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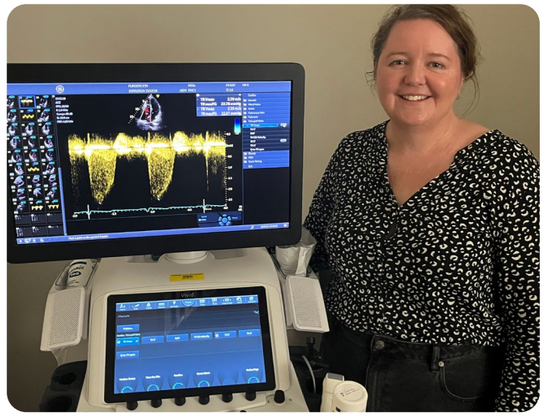
Productivity without pain

Why AI has the potential to help sonographers at risk of serious injuries

Repetitive motion. Tedious tasks. Click after click. As the demand for echocardiograms grows worldwide, so does the physical burden of scanning on sonographers. Even with improved design and ergonomics, studies show an alarming number of sonographers have work-related musculoskeletal injuries (WRMSDs). According to researchers, leveraging AI in the echo lab could play a critical role in prevention.[1]

Dr. Rebecca Perry



Kylie Hollitt

Even with improved design and technological advancements to equipment, the studies show an overwhelming number of sonographers are scanning in pain.[1] The rise in obesity is only adding to the problem—with increased body surface areas (BSAs) driving more technically challenging exams.[2] At the same time, staff shortages and more referrals have resulted in insufficient rest periods, further increasing a sonographer's exposure to risk.

AI and automation are already streamlining workflow in the echo lab, saving valuable time and effort. These productivity tools can help reduce the need for manual inputs and may help reduce the risk of operator fatigue and exposure to WRMSDs. The added benefit is providing consistent and repeatable measurements, despite variations in operator experience.

Dr. Rebecca Perry is the program director for Medical Sonography at the University of South Australia and an honorary post-doctorate researcher in echocardiography at Flinders Medical Centre. She has been a clinical and research cardiac sonographer for more than 25 years and is passionate about education and exploring advanced echocardiographic techniques.

Dr. Perry partnered with GE HealthCare Clinical Applications specialist and former sonographer Kylie Hollitt, to explore the impact of AI on sonographers. Their study investigates whether a combination of 2D, 4D, and AI-assisted scan protocols can reduce cardiac sonographer scan time and ultrasound system interaction without affecting results.

We asked Dr. Perry and Kylie Hollitt to share some of their findings, along with the technology that could be pivotal in supporting today's cardiac sonographers.

What sparked your latest research on AI and why did you want to focus on cardiac sonographers?

Dr. Perry: *My passion for advanced echocardiography has always been about helping people. That highlight can be on the patient, the sonographer, or the treating physician. The current focus of this research is on how we can have both better patient outcomes and help prevent sonographer injuries. It's a topic really close to Kylie and my heart. Kylie and I have both had shoulder surgery on our scanning arms, so we are really passionate about this research to help many sonographers.*

Kylie Hollitt: *With my clinical applications background, a lot of my interest has been in trying to help customers understand the clinical benefits of the technology and how it can make a difference. Now I've got this extended interest in the longevity of sonographers too because I frequently have touch points with different sonographers over a long period of time. I've heard their stories about being off work because of injuries and scanning in pain. I'm passionate about helping them see how their machines can actually help them more and make their day more streamlined.*

Musculoskeletal injuries are a huge problem. What should sonographers know about scanning in pain?

Kylie Hollitt: *What people don't realize is that it's the accumulation of a lot of micro traumas that causes big injuries. It's not just one event. It's sad, but I think sonographers expect to be scanning with some degree of pain. They may think it doesn't matter today. I will worry about that tomorrow.*

Dr. Perry: *There's a lot of camaraderie in echo departments and everybody's working together. You'll often find that sonographers don't want to burden their colleagues or take time off. I think people go into this industry because they have a lot of compassion, and they care a lot about patients. Unfortunately, that can work against them because they care so much about getting a good result and not burdening their colleagues that they put themselves at risk.*

Besides WRMDs, what are other challenges in echocardiography that could be addressed with artificial intelligence and automated tools?

Dr. Perry: *Another massive issue in echo is reproducibility. For example, think about ejection fraction. We know that the test-retest variability of ejection fraction is up to 12%.[5] And when you think about a drop of 10% in ejection fraction being considered as a clinical change, having a reproducibility error of 12% means that we can't rely on that being a true clinical change.*

How can these ongoing challenges impact patient care?

Kylie Hollitt: *There's research that shows that when sonographers are scanning in pain and while injured, it can actually have a negative impact on image quality. Basically, they can't scan optimally when they are uncomfortable or distracted. Obviously, the ability to get quality images that improve diagnostic confidence could be impacted if sonographers are suffering from musculoskeletal injuries.*

Dr. Perry: *I also think that by reducing musculoskeletal injuries in sonographers, we retain them in the workforce. That way, we can have that longevity and more experience in the workforce, which has an impact on patient care. Also, it's important from a reproducibility standpoint. If we have a reproducible measurement, we know it's a real clinical change, rather than a possible measurement error.*

You are in the final stages of wrapping up your study. Can you tell us about your research?

Kylie Hollitt: *The first project started during Covid and was looking at automation, artificial intelligence tools, and multi-plane imaging tools and how they impacted sonographer keystrokes and the length of time to scan.*

Dr. Perry: *For our second project, we actually took all the raw data acquired from the first project and used the AI tool on the EchoPAC v206 software and compared this to our manual measurements.*

A painful problem

1 out of 5 echocardiographers have a work-related musculoskeletal injury[1]

Up to **90%** of sonographers work in pain[3]

Direct and indirect costs to employers = **$120 billion** each year[4]

What were some of your initial findings?

Dr. Perry: *The key takeaway from our first study is that we reported a more than 50% reduction in keystrokes. We've also seen a reduction of approximately five minutes in scan time and a reduction of 30% in extended reach to the keyboard, using combination of 2D, 4D, and AI-assisted scan protocols. All of this equates to a reduction in risk of musculoskeletal injuries.*

For study two, which focused on measurements and reproducibility, we found a big reduction in time using AI tools versus manual measurements. And even if you have to manually interact or override some of those AI measurements, there was still a significant time savings. It's also much more reproducible from an inter and intra-operator variability.

In your opinion, why is a reduction in keystrokes more significant than time savings?

Kylie Hollitt: *Having both worked in busy sonography departments, we were more excited about the reduction in keystrokes than we were about the reduction in time. That's because ergonomic studies on cardiac sonographers found that their shoulders, particularly on the console side of the machine, spend about a third of the scan at an extended angle of greater than 30%. That can actually contribute to reduced blood flow to the shoulder and can contribute to injuries. By reducing the keystrokes, we are obviously making things faster, but we are benefiting both arms.*

Dr. Perry: *The time savings is important, but we don't want people to think it means that they can squeeze a whole extra scan into the day. Sonographers should be able to take time out of that static position to help with injury prevention. We also like the idea that the sonographer can spend more time focusing on the patient, making sure that they're prepared properly for the scan, and getting a complete scan to optimize the images.*

> *"The key takeaway from our first study is that we reported a more than 50% reduction in keystrokes. We've also seen a reduction of approximately five minutes in scan time and a reduction of 30% in extended reach to the keyboard."*

You are big advocates of strain imaging (Easy AFI). Why is this tool so important and what other AI and automation technologies are especially helpful in the echo lab?

Dr. Perry: *Easy AFI is one of my favorite tools and I use it all the time. I'm very big into strain imaging, so I love it. Easy AFI will pick the best image for your strain measurement and the most equivalent heart rate between your apical four, two and apical long axis views, so you're getting that heart rate agreement as well. If you want to override the beat or image picked for you, that's fine. But within seconds, literally seconds, you can get a full GLS profile, and it will give you an ejection fraction as well based on where it's put the region of interest. For strain, we know that the Mayo Clinic recommends not to override the automatic placement of the strain region of interest or interact with it as little as possible for reproducibility. And that's true in this case. Easy AFI is just the next step in strain imaging where it really detects that border—that compacted myocardial border—much, much better.*

Kylie Hollitt: *What really excites me about Easy AFI is that it's simple and quick to use. I am really hoping that we'll actually see a lot more uptake of people actually adopting strain technology as a part of their day-to-day scan.*

Dr. Perry: *We also use AutoEF, when not performing strain, which can detect the border in a more reproducible way than having multiple sonographers trace it manually. Because it's looking for the compacted myocardium and those different landmarks, it will often do a better ejection fraction—a more accurate and reproducible ejection fraction—than someone doing it manually.*

Kylie Hollitt: *Another technology we utilize has been available on GE HealthCare Vivid machines for many years. Scan Assist Pro is a pre-programmable tool where you can apply changes to depth, imaging modes and other things. That in itself has been hugely beneficial in a reduction in keystrokes.*

Dr. Perry: *One of the best AI tools is the Auto Doppler feature. You can get as many beats (that are available on the screen) analyzed within a split second. In the case of a patient with arrhythmias, especially atrial fibrillation, you can slow down the sweep speed. With the AI tool, your sweep speed doesn't matter. You don't have to measure everything at 100 mm/s to assist with manual tracing to be more accurate. The AI tool is looking for landmarks, so it's accurate at any sweep speed. If you need five beats on the screen to measure, it will do it instantaneously.*

Finally, we should mention that the 2D AI tool for measuring parasternal long axis LV measurements is fantastic. Even if you're unhappy with how it's measured, the interventricular septum, for example, you can very quickly just override that measurement without affecting the rest. So, it's much quicker than finding end diastole yourself, and scrolling back, activating measurements, measuring the septum, measuring the LV and diastole, measuring the posterior wall, scrolling to systole and doing the same thing for the LV. It will actually do side by side your end diastolic and systolic frame.

How can AI be helpful as a teaching tool?

Dr. Perry: *I think a good role of AI is helping those who are just learning to scan. I've found that inexperienced sonographers will do the measurements manually as part of their training, but they use the auto ejection fraction tools to cross-check measurements. It's almost utilizing AI as a self-teaching tool, which is really nice because it improves their confidence. It can also be really helpful as departments become more stretched.*

What do you see as the biggest barriers to adoption?

Dr. Perry: *I think one of the main barriers with senior sonographers has been that very early iterations of AI didn't work very well. They were clunky and difficult to override. Some of the systems had AI from 10 years ago, so they aren't willing to give new technology a chance. What they don't realize is how much time and keystrokes they can save. I think the more that these tools are demonstrated and talked about, the more uptake there will be.*

Kylie Hollitt: *The other thing I see in my clinical applications role is almost like a myth or urban legend. Sonographers will say, "I would use AI, but if I don't like the result, it would just be faster to measure it myself." I'd really like to be able to blow that myth out of the water. With this study, I can confidently say to them, "Well, actually I've done some research and that is actually not the case, so you should give it a try."*

How is your study different than other artificial intelligence studies and what is the significance?

Kylie Hollitt: *A lot of the time you will see information on a specific automatic tool, but I feel like this is the first comprehensive study that puts it all together. I also really like that this research is about sonographers. For Bec and I, our entire world is surrounded with sonographers. We really wanted to give something back to sonographers.*

> *"I think it's really about empowering sonographers. Letting them know that scanning in pain is not okay. We want to show them there is technology out there that can help."*

Dr. Perry: *Yes. I think focusing on the sonographer is quite novel. I'm also always excited about new tools and testing new technology. To be able to demonstrate how these tools are essential and clinically useful is really exciting.*

With your research, what is the message you want to send to sonographers and others in cardiac care?

Kylie Hollitt: *We know what's happening to sonographers and the terrible statistics. We've got so much technology, but sonographers don't know how to utilize it to make their lives better and make their day-to-day scanning situation better. We want to show them there are solutions that are available right now and that we've tested them.*

Dr. Perry: *I think it's really about empowering sonographers. Letting them know that scanning in pain is not okay. We want to show them there is technology out there that can help, and we've proven it works effectively. I think our key message is try it and see if you like it. You will.* ■

Dr. Rebecca Perry is the Program Director for Medical Sonography at the University of South Australia and has an honorary position as a post-doctoral researcher in echocardiography at Flinders Medical Centre. She has been a cardiac sonographer since 1998 and has been involved in research and advanced echocardiographic techniques since 2003. Dr. Perry has extensive experience in advanced echocardiographic techniques such as strain and 3-D echocardiography. She completed her PhD in 2013 and her Post-Doctoral Fellowship with the Heart Foundation through Flinders University in 2018. She is passionate about education and excellence in echocardiography and advanced imaging techniques.

Kylie Hollit has worked in cardiology since 1997. Initially as a Coronary Care Nurse and Clinical Nurse Educator. Kylie crossed to cardiac sonography in late 2005 and completed a Diploma of Medical Ultrasound in Cardiac. With a graduate certificate in cardiovascular health and a graduate certificate in clinical teaching and in 2021, Kylie started a Master of Research with Dr. Rebecca Perry as supervisor. She has been part of GE HealthCare Cardiovascular team as Clinical Applications Specialist since 2017.

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2 Uppot RN. Technical challenges of imaging & image-guided interventions in obese patients. Br J Radiol. 2018 Sep;91(1089):20170931. doi: 10.1259/bjr.20170931. Epub 2018 Jun 5. PMID: 29869898; PMCID: PMC6223172.

3 Hogan A. Pain Levels and Injuries by Sonographic Specialty: A Research Study. Journal of Diagnostic Medical Sonography. 2022;38(1):53-58. doi:10.1177/87564793211044122

4 Forecasting the Future of Cardiovascular Disease in the United States, AHA Policy Statement, 2011, source: CIR.0b013e31820a55f5

5 Otterstad JE, Froeland G, St. John Sutton M and Holmet L. Accuracy and reproducibility of biplane two-dimensional echocardiographic measurements of left ventricular dimensions and function. European Heart Journal (1997) 18, 507-513

The statements by Dr. Bec Perry described here are based on her own opinions and on results that were achieved in her unique setting. Since there is no "typical" hospital/clinical setting and many variables exist, i.e. hospital size, case mix, staff expertise, etc. there can be no guarantee that others will achieve the same results.

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