The World's First AI Precision Health Institute

Body shape is a visual representation of all omic Processes. Assessing body shape using AI is a powerful risk biomarker for multiple diseases.

John Shepherd, PhD, Founder and
Director, AI Precision Health Institute

Last week I visited the world's first AI Precision Health Institute located at the University of Hawai‘i Cancer Center in Honolulu. The AI PHI is using advanced technology including AI, machine learning and deep learning to assess human health and predict risk of disease. Some of the most exciting recent advances in medicine have come from using AI to analyze medical images. In one study published in May, computers equalled radiologists in assessing breast cancer risk. This study also found that assessment by computer algorithm were more reproducible and less subjective than assessments by human radiologists. John Shepherd, PhD, one of the authors of that study, has been researching quantitative imaging for 30 years, and was one of the first to show that volumetric breast density measures are a stronger risk predictor than areal density measures.

This year, John Shepherd, PhD, a cancer epidemiology researcher at UH Cancer Center, founded the AI PHI. The AI PHI is located at the UH Cancer Center in Honolulu in one of the most beautiful settings in the world overlooking the Pacific Ocean. The six story 150,000 square foot UH Cancer Center is one of only 69 NCI designated Cancer Centers in the United States and the only one in Hawai‘i and all of the Pacific Islands. The NCI designation signifies the depth and quality of the research they're doing. Dr. Shepherd and his colleagues created the first Hawai‘i and Pacific Islands Mammography Registry and are designing a study that will analyze mammograms from 5 million women on 5 continents using deep learning. The UH Cancer Center is a state of the art facility that has the ability to attract the best scientists to research cancer. Their research is unique because they research how cancer affects people with different ethnic, cultural and environmental characteristics. UH researchers conduct population based and laboratory based cancer research. Since Hawai‘i has one of the most diverse populations in the world, it's an ideal place to study why some ethnic populations are more susceptible to certain cancers and how genetic susceptibility interacts with environmental factors in producing cancer risk.

Dr. Shepherd is known worldwide for his expertise in quantitative X-ray imaging using ML and the use of AI and DL to extract more cancer risk information from various forms of medical imaging including dual-energy X-ray absorptiometry, digital mammography, tomosynthesis, MRI, and 3D optical images. He has over 200 peer reviewed papers and has been cited in other publications over 10,000 times. Dr. Shepherd is developing novel biomarkers and conducting research in the following areas:

Bone density and body composition

- Researching the combination of DXA and bioimpedance measures to describe fat and muscle status in athletes and other individuals where hydration may vary.

Breast Cancer

- Improving the ability of mammography to detect cancer and to offer quantitative risk of cancer, and using deep learning models for reading mammograms to reduce recall rates and unnecessary biopsies for women.

Body Shape

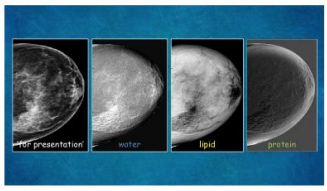
- 3D optical whole body scanning for quantifying body shape as a risk factor for metabolic diseases, and monitoring lifestyle interventions.

Frailty

- Researching the best way to describe frailty and function using quantitative composition measures.

Shape Up! Cohort

Da Kine Body Composition Study



Three Compartment Breast Lesion Detection Study

Accessible Breast Cancer Screening in the Pacific Study

SMART Melanoma Study

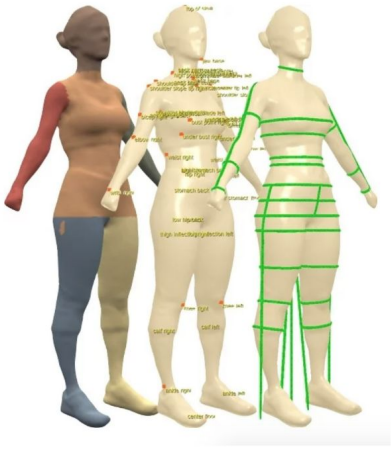
Hawai'i and Pacific Islands Mammography Registry

Research at UH has shown that certain ethnic populations have higher abdominal fat even if they are not obese. This abdominal fat leads to an increased incidence of liver cancer. They are researching ways to treat and prevent the accumulation in abdominal fat in these groups to reduce the risk of liver cancer.
Research in breast cancer at UH has revealed differences in survival rates among women from different ethnic backgrounds. Japanese women have the highest survival probability, followed by Chinese and Caucasian women. Native Hawaiian and Filipino women have lower survival rates. Researchers are studying factors including environment, diet, genetics, weight, and hormonal statuses that could help explain these differences.

> "We are truly at a pivotal juncture in the goal of turning the tide back against cancer. I don't think it's ever been a more tangible reality than it is today."
>
> Nobel Laureate Dr. Elizabeth Blackburn, PhD, Speaking at the Opening of the University of Hawai‘i Cancer Center

The AI Precision Health Institute's Advanced Health Analysis is designed to tell you as much as possible about your body using noninvasive methods including full body optical 3D imaging with high spatial resolution. Human body shape is an intuitive marker of health. Monitoring body shape using various types of imaging can help assess risk for many diseases including diabetes, cancer, and cardiovascular disease. The Advanced Health Analysis includes multiple 3D full body scans, dual-energy X-ray absorptiometry scans for body composition, blood tests for metabolic markers, and strength assessments. Following the scans, advanced statistical modeling is used to assess your current health and your risk of developing disease in the future.

The BOD POD measures your body volume to determine body composition (fat vs. lean). Since it doesn't involve radiation, the BOD POD can be used to monitor changes frequently in children and adults. The BOD POD uses a technique called Air Displacement Plethysmography to measure body density. Similar in principle to underwater weighing, the BOD POD measures body volume and mass. The BOD POD differs from underwater weighing because it uses air instead of water to measure body volume.



The Styku scan takes about 30 seconds. During this time, the machine takes 600 infrared images of your body and millions of measurements are calculated. An avatar is created from your unique data within minutes. Styku uses Microsoft Kinect V2, the world's most powerful 3D camera, to create scans which are then immediately processed locally on a Nvidia GPU.

The DXA Scan uses small amounts of x-ray to measure your bone density and body composition. The bone density measure is the primary way that osteoporosis is diagnosed worldwide. Dr. Shepherd is one of the world's experts in DXA and holds several patents regarding the technology. It's the only method in the lab that can measure body composition in infants down to 1 kg as well as patients up to 450 lbs. Because DXA uses low-dose radiation, the method is used sparingly, but it's the criterion method for regional fat and muscle measures. DXA is also used to calibrate models of body composition from the other technologies since less assumptions are used to measure body composition.

The Muscle Dynamometer is used to measure the power output of a muscle as you go through a range of motion. This particular device has attachments to measure virtually any muscle in the body. The lab uses this measure for many studies but also to document the power characteristics of key muscles groups known to be related to mortality in older adults as well as strength symmetry for injury recovery.

SizeStream captures body shape in less than 4 seconds and in color. Because of its high acquisition speed, it can be used to take multiple avatars to study posture independently from shape, and also balance studies. The color can be used to identify landmarks placed on the body to investigate small displacements for stance and balance.

The Fit3D machine scans your body for 40 seconds and extracts information about your trunk to leg volume ratio, body fat percentage, and BMI. It also measures waist to hip ratio. The waist to hip ratio is used to evaluate whether you are at high risk of diabetes, coronary heart disease, and high blood pressure. The machine evaluates the correlation between each algorithm and calculates the weighted values for health risk. At the end of the scan, you are given a Body Shape Rating on a scale of 1-100. You can improve your BSR score by increasing body density, building leg muscle, and decreasing waist circumference. Dr. Shepherd uses Principal Component Analysis to model what you'll look like if you gain or lose fat or muscle.

When you complete the Advanced Health Analysis, your data is analyzed using AI. When analyzed this data can predict many things. An avatar created using your personal data is presented to you on a private dashboard that you can access securely over the Internet. Your dashboard includes data and measurements collected from your scans and your personal health scores. Visiting the AI Precision Health Institute was incredibly informative, interesting, and motivating. I've seen the future of medicine and it's amazing.

This article was written by Margaretta Colangelo. Margaretta is Managing Partner at Deep Knowledge Ventures, an investment fund focused on DeepTech with investments in AI, advanced biomedicine, and Longevity. Margaretta serves on the Advisory Board of the AI Precision Health Institute. She is based in San Francisco. This article and images are property of Margaretta Colangelo and may not be used without her express written permission. @realmargaretta

The quote from Dr. Elizabeth Blackburn, PhD, speaking at the opening of the University of Hawaii Cancer Center was extracted from this video. Dr. Blackburn co-discovered telomerase, the enzyme that replenishes the telomere. For this work she was awarded the 2009 Nobel Prize in Medicine.