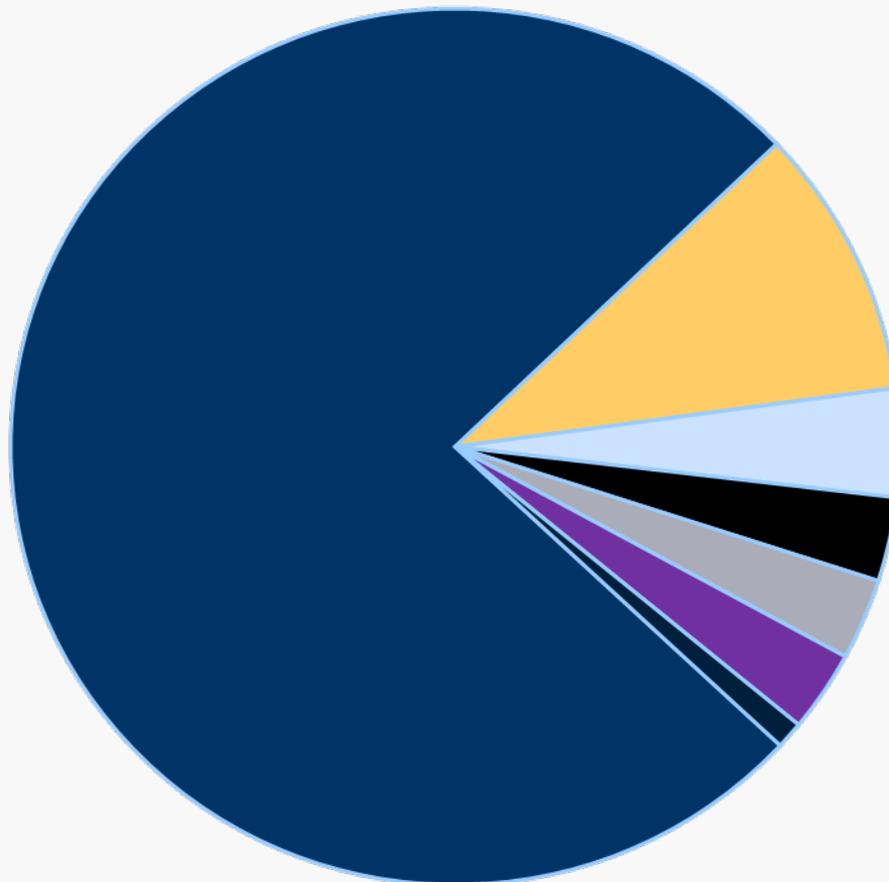
“We are stuck with technology when all we want is just stuff that works”

Douglas Adams



Which routine POCT tests are used most frequently?

UMass POCT Testing



■ Blood Glucose

■ Coagulation Studies

■ Electrolytes

■ Blood Gas

■ Hemoglobin A1c

■ Other

■ Lactate

Why is blood glucose testing the most frequently used POCT?

- 1. Blood glucose monitoring is part of the ICU admission order set**
- 2. ICU nursing competencies include using the POCT device**
- 3. POCT tests are electronically entered into the electronic medical record without nurse entry**
- 4. Electronic interfacing of results allows alerts that are not impacted by errors of transcription**

“Any sufficiently advanced technology is indistinguishable from magic.” **Arthur C. Clarke**



Opportunities for growth of POCT

Tests where time matters

- 1. Recognition and management of infectious diseases**
- 2. Diagnosis of acute coronary syndromes**
- 3. Treatment of electrolyte disturbances**
- 4. Hematological testing**
- 5. Early recognition of neurological emergencies**



Recognition and Management of Infectious Diseases

Tests where time matters

- 1. Detection of cases that require isolation**
- 2. Early diagnosis of sepsis**
- 3. Diagnosing patients resistant and virulent organisms**
- 4. The right source control right now**
- 5. Identifying cases that require more than antimicrobials**



Detection of cases that require isolation

Can you know at or before triage?

Pathogens that require isolation

- 1. Early isolation to prevent lateral transmission**
- 2. Limit risks to our health to our health care workers**
- 3. Protection for family and visitors**

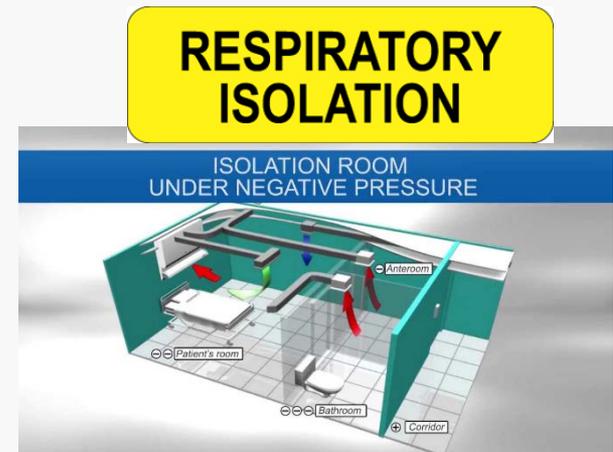
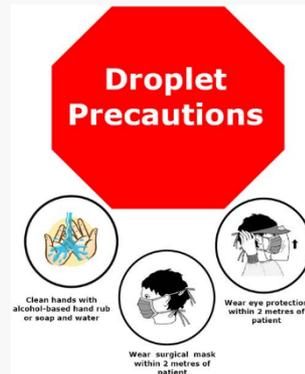


Effective respiratory isolation

Workplace safety

Pathogens that require respiratory isolation

1. Influenza
2. Tuberculosis
3. Diphtheria
4. Mumps, Rubella, Pertussis
5. Meningococcal meningitis
6. Middle east respiratory syndrome (MERS)
- 7 Hemorrhagic Fevers



Contact Precautions when you need them

Preventing lateral transmission

Pathogens that require contact precautions

1. **Clostridium difficile**
2. **Scabies, Pediculosis**
3. **RSV, Diphtheria**
4. **Rotavirus**
5. **VZV (shingles), Furunculosis, impetigo**
6. **Resistant bacterial pathogens (ESBL, Acinitobacter)**
7. **Hemorrhagic fevers**



Detection of cases that require isolation

Special case of Hemorrhagic Fevers

Family of viruses	Vectors	Name of viral hemorrhagic fever
Bunyaviridae	Mosquito	Rift valley fever
	Tick	Crimean-congo hemorrhagic fever
	Rodent	Hantavirus fever
Flaviviridae	Mosquito	Dengue fever, yellow fever
	Tick	Omsk fever, kyasanur forest disease
Arenaviridae	Rodent	Lujo virus fever, lassa fever, argentine fever, bolivian fever, venezuelan fever
Filoviridae	Bat	Ebola hemorrhagic fever, marburg hemorrhagic fever



Powered Air Purifying Respirator



The Role of POCT for the early diagnosis of Sepsis

Tests where time matters

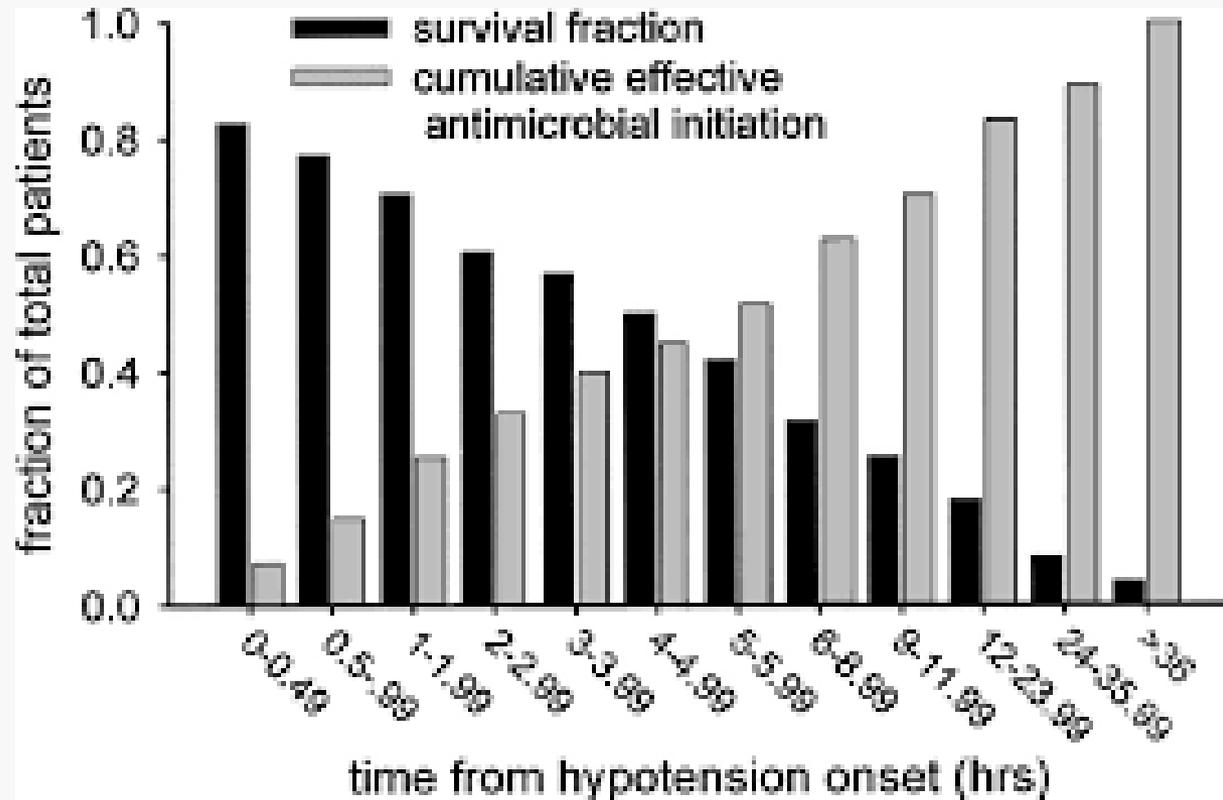
An immediately available sensitive test for the presence of a pathogen would make early therapy accessible to more patients

“HECTIC FEVER AT ITS
INCEPTION IS DIFFICULT
TO RECOGNIZE BUT EASY
TO TREAT; LEFT UNTENDED,
IT BECOMES EASY
TO RECOGNIZE BUT
DIFFICULT TO TREAT.”

– NICCOLÒ MACHIAVELLI IN “THE PRINCE”¹¹

Early Diagnosis of Sepsis

Tests where time matters



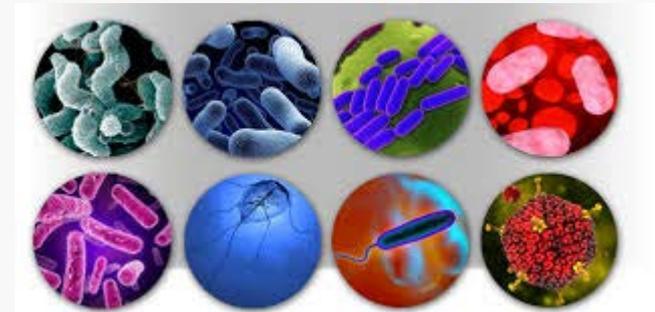
Every hour that effective antimicrobial therapy is delayed decreases that chance that the patient will survive

Kumar et al. Cri Care Med 2006; 34: 1589-96

Recognition and Management of Infectious Diseases

Tests where time matters

The ability to detect the presence and absence of resistant and virulent pathogens is the key to targeted rather than broad spectrum initial antimicrobial therapies



Identification of Infections that require source control

Tests where time matters

The right source control right now

- 1. Perforated viscus**
- 2. Necrotizing fasciitis**



When antimicrobials are not enough

Tests where time matters

POCT can identify cases that require more than antimicrobials

- 1. Adrenal Insufficiency**
- 2. Toxic Shock Syndromes**



A pituitary patient on hydrocortisone, who is in shock, has been in an accident and is vomiting. Suddenly needs a higher dose of hydrocortisone (usually by using injection)

- Think - Adrenal Insufficiency
- Realize - Adrenal Crisis!
- Act NOW to treat this patient and save their life!

An adrenal crisis is life threatening!

The Pituitary
PITUITARY FOUNDATION
www.pituitary.org.uk
f t

Skin changes of TSS



Recognition and Management of Acute Coronary syndromes

Tests where time matters

The most common cause of acute transfer from a skilled nursing facility is the evaluation of chest pain

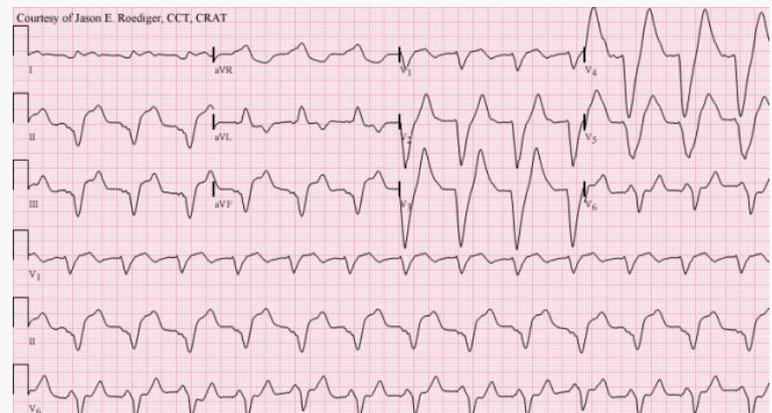
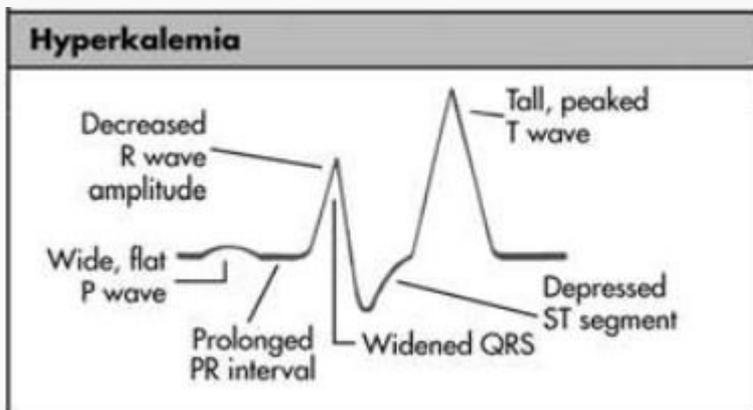
There is substantial value in providing POCT that can prevent inappropriate transfers to emergency departments



POCT for Electrolyte Disturbances

Tests where time matters

- 1. Monitoring response to therapeutic interventions for hyperkalemia**
- 2. Management of hypokalemia**

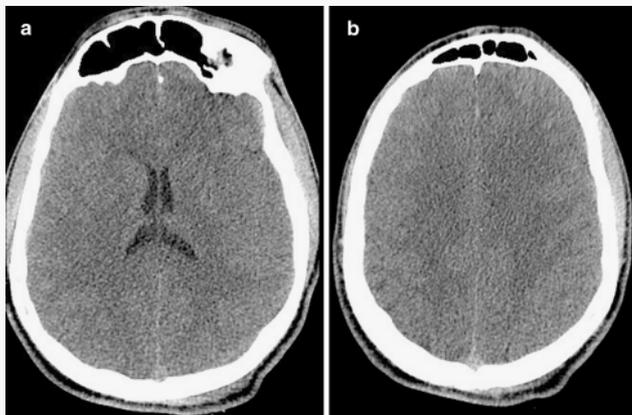


POCT for Electrolyte Disturbances

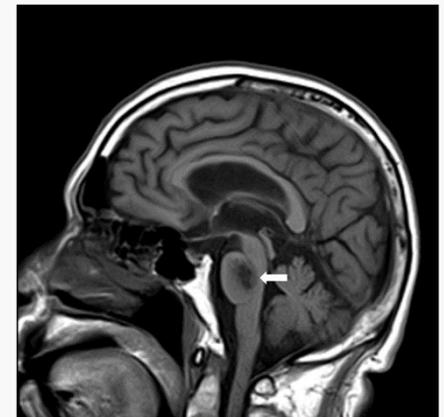
Getting water balance right

3. **Detection and monitoring of sodium balance**
 - a) **During treatment of traumatic brain injury**
 - b) **Management of Diabetes insipidus**
 - c) **Management of acute hyponatremia**

Diffuse Cerebral Edema



**Osmotic
Demyelination Syndrome**



Urgent Hematological Testing

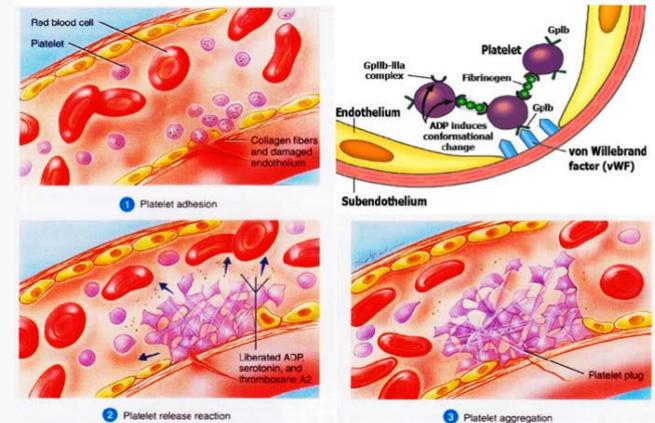
Tests where time matters

1. Monitoring the effectiveness of resuscitation from hemorrhagic shock
2. Monitoring adequacy of support for hemostasis

Trauma Bays



Elements of Hemostasis



Detecting Acute Neuronal Injury

Tests where time matters

Early recognition of neurological emergencies

Identification of acute stroke

Early detection of hemorrhagic transformation



Where POCT growth may not occur

Arterial Blood Gas Testing

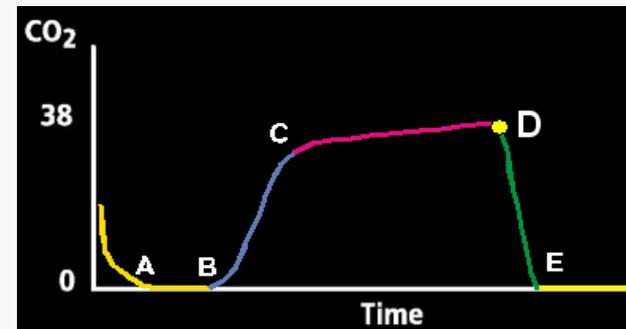
The components of an ABG may be available from other sources

1. Increasingly reliable information regarding oxygenation is available from bedside monitors
2. Hypercarbia can also be measured by bedside monitors



Bedside Pulse Oximetry

Point "D" is End Tidal CO₂



Where POCT growth may not occur

The use of ABGs is decreasing

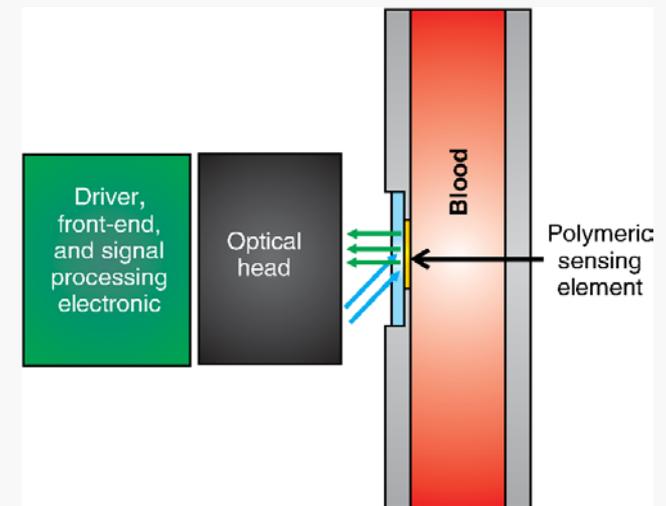
The components of an ABG may be available from other sources

3. Intra-arterial devices that report pH may soon be available

Using Incentives to Improve Resource Utilization: A Quasi-Experimental Evaluation of an ICU Quality Improvement Program

Murphy, David J. MD, PhD^{1,2}; Lyu, Peter F. MSPH²; Gregg, Sara R. MHA²; Martin, Greg S. MD, MSc, FCCM^{1,2}; Hockenberry, Jason M. PhD³; Coopersmith, Craig M. MD, FCCM^{2,4}; Sterling, Michael MD, FCCM^{2,4}; Buchman, Timothy G. PhD, MD, MCCM^{2,4}; Sevransky, Jonathan MD, MHS, FCCM^{1,2}

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Arterial pH Monitoring

Improving Critical Care Delivery

- *POCT is bringing value to Critical Care by providing the right information at the right time*
- *The future involves integration of laboratory and non-laboratory data for display in the electronic health record*

