POINT OF CARE TESTING

By

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READING & BACKGROUND [do this before class]


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DATA SYNTHESIS: Point-of-care testing devices and technology are increasingly used in the delivery of care and therapeutic decision making. No studies have evaluated the impact of point-of-care testing, by itself, on patient care and outcomes. All studies have incorporated point-of-care testing with changes in the way patient care is delivered and have shown significant improvements when this approach is taken. The cost of point-of-care testing on a per test basis is sometimes greater than traditional laboratory testing, but that increased cost may be offset by improvements in the management of patient care, improvements in patient outcomes, and decreased utilization of the healthcare system. Point-of-care testing has been used successfully by pharmacists in disease management programs. Various government regulations and legislation impact the use of point-of-care testing.

2) On HIV testing -- read this
http://www.cdc.gov/MMWR/preview/mmwrhtml/mm5236a4.htm
Abbott Diagnostics has received 510(k) clearance from the FDA to market its i-STAT BNP cartridge. Four other cartridges obtained earlier FDA approval. BNP is a protein secreted by heart muscle when a patient has congestive heart failure (CHF).

Determining the level of BNP in a patient's blood, an objective marker of the presence of heart failure, can help physicians quickly and more accurately diagnose and assess disease severity. Additionally, BNP testing at the patient bedside accelerates triage, diagnosis, treatment and disposition of patients, clearing overcrowded emergency departments, and patient survival rates. Nearly 80 percent of heart failure patients admitted to the hospital come through the emergency department...These patients present with shortness of breath, which doctors must assess to differentiate between heart attack, pulmonary embolism, asthma, the flu or a number of other conditions in addition to CHF.

Point-of-care-testing (POCT) has labored under a number of burdens since its introduction, one of which has been the need to justify the additional unit cost of a test when compared to the cost of a comparable test performed in the central labs. The cost of centralized lab testing will usually be less expensive than the former because of economies of scale.

Lab professionals tend to have a vested interest in performing test in the central lab in order to justify the cost of their high-throughput automated instruments and because, at least in the past, they have had more confidence in central lab quality control procedures. For those hospitals with pneumatic tube systems that permit rapid transit of specimens to the central lab, it is not uncommon for routine lab testing in chemistry and hematology to approach the turn-around-time (TAT) available from Point of Care tests (POCT).

The i-STAT BNP test is a very good example of a test with a highly favorable return-on-investment (ROI) because it can rapidly provide both a diagnosis and severity assessment for congestive heart failure patients seen in the Emergency Department. Any test that can help rapidly clear patients out of the ED will be welcomed and the added expense can be easily justified.
4) How Investors View the Area (read this)

Market Evaluations provide comprehensive and detailed analyses of emerging technologies and markets.

Point of Care Diagnostics Market in the US: Opportunities and Challenges (*Published August 2006 by BioPerspectives*)
Diagnosing at the point of care offers many advantages: increased patient empowerment, improved clinical outcomes, and fewer days at the hospital. As a result, physicians are ordering more point of care tests and companies are racing to meet growing demand. Their efforts are made easier by improved knowledge of diseases and drug responses at the molecular level and improved technologies that enable simpler, more self-contained testing. These trends, according to a new report from BioPerspectives, are expected to drive double-digit growth over the next five years. According to this new report, the market is expected to grow from $5.5 billion in 2005 to as much as $7.5 billion in 2010.

But this opportunity is not without challenges. Point of care diagnostics is a highly competitive and challenging marketplace, with more than 50 companies and 40 types of tests, not to mention regulatory guidelines, reimbursement challenges, and information technology infrastructure needs. Moreover, point of care testing is inherently more expensive than central laboratory-based testing on a per test basis, resulting in intense price pressure. Success in this market depends on a detailed understanding of the trends, the unmet needs, the technologies, and the prices.

5) Estimates of Market Potential (read this)

The global POC testing market is currently estimated to be worth US $10 billion and accounts for approximately 36% of the US $28 billion global *in-vitro* diagnostic (IVD) testing market. Currently, diagnostic testing accounts for only
between 1-2% of government healthcare expenditures worldwide, yet influences between 60-70% of healthcare decisions. Cost is one of the key drivers in the strategic transfer of diagnostic testing from central laboratories into point-of-care settings. While costs vary widely from lab-to-lab, in general the cost for an assay performed by a certified pathology laboratory is about $55 in billable charges. POC assays also vary widely in costs with a substantial discount for multiple kits. Nevertheless, the average cost to the POC assayer is about $7.50. Some assays require the acquisition of a “reader” hardware which may or may not be free. If the hardware is purchased, the price charged per assay is almost always less than if the hardware was provided free. This is sometimes called the Gilette Principle (give away razors but sell the blades).

Faced with health payer demands to reduce expenditure, hospital administrators are coming under increasing pressure to move patients through the healthcare system faster to cut costs. Point of care diagnostic testing allows physicians to diagnose patients more rapidly, often within minutes. The single most important advantage a patient can have to survive a life-threatening disease is early detection. A faster diagnosis enables a quicker start to appropriate therapy, offering the potential to improve clinical outcomes, while reducing costs.

Growth in POC diagnostics has been made possible through advances in technology, automation and IT which have enabled the development of portable analytical equipment that is easy to use by non-laboratory staff and which offers reliable and reproducible results. In many hospitals, POC testing now accounts for 20% of diagnostic testing and has extended beyond the hospital to primary care surgeries and the home. As a result, the POC diagnostics market is growing rapidly and is expected to continue to do so in the foreseeable future.
WHY DO “POINT-OF-CARE”? 

$7.50 vs. $55.20  [True costs are not a simple issue.]

1 minute response vs. 24 hour response

Therapy (response) directly coupled to measurement

Patient sees consequences of action

Patient can receive results confidentially

WHAT IS “POINT OF CARE” TESTING?

[what “points” ? what is the FDA law on such testing? “....if results will be used to dictate any kind of therapeutic intervention for the individual tested..”]

what falls through FDA’s crack?
   Insurance risk assessment

   Fertility/ovulation testing and EPT (many tests are voluntarily submitted for FDA approval)

   Any assay claimed for the companion animal market
WHAT ARE THE MAJOR TARGETS?

Blood Glucose (ca 65%)

Pregnancy/ovulation/sperm count (ca 12%)

FertilMARQ
“yes” v “no” at 20M swimmers/mL

Cardiological assays (ca 10%)

Coagulation

Infectious Diseases
   a) HIV
   b) hepatitis
   c) bladder infections

Electrolytes, Blood Gases

Alcohol Intoxication

Heart Attack

Rupture of Liver Cells

Impaired Metabolism of Multi-Drug Prescriptions (Saladax)
http://www.saladax.com/home/default.php
[not initially POC but “in-office”]
**WHAT DO THE DEVICES LOOK LIKE?**

![Devices Image]

- Glucose + Lipid
- M.I. (heart attack)

How ‘bout EPT? Does it count as “point of care?”
How about the Ovulation test? Does it count?

a) rising rapidly in popularity
b) being used improperly to *avoid* fertilization
How does a home ovulation test work?

When a woman is about to ovulate, her body releases a large amount of Luteinising Hormone. L.H. is always present in human female urine but the levels rise sharply in the middle of a woman’s cycle, causing her to ovulate. When this so-called “LH surges” occurs ovulation is very likely to occur in the next 24 to 48 hours. If pregnancy is desired intercourse should occur during this time.

How does the chemistry in the test work? [requires a mobile anti-LH antibody with a color tag on it and a “linked” anti-antibody]

**WHAT DO YOU NEED TO MAKE THE TESTS WORK? [THE BIO-MARKER !!!]**

*A highly specific marker?* [glucose for diabetes, ethanol for drunkenness, the CPK isoenzyme set for heart attack, blood in feces, antibodies to HIV for AIDS, β-HCG (Human Chorionic Gonadotropin) for pregnancy, LH for ovulation, “ferning” for saliva testing for ovulation (visual...requires a microscope), lichen-affinics for sperm count]
Estrogens, lipids, salt, and carbohydrates form a new, highly structured mucus

A SIDE BAR DISCUSSION

The Cough Syrup Fertility Drug

GUAIACOL - S.K. Klasko

Pine tree lignin + oxygen = guaiacol

“Expectorant and thinning agent for mucus” [patent to Hoechst Pharmaceuticals]

A highly specific QUALITATIVE chemistry

a) an enzymic reaction

b) an immuno-reaction

c) a specific electro-reduction potential

[d) a specific redox - for glucose; visual color change]

glucose + Cu²⁺ = glucuronic acid + Cu⁺¹ (as Cu₂O)

       green-blue                 red
WHAT MAKES “OCCULT BLOOD” TEST WORK?

HIGHLY COMPETITIVE: The Guaiac test
- Hemoccult®
- Instaccult®
- Hemoquant®
- HemeSelect®
- QuickVue®
- and over 20 other commercial versions!

HOME USE or IN-OFFICE USE
- Lawyers “kill” a product in toilet paper
- Spoons, brushes, wooden sticks, and fingers for sampling

LOTS of ERRORS:

FALSE POSITIVES: black pudding, radishes, turnips, cabbage, cauliflower, horseradish, uncooked broccoli, cantaloupe, steak tartare, Hemorrhoids
FALSE NEGATIVES: Citrus, Vitamin C

HOW DOES IT WORK? A Specific Oxidized Complex.
- Porphyrins in Blood form oxidized BLUE complex with

\[
\begin{align*}
\text{OH} & \quad \text{OCH}_3 \\
\end{align*}
\]
A highly specific QUANTITATIVE chemistry

1] chromatography
[diluted colors are often invisible but concentrated ones can be seen]

2] Colorimetric with instant visual read-out (specificity resides in the molecular recognition event)

MoAB-binding site (a pre-colored compd) +

analyte (a tighter binding compd) →

MoAB-binding site (analyte) + free pre-colored

Compd which now becomes colored

3] electrochemistry

Chemical + electron = Reduced Chemical⁻

Occurs at a specific potential

Amount of current flowing is related to concentration

Great for use in Emergency Room for blood gases, electrolytes, salts. Fast answer but an expensive electrochemical device is required

4] Don’t forget: Pressure, temperature, observation
WHY NOT DO "POINT-OF-CARE"?

Untrained assayer

Test is inherently less accurate

Community medicine misses a community trend

Insurance seldom covers “point-of-care”

WHAT HAS MADE BETHLEHEM FAMOUS? (OraSure, 2nd St)

1] Saliva (agent concentrations are ca $10^{-3}$) less than blood

2] antibodies, ethanol, drugs can all be measured (live virus is not easily measured unless there is a cut)

3] saliva assays trade off convenience and ease of sampling for a loss in sensitivity (errors are higher if analyte target concentration is lower)

4] same concept works for hepatitis C
SUMMARY:

A bright future

Cost savings to the patient

For now, some few tests are a bit more expensive (per test)

Major increase in medical effectiveness

An Exciting Area of Research