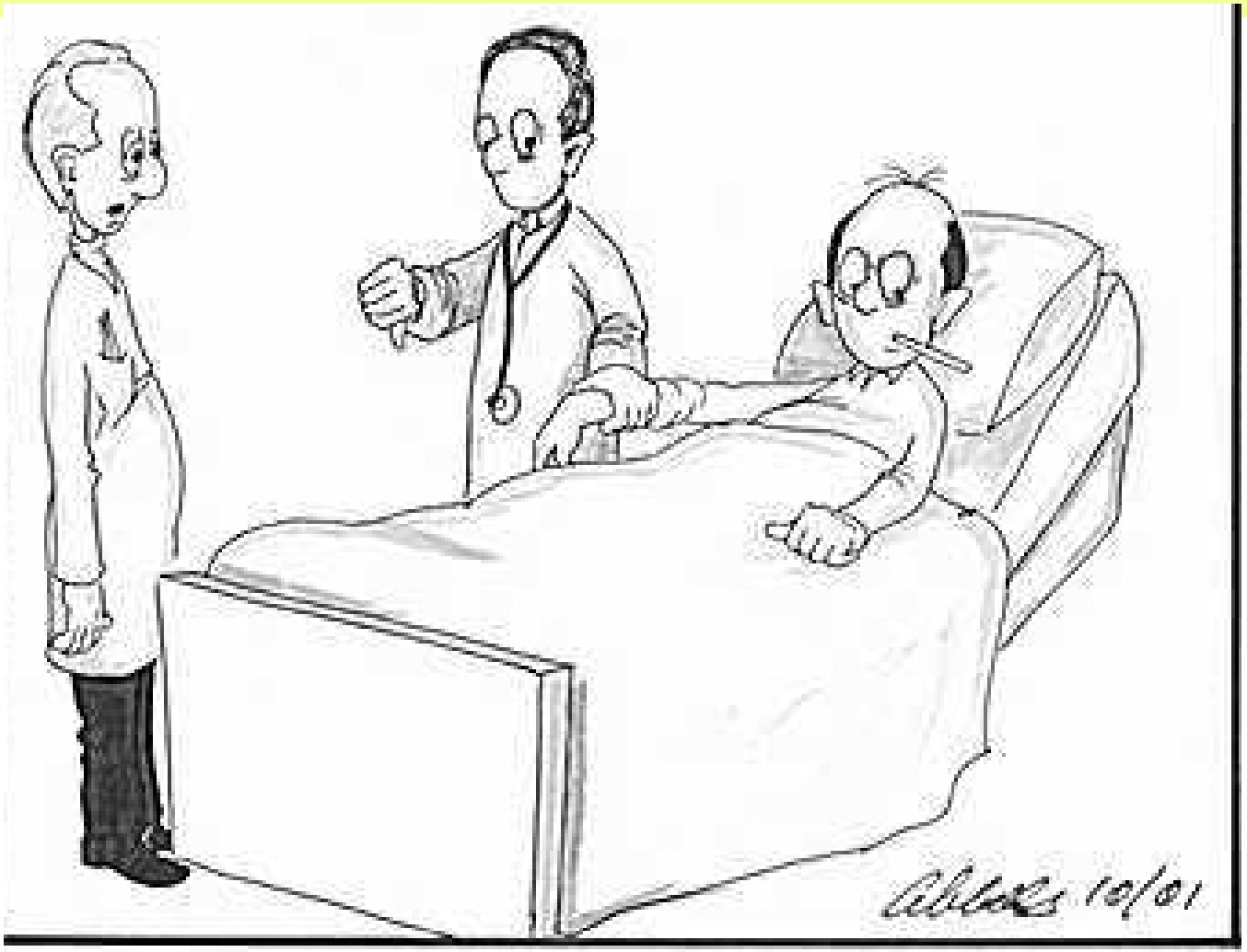
Point of Care Testing

Ned D. Heindel
Chemistry
ndh0@lehigh.edu

What do these have in common?

And this? (thermometer)



"Do you still have my rectal thermometer?"

And this?


Clearblue
DIGITAL OVULATION TEST
Easy-Read
Digital
Results
OVER 99% ACCURATE
Tells you the best 2 days
to conceive naturally
No.1 selling brand in the UK
7 Tests
Clearblue
DIGITAL OVULATION TEST

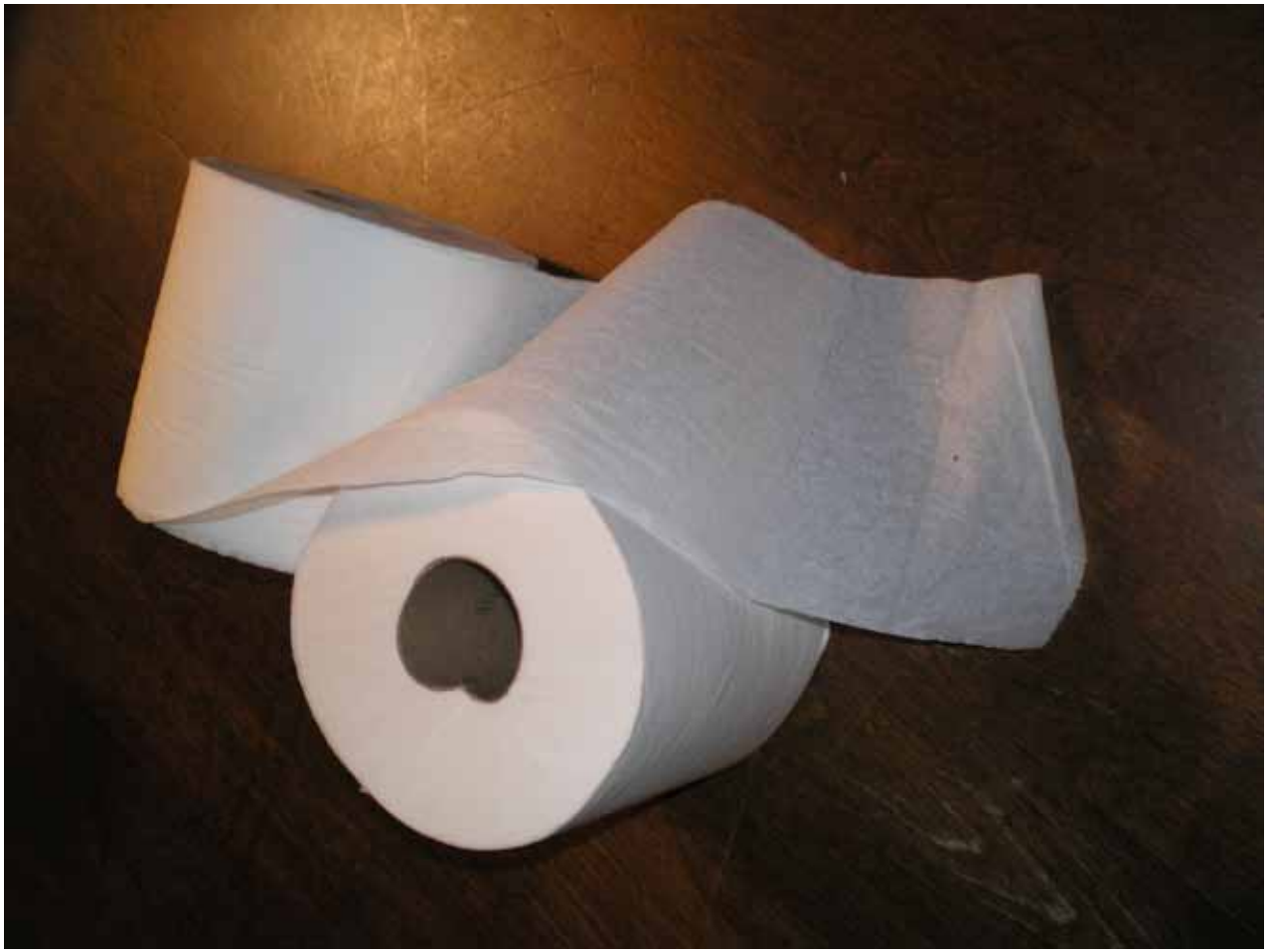
And this?

And this?


i-STAT
EG
7+
Measured Values
pH PCO2 PO2
Na K iCa
Hct
Calculated Values
HCO3 TCO2 BE
sO2 Hb


i-STAT
37°
EG
7+
FILL
TO

And even this?



& this, THE Most Popular!

THESE ARE ALL

POINT-OF-CARE (POC)

ASSAY KITS

Now Just What is "Point-of-Care"?

Answer: Home, bed-side, office

WHY PERFORM "POINT-OF-CARE"?

- $7.50 vs. $55.20 [careful here!]
- 1 minute response vs. 24 hour response
- Therapy (response) can be instantly coupled to the measurement
- Patient sees consequences of action
- Patient can receive results confidentially

WHAT'S THE ROLE OF FDA IN POC DIAGNOSTICS?

How Does FDA View Pt-of-Care?

- **Will test results be used to alter patient therapy? If so…FDA approval needed**

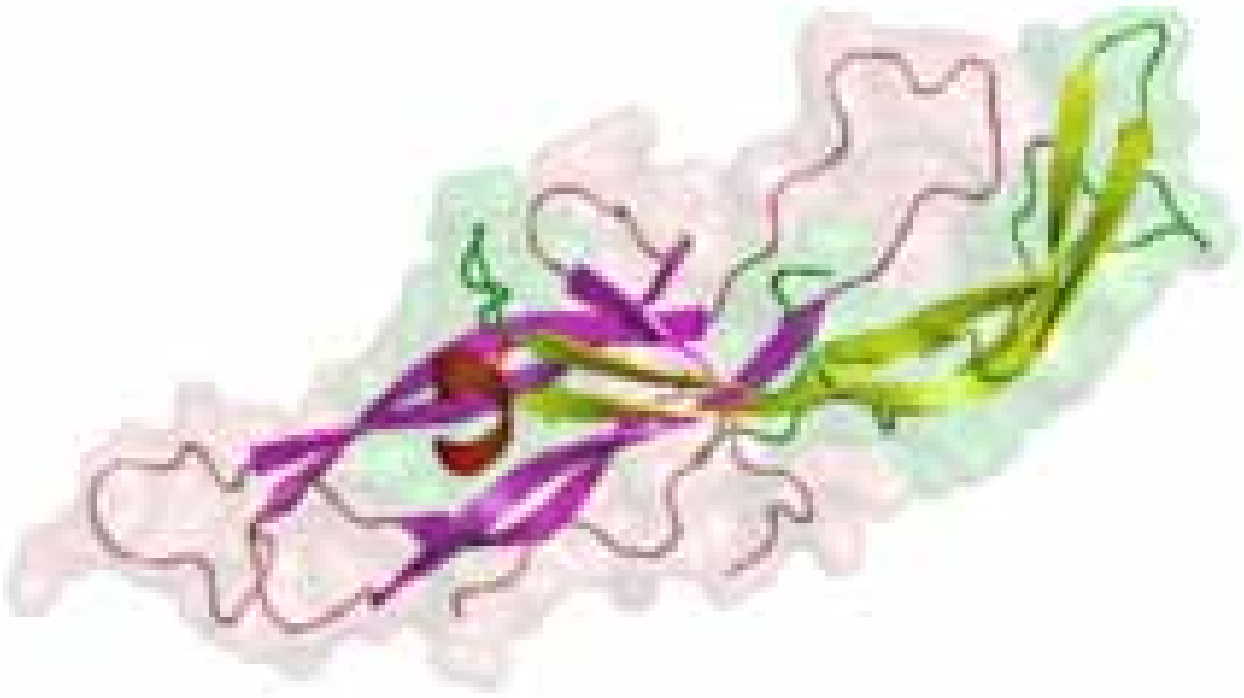
  Blood glucose?

  Blood pressure?

  Pregnancy? Ovulation?

- **Will assay be sold overseas? If *in total* FDA approval needed, if *in part*, not.**

Ya Gotta Have a Specific “Bio-Marker” or POC Won’t Work



Beta-HCG, 244 amino acids, 36,700 D, made by embryo

Other Bio-markers

Elevated glucose in urine or blood

High Blood Pressure or Body Temperature

Cardiac (or liver) enzymes ex-organ

Luteinizing Hormone

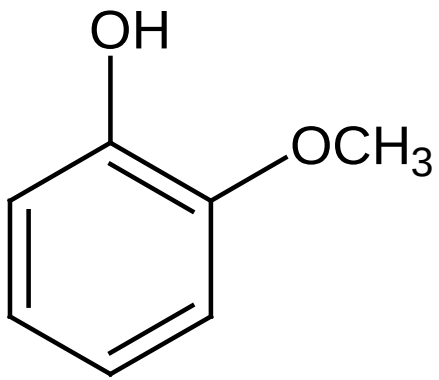
And many, many others! **(some observational)**

“Ferning” & Fertility

“High Content Screening”

[This is an insult to Chemists!!!]

Guiacol, Fertility, Blood, and Steve Klasko, LU B.A. ‘74



What Clinical Conditions do we Test for by POC?

- **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)**

How do We Get Specificity?

- A Specific Chromatographic Migration
- Enzymatic Recognition
- Immuno-Recognition
- Electrochemical Reduction

Electrochem Specificity

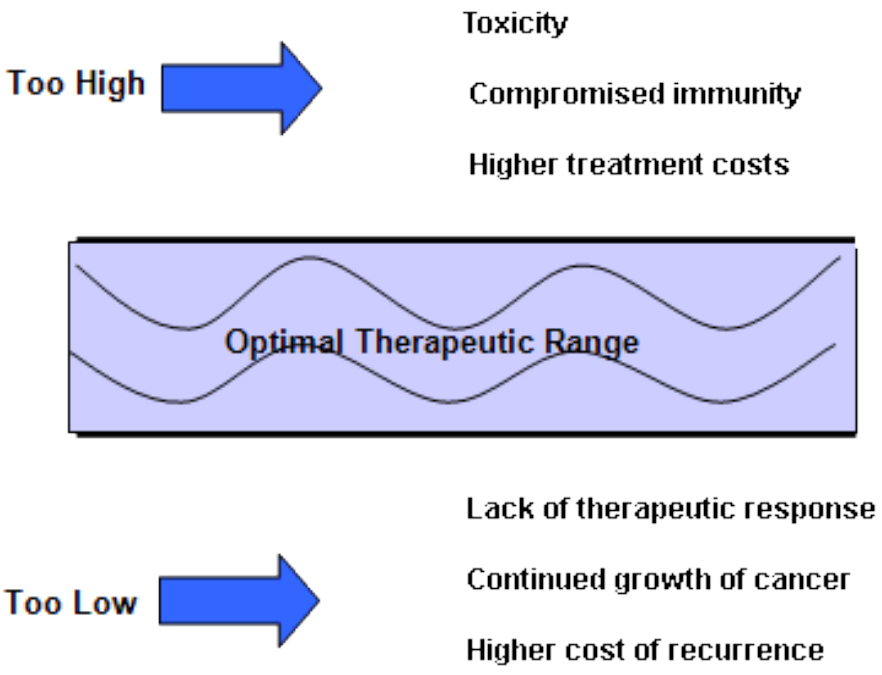
Pharmaceutical Examples

DRUG + e^- à	$[DRUG]^-$	(at precise potential)
Misonidazole		-0.64 v
Clotrimazole		-0.19 v
Streptozotocin		-1.34 v
Ritonavir		-1.91 v

Precise potential for reduction identifies the drug, total current flow measures the amount

What are the Justifications? Most are obvious…a few not so.

Monitoring anticancer drug metabolism at home or at lab



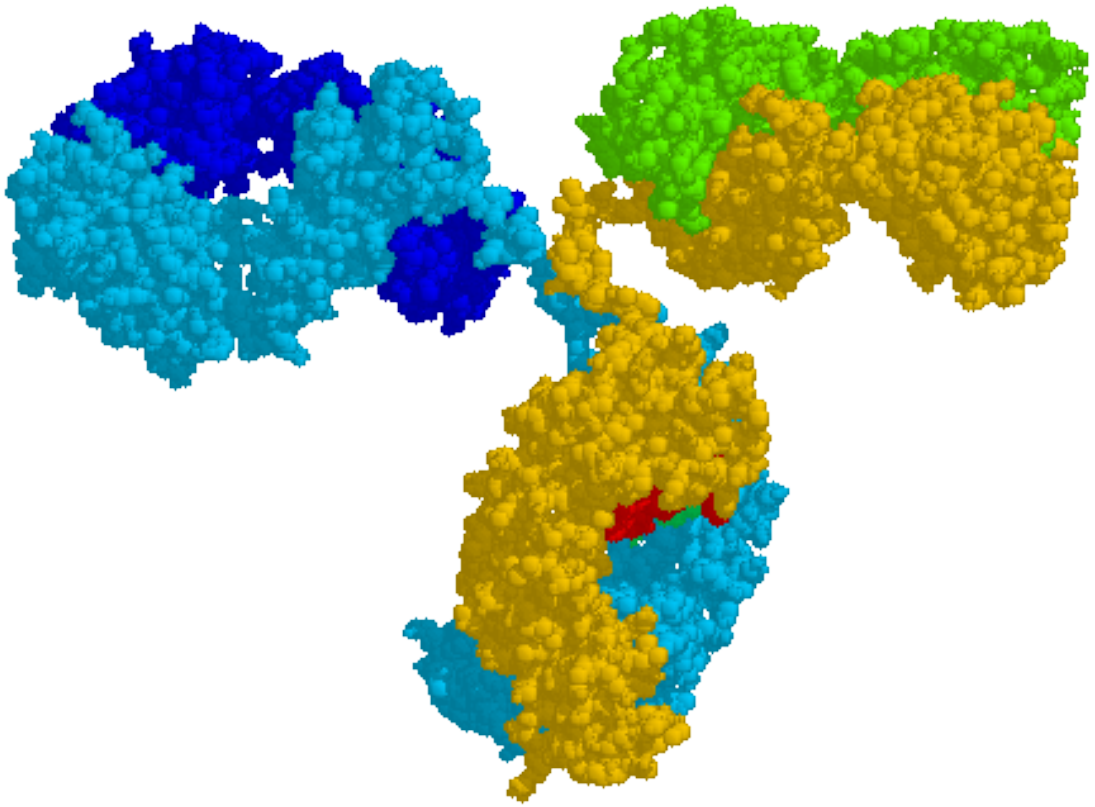
Challenges in Configuring the Assay

- What should we sample?
- "Yes" vs. "No" (cut-off assay) or precise measurement assay
- Simplicity of Use (the 'blue line' rushes past)
- Checks-and-balances (air, water, sun, decomp of reagents, stabilizing reagents)
- Handling confirmation of serious finding

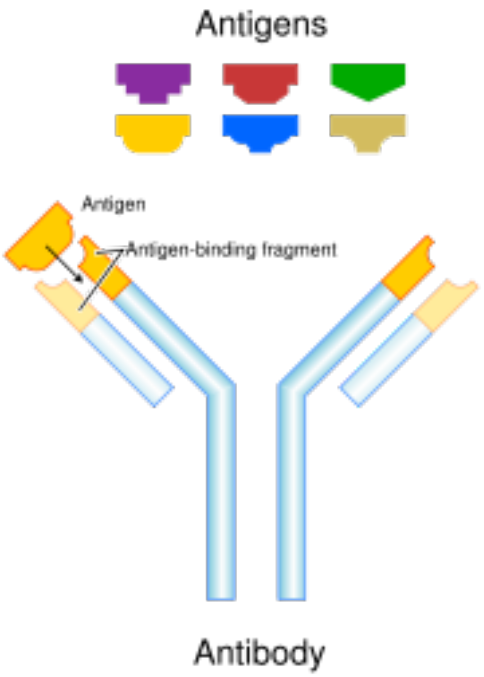
Handling Reagents

CONSTRUCTING AN ASSAY with MAb

heavy chains = yellow & light blue, light chains green & dark blue. carbohydrate = red



CONSTRUCTING AN ASSAY



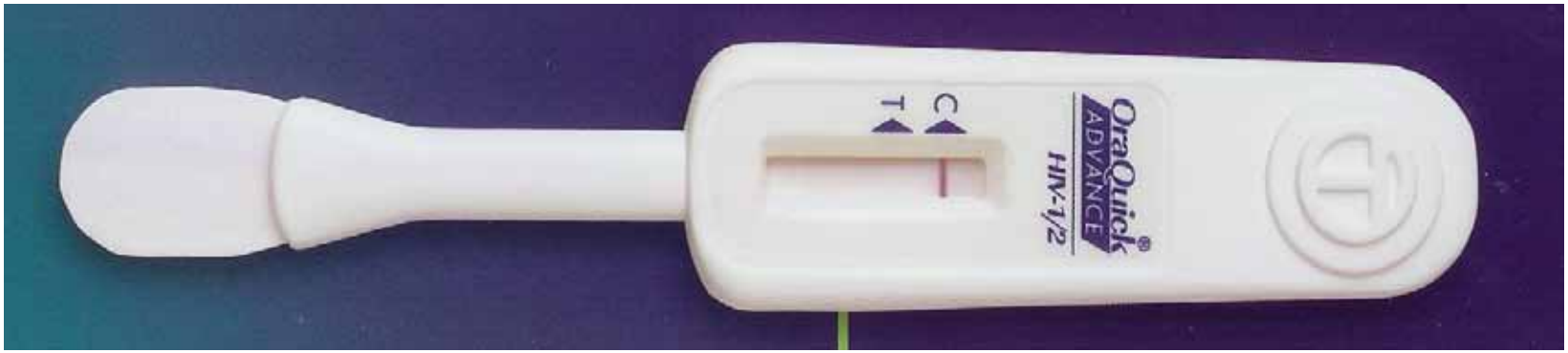
MAb[tag] + analyte =

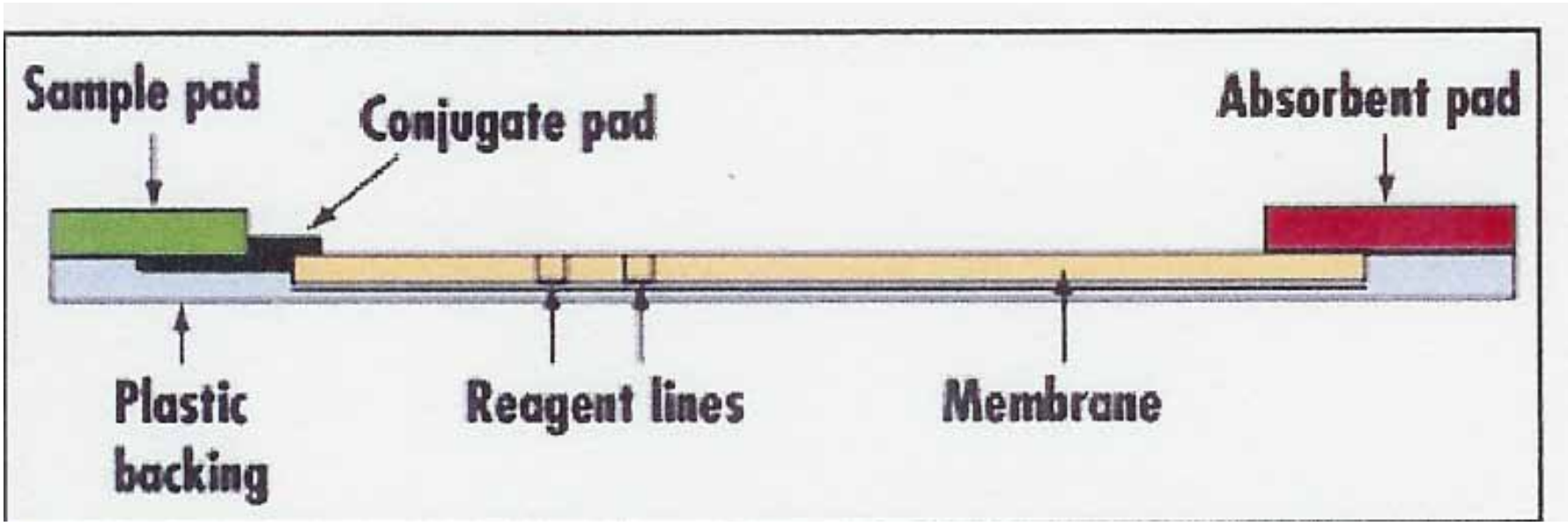
MAb[tag]--analyte *then*

Anti-MAb to MAb[tag]--analyte grabs & holds this combo in a narrow target zone

Visual “tag” not bound covalently can be released by the binding event

Assembling the Assay





What Can Go Wrong?

- Untrained assayer
- Test is inherently less accurate
- Community medicine misses a community trend
- Insurance seldom covers “point-of-care”

A FEW FAMOUS FAILURES

- Toilet paper fecal blood test
- Fecal sampling spoon and rubbing paper
- Ejaculate on bulls eye and microwave
- Heated patch for sweat sampling
- Home-use “ferning” assay with scope

WHAT's THE FUTURE?

- A bright future for R&D and investment where chemistry, biology, & medicine meet
- Possible cost savings to the patient (For now, a few tests do appear to cost more per test)
- Major increase in medical effectiveness
- Confidentiality and increased patient responsibility for personal health

Let's Look at it as a Business

- **Time to market for a diagnostic = 3.5 yr**
- **Time to market for a drug = 9.2 yr**

- **ROI per year for diagnostic ca 8.5%**
- **ROI per year for a drug ca 18%**

- **Legal protection for a diagnostic ca $65K / year/ product**
- **Legal protection for a drug > $150K/yr/product**

“Better things for better living through CHEMISTRY”!

http://www.craigmedical.com/