The SPRIND HORMONE CHALLENGE

This exposé defines a Challenge aimed at *continuous* hormone monitoring, in women.

Data on the female body's operating system

Executive Summary

Why measure hormones?

Hormones are the body's most powerful communicators - tiny molecules that regulate and literally help shape nearly every cell, tissue, and organ in the human body. It is not farfetched to call them the operating system of the body. They decide how fast we grow, how well we sleep, how we respond to stress, and even how we connect with one another. Kidney hormones like renin set our blood pressure; brain hormones like oxytocin influence trust and affection; cortisol and thyroid hormones orchestrate our metabolism, stress response, and circadian rhythm - adapting our body and mind to the changing world every moment of every day.[1-5]

Hormones remain an area of women's health that remains poorly understood, even by scientists. Though a key driver of health, hormones are infrequently measured clinically. When they are measured, even the best technology offers

only a static snapshot, which does not capture our hormones' dynamic, pulsatile, and circadian rhythm. These measurements are therefore of limited diagnostic utility in an array of diseases. [1, 6-8]

Healthcare's most expensive blind spot

Women's health is societal infrastructure. It is extremely expensive for societies that women don't get adequate health care. An estimated 1 *trillion* dollars *every* year. Women spend 25% more of their lives in poor health than men. Many expect to experience health issues clustered towards life's end, but women, in particular, can expect the issues to bleed through their prime, productive years. Across Europe and globally, our workplaces are hemorrhaging talent, lost productivity, and innovation, simply because we lack the fundamental understanding of the hormonal transformations driving their health outcomes. [9-12]

What our healthcare systems are waking up to understand is that women don't have "hormone problems". They have a hormone data problem. Increasingly our AIs also have a data problem: We are feeding them outdated data from a time when women were omitted from research *because of* their hormones: Women have historically been left out of much medical research and drug development because of the fluctuating hormones that "disturbed" the trials. This means that we go from an era of incomplete knowledge stored in books and acted upon by doctors to a repeat where AIs will do the same. This is a crucial moment to not make that extraordinarily expensive mistake again, to let catastrophic lack of data on women's bodies define health care in the coming decades. [13-16]

Goal

Gaining a more robust dataset on women's hormones will help fill some of the fundamental gaps we still have in our understanding of the female body in relation to areas such as fertility and infertility, hormonal conditions such as endometriosis, PCOS, as well as many diseases where women are either differently or disproportionately affected, such as in cardiovascular health, autoimmune disease, Alzheimer's, osteoporosis, depression, anxiety, menopause and many others. [1,2,10,11,15,17]

The goal is two fold: One, to build a biosensor technology (or several) to enable continuous, individualized assessment of female endocrine function that empowers clinical decision-making, consumer wellness, and population-level research.

And secondly to establish a Data Pool, with the first-ever gold standards for hormone values, fluctuations, and concentrations across diverse populations, lifespans, and conditions. Without clinical valid reference data on hormones biosensors cannot be built. Furthermore this dataset will lay the steppingstone for a Foundation Model of female physiology, the basis for digital twins, AI models, predictive, personalised and preventive care. All urgently needed for a healthcare system bugling under the weight of older and more sick populations. Of which women's health is *the* major expense burden.[11,18,19]

This Challenge will give scientists the resources to develop the next generation biosensors, utilizing emergent technologies that the private funding environment doesn't allow for, simply because it is too risky, takes too long, is too complex, is too expensive and requires the kind of data collaborations that currently doesn't exist and which the scientists ask for. It is also an opportune moment to make sure the epicentre of this technology will be built in Europe under EU data protection laws, guided by strict ethical principles, which given the sensitivity of this technology, and the current political climate in the US in particular, is important.

To get this signal out of the body more than once we have to overcome a number of yet unsolved problems depending on the technology we apply; how to prevent biofouling in microneedles, how to make aptamers release their analytes after they have been captured once, how to be able to process the data so that the signal is still meaningful after the sensor signal decay after some days, and many more. Teams will be working on different technologies, the verdict is still out on what will be the winning bet to do what is their shared goal: To be able to measure minimum 4 primary hormones, at least five times per 24 hours, for a minimum of one week.

Why is it technologically hard to build a continuous hormone monitoring system?

Hormones are themselves diverse, fluctuating, unstable and complex. Some are large molecules, some are steroids, some are found in saliva, some in blood, some are metabolised, others not. They impact each other, they get made in several organs of the body, in the brain, in the gut and in tissue. The endocrine system is wildly complex, in fact it is miraculous how well it works, and maybe not surprising that most women will encounter some trouble with their hormones at some point in their lives. Not to mention the out of scale fluctuations a pregnant woman will embody or the total hormonal reconfiguration that happens during peri-menopause, which of course is relevant to 100% of women. [1-3,6, 21,22]

Capturing these molecules is hard enough, but something that we can do. To do it *continuously* is an entirely different magnitude of technological challenges. To find sensors that can pick up concentrations equivalent to a sugar cube dissolved into an olympic size pool is hard (that's the estrogen levels found in saliva and it is even lower in sweat), but to build a sensor that can do this reliably over several days or weeks (like a glucose sensor) is *really* hard. In fact no one can do it yet. To imagine a sensor that could sit on a finger like an OURA ring, or be a tiny 1mm x 0,5 mm sensor hiding in a tear duct (we can expect to see both technologies represented in the Hormone Challenge!), will require a new generation of technologies all together, spanning across biosensing, data processing, biology, chemistry, electronics and many other disciplines, as well as navigating regulatory pathways, manufacturing, usability and business models. And of course in the end both practitioners and consumers have to understand what the hormonal data means and how to base clinical protocols and behaviour upon it. It is an extremely complex puzzle that all has to come together.

But let’s focus on the first challenge, to get the actual data from the biomarkers in the body; the raw hormonal data! In parallel, the Challenge has one more outcome - as both an enabler and a goal in itself: To establish a shared reference Data Pool to enable this sensor development short term and many more things long term.

How do we build sensors that are sensitive enough for those low concentrations, how do we build systems agile enough to span the ranges that a female body presents? Well the short answer is, currently we don’t.

Teams are trying - kind of. A few teams have gotten some funding, but while the press releases says “continuous hormone sensing” the reality is that these (few) VV backed teams, like all early stage teams, have been backed on the vision to one day be able to do it. HOw ever, the *one day* often remains on the horizon because teams are asked to bring something to market almost immediately by their investors and therefore turn existing tech (which is not continuous *at all)* into products, and the *continuous* next gen biosensors remains a somewhat neglected idea in these startups. A few researchers are working on sensors, but they work underfunded, isolated and often without enough understanding of all the other parts needed to make an innovation make it all the way to market (and be successful). And most of the research groups working on advanced biosensors like photoacoustic patches or bioprinting of implantable bioelectronics, do not look at female sex hormones as a target. Women’s health needs are not top of mind for them and they explore use cases like aorta blood pressure or tumor palpation, but maybe they *could* look at hormones.

Why does hormone data have breakthrough potential?

Of all the hormones running our lives, the sex steroid hormones - estrogen, progesterone, and testosterone – are among the most dynamic signals in human biology. Sex steroid hormones don’t just determine sex-specific traits - though those are fascinating: Things like shaping our muscle size, bone density, skin and hair growth, regulating aggression, temperament, artery elasticity, and, of course, menstrual cycles, pregnancy, and menopause – are impressive. But they do more than that. These hormones tell every cell how to grow, adapt, and thrive in a changing world. They reveal the intricate choreography between the brain, endocrine, and immune systems. [1-5,21-27]],

In essence, they run our lives. Estrogen regulates mitochondrial function, literally influencing how every cell produces energy. Together, estrogen, progesterone, and testosterone control “growth factors” – amazing proteins that repair wounds, direct immune responses, and, when dysregulated, can turn the immune system against itself – or worse, fuel cancers. [1-5,21-27]

Even the brain bends to their influence. Estrogen shapes the structure of neurons, increasing dendritic connections that affect memory, language, and emotional resilience. [23,26,27] It’s an astonishing fact that the very molecules shaping our minds and bodies remain so poorly captured as data points in modern medicine. Despite advances in personal health tracking (heart rate, glucose, sleep), one crucial piece is missing: Real-time, continuous hormonal data - particularly for women. There are also strong indications that some of our other hormones, like prolactin, oxytocin, vasopressin and renin may influence our physiology and mental health in ways we have not discovered yet. [2,28-30] That might be interesting scopes for future Challenges!

Every day, tiny hormonal fluctuations adjust how we think, feel, heal, and age. Most go unnoticed, but small shifts that repeat and accumulate can become enormous health issues: Chronic inflammation, mood instability, metabolic drift, infertility, heart disease, even accelerated aging. Hormones are not background noise - they *are* the operating system of human biology. [1-6, 21-30]

- And why continuously?

Until now, we’ve only understood hormones in static snapshots: a blood draw once a year, a single data point in a moving river. But emerging biosensors, AI modeling, and miniaturized chemistry now make it possible to see what has always been invisible - the continuous hormonal rhythms that organize our physiology in real time.

Research on the menstrual cycle offers a powerful window into this new frontier. The ebb and flow of estrogen and progesterone don’t just affect reproduction - they reshape immune responses, metabolism, and even brain connectivity. Daily imaging studies show that as hormones rise and fall, the brain’s network architecture shifts, revealing that chemistry and cognition move in synchrony. [1-3,23,25,31-33],

This isn’t just a women’s health story - it’s a human systems story. Women’s hormonal cycles provide a natural, high-amplitude model of biological rhythm, the largest signal nature gives us to study how chemistry and connectivity interact over time. What we learn here could redefine how we predict, prevent, and personalize health across the lifespan.

Continuous hormone monitoring will let us see biology as it truly is: dynamic, adaptive, rhythmic. It will change not only how we diagnose disease, but how we understand *being alive*.

Bench science keeps telling us how fundamental these hormones are, but clinical data remain sparse - not for lack of insight, but for lack of, indeed, technology.

There lies an even deeper layer of biology – a nearly unchartered territory: hormone *pathways*. After being secreted, hormones travel through the blood *into* the cells' target tissues, where they interact with mitochondria, alter gene expression, and regulate which proteins each cell produces. Even the way these hormones are metabolized determines health outcomes - break them down one way, and you protect against disease; another way, and you promote breast cancer or fibrosis! [34-37]

Science could be pushed over the threshold of being able to measure this entire pathway - dynamically, continuously, and in real time. But it needs a unifying, shove – a Challenge to get there. Current reference ranges tell us little about actual hormonal activity, but having data from continuous hormone monitoring could revolutionize how we understand human health itself, and how we can optimize for health.

We start with women - not because women are the only ones affected, and their health in turn affects society the most, but also because their hormonal systems are the most dynamic, offering the strongest signal. The orchestras of the menstrual cycle, pregnancy, childbirth, and menopause are among the most intricate and least studied in biology. Understanding them isn’t just women’s health - it’s human health at its most fundamental level.

Rhythms carry meaning

Thyroid hormone and cortisol hormones fluctuate dramatically throughout the day setting one's circadian rhythm. The sex steroids have smaller amplitude intra-day fluctuations, but all are affected by these two master regulators. Disruptions to the circadian rhythm can accumulate and lead to disruptions in a menstrual cycle, fertility and more. Further, estradiol and progesterone are pulsatile with circadian, ultradian, and infradian structure; the pattern, the amplitude, timing, and relationship encodes biology that a single draw cannot see (eg, luteal stability, anovulatory cycles, peri-menopausal volatility, effects of medication timing and countless more we will only discover with monitoring - we truly do not know what we don't know here). Continuous, high-frequency data could reveal signals we didn't even know to ask about in disease states because we didn't know they were being impacted by these fluctuations - to say nothing of fetal development and other critical impacts for society. [1-6, 21-37]

Here are a few examples of why snapshots won't do:

Organ-level adaptation: Recent data show that kidney cells expand in an estrogen-dependent manner from puberty on. Kidneys regulate blood pressure. The growth of these kidney cells accelerates during pregnancy to adapt to the blood pressure demands of the baby. If the mother's kidney cells do not get enough estrogen it links directly to preeclampsia - a potentially fatal hypertensive crisis of pregnancy. The increase in healthcare utilization for the emergency C-section, concomitant hospital stay, NICU unit for the baby, and long term damage of preterm birth could all be avoided if clinicians saw the hormone signal earlier. We do not monitor estrogen at all in a pregnancy, even though it is the most estrogen-replete and dynamic event in human health. Even if we did, a static measurement would not capture this. This costs lives. [38] Since men's blood pressure is set the same way, who knows what we will learn about all human health..[]

*Neuroendocrine targets are dynamic***.** Brain estrogen receptor density tracks menses and menopausal transition and correlates with both cognition and mood. If the target is moving, dosing must be timed to dynamics; this is impossible without longitudinal measurement. [31 -34]

Immunity and rejection risk are context-sensitive. Sex hormone milieus shape both innate and adaptive immune responses; mapping those milieus around transplant surgery or autoimmune flares is a plausible path to fewer adverse events, but only if we measure the milieu as it changes. [39 - 42]

Population ranges mislead. Repeated measures establish personal reference ranges for hormones and actionable deltas; precision medicine simply does not exist without this, and if you only have, say, one yearly test (which very few women even have) it doesn't actually give you any sense of your own baseline, let alone account for seasonal variation - which is significant in thyroid hormone. [7,8, 43-46]

Behavior change needs feedback. People won't sustain habits for a risk 40 years out; or none of us would eat junk food now, knowing our arteries will suffer later. Showing near-real-time endocrine trends tied to sleep, stress, food timing, and activity turns prevention into closed-loop learning (an effect we've already seen in glucose). [47]

By studying these fluctuations continuously, we open a window into how hormones shape human health itself - from mood and metabolism to immunity and aging to consciousness itself.

How to define continuous

Some sensors can measure heart signals several times per second, a continuous glucose monitor measures every few minutes so how do we define *continuous*? The Challenge takes a pragmatic approach since the answer on one hand has to fulfill medical ambitions that will vary from team to team, and on the other give us a unifying target that allows for comparison between teams, and sets a bar high enough to move the field forward. In real life it is to be expected that some use cases will need more frequent measuring and some less frequent. However with 5 readings per 24 hours both medical relevance and technological ambition will be met. To be able to do this for 7 continuous days pushes the bar well above what is doable today, but it is not a goal completely outside what is conceivable to obtain in three years.

Most disease is not sudden

It's a slow accumulation of damage over time. Cancer mutations can smolder for decades before a tumor appears, and cardiovascular risk builds from young adulthood. Endocrine biology drives similarly long arcs in women; hormones play pivotal and gender specific roles.

See references for more examples of medical relevance to having better and continuous hormonal data.

Reference datasets

The reference intervals we do have are so broad they lack clinical meaning. They are also insensitive to cycle phase, diurnal timing, age, and - importantly, to an individual, "normal" is often not decision-useful. Methodological drift compounds the noise. What clinicians need are individual baselines and dynamics tied to symptoms and outcomes, not a one-size 2.5–97.5% band. [7,8,43-46, 48]

Put simply: if we want to bend the curves of *for example* dementia, cardiovascular disease, autoimmune damage, surgical outcomes, and healthy longevity for half the population, we must treat hormones as continuous vital signs, not as occasional snapshots.

It is not a far stretch to say that data on women's hormones very well could catalyze a major breakthrough *across all* of women's health. But even beyond women's health, continuous hormonal data will be a breakthrough rippling through academia, health care systems, consumer health, sensor technology, data infrastructure, business models and creation of new industries!

"I don't think there will be successful LLM-wrapper companies in healthtech until there are transparent, health-specific foundation models."- Courtney Nadeau, AI and Regulatory at DNV Medech investor.

Status quo: Tech, science and funding

What is possible today, technologically

While we see many start-ups offering at home solutions for testing of female hormones *no one can do it continuously*. What we get are only snap shots of what levels of these hormones are available in bio-matrices like saliva, serum, sweat and interstitial fluids. And the few scattered data points we get, we can't truly make much sense of the data. Consumers are often desperate for relief, and pay expensively out of pocket to try and understand their hormonal issues.

What exists on the market for at-home testing today, for consumers

- **Saliva-based lateral flow assays combined with optical readouts**
  These tests use saliva samples and detect specific biomarkers via lateral flow strips, similar to pregnancy tests. Optical readouts, often via smartphone apps or small readers. They are increasingly used for hormone, stress, or fertility monitoring.
- **Urine-based lateral flow assays for non-quantitative results (yes/no tests)**
  Urine-based tests remain the most common consumer diagnostics format, offering simple "positive or negative" results. They are used for pregnancy and ovulation testing. While convenient and inexpensive, they typically do not provide quantitative hormone levels or trend data.

- **Finger prick for dried blood analysis (send sample to a lab)**
  Consumers can collect a few drops of capillary blood on a filter card and mail it to a certified lab. This method allows for more accurate, lab-grade analysis of a few hormones like AMH (to see how many eggs you have left as a woman). Results are delivered digitally within days, offering a balance between convenience and analytical reliability. Those are quite costly, and a user only gets a few data points.

What kind of hormone testing can be done in a lab today by clinicians

- **Blood work for specific hormones, ELISA assays**
  Clinicians routinely measure individual hormone levels (e.g., estrogen, progesterone, cortisol, thyroid hormones) using venous blood samples. ELISA (enzyme-linked immunosorbent assay) remains a gold standard for quantitative detection, offering high sensitivity and specificity but with the above mentioned reference ranges that are so broad they almost lose meaning.
- **DUTCH test for a more comprehensive panel of hormones**
  The DUTCH (Dried Urine Test for Comprehensive Hormones) test analyzes metabolites from multiple hormone pathways over a 24-hour period using dried urine samples. It provides a detailed picture of hormone metabolism, giving clinicians deeper insight into hormonal health than standard blood tests alone.

Biosensor technology's cutting edge

No one can do continuous hormone tracking, but the field is ripe with solutions that given enough resources could possibly deliver continuous sensing:

Aptamers

Aptamers are synthetic, short sequences of single-stranded DNA or RNA that fold into specific 3D structures, allowing them to bind with high affinity and selectivity to target molecules, similar to how antibodies work. They are highly customizable, chemically stable, and can be selected for almost any target, including proteins, small molecules, or cells. Aptamers are promising for use in biosensors for continuous or semi-continuous monitoring of analytes in interstitial fluid (ISF).

Main hurdles:

- Long-term stability: Aptamers are prone to nuclease degradation and may lose binding efficiency over time, especially in vivo or in harsh physiological environments.
- Reusability and regeneration: Most aptamer sensors struggle to maintain performance in a fully closed-loop, long-duration scenario since repeated binding/unbinding or exposure to biofluids can foul or denature the aptamer.
- Translation from lab to clinic: Ensuring consistent performance in complex, real-world biological settings remains a key barrier to commercial and clinical adoption.

Sweat-Based Nanobiosensors Using Aptamers and Iontophoresis

sweat-based wearable biosensors that combine aptamer sensing elements with iontophoresis to stimulate sweat production on demand. Iontophoresis uses a mild electrical current to drive ions and induce sweat at the skin, enabling semi-continuous sampling without exercise

Main hurdles:

- Limited analyte scope: Devices have mainly validated a narrow range of biomarkers (e.g., estradiol), and extending to others is an open technical challenge.
- Sensor longevity: Current sensors function semi-continuously, but extending reliable operation beyond 24 hours—while ensuring accuracy, non-invasiveness, and user comfort—is a major hurdle.
- Signal interference: Sweat is a complex matrix, and contamination, variable rates of sweat production, and skin condition can all affect signal reliability and sensitivity.

Nano-MIPs (Nanoscale Imprinted Polymers)

Nano-MIPs are molecularly imprinted polymers engineered at the nanoscale. They are produced by polymerizing monomers around a template molecule (target), then removing the template to leave behind complementary nanoscale binding sites. These act as synthetic receptors with high specificity for the target.

Main hurdles:

- Template removal and reusability: Ensuring complete removal of the template molecule and full accessibility of imprinted sites without destroying nanoscale structure is technically challenging.
- Batch reproducibility: Variability in polymerization at the nanoscale can lead to inconsistent sensor performance.
- Biocompatibility: Integrating Nano-MIPs into biological systems or wearable devices requires control over toxicity, fouling, and immune responses.

Nanosensors Inside Cells (Intracellular Nanosensors)

Intracellular nanosensors are nanoscale probes or devices that operate within living cells to detect and report on intracellular chemical, physical, or biological signals, including ions, metabolites, pH, or mechanical properties.

Main hurdles:

- Delivery and targeting: Effectively delivering the nanosensor to the target location within the cell without disrupting cellular function is a significant challenge.
- Biocompatibility and toxicity: Long-term retention within cells without toxicity or immune response remains a concern.
- Signal transmission: Extracting meaningful readouts from inside the cell, especially in real-time and non-invasively, is still difficult with current technology.

Microchips and Nanotubes

These technologies use silicon microchips and carbon nanotubes (or other nanostructured materials) to create high-density arrays of sensing elements for electrical, chemical, or physical detection.

Main hurdles:

- Biofouling: Sensor surfaces rapidly lose sensitivity due to protein deposition and cell adhesion in biological environments.
- Integration: Reliable electrical and mechanical integration with soft biological tissues over long periods is challenging.
- Miniaturization and power: Achieving sufficient sensitivity, selectivity, and signal transduction in small, power-efficient packages is still a work in progress.

Photoacoustic Sensing

Photoacoustic sensing uses pulsed laser light to induce ultrasonic waves in tissues or sensors. The detected sound waves are used to infer the concentration of analytes (via optical absorption).

Main hurdles:

- Miniaturization: Reducing the device size for integration into wearable or implantable platforms is still under development.
- Specificity: Achieving highly specific photoacoustic contrast for individual analytes in complex in vivo settings is an unsolved problem.
- Calibration: Quantitative, reproducible calibration of biosensors across patients or body sites is a persistent challenge.

Bioprinting of Implantable Bioelectronics

Bioprinting uses 3D printing of bioinks (living cells and materials) to fabricate flexible, biocompatible electronic devices that can be implanted in the body for sensing or therapeutic applications.

Main hurdles:

- Material compatibility: Developing conductive, flexible, and biodegradable inks that maintain function in vivo is still ongoing.
- Long-term integration: Ensuring stable implantation, minimal scarring, and reliable device-tissue interface over months or years is very challenging.
- Manufacturability: Scaling up precise, reproducible bioprinting for complex, patient-specific devices is not yet likely for routine clinical use.

In summary, while all these emerging technologies are driving major advances in biosensing, each faces critical engineering and biological obstacles before they can be fully realized for consumer or clinical use.

Our scientific knowledge on hormones's effect

We know that hormones play a massive role. And we know that there are differences in how diseases affect and manifest in women versus in men. *But our understanding of what role hormones play is far from complete and there are substantial gaps in our datasets*. Here are some of the main categories (this is not a complete list) where more hormonal data could play a really huge role in how we understand, diagnose and potentially treat women:

Autoimmune Diseases: Women account for roughly 80% of all autoimmune disease cases, including lupus, rheumatoid arthritis, Hashimoto's thyroiditis, and multiple sclerosis. The female immune system tends to mount stronger immune responses — both protective and pathological — than the male system. [35,37,41]

Hormonal Influence

- **Estrogen** enhances immune activation. It boosts antibody production and stimulates T and B cells, which can improve defense against infection but increases the risk of autoimmunity.
- **Progesterone** and **androgens (like testosterone)** tend to suppress immune responses, which partly explains the lower prevalence of autoimmune disease in men.
- Many autoimmune diseases **flare during pregnancy** (when estrogen and progesterone rise) and **improve after menopause**, when these hormones drop.

Cardiovascular Disease (CVD): CVD is the leading cause of death for women, yet it is underdiagnosed and often presents differently and outcomes after heart attack are often worse for women. [49,50]

Hormonal Influence

- Estrogen is protective before menopause: it improves lipid profiles, dilates blood vessels, and has anti-inflammatory effects.
- After menopause, the drop in estrogen increases LDL cholesterol, arterial stiffness, and inflammation, sharply increasing risk.
- Hormone therapy after menopause can modulate risk, but its benefits and harms depend on timing, formulation, and individual factors.

Neurological and Psychiatric Disorders: Women are twice as likely to experience depression and anxiety. Migraine, and Alzheimer's disease are more common in women.

Hormonal Influence

- Fluctuations in estrogen (across menstrual cycles, postpartum, and menopause) strongly affect mood and cognition.
- Estrogen interacts with serotonin and dopamine systems; its drop postpartum or in perimenopause can trigger depressive episodes.
- In Alzheimer's, loss of estrogen may accelerate brain aging and amyloid accumulation.

Metabolic and Endocrine Disorders: Women have higher rates of thyroid disease and polycystic ovary syndrome (PCOS). Women with diabetes face higher cardiovascular risk. [52,53]

Hormonal Influence

- Estrogen helps regulate glucose metabolism and fat distribution.
- Its decline after menopause contributes to insulin resistance and central fat accumulation.
- Androgen excess in PCOS drives insulin resistance and inflammation.

Pain and Immune-Inflammatory Conditions: Conditions like fibromyalgia, chronic fatigue syndrome, irritable bowel syndrome, and migraine are more prevalent in women. In such conditions as these, women report greater pain sensitivity and lower thresholds. [54]

Hormonal Influence

- Estrogen modulates pain pathways in the brain and spinal cord, sometimes amplifying sensitivity.
- Pain intensity often fluctuates with the menstrual cycle, and some conditions improve during pregnancy.

Cancer: Beyond reproductive cancers, some cancers (like thyroid cancer) are more common in women.

Hormonal Influence

- Estrogen and progesterone can promote or inhibit tumor growth depending on the tissue.
- Immune and metabolic differences between sexes also shape cancer risk and treatment response.

Infectious Disease and Immunity: Women generally clear infections faster and mount stronger vaccine responses. However, they also experience more adverse vaccine reactions.

Hormonal Influence

- Estrogen enhances immune defense; testosterone is anti-inflammatory.
- These hormonal effects can alter susceptibility and outcomes for infections like influenza or COVID-19.

Reproductive health: For obvious reasons fertility treatment, pregnancy, contraception, menstrual health all affect women disproportionally and hormones are essential.

Status quo of the funding and innovation landscape

Despite clear scientific and societal need, the field of continuous hormone monitoring remains underfunded and fragmented:

- Individual researchers are driving much of the early innovation, often with limited institutional backing and constrained resources. Their work tends to be siloed and incremental rather than systemically supported or coordinated across disciplines.
- A few academic institutions are exploring biosensing technologies or hormonal analytics, but these programs are small in scale, and interdisciplinary collaboration between engineers, biologists, and clinicians is still rare.
- A handful of startups are emerging in this space, backed by venture capital. However,
    - These companies operate under *significant pressure to commercialize quickly,* which limits their ability to pursue the kind of deep, risky, and long-term R&D that the field truly requires.
    - Given the complexity of generating, making sense of and making the data matter to a user in the end, the chances of these startups delivering hormonal data at scale is minimal: It will take an ecosystem to make it all come together.
    - There is no public infrastructure for reference data validation and data sharing.
    - Some are building platform technologies, but to be relevant to women's health someone has to optimize for these use cases. That won't happen in the platform companies. The path for these emergent technologies to make a difference in women's health is unacceptably long.
    - The scientists who work on biosensor technologies often don't have women's health on top of their minds and women's health are complicated use cases, and female sex hormones are some of the hardest analytes to target so they are not on the roadmaps.
    - VCs are often deterred by regulatory hurdles, so use cases that have a diagnostic claim will need to be de-risked significantly before commercial funders will fund them. This is a big hurdle for use cases in women's health and makes fundraising hard.
- Public innovation grants are difficult to obtain and rarely large enough to fund the full development cycle from biosensor discovery through clinical validation and manufacturing. Existing funding frameworks such as grants from the European Investment Bank often favor incremental innovation or narrowly defined outcomes, because of their commercial focus, rather than ambitious cross-disciplinary breakthroughs.
- In the United States, the current political and funding climate further complicates research in women's health and gender-specific biology. Public institutions and NIH programs focused on these areas have faced shifting priorities, reducing opportunities for sustained, large-scale investment which impedes this innovation but is a competitive opportunity for Europe.
- To truly accelerate progress, this challenge should seek to attract the best global talent to not only strengthen the scientific outcomes but also ensure that the resulting technologies and datasets are globally relevant, inclusive, and equitable.

Opportunities

Basic and applied research on hormones and women's physiology

We're sitting on the largest untapped dataset in human health. At any given moment, every female body is generating continuous hormonal data that could revolutionize our understanding of metabolic, mental, cardiovascular, neurological, and longevity health.

Continuous monitoring will also enable unprecedented understanding of hormonal dynamics in *everyday life*. Instead of sparse data points, researchers could observe hourly hormone patterns and their relationship to sleep, stress, nutrition, physical activity and much more. Such data will advance fundamental research into menstrual physiology, perimenopausal transitions, and endocrine responses to environmental factors. This work could redefine normal ranges for hormonal variation and illuminate previously invisible physiological rhythms, creating a foundation for new diagnostics and therapeutic strategies.

Clinical outcomes

Continuous hormone monitoring has the potential to transform clinical care by enabling real-time insights into endocrine health. Instead of relying on sporadic blood tests or symptom-based assessments, continuous data streams could allow clinicians to track hormonal fluctuations across menstrual cycles, detect early signs of dysfunction (e.g., anovulation, PCOS, luteal insufficiency, perimenopausal transitions), and tailor interventions to individual physiology. In fertility care, this could improve the accuracy of ovulation detection, save patients endless trips to get their blood drawn at their doctors office and it could provide treatment personalization. In metabolic, oncological, cardiovascular and autoimmune disease and in mental health, hormone-driven changes could be linked to mood, energy, or glucose responses - allowing for earlier, more precise, and less invasive clinical management while saving the health care system billions.

Consumer-facing health tech

Translating continuous hormone monitoring into consumer products could empower individuals to understand and manage their hormonal health proactively. By combining sensor data with data processing and delivery to consumers via digital platforms, users could receive personalized insights, health trend analyses and time critical alerts for intervention. Integration with existing digital ecosystems (e.g., period trackers, fitness trackers, glucose monitors, or digital health apps) would make hormone data actionable in daily life - bringing medical-grade sensing to consumer tech.

- The market for wearables has seen a steady and rapid climb and is expected to reach 25,6% growth by 2030 from 2022.
- The global consumer health market, driven by women, has exploded into a more than €47 billion ecosystem, growing at 17% annually, which is nearly triple the rate of the broader health and wellness market.
- Women invest €100-300 monthly in performance optimization, from boutique fitness classes to wearable recovery tools to continuous glucose monitors.
- Women's health investment hit a record $3.9B USD in 2024, up 55% from the previous year.
- Companies like ŌURA reached $5.2B valuations by building sophisticated biometric monitoring that attracts a user base that's over 60% female.
- This consumer-driven transformation represents both market growth and a fundamental restructuring of how women approach their health (user-centric, data driven, preventative etc).
- 20% of women report having symptoms dismissed by healthcare providers and 72% say their hormonal concerns are minimized.

Population-wide relevance, societal and economic impact

A population-scale approach to hormone monitoring would fill a critical gap in public health data, enabling large-scale studies on hormonal variability across age, ethnicity, environment, and lifestyle. Insights could inform guidelines for reproductive health, cardiovascular risk, and menopause management, to just mention a few. The resulting datasets could support equitable research that includes women and gender-diverse populations, addressing long-standing data biases in health science.

By shifting from episodic (which most women don’t even have) to continuous monitoring, hormone sensors enable a proactive model of health. Early deviations from an individual’s baseline can signal stress, metabolic imbalance, or reproductive dysfunction long before clinical symptoms appear. Integrating hormone data into preventive care frameworks can support early interventions, lifestyle adjustments, and precision medicine. Over time, population-level hormone analytics could enable predictive models for chronic disease risk, alerting for high risk of preeclampsia or post natal depression for instance and closing a critical gap in women’s preventive healthcare.

This data would be instrumental in reducing absenteeism and early workforce exits. It is extremely costly that women leave their jobs early because of menopause symptoms, often misdiagnosed. For healthcare systems it would shorten diagnosis times and improve efficiency. For up to 50 % of public health care spending directly related to women’s health, this is an enormous potential to help bridge the mounting challenges that our systems have in coping with an aging population.

Hormone monitoring that is *continuous* doesn't just solve the hormone monitoring problem, it fundamentally reframes what women's health could be. We are graduating from reactive sick-care to proactive optimization; from managing problems to maximizing health. From understanding hormones as inconvenient to recognizing the endocrinological system as complex, foundational and data-rich.

Sensor Technology Development

This Challenge will advance continuous biosensors for real-time hormone detection, built with a privacy-first mindset, and establish a shared data infrastructure which will lay the groundwork for clinically meaningful, user-centered hormone monitoring.

Biosensor

- Multiplexed detection: Developing platforms capable of simultaneously detecting multiple hormones and biomarkers in parallel.
- Long-term biocompatibility and anti-fouling: Engineering strategies and sensor surfaces, coatings, and materials to minimize biofouling and immune responses, crucial for stable long-term monitoring.
- Advanced data analytics and AI integration: Implementing machine learning and predictive models that interpret complex, longitudinal hormone patterns, enhance calibration stability, and flag abnormal trends.
- User interface and accessibility: Developing the technology with having an eye at the end goal, to have intuitive interfaces for diverse users (clinical or consumer facing), ensuring clear communication of hormone trends, alerts, and personalized recommendations.
- Regulatory and clinical pathway alignment: Establishing robust protocols for regulatory compliance, clinical validation, and real-world usability testing.

Shared Reference Data Pool

- Improved calibration and benchmarking: A harmonized, anonymized data repository enables cross-device and cross-study calibration, standardizing performance benchmarks.
- Enhanced algorithm training: Pooled and machine readable data supports machine learning models that can adapt to population-level and individual variations, improving the accuracy and relevance of hormone trend analysis.
- Accelerated innovation: Access to broad, shared datasets lowers the barrier for research groups and developers, fosters transparency, and stimulates collaborative problem-solving and innovation.
- Faster regulatory acceptance: Agreed-upon reference datasets provide regulators with more robust evidence, streamlining the path toward device approval and clinical adoption.
- Privacy-by-design: When constructed with privacy principles, such as strong de-identification and user consent protocols, a shared data pool balances societal benefit with individual data protection.

  See more about the Data Pool further down.

Breakthrough Potential

The SPRIND Hormone Challenge has breakthrough potential across multiple dimensions:

Women’s health is societal infrastructure, and right now women’s life energy is leaking out of this infrastructure. Understanding hormonal health by having better and longitudinal data will **unlock better care across many areas of women's health**. The societal gains are tremendous which will impact women’s ability to participate more fully in society and **address the many big planetary issues we are facing**.

This Challenge will help establish **a deep and broad dataset on hormone values in women**, including fluctuations and concentrations in various body fluids, across life spans, across ethnicities and conditions. All of which is the **foundation for further scientific breakthroughs**: There is still much discovery to be made to understand how women's lives are impacted by hormonal shifts over the course of their lives.

Having technology that could provide this level of insight into the female body will form the foundation of many new innovations and businesses. It would unlock **a whole field of consumer health technology and services**, as well as **give many health professionals new and unmatched tools** at their hands to deliver radically better and novel care. The pharmaceutical industry could develop much more targeted and individualised hormonal products and protocols could be updated for many huge areas of medicine, leading to reduced costs, better outcomes and improved lives.

This data will also enable us to gain a monumental competitive **advantage in Europe in gender informed medicine**, which is one **important step towards precision medicine, and preventive care**. Which in turn is an urgent shift that the public health care systems have to make in the near future to handle the demographic and lifestyle driven sickness that will burden them.

The **intersection between consumer health and public health care systems** will increasingly be the data that a consumer/patient generates about their own body, and bring with them into their meeting with doctors. Enabling both consumers and healthcare providers with a relevant and rich dataset on hormones could, for many women, be one of their most central datasets for lifelong preventive and precise care.

The design of the Hormone Challenge itself

Requirements to join the Challenge

Participating teams will be assessed on their technology's readiness level. They must be at minimum level 2 at entry, and by the end of the Challenge they should have reached level 6 or greater:

Technology Readiness Levels:

Research activities (TRL1-4) aim to deliver basic technological components that work together in a low fidelity environment. Development activities/prototyping (TRL5-7) facilitate transition towards expected behavior of the future product in a realistic environment. Finally, innovation activities (TRL8-9) combine production configurations with desired fully-functional products. [55]

1. Define basic properties
2. Analytical study
3. **Proof of concept**
4. **Pre-prototype**
5. **Pre-prototype tested in lab**
6. **Prototype tested in relevant environment**
7. Approved prototype
8. Pre-serial manufacturing
9. Product on market

To ensure funding only goes to teams with timely progression of their work there are two milestones, see below for more detail.

Hormonal data will have many potential applications and uses and the Hormone Challenge will have a broad breath of target uses. However, it must be a use case relevant to women's health. Each team must develop their technology with one particular use case in mind, and it should be optimised for this purpose. That of course includes selecting

the most relevant hormones for that particular use case. They are free to add additional biomarkers, meta- or contextual data beyond the minimum required scope of the Challenge.

The teams will be assessed on the high potential and novelty of their technology, and the impact of their chosen use case. As a SPRIND Challenge teams must demonstrate a high return potential and willingness to take the risks that will get them there.

Teams will also be selected by the strength and knowledge of the team, both scientifically and start up experience. SPRIND will assess how mature their technology is and the viability of their business idea. Furthermore it will be a consideration to select teams so that they collectively cover several technological directions and sensor types.

Goal of the Challenge

The aim of the Challenge is to de-risk the development of this hard-to-do innovation, to the point where teams should be able to find further funding and take the final steps before the technology can make it through regulation (if needed) and to market.

It is a supporting, but crucial goal of the Challenge to also establish a Data Pool with hormonal reference data to enable the participating teams, and to support further research after the end of the Challenge.

Privacy
Women's bodies, health and data has throughout times been a political area of contention. Often used and misused for ideologies, as weapons of war, and as battle fields for ideological ideas, leaving little room for women’s own wishes and autonomy. This Challenge will build powerful technologies that could be misused and a foundational dataset to understand women’s physiology which could also be used for unethical purposes. Therefore it is of uttermost importance and a non-negotiable requirement that this technology is built with a privacy-first mindset and adhere to strict ethical principles and EU regulations for the data which is generated.

Biosensor
To build biosenor(s) that enables continuous, individualized assessment of female endocrine function.

Data Pool
To compile a shared, secure database with reference data on hormones. See below for more details. This will be undertaken by a contractor.

Each biosensor team must aim to fulfil the following technical and performance requirements at the end of the Challenge:

- **Analyte panel:**
  Quantify a minimum of 4 of these distinct hormones:
  - Estrogen (estradiol or estrone)
  - Progesterone
  - Luteinizing Hormone (LH)
  - Follicle-Stimulating Hormone (FSH)
  - Cortisol
  - Testosterone
  - Thyroid hormones (T3, T4 or TSH)
  - Anti-Müllerian hormone (AMH)

  Potential second-tier analytes (prolactin, DHEA, insulin, hCG etc) as optional metadata layers.
  Temperature, cycle data etc can be added as meta or contextual data.

- **Sensitivity and specificity:**
  Achieve analytical sensitivity within the physiological range of the target hormones and demonstrate specificity to the intended analytes.
- **Temporal resolution:**
  Acquire no fewer than five data points within a 24-hour period, ensuring sufficient temporal granularity to capture physiological fluctuations across circadian and ultradian cycles.
- **Continuous monitoring capability:**
  Employ a sensor platform capable of continuous measurement for a minimum of one week, with stable signal acquisition and minimal baseline drift.
- **Analytical reliability:**
  Demonstrate repeatability, accuracy, and precision within biologically relevant concentration ranges (e.g., 10^{-12}–10^{-6} mol/L, depending on the hormone), with statistical validation of measurement reproducibility.
- **Form factor and measurement principle:**
  The sensor may be wearable, implantable, or based on an alternative form factor, provided that the measurement is made directly on the target biomarker (hormone) in a relevant biological matrix (e.g., interstitial fluid, sweat, saliva, or blood), rather than inferred through a surrogate parameter or via proxy measures (e.g., temperature, heart rate, or other secondary parameters).
- **Data interoperability:**
  Enable secure and accurate data export or transmission in standard digital formats suitable for subsequent computational or clinical analysis.
- **Manufacturability:**
  Design a sensor system that is realistically manufacturable at scale, considering material cost, assembly feasibility, sustainability considerations and robustness under real-world use conditions.
- **Data contribution and sharing:**
  Each team must **contribute to the shared data pool**, as described in the subsequent section, ensuring that collected datasets are appropriately formatted, anonymized, and compliant with the data integration framework specified later in this document.
- **Data privacy and protection:**
  Each team must formulate an ethical framework for data privacy design of all aspects of the technology, including the business model. If teams wish to, they can formulate one shared document.

Data Pool

There are currently no shared established standards or reference datasets which are needed for this development. We don't have a place find the values (for instance) of what levels of progesterone to expect in a 20 year old woman's blood vs interstitial fluid, or know what level she might be at when she is 40 based on her levels as a teenager, or how they would differ if she had PCOS, or how a caucasian woman might differ from a person with black ancestors, or Southeast Asian roots. The lack of this kind of basic reference data set makes sensor development difficult. In fact every team has to try to build their own data base. This is ineffective and produces datasets that aren't trustworthy and comparable, leaving each of them small and incomplete. To succeed in building a comprehensive dataset, needed for all further innovation and understanding, we have to make an orchestrated effort.

The Hormone Challenge aims to establish a dataset combining continuous biosensor data (e.g., interstitial fluid, sweat, or saliva sensors) with validated laboratory hormone assays and standardized metadata. The goal is to create an interoperable benchmark resource to accelerate innovation, reproducibility, and clinical translation in hormone sensing and female health research.

Vision
The Shared Data Pool for Continuous Hormone Monitoring aims to create a lasting, ethical, open, and clinically valid reference database of hormone levels in women. The initiative will provide a foundation for developing accurate, trustworthy, and equitable continuous hormone biosensing technologies, enabling researchers and innovators to build models that deepen understanding of women's health across life stages and health conditions. This might very well be the cornerstone of a **foundation model of women's physiology** paving the way for the next leap in medicine -

digital twins, AI models and predictive, personalised and preventive medicine. It can also serve for a template for crucial data sharing and collaboration, a central function for accelerated innovation and research.

Purpose

The data pool will be an important and lasting contribution to women's health, and an open resource for all to benefit from. The Data Pool will be a unified, machine-readable, and regulated database serving as a public good. It will be accessible to qualified researchers, startups, and health innovators developing non-invasive hormone monitoring systems and beyond. The data pool will outlive the three-year challenge program and be maintained by an institution committed to women's biomedical data sovereignty and long-term model development, *while upholding the strictest ethical and privacy principles.*

Objectives

- Build a high-integrity database of clinically validated hormone reference data representing diverse populations
- Provide standardized protocols for sample collection, handling, and data readouts to ensure comparability across research teams.
- Enable secure and ethical data contribution and retrieval consistent with EU data protection and consent laws.
- Support the creation of a foundational biological model of women's hormone dynamics.
- Demonstrate governance principles for data collaboration between public research institutions and private innovators

Scope of the Data Pool

The dataset will aggregate hormone reference values across:

- Included hormones and endocrine markers:
    - Estrogen (estradiol, estrone)
    - Progesterone
    - Luteinizing Hormone (LH)
    - Follicle-Stimulating Hormone (FSH)
    - Cortisol
    - Testosterone
    - Thyroid hormones (T3, T4, TSH)
    - Anti-Müllerian hormone (AMH)
- Life stages: puberty, reproductive years, perimenopause, menopause, and postmenopause.
- Health states: healthy baseline, endocrine disorders, metabolic diseases, reproductive health conditions.
- Demographics: ethnicity, age, geography, body composition, and lifestyle factors.

Potential second-tier analytes (prolactin, DHEA, insulin, hCG) as optional metadata layers

The dataset will most likely not be complete by the end of the Challenge, and the scope is not for the Data Pool provider to generate data, or do sample collection. It will only contain the data which the sensor teams generate anyhow in their development of their sensors.

Data Collection and Validation Protocol

Each participating team will adhere to standardized protocols defining:

- Sampling procedures: biological matrices (serum, ISF, sweat, saliva) and time-of-day control.
- Sample handling: storage temperature, extraction method, and chain-of-custody documentation.
- Assay validation: calibration against clinical reference assays and reporting of analytical sensitivity, specificity, and repeatability.
- Metadata structure: demographic variables, device ID, assay type, timestamp, and environmental context.
- All data will be structured in machine-readable formats (e.g., JSON, CSV with metadata schemas) to support integration with AI model pipelines.

Participating teams will follow a contribution protocol defining what data formats are accepted and how data quality is verified.

Ethical framework
Data must be collected with fully informed consent and independently verified ethical approval.

- Contributors must adhere to the EU General Data Protection Regulation (GDPR), also if they are based outside the EU.
- Individual privacy will be maintained through de-identification, federated data storage, and controlled access mechanisms.
- Contributors will retain ownership of their primary data but grant usage rights for aggregated, anonymized analysis

Data Governance

- A central governance board—including academic, clinical, and citizen representatives—will oversee compliance, access, and updates during the three years the Challenge is running. Governance principles will ensure transparency, reproducibility, and accountability.
- The database will transition to a long-term hosting institution after the grant period, ideally within a European research infrastructure or digital health commons such as GO FAIR or Global Biodata Coalition (GBC). The selection of partners will be done in collaboration with SPRIND, and the organisation must be based in Europe. After that the chosen organisation will govern the data.
- The dataset and schema will be open-access, aligned with FAIR data principles (Findable, Accessible, Interoperable, and Reusable).
- Benefits of participation include shared access to aggregated insights, benchmarking tools, and inclusion in public validation studies

Foundation modeling of women's biology
A further ambition is to make sure that this data is integrated at as many relevant datasets as possible across many health areas, such as in genomics or brain mapping centres. This initiative lays the groundwork for future foundational models of women's biology. By linking hormone profiles with physiological, environmental, and behavioral variables, the data pool will support the development of AI-driven systems modeling hormonal dynamics, cycle irregularities, and disease states. Long-term, the goal is to integrate this into a universal female physiology model, fueling both clinical research and personalized health technologies. This will also open up a whole new area to use hormones in new indications, potentially saving billions and reducing adverse events.

"In the near future we will be shocked that we only took occasional snapshots of analytes in our bodies." Cantos, VC

Milestones

Biosensor teams milestones

The teams have to reach the milestones to continue receiving funding. The expectation is that of the 8 teams starting four will complete the Challenge, and that all 5 Rising Stars and 5 Global Frontrunners (see below for more details) will stay for the duration of the three years. However they do have to reapply each year, to ensure that they are actively working on biosensors for hormone monitoring.

As part of the application process the teams are asked for specification of their milestones under the headlines, the bullet points under each milestone are additional goals to reach:

Technology Readiness Levels

1. Define basic properties
2. Analytical study

This is where the teams are at the beginning of the Challenge

Milestone 1: 12 months:

3. **Proof of concept**
    - Ethical guidelines established

Milestone 2: 24 months:

4. **Pre-prototype**
    - Necessary certifications obtained for first-in-human feasibility demonstration
    - First-in-human feasibility demonstration
    - Clear user or market need identified
    - Manufacturing feasibility study

Last year of Challenge grant funding: 24-36 months:

5. **Prototype tested in relevant environment**
    - Data processing optimisation
    - Plan for further funding
    - Regulatory pathway (if needed) identified
    - Founding of company (if it isn't already done)

At the end of Challenge, this is how far the teams are:

- Regulatory approvals underway for the next step of clinical trials
- Initial conversations on manufacturing lines and subsequent multi-centric studies
- Manufacturing license obtained for commercial batch manufacturing
- Commercial launch of new product and post marketing studies and surveillance

Data Pool provider milestones

Milestone 1*: 6 months: Team by-in and user research, concept description incl ethical guidelines, strategy for long terms sustainability, sample data collection from teams

Milestone 2: 12 months: Standards configuration, technical requirements specification, team feedback

Milestone 3: 18 months: Data base design and development

Milestone 4: 24 months: Team data collection according to specifications

Milestone 5: 30 months: Enabling others to query the data, porting to other relevant data bases,

Timeline 6: 36 months: Partnership establishment and data transfer to partners

*All milestones will be refined in partnership with the Data Pool provider.

Application process

February 2026

The call opens and biosensor teams, Rising Stars and Global Forerunners are asked to apply with a 3-5 page concept description including:

- Use case
- Analytes that are targeted and any contextual or meta data
- Technology and readiness level assessment, or area of research (for Rising Stars and Global Forerunners)
- Funding history
- Team or personal bio

March 2026
Selected teams are invited to submit a full application including:

- Technical details, including opportunities and challenges
- Milestones
- Budget
- Existing reference datasets
- Considerations and learnings (if any) on manufacturing, regulatory path way, ethics, usability testing and business model

April 2026
Interview with selected teams, contract signatures
Contracting provider for the Data Pool

May 2026
Hormone Challenge kick off, in person
First financial transfers are made.

Inclusion of the industry

By creating a *knowledge ecosystem* that encourages interdisciplinary experimentation and collaboration - while the teams will also be competitors, the challenge directly targets the technical and systemic barriers that have slowed innovation in this field: Currently no ecosystem exists and the Hormone Challenge has a unique opportunity to create one, a world leading field of this central area of innovation. The outcome is not just a single product, but the foundation for an entirely new industry centered around real-time hormone sensing.

Our European culture of collaboration - and SPRIND's structure will be a welcomed change to teams who have worked isolated because the funding models do not incentivise an ecosystem to be formed, and simply no-one has created one. The VC model motivates secrecy, stealth mode and hype. Similarly in the academic world competing for public grants is done by publishing papers instead of bringing technology to market. This has not driven collaboration between scientists though *all* teams have expressed a desire to be part of such an ecosystem.

To get from a working biosensor for hormone monitoring to the data making a difference for a user or patient in the end, a whole complex web of things have to come together. It is like a giant jigsaw puzzle with many pieces, and the SPRIND hormone Challenge will be where all aspects can come together.

There will be a large industry group forming around the teams and participants. Each brings one of the pieces to the table: Expertise in manufacturing, in regulation, and pharma and diagnostics who can help teams understand how to find commercial partners. There will be the regulators, the patient voices, the interest organisations that shape policies that can block or pave the way for the new technologies to meet the real world. There will be media and the VCs because without them few startups are successful. There will be the consultants that will help the teams fill a critical expertise gap on their journeys, whether that is usability testing, sample collection, material science or something else. See examples of the industry group in references. The number of companies who have already expressed interest is long, and the final curation will happen in Q1 2026

Meeting in person twice per year

All teams, Rising Stars, Global Frontrunners, the mentors and jury members (see below) and relevant SPRIND team members, as well as the industry companies and organisations will all meet twice per year. These will be facilitated days to ensure maximum knowledge sharing, cross pollination and networking. These gatherings will partially be hosted at relevant industry partners, and at SPRIND (own or otherwise) locations.

Suitability of the Challenge

The Hormone Challenge fits well for the SPRIND Challenge format because it addresses a clear innovation bottleneck (*continuous* monitoring*)* with enormous real-world potential (hormonal data's impact across an array of applications). Continuous hormone monitoring has seen too little progress in the past 20 years, and is yet to be the transformative "next thing" for preventive healthcare, fertility, endocrinology, and many other areas.

The challenge format fosters multiple parallel solution pathways (different technologies) and ensures that each team develops a sustainable route beyond the project's funding horizon. This will be supported by having industry partners be included all along their innovation process, including the VCs.

The inclusion of a shared data pool ensures that the progress of one team contributes to the collective advancement of the field, accelerating innovation while maintaining diversity of approaches. This dataset will be available openly for the public and will support further innovation in biosensors. Ultimately, this challenge aims to establish the relational, technological, scientific, and commercial groundwork for a lasting ecosystem of innovation, one that continues to grow long after the SPRIND funding phase ends, driven by viable teams, open data, and an emerging industry dedicated to continuous hormone monitoring.

Broder network

During the scoping of this Challenge hundreds of people have shown their interest in this work, from which talent for the participating teams, business partners and many other things can spring. Part of the communication work of the Challenge will be to keep the interested broader network informed about the ongoing Challenge. This will bring attention to SPRIND and lay the ground for innovators interest in future Challenges, as well as give continuous hormone monitoring a large and engaged community to sustain it.

Special features of the Hormone Challenge

Rising Stars

The capacity to fund teams in the Challenge will be limited to the most promising teams who have already reached a certain level of development of their sensors. However there are a few exceptionally gifted and dedicated young researchers working in this field. The Challenge will provide micro funding for five of these rising biosensor stars, oriented towards continuous hormone monitoring.

They will be part of the program, but will not be held to the same milestones, nor will they receive the same level of funding. Each Rising Star is eligible for 3 years of 50k EUR funding. They have to reapply every year.

They will benefit from being part of the ecosystem, and the more established teams will be acquainted with a select pool of talent that might serve as a pipeline as they grow their teams. And the Rising Stars might also present new ideas, and different perspectives that can drive their innovation process. It is also possible that the Rising Stars found their own companies, or raise funding to develop them further and become great investment opportunities for the participating VCs.

The Rising Stars also bring networks to academia as they come relatively fresh out of research organisations.

Global Frontrunners

The ambition of the SPRIND Hormone Challenge is to form the global epi centre of innovation for biosensors for continuous hormone monitoring. By bringing the world's best talent together, informed and supported by the industry we will form a powerful ecosystem to accelerate and enable this breakthrough innovation much needed in women's health - and beyond!
However SPRIND cannot fund teams that are not based in Europe, and even with the US Twin challenge global talent still can't get funding. To fully gather the global top talent in this field we should not miss out on the global talent. Five Global Frontrunners, which are five highly selected extraordinary researchers, founders and scientists from geographies outside Europe and the US, will be invited to participate in the Challenge and be part of completing the ecosystem. They will not receive funding but be supported with flight tickets and accommodation for the in-person gatherings.

This will also ensure that Europe develops its innovation with a global market understanding, something which is important to ensure long term competitiveness.

Twin challenge in the US

Not surprisingly the innovation of biosensors is taking place not only in Europe, though Europe is well represented. Great teams are based in the US too, and the ambition is to raise € 20m in funding from a funder in the US to be able to include up to 3 additional US based teams into the Hormone Challenge. They would all be under the same program, and also physically be invited (and expected) to participate in the in-person gatherings in Europe twice per year.

Risk

The Hormone Challenge naturally faces a variety of risks spanning technical, financial, regulatory and operational domains. These risks can impact the achievement of program objectives and the ultimate societal impact of the funded research. This in turn could stain SPRINDs reputation.

Technical

- Sensor technologies may not reach the required sensitivity, selectivity, or stability, leading to failure in clinical or field deployments.
- Biosensor development is challenged by biofouling, calibration drift, limited reproducibility, and operational lifetime, especially for next-generation nanomaterials and wearable formats.
- Data interoperability and standardization may lag, hindering integration with health systems or research platforms.

Regulatory

- Grantees may encounter complex, evolving regulations for medical devices, data protection (e.g., GDPR), and clinical research, causing delays or increased costs.
- Intellectual property (IP) protections and legal structures might be insufficient, or complicated to translate out of academic institutions, limiting future commercialization or data sharing.

Financial

- High R&D costs and long timelines before commercialization may exhaust grant resources or deter follow-on investment.
- If the program does not produce investable results (i.e., TRL 5 or above), projects may not secure venture capital for further development.

Operational

- Poor project management or weak partnerships may result in missed milestones, inefficient spending, or project termination.
- Inadequate due diligence, performance monitoring, or risk assessment practices increase exposure to non-compliance and financial mismanagement.

Reputational

- Consumer push back if this sensitive data is not handled with care or the general public misunderstands the objectives and motivations for the development of hormone monitoring technology.
- High-profile failures, misuse of funds, or lack of responsible data practices can harm the funder's reputation and erode stakeholder trust.
- If gender equity and inclusivity goals are not rigorously implemented, the program risks perpetuating disparities it seeks to address.

Environmental and sustainability

- Use of advanced nanomaterials may raise concerns about long-term environmental impacts or sustainability in manufacturing and disposal.
- Insufficient post-grant planning might leave data or infrastructure unsupported, limiting long-term program legacy.

Mitigation strategies include phased funding, clear milestones, strong governance frameworks, mandatory compliance checks, expert advisory boards, and transparency throughout the program cycle., as well as proactive communication to the broader public.

These risks highlight the importance of diligent risk management and adaptive program design to fulfill both the scientific and societal aims of this ambitious SPRIND Challenge.

Execution of the Challenge

Programme Design

- Timeline: May 2026 - May 2029
    - Aspirational open call date 01.03.2026
    - Aspirational start date of the challenge 01.05.2026
- 36 months total
- 2 milestones
- Selection: up to 8 teams from Europe
- (US twin Challenge will add 3 teams, which will not financially burden the Hormone Challenge significantly since funding for these teams will be found in the US)
- Mentor fees (see list of potential mentors in references)
- Jury fees (see list of potential jury members in references)

Budget:

- **Biosensing teams grant funding**
    - At start: € 1,5m x 8 teams
    - After milestone 1: €2m/team x 6 teams
    - After milestone 2: €2,5m/team x 4 teams
        - Total €34m
- **Data Pool**
    - 1 Data Pool provider
    - Estimated budget €1,8m
    - Contingency 15 %: €270k
        - Total €2,07m
- **Rising Stars**
    - Rising star track €50k/year per person x 5 people (750k)
    - Fights and accommodation for a total of 7 gatherings (twice per year plus a kick off) (57k)
        - Total €807k

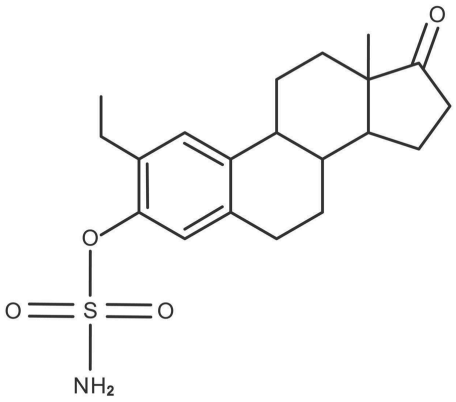
- **Global Frontrunners**
    - Global Frontrunners x 5 people, no funding
    - Fights and accommodation for a total of 7 gatherings (twice per year plus a kick off) (57k)
        - Total €57k
- **Mentor and Jury member fees**
        - Estimate <€100k
- SPRIND will contribute in the following areas, and associated costs will not come out of the Hormone Challenge budget:
    - Legal and contracting
    - Marketing & PR
    - Program manager salary
    - Technical program manager salary
    - Event organization and execution, (twice per year plus a kick off)
- Industry partners, no cost (other than event participation (food, facilitation and location, not travel and accommodation costs)

Total cost ≈€37m plus €3m kept for teams over performing and unexpected expenses.

Total budget €40m

The SPRIND Challenge is ready to become reality, potentially changing the lives of countless individuals, health care systems, national economies, gender roles, consumer tech and clinical practices. As well as increase our fundamental understanding of female physiology, and making sure our AIs do too.

Let's build these sensors and get data on those hormones!



Estrogen

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Thanks

Many deepfelt thanks to the many people who have supported the Hormone Challenge till date, by sharing their knowledge, network and reflections. A special thanks to Amy Fritzpatrick who has contributed with her deep understanding of the endocrine system.

Those are people I have had 30 min conversation or more with, or have met in person to discuss the SPRIND Hormone Challenge with:

They are potential **industry partners, jury members, mentors, potential participating teams, potential Rising Stars, potential Global Frontrunners** and others, relevant to the Hormone Challenge in various ways. They have *all* expressed their interest in participating in various ways:

Ciaran Seoige
Austrian Innovation agency
NHS Innovation Accelerator
Kat Zargychta, EU Commission
Serena Smeazzetto
Robin Vergouwen
Renee Wegrzyn, mentor
Carin Suveer
Michael Herman
Louise Barret
Anna Harley-Trochimczyk
Sukie Whitehall and Millie Ashton from CDP
Alex Shintaro Araki
Daisy Robinton
Jenica Pattersson
Calvin Robert and team, ARPA-H
Jan Jedryszek
Xiaoyi, Curv
Gianluca Barbruni, Molsesense
Kotryna,Misslaboratory / Lithuanian University of Health Sciences
Heath Hartle, Impli Health
Anna Impli
Kalaiarasi Sivaji
Brad miller, peach health
Wei Gao, Shiv, Persperity
Erik Young, Quicksilver Biosciences
Sue Hadjur, no name yet Alexandra
Tanu
Mattea
Noe Brasier
Julian Maar
Isam B, Istanbul Technical University
Kilian & Niels, Physikit
Gianluca
Alice Mitchell
Thomas Cortina, Eli
Amy Beckley, Poove
Fee Sandoval
Oova
Melis
POM Health

Hormony (singapore)
Karolina Loefqvist, Hormona
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Inito, Aayush Rai
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Milken Institute, Esther Krofah, Ayodola Anise
Annalisa Coraducci, Panacas
Elisa Rossi
Dijana Atanasorka, Sophie Feith
Rowan Gardner
Tina
Professor Eugene Oteng-Nti
Lynn Grey Meltzer
Frankie Shelton
Susan Craig, Pandia health
Fee Sandoval
Helene Guillaume, Femtech founder, Wild AI
Diana Torgersen, Organon
Natalia Belokoneva
Olav Carlsen
Aditi Basdeo, Only Biotechnology
Omer Inan
Pierre-Alexandre Fournier
Kate Rowley
tech4fem, rome
Sara, NWHH
Julia Persson, CPH Femtech, Nordic Women's Health Hub
FAB
Jeanette kaesler
Berlin Road Map members
Serena Leke, Community connector in women's health in CPH
Christiane Hagel, Femtech Germany
Marc Lemecke, UN (WHS announcement)
Marian Conelle and Gabrielle Laurenir
Florentine Kaesler
Xinyue Huang (Haylay) Femtech China, Hongkong Uni
Zhu, Beijing University
Soeren Mortensen
Erika Johnson-Froneberg
Farhan
Chad Steele
Kaare Pour, 21st Europe
James Gooch
Kerstin Papenfuss
Karsten Hoppe
Christopher Smith, ARPA-H
Lorana Gordillo and Sandra Dittrich, Becker Labs
Shenan Bao
Avni Argun
Ismail Butun
Sukie Whitehall and Millie Ashton from CDP
Jenny Duan, Abhivar Agrawal, Claire
Teresa De Sanctis
Irene Jia, Level Zero Health / Imperial College London
Katerina Komarkova
Saylee Jangam
Rebecca Donalds
Mario Sierra, Harmoniq Biosciences
Uros Kuzmanovic
Liza Levy, Veronika Bridgman, Unravel
Shalen Kumar
Andrea Gallen
Shamik J Parekh

Additionally *hundreds* of people have contacted me, interested to learn more. This is a sample:

Name	Organisation
A J Cohen	Ultrasound AI
Aleck Jones	Kindling Bio / UCL
Alexandra Sereda	Sensirion
Anchal Chandra	bioLOCKEY Healthworks
Andreas Mershin	RealNose Inc. / MIT
Annika Lundström	ReMinded
Aparna (Amy) Divaraniya, PhD	OOVA, Inc. / Icahn School of Medicine at Mount Sinai
Asha Easton	Innovate UK Immersive Tech Network
Atharv Naik	Imperial College London / Stanford University

Aude (Trividic) Clement	Regulatory Science & Strategy / Digital in Health
Aura Chaya Bitton	Essencia NY
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Claudette Lovencin	Sciences Po
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Emily Lu	Tia
Farhan Ali Baig	10xEngineers / University of Engineering and Technology, Lahore
Fariah Mahzabeen, Ph.D.	NSU / Stanford University / Google / SJSU
Fariah Mahzabeen, Ph.D.	NSU / Stanford University / Google / SJSU / Tackle
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Jacomina Tjallema	Harvard University
James Gooch	TTP plc
Julia Rozman	BARDA DRIVe / HHS / VCU
Kate Womersley	The University of Edinburgh
Kavya Sharman	Phase Capital / Vanderbilt University
Kush Punyani	SmiLe Venture Hub
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Lili Belyaeva	Mira / ESCP Business School
Madhuri Iyer	Medical Technologies / Digital Health / SaMD
Mandi Bateman	LubbDubb / Quantic School of Business and Technology
Maria Marinova, PhD	The Thalion Initiative
Marina Pavlovic Rivas	Eli Health / Mila
Mark Luhovy, MD	BioEnginuity
Mattia Carletti	University of Oxford
Meenakshi Pundir	Université Laval
Menno Van Der Eijk	Erasmus University Rotterdam
Miguel Amador	Complear / Instituto Superior Técnico
Mila Shabalina	Wealthing VC Club
Mohammad Hossein Ghanbari, Ph.D.	FAU Erlangen-Nürnberg
Noe Brasier	ETH Zurich
Pavlina Yanakieva	Future Unicorns Accelerator
PLUX Biosignals	PLUX Biosignals
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Priyanka Vaidya	Coyote Ventures / PriMi Health
Reesha Solanki, Ph.D.	Airfinity Ltd / Tiny Ventures
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Saranya Ramakrishnan	Paradigmatic / Harvard T.H. Chan School of Public Health
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Summer Mengelkoch	UCLA Stress Lab / Texas Christian University
Tarek Hamid	VivoSense
Vastpoint Fund (Female-led team)	Vastpoint I
Vicki Powell	Lume Health / University of Oxford
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Technology Readiness Levels

https://euraxess.ec.europa.eu/career-development/researchers/manual-scientific-entrepreneurship/major-steps/trl#hardwaretrls-collapsible-1

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