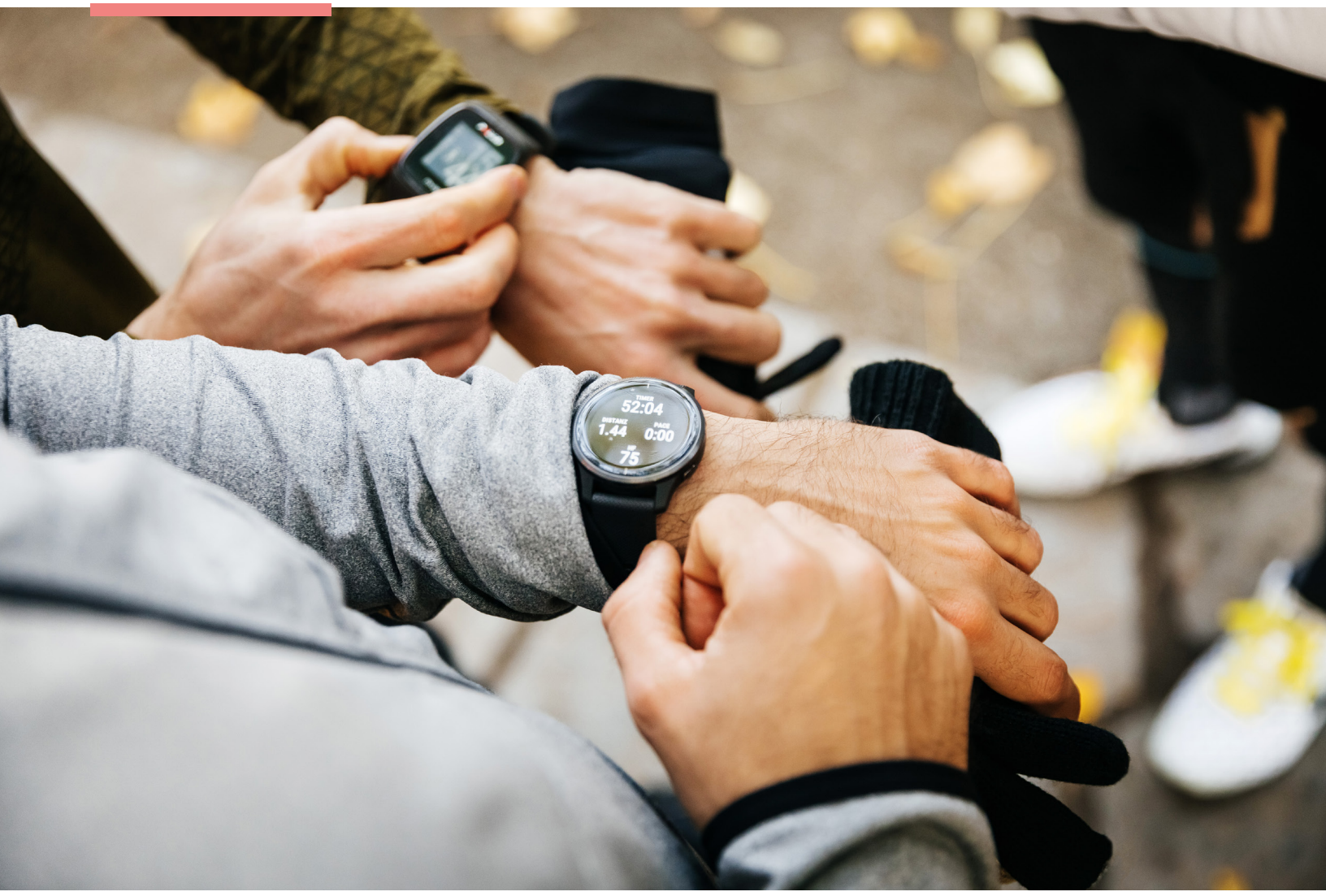
WHITE PAPER

Phillips Medisize
a molex company

Next-Gen Wearables:
Bringing it All Together for Optimal Health



Introduction

Wearable medical devices are paving the way for a brighter future featuring a more curated and unique patient healthcare experience.

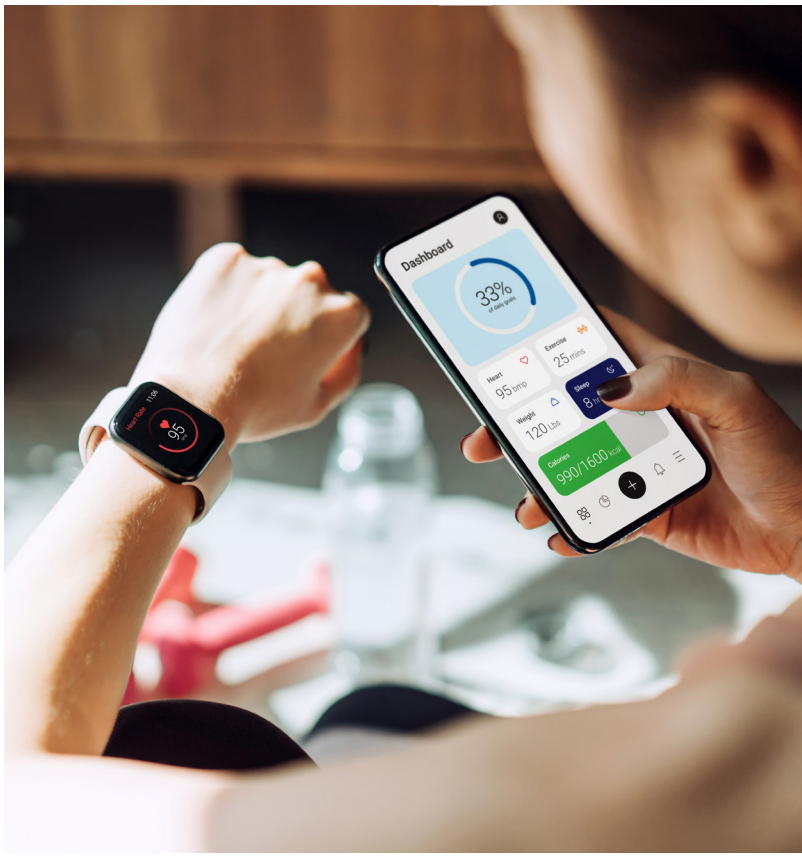
As engineers work towards creating the next generation of wearables, they must look at the anticipated customer needs, design considerations and manufacturing protocols. Bringing new ideas to the market is a complex process that requires strategic planning — something often easier said than done.

A partner with end-to-end capabilities makes the transition from prototype to product much more seamless and efficient. With all of these factors requiring complete understanding and consideration, this whitepaper will explore the nuances of creating next-gen medical wearables as a part of a comprehensive team leveraging their unique comparative advantages.

As engineers work towards creating the next generation of wearables, they must look at not only the anticipated customer needs but also design considerations and manufacturing protocols.

Increasing Consumer Demand

As more people want to take advantage of wearable medical technology, the demand for these devices is increasing. According to research from Insider Intelligence, over 82.7 million Americans were using wearables in 2022 – a figure that is expected to increase to over 93 million in 2026. With this demand comes a need for a rapid cycle of advanced innovations.



Because the average person today is more concerned with keeping track of their fitness on a day-to-day basis rather than waiting for their next physical or checkup, the race to create new technology is at the forefront of the medical device community.

This increased consumer demand for wearables indicates more than a technological evolution. A recent Molex survey found that 61% of the 600 engineers of varying professional levels that participated viewed patients — the actual wearable users — as a driving force for stakeholder input. Providers and other medical staff came in a close second (~40%), as they provide additional clinical input that a customer cannot.

In both prescribed and direct-to-consumer wearables, there are enormous opportunities for growth. But what challenges should design engineers anticipate as they begin drafting ideas for new technology?

Innovations and Challenges in Wearable Technology

By definition, wearables are portable, convenient devices that provide medical monitoring and treatments or interventions for patients. While today's wearables offer life-saving data to support treatment of conditions like diabetes and heart disease, this wasn't always the case.

The industry has evolved from creating products capable of gathering basic health data to devices that generate accurate, real-time disease monitoring based on critical medical criteria. Between smart rings, shoes and even fabric, there are a plethora of options for wearable device manufacturers and consumers to choose from. Each device has multiple applications, from collecting data on heart rate to tracking disease side effects. Some examples are:

- Fitness tracking, monitoring heart rate, breathing, caloric intake and steps
- Sleep hygiene, including body temperature, respiration, snoring, sleep interruptions
- Monitoring medical information related to diseases, such as vital signs, blood oxygen levels, glucose levels, brain waves, tachycardia and more
- Tracking symptoms that could be indicative of viral infections like COVID-19 and influenza

Advanced mechanisms like artificial intelligence have also revolutionized the way that precision medicine can work, transforming treatment plans from distant and clinical to personalized.

From conception, engineers must consider general functionality concerns and the labyrinth of design considerations wearables require. These include:

- **Quality:** The device should be capable of handling different types of environments and the elements within them. This includes supporting the proper level of biocompatibility to deal with skin secretions, being moisture-resistant for places like the shower, or having a sturdy external structure to protect it from harm during day-to-day use. It also must be able to adhere to different types of skin. Portability and durability are also essential.
- **Level of Comfort:** Many consumers who require wearable medical devices look for something feasible for daily use, so a cumbersome design will not work. To improve on this, incorporating lightweight plastic parts and a sharp insertion with a miniaturized size and depth are becoming more essential.
- **Connectivity:** For users to connect their wearables to their phone, watch or another smart device, ensuring the design plan incorporates a solid signal, reliable data integration, and compatibility with mainstream operating systems is necessary. Devices must be designed with antennas placed as far from the skin as possible, and they require cloud-based systems and Bluetooth capability to ensure no connectivity loss in countless different settings.

Commercialization of Wearables

Creating new products involves more than brainstorming different ideas and considering design factors; they must first reach a commercialization-ready state. However, transitioning an idea for a wearable from a prototype to a market-ready product takes longer than one might expect.

The number of design disciplines a wearable requires also slows the commercialization process. The more detailed and complex a design plan for a device is, the longer it can take to implement. Partially due to the level of thought and intention that these plans require, this poses a significant challenge for getting products to market quickly.

Other factors influence commercialization outside of time-to-market as well. Insurers need a clear return on investment (ROI), and consumers need to be able to purchase the device at a lower cost. To this end, bill of materials and other cost variables are the second most essential considerations for design teams developing new technology. As an example, miniaturization is one of the most notable innovations in the wearables space that can help reduce the overall cost of a wearable device. The smaller the device, the more convenient and feasible it will be for users.

Further, novel manufacturing capabilities also bring forward compelling new options for reducing cost, as well as time to market. For example, 3-D printing can open doors to rapid prototype development. And magnesium thixomolding enables the devices to be made in ever more miniscule formats, accommodating for gaps in thermoplastic injection molding and die casting processes that make it difficult to develop lightweight devices. Creating a device that is small enough to be convenient while maintaining all the necessary advanced technological functions is exceptionally challenging and meticulous.

Continuous glucose monitors (CGMs) are one example of a device needing complex functionality in an extremely small form factor. CGMs are wearable medical devices that measure blood glucose levels continuously throughout the day, providing a more accurate reading of whether blood sugar is in a healthy range. Used daily on a person's body, most of the activity in a CGM is centered in a compartment measuring about 5mm thick. This leaves little room for extraneous parts and makes magnesium thixomolding techniques particularly valuable for next-gen wearables.

Wearable Insulin Pumps (WIPs) are another example of wearable technology that has improved over the past several years thanks to material and manufacturing advances. Some of the most recent WIPs feature watertight seals, micro-molded internal components and selective plating that solve many of the problems past models have failed to remediate, including:

- Skin irritation and pain
- High monthly costs
- Trouble with adhesion
- Inconvenient placement and timing
- Inaccurate readings

The real solution to this multitude of challenges requires partnering with a company that can accomplish the daunting task of optimizing space within the CGM. By using soft and hard-molded plastics and installing a system of micro-connectors and sensors that enable Bluetooth communication and other factors, maximum functional output, and diminished overall device footprint can be achieved. Further, with global supply chain issues continuing to worsen, potentially contributing to further manufacturing and delivery delays, it is vital to have reliable and knowledgeable partners in this specialized area within reach.

The Value of In-House Expertise

Vendors with extensive in-house experience greatly benefits design engineers looking to bring their wearable technology innovations to life. Traditionally, companies seek individual partners for each portion of the design process, creating a fragmented approach to completing a new device design project. In contrast, interdisciplinary teams that collaborate actively to design next-gen wearables eliminate the need for multiple intermediaries that complicate an already intricate chain of command and also introduce requirements for redesign and rework due to misaligned expectations and specifications.

In addition to collaboration, a comprehensive design structure is necessary. Designing everything simultaneously eliminates the back-and-forth dialogue that comes with using multiple vendors for different parts. Each part is created in sync, lowering the potential for error. And it also enables those devices to be optimized along the way for everything from weight and durability to manufacturability and more.

Customers also play a unique role in the collaboration process. With their input, a significant portion of the nuanced knowledge about the actual use cases for the wearable, its business-critical and human-centered goals is a vital consideration.

Overall, these collaborations have proved successful for all parties involved in contributing to innovations that guide the future of next-gen wearables.

Collaboration of interdisciplinary teams is an excellent asset to those designing next-gen wearables, eliminating the need for multiple intermediaries that further complicate an already intricate chain of command.

Continuous Glucose Monitors Influence Next-Gen Wearables

While many wearable medical devices make it into the hands of professionals and patients in the medical community, few have advanced more significantly in the past decade than CGMs.

While CGMs contribute significantly to the development of more effective and efficient diabetes management tools, they also exemplify how quickly designers can adapt to consumers' needs with innovative technology.

When imagining traditional glucose monitoring (TGM), the first thing that comes to mind is a needle. Most TGM systems puncture the skin with a needle to collect a blood sample. But, because newly diagnosed patients may not be used to pricking themselves or may have an aversion to needles, creating a design that accommodates the needle experience will create a better overall user experience.

These use cases, coupled with potential day-to-day pain points, can inform designers on key customer experience improvements to what is already available.

This has encouraged developers to formulate solutions to make glucose monitoring on a daily basis less of a hassle. For example, by creating a web design with embedded circuitry, a signal is communicated through the skin to the device – alleviating the need to repeatedly puncture the skin to secure an accurate reading. Like many other wearables, data collected from a GCM can be transferred to several platforms, making obtaining and storing information about readings much more manageable.

Wall thickness is another technical issue frequently noticed in CGM product development. What is the best way to get materials to cooperate without decreasing the efficiency, efficacy and quality of the design? Phillips-Medisize demonstrates unparalleled ability to use techniques like precision plastic injection molding to create optimal and consistent wall thickness — just one example of how to solve critical design challenges.

Offering novel solutions allows developers to complement miniaturization without compromising innovation.

In conjunction with the device, a simple yet flexible and efficient set of controls should be accessible. And an easily navigable control panel was created by Phillips-Medisize with customers in mind in one key application. Yet true design elegance meant adding this functionality without sacrificing the protection of internal components. Through effective and iterative customer collaboration and user experience testing, both were achieved.

Offering novel solutions allows developers to complement miniaturization without compromising innovation. Further, integrating small, compact designs with the feasibility of Bluetooth and cloud connectivity, along with other crucial technology, has proven to be a successful way to create more cost- effective and highly advanced CGMs.

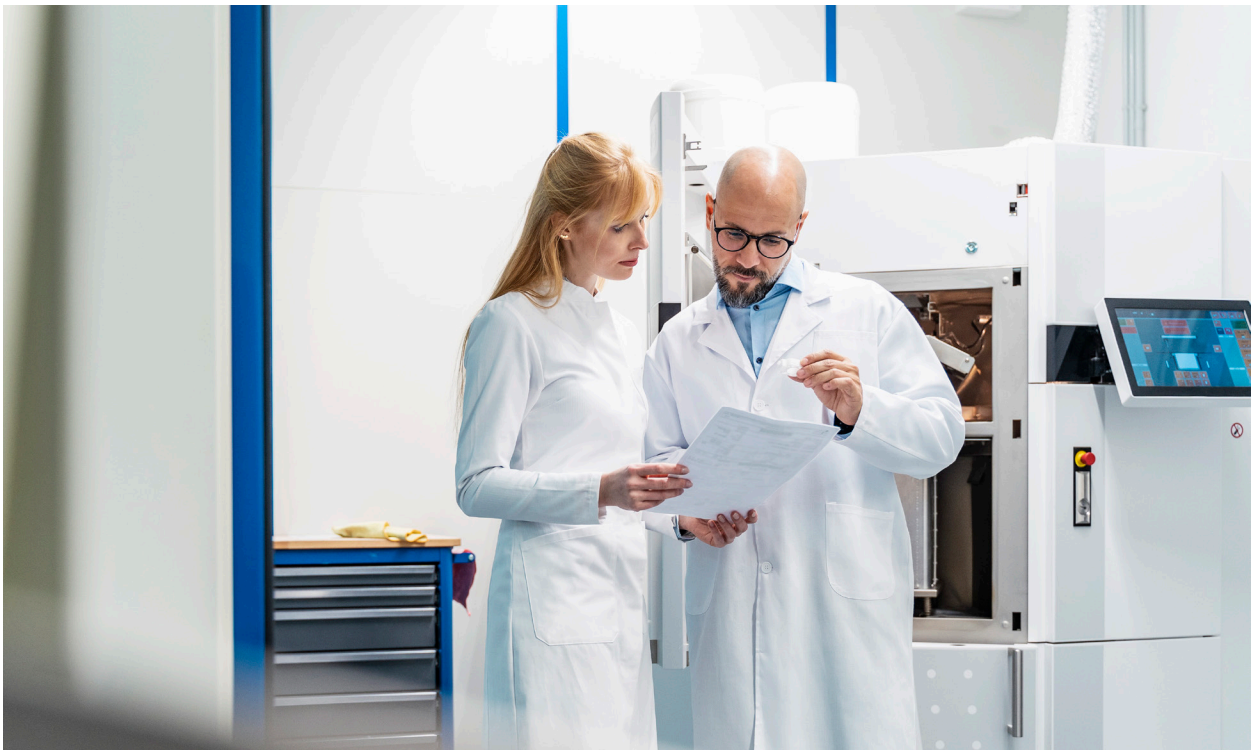
What Does the Future of Wearables Entail?

As all the device design process contributors work together to create next-gen wearables, it is imperative first to identify the target audience and their desired experience. Who is the device for? What problem is it solving? How will the product's design impact a user's experience? Most importantly, what is the best way to assess the full design scope, along with the nuances mentioned above that apply to niche products (like CGM)?

Choose a partner that will help accelerate product development and innovation. As the wearable medical device industry continues to evolve, staying ahead of competitors with value-added features and leap innovation is a must. Using scale and global reach to continue miniaturizing designs gives companies a competitive advantage in product designs, cost optimization, prototype-to-product timelines and managing the unpredictable supply chain.

The teams at Phillips-Medisize also work closely with the teams at Molex to develop new hardware and other necessary software that would otherwise not be possible. All knowledge is kept in-house, streamlining product development and commercialization paths. Together, both have unmatched end- to-end capabilities manufacturing and electronic design capabilities.

These are just a few of the benefits wearable companies get by partnering with Phillips-Medisize. Learn more about how our end-to-end design and manufacturing expertise can ensure your competitive edge at .



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