[BT] Startup Pitch

Fall 2023

Meet the Founders

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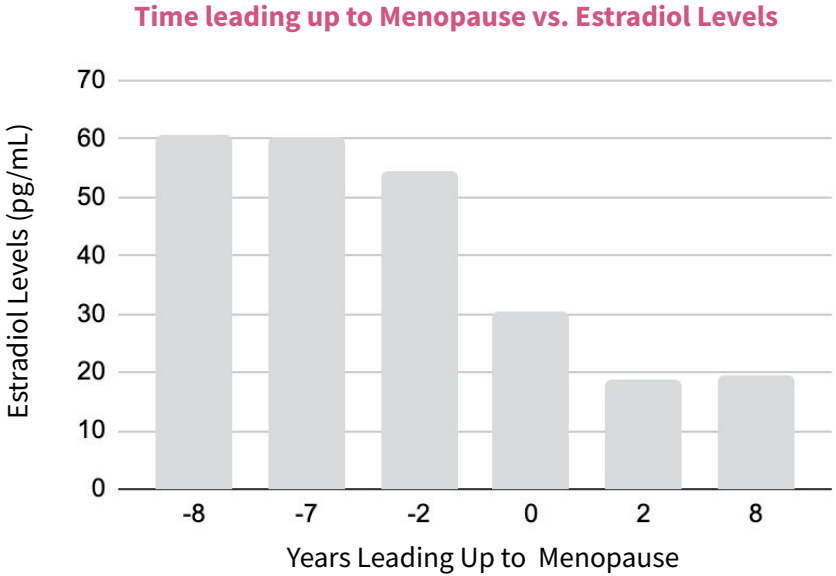
osteoX

Background



Osteoporosis is a **disease** that causes a loss in **bone density & mass** leading to an increased risk of fractures

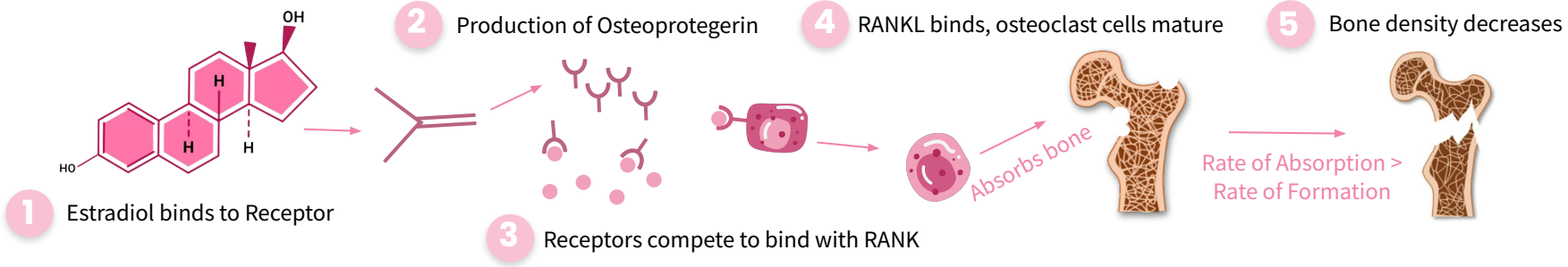
Osteoporosis is **a silent disease** that often result in a deadly osteoporatic fracture to undiagnosed patients

50% of women over the age of 50 will experience an osteoporotic fracture, a result of **untreated** osteoporosis

Estradiol levels drop in postmenopausal women, putting them at risk for osteoporosis without awareness

Postmenopausal women are at **high risk** for osteoporotic fracture, but often are unaware until **it is too late**

Estrogen and Osteoporosis



Estradiol & Osteoclast Mechanism

- Estradiol binds to a receptor creating **Osteoprotegerin**
- Osteoprotegerin competes with receptors on osteoclast precursor cell, inhibiting **RANKL** ligand binding
- Estradiol **decreases the level of osteoclasts** produced
- Osteoclasts resorb bone cells while osteoclasts create new ones, estradiol keeps the balance between the two

Menopause and Bone Density

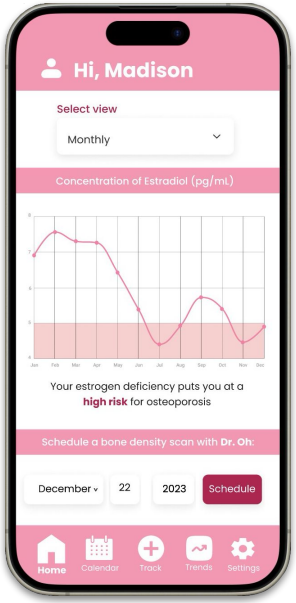
- During **menopause,** estradiol significantly decreases
- Decreased Estradiol levels increase osteoclast production, leading to **increased bone absorption**
- Cell absorption and formation of is thrown out of balance, leading to **loss of bone mass and density**
- Loss of bone mass leads to risk of **osteoporotic fracture**

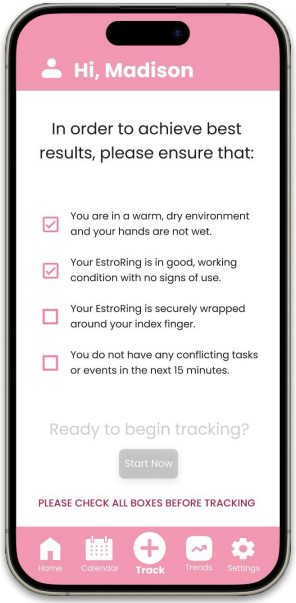
EstroRing

Single-use biowearable ring that monitors estrogen levels in sweat

Mechanism: Competitive Binding

1. In EstroRing, **MB-ssDNA** (molecules that are similar to estrogen) are partially attached to **aptamers** (estrogen-specific single-stranded DNA)
2. When **estrogen** is present, it competes for the binding site on the **aptamer**, disrupting the connection between **MB-ssDNA and aptamers**
3. Displacement of **MB-ssDNA** is captured by a **sensor**, releasing a signal intensity that corresponds to number of **displaced MB-ssDNA molecules**
4. Signal information is transmitted to an **app** that interprets and displays the **estradiol concentration**, along with an **osteoporotic analysis**





Market Analysis

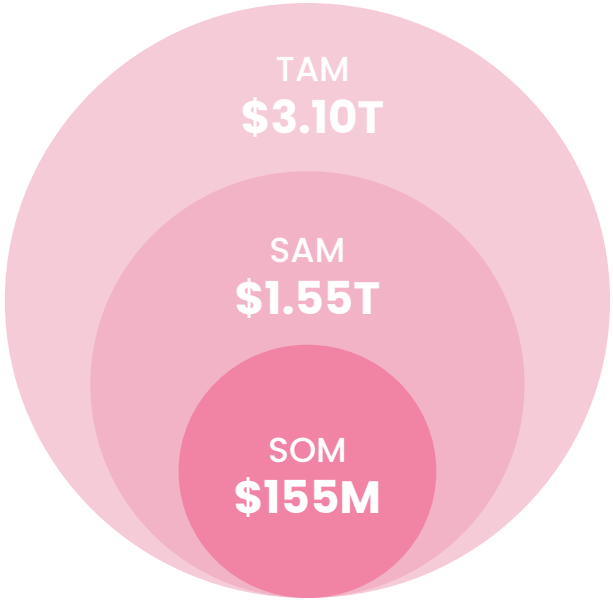
Key Players: Estrogen Trackers

	Measures	Location	Unit price	Min (pg/ml)
inito	E3	**Home**	**$3.20**	20
verisana	**E2**	Lab	$69.95	19
osteoX	**E2**	**Home**	**$4.00***	**4**

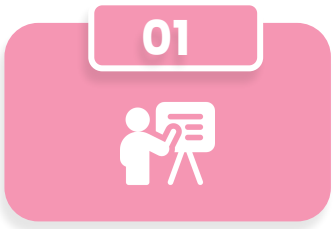
Key Players: Osteoporosis Risk Detection

	Measures	Location	Unit price	Invasive
vitall	Vit D	Lab	$106.80	Y
BodySpec	BMD	Lab	$1300	**N**
osteoX	**E2**	**Home**	**$4.00***	**N**

TAM-SAM-SOM Analysis



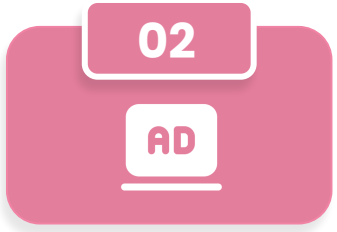
Marketing Strategy



Trade Show Demonstrations

Introduce **UI and app** feature offerings through **live demonstrations**

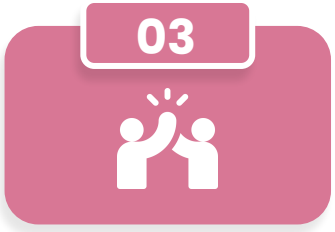
Encourage potential users to try the product with an **Estrogen tracking demo**



Social Media Advertisements

Target **women >35 years** old through most used Social media apps

Focus on **Facebook & Instagram** — largest user base of women > 35 years



Connections in FemTech

Partner with companies that have aligned goals including **Flo and Clue**

Leverage establishing relationships to reach and **target market segment**

Message Beyond the Product

Maintain consistent **motif** throughout ads promoting **women's health**

Tie product advertising with **campaigns** for Osteoporosis awareness

Risks and Mitigations

Risk	Mitigation
Frequency of tracking is **entirely up to user** and they may not maintain **consistent use** that is most effective	Have users **stay in contact** and work with their healthcare provider to determine the **best frequency of use**
Prevention and measuring is **expensive** as measuring is daily and rings are single use as opposed to reuse	Partner with **insurance companies** to cover for ring costs which is **significantly less** than bi-annual DEXA scans
Collecting and storing sensitive data creates the risk of **data breaches** that could **leak user information**	Ensure that data is **securely stored and encrypted** within the app and have strict **guidelines** regarding user privacy

Agrify

Background

44.36% of the United States is farmland, with the average land size consisting of → **90%** of U.S. food

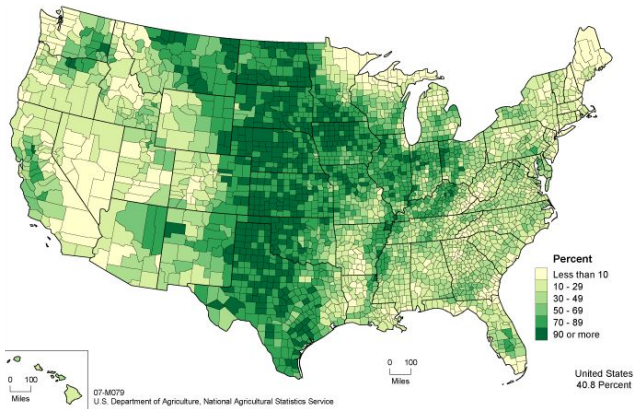
Climate change and **diseases** lead to significant yield losses, with fungal organisms accounting for **85%** of plant diseases

Agricultural soil testing is necessary every **3 to 5 years** for **disease and overall nutrient testing** in various crop sectors

Soil units require **extensive laboratory examinations** and can be very costly — around $14 for 15-20 acres

Around **$365 per farm** for complete soil testing for **over 2 million** farms throughout the US

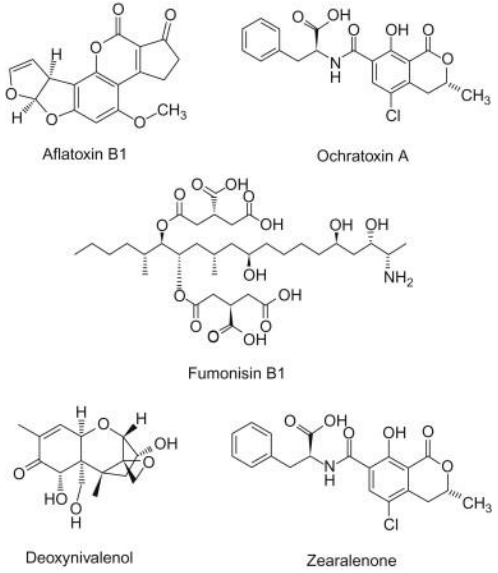
US Farmland Percentage



Soil testing is crucial for disease detection but are often **time consuming** and **expensive** for large farmlands

EcoSense

Genetically engineered plants for continuous crop disease warnings



Detection of Mycotoxins

1. Carbon nanotubes (CNTS) can be functionalized with **mycotoxins** which are naturally produced by fungi and are related to crop disease
2. These nanosensors are then embedded into the leaf of our plant where they emit a **fluorescent signal** when mycotoxins are present
3. Within **10 minutes** of a mycotoxin entering the root system the plant can draw up the molecule where they encounter the detector

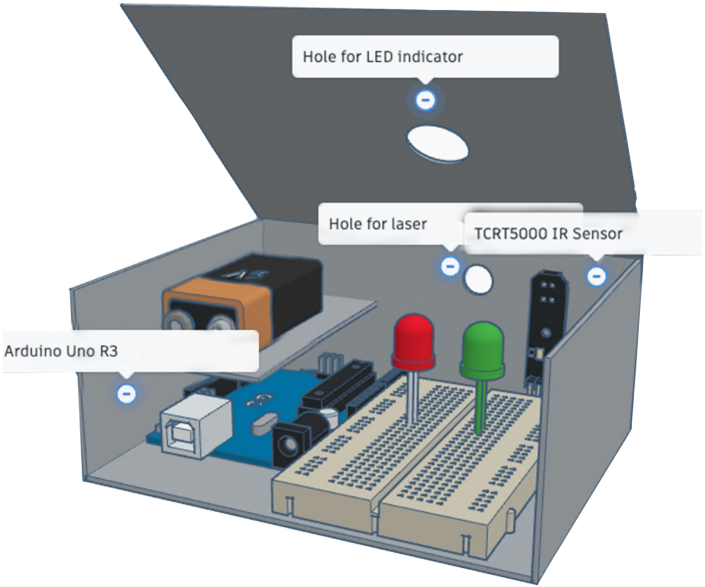
Due to the versatility of this technique **any living plant** can be embedded with these nanosensors

EcoSense Detector

Hand-held infrared signal and sensor to indicate mycotoxin presence

Detection of Fluorescent Signal

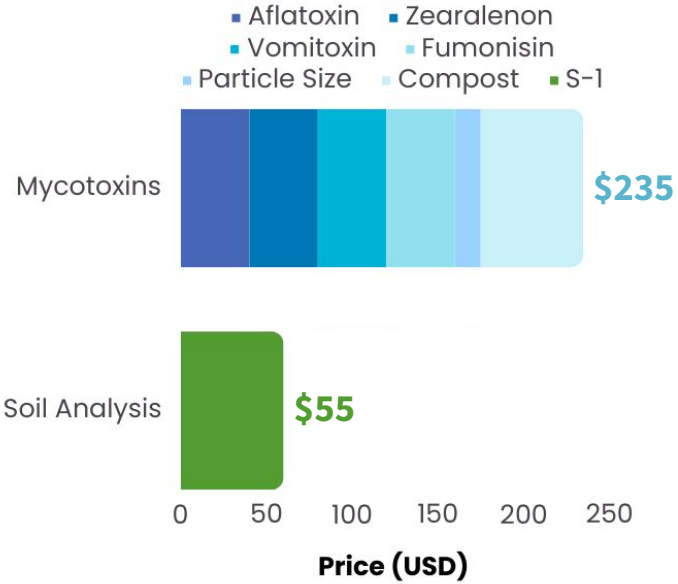
1. Our complimentary device uses a laser to excite the nanosensor fluorescence, prompting the nanotubes to emit a near-infrared signal
2. The built in infrared sensor can detect whether an infrared signal is present or not and convey this data to an Arduino.
3. The device then shows a green light if no mycotoxins are present (no infrared signal) and a red light if mycotoxins are detected (infrared signal)



This **9 volt** powered device is simple for users and clearly indicates the presence of crop disease

Market Analysis

Soil Testing Competitor Facilities



USA Agriculture Growth

An annual growth rate of **5.66%** is expected for **export value** (CAGR 2023-2028)

Production value in the agriculture market is projected to reach **$298.30 billion** in 2023 and **$342.70 billion** in 2028

Marketing Strategy

Agriculture & Farming Shows

Demonstrate **ease of use** and advanced modern technology

Opportunity to **network** with industry leaders and generate a **larger user base**

Directly promotes brand to all farmers

Major Retail Stores

Lowes, Home Depot, and local supply business can host EcoSense

Widely available for **commercial** farmers and also **small scale** farming/lawn care

Agricultural Organizations

Partnering with USDA's Farm Service Agency to allow the use of EcoSense to farmers at a **discounted** rate

Government agency provides a sense of **credibility** to the product

Location-Based Social Media

46% of U.S. farmers use Facebook for both **personal** and **professional** business reasons

Facebook ad recommendation algorithm allows a **streamlined** approach for farmers to view EcoSense

Risks and Mitigations

Risk	Mitigation
False positive results may arise due to the CNTs incorrectly detecting mycotoxins or detecting different biomolecules	CNTS have a high surface area and reactivity so they can be covalently or noncovalently **functionalized** specifically to mycotoxins.
If CNTs-modified plants are newly introduced to the ecosystem, there is a risk of them becoming **invasive**	There is **variability** between the plants that can be engineered with CNTs, allowing **safe usage** for all lands and crop fields
Farmers **may be hesitant** to adopt genetically engineered plants due to concerns about efficacy and long term effects	Conduct thorough **field trials** to showcase the performance, benefits, and safety of genetically modified plants

Q&A Session

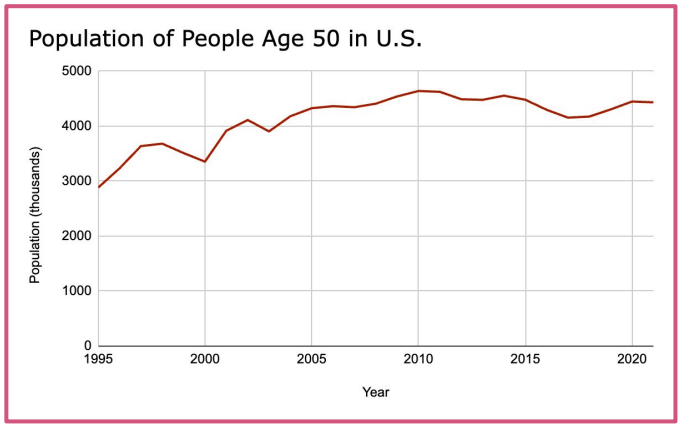
Appendix - Population with Osteoporosis

Why osteoporosis is a problem:
"Osteoporosis is a silent disease with increasing prevalence due to the global ageing population. Decreased bone strength and bone quality is the hallmark of osteoporosis which leads to an increased risk of fragility fractures in elderly. **It has been estimated that approximately ~50% of women will suffer during their lifetime from an osteoporotic fracture.** This must be considered as a major health concern, as it has previously been established that **fragility fracture has been associated with decreased quality of life due to increased disability, more frequent hospital admission and most importantly, osteoporotic fractures have been related to an augmented mortality risk.** Anti-osteoporotic drugs are available for improving bone quality. Although there is access to these therapeutic options, there remain multiple unmet needs in the field of osteoporosis and fracture care, for example, **the primary prevention of osteoporosis in young individuals (to reach a high peak bone mass), the optimization of the use of imaging techniques [dual-energy X-ray absorptiometry (DXA), vertebral fracture assessment (VFA) and new techniques measuring bone quality]**, the use of nonmedical treatment options and surgical techniques of fracture healing."

Why education and awareness is important:
"**The first step is to create awareness of the burden of fracture risk in later life**. The next step will be primary prevention of osteoporosis by **education programmes for adolescents and young adults**, preferably with support of their parents. Implementation of programmes around primary prevention are usually difficult, but certainly worthwhile, given the threat of an enormous increase in the number of fractures in the coming years"

Appendix - Postmenopausal Population Growth

Growing world population of postmenopausal women (WHO):
"**The global population of postmenopausal women is growing**. In 2021, women aged 50 and over accounted for 26% of all women and girls globally. This was up from 22% 10 years earlier.[i] Additionally, **women are living longer**. Globally, a woman aged 60 years in 2019 could expect to live on average another 21 years.[ii]"



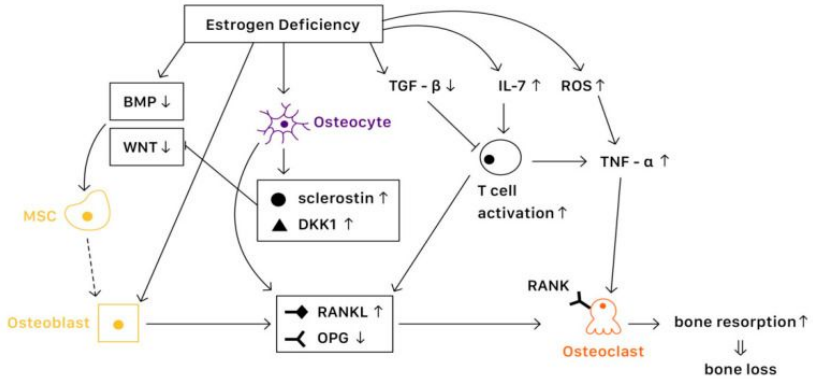
KEY ASSUMPTION: If the population of men is growing in the U.S./North American market, then the population of women is also increasing.

Appendix

Appendix - Biological Mechanism (Estrogen)

In Osteoblasts:
"Several pathways are essential to the **activation of osteoblast and bone formation**, such as canonical WNT, bone morphogenetic protein (BMP), and TGFβ signaling pathway. Almeida et al. demonstrated that ER complex in osteoblast progenitors activated Wnt/β-catenin signaling, thereby increasing osteogenesis [22]. **Estrogen is also known to upregulate BMP signaling, which promotes mesenchymal stem cell differentiation from pre-osteoblasts to osteoblasts**, rather than adipocytes. Moreover, estrogens stimulate the production of IGF1 and TGFβ by osteoblasts, **enhancing bone formation**."

In Osteoclasts:
"Various factors are involved in the differentiation and activation of osteoclasts. **One key pathway is the NF-κB signaling**. The receptor activator of NF-κB (RANK) is expressed on osteoclasts, which is activated when binding with the receptor activator of NF-κB ligand (RANKL) and suppressed when binding with osteoprotegerin (OPG) [23]. **Estrogen regulates RANKL and OPG, promoting the expression of OPG and thereby reducing bone resorption**. Moreover, **estrogen inhibits osteoclast differentiation and advocates osteoclast apoptosis** by increasing the production of TGFβ [19]. **In the status of estrogen deficiency, RANKL expression is induced, which leads to osteoclastogenesis."**



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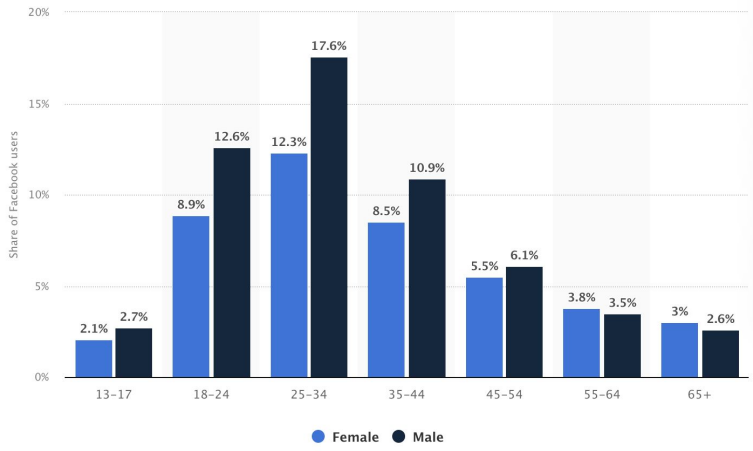
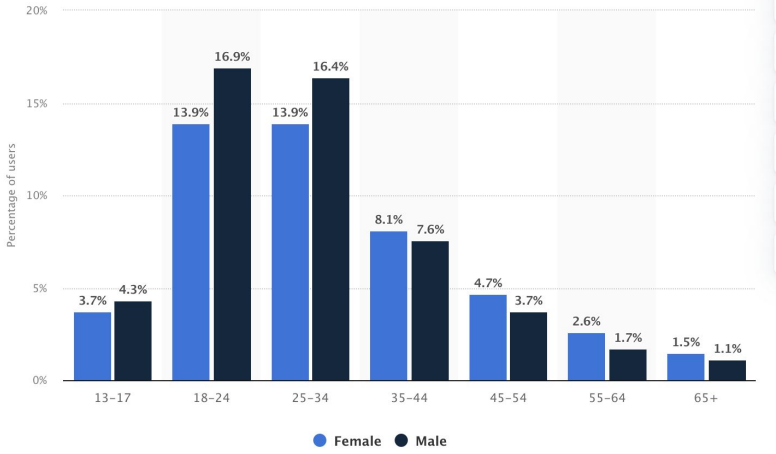
Appendix - App User Statistics

Facebook distribution by age and gender



Instagram distribution by age and gender



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Appendix - Estradiol Levels and Menopause

Estradiol Levels:

Graphs explanation:

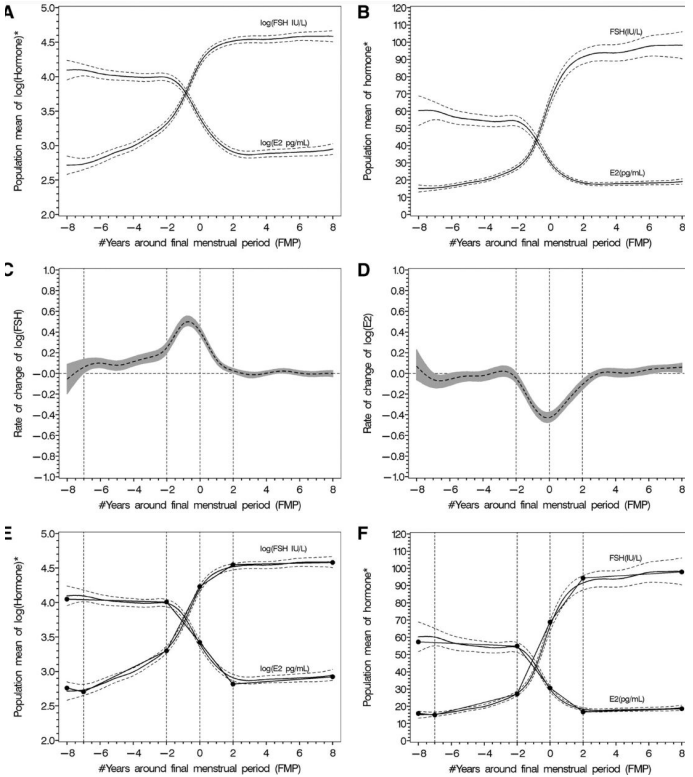
"Adjusted population means (95% CI) for natural logarithm-transformed FSH and E2 (A), back-transformed FSH and E2 (B), rate of change for natural logarithm-transformed FSH (C) and E2 (D), and segmented mean profiles of log(FSH) and log(E2) (E), and FSH and E2 (F) across the FMP (total n = 1215). *, The y-axis is unitless for A, B, E, and F. The units of hormone are marked in the corresponding curves."

"The strengths of this **report include a large sample of diverse women more representative of community-based population groups rather than a selected clinical convenience sample."**

Note on Estradiol variation across races, ethnicities

FSH and E2 by race/ethnicity

"the mean acceleration in serum FSH levels commenced from 6.72–6.38 yr before the FMP in nonobese women of the four racial/ethnic groups, whereas the mean acceleration occurred at 5.04 and 4.30 yr before the FMP in the obese The decline in serum E2 occurred at 2.01 and 1.92 yr before the FMP in the African-American and Caucasian women, respectively, but at 1.33 and 1.56 yr before the FMP in Chinese and Japanese women, respectively. Mean serum E2 stabilized 1.95–2.03 yr after the FMP in all race/ethnic groups except the Japanese women in whom it stabilized at 1.66 yr."



Appendix

Appendix – FLO and Clue User Base and Mission

Flo and Clue at both apps with a large user base of people with periods which can serve as a funnel for our product
From Flo's Website: "Over **300 million people** around the globe use Flo as their ovulation and period tracker app, fertility calendar, and pregnancy assistant"
Mission statement: **"Building a better future for female health"**
"We're on a mission to put the **power back in your hands. F**lo helps you harness the power of **your body signals** so you can stay well and live better. Our global community of women, girls and people who menstruate is growing every day."

Clue:
"**10 million people in over 190 countries** rely on our app"
"One of Clue's **co-founders, Ida Tin, c**oined the term femtech in 2016 to define the group of technologies that are designed to support and **advance women's healthcare."**
" The technologies within this category include fertility solutions, period and fertility tracking apps, reproductive system health care, women's sexual wellness products, pregnancy and nursing care, period care goods, at-home fertility monitoring devices and general healthcare."
"By defining the group of products that are associated with female health, we are creating an entirely new category of technology. Grouping these technologies paves the way for femtech conferences and VC's to invest in femtech and create even more products within this segment that are important and needed in the world."
"Clue helps everyone who menstruates to understand their bodies—and **to be empowered by that knowledge.** Our vision is to enable women and people with cycles to **live in tune with their biology, not in spite of it."**

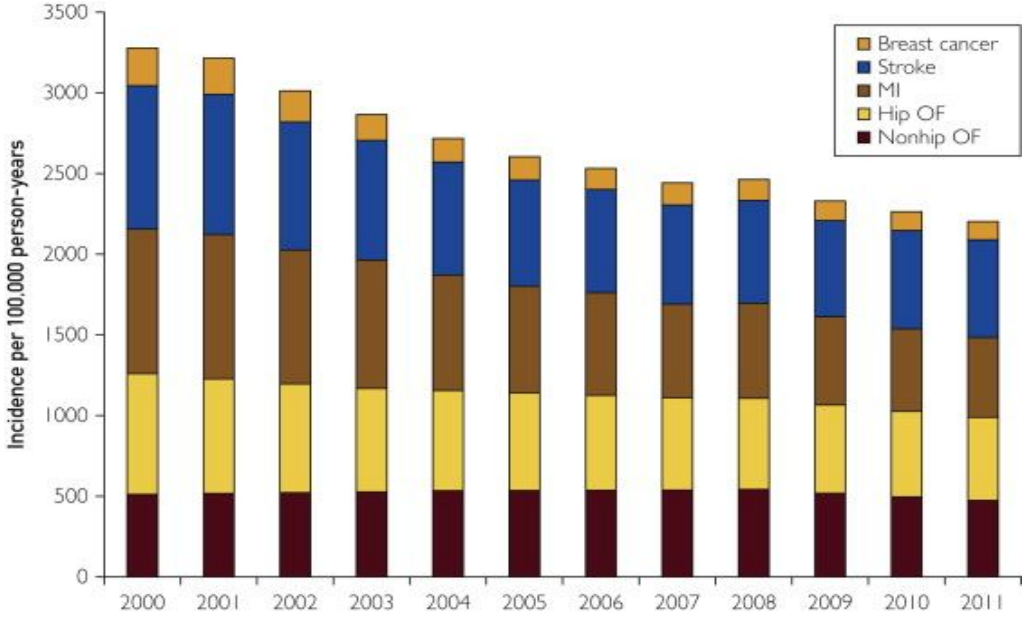
Appendix - Data Encryption for Health Apps

Model Data Encryption based on established apps like Flo

1. **Servers and networking:** We use AWS to host all production environments. AWS is designed to help us build a secure, high-performing, resilient, and efficient infrastructure for our app. AWS data centers are secure by design and SOC 1, SOC 2, and SOC 3 certified. For added security, we also use additional AWS services such as a virtual private cloud (VPC) and AWS multi-account infrastructure. To secure communication over the network, we use HTTPS protocol encrypted using Transport Layer Security.
2. **Encryption:** We use AWS Key Management Service to create and manage keys and control the use of encryption across a wide range of AWS services and our app.
3. **Storage:** Flo stores all data such as metadata, activity, original files, and customer's data in different places.
4. **System monitoring and alerting:** At Flo, the production application and underlying infrastructure components are monitored 24/7/365 days a year, by dedicated monitoring systems. Critical alerts generated by these systems are sent to 24/7/365 on-call service owners and escalated appropriately to operations management.
5. **Vulnerability (penetration) testing**: Flo performs regular penetration tests conducted by industry-leading cybersecurity red teaming companies for network configuration, infrastructure, and application layers. This vulnerability testing includes the use of commonly known web application security toolkits and scanners to identify application vulnerabilities before they are released into production.
6. **Traffic management:** Cloudflare security suite allows Flo app to automatically block malicious traffic and ensure app reliability. No matter where our users are located — Flo works smoothly on their smartphones thanks to smart traffic routing, and content in the app is now delivered to the user from the closest Cloudflare server.
7. **Incident response and data breach notification:** Flo established a process describing the actions to be taken once Flo Health becomes aware of any type of event categorized as an Incident including a Personal Data Breach, according to international guidelines and regulation act.

Appendix - Burden of Illness for Osteoporosis

Incidences of Osteoporotic Fractures:



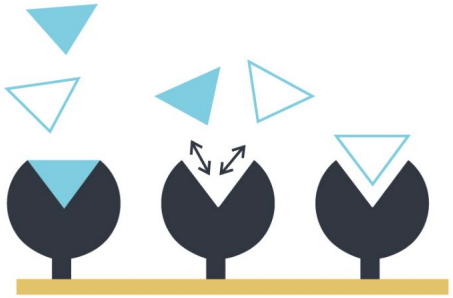
Cost Burden of Osteoporotic Fractures:

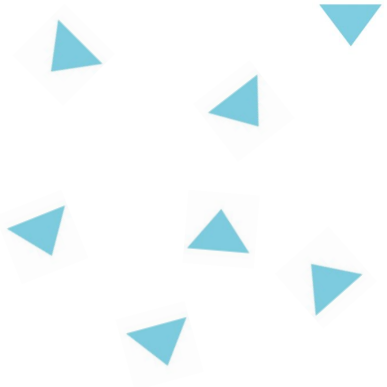
"For example, although our analysis found the mean total inpatient cost of hip fracture per admission to be $15,845, other studies have shown the mean health care costs (including inpatient, outpatient, and pharmacy) associated with fracture during the first year to be between $25,332 and $38,662.28. Concurrently, the **annual total fracture costs across all fracture types for US women are projected to be more than 18 billion in 2025.** These numbers are significant and further highlight the need for increased focus on prevention of fractures and their associated resource utilization."

Appendix

Appendix - EstroRing Mechanism

Competitive Binding Assay





= **Aptamer**

= **MB-ssDNA**

= **Estrogen**

The aptamer has a higher affinity for estradiol than MB-ssDNA, causing MB-ssDNA molecules to be displaced in the presence of estradiol.

Appendix - DEXA Scan + Frequency

Average out of pocket cost of a DEXA scan: $160 - $1319 (with insurance) → scanned every 2 years during risk years
“This analysis was limited to women ≥67 years, so different results might be obtained from analyses that included younger postmenopausal women. In addition, 99% of the participants were white. Because the prevalence of osteoporosis of the hip among white women is equal to or slightly higher than it is among nonwhite women, it is likely that the suggested intervals are reasonable estimates for women of all races

FAST TRACT
The suggested screening intervals are reasonable estimates for women of all races.

In women >80 years, the interval between baseline testing and the development of osteoporosis was shorter than that of their younger counterparts. Thus, it might be reasonable to reduce rescreening intervals by a third for women in their 80s

Appendix - TAM SAM SOM Analysis: TAM

Total Addressable Market: $3.10T

- **2.12B** - We assume that the population of women currently undergoing perimenopause (time period between ovulation and menopause where symptoms of menopause have not yet occurred) is equal to the U.S. population of women age 50 in 2022. (Statista)

- **$4** - We predict that each unit of single-use EstroRing can be priced at $4. The average test strip for glucose monitoring costs $0.22 (Healthline), but costs $0.05 (Wilson et al.) to produce, which leads to a gross profit margin of 77.27%. Since each estradiol monitor unit costs $2 to produce (Dai, Chiun-Liu), selling at a price of $8.80 will achieve a gross profit margin of 77.27%. Since EstroRing is not as established as its competitors in glucose monitoring industry, we believe a starting gross profit margin of 50% is reasonable, taking into account fixed costs.

- **365 days** - For perimenopausal women whose estradiol levels fluctuate every day, and to a greater extent than any other life stage (Gordon et al.), it is important to collect data about estradiol levels daily, in order to develop a more in-depth analysis of trends.

- [Number of women in perimenopause] x [Revenue per day] x [Days per year] = Total Addressable Market
  2,120,000,000 x 4 x 365 = 3,095,200,000 = **3.095T**

Appendix - TAM SAM SOM Analysis: SAM

Serviceable Addressable Market: $1.55T

- **3.10T**- Total Addressable Market
- **50%** - Since approximately 46.8% of women (Siris et al.) will experience an osteoporotic fracture within their lifetime, we predict that osteoX can reasonable target around half of the market.
- [Total Addressable Market] x [Percent available to target] = Serviceable Addressable Market
  3,095,200,000,000 x 0.5 = 1,547,600,000,000= **1.55T**

Appendix - TAM SAM SOM Analysis: SOM

Serviceable Obtainable Market: $155M

- **1.55T**- Serviceable Addressable Market
- **0.01%** - Currently, risk awareness for osteoporosis is low and women are not motivated to address osteoporosis through preventative measures. Older women are also less likely to use mobile device apps, so we believe that 0.01% obtainable market is a reasonable projection.
- [Serviceable Addressable Market] x [Percent obtainable] = Serviceable Obtainable Market
  1,547,600,000,000 x 0.001 = 154,760,000 = **155M**

Appendix - Fungal Plant Diseases

Most plant diseases – **around 85%** – are **caused by fungal or fungal-like organisms**. However, other serious diseases of food and feed crops are caused by viral and bacterial organisms. Certain nematodes also cause plant disease. Some plant diseases are classified as “abiotic,” or diseases that are non-infectious and include damage from air pollution, nutritional deficiencies or toxicities, and grow under less than optimal conditions. For now, we’ll look at diseases caused by the three main pathogenic microbes: fungus, bacteria and virus. If plant disease is suspected, careful attention to plant appearance can give a good clue regarding the type of pathogen involved.

Appendix - Crop Disease in the US

Crop diseases can have a large impact on agricultural productivity. Invasive plant pathogens, including fungi, cause an estimated $21 billion in crop losses each year in the United States (Rossman, 2009). Verticillium dahliae is a soil borne fungus that is introduced to the soil via infested spinach seeds and that causes subsequent lettuce crops to be acted with Verticillium wilt (V. wilt). Lettuce is an important crop in California, and the majority of the lettuce production in the United States occurs in California. The value of California's lettuce crop was $1.7 billion in 2013 (National Agricultural Statistics Service, 2015).

Appendix - Mycotoxin and Soil Relation

Soil phytopathogenic fungi are principally associated with crop diseases; however, the effects of fungal infection may extend beyond the field to human and animal consumers putting their health at risk. Mycotoxigenic fungi can produce secondary metabolites known as **mycotoxins**, which are considered to be **toxic when present in human food and animal feed**. Mycotoxins are characterized as odourless and tasteless compounds, thus their identification in food is difficult. Furthermore, mycotoxins are heat resistant and tolerate a wide range of pH, making them hard to breakdown. In this review we follow the fates of mycotoxins from the ecology of their producers in the soil to pre-harvest occurrence in host plants, postharvest in storage and their effect on human well-being, focusing on aflatoxin as a case study.

Appendix - MIT Bomb-Detecting Spinach

In the new study, the researchers **embedded sensors for nitroaromatic compounds** into the leaves of spinach plants. Using a technique called **vascular infusion**, which involves **applying a solution of nanoparticles to the underside of the leaf,** they placed the sensors into a leaf layer known as the mesophyll, which is where most photosynthesis takes place.

They also embedded **carbon nanotubes** that emit a **constant fluorescent signal** that serves as a reference. This allows the researchers to compare the two fluorescent signals, making it easier to determine if the explosive sensor has detected anything. If there are any explosive molecules in the groundwater, it takes about 10 minutes for the plant to draw them up into the leaves, where they encounter the detector.

To read the signal, the researchers shine a laser onto the leaf, prompting the nanotubes in the leaf to emit near-infrared fluorescent light. This can be detected with a small infrared camera connected to a Raspberry Pi, a $35 credit-card-sized computer similar to the computer inside a smartphone. The signal could also be detected with a smartphone by removing the infrared filter that most camera phones have, the researchers say.

In the 2014 plant nanobionics study, Strano's lab worked with a common laboratory plant known as Arabidopsis thaliana. However, the researchers wanted to use common spinach plants for the latest study, to demonstrate the versatility of this technique. "You can apply these techniques with any living plant," Strano says.

So far, the researchers have also engineered spinach plants that can detect dopamine, which influences plant root growth, and they are now working on additional sensors, including some that track the chemicals plants use to convey information within their own tissues.

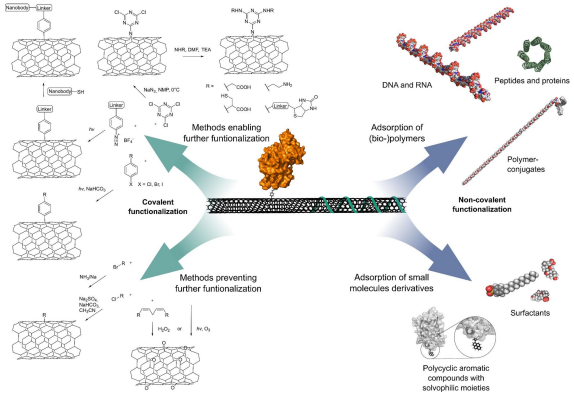
Appendix

Appendix - Biosensing with Carbon Nanosensors

Both covalent or noncovalent functionalization approaches play an essential role in tailoring molecular interactions close to the SWCNT surface. By using such concepts, SWCNT-based biosensors for many highly important biomolecules have been developed.

More recently, this allowed chemical signaling to be mapped in a completely new manner, for example, release patterns of neurotransmitters from cells with high spatial and temporal resolution, which provides unique insights into fundamental biological questions. Moreover, recent advances have been made in remote in vivo biosensing applications by the multimodal optical detection of several analytes. By combining multiple nanosensor elements and integrating them into functional arrays, analytes can be identified and distinguished on the basis of their characteristic image signatures. Such a combination of optical nanosensors could pave the way for the next generation of fast and reliable in situ diagnostics. In addition, these approaches provide completely new opportunities for standoff process controlling, for example, fabrication of antibodies or monitoring in food and agriculture industries (smart plant sensors).

The extended π-system makes SWCNTs hydrophobic and consequently they easily aggregate in solvents like water. Therefore, an important step in the preparation of SWCNT-based sensors is their functionalization to isolate, solubilize and colloidally stabilize single SWCNTs. The functionalization also serves the purpose to a) interact (specifically) with other molecules and b) translate this interaction into a fluorescence change.



Appendix

Appendix - Functionalization of Mycotoxin

The MWCNTs have emerged as a promising carbon nanomaterial especially in the fabrication of biosensors. Specifically, the carboxylic acid-functionalized MWCNTs (cMWCNTs) are extensively used as they enable rapid and direct electron transfer in electrochemically active materials. However, the aggregation problem in aqueous medium limits their application. To overcome this issue the fabrication of nanocomposites of cMWCNTs with a polymer such as chitosan (CH) and PEI or amino acid cysteine (CY) was shown to effectively enhance the water-solubility, film-forming tendency and electrochemical signals for highly sensitive detection of AFB1 and PAT.

The use of multi-walled carbon nanotubes (MWCNTs) in biosensor fabrication, particularly carboxylic acid-functionalized MWCNTs (cMWCNTs), has shown promise for the sensitive detection of mycotoxins. Despite challenges such as aggregation in aqueous media, nanocomposites of cMWCNTs with polymers like chitosan (CH), polyethyleneimine (PEI), or cysteine (CY) have been employed to enhance water solubility, film-forming tendencies, and electrochemical signals. Notably, these nanocomposites have demonstrated efficacy in detecting mycotoxins such as aflatoxin B1 (AFB1), patulin (PAT), and zearalenone (ZEA).

Immunoassays with Nanocomposites:
Nanocomposites of cMWCNTs and chitosan (cMWCNTs/CH) have been used for electrochemical immunoassays, showing high sensitivity and selectivity for ZEA detection at low working voltages. Similar approaches have been employed for AFB1 detection with high recovery rates.

Appendix - Cost Breakdown

Detector

$35.00	Arduino Uno R3
$1.80	TCRT5000 IR Sensor
$15.80	785 nm Laser Diode
$15.00	Electric Components

$67.60 per device

Plant Type

$5.99	Spinach Sapling
$5.48	Lettuce Seedling
$2-5.00	Herb Seedlings

$4.62 on average

Total

$72.22 on average

Appendix

Appendix - Social Media for Farmers

In general, younger farmers tended to use social media more than average. About 46% of U.S. farmers use Facebook for personal reasons, according to the survey. Of those, 56% were age 35 and under. About 9% use Facebook for farm business reasons, while 21% of those age 35 and under did. Just less than 10% use Facebook to advocate for agriculture; that number jumps to 21% for the 35 and under crowd.

Appendix - When to Soil Test

How Often Should I Soil Test?

Generally, you should soil test every 3–5 years or more often if manure is applied or you are trying to make large nutrient or pH changes in the soil.

When to Soil Test?

Sample fields the same time each year to achieve more accurate trends in the soil fertility.

For cropland and vegetable production, it is best to sample in the fall of the year.

For pastures and perennial crops, it is best to sample during the late summer period.

Appendix - What Soil Testing Provides

Soil testing involves collecting soil samples from different parts of a field or garden, which are then sent to a laboratory for analysis. The laboratory tests the samples for key parameters such as microbial activity, disease risks, pH, nutrient levels, organic matter content, and more. Soil testing can provide growers and farmers with valuable insights into the unique characteristics of their soil, enabling them to make data-driven decisions about soil management practices that ultimately improve crop yields and overall soil health.

Soil testing can identify nutrient deficiencies or imbalances that may be limiting plant growth and yield, enabling growers to adjust their fertilization practices and optimize crop yields.

Soil testing can also help growers avoid over-application of fertilizers, which can be costly and have negative environmental impacts.

Soil testing can provide valuable insights into soil health, including organic matter content, pH, and texture. By managing soil health appropriately, growers can improve soil structure, nutrient cycling, and water retention.

Appendix - Mycotoxin Price (AgLabs)

MYCOTOXINS	
Aflatoxin	$40.00
Zearalenone	$40.00
Vomitoxin (DON)	$40.00
Fumonisin	$40.00
Particle Size	$15.00
Compost Analysis	$60.00

Appendix - Soil Analysis Price (CSI)

Soil Chemistry Testing and Packages

Complete Soil (Recommended for most growers/gardeners)

This package is recommended for most growers and gardeners as it includes three separate tests into one Complete package. Included are: **1) Standard CEC**– Mehlich III extractable (S, P, Ca, Mg, K, Na, B, Fe, Cu, Mn, Zn, Al), Cation Exchange Capacity (CEC), Base Saturation, pH and Organic Matter. **2) Saturated Paste**– Water soluble nutrient analysis (pH, Soluble Salts, Bicarbonates, (S, P, Ca, Mg, K, Na, B, Fe, Cu, Mn, Fe, Al), and **3) Nitrates and Ammonium**. The Complete Soil test provides the ideal framework to make educated and calculated decisions for improving soil and plant health and productivity.

$55.00

Complete Soil + Extras

This package is recommended for those growers that are looking for the "Extras"! In addition to the Complete Soil test from above, the extras included are Cobalt, Molybdenum, Selenium, Silica, Electrical Conductivity, and Estimated Nitrogen Release. This package is for those in livestock production, or just feel they want the best of the best!

$60.00