

Applying the Glycemia Risk Index (GRI) to User Data from a Digital Health Tool Reveals Patterns of Engagement That Differ by Type of Diabetes

Junjie Luo¹, Mansur E. Shomali², Abhimanyu Kumbara², Anand K. Iyer², and Guodong "Gordon" Gao¹

¹Carey Business School of Johns Hopkins University, Baltimore, MD, U.S.A. and ²Welldoc, Inc. Columbia, MD, U.S.A.

PURPOSE

- Optimizing glucose management for people with type 2 diabetes requires them to know their glucose data and understand what to do with it
- Continuous glucose monitoring (CGM) solves the problem of providing critical real time glucose data to individuals with diabetes
- Welldoc® continues researching how regulated, AI-driven personalized digital health solutions combined with CGM data can be effective at helping people with diabetes improve lifestyle factors that affect their diabetes
- The Glycemia Risk Index (GRI)¹ was developed as a composite metric from continuous glucose monitor tracings, to assist with basic clinical interpretation of CGM data
- We applied the GRI to a large data set of digital health tool² users in order to further quantify and understand the potential benefit of CGM plus digital health on glycemic outcomes

METHODS

- A real-world data set of 499 CGM users who were utilizing a digital health tool was created
- The data were de-identified according to standard procedures
- The GRI was calculated for the first 3 days and last 3 days of a 14-day observation period in those with at least 80% sensor wear time (n=381)
- People with diabetes can be mapped to GRI zones A (best glycemia) to E (worst glycemia) seen in Figure 1
- A better glycemia outcome was defined as a lower GRI value at endline from the baseline GRI value
- The digital health solution (BlueStar®* by Welldoc) features analyzed were classified into 4 categories: health, lifestyle, education, and medications

Figure 1: The Five GRI Zones¹

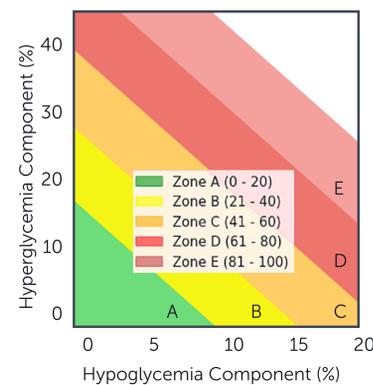
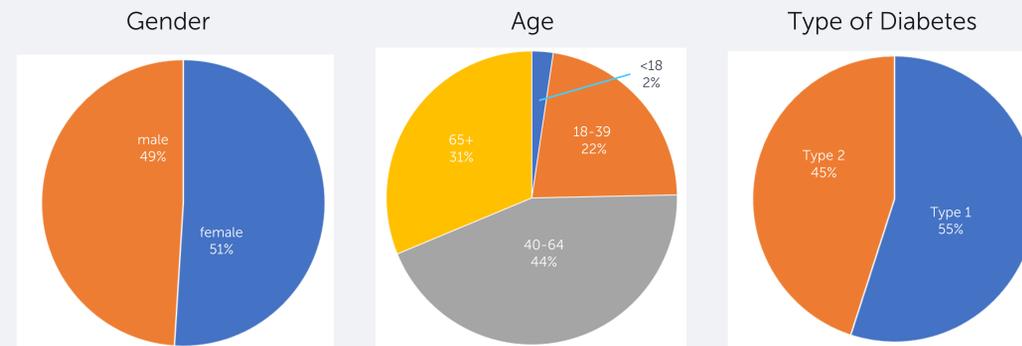


Figure 2: Screenshots of the Digital Health Solution²



RESULTS

Figure 3: Demographic Data



GRI Over a 14-day Period

The mean GRI of the population improved by 6 points (+/-29) during the first 14 days of use of the digital health tool.

Figure 4: Main Correlations Detected by Logistic Regression

	A: All Users							B: Type 2 Diabetes						C: Type 1 Diabetes																											
Total People: 381; outcome: better_gri														Total People: 178; outcome: better_gri														Total People: 211; outcome: better_gri													
Patients: (1) Initial Glucose Status: [1, 2, 3, 4, 5] (2) DiabetesType1 (1: DT1, 0: DT2): [0, 1]														Patients: (1) Initial Glucose Status: [1, 2, 3, 4, 5] (2) DiabetesType1 (1: DT1, 0: DT2): [0]														Patients: (1) Initial Glucose Status: [1, 2, 3, 4, 5] (2) DiabetesType1 (1: DT1, 0: DT2): [1]													
	M1	M2	M3	M4	M5	M6	M7	M1	M2	M3	M4	M5	M6	M1	M2	M3	M4																								
Intercept	-4.69*	-3.68*	-4.0*	-4.16*	-4.57*	-3.72*	-4.53*	-2.42	-	-	-	-	-	-6.45*	-6.26*	-7.19*	-6.51*																								
BS_fNdays	-	0.01*	-	-	-	-	-	0.03*	-	-	-	-	-	-	-	-	-																								
HealthCare_fNdays	-0.03	-	0.0	-	-	-	-	0.01	-	-	-	-	-	-0.02	-	-	-																								
Medication_fNdays	0.14	-	-	0.22*	-	-	-	-	-	0.22*	-	-	-	-	-	0.26	-																								
FoodLike_fNdays	0.14	-	-	-	0.46	-	-	-	-	-	0.24	-	-	-	-	6.84	-																								
LifeStyle_fNdays	0.01	-	-	-	-	0.01	-	-	-	-	-	0.04*	-	-	-	-	-0.0																								
Education_fNdays	17.78	-	-	-	-	-	15.1	-	-	-	-	-	-	-	-	-	-																								
actcgm_fNdays	4.31*	3.71*	4.07*	4.28*	4.48*	3.76*	4.17*	-	-	-	-	-	25.4	-	-	-	-																								
actcgm_fNdays	0.66*	0.55*	0.55*	0.6*	0.58*	0.55*	0.6*	2.86	3.33	3.66	3.8	2.83	3.29	5.78*	5.65*	6.04*	5.84*																								
zone2_init	0.92**	0.78*	0.78*	0.81*	0.78*	0.79*	0.82*	0.6	0.54	0.59	0.53	0.61	0.58	0.53	0.53	0.67	0.54																								
zone3_init	1.38***	1.23**	1.2*	1.31***	1.28***	1.21**	1.25***	0.63	0.6	0.72	0.6	0.71	0.57	0.85*	0.8*	0.97*	0.87*																								
zone4_init	1.98***	1.81***	1.77***	1.91***	1.88***	1.8**	1.74***	1.5*	1.38*	1.53**	1.41*	1.5*	1.39*	1.11*	1.13*	1.31*	1.13*																								
zone5_init	-0.43*	-0.46*	-0.47*	-0.5*	-0.47*	-0.46*	-0.42*	1.48*	1.3*	1.52*	1.34*	1.5*	1.06	2.12**	2.12**	2.31**	2.14**																								
GenderMale	-0.08	0.2	0.31	0.01	0.09	0.24	0.22	-0.47	-0.53	-0.57	-0.51	-0.46	-0.49	-0.42	-0.45	-0.4	-0.42																								
TrackingMed	-0.69	-0.66	-0.75	-0.71	-0.73	-0.68	-0.72	-0.12	0.19	-0.26	-0.02	-0.09	0.13	0.46	0.27	0.2	0.47																								
DiabetesType1	0.38	0.3	0.33	0.36	0.36	0.32	0.34	0.55	0.63	0.69	0.62	0.59	0.6	-0.04	-0.05	0.06	-0.05																								
HasCorMorbid	0.57	0.17	0.26	0.19	0.41	0.18	0.63	-0.45	-	-	-	-	-	0.3	0.23	0.64	0.31																								
Age18_39	0.33	-0.1	-0.02	-0.07	0.17	-0.09	0.36	-0.99	-	-	-	-	-	0.12	0.05	0.48	0.13																								
Age40_64	0.27	-0.13	-0.09	-0.12	0.07	-0.13	0.26	-0.98	-	-	-	-	-	-0.03	-0.08	0.38	-0.03																								
Age65_	MR_1	-0.51	-0.48	-0.48	-0.52	-0.49	-0.48	-0.46	MR_1	-0.47	-0.43	-0.51	-0.46	-0.39	MR_1	-0.47	-0.43	-0.51	-0.46	-0.39																					
	MR_2	1.32	1.29	1.26	1.37	1.36	1.27	1.25	MR_2	1.3	1.26	1.35	1.32	1.25	1.2	MR_2	1.3	1.26	1.35	1.32	1.25	1.2																			
	MR_3	-6.9	-1.69	-1.19	-3.75	-14.92	-1.44	-1.1	MR_3	-2.06	-0.99	-3.51	-7.95	-1.84	-0.83	MR_3	-2.06	-0.99	-3.51	-7.95	-1.84	-0.83																			
	MR_4	-1.85	-2.02	-2.15*	-2.01	-1.95	-2.05	-2.02	MR_4	-1.82	-2.12	-1.91	-1.92	-1.82	-1.98	MR_4	-1.82	-2.12	-1.91	-1.92	-1.82	-1.98																			
	MR_5	-0.51	-0.42	-0.42	-0.59	-0.48	-0.38	-0.41	MR_5	-0.26	-0.29	-0.46	-0.38	-0.19	-0.3	MR_5	-0.26	-0.29	-0.46	-0.38	-0.19	-0.3																			
	MR_6	-0.04	-0.02	0.04	-0.02	0.01	-0.01	0.04																																	

For all individuals, medications and lifestyle feature use as well as CGM wear time increased the probability of improved GRI.

For type 2 individuals, medications and lifestyle feature use increased the probability of improved GRI.

For type 1 individuals, CGM wear time was associated with increased probability of improved GRI.

CONCLUSIONS

- Confirmed probability of improved GRI was established for all individuals and type 2 segments, due to utilization of digital health features
- Confirmed probability of improved GRI was established for type 1 individuals based on CGM wear time
- These data demonstrate how the GRI – a simple but powerful composite metric – can help characterize the behavior and outcomes of populations of CGM users
- The GRI may be a useful tool for digital health software to coach individuals on self-management behavior based on baseline and progressive values of GRI
- The GRI may also be used to provide decision support and population management tools to health care professional
- Further research and analysis is required to assess longer term improvements and duration of improvement

REFERENCES

¹Klonoff DC, Wang J, Rodbard D et al. A glycemia risk index (GRI) of hypoglycemia and hyperglycemia for continuous glucose monitoring validated by clinician ratings. J Diabetes Sci Technol. 2022 Mar 29.

²Quinn CC, Shardell MD, Terrin ML, et al. Cluster-randomized trial of a mobile phone personalized behavioral intervention for blood glucose control. Diabetes Care. 2011 Sep;34(9):1934-42.

DISCLOSURES

Guodong "Gordon" Gao and Junjie Luo have received funding from Welldoc. Mansur E. Shomali, Abhimanyu Kumbara, and Anand K. Iyer are employees of Welldoc.

*Welldoc® Diabetes and Welldoc Diabetes Rx is an FDA-cleared medical device ("BlueStar"), intended for use by healthcare providers and their adult patients with type 1 or type 2 diabetes. For full labeling information, visit www.welldoc.com.

17th Annual Cardiometabolic Health Congress
Boston, MA
October 19-22, 2022