

Executive Highlights

Hello from Las Vegas, where we're squeaking through the halls with over 175,000 attendees here at the 50th edition of CES.

Each year since [2011](#), we've come to CES wondering, "What is the state of digital health?" Our favorite answer (perhaps ever) came on Wednesday in a combined comment from Qualcomm Life's Dr. James Mault and Philips' Jeroen Tas: "We're at the bottom of the hockey stick and the peak of the hype cycle." In other words, a lot of groundwork has been laid that poises the field to accelerate exponentially, but hype for the field is at an all-time high right now. On the bright side, we're noticing fewer generalities this year and more specific examples, particularly regarding payers and health systems.

This days #1-2 report includes topline highlights so far (very little specific to diabetes). In our upcoming full report, we'll add more on the key trends and future of wearables and tech: composite outcome metrics that are more validated to impact long-term outcomes (going beyond steps alone), adding contextual awareness, better battery life, "hearables" (growing faster than wearables), voice as the new user interface, 5G cellular (key for the "Internet of Medical Things" and a huge focus for Qualcomm), and augmented/virtual reality. [Read our CES Preview here.](#)

1. We ran into two early-stage startups forging bravely ahead on non-invasive glucose monitoring. Paris-based PK Vitality showed off a prototype of [K'Track Glucose](#), which looks like a standard smartwatch and includes an electrochemical sensor (K'apsul) on the bottom that comes in contact with the skin, pulls up a drop of interstitial fluid via microneedles, and reads glucose (non-continuous). Montreal-based [BioMindR](#) has a contact-free glucose sensor in development that uses "wireless signals and machine learning" for continuous monitoring. Both technologies are very early.
2. Several speakers argued that payers and hospital systems are now more open to digital health than ever before. UnitedHealthcare got a lot of airtime yesterday and today with [the Motion Program](#) ([expanded this week to include Fitbit](#)), which is offered through employers and gives up to \$4 per day and \$1,500 per year for employees that that meet one or more of the "FIT" activity goals measured via a wrist-worn tracker. We include our test drive of the app and more examples of encouraging payer relationships below.
3. What are the biggest challenges for digital health? Healthcare provider-related barriers came up most often in discussion on Wednesday, especially clinical workflow and lack of intelligent algorithms to make sense of data during visits.
4. Fossil Group's Sonny Vu (formerly of AgaMatrix) harkened back to his BGM days, arguing that "Accuracy is important, but precision is much more important from a user experience perspective." It was a brilliant point with a lot of implications for glucose monitoring devices, especially CGM and the idea of "perceived" vs. "actual" accuracy.

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Top Highlights

1. TWO NON-INVASIVE BGM STARTUPS IN THE EXHIBIT HALL: PK VITALITY'S K'TRACK GLUCOSE AND BIOMINDR

We encountered two new early-stage non-invasive glucose monitoring startups in the exhibit hall. Here is what we learned:

- **Paris-based PK Vitality confidently showed off an early prototype non-invasive wrist-worn glucose monitor, [K'Track Glucose](#).** The device looks like a standard smartwatch, but includes an electrochemical sensor (K'apsul) on the bottom that comes in contact with the skin, pulls up a drop of interstitial fluid via microneedles, and reads glucose non-continuously. Each test takes a fairly significant 35 seconds right now (a 15-second press and then a 20-second countdown to display a result), and CEO Luc Pierart said this could expand to ~60-90 seconds once clinical trials begin (e.g., testing a wider variety of skin types). Each sensor looks like a small cylinder that fits into the bottom of the watch, is expected to last one month (unlimited blood glucose checks), is factory calibrated, and uses a "classic" electrochemical enzyme (presumably similar to glucose oxidase). Accuracy is expected to be comparable to current BGMs, though the company did not share any clinical data to back up this claim. PK Vitality expects each one-month sensor will cost \$99, while the watch will go for \$149 - we'd note that this is comparable to FreeStyle Libre sensors on an ongoing basis (118 euros per month) and roughly triple Libre's startup cost of 59 euros (for the handheld). Mr. Pierart demoed the device on himself and it seemed to work as advertised, showing "92 mg/dl" after the 15 second press and 20 second countdown; he wouldn't let Adam try it on to compare to his CGM or a fingerstick meter, so it's hard to know if it's the real deal. PK Vitality is at CES looking to raise a seed round of \$5 million to pursue CE Mark trials. A CGM form factor is possible too, though it will require an armband configuration that applies constant pressure between the sensor and skin. The company also has a lactic acid sensor developed for athletes, and the watch talks to a paired smartphone app. We like the idea of a wrist form factor for checking glucose non-invasively and without a phone, though there is still a lot to prove with this technology, particularly given the baggage from GlucoWatch (Mr. Pierart did assure us that this technology is different). The lengthy test time is a major drawback that is very undersold [in the glossy promo video](#). This product was honored with a [CES 2017 Best of Innovations award](#), and in our view, has since received a lot of [overly optimistic press](#) given this field's history and the company's early stage. For more information, [see the PK Vitality's website here](#).



- **Montreal-based [BioMindR](#) has a contact-free glucose sensor in development that uses "wireless signals and machine learning" for continuous monitoring.** According to the rep, the sensor will give a traffic light for high, in-range, or low and not produce a specific number. The sensor technology does not require contact with the skin, meaning it could theoretically be embedded into textiles, car seats, etc. - that would be incredible if it works. We're not sure how the sensor technology actually reads glucose wirelessly and separates signal from noise, but the [website](#) says the technology is insensitive to interferences (sweat, body location, ambient light, skin tone) and can sense multiple analytes. To date, hydration has been the focus, but glucose, sodium, and blood pressure can reportedly be extracted with a single sensor. The [website](#) also boasts 10x lower power consumption vs. "conventional solutions." The [team](#) appears to be four people and none have glucose monitoring expertise from what we can tell.

2. PAYERS AND HEALTH SYSTEMS MORE ON BOARD WITH DIGITAL HEALTH AND WEARABLES? UNITEDHEALTHCARE, KAISER, AND MORE.

Several speakers argued that payers and hospital systems are now more open to digital health than ever before. UnitedHealthcare got a lot of airtime yesterday and today with [the Motion Program \(expanded this week to include Fitbit\)](#), which is offered through employers and gives up to \$4 per day and

\$1,500 per year for employees that meet one or more of the "FIT" activity goals measured via a wrist-worn tracker: (i) Frequency (take 300 steps in five minutes, 6x per day, spaced an hour apart); (ii) Intensity (take 3,000 steps in 30 minutes once per day); and (iii) Tenacity (>10,000 steps per day). Employees can put this money towards out-of-pocket costs like co-pays, and the [UnitedHealthcare Motion app](#) makes the financial incentives *very* clear with dollar signs that indicate how much money has been earned today and this year (more details below). Qualcomm Life Chief Medical Officer Dr. James Mault called this a "landmark" program, with a "health plan design predicated on data flowing from a digital wearable device and significantly incentivizing employees to not just wear devices, but actually practice a set of behaviors that are now documented to beneficial outcomes" (FIT goals; see above)." That last point is a critical one for payers and device companies - showing that the metrics actually impact outcomes. We see this program as a highly encouraging sign for diabetes technology - it suggests payers are increasingly realizing the cost-effectiveness/clinical value of digital health devices and are open to composite outcomes based on patient-generated data. Where could this go in diabetes? We could envision a similar program for BGM, CGM, or even insulin delivery: patients get \$X per day or per year for meeting certain glucose or insulin dose goals based on connected devices (e.g., a certain average blood glucose and standard deviation, time-in-range, taking daily doses, etc.). What can diabetes devices learn from this program? What basket of short-term outcomes is correlated with lower costs and better outcomes? What would payers need to see to rollout a similar program? And are patients motivated by earning \$4 per day, or does the novelty factor wear off quickly?

- **Panelists mentioned other compelling examples of digital health driving savings and efficiency:** more than 50% of Kaiser Permanente's consults [are now done remotely](#) ("they redesigned the whole care flow," said Philips' Mr. Jeroen Tas); Penn Medicine is using analytics to predict septic shock with 85% accuracy an impressive 30 hours in advance (using Intel's analytics platform); Arizona-based hospital Banner Health used at-home mobile devices (with partner Philips) to cut costs by 20% and hospital admissions by 50% in the costliest patients; and Philips has built virtual ICUs that allow providers in Sydney and Atlanta to care for each other's patients overnight more safely with better outcomes at lower costs ("works like a charm" and "looks like a trading desk!").
- **Overall, we've heard more optimism on the payer environment at this CES, particularly as healthcare shifts to value-based payment.** Many speakers emphasized that digital health can drive the payment transformation via real-world data collected passively, population management, and more scalable remote care delivered at lower costs. There was some interesting tension, however, as some speakers did argue that digital health will likely be a consumer-driven, bottom-up field rather than a payer-driven, top-down field. This divergence was not probed, and we suspect both trends will play a role.
- **We downloaded the [UnitedHealthcare Motion app](#) and tested it in the exhibit hall today. The user experience was underwhelming compared to consumer-grade devices, but this program represents an encouraging move by a huge payer. The Fitbit integration is excellent to see and hopefully a good sign of openness to further device company partnerships.** UHC was giving away its own free activity tracker in the exhibit hall today (powered by striiv), which paired with the UnitedHealthcare Motion app very quickly. The striiv tracker is the Motion Program's "stock" device, and was low quality in terms of user experience (hard-to-use and read touchscreen, falls off the wrist easily, feature set limited to step tracking, etc.). UHC's Motion app is also very basic, offering little analysis, unreliable Bluetooth syncing, and a dated user experience. However, the Fitbit partnership is a very positive move to integrate a far better health-tracking device (Charge 2, "the top selling fitness tracker in the US") with Fitbit's more consumer-friendly design and better app user experience (social, better data analysis, etc.). Once the combined UHC Motion/Fitbit integration launches early this year, plan members with a Charge 2 (or those who want to get one) can sync it right into the Motion program. The Charge 2 will also show the three "FIT" goals right on the device (see above), meaning this is a tight integration and there is a lot of work on the software side here. In addition to offering its own free device and syncing with Fitbit's Charge 2, UHC will approve other devices going forward in a "bring your own

device" model - these will be vetted by UHC on a case-by-case basis to ensure the data is high quality. As a reminder, Qualcomm Life's 2net platform powers the Motion Program on the backend. Read more details [here](#).

- **Pathway Genomics' Dr. Michael Nova: "We do genetic testing and use artificial intelligence. I couldn't get any insurance company to talk to us a couple years ago. But a couple months ago,** I was visiting a huge insurance company in New York, and all they wanted to talk about was wellness programs, artificial intelligence, genetics, and preventing people from getting sick. Even Aetna is publishing papers using genetics. **To get anything done [in digital health], you have to get payers and large companies on board, and that is really starting to happen in the last six months."**
- **"Understanding the behavioral economics of digital health is becoming more and more important."** - Dr. Matthew Diamond, Medical Director, Fossil Group. Dr. Diamond further noted that Misfit Wearables (now owned by Fossil) worked with startup insurer Oscar to provide members with activity trackers. The partnership got members engaged and even had an overflow effect for the Oscar app - patients started "making smarter choices about their care overall." This was a brilliant point - a device can actually enhance an insurer's offering and lead to ripple effects on health.

3. WHAT ARE THE KEY BARRIERS IN DIGITAL HEALTH? HCP WORKFLOW TOPS THE LIST FOR MANY SPEAKERS

What are the biggest challenges for digital health? Healthcare provider-related barriers came up most often in discussion today, especially clinical workflow and lack of intelligent algorithms to make sense of data during visits. Interestingly, most panelists felt that progress on the core wearable sensor hardware and software and data interoperability standards (HL7, FHIR) has been strong; it's the translation to the practice of medicine that has been holding back the field. Clinical workflow and showing value for physicians were repeatedly mentioned as some of the biggest roadblocks in the field, with most speakers (many of whom were former physicians) noting that HCPs have no idea what to do with data from wearables and digital health devices and apps - they cannot make sense of all the data in short visits, the data doesn't impact clinical decision making, there is often no way to view it and store it in an EMR workflow, and there is no payment to look at the data remotely and use it proactively. Particularly as genomic data becomes more common, panelists emphasized that intelligence, filters, and dashboards must improve to facilitate therapeutic change from all this data. We could not agree more for diabetes, particularly as personal and professional CGM prescribing expands beyond early adopter clinicians. Provider trust also remains an issue - can heart rate data from a consumer-grade Fitbit be trusted and used to titrate medications or diagnose conditions? (The same could be said for CGM devices - do providers trust the accuracy enough to change insulin therapy? Would providers trust insulin dose titration algorithms?) Some of our favorite quotes related to this theme:

- **Dr. Mault: "No doctor wants to look at 3,000 blood pressure measurements every morning. That's not going to happen. In fact, they say, "Shut it off, I don't know what to do with it."** The same thing is true with genomics. There is a lot of work to be done on how to manage this data - the intelligence layer. The heavy lifting needs to happen on this new flow of information and how to use it in the workflow. What do I do differently in my day-to-day and hour-to-hour workflow? This will require a retraining. Think about any industry that went from analog to digital. In the next 3-5 years, all of this workflow, information management, software systems, predictive algorithms, in the next 3-5 years is where all the money is going to be made.
- **Verily's Cardiovascular Health Innovations Head Dr. Michael McConnell: "I see a number of patients in my [part-time] clinical practice, and these are Silicon Valley, tech-enabled patients. There isn't any natural workflow that allows wearable data to easily be visualized and put into the EMR.** Often I am looking at a patient's phone screen or they are printing something out or simply telling me what they are doing. That is clearly a big gap in

how we're currently doing things. Stanford redesigned part of its EMR for patients so that it can bring in some of this wearable data, but it still remains a challenge."

- **Dr. Mault: "The CEO of the AMA, in his summer keynote address at the annual AMA meeting, gave a talk titled, "Digital Health: The Snake Oil of the 21st Century." We're at an interesting time in healthcare, particularly for physicians -it's a very difficult transition** from fee for service to value based healthcare. A lot is changing that is disruptive, and much of that is digital health. The way we practice medicine is going to change dramatically. About 80% of physician visits that we incur today are likely to be safely and reliably delivered into your home. If your kid has a sore throat or fever or ear infection, why pack up and drive to the pediatrician? You should be able to take a strep test out of the closet, Bluetooth connect to your phone, and then a provider can coach you remotely as you use a stethoscope with augmented reality. That's a hard transition for physicians. But there is some legitimacy to this 'snake oil' concern. If consumers expect us to take care of them without seeing them in the clinic, then I need to know data from the heart rate monitor is accurate and reliable. And is the blood pressure measurement 180/60 or 108/60? Over the next few years, we're going to see a raising of the bar. It's time to say, what's the accuracy of that wearable? Can we use it to make medical decisions? The big home run for digital health is to be able to take care of you in all your healthcare settings and needs."
- **Philips' Mr. Jeroen Tas: "You must be willing to redesign your whole workflow and care flow. If we keep thinking of digital wearables in classical systems, it won't work.** If we redesign the care system, then it will work. Patients will drive it. If you are busy, you don't want to go to the hospital and wait in the waiting room. You want care digitally, remote, etc. The whole system and behavior needs to change."

4. SONNY VU: PRECISION CAN BE MORE IMPORTANT THAN ACCURACY FROM A USER EXPERIENCE PERSPECTIVE

Fossil Group's Sonny Vu (formerly of AgaMatrix) harkened back to his BGM days, arguing that "Accuracy is important, but precision is much more important from a user experience perspective." He was referencing this comment from the perspective of wearables' tracking accuracy, but it was a brilliant point for glucose monitoring too. When a device doesn't give *repeatable* and *consistent* results under the same conditions, it's highly frustrating for the user, erodes trust, and can lead to device abandonment. Even if a device is highly accurate, but not precise (giving consistent measurements), it will "feel" inaccurate to the user. We think CGM and BGM both have a lot to learn from balance of precision vs. accuracy, particularly the concept of "perceived" accuracy. With CGM, when users compare the sensor results to a meter and see a big discrepancy, it drives frustration with the CGM. (In fact, it may be that the CGM is right, in many cases due to hand washing.) This is why non-adjunctive use and factory calibration will be SO important from a sensor user experience and satisfaction point of view. But more broadly, devices have to balance these two metrics, and sometimes that is very difficult. Sonny's full quote on precision vs. accuracy and a relevant one from Valencell's Dr. Steven LeBoeuf (a company that supplies components for wearables) are below:

- **"I've learned a lot from previous startup companies in the blood glucose monitoring space for people with diabetes. A lesson learned time and again is that accuracy is important, but precision is much more important from a user experience perspective.** Repeatability - getting the same number in the same state with consistency - is incredibly important. From a user experience, you could be not amazingly accurate, but if you are precise, a user will perceive it as more accurate. People calibrate themselves to devices. Think of an activity tracker that measures steps from the home to the office. One day it shows 1,600 steps, and another day it shows 2,400 steps, then that doesn't seem very accurate. Think of another device that shows around 2,100 every day. The first set is more accurate - since it averages out to the actual 2,000 steps - but the second set is more consistent. You will feel that the consistent one is more accurate. So it's important to balance both accuracy and precision, and that's a balance that product makers are

challenged with in a number of product categories." - Sonny Vu, Fossil Group Connected Devices President and CTO

- **"In terms of accuracy focus, be good enough for the use case.** If all you want to do is show an average heart rate, you can get by with a lower quality heart rate sensor. If you want to do atrial fibrillation or determine if you are in the right hear rate zone or if someone's VO2 max is improving, accuracy is really important. Get the accuracy right for the use case, and validate it from the prototype to final product." - Dr. Steven LeBoeuf, President and Co-founder, Valencell

-- Adam Brown and Kelly Close