HRIDAY (Heart Rate Increase Due to ActivitY): A Novel Predictive Framework for Heart Disease Using Real-time Activity and Heart Rate

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Coronary Artery Disease (CAD)

- Leading cause of death in US (CDC, 2015)
  - 610,000 people/year
- Asymptomatic (Medtronic, 2017)
  - Difficult to diagnose

http://www.zorroo.nl/zorgprogramma/wat-cvrm/

Wearable Devices

- Fitbit/Apple watches
- Measure metrics involved in stress tests in real time
- Dynamically download data to connected app

http://www.stickpng.com/img/electronics/fitbit/fitbit-trackers

http://www.idownloadblog.com/2016/12/23/have-any-health-information-at-a-glance-with-healthface-for-apple-watch/

Early Intervention

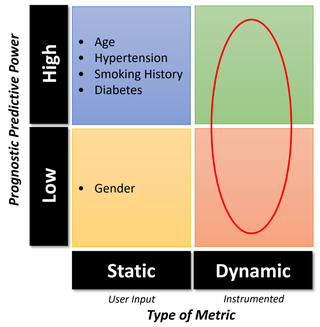
- Greatly improves patient outcomes (Fernández-Ortiz et al., 2013)
- Risk assessments detect CAD

https://www.shareicon.net/magnifying-glass-loupe-medical-checking-heart-744112

Hypothesis

By mimicking diagnostic capabilities of stress tests on a dynamic basis, in addition to the basic ACC/AHA risk assessment, we could provide a novel, scalable, dynamic solution to predicting Coronary Artery Disease for thousands worldwide

American College of Cardiology (ACC) and American Heart Association (AHA)



(Goff et al., 2013)

Predictive Modeling

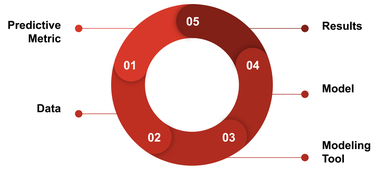
http://www.fdot.gov/planning/statistics/

The Stress Test

- Helps diagnose CAD (Banerjee et al., 2012)
- Doctors note heart rate changes under activity (JHU, 2017)
- Periodic; selective; expensive, exclusive

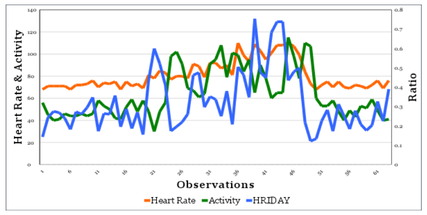
https://www.tumblr.com/search/triple%20attack

Components of the Approach



Predictive Metric

HRIDAY (Heart Rate Increase Due to ActivitY)



Results

Results & Discussion

	Coefficients	*Standard Error*	*z-value*	*P-value*
Intercept	-2.8507	0.7244	-3.9350	0.0001
age	0.0146	0.0102	1.4350	0.0755
hxofHT: History of hypertension	-0.0464	0.2609	-0.1780	0.4295
hxofdm: History of diabetes	0.0137	0.2441	0.0560	0.4775
hxofcig: History of smoking	-0.2539	0.2938	-0.8640	0.1935
HRIDAY	0.0887	0.0597	1.4860	0.0685

- p-value of HRIDAY is 0.0685
- Less than αlpha value of 0.10 & other traditional parameters
- HRIDAY indicates occurrence of cardiac event more than chance alone

Conclusion

- HRIDAY holds promise as a predictive metric
- Complements traditional risk factors
- Dynamic metric that can be implemented as a scalable solution

Data

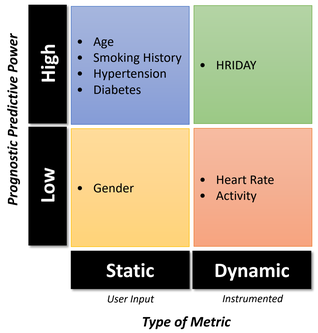
Test Data

- Garfinkel et al., 1999
  - Stress test on 558 subjects
    - Heart Rate
    - Activity Level
    - Cardiac event

http://blog.digitalroute.com/the-fuel-of-future-success-isnt-big-data

Updated Summary of Metrics

(Goff et al., 2013)



Future Directions

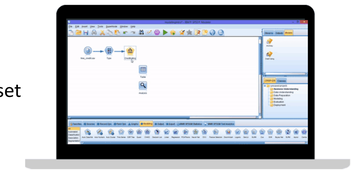
- App is developed
- Testing with a broader population
- Develop affordable wearable wristbands
  - Solar powered
- Depending on progress, FDA trials

https://rainbow-machine.deviantart.com/art/Happy-World-210750610

Modeling Tool

IBM SPSS Modeler (SPSS)

- Identifies patterns
- Applies patterns to a data set
- Calculates statistical fit



https://www.ibm.com/analytics/hk/en/technology/spss/

HRIDAY Mobile Application

- Developer currently developing app based on our specifications
- Integrated with Apple Health
- ACC/AHA Algorithm + HRIDAY
- Real-time display
- Individualized risk assessment
- Look for patterns in different time windows

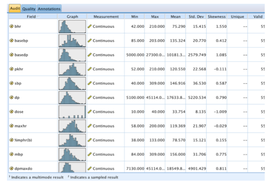
Acknowledgments

- My Mentor
- My Teachers
- My Family
- My Judges
- My Audience

Model

Auto Classifier

- Recognizes graph to fit data
  - Selected variables
  - ACC/AHA risk factors and HRIDAY
- Logistic Regression Model
  - Binary outcome variable



SPSS Modeler

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