

A NOVEL CALCULATOR TO DETERMINE THE RISK OF INSULIN THERAPY IN WOMEN WITH GDM

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Disclosures

- No conflicts of interest

Background

- Prediction model for Insulin therapy

Seven point scoring system:

- Age > 30 years
- BMI \geq 30 kg/m²
- Diagnosis GDM prior to 24 weeks
- Fasting venous glucose \geq 5.3mmol/L
- HbA1c \geq 5.5% (37mmol/mol)
- Family history of T2DM
- Prior GDM

¹ Barnes RA, Wong T, Ross, GP, Jalaludin BB, Wong V, Smart CE, Collins CE, McDonald-Wicks L, Flack JR. A novel validated model for the prediction of insulin therapy initiation and adverse perinatal outcomes in women with gestational diabetes mellitus. Diabetologia. 2016. 59:2331–2338.

Background

Number of predictors present	Bankstown-Lidcombe Hospital Diabetes Centre		Liverpool Hospital Diabetes Centre	
	MNT only	MNT+I	MNT only	MNT+I
0	175 (90.7)	18 (9.3)	55 (87.3)	8 (12.7)
1	522 (85.3)	90 (14.7)	109 (69.9)	47 (30.1)
2	620 (75.3)	203 (24.7)	136 (63.8)	77 (36.2)
3	549 (69.1)	246 (30.9)	130 (56.5)	100 (43.5)
4	265 (52.0)	245 (48.0)	79 (42.2)	108 (57.8)
5	107 (39.5)	164 (60.5)	28 (23.5)	91 (76.5)
6	12 (14.3)	72 (85.7)	12 (20.7)	46 (79.3)
7	2 (6.9)	27 (93.1)	0 (0.0)	14 (100.0)
Total	2252 (67.9)	1065 (32.1)	549 (52.8)	491 (47.2)

Data are *n* (%)

¹ Barnes RA, Wong T, Ross, GP, Jalaludin BB, Wong V, Smart CE, Collins CE, McDonald-Wicks L, Flack JR. A novel validated model for the prediction of insulin therapy initiation and adverse perinatal outcomes in women with gestational diabetes mellitus. *Diabetologia*. 2016. 59:2331–2338

Background

- Pilot - new Model of Care
 - “Step down clinic” for patients with low predictor score likely to be managed by diet alone.
- Caveat:
 - Current scoring assigns equal weighting per predictor variable.
 - However not all predictor variables are of equal significance.

Aims

- (1) To develop the seven point predictor model into a weighted risk calculator to predict insulin therapy.
- (2) To compare the weighted risk calculator against the existing seven point predictor model.

Methods

- Single Centre, Retrospective Cohort study at Bankstown-Lidcombe Hospital.
- All singleton pregnancies (1992-2014) diagnosed with GDM at Bankstown-Lidcombe Hospital according to ADIPS(1998) criteria¹.
- Primary Outcome –
 - Need for insulin therapy

¹Hoffman L, Nolan, C, Wilson, JD, Oats JJN, Simmons D (1998) Gestational diabetes mellitus management guidelines. The Australasian Diabetes In Pregnancy Society. MJA pp169:93-97.

Methods

- Logistic regression model using the 7 categorical variables.

- Weighted Risk Score (WRS) calculated

$$WRS = \beta_0 + \beta_1 x_1 + \dots + \beta_7 x_7$$

- Probability of Insulin therapy (P) derived from logistic regression equation

$$\ln \left[\frac{P}{(1 - P)} \right] = \beta_0 + \beta_1 x_1 + \dots + \beta_7 x_7$$

$$\ln \left[\frac{P}{(1 - P)} \right] = WRS$$

$$P = \frac{e^{WRS}}{(1 + e^{WRS})}$$

Age > 30
BMI ≥ 30
Dx < 24 weeks
FPG ≥ 5.3mmol/L
HbA1c ≥ 5.5%
FH of T2DM
Prior GDM

Methods

- Women diagnosed with GDM –
 - Diabetes Education
 - Glucose targets:
 - Fasting < 5.5mmol/L and 2hr < 7.0mmol/L
 - Two consultations with dietitian
 - Medical nutrition therapy (MNT) + Exercise
 - Insulin used if outside glucose treatment targets
 - Metformin was not used.

Methods

- IBM SPSS version 24
 - Logistic regression model
 - Patients without complete 7 point data were excluded from analysis.
 - Receiver operator curves generated using unweighted risk and probability scores
- Risk Calculator developed in Microsoft Excel (version 2003)

Results

- 2598 pregnancies with complete data to calculate both weighted and unweighted risk scores:
 - 1760 (67.7%) on MNT (diet),
 - 838 (32.3%) requiring MNT + Insulin.

Patient Characteristics

	MNT (Diet) (n=1760) cases/total (%)	MNT + Insulin (n=838) cases/total (%)	p-value
Ethnicity (% of eth)			
Caucasian	363/590 (61.5)	227/590 (38.5)	<0.0001
African	35/50 (70.0)	15/50 (30.0)	
Middle Eastern	397/666 (59.6)	269/666 (40.4)	
South East Asian	724/923 (78.4)	199/923 (21.6)	
New Zealand	15/27(55.6)	12/27 (44.4)	
Samoan	33/54 (61.1)	21/54 (38.9)	
South Asian	193/287 (67.2)	94/287 (32.8)	
Unknown	0/1 (0.0)	1/1 (100.0)	
Prior GDM	338/1760 (19.2)	282/838 (34.1)	<0.0001
Family History	942/1760 (53.5)	567/838 (67.7)	<0.0001
Diagnosis < 24 weeks	286/1760 (16.3)	294/838 (35.1)	<0.0001

Patient Characteristics

	MNT (Diet) (n=1760) Mean±SD	MNT + Insulin (n=838) Mean±SD	p-value
Age (years)	31.9±5.2	32.6±5.3	<0.01
Gestational Age at Dx (wks)	27.9±5.3	24.9±6.4	<0.0001
Gravida	2.8±1.8	3.2±2.0	<0.0001
Parity	1.2±1.4	1.6±1.6	<0.0001
Pre-Preg BMI (kg/m ²)	25.1±5.7	28.7±6.9	<0.0001
Fasting glucose (mmol/L)	5.0±0.7	5.4 ± 0.9	<0.0001
2 hr glucose (mmol/L)	8.7 ±1.2	8.9 ±1.6	<0.01
HbA1c (%)	5.2±0.5	5.5±0.7	<0.0001

Logistic Regression Model for Insulin Rx

	Coefficient (β)	Standard Error (SE)	p-value	Exp (β) Odds Ratio	95% CI for Exp (β) /Odds Ratio
Age >30 years	0.183	0.09	0.063	1.200	0.990 – 1.455
BMI \geq 30 kg/m ²	0.687	0.107	<0.0001	1.987	1.610 – 2.452
Prior GDM	0.366	0.108	<0.001	1.442	1.166 - 2.452
Family history T2DM	0.371	0.096	<0.001	1.449	1.200 – 1.783
FPG \geq 5.3mM	0.828	0.098	<0.0001	2.288	1.890 – 2.771
HbA1c \geq 5.5%	0.632	0.096	<0.0001	1.882	1.558 – 2.273
Dx GDM < 24 weeks	0.972	0.111	<0.0001	2.643	2.128 – 3.283
Constant	-2.195	0.120	<0.0001	0.111	

Risk Calculator – Example 1

Calculator For The Risk of Insulin Therapy in Women with GDM

Variable	Coefficient	Coefficient x Variable	Input (Y/N)
Age > 30	0.183	0.183	y
BMI ≥ 30	0.687	0	n
Prior GDM	0.366	0	n
Family History	0.371	0	n
Fasting ≥ 5.3	0.828	0	n
HbA1c ≥ 5.5	0.632	0	n
Diagnosis before 24 weeks	0.972	0	n
Sum of Coefficient x Variable		0.183	

Calculation	Value
Sum of Beta x Variable	0.183
Constant	-2.195
Calculated Weighted Risk Score (WRS)	-2.012

Probability Insulin Rx (%)	12%
$e^{WRS} / (1 + e^{WRS})$	

↑
Enter Y/N
for patient

Example - 2

Calculator For The Risk of Insulin Therapy in Women with GDM

Variable	Coefficient	Coefficient x Variable
Age > 30	0.183	0
BMI ≥ 30	0.687	0
Prior GDM	0.366	0
Family History	0.371	0
Fasting ≥ 5.3	0.828	0
HbA1c ≥ 5.5	0.632	0
Diagnosis before 24 weeks	0.972	0.972
Sum of Coefficient x Variable		0.972

Input (Y/N)
n
n
n
n
n
n
y



Enter Y/N
for patient

Calculation	Value
Sum of Beta x Variable	0
Constant	-2.195
Calculated Weighted Risk Score (WRS)	-1.223

Probability Insulin Rx (%)

$$e^{WRS} / (1 + e^{WRS})$$

23%

Example - 3

Calculator For The Risk of Insulin Therapy in Women with GDM

Variable	Coefficient	Coefficient x Variable
Age > 30	0.183	0.183
BMI ≥ 30	0.687	0.687
Prior GDM	0.366	0.366
Family History	0.371	0.371
Fasting ≥ 5.3	0.828	0.828
HbA1c ≥ 5.5	0.632	0.632
Diagnosis before 24 weeks	0.972	0.972
Sum of Coefficient x Variable		4.039

Input (Y/N)
y
y
y
y
y
y
y



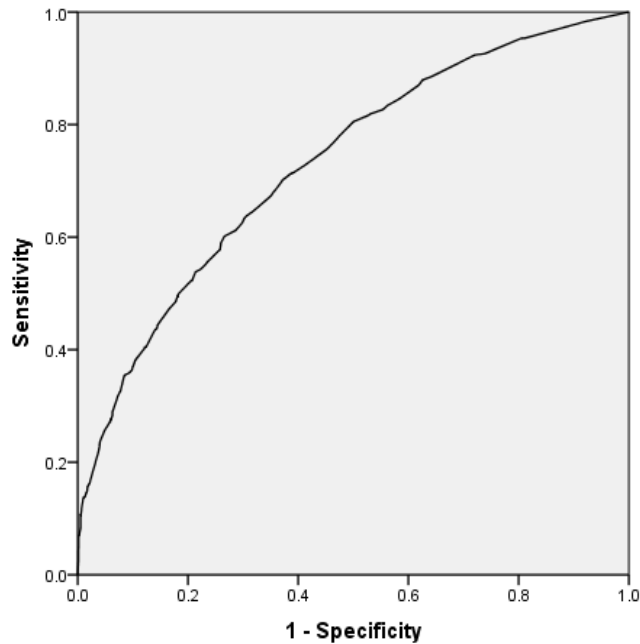
Enter Y/N
for patient

Calculation	Value
Sum of Beta x Variable	2.435
Constant	-2.195
Calculated Weighted Risk Score (WRS)	1.844

Probability Insulin Rx (%)	86%
$e^{WRS} / (1 + e^{WRS})$	

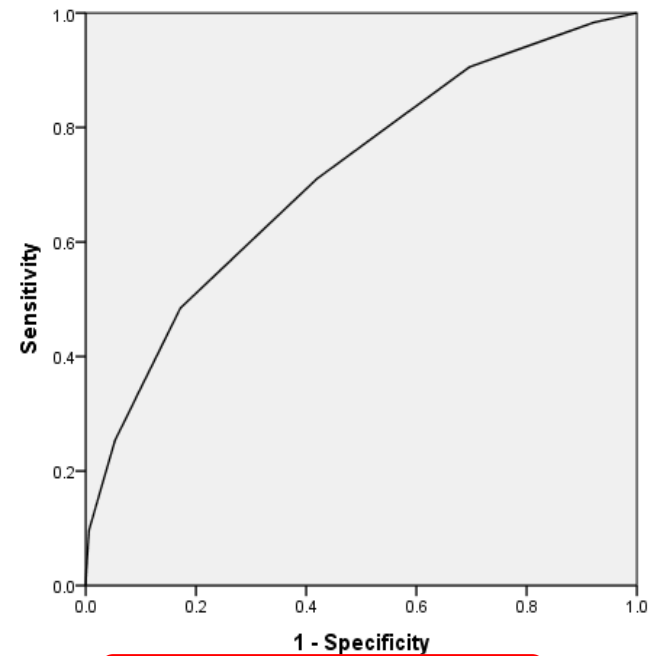
Results - ROC

Weighted Risk Score/Percentage



AUC 0.730 (95% CI 0.710-0.751)

7-Point Unweighted Predictor Score



AUC 0.715 (95% CI 0.693-0.736)

Strengths/Limitations

Strengths:

- Consistency of GDM management—
 - Same diagnostic criteria and management.
 - Standardised Data Collection as part of work practice for GDM women.
 - Same clinician running the service (JRF).

Limitations:

- External Validity
- Dataset using patient diagnosed on old criteria
 - Implications for IADPSG diagnosed patients?

Summary

- A weighted risk/probability score calculator performed better than an unweighted 7 point system in predicting the likelihood of insulin therapy in women with GDM.
- An insulin risk calculator could be used to identify patients who are at lower risk that could be managed in “usual” obstetric care settings.

Acknowledgements

- Nurses/Diabetes Educators at Bankstown-Lidcombe hospital.