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Data Analytics in Clinical Laboratories: Advancing Diagnostic Medicine in the Digital Age

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Guests: Dr. Mark Zaydman from the Division of Laboratory and Genomic Medicine of Washington University in St. Louis and Dr. Anna Merrill from the University of Iowa Hospitals and Clinics.

Bob Barrett: This is a podcast from *Clinical Chemistry*, a production of the Association for Diagnostics & Laboratory Medicine. I'm Bob Barrett. It's no secret that clinical laboratories generate data. Lots and lots of data. With the transition to a predominantly digital workflow, electronic health records and laboratory information systems have become massive repositories of patient data just waiting to be put to good use. Distilling these databases into actionable observations can lead to any number of improvements in patient care, including better adherence to disease screening guidelines, reductions in turnaround time for essential test results, and increased access to specialized testing. Unfortunately, despite its potential to make sweeping improvements in healthcare delivery, the number of real-world issues addressed by data analytics remains limited. A Q&A session appearing in the December 2023 issue of *Clinical Chemistry* surveys experts in data analytics to find a path forward.

Why has it been challenging to translate repositories of patient data into solutions to clinical problems? How can these challenges be overcome to harness the power of the millions of data points generated by clinical laboratories every day?

In this podcast, we are pleased to welcome a moderator and a content expert from the Q&A session. Dr. Mark Zaydman is an Assistant Professor of Pathology and Immunology in the Division of Laboratory and Genomic Medicine of Washington University in St. Louis. His primary clinical role is in the Section of Pathology Informatics, where he focuses on utilizing data analytics to improve the quality, efficiency and value of laboratory services. Dr. Anna Merrill is a Clinical Associate Professor of Pathology and Associate Director of Clinical Chemistry at the University of Iowa Hospitals and Clinics. Her research interests include data-driven quality improvement initiatives in all phases of the total testing process. And Dr. Merrill, let's start with you and get pretty basic. What is data analytics and how is it being used to drive decision making in laboratory medicine?

Anna Merrill: Sure, I will start with the definition of data analytics. So, it is a subdiscipline of informatics, where raw data is processed to get key information or patterns, and then those are interpreted to take some sort of an action. So, in other words, data analytics is where we convert raw data into actionable insights. For those of us in the field of lab medicine, data analytics is really how we can unlock the value of the massive amount of data we produce to make more informed decisions to improve both our labs and also the patient care that we provide.

Next, I can review general areas where data analytics can be applied within organizations and throughout health systems. So, the potential applications of data analytics within lab medicine are really limitless, but they most commonly include things like optimizing our day-to-day operations. So this could be related to staffing decisions or maybe even reagent inventory decisions. We can also use data analytics to evaluate patterns of test utilization. This can be important to identify tests that might be over or under, or maybe even misutilized. We can also monitor quality metrics like turnaround times and also develop policies. The experts who contributed to this Q& A discussed practical examples of how they have meaningfully used data analytics in their organizations, and a few of these examples really stood out to us. One was the use of data analytics for change management related to test implementation and the electronic health record. Dr. Stoffel shared a practical tip that a data driven approach to any test changes can streamline communication with relevant clinical stakeholders and improve the satisfaction of those end users with the clinical lab services provided.

Another interesting example was given by Dr. Baron, and recently his organization, in collaboration with multiple other academic medical centers, harnessed a national insurance claims database to identify testing disparities and HIV testing patterns for people on preexposure prophylaxis, and what's interesting is they plan to use these findings to work with health systems and other stakeholders to improve testing access to those vulnerable populations identified in their research study.

Bob Barrett: So, Dr. Zaydman, how easy is it to integrate laboratory data with other non-laboratory clinical data?

Mark Zaydman: That's a great question, Bob. So, unfortunately, it remains a challenge to integrate laboratory data with other data streams. The data streams we're talking about include the electronic health record claims and billings data, social determinants of health access to healthcare services, as well as data from care outside healthcare systems. These data are very important so they can be highly relevant to specific

decisions that we might make within the laboratory. For example, there are two administrations that are documented in the electronic health record are important when we interpret serum protein electrophoresis studies as well as pretransfusion testing in the blood bank.

More broadly, we really need better ability to document patient outcomes that are not recorded within our laboratory data systems, and those are needed so that we can optimize our laboratory testing to provide the best value to the patient. Now, the experts in the Q&A reported different levels of access to non-laboratory clinical data. Some lacked access entirely, others had to go through specialized reporting services, and even those who were at institutions that warehouse data in a centralized repository providing single access to all these data streams. They still reported challenges, and those challenges include a lack of standardization in the nomenclature as well as lack of standardization in the data structures.

It was interesting to note that many of our experts reported migrating toward a single vendor for their laboratory information system and electronic health record with the hope that this would lead to better interoperability between the laboratory and non-laboratory clinical data. So, in summary, there is broad perceived value and importance in integrating laboratory data with other non-laboratory clinical data. However, there are significant challenges that remain, even for us so-called experts in laboratory data analytics.

Bob Barrett: So how can we improve our ability to synthesize and interpret combined data sets?

Mark Zaydman: There's a lot that we can be doing, Bob. We can collaborate with stakeholders and subject matter experts across different clinical subspecialties. They can help us to identify use cases for integrated analytics and to better understand the complex processes that generate these different data sets. We should be advocating that access to integrated clinical data streams is not optional or extra, but rather it's absolutely required for us to do our jobs effectively. Finally, we should collaborate with our information system vendors to improve access to data at all scales, data from our instruments, our middleware, our laboratory information systems, and beyond.

Bob Barrett: Dr. Merrill, what are some barriers preventing individuals and organizations from fully exploiting the benefits of data analytics?

Anna Merrill: Well, unfortunately, there are many barriers that we face as individuals and organizations that prevent us from really realizing the many benefits that data analytics has to offer. So starting with barriers that individuals face, uneven data

literacy is a really big challenge. Many people in our lab medicine community have really phenomenal questions that could be meaningfully answered with data, but don't have the access, knowledge, and/or skills to approach that question from really a data-driven perspective. And speaking from firsthand experience, this can leave you feeling sometimes paralyzed and not able to engage with data analytics in any capacity. Multiple experts in this Q&A identified this gap between current data capabilities and potential applications as a significant missed opportunity. We really need lab medicine professionals in all roles to feel empowered to engage with data analytics in a way that would be meaningful for their individualized work settings, whether that be using commercial tools like Microsoft Excel, or reporting or visualization tools within their electronic health record or laboratory information system, or maybe using open source programming languages like Python and R.

At the institutional level, one barrier is that organizational culture can be very resistant to change. We tend to be reactive instead of proactive, firefighters instead of engineers, as Dr. Zaydman notes in the Q&A, tending to focus all of our resources on acute issues and not planning intentionally for the future when it comes to data analytics. Furthermore, we often work in silos. It is all too common, painfully common, that different work units are independently tackling the same data-related problem without each other's knowledge, which is really inefficient but it also deprives us of the opportunity to collaborate with each other and to learn from each other. Another barrier that organizations face is an over reliance on vendor solutions for data analytics. Now, these solutions certainly add value by democratizing analytics but they are also somewhat restrictive because they can't be customized for diverse workflows.

Furthermore, when organizations rely predominantly on those vendor solutions for their data analytics needs, they may be less likely to invest in building internal data analytics infrastructure and expertise, and this can really be a significant problem as our field needs more resources devoted to data analytics, both for implementing data driven solutions that improve patient care, but also for training the next generation of lab medicine professionals. We still don't have a clear path forward as to how we should account for the value of data analytics.

Bob Barrett: Well, how can all these professionals you've spoken of work together to overcome these barriers?

Anna Merrill: Yeah, that's a great question. There are lots of opportunities for us to work together to begin to address these challenges. So first, we really need better mechanisms for partnerships between industry or vendor informatic solutions and health

systems, and also for partnerships between different health systems. We need to ensure that these collaborations don't compromise the security of patient data, and once formed, these collaborations will help us to define the value of data analytics and benchmark it based on outcomes from real world studies. We should also work together to advocate for investment in data analytics for our entire field. The digital transformation of healthcare we have witnessed over the past decade or so means that data literacy should now be an expectation for laboratory medicine professionals, not just an added bonus for those individuals with interest in, or perhaps aptitude for, analytics. To this end, ADLM has made data analytics a core strategy to improve and expand data literacy. We can all work together to foster an environment of continuous learning around data analytics and all laboratory medicine professionals should feel as though they have data analytics tools that they can use to answer important questions about their work and its impact.

Finally, we can and should empower others to engage with data analytics by sharing our data analytics success stories using presentations, publications, and other routes of dissemination. Actually, that is one of the goals of this Q&A related to data analytics and laboratory medicine.

Bob Barrett: Okay, well, Dr. Zaydman, we'll give you the last word. Looking ahead, what does the future of data analytics and laboratory medicine look like?

Mark Zaydman: In the future Bob, increased adoption of data analytics will surely make our practice of laboratory medicine less of an art and more of a rigorous discipline, insofar as that it is a discipline that will deliver transparent, reproducible, and evidence-based clinical information in order to improve patient outcomes and experiences. We foresee that there will be at least two different growth trends. One trend is that we are going to scale up our conventional data analytics. These are tools that we have currently available that are underapplied, but will help us to improve robustness, efficiency, and quality throughout the total laboratory testing process. The second direction is that we will begin translating advanced and emerging tools such as machine learning and large language models. This is more forward-looking, but very exciting, as these novel technologies may offer new and unforeseen opportunities to solve complex and persistent problems in laboratory medicine. Our experts identified key areas of needed investment to achieve this future state, and I think Dr. Merrill did a great job of putting forth a roadmap of how we move forward as a field towards that future state. Overall, the experts expressed a great deal of optimism that we will continue to grow in our ability to apply data analytics to improve patient outcomes. They pointed out that

laboratorians are very well positioned to help lead our institutions towards this data informed future state.

First, we have a long history, Bob, of translating novel technologies into patient care while simultaneously ensuring quality and safety. We have access to collaborators across diverse clinical specialties and are privileged to contribute broadly to patient care. We are patient centered, yet versed in operational, strategic, and system level thinking, and we've long been the stewards of what is arguably the most informative and well-structured data stream that is the one provided by laboratory testing that has remained the bedrock of evidence-based medicine. In short, it's a really exciting time to be working on laboratory data analytics, and we're all very excited to see what comes next.

Bob Barrett: That was Dr. Mark Zaydman from Washington University in St. Louis and Dr. Anna Merrill from the University of Iowa. They authored a Q&A session on data analytics in the clinical laboratory in the December 2023 issue of *Clinical Chemistry* and they've been our guests in this podcast on that topic. I'm Bob Barrett. Thanks for listening.