TECHNICAL OVERVIEW
Yi Assessment Tool

Introducing a new way to stratify your employee population without the high cost and use of an invasive biometric procedure.

The Yi assessment was developed and validated over a 20-year period in an endocrinology and wellness center using internal patients with established diagnoses of diabetes or metabolic syndrome. It also has been clinically validated in peer reviewed publications and presented at national meetings.

This non-invasive methodology predicts the likelihood of someone currently having diabetes and metabolic syndrome using only six inputs:

A person's
➜ Age
➜ Gender
➜ Weight
➜ Height
➜ Waistline
➜ Hipline

YI ASSESSMENT ALGORITHM DESCRIPTION AND HbA1C COMPARISON

In a study published in 2011 in PLOS One, approximately 1,500 individuals were tested to determine the accuracy of the Yi assessment methodology.[1] The study showed that body composition analysis using a Dual-energy X-ray absorptiometry (DXA) scanner measurements can predict diabetes risk. Additionally, the above biometrics (anthropometric variables) were used to determine body composition and results were shown to be closely comparable to DXA scans.

As a result, **the study established that simple body measurements could accurately predict DXA body composition** and therefore, those same simple measurements could be **used to predict type 2 diabetes as accurately as the HbA1c blood test.**

Using logistic regression models, the following accuracy for detecting type 2 diabetes was established:

• Data from 341 females used for modeling resulted in good predictive ability with an AUC = 0.78. *See page 2 for discussion on AUC.*

• The algorithm was then used in a database of 1,153 females from a general endocrinology practice to yield an improved AUC = 0.81.

• The blood test HbA1c as a reference test has an AUC of approximately 0.82.[2]

A recent study compared the accuracy of HbA1c for diagnosing diabetes and pre-diabetes to fasting blood sugar levels and to the standard 2-hour glucose tolerance test in many different age and ethnic groups. The AUC for HbA1c ranged from 0.736 to 0.911.[3]

1 https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0024017

2 Guo F, et al., Metabolic Syndrome and Related Disorders – Vol 12. No. 5, 2014, https://www.liebertpub.com/doi/full/10.1089/met.2013.0128

3 Guo F, et al., Metabolic Syndrome and Related Disorders – Vol 12. No. 5, 2014.

WHAT IS AUC?

In order to interpret the above results, its important to take a step back and discuss Area Under the Curve (AUC) for a Receiver Operator Curve (ROC).

To provide context, its also important to show what these curves look like. Exhibit 1 below indicates that a straight line (labeled worthless) has an AUC of .5 and suggests there is no value in the test. As the AUC increases to levels above .7, the test can be considered fair to good predictors as the accuracy of the diagnostic test is sufficient.[4] This suggests that tests for diabetes screening with AUC at or above 0.7 are valid tests for identifying those with type 2 diabetes, pre-diabetes, or normal blood sugar.
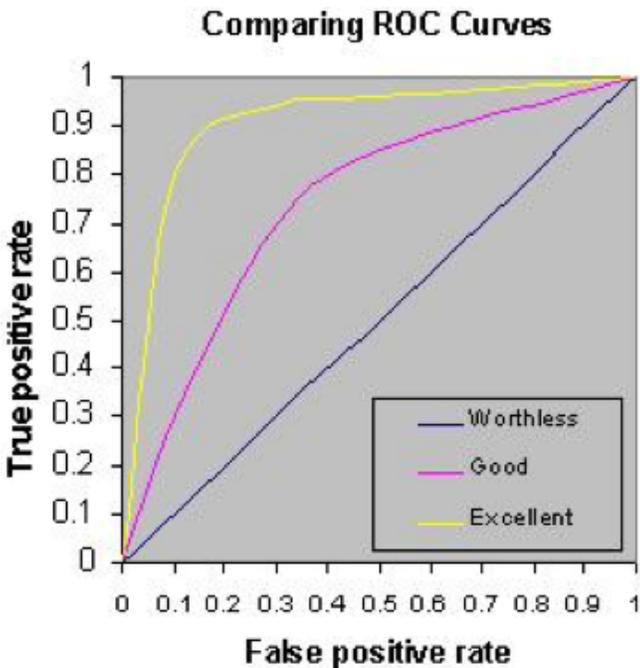
Comparing ROC Curves

Exhibit 1: ROC Examples

In a second internal study, HbA1c results from 22,576 people from different genders and ethnicities with a diagnosis of diabetes, pre-diabetes and no diabetes were assessed. The result of this study using logistic regression with the Yi algorithm showed excellent accuracy to identify those with diabetes, pre-diabetes, or neither condition as defined by HbA1c:

A1c > 6.5% (diabetes)	A1c 5.7% - 6.4% (pre-diabetes)	A1c < or = to 5.7% (no diabetes)
AUC = **0.82**	AUC = **0.75**	AUC = **0.77**

Based upon the above studies, it is clear that the Yi algorithm can accurately predict individuals with diabetes or pre-diabetes, and distinguish them from those with normal blood sugar. **This proves that the methodology is an effective and noninvasive test providing immediate insight as to the individual's risk profile.**

Additionally, these same measurements can be used to assess the general risk of metabolic syndrome (MetS) as that model has also been tested within Dr. Yavari's endocrinology practice. MetS has various definitions; however, the core components are elevated glucose (pre-diabetes or diabetes), central obesity, hypertension, and dyslipidemia (elevated triglycerides and low HDL.)[5] It must also be mentioned that MetS is referred to the stratification of pre-diabetes (A1c: 5.7%-6.5%) where cardiovascular damage begins even before overt diabetes.[6] At his center, Dr. Yavari has determined that the Yi assessment can predict MetS with an AUC of 0.75. Therefore, the **Yi assessment is valid for identification of people with diabetes, pre-diabetes, and metabolic syndrome.**

Over the past few years this assessment tool has been used to stratify risk profiles within a host of large and small populations like health organizations, large retailers, and small manufacturing firms. This tool is used daily in Dr. Yavari's center for patient evaluation and coaching. and, as a non-invasive screening tool, it is used for accurate risk stratification in employee groups and to monitor the effectiveness of wellness or disease management programs.

4 http://gim.unmc.edu/dxtests/roc3.htm

5 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2901596/

6 https://cardiab.biomedcentral.com/articles/10.1186/1475-2840-2-4