

# Thorne HealthTech

Multi-omic microbiome health effects for precision health on thousands of people

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 Professor (on leave), Institute for Systems Biology



The diagram shows research areas at the Hood-Price Lab at ISB, including: PA Healthcare & Big Data Science, Alzheimer's Disease & Brain Health, Cancer, Infectious Disease & Biomarker Discovery, PSC Health & Computational Modeling, Pregnancy & Parturition, Scientific Wellness, and Longevity & Aging.

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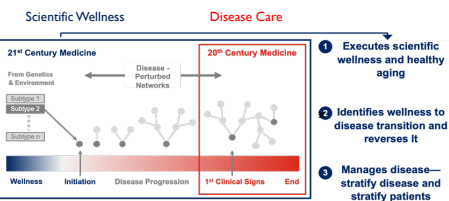
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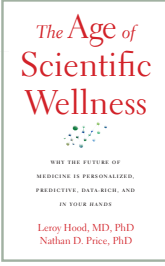
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## Challenges, Opportunities, and Technologies of the 21<sup>st</sup> century Necessitate and Enable Focus on Wellness and Prevention



The diagram illustrates the transition from Scientific Wellness to Disease Care. It shows a progression from Wellness (Subtype 1, 2, 3) through Initiation, Disease Progression, and 1<sup>st</sup> Clinical Signs to End. A central box labeled 'Disease - Perturbed Networks' connects the two eras.

- Executes scientific wellness and healthy aging
- Identifies wellness to disease transition and reverses it
- Manages disease—stratify disease and stratify patients



*The Age of Scientific Wellness*  
 WHY THE FUTURE OF MEDICINE IS PERSONALIZED, PREDICTIVE, DATA-RICH, AND IN YOUR HANDS  
 Leroy Hood, MD, PhD  
 Nathan D. Price, PhD

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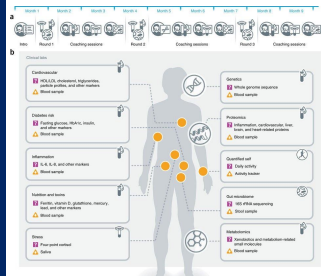
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## Scientific Wellness Pilot: Pioneer 100

PIs: Nathan Price and Lee Hood

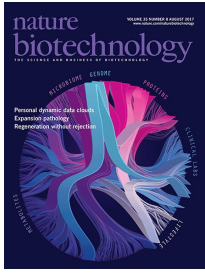


The dashboard shows a timeline from Week 1 to Week 8. It includes sections for Clinical Data, Wellness, and Disease. Wellness categories include:
 

- Cardiovascular: High cholesterol, hypertension, diabetes, and other factors.
- Immunity: Fasting glucose, HbA1c, insulin, and other markers.
- Metabolism: HbA1c and other markers.
- Neurological: Fasting glucose, HbA1c, insulin, and other markers.
- Other: Fasting glucose, HbA1c, insulin, and other markers.

 Disease categories include:
 

- Diabetes: High cholesterol, hypertension, diabetes, and other factors.
- Cardiovascular: High cholesterol, hypertension, diabetes, and other factors.
- Immunity: Fasting glucose, HbA1c, insulin, and other markers.
- Metabolism: HbA1c and other markers.
- Neurological: Fasting glucose, HbA1c, insulin, and other markers.
- Other: Fasting glucose, HbA1c, insulin, and other markers.



*nature biotechnology*  
 Personal genomics data shows Expansion pathway: Reproductive cell lineages

Price, Magis, Earls...Hood, Nature Biotechnology, 2017

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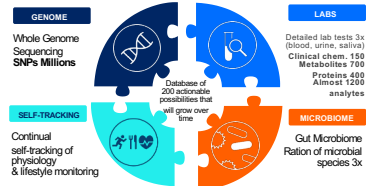
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## Assays / Measurements—108 Pioneers

Creating personal, dense, dynamic data (PD3) clouds – “deep phenotyping”



Price, Magis, Earls... Hood, Nature Biotechnology, 2017

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### Baseline characteristics of deeply phenotyped population

Characteristic	Total N=4886
Age, mean years (sd)	45.9 (12.9)
Males, no. (%)	2184 (35.1)
Nonwhite, no. (%), n=6107	1480 (24.2)
Number of people with one or more blood draws, no. (%)	4886 (78.5)
Number of blood draws per person, mean (range) (n=4886)	2.3 (1-10)
Total bloods drawn	11,151
BMI, mean (sd), n=4703	27.5 (6.2)
Obese <sup>a</sup> , no. (%), n=4703	1242 (26.4)
<i>Past and/or current self-report of:</i>	
High cholesterol, no. (%), n=4885	1101 (22.5)
Hypertension, no. (%), n=4897	778 (15.9)
Type 2 Diabetes, no. (%), n=4837	175 (3.6)
Coronary artery disease, no. (%), n=4817	67 (1.4)

<sup>a</sup>Obese defined as BMI≥30

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What have we learned so far from analyzing scientific wellness data from 5000 people?

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## Deep Phenotyping Catalyzes Understanding of New Data Types



Example: The Gut Microbiome



**Noa Rappaport**  
Research Scientist



**Tomasz Wilmanski**  
Postdoctoral Fellow



**Christian Diener**  
Postdoctoral Fellow  
(Gibbons Lab)



**Sean Gibbons**  
Assistant Professor




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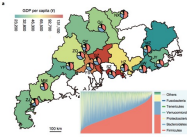
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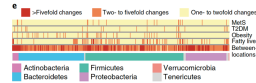
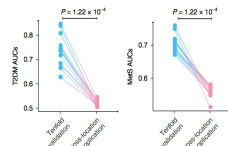
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## Defining a Reference ('healthy') Microbiome has Proven a Challenge



**Conclusions**  
"Localized baseline and disease models need to be built in order to predict metabolic risks"



He et al., Nat. Medicine (2018), 24:1532-1535




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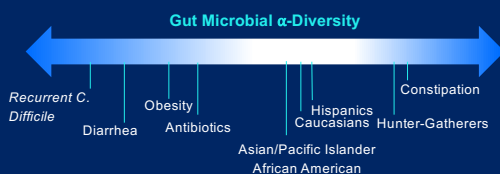
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## Gut Microbial Diversity as marker of Microbiome Health

- Tends to be more consistently associated with disease conditions than specific microbes
- Several metrics: Shannon, PD whole tree, Chao1 (species richness)
- Is there an **optimal range** for gut microbial diversity?



Brooks et al., PLOS Biology (2018), 16(12): e2006942  
Schnoor et al., Nature Communications (2014), 5:3654




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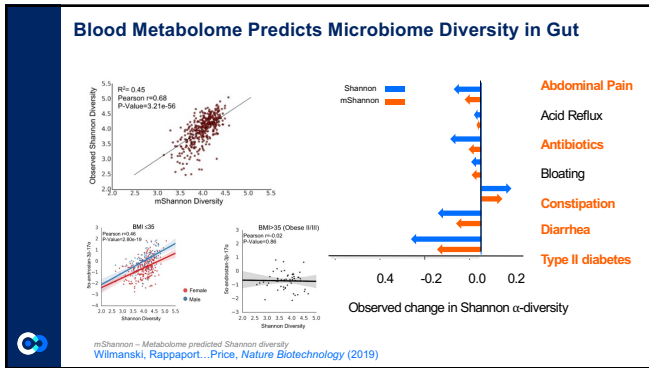
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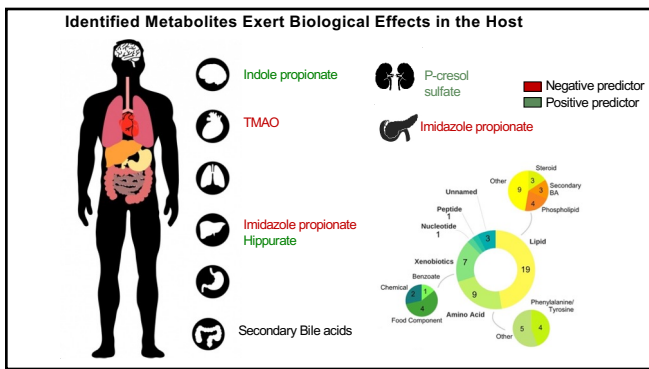
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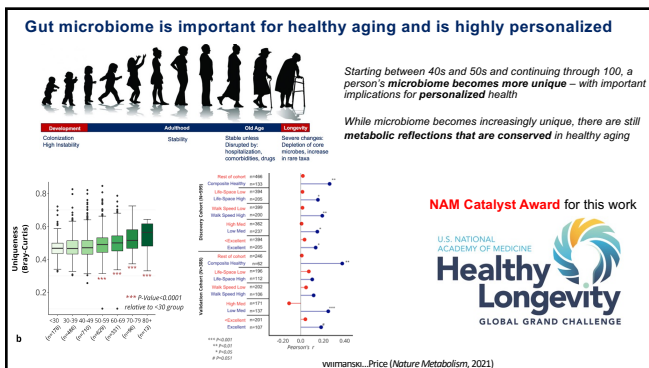
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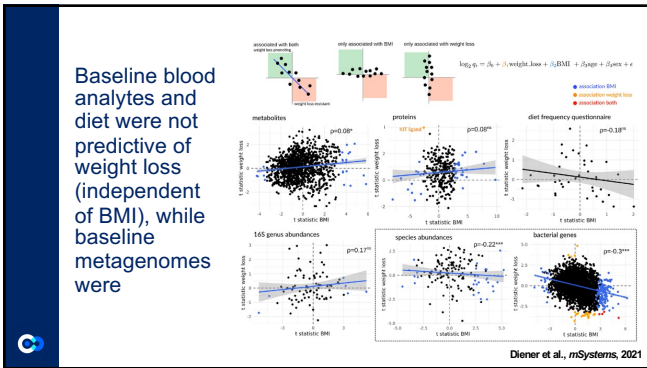
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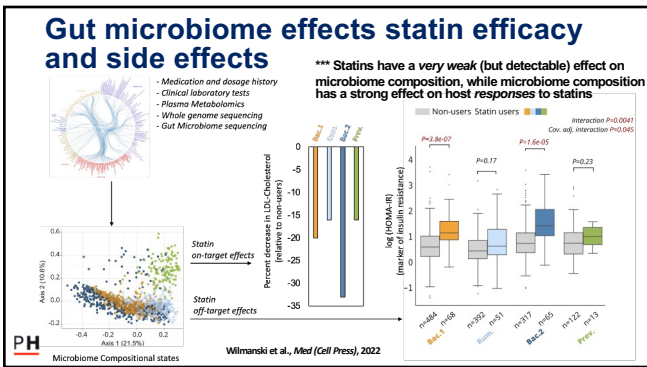
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**Where we are headed: At home measurements and much deeper profiling coupled with health intelligence**

**ISO 13485**

150ul sample volume    Stable Transport    5 min average collection time    No cold-chain necessary    Near pain-free

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**The development, validation and application of remote blood sample collection in telehealth programmes.**

[Request a copy](#)

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**Authors**  
 @ Research, Albert Remus, Kristian Partington, Devon Tyrrell, Carina Cati, Michael Giannini-Kotinas, Effrosyni Wavreiris, Nick

**Journal Title**  
 Journal of Telemedicine and Telecare

**Citation**  
 Koultas, A., Remus, K., Partington, D., Tyrrell, C., Cati, M., Giannini-Kotinas, E., & Wavreiris, N. The development, validation and application of remote blood sample collection in telehealth programmes. *Journal of Telemedicine and Telecare*. <https://doi.org/10.1177/13633270211017963>

**Abstract**  
 Introduction The ability to collect blood samples remotely without the involvement of healthcare professionals is a key element of future telehealth applications. We developed and validated the application of the Drawbridge OneDraw device for use at home for blood sample collection. The device was then applied in a large population-based remote monitoring study to assess changes in SARS-CoV-2 IgG antibody levels. Methods We tested: (1) feasibility of participants using the device at home without a healthcare professional on their arm and thigh sites (2) stability of the dried blood sample collected remotely (3) participant acceptability of the device compared with finger-prick and venous blood samples and the stability of SARS-CoV-2 virus antibody measurement versus venous blood samples (4) application to the Ferland-COVID19 study in 4,023 participants at 3 timepoints across 6 months. Results Participant acceptability was high, with a significantly lower median perceived pain score and 70% preferring the OneDraw device over the other blood collection methods. There was high level of agreement in SARS-CoV-2 virus antibody results with venous blood samples in 150 participants (Cohen's kappa 0.68 [95% CI 0.56, 0.82]). In Ferland COVID-19 study 92% of participants received a sample at baseline (1,702/4,023), 89% at 3 months (3,462/3,918) and 93% at 6 months (3,453/3,711), with almost all samples received successfully processed (99.9%). Discussion The OneDraw device enables a standardised blood sample collection at home by participants themselves. Due to its ease-of-use and acceptability the OneDraw device is particularly useful in telehealth approaches where multiple samples need to be collected.

**"76% [preferred] the OneDraw Device over other blood collection methods"**

**"Due to its ease-of-use and acceptability the OneDraw device is particularly useful in telehealth approaches where multiple samples need to be collected."**

**UNIVERSITY OF CAMBRIDGE**

Drawbridge HEALTH

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**Implications for the future**

We should evaluate the contributions of the microbiome based on reflections in the host – especially in the metabolome

We will need to map how diet and microbiome interact to fill in health-enhancing niches

Microbiome is a key component in healthy aging – and becomes increasingly unique to each individual

Microbiome wipe should provide a much-improved sample collection experience – and making measurements easier and cheaper is key

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**Acknowledgements**


**Hood-Price Lab @ISB**




**Thorne HealthTech**




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(Merged with Thorne)




**Joel Dudley, Ph.D.**  
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(Merged with Thorne)




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**Christian Diener, Ph.D.**  
Postdoctoral Fellow, ISB



**Bodi Zhang, M.D., Ph.D.**  
Chief Strategy Officer  
Thorne HealthTech

**Funding**



**Thorne HealthTech**

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**Thank You!**


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