Quicklook™ Technology Assessment

Liquid Core Optical Fiber Biofluid Diagnostic Tool

By TEAM C or “DECK LV (55)”
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Technology Description

The Liquid Core Optical Fiber biofluids analysis tool, LCOF, uses Raman spectroscopy to provide fast and accurate analysis for the basic chemical diagnostic panels sought in blood and urine testing. LCOF offers a particular innovation over traditional Raman technology; its measurement is done within a liquid core optical fiber with specialized corrective capabilities. As such, it does not require the use of chemical reagents kits, as is standard in existing equipment, and could provide significant cost savings over time.

Raman spectroscopy is commonly used technology in industry today. It is based on the concept that different substances, when irradiated with light, shift the light based on their molecular makeup. These patterns of light shifts (spectra) are specific to each molecule and therefore to each substance. This consistency provides the ability to compare the spectra of unknown compounds with known spectra for identification purposes. Typically, a laser beam is used to illuminate a sample. Light from the illuminated sample is collected by a lens and is capture via a spectrometry or other means. The spectra comparison can then be made.

LCOF builds on existing Raman spectroscopy technology by adding a fiber optic core that the analytes (substance to be analyzed) can flow through while being analyzed. Using the liquid core technology enhances the current Raman technology three ways:

- First, the use of the fiber optic core enhances accuracy of the analysis. (Optical absorption effects created by the shape of the tube are corrected with software and using a simultaneous measurement of the white light absorption spectra.)
- Second, the tube can allow for an automated, high volume system for routine clinical libratory testing of the most commonly measured blood components without the use (and cost) of chemical reagents. In addition, the Raman technology requires a much smaller blood sample from the patient.
- Third, the tube allows for the potential for real time monitoring of liquid compounds. Because this is a flow-through system and provides a real time signal, it could be configured to monitor urine outflow, as a real-time monitor for renal failure. For urine analysis, the Raman spectroscopy can measure UUN and creatinine (the key indicator of renal failure).

This technique lends itself to an automated, high volume system for routine clinical laboratory testing. As such, it is a good candidate as a workhorse device in a clinical laboratory. Its methodology is fast and accurate. It can handle about half of the components typically measured in routine blood serum analysis and is likely to cost less than, or similar to, similar equipment currently in use.

Potential Benefits

- It does not require the use of chemical reagents and will not require ongoing chemical reagent costs.
- The Raman spectroscopy is done on a single sample of blood, requiring a much smaller blood sample from the patient.
- Since the measurements are made as the blood serum flows through the optical wave guide, and this hollow waveguide can be easily cleaned between samples by flushing, the technique lends itself to an automated, high volume system for routine clinical laboratory testing.
- Because this is a flow-through system and provides a real time signal, it could be configured to monitor urine outflow, as a real-time monitor for renal failure.

Potential Commercial Markets

Spectroscopy Market Overview

The total worldwide market for process spectroscopy instrumentation is expected to rise from $178 million in 2004 to $232 million in 2009, at an average annual growth rate (AAGR) of 5.4%. The highest growth rate is expected in Raman spectrometers, with an AAGR of 8% through 2009. The once-academic technology has made significant inroads into process monitoring in recent years.

There are two primary applications to be considered for LCOF:

1. As a workhorse analytical tool for testing routine blood and urine samples. It would act as a supplementary device in a lab. As such, it could be a useful system in any environment that does a high volume of routine biofluids work.
2. In inline products where the patient's measurements are being taken in real time (e.g. for creatinine level detection during dialysis treatments.)

High volume, routine biofluids analysis

Centralized Laboratories

One potential market are the centralized laboratory chains that perform out-sourced testing of blood and urine samples for doctor's offices and regional clinical networks. These labs typically focus on a specific group of tests such as blood-serum for complete blood chemistry analysis and urine-analysis to test creatinine levels. Because these business entities need cost-effective, rapid processing and easy-to-learn testing, LCOF could be a fit with a return on investment over time through the elimination of recurrent reagent costs. The American Association of Test Labs indicates that there are ~6,000 of these

facilities in the US and are forecasted to grow at a rate of 19% for 2006.

In-hospital laboratories

Another potential market is the in-hospital laboratory where thousands of samples are analyzed on an annual basis. Businesses like these are always looking for ways to cut costs, improve efficiencies and be more responsive to doctors with accurate test results. As with the centralized labs, these in-hospital labs may benefit from a machine that could take on the routine blood and urine analysis. The American Hospital Association states that the growth of these labs is flat due to fewer hospitals being built throughout the US.

Government laboratories

Government labs, whether they are for research or for military in-field hospital applications, may also be able to benefit from LCOF. Because it is the military/government, this market must be listed as its own.

Veterinary offices

Veterinarian offices and labs pose as potential customers for LCOF. Because the nature of patient care is different between human and animal medicine, it is important to describe this potential market separately from that of the others listed above, even though the fundamental analysis approach is the same. They do not have as many potential barriers, since the FDA does not regulate veterinary medicine and they charge the consumer directly for their tests.

Inline application markets

LCOF has potential for real-time, or inline, monitoring. Dr. Ed Womble, co-founder of Raman Systems Inc. mentioned that they have looked into inline urine analysis. The following is from the Raman Systems Inc. website:

> "RSI announces a major breakthrough in utilizing Raman Spectroscopy to analyze blood non-invasively. Working with the Boston University Medical Center, RSI has been able, for the first time ever, to monitor the Urea level in patients' blood while the patients were undergoing Dialysis. The in situ measurements were accomplished with RSI's patented battery powered R3000 model Raman Spectrometer (5,982,484) and patented probe (6,897,951)."

As Raman technologies establish a track record for inline use, there could be significant potential for LCOF. For example, LCOF could have specific utility in kidney dialysis treatment centers.

Market Interest

Mr. David Martin, Director of Austin Regional Clinics' Lab Facilities, indicated that he already has workhorse machines in his laboratories that do their jobs well. Despite the fact that this machine may have reduced costs over time, this potential benefit did not sufficiently intrigue him without being able to see convincing data around that savings. His primary concerns were as follows:

- Maintenance of the machine - the device currently doing this 'job' costs about $1000 a month in maintenance.
- Unified platform on the lab floor – he is working to have standard equipment across the lab for ease of training, maintenance, etc.
- Costs over time – it is hard to demonstrate the cost savings of eliminating chemical kits.
- Limited analyte testing – the machines he uses now test for a far greater range than is possible from LCOF and as such, would be difficult to displace. He did not see a need for a supplemental device to take on the routine work.

Joe Skraba, Vice President of Business Development of LabNow, who is currently developing a point-of-care biofluids analysis tool, reviewed LCOF from his perspective for its commercialization potential. From a lab perspective, the fact that there are no reagents may be beneficial due to lower expense, however, from an instrument manufacturer business perspective, this may be a negative. He cautioned that there may be a challenge of selling the instrument alone because there is no on-going revenue stream (no residuals).

This may significantly impact the potential for a healthy economic model for LCOF. He cautioned that the developing a laboratory instrument and getting FDA approval on to commercialization can cost from $100 million to $300 million. Even on the low end, it will take a lot of revenue to recoup that money. It may be difficult to find a manufacturer who will be interested in developing with without a clear indication of a healthy economic return.

The cost savings to the lab will need to be proven as well, since labs are reimbursed according to the cost structure of diagnostic testing. Dr. Martin described that process as reimbursals per diagnostic test using CP Codes determined by the American Medical Association. These codes are established for each test (or panel of tests) and each methodology. The establishment of CP Codes lags behind the availability of equipment, and the AMA establishes 'relative based relative value' codes that allow clinics to chose a code for a similar panel. There is a lot of guessing involved in that process and significant potential for being under-reimbursed. Again, here the lower cost of technology may not extend to real cost savings to the lab.

Veterinary laboratory testing appears to track closely with biofluids testing in

humans, and veterinarians are using the same equipment and technology. Dr. David Newby, DMV, a large animal veterinarian in rural Kansas, indicated similar concerns as Dr. Martin, suggesting that the limited number of tests was a challenge for LCOF. However, because veterinarians can charge the customer per test, and these tests are a direct revenue stream for the veterinary clinics, there may be a more open economic model. Dr. Newby thought that his equipment cost in the range of $20,000-30,000. If LCOF can be produced in that range, or a reasonably accessible price point above that, than vets may see significant returns on investment sooner than in traditional medicine were FDA approvals and medical reimbursement are significant issues.

Dr. Sam Miller, DMV, is a small animal veterinarian in Houston Texas. He was intrigued by the potential cost savings, and was not daunted by the limited range of tests. This strengthens the suggesting from Dr. Newby that the LCOF may have a suitable placement in veterinary medicine.

Dr. Ed Womble, co-founder of Raman Systems Inc., was only available for a short interview, but his interview indicated that they have looked at both blood and urine. As mentioned previously, RSI has specifically investigated real-time, inline application of Raman technologies. As such, they may be a potential licensee of the technology.

Another potential use might be along border towns in Mexico. Investigating the regulatory environment in Mexico was outside of the scope of this Quicklook, but this technology may be well suited for routine pre-natal blood testing among border populations.

Development Status

This device exists only as a laboratory device, and has not been taken to a prototype stage. Projections for a prototype are relatively straightforward. A research quality prototype would require:

- A readily available laser (which current runs $5,000 -$10,000 and prices are dropping so we might get to $2,000 - $3,000 range).
- A spectrograph ($5,000 - $10,000)
- A detector ($12,000 - $15,000)

A total ballpark for putting together a research quality prototype runs $30,000, but it is highly likely that figure can be driving down to closer to $15,000.

It has not been tested for high volume use, and so there is a particular unknown with regards to its tubing. The tubing would likely need to be replaced occasionally, but that frequency is unknown. The tubing itself has a low refractive index and is only made by DuPont. It is relatively expensive at ~$100 per foot. Other operational costs are minimal. The tool is mechanically very stable in the lab. With the exception of the tubing, the tool can be created with

standard parts.

Dr. Womble indicated that the development of blood spectra libraries should not be an issue and Dr. Berger's group may already be working on this. It should be documented for the prototype.

Proprietary Status

A provisional patent has been filed. Dr. Berger readily acknowledges that patents exist on much of this technology, and our other experts agreed that most of this technology is standard Raman technique. This tool's novelty is that the biofluids are being placed in tube and the tool has an additional corrective methodology to improve its accuracy.

With companies such as RSI already pursuing inline application, there may be specific efforts necessary to protect that potentiality. There may be other technologies that are investigating inline, real-time applications (such are urea biosensors.) This would be another avenue for exploration to assess the competitive potential for LCOF.

Competing Technologies and Competitors

While, Raman spectroscopy has made inroads, it is still perceived as more of a qualitative than a quantitative technology. Heather Flanagan, a contact from LabNow provided by Mr. Skraba provided this feedback via email. Such perceptions do not reinforce the positioning of this device as a qualitative workhorse.

Direct Competitors

This tool will compete directly with devices like the RXL Dimension, manufactures by Dade Behring. The RXL retails over $200,000, but used refurbished machines are available at $9,995 - $20,000. This device performs 788 tests per hour and uses small sample sizes from 2 to 60 ul. It's considered a strong competitor because it is a single device that performs more than 95% of most requested tests (as opposed to LCOF, which would provide less than half).

Dr. Womble and Raman Systems Inc., maybe be direct competitors and are worth further investigation. As previously mentioned, Dr. Womble agreed to a very short interview.

Other competitors that could feasibly enter the market include companies that make hand held Raman tools. They are also prospects for partnering for manufacturing. Such manufacturers include:

- Kaiser Optical http://www.kosi.com/

- Ocean optical: http://www.oceanoptics.com/

Potential Barriers to Market Entry

The limitations of Raman Spectroscopy

Dr. Berger indicated that Raman technology has been seen as 'almost practical' but with a horizon that always seems to move further out. Basic limitations to Raman work in clinical settings include:

- While optical fibers are great they are made out of materials that are often problematic for Raman technologies. Corrective techniques must be used to offset these issues.
- Raman is still expensive. It is stuck at price and speed level. (It still isn't less than $10,000 per device.)
- Raman is comparatively slow. While it can do a particular test in approximately 10 seconds. Dermatologist would need a much faster device if, for example, they are diagnosing 100 moles in a sitting.

Joe Skraba, Vice President of LabNow, indicated that Raman was not suitable for point-of-care measurements, which would be in keeping with Dr. Berger's expectations of LCOF as a lab workhorse, rather than a POC device.

Barriers for diagnostic devices

Mr. Skraba is currently moving point-of-care medical devices through the process of commercialization, and he indicated that that costs of getting a medical device into the market can be $100 - $300 Million. This is an extraordinary investment and the hurdles to market are significant, and include:

- FDA approval processes, including clinical trials and validation studies.
- Approvals from the Clinical Laboratory Improvement Amendments (CLIA), a federal agency that inspects medical laboratories.
- AMA review and establishment of reimbursement processes.
- Manufacturing and supplier relationships must be built and established.

Barriers for entering clinical laboratories

Mr. Martin expressed that his existing equipment was providing an accurate solution to this particular need, and that this equipment provides more capability than LCOF provides. Challenges for entering an environment such as the Austin Regional Labs include:

- Mr. Martin would like to unify the technology throughout his clinics around a single platform.
- Return on investment over time would have to backed with very solid

numbers around costs, maintenance versus the costs of reagents. These forecasts will need to span 5-10 years.

- The equipment will need FDA and CLIA approvals.

Recommendations

In summary, LCOFs weaknesses lie in a lack of a compelling case for a return over investment over time through a savings of reagent costs, and the existence of equipment today that is satisfying the market. The market for Raman technology is sufficiently strong, and the technology is meritous, that a 'go forward' with certain reservations is merited. While we do not recommend an aggressive path to market, we suggest the following steps.

Continue with efforts on the patent and actively pursue any future developments that would protect the IP of the liquid core capability and its corrective methods. This technology could be a strong candidate for licensing if partnered with other Raman innovations (or simply innovations in existing Raman tools).

Further research could be done to examine where such partnership opportunities exist. The manufactures of tools such as the Dimension RXL could be approached directly to see if LCOF might add leverage to their systems, and to see if licensing the technology fits into the roadmap for their devices.

Specifically investigate options for inline application of LCOF and its use in real-time monitoring. Deeper investigation into efforts such as those by Raman Systems, Inc., may reveal a specific and very useful opportunity.

Dr. Berger's team should also be on the lookout for 'purposeful serendipity.' Are there other uses for Raman technology with a liquid core fiber optic outside of clinical lab work? For fluids other than biofluids? As part of another device? Further research might uncover an opportunity not seen in the scope of this exercise. As Dr. Berger's team progresses, and as Raman technology matures in the market, it is worth examining new data to see if new possibilities become apparent.

Commercial Potential Rating

Factor	***Weight***	***Score***	***Weighted ranking***
Market Potential	25.00%	1.5	0.375
Market Maturity	15.00%	2.5	0.375
Technology Development	40.00%	2.25	0.9
Competitors/Patents	20.00%	1	0.2
Total	100.00%		**1.85**

Table 1: Commercial Potential Score Values: 1 (Low) - 2 (Medium) - 3 (High) - 4 (Very High)

The weightings used are based on example criteria from a federal laboratory,

and are appropriate for a technology that is likely to take a licensing path to market. In this case, technology development is critical, since potential customers will want to see a working prototype and data that compares the tool to comparables in the market. Through the process of creating a prototype, a more definitive view of pricing and economic factors can be examined.
The rational for the commercial potential scores are as follows:

Market Potential

This was given a 1.5 because our interviews have not uncovered a substantial amount of commercialization potential for the technology. Barriers to entry seem quite high, and since we have not gone to a prototype stage we still have significant outlying questions on price. We also have not been able to tell precisely how much existing processes are costing over the life of current equipment (exactly how much are chemical reagents costing labs over the span of 5-10 years?). More data on that point would clarify the market potential, and this score represents our understanding based on data to date.

Market Maturity

This was given a 2.5 because the market for blood diagnostic equipment is relatively mature. Determining potential manufacturers and the buying processes for potential customers will be relatively straightforward process. The score is not any higher than this, because the incumbent technology is a significant barrier to getting this out the door. This technology is not a disruptive innovation against what already exists, but rather an innovation on existing systems.

Technology Development

This was given a 2.25 because the technology itself is very sound and has relatively few unknowns, and Dr. Berger's team is very willing to work on issues of feasibility for prototypes. Developing a prototype from what is now a bench tool will be reasonably straightforward.

Competitors/Patents

This was given a 1 because there are major competitors in the field and target markets have made significant investments in both monetary and human capital for the equipment they use today. Dr. Berger indicated that the unique quality of the IP for this device lay in the liquid core and additional corrective qualities, but that everything else regarding the technology is already patented. The LCOF device has a more limited test range than machines it's competing with, and offers to a supplemental device rather than a replacement. In addition, it will encounter economic barriers in trying to garner a return on investment through the sale of a piece of equipment that does not have any residual revenue stream.

Interview Summaries

Team Phone Interview: David Martin. Director of the Austin Regional Clinic;
Subject: LCOF in the context of a regional clinical laboratory chain;
Date: TH – 8JN06

Michael Vasquez sent Mr. Martin the documents for each technology in advance, and Mr. Martin was able to address each in detail.

Scope of the ARC:
The Austin Regional Clinics perform about 1.7M test per year, across 12-13 sites, and anticipate adding 30 doctors this year. That works out to about 3500 patients daily across Travis and Williamson counties. They do approximately 600-700 HIV tests a week, across two batches a week.

Infection disease tools are very recent – and there are not many that can do everything. This makes the biosensor very intriguing for infectious disease efforts.

Issues with molecular diagnostics -
For example, we run about 80-90 GroupA strep tests now, but 200 a day during peak seasons. The techs can't do it rapidly enough and something that would quickly this would be useful. We capture rna from specimum, and can run 200 in 3 hrs. We currently use a multiprobe type header - sandwich with luciferase (firefly) As another example, clymidia is a 3 hr process.

Infectious disease is slower in comparison and more complicated than blood tests. David uses thermoelctrones OIA, which appears to be the same as described in biosensor.

Costs will need to be below 12$ per 'kit' (plastic square one a time, takes 10 -15 minutes to do them.) Does massive assay mean that part will be easier?
As a general rule:
Chemistry - low volume high expense
Infectious - high volume low expense

Insurance reimbursement for occurs for panels, or one at a time.
On the chemical analysts we can bill by panel. On hemototlogy - I can only bill for a complete blood count. If it only does one 'test' you can only bill for one 'result'. This will impact both how you implement it and how it is billed through CPT codes.

For example, GC or Clymidia test will send back (+) but we don't know which,so we run all gcs and clymidea to get 2x the billing capabilities.

CPT codes:

There is a CPT for each analyte and the technology used if there is no code then you have to go to the one closest to it billing is reimbursed based on a 'relative based relative value' You can get underreimbursed so in molecular genetics. There is a lapse between the new tech and CPT's ability to figure out what it's worth.

FDA approval is the first step
PMA - premarket approval
CLIA Certification is required at the state level and predicated on FDA.
Alot of things get started in Europe, so we might look there to begin.

A comprehensive metabolic profile - 12-14 analytes (reimbursed at $14.75)
The LCOF appears not to handle potassium/sodium.
Existing equipment runs 200k? Maintenance 1000 a month
Instruments reagents over 5 years - RXLs - vol. (cmp, basic metabolic, and all would take alot of crunching)

The number of analytes the thing can do is important. For a baseline, look at the CPT code book - 8000 series. Can it handle: bilirubin? calcium? chloride? potassium? sodium?

Doctors screen with that panel extremely often. If I can expect reimbursement for $14.77, where I can make some $$? Less than a dollar and assay - .40 or .50

RXLs are workhorses do this and a whole lot more and my investment is in one platform. There is nothing wrong with these machines accuracy. Lots of room for wiggling in chemistry (routine blood work) but none in infectious disease

Concerned about protein build up in the tool. Cleaned every night, special solutions to clean them out. Coats them and creates background noise.
Will they cling to the sides and hang on then have to be cleaned out??

If you have someone running huge loads is our instrument going to get this buildup? Breakdowns every 2-3 weeks, what do you anticipate as maintenance? If our tool is a lot less expensive list, our market may be doctor's offices and not labs.

Key in the game of laboratory with numbers. If you are small docs you are fooling youself if you think it's going to be profitable.

Vets is a completely different animal...(haha!)
They may have a hemotology instrument and a chemistry instrument and not the overhead we do, no fda approval, etc. They are charging as much as in human medicine - urinalysis in the vet is about the same

In Person Team Interview: Belinda Vasquez, Austin Regional Clinic;
Subject: LCOF within the context of ARC Lab Processes
Date: Sat – 27May06

Needs: cost effective, easy to use (intuitive) test methods
Tests: CBC's (complete blood count) – 5/day; urinalysis – 30/day
electrolytes (Na/K/CO2)
Equipment: (1) Hematology – Beckman/Coulter; (2) Dade/Beringer (Dimension) photometer
All labs must be CLIA-certified (Clinical Lab Inspection Agency)

Uses CPL as a reference lab
Be aware of insurance implications
Next step: talk to David Martin – ARC lab director to address equipment buying trends

What about vets?

Volume per day:
5 cbcs in small labs
30 urines - 1 minute
Far West - 100s a day

Notes about potassium (which LCOF can not detect):
Very sensitive test - tourniquet too tight, patient moves (wiggles, moves hand) sits too long, pot leaks out - new lab with a new assistant you can watch the p. levels will go wild.

Can do a full chemical on about 7ccs (one small tube)
Does this tool need calibration? If so what does that look like?

Doctors preference (to mayo lab or for specific xyz) may indicate could take anything and then have a software interface to run appropriate diagnostics - the docs may really like that
- are the docs after a technique?
- are they after an algorithm and a specific result??

Challenges
- FDA Approval
- CLIA Inspection Agency (State level) - is it CLIA waived? - approve equipment and people
- Easy to use
- Cost effective
- Insurance reimb or patient willing to pay out of pocket (flu verification)

Phone Interview: Dr. David Newby, DMV;
Subject: LCOF within the context of a Large Animal Veterinary Practice in Rural Kansas
Date: Sat –

What is done….
Blood is taken from animals for testing
Generally do not test whole heard just the sick
Is a source of revenue for the clinic

How is it done…
General blood work can be performed in the office.
Blood work machine cost 20-30K – did not know if they are given away of agree to purchase so much reagents.
Complete blood work counts
Liver and kidney tests, etc.
Some labs exist for animal diagnostics

Some of the more common disease tests are Heart worm, Lyme disease and Parvo. Snap tests – test packet with all items needed to conduct test. (Reminds me of a home pregnancy test)
Mix reagent with some of blood and then wait ten minutes for results
Based on antibodies
Based on Elisa technology

Blood and snap test - some tests have reagents some do not

What does it cost…
Blood work - Some do in house some send off to labs. In house costs about 15$
Blood work - Cost to have lab complete analysis $30-$40.
Other costs are machine and someone to operate training is done in house.

Snap test is $12-13 per test
Costs to patient based on cost of test and where the vet is located. Rural Kansas a test might run $45 for general blood work, in a big city test might run $140. Cost structure is the same though. Same with snap testing.
Snap test – IDEXX Labs

Frequency of testing…
Heartworm test rate – based on what practice is like – some test every dog once a year others test just when required
Some recommendations and guidance but not enforced.

Challenges…
What we can test is the biggest hold back
Desire to cover multiple diseases for each test

Team Phone Interview: Joe Skraba, VP of Business Development, LabNow;
Subject: Commercialization Prospects in the context of a company currently commercializing a Point of Care device.
Date:

Challenge in selling instruments because there is not an ongoing revenue stream. The diagnostic medical device into market is 100-300M – so without a means to return on that investment that will definitely be a challenge.

Limited number of tests that can run on – and they'll need another piece of equipment and the lab may not see a savings. Lab reagents costs probably won't outweigh this over time.

Interesting research but much more work to show to show commercial opportunities.

Not something they can't do now – substitute for something that works well now and makes the value proposition high. Data needed to correlate to measurements.

Offset with validating, qualifying and close examination of the economic models.

Raman not suitable for Point of Care measurements.

Phone Interview: Dr. Sam Miller DMV; (413) 687-4156
Subject: LCOF within the context of a small animal veterinarian – Houston, Tx
Date: Sat –

What and how is it done:

- Blood counts – CBO, Red and White
- Blood chemistry panel – What is going on in the body, how are the organs functioning – liver, kidney, pancreas, ect.
- Electrolytes –
- Disease diagnostics – Snap tests, Elisa based – yes or no answers not quantitative in nature. Does not indicate the concentration level.

Polymerase Chain Reaction (PCR) – performed labs – may look for actual virus, marker or particular agent. "Viral diseases, .. can be detected using PCR through amplification of the viral DNA. This analysis is possible right after infection, which can be from several days to several months before actual symptoms occur."
Screening – Parvo, Ehrlichia, Rocky Mountain spotted fever, Lyme disease, Heat worm

Diagnosis starts with the blood counts and basic chemistry. If indications exist, more tests are required. A snap test is administered, if no conclusive, move to titer test and then ultimately to PCR. Each test becomes more sensitive and specificity increases.

Sensitivity example - if a dog has been vaccinated for parvo which forces the creation of antibodies. Later the dog comes back in to be tested for parvo, the antibodies will be present forcing a false positive reading in the test. The level of parvo antibodies becomes important, thus sensitivity comes into play – how many antibodies are present? Is it a clinically infected animal or is it simply a detection of antibodies created by the vaccine or in some cases simple exposure to the disease or is it full blown case of parvo? Test may provide indication of exposure only not indication of the disease.

Specificity Example – Some tests are not specific enough, indicating a bonding between the antigen or antibody and the protein took place when in actuality the bonding took place with the incorrect protein. This is a non-specific bind causing a false positive. In the case of parvo, Leptospirosis antibodies might give a false bond indication.

Two types of in house test – antibodies and antigens – based on the available technology. Both have room for error based on specificity and sensitivity.

How is it done
Blood counts, blood chemistry and electrolytes can be done in house or at a lab.

Titer and PCR test are done at labs. Snap test are done in house.

What does it cost…
Equipment is required for the blood counts, blood chemistry and electrolytes. His costs are around 30K for the blood equipment and he leases the Electrolyte machine.
In house is more expensive due to hands on time and reagents, therefore depending on the urgency they may opt to send to a lab.
Snap test are done in house at a cost of $10-$14 per test. Generally, he doubles the costs of the test to the client.

Frequency of testing…
Basic screening can be done on an annual basis.
Yearly or when exposed - Dogs – Parvo, ehrlichia, rocky mountain spotted fever, lyme disease, heat worm.
Yearly or when exposed - Cats – feline leukemia, feline AIDS, feline immunodeficiency virus (FIV) and toxoplasmosis.
Diagnosis testing as required.
Screening is the bulk of his business.

Challenges…
Increased specificity and sensitivity
Affordable and easy to use by practitioners – stay in the same price range as the current testing process.
Does not know if equipment is approved by a body similar to FDA. Indicated his lab was not regulated by the government.

General notes…
Had a spectrometry based system (dry) but did not give the accuracy and depth of information that he likes. Went back to a wet (reagent) based system.

LCOF was interesting because he could reduce the costs of reagents. Was not turned off by the limitations concerning what it could test for.

He offered to provide a breakdown of costs and revenues based on testing.
Offered contact for labs and specialists in town.

Phone Interview: Dr. Ed Womble, co-founder of Raman Systems Inc. ;
Subject: LCOF within the context of the Raman Spectroscopy Industry.
Date: Thursday – 6July06

http://www.ramansystems.com

Dr. Womble indicated that RSI has already looking at blood and to some extent urine. He was skeptical that LCOF could look for all the components listed. He indicated that creating blood spectra is not a problem and believed there were ways to calibrate different machines and verify so quantitative model could be moved from machine to machine.

He did not see anything in our technology that would "light the fire" under his research.

The interview was very short in nature and he was elusive. Invited him to talk to Andrew but he declined. He did go to the University of Rochester site to review the technology.

He indicated that nothing has been commercialized yet with respect to inline analysis.

He alluded to testing inline application, and the following information is available on their website:

> Completed this test ***"Medical News*** RSI announces a major breakthrough in utilizing Raman Spectroscopy to analyze blood non-invasively**.** Working with the Boston University Medical Center , RSI has been able, for the first time ever, to monitor the Urea level in patients' blood while the patients were undergoing Dialysis. The *in situ* measurements were accomplished with RSI's patented battery powered R3000 model Raman Spectrometer (5,982,484) and patented probe (6,897,951)." http://www.ramansystems.com/content/view/118/44/