Lab Pinnacle Series Advancing Precision Medicine through Molecular & Genetic Testing: The Power of Purpose-Built Laboratory Information Management Systems

ROUNDTABLE CONTRIBUTORS

This discussion includes input from several molecular LIMS integration experts, including:

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The value of a having a laboratory information management system (LIMS) for molecular and genetic testing – that was the primary topic when thought leaders from Sunquest, CliniSys Group, and Data Innovations recently came together to discuss the continued rise in molecular testing and the importance of molecular LIMS technology.

What follows is an insightful exploration of the growing need and demand for molecular LIMS to support a faster, more reliable and efficient path to precision medicine and research. Through flexible, fit-for-purpose systems designed to accommodate the data and workflow complexities of molecular and genetic testing, laboratories across the globe can provide robust contributions to improving health outcomes through personalized patient care.

This report is just the first in a series – the Lab Pinnacle Series – that will focus on key topics of interest for lab leaders focused on delivering their lab to new heights – or pinnacles – of performance.

Moderator: Let's start with how markets for molecular and genetic testing vary in different countries. In the U.S., what initiatives have most affected the need for LIMS in molecular testing?

Laura Voeghtly: When U.S. precision medicine initiatives began to gain momentum, clinicians turned their focus to molecular testing, which was new to many of them. Lab leaders quickly needed to support higher volume and greater test complexity. They also needed to educate clinicians about the tests and what the results mean for patients, including diagnostic, prognostic, and therapeutic implications. To manage all of that, LIMS automation, instrument integration, and general laboratory interoperability has become essential for efficiency and sustainable growth.

Moderator: What initiatives are underway at NHS England that impact the need for LIMS technology?

Steve Abbs: To deliver a national genomic medicine service in partnership with the clinicians providing direct patient contact, NHS England has commissioned seven Genomic Laboratory Hubs (GLHs) and developed a National Genomic Test Directory of tests that GLHs can provide as a network. This initiative includes certain goals for standardization, equity of access to testing, economies of scale, and volume growth that are collectively increasing demand for well-integrated LIMS technology.

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Tony Oliver: NHS laboratories also do a lot of genetic testing for infectious disease. Just think of COVID-19 to grasp the volume of molecular PCR amplification techniques and sequencing events. Here in the U.K., those are generally done in large metropolitan teaching hospitals, but with the commoditization of molecular testing, we are seeing a greater need for specialized LIMS technology.

Moderator: What about EU countries?

Stéphane Decap: We make a sharper distinction between molecular and genetics tests. Molecular techniques are routine techniques used not only for human genetics test, but also by other laboratories such as virology. Most human genetics testing is performed by university hospitals, but there are notable differences in the genetics markets between countries. For example, in Germany, there are many private labs doing human genetics tests, but in France, there are only a few, and only two genomics hubs have been created that do the full genomics test. The need for GLIMS, which is our lab information system that supports genetics, has not been as high in France nor Belgium so far, but as those countries look to follow the U.K. example of more testing, demand will grow. Genetics and genomics tests are very complex and specialized, which calls for specialized lab technology that integrates with all necessary databases and systems from order to invoicing.

Moderator: Why not just use the Laboratory Information Systems (LIS) for molecular and genetic testing? What core benefits does LIMS deliver?

Shirley Li: LIS' are built to accommodate clinical pathology, so they can be fairly rigid in their database structures. With molecular and genetic testing, applying different ways to sequence new modules requires a flexible, agile workflow solution. The application of different assay technologies varies among laboratories, and even for a given instrument there can be differences in analysis and data interpretation needs. Then there's next generation sequencing (NGS), which requires much more sophisticated analysis for bioinformatics that can also differ from one lab to the next. LIMS can be key to supporting the right level of configurability and modularity for labs to define their own plans and strategies in this field.

Filip Migom: We can work with middleware partners to support molecular workflows – and within the human molecular testing domain, if your focus is testing with yes/no results, a traditional LIS can handle that. If you want to start doing more complex procedures, however, it is better to manage this outside the standard LIS. Techniques change rapidly, but generic approaches are possible, and this is what we have done in Europe with our GLIMS. We have built a special purpose module, GLIMS Genetics, to support the flexible workflows typically needed in those environments. Instead of dedicated hematology or biochemistry modules, we have a more general approach, so we can support some complex workflows.

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Moderator: Speaking of middleware, how important is instrument interfacing in molecular LIMS workflow?

Carol Beth Casto: Across the board in the laboratory, interfacing gives you efficiency, quality, and scalability. For molecular and genetic testing, instrument interfacing is in its infancy, but the importance is growing rapidly. Different molecular and genomics labs have different workflows. At Data Innovations, we are making inroads with workflow variability by establishing that standard, lower-level protocol for the output, and being able to tweak here and there. We work closely with instrument vendors and LIMS systems to provide standardized translation from the system to the instrument and back with our Instrument Manager middleware.

Filip Migom: Here in Europe, test orders come in and results go out through different systems with different protocols, formats and languages. Middleware makes it possible for our GLIMS to manage all those variables. We must translate all types of requests to standardize within our database, and then we must translate again for the reporting and business side. In the middle, we must also translate all the interoperability with the instruments because performing a download of a plate depends on the instrument technique and the instrument's reporting code. Middleware plays a key role in facilitating this level of integration and interoperability.

Moderator: How can lab leaders know when to make the business case for bringing molecular testing in house and implementing LIMS technology?

John Lebon: For private labs, the right time is generally when it can be profitable. Planning early is important because volumes will grow beyond the capabilities of the current LIS' in use, which have limited interfacing and functionality for molecular and genomic testing. Interfacing with variant analyzing systems within hospitals or health systems is difficult, and that work is often performed manually today. Lab leaders will be able to drive and support higher volume with technology that provides one view on a combined result set across all disciplines.

Shirley Li: Agreed – profitability is the primary driver for most U.S. labs as well, which means scalability and reimbursement above cost. If we look at adoption for NGS, for example, we know that approximately two-thirds of lab costs come from reagents. Additional efficiencies in staff time and resource allocation are also a worthwhile consideration. Moving from paper-based, offline systems into something like Sunquest Mitogen™ LIMS helps lab leaders understand where their costs are today and how to improve cost analysis measures.

Stéphane Decap: For university and hospital-based labs, another business consideration is keeping the power inside the institution. Testing within the system, sometimes even before it is profitable to do so, can be better for the overall business strategy than sending samples out to a private lab. For many

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diseases, breast cancer as an example, tests are performed by different lab specialties, such as pathology and genetics. Keeping everything within one lab system can have important implications for an institution's operational strategy. By using a sophisticated LIMS to automate the workflows, a lab can streamline processes and handle higher volumes with fewer people.

Laura Voeghtly: If a testing method emerges that drastically reduces lab costs, labs will often make the case to bring it in – and that is easier to do when you already have LIMS or other software that provides an efficient process to manage testing. Likewise, if you already have a good volume of testing, that lends itself to the need for bringing in a LIMS or other process to manage the volume and support continued growth.

Steve Abbs: Many U.K. labs used NHS funding to purchase LIMS with the first big genetics push in the early 2000s, and many still use the same system today – which is outdated now, given all the advances in testing technology. With the current national genomic medicine initiative, laboratories are expected to deliver change by standardizing and industrializing the testing. To do that, they need tools like modern, purpose-built LIMS technology to lead the way forward, with NHS funding available again for that.

Moderator: How can LIMS technology support the lab's efforts to take molecular and genetic testing further, beyond workflow and into analysis, particularly for NGS?

Shirley Li: Having LIMS to support data transfers, including coordinating transformations and different analyses, is very valuable. Molecular and genetic testing involves large volumes of complex data. That is especially true with NGS, where a typical whole exome sequencing identifies around 10,000 variants per patient, per sequencing run. Managing that data manually carries risks of human error and data loss, and it is a challenge to filter down on that information, find what is already known, and decide what to report for clinicians. To support better workflow and data flow, the LIMS we offer today – which we are continually improving – helps data files and assets move across the lab, corresponding to the testing and ultimately being translated for the different analysis pipelines laboratories use.

Steve Abbs: The same is true in the U.K. We have independent bioinformatics and variant interpretation software providers, and our current priority is interfacing those solutions with our LIMS. With the bioinformatics process being so complex, interfacing is necessary to get that output into the LIMS and ultimately into the diagnostic report, which then goes into the electronic patient record. For more basic genomic tests that require a simple genotype and produce a positive/negative result, LIMS users can apply rules-based logic to automatically generate a report based on the result.

Stéphane Decap: Inside the LIMS, we collect a lot of data about the phenotype, clinical information and family history, which can be very

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useful for NGS techniques. For the LIMS to manage all that data, there must be connectivity beyond the instrument, beyond the wet lab. It needs to connect to a Human Phenotype Ontology (HPO) database to manage the NGS information, and it needs to connect to the variant analysis informatic pipeline. LIMS technology can support automatic input of the right information across multiple sources, formats and languages – all the way from order to test, result, report and invoice.

Moderator: What were the biggest challenges of developing and configuring new drivers and instruments to handle COVID-19 testing?

John Lebon: Development was not a big issue because we already had many existing interfaces available for PCR instruments that were connected directly to our LIMS. The biggest challenge was having it all configured and installed at the right time when suddenly every lab was purchasing new instruments and wanted to significantly increase PCR capacity at once. Our team made it work through remote installation and a lot of logistical problem-solving.

Tony Oliver: The main reason labs were purchasing so many additional instruments was mostly because reagents were not available for the instruments they had. That lent itself to an explosion in demand for interfacing here in the U.K. We deployed to data centers, but cybersecurity regulations make processing text files problematic when data-center-deployed interfaces are involved. With the sudden surge in brand new labs and instruments came a correlating surge of text file interfaces required. So that was really the only notable technical challenge we faced in the U.K.

Laura Voeghtly: Demand for interfacing also spiked in the U.S., not just for new instruments but also for the laboratories' existing platforms as new reagents received emergency use authorization (EUA). Another interesting piece is that standard regulations were not yet in place for these EUAs, creating a 'wild west' situation with many moving parts – particularly as we worked to support the many COVID-19 labs that were entirely new to molecular testing.

Moderator: How do technology and integration support pop-up labs and other fast-moving COVID-19 response measures?

Filip Migom: In Belgium, the government created a pop-up laboratory to perform faster testing for the entire Belgian population. Everything was centralized and pre-labeled with barcodes through the LIS, but the lab had many different instruments using a range of techniques for COVID-19 testing. In a normal lab workflow, you know in advance which instrument you will use, but the LIS is not designed for molecular testing workflow and does not know upfront which instrument to use for any given plate. Every instrument has its own plate structure format, so we very quickly needed to support the ability to select the correct interoperability upload file for the plate configuration. Because we were all very motivated, we achieved it, but it was still a big challenge.

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Laura Voeghtly: We had to be nimble in order to support pop-up labs in the U.S. We encountered two main types: (1) pop-up labs in health systems and physician practices focused on acquiring specimens and clients from across the region and country; and (2) brand new laboratories at academic institutions that needed to test students, faculty, and staff. For the healthcare organizations, we provided quick integration with our ordering process through Sunquest Atlas™, providing a physician portal to be able to acquire specimens from across the country. For the academic institutions, we managed the integration of the necessary components to support COVID-19 testing for new and potentially inexperienced labs.

Moderator: What is coming next for molecular testing and LIMS?

Stéphane Decap: More and more, geneticists in Europe will use molecular techniques to support clinicians in delivering personalized treatment based on precision research. As this trend grows, we will see corresponding growth in the need and demand for information management systems that can automate data flow across the entire process, from test orders to results to patient care.

Shirley Li: Over the next 15 years or so, we should see some convergence of testing into singular technology. There is a lot of speculation that NGS may be the highest diagnostic yield assay that laboratories will adopt, but across all the assays, the need for LIMS technology that can make sense of the data for clinicians and package all diagnostic information together will only continue to grow. That is certainly something that has been top of mind for us for our LIMS integrations, just as it has been for our anatomic pathology and clinical LIS integrations.

About CliniSys Group and Sunquest Information Systems

CliniSys Group and Sunquest Information Systems together provide leading diagnostic solutions to laboratories worldwide. Our combined cross-discipline expertise, spanning more than 40 years, provides our customers with solutions to support laboratory workflow across clinical, histology, molecular, genetics, including order management, reporting and results delivery; as well as solutions to support public health disease surveillance and outbreak management. We are dedicated to our customers and their strategic initiatives, with focus on quality to improve resource efficiency, cost savings, patient safety and vendor-agnostic open standard interoperability.

About Data Innovations®

Data Innovations provides lab enablement software and solutions for clinical labs to optimize performance across all disciplines. With key solutions spanning lab connectivity, productivity, quality, performance and reliability, and analytics, Data Innovations is credited with establishing the lab enablement software space and driving vendor-neutral solutions within and across labs. They are a global software company, serving 6,000+ hospitals and laboratories in 85+ countries.

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