

Episode 37: Sigma Metrics and the Value of Real World Evidence

Andrea Ott-Vasconi:

Hello, I'm Andrea Ott-Vasconi, and welcome to QuidelOrtho Science Bytes. In this episode, we'll be talking about Sigma metrics. Six Sigma was first used in manufacturing to decrease the number of defective products made, improve cost efficiency, and reduce process variability. Six Sigma strategies were then adapted and applied to many other sectors, including in vitro diagnostics and laboratory medicine. With me today to discuss this important topic is Johanna Miller. Johanna's a data scientist at QuidelOrtho. She spent 10 years in product development where she gained expertise on the automated Vitros systems and the data they generate. Now she focuses on developing methods for using data to bring insights directly to labs. Thank you, Johanna, for joining me today.

Johanna Miller:

Yeah, thank you so much. I'm really excited to be here, especially because this podcast, when I was pregnant with my son recently, you did an episode on the weak Rh factor in the transfusion medicine space. And I had actually just undergone an issue, believe it or not, where my blood type came back, as part of the pregnancy screening, as O negative. And I had always been O positive when I donated to the Red Cross. It was this whole back and forth. And yeah, it turned out I'm one of those rare people. So that was right when that podcast came out, and so it was perfect timing.

Andrea Ott-Vasconi:

Oh, wow. I'm glad you could make a connection to the topics. Congratulations on becoming a new mom! So for today's episode on Six Sigma metrics, let's start with some definitions. What are Sigma metrics in the clinical laboratory space?

Johanna Miller:

So Sigma metrics, they're a way to measure quality. And what they kind of do is they distill two metrics that laboratories often calculate, which should be accuracy and precision, and they distill them down into a single metric. And the calculation is done relative to an allowable error. So the calculation is your allowable error minus your bias, which is that accuracy term, over your precision. And what you get is a number that ranges from zero to six, with six being higher quality.

Andrea Ott-Vasconi:

And can you provide some more detail around what the terms accuracy and precision mean?

Johanna Miller:

Yeah. So if you were a runner and you went out in your morning jog every day and you ran a mile. On average, you ran a six-minute mile, you're doing pretty good. But the thing is you're not really running a six-minute mile every single time you go out for a run, right? There's all these factors. Are you feeling good that day? Are you maybe not with it? Is the weather not cooperating? And so there's variation there, and that's precision. So precision is how much variation there is around your average. And then accuracy or bias is, in the context of the clinical lab space, it'd be how far you are from the average. So if you average a six-minute mile, but most people doing that same run average an eight-minute mile, you're actually doing better. Your bias is two, in this case in a good way.

So when you talk about the last piece of that calculation, the allowable error, that would be kind of like saying, "I have to run a mile in less than seven minutes." And I know that sounds ridiculous from a morning jog perspective, but that's the kind of thing that laboratorians have to deal with every day. You have to produce a test result that's this close to a particular value. And so what's nice is all three of those factors, how close you have to be, how consistent you are, and how close you are to truth is all factored into that calculation.

Andrea Ott-Vasconi:

That's very helpful, and thank you for the analogy. That's definitely something I can relate to when using the running analogy. So what variables play a role in Sigma metric values?

Johanna Miller:

So when you say, what that question is, what I'm hearing is, okay, it's what plays a role in quality. So anything that impacts quality impacts Sigma metrics, because Sigma metrics are a measure of quality. So absolutely, the assays that a laboratorian purchases impact quality. Same with the instrument that they're running on. Both of those are very important factors, but I mean, that's not the only thing. The lab itself has control over the quality of their results. So their material handling and lab

processes all play a role in quality, and they're all factors for the Sigma metric result that you would get.

Andrea Ott-Vasconi:

If I wanted to know the Sigma metrics for a particular assay, how can I measure them?

Johanna Miller:

So really what you need is you need to know the components. So typically, you'd use your QC, so the precision of your QC, but there's two ways to go about it. You can look at your historical QC data or you could run a new study. So that's kind of like saying with the run analogy, you can either look back for how quick you ran for the past month, or you can say, "I'm going to record myself, how fast I run every day for the next 20 days." And both are really valid. But historical metrics, they tend to be considered a little more representative just because we all know that if we're measuring ourselves that we tend to do a little better, might run a little harder.

Andrea Ott-Vasconi:

And what action can a lab take once they have information on Sigma metrics?

Johanna Miller:

So the nice thing about Sigma metrics is that because they account for the bias and the precision, and specifically that allowable error, the calculation results, everything is all the same scale. So all of your assays, every assay that you include in your analysis would end up on the same scale from zero to six. So yes, you can look at individual assays and say, "Okay, is this acceptable? Am I okay with the five? Am I okay with the four?" You probably would be because a five is considered excellent. But then taking a step back, you can look at all your assays and look at your entire menu and sort of assess, "Okay, where am I struggling? Where does it make sense to focus my efforts for continuous improvement?" And if you were to incorporate Sigma metrics as part of a broader program, you could monitor Sigma metrics and how they change over time. It's a way to prove that your lab is improving in quality.

Andrea Ott-Vasconi:

I see. And you mentioned the different numbers, there's different ratings. Can you talk a little bit more about what the numbers mean? So a six versus a five versus a four, for instance.

Johanna Miller:

So at the highest level, a six is better than a five, which is better than a four, et cetera. Each number has a rating. So six would be world-class, five is excellent, four is good, three is marginal. Three is kind of about the lowest you'd really want to see. I mean, Sigma metrics, they're not regulated things. So of course if you get a 2.8 and you're passing your QC, you're not deficient, but it could be an opportunity for improvement. So that's kind of at a high level.

At a little more detailed level, each number, it maps out to what is called a defect per million opportunities. So it's this idea, so if you have an assay that's Six Sigma, and if you took a fluid, the theory would be that if you ran it a million times, you would only get something outside your allowable error three times or 3.4 times. And then as the Sigma metrics decrease, the amount of potential defects per million opportunities increase. So it's a scale from zero to six, but behind the scenes, it maps to how often you would expect a result to be defective or outside, I should use the term outside, your allowable error.

Andrea Ott-Vasconi:

That's very helpful, thank you. I know our team at QuidelOrtho developed a new approach for calculating Sigma metrics using data from over 1,300 instruments used in clinical laboratories. Describe for us the approach that was used.

Johanna Miller:

Yeah, thank you. So what we did was, so using my background in data science, QuidelOrtho has a large E-connectivity® database that has anonymized patient results, QC results, and typically that's used to help customers. So for example, if they call our hotline, then we could pull up their data and more quickly assist them. But the data is there in this database. And so what we did, we wanted to know what the Sigma metrics were across our population.

So we would take an analyzer, pull their QC results, calculate the precision and the bias. In this case, the bias was relative to the peer group. And we would compare it and use the CLIA, the new CLIA 2024 limits, for the allowable error. So then we would calculate the Sigma metrics for that analyzer, and then we'd move on to the next one, and calculate the Sigma metrics for that analyzer and so on and so on. And so going across the entire field. So then what we had is this giant pile, or you could say distribution, of Sigma metrics across our field. And we took the median, saying that that's the most representative. And so we did that, and then we repeated it for every assay that we examined. And of course I say we did this, really it's all programming,

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it's all done in Python. So you don't have to feel bad for any person crunching through Excel. It was done much more efficiently than that.

Andrea Ott-Vasconi:

For how many assays did you use that approach for?

Johanna Miller:

So it was over a hundred, it was 113. And I get the question of why that number, why not, QuidelOrtho's entire Vitros menu. And the truth is that you can't actually calculate Sigma metrics for every possible assay because some assays, they're qualitative. So like hepatitis. It's either like a true false. So there's no concept of allowable error. There's no gray area that you need in order to do this calculation. So all of those, the virology testing, the drugs of abuse, any qualitative test was excluded, but our chemistry and our amino assays, they're well suited to this type of metric. So that's what was included.

Andrea Ott-Vasconi:

That makes a lot of sense. Tell us more about how the idea came about.

Johanna Miller:

Well, I mean, there's been a lot of chatter in the industry. A lot of other IVD companies are using Sigma metrics to measure quality. And so why not us too? And knowing that historical QC data is generally considered the most representative, and coming from a data science background, we just felt that it was something that we could bring to this space, some new insights.

Andrea Ott-Vasconi:

Definitely very valuable insights. Thinking of which, so tell us more about the value of using real-world data to perform these Sigma metric studies.

Johanna Miller:

Yeah, that's a really good question. So I mean, at the end of the day, when you're looking at data, so of course if you measure your own Sigma metrics, that's the truth and that's the most relevant to you. But if you were interpreting a different study or if you wanted to know how your Sigma metrics compared, you have to compare them to something and there's literature and there's reported values. And then it kind of becomes, "Okay, well, is that data representative of what I should expect?" And that's where the value of real-world comes in. It helps pinpoint what you can expect because if the study was conducted on one analyzer and one reagent lot in a manufacturer's facility somewhere under these pristine controlled conditions where the techs had nothing else to do, they're probably going to report really good Sigma metrics. But that's not really representative. On the same token, if you're reading a study and it's one lab and one data point, that's certainly better because it's a real lab. But it's different processes, different factors. It's hard to know how representative that is. So bigger studies with more analyzers can just provide that more clear picture around what's realistic to expect for this type of data.

Andrea Ott-Vasconi:

Yeah, that's great that you were able to use data from so many instruments from over 1,300. To wrap up this great discussion, what should laboratorians be aware of when interpreting Sigma metrics?

Johanna Miller:

That's another good question. So it kind of ties into the value of real-world data. It's, okay, looking at it, is this representative to the reality that you exist in? So how many analyzers? Where was this conducted? Is this a real lab? Is this a manufacturer's facility? The fact is it's really easy to cherry-pick.

I myself, I could find in my dataset a customer with excellent Sigma metrics just as easily as I could find a customer that's struggling for various reasons and their Sigma metrics may not be so stellar. It's too easy to do. So just kind of being aware for these sort of cherry-picked studies and cherry-picked results and just have a grain of salt when you're looking at them. And then the other thing is, are they testing assays that you run or is it really representative of your menu? Because I've seen studies where they run seven assays, and of course that data could be insightful for that lab and those assays. But if you're trying to think about the quality of a lab, you really need more than seven assays, right? So to summarize you want, the more assays the better, and of course, real data from real labs.

Andrea Ott-Vasconi:

That's great advice and great key takeaways. Thank you so much, Johanna, for this very insightful and informative discussion today on the topic of Sigma metrics.

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Johanna Miller:

Oh, thank you so much.

Andrea Ott-Vasconi:

I hope everyone enjoyed this podcast episode. Make sure to review sections within the podcast description and suggested reading materials and links to learn more. Based on today's podcast, I'll leave you with our pop quiz. What combination of factors contribute to the Sigma performance observed in the lab? You can go back and listen again if you'd like some more details. Thank you for listening today. Please subscribe to QuidelOrtho Science Bytes, our monthly podcast, brought to you by QuidelOrtho Corporation, where we are transforming the power of diagnostics into a healthier future for all. Take care.

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