The 23rd Spring Congress of the Korean Diabetes Association (KDA)

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The Role Of HbA_{1c} In Diagnosing Diabetes

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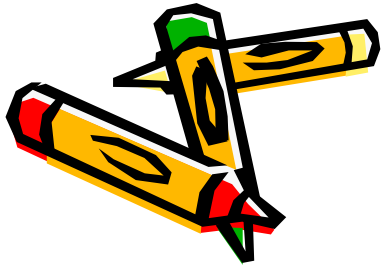
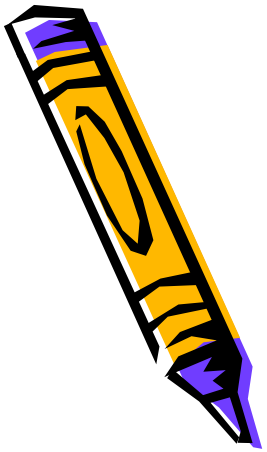
Outline

1. Diagnosing diabetes
   - ✓ a quick review ♠
2. PG & A1c for diabetes diagnosis
   - ✓ the Good, the Bad & the Ugly ♥
3. Suggestions from IEC/ADA ♣
4. Ways forward in diagnosing diabetes ♦



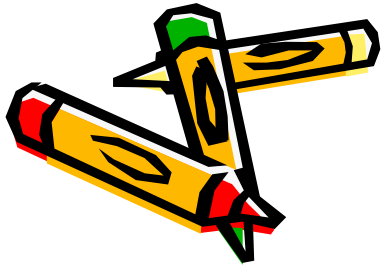
Diabetes Mellitus



"A group of metabolic diseases characterized by hyperglycemia

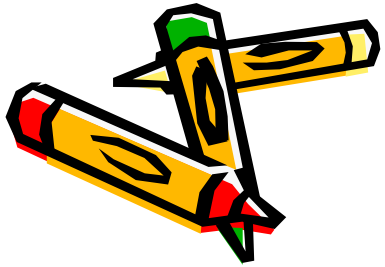
- resulting from defects in insulin secretion, insulin action, or both."

ADA. Diabetes Care 2010;33(Suppl 1):S62.



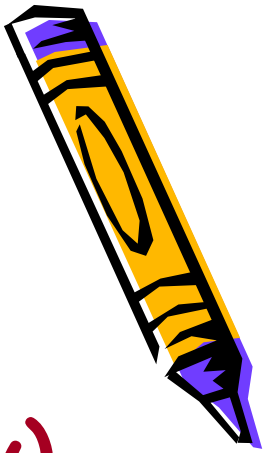
'classic' criteria

	NDDG 1979 (National Diabetes Data Group)	WHO 1985	ADA 1996
Classical symptoms	√	±	±
FPG (venous)	≥7.8 mmol/l (140 mg/dl)	≥7.8 mmol/l (140 mg/dl)	≥7.8 mmol/l (140 mg/dl)
Random PG	-	≥11.1 mmol/l (200 mg/dl)	≥11.1 mmol/l (200 mg/dl)
OGTT 2hr PG	≥11.1 mmol/l	≥11.1 mmol/l	≥11.1 mmol/l
Values	Symptoms + 1 value	Preferably 2 values if asymptomatic	2 values if asymptomatic



NDDG. Diabetes 1979;28:1039-57
WHO. Tech. Rep. Ser. 727, 1985
ADA. Diabetes Care 1996;19:S4

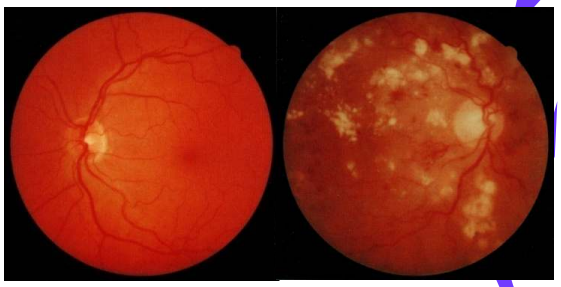
DM - DIAGNOSIS



• 2hr PG cutoff 11.1 mmol/L:
base on clinical outcome (retinopathy)

I. The Whitehall Survey

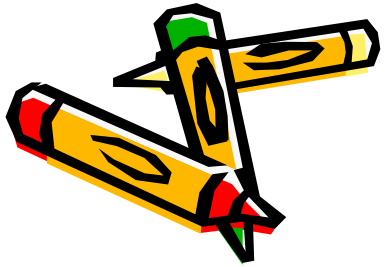
Al Sayegh H et al. Lancet 1979;2:431-3.
Reid DD et al. Lancet 1974;1:469-73.



II. The Bedford Study

- On FU, retinal vascular changes was confined to individuals with 2-hr PG ≥ 200mg/dl

Jarrett RT et al. Lancet 1976;2:1009-12

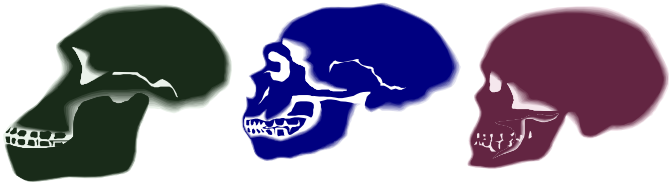


***FPG value was "projected" from 2hr PG value**

Sayetta et al. Diabetes Care 1979;2:105-19.

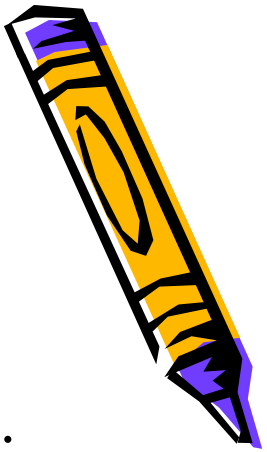
DM - DIAGNOSIS

- FPG = 7.8 mmol/l (140 mg/dl) is
  - too HIGH in corresponding to 2hr-PG of 11.1 mmol/l (200 mg/dl)



To achieve an optimal balance between sensitivity and specificity for diagnosing DM, a lower FPG value, ranging from **5.3 to 7.1 mmol/l, has been suggested.

DM - DIAGNOSIS



Cockram CS et al. *Diabetes Care* 1992;15:988-90.
(**5.7** mmol/l, HK Chinese)

Hanson RL et al. *Arch Intern Med* 1993;153:2133-40.
(**6.8** mmol/l, Pima Indian)

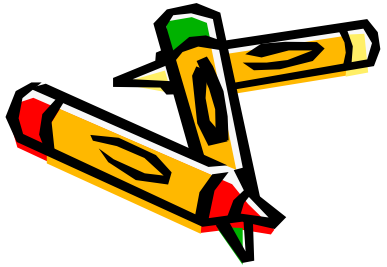
Ramachandran A et al. *Diabet Med* 1993;10:811-13
(**7.1** mmol/l, South Indian)

Clements JP et al. *Acta Diabetol* 1994;31:187-92
(**6.4** mmol/l, North European)

Bortheiry AL et al. *Diabetes Care* 1994;17:1269-72
(**5.6** mmol/l, Brazilians)

Larsson H et al. *J Intern Med* 1995;237:537-41
(**5.3** mmol/l, Swedish women)

Ko GT et al. *Diabetes Care* 1997;20:170-2
(**5.4** mmol/l, HK Chinese)



DM - DIAGNOSIS

FPG cutoff value of 7.8 mmol/l is too high to diagnose DM (for both Chinese & other populations) -

Revised "magic figures":

7.0

7.8

11.1

DM - DIAGNOSIS

	ADA 1997	WHO 1998
Classical symptoms	±	±
FPG (venous)	**≥7.0 mmol/l**	**≥7.0 mmol/l**
Random PG	≥11.1 mmol/l	≥11.1 mmol/l
OGTT 2hr PG	≥11.1 mmol/l	≥11.1 mmol/l
Values	Preferably 2 values if asymptomatic	2 values unless unequvicocal e.g. acute decompensation
IFG	**≥6.1** to <7.0 mmol/l (≥110 to <126 mg/dl) = impaired fasting glucose	**≥6.1** to <7.0 mmol/l (≥110 to <126 mg/dl) = impaired fasting glycaemia
OGTT	Not recommended for routine use	Either FPG or 2hr PG may be used

ADA. Diabetes Care 1997;20:1183-97
Alberti KGMM et al. Diabet Med 1998;15:539-53

DM - DIAGNOSIS

? Why 7.0 mmol/L:

1) FPG cutpoints corresponding to the 2hr PG criterion of 11.1 mmol/l in many populations

2) Increased risk of retinopathy in persons with FPG ≥110-129 mg/dl (6.1-7.2 mmol/l)

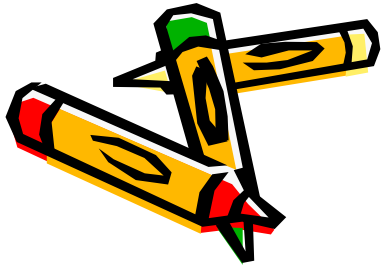
McCane DR et al. BMJ 1994;308:1323-8

Engelgau MM et al. Diabetes Care 1997;20:785-91

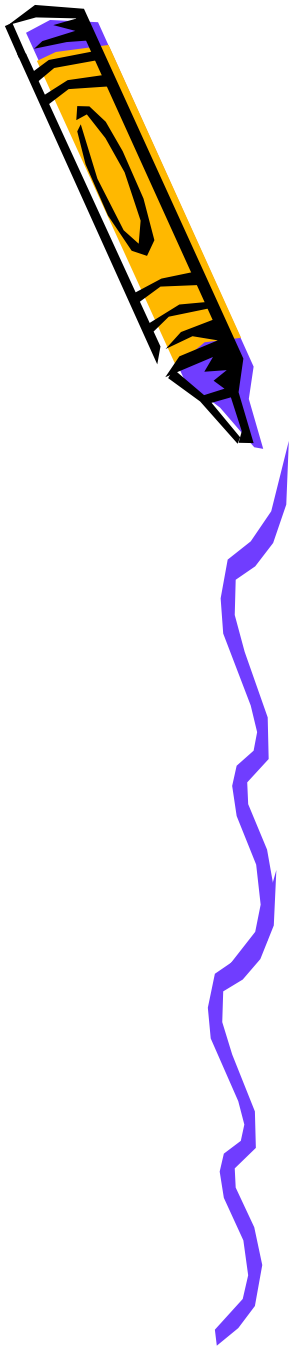
NHANES III

3) Increased incidence of CHD at FPG ≥6.9 mmol/l

Jarrett RJ et al. Lancet 1976;ii:1009-12



DM - DIAGNOSIS



Revised "magic figures":

6.1

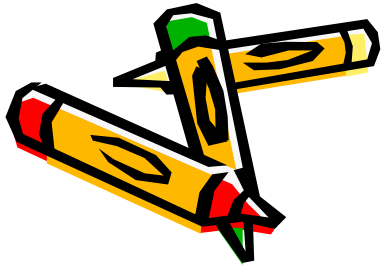
7.0

7.8

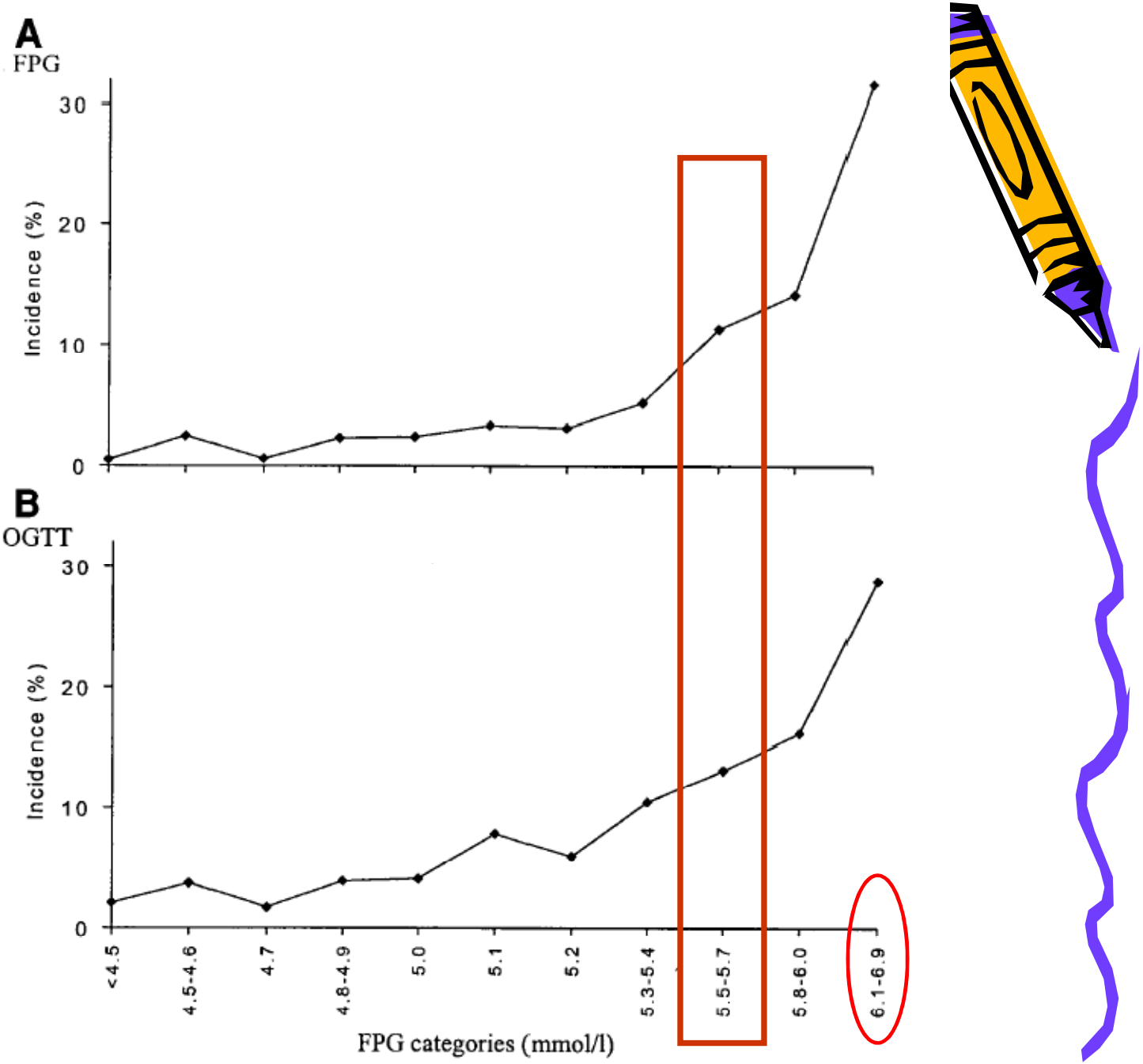
11.1

DM - DIAGNOSIS
Added issues on IFG

- To predict future diabetes (metabolic outcome), using ROC curve analysis for best sensitivity and specificity:
  - Ducth - 5.7
  - Pima Indian - 5.4
  - Mauritius - 5.4
  - San Antonio study - 5.2



Future risk of developing diabetes



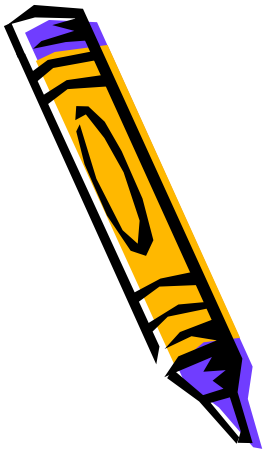
Shaw JE et al. Diabetes Care 2000

DM - DIAGNOSIS

	ADA 2003	WHO 1998
Classical symptoms	±	±
FPG (venous)	≥7.0 mmol/l	≥7.0 mmol/l
Random PG	≥11.1 mmol/l	≥11.1 mmol/l
OGTT 2hr PG	≥11.1 mmol/l	≥11.1 mmol/l
Values	Preferably 2 values if asymptomatic	2 values unless unequvicocal e.g. acute decompensation
OGTT	Either FPG or 2hr PG may be used	Not recommended for routine use
IFG	**≥5.6** to <7.0 mmol/l (≥100 to <126 mg/dl)	≥6.1 to <7.0 mmol/l (≥110 to <126 mg/dl)
HbA1c	**NOT recommended**	**NOT recommended**

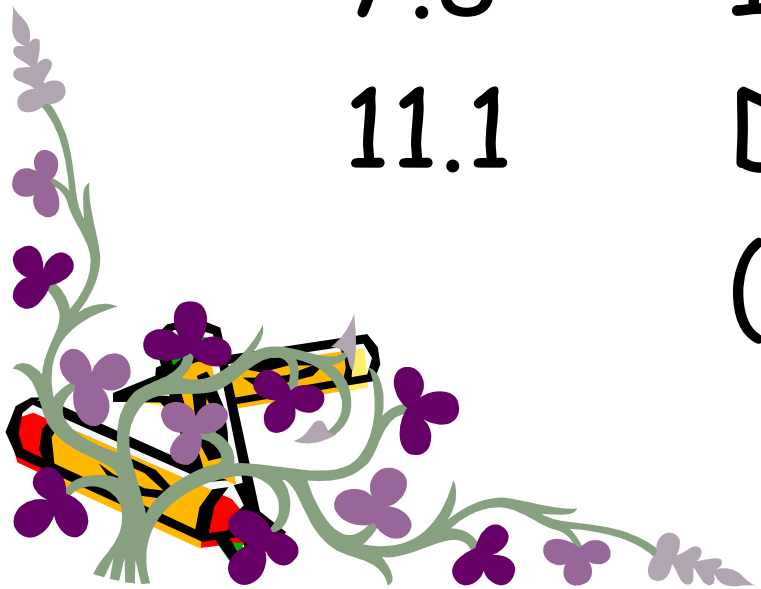
ADA. Diabetes Care 2003;26:3160-7
Alberti KGMM et al. Diabet Med 1998;15:539-53

DM - DIAGNOSIS



"magic figures"

5.6/6.1	NFG, IFG (FPG)
7.0	DM (FPG)
7.8	IGT (OGTT)
11.1	DM
	(2hr or random PG)

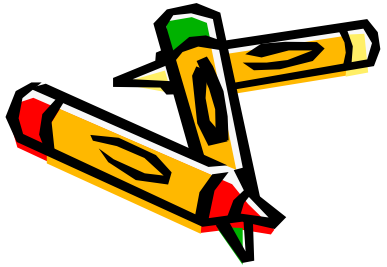


PG or HbA_{1c} to diagnose diabetes

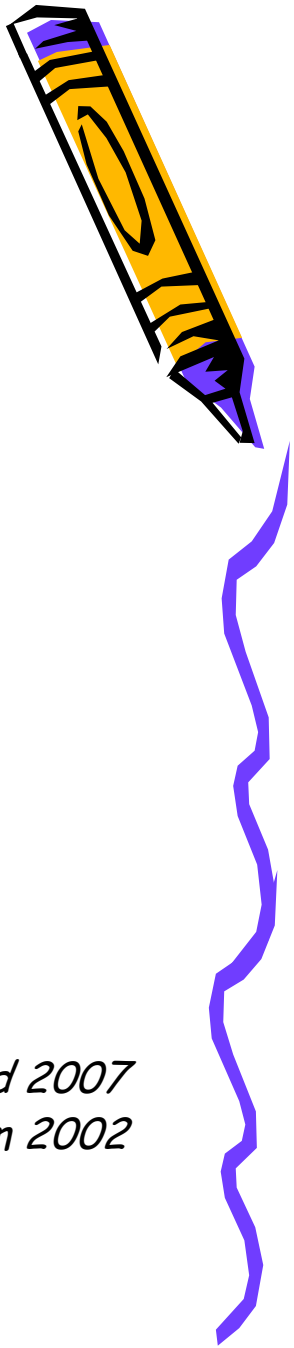
The Good, the Bad and the Ugly

The BAD of PG

- Fasting &/or 2hr OGTT: need special arrangement
- Higher assay variability of PG as compared to A1c ♠
- Variation between plasma, whole blood & capillary blood values ♥

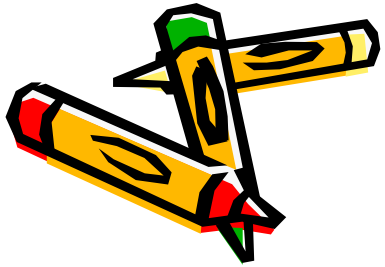


Assay variability

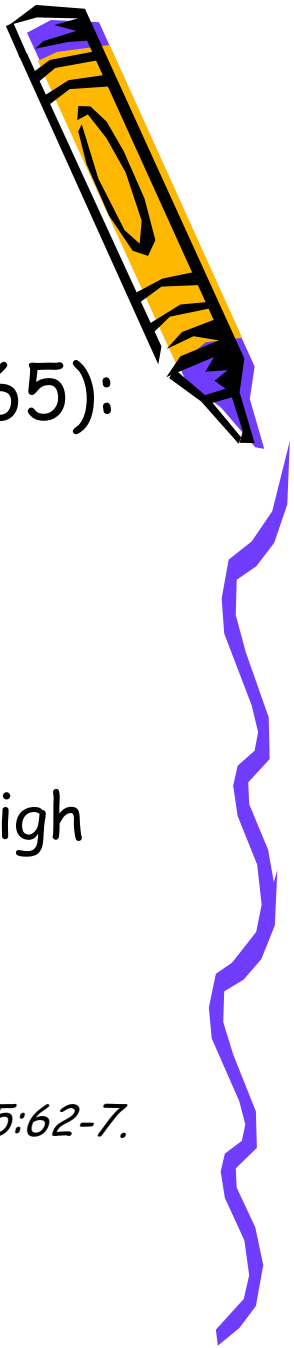


- Biological variability with same subject:
  - Time of day, stress, timing to sample processing, …
  - Intra-CV:
    - A1c = 3.6%
    - FPG = 5.7%
    - 2hr PG = 16.6%

Selvin E et al. Arch Intern Med 2007
Rohlfing C et al. Clin Chem 2002



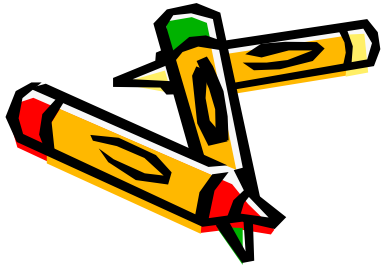
OGTT: 2hr PG



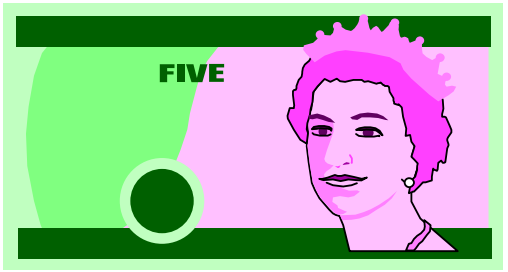
- 212 Hong Kong Chinese subjects (age 30-65):
  - 2 OGTTs in a 6-wk period
  - Reproducibility = 65.6%

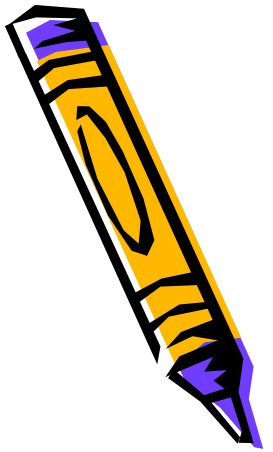
    (139/212: 74 normal OGTT, 24 DM, 41 IGT on both occasions)
  - Among subjects with high HbA1c (≥5.8%) or high BMI (≥25 kg/m²):
    - reproducibility = 52.8% & 58.3% respectively

Ko GT et al. Ann Clin Biochem 1998;35:62-7.

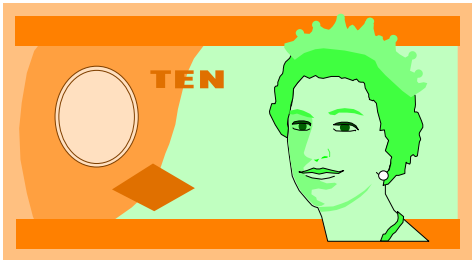


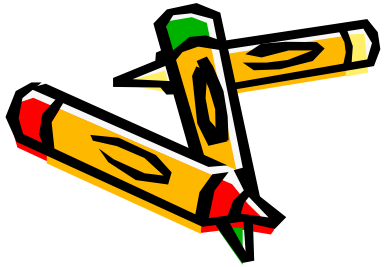
OGTT: 2hr PG





- **Reproducibility**:
  - Only 50% of OGTTs are reproducible in normal population





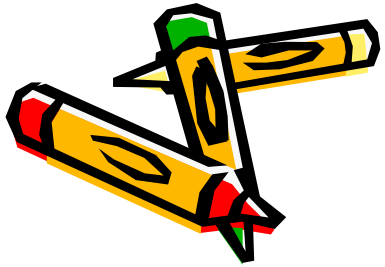
Ganda OP et al. Diabetes 1978;27:715-25.

Troxler RG et al. Aviat Space Environ Med 1975;46:729-35.

Drawback of OGTT (2hr PG)

- poor reproducibility
- laborious
- time consuming
- costy
- inconvenient to patients
- GI upset

(NOT recommended by ADA 1997/2003 & WHO 1998 guidelines)

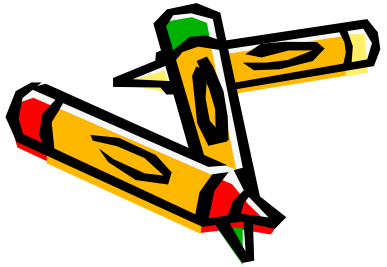


Variations between types of samples

		Fasting		2-hr	
Plasma	Venous	6.1	7.0	7.8	11.1
Plasma	Capillary	6.1	7.0	8.9	12.2
Whole blood	Venous	5.6	6.1	6.7	10.0
Whole blood	Capillary	5.6	6.1	7.8	11.1

- Plasma glucose > whole blood glucose
- venous glucose < capillary glucose
  fasting: similar; post-meal: difference

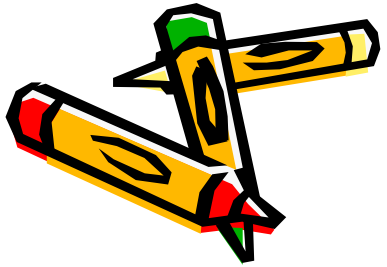
~10% difference in each condition



The GOOD of A1c

Advantages of A1c for diagnosis of DM:

- No need for fasting or timed samples (convenient)
- Substantially less biologic variability; less pre-analytic instability (reproducibility)
  - Relatively unaffected by acute (e.g. stress or illness related) perturbation in PG levels
- Assay: standardized and alignes to DCCT/UKPDS (PG is less well standardized) ♠
- Currently used to guide Mx and adjust Rx ♥
- Better index of overall glycemic exposure and risk for long-term complications / metabolic outcome ♣



Assay standardization

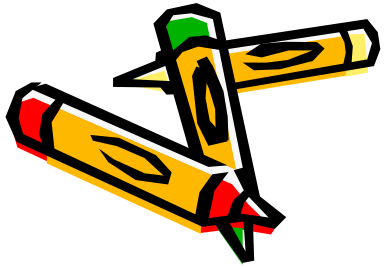
Standardization led by:

- the International Federation of Clinical Chemistry and Laboratory Medicine (IFCC)

Miedema K. Diabetologia 2004

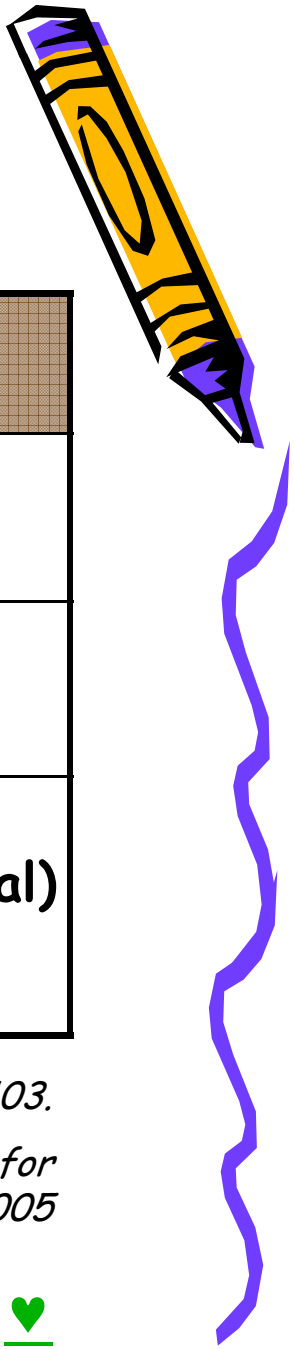
College of American Pathologists (CAP)

- Average CV of A1c:
  - 6-7% in 2003 to ~4% in 2009
- Acceptable limits for error:
  - 10% in 2009
  - plan to reduce to 6% in coming years



Little RR et al. NGSP. ADA abstract 2009

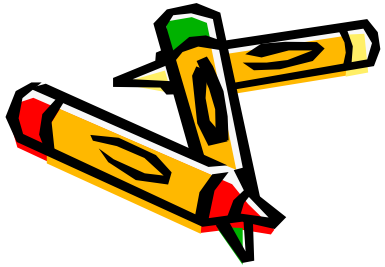
Treatment targets



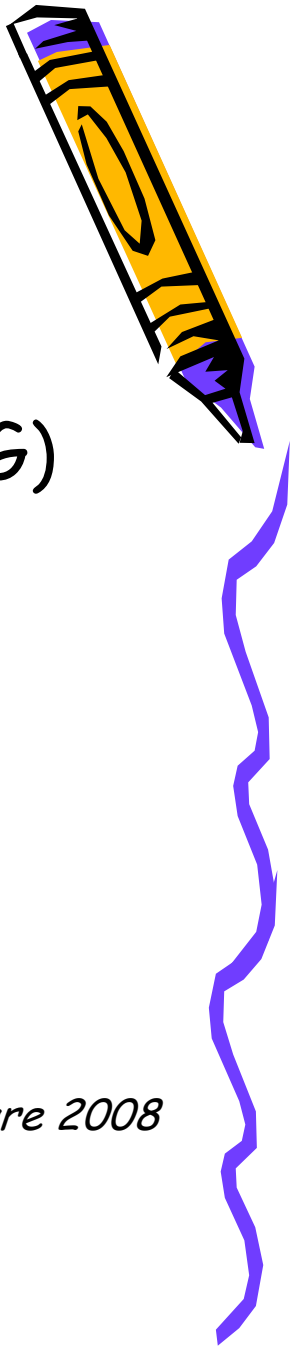
	ADA	IDF
HbA1c	<7%	<6.5%
Pre-prandial PG	5.2-7.0 mmol/L	<6 mmol/L
Post-prandial PG	<10.0 mmol/L	<8 mmol/L (1-2 hr after meal)

ADA. Diabetes Care 2007; 30 (Suppl 1): :S1-S103.

IDF Clinical Guidelines Task Force, ed. Global Guideline for Type 2 Diabetes. Brussels: IDF 2005



Overall glycemic exposure



- Estimated Average Glucose (eAG)
- Mean Self-Monitored Blood Glucose (SMBG)
- A1c-Derived Average Glucose (ADAG) Equivalent (ADAGE)
- Continuous Glucose Monitoring (CGM) level

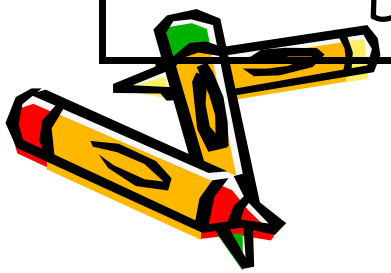
- 'Average glucose' = $28.7 \times \underline{\text{A1c}} - 46.7$
  - $R^2 = 0.84$

Nathan DM et al. ADAG Study. Diabetes Care 2008

(? Ignored: age, ethnicity, Hb level, renal fx, …)

Relationship of PG with outcomes / CVD / mortality

	Fasting PG	2hr or Pp-PG
Whitehall survey		√
Paris Prospective Study		√
Helsinki Policemen Study		√
Coutinho M 1999	√	√
Honolulu Heart Program 1999		√
Chicago Heart Study 1997		√
Rancho Bernardo Study 1998		√
Shaw JE 1999	×	√
DECODE 2003	×	√



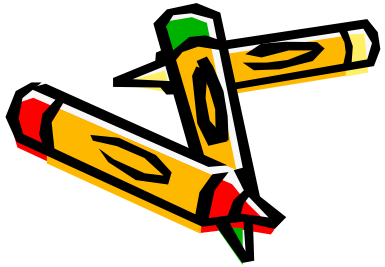
A1c reflecting risk and outcomes

- A1c tertiles associated with CVD risk factors in subjects with NGT

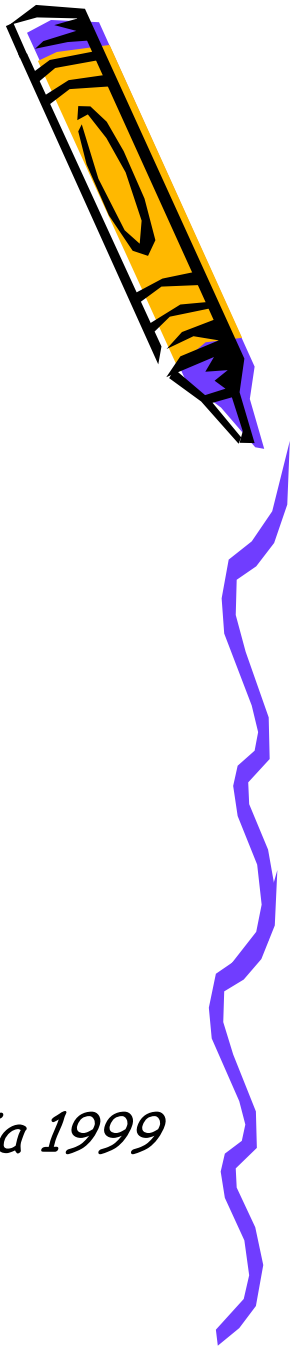
Ko GT et al. Diabet Med 1998

- ⇑ CVD risk with ↑ A1c values among non-DM and DM

Khaw KT et al (Norfolk Study). Ann Intern Med 2004
Selvin E et al (ARIC Study). Arch Intern Med 2005
Pradham AD et al. Am J Med 2007
Brewer N et al (New Zealand linkage study). Diabetes Care 2008
Gerstein HC et al (CHARM Program). Arch Intern Med 2008

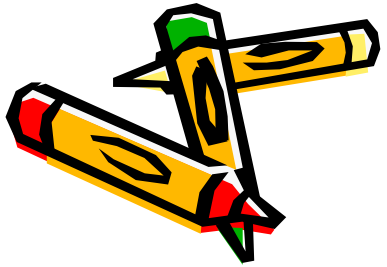


A1c vs. PG reflecting outcomes



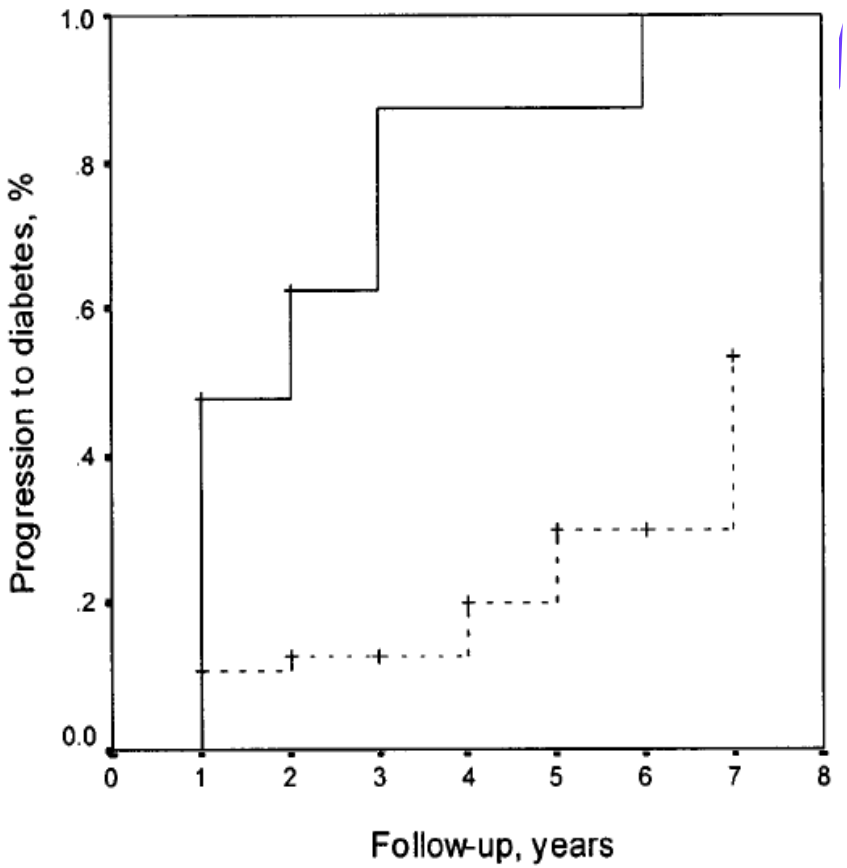
- Hoorn Study
  - 2-h PG and to a lesser extent HbA1c, indicate a risk of all-cause and cardiovascular mortality in general population
  - RR for all-cause & CVD mortality
    - A1c 1.4 (1.2, 1.7) vs. 2hr PG 1.5 (1.3, 1.9)
    - A1c 1.5 (1.2, 1.9) vs. 2hr PG 1.6 (1.3, 2.1)

De Vegt et al. Diabetologia 1999



HK Chinese subjects with risk factors for DM:

			LR	Prog to DM, %/yr
FPG	A1c	No.	DM	ADA
≥6.1	≥6.1	21	9.32	44.1
≥6.1	<6.1	18	1.06	17.4
<6.1	≥6.1	36	0.90	13.7
<6.1	<6.1	133	0.58	8.1
Total		208	-	13.2

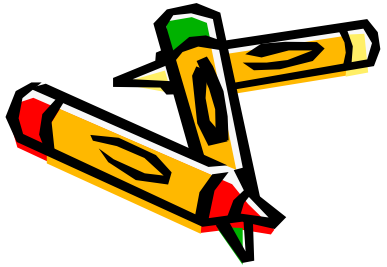


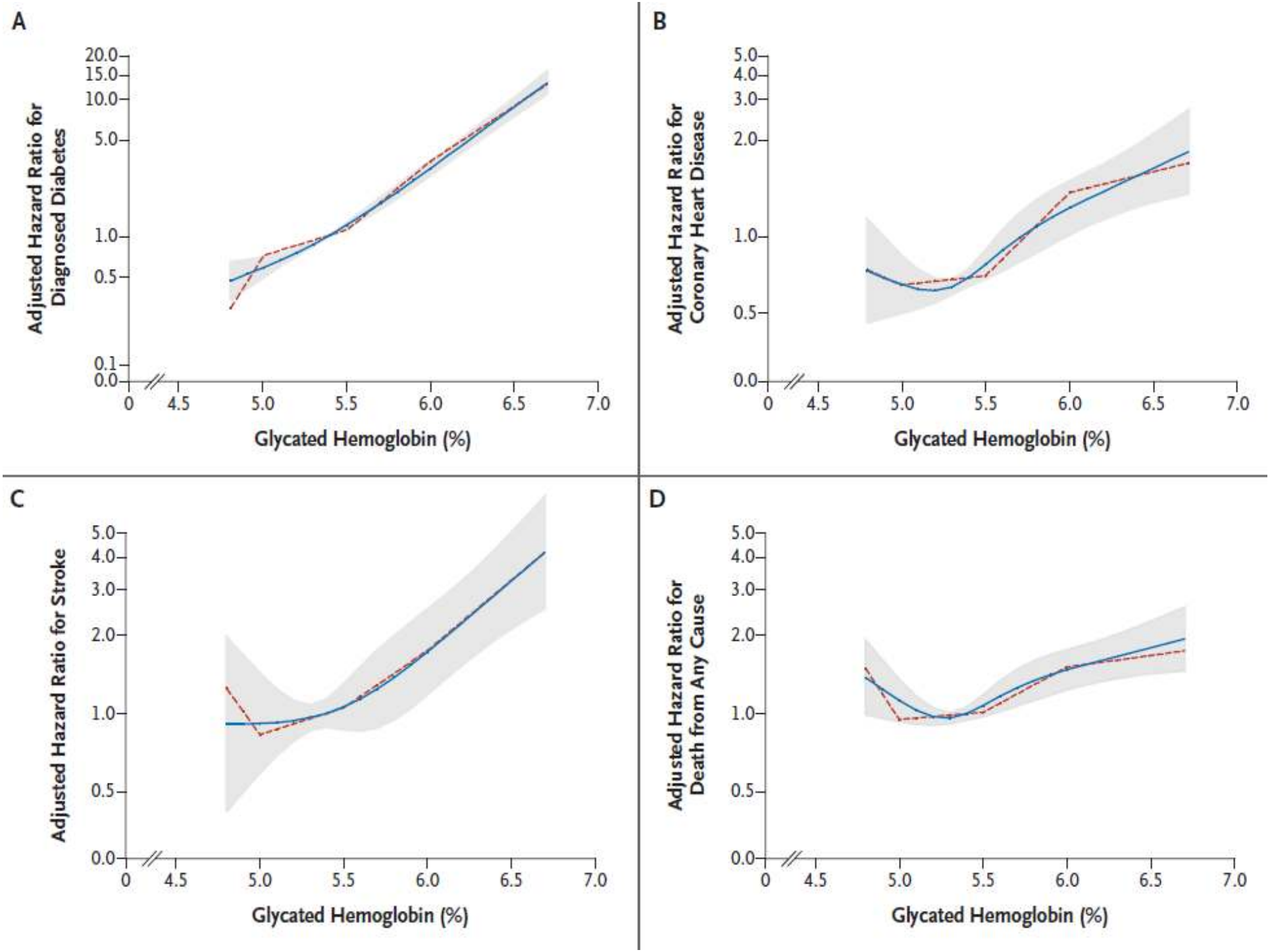
Ko GT et al. Diabetes Care 2000;23: 1770-3

A1c vs. PG reflecting outcomes

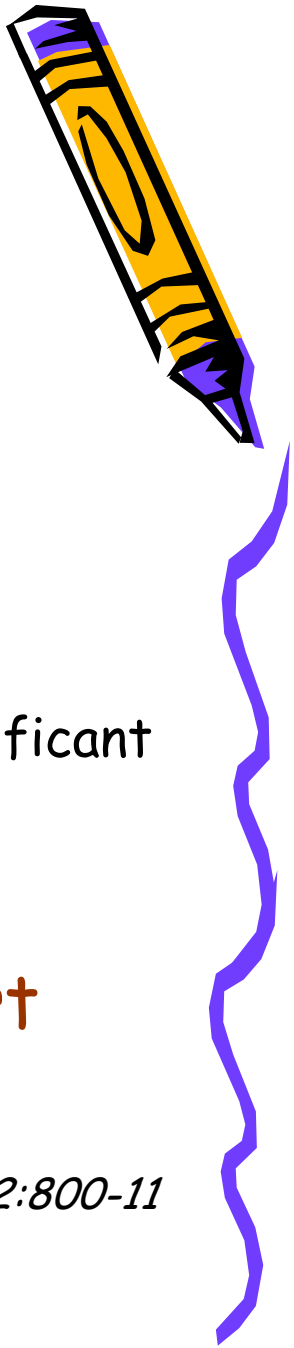
- Atherosclerosis Risk in Communities (ARIC) Study
  - 11092 non-diabetic adults (1987-89)
  - Assessed prognostic value of A1c and FPG for DM, CVD, all-cause mortality
  - Median FU 14 years

Selvin E et al. NEJM 2010;362:800-11



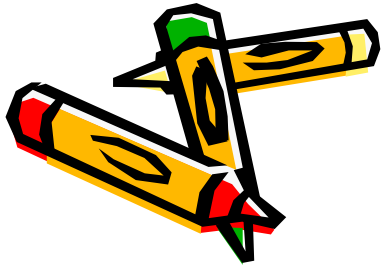

A
Adjusted Hazard Ratio for Diagnosed Diabetes
20.0
15.0
10.0
5.0
1.0
0.5
0.1
0.0
0
4.5
5.0
5.5
6.0
6.5
7.0
Glycated Hemoglobin (%)
B
Adjusted Hazard Ratio for Coronary Heart Disease
5.0
4.0
3.0
2.0
1.0
0.5
0.0
0
4.5
5.0
5.5
6.0
6.5
7.0
Glycated Hemoglobin (%)
C
Adjusted Hazard Ratio for Stroke
5.0
4.0
3.0
2.0
1.0
0.5
0.0
0
4.5
5.0
5.5
6.0
6.5
7.0
Glycated Hemoglobin (%)
D
Adjusted Hazard Ratio for Death from Any Cause
5.0
4.0
3.0
2.0
1.0
0.5
0.0
0
4.5
5.0
5.5
6.0
6.5
7.0
Glycated Hemoglobin (%)

A1c reflecting risk and outcomes



- ARIC Study
  - A1c:
    - DM/ CHD/ stroke: +ve association
    - All-cause death: J-shaped curve
    - Remained significant after adjusting baseline FPG
  - FPG:
    - DM/ CVD/ death: +ve association became non-significant when adjusted for A1c

- Conclusions: A1c was superior to FPG for assessing long-term CVD risk, and support use of A1c to diagnose DM



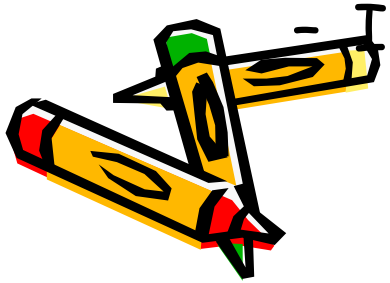
Selvin E et al. NEJM 2010;362:800-11

Relationship of PG with outcomes / CVD / mortality

	FPG	2hr / Pp-PG	A1c
Whitehall survey		√	
Paris Prospective Study		√	
Helsinki Policemen Study		√	
Coutinho M 1999	√	√	
Honolulu Heart Program 1999		√	
Chicago Heart Study 1997		√	
Rancho Bernardo Study 1998		√	
Shaw JE 1999	×	√	
Hoorn Study 1999		√	√
DECODE 2003	×	√	
Ko et al 2000; Norfolk Study 2004; NZ linkage study 2008; CHARM Program 2008			√
ARIC Study 2010	+/-		√

The BAD of HbA1c

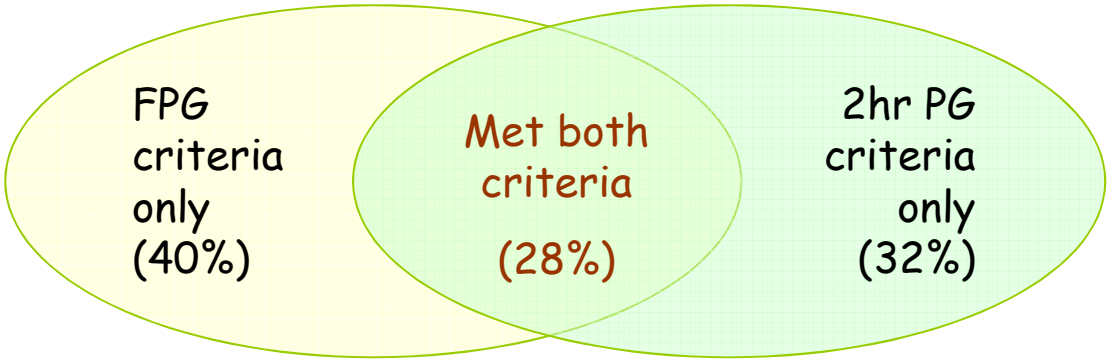
- ? Optimal cutoff
  - Sensitivity vs. specificity
  - Relationship / overlap with 'gold standard' ♠
- Assay methods ♥
- Confounding medical conditions e.g. hemoglobinopathies, anemia ♣
- Cost (needs 2 values to make a diagnosis)
- Ethnic differences in A1c are independent of glycaemia
  - Inter-patient variability of Hb glycation



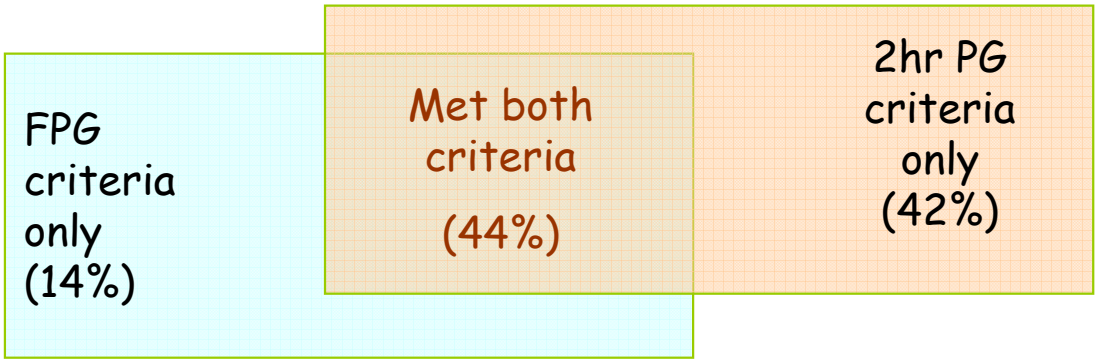
♦

"Overlap" between FPG and 2hr PG

Asymptomatic diabetes

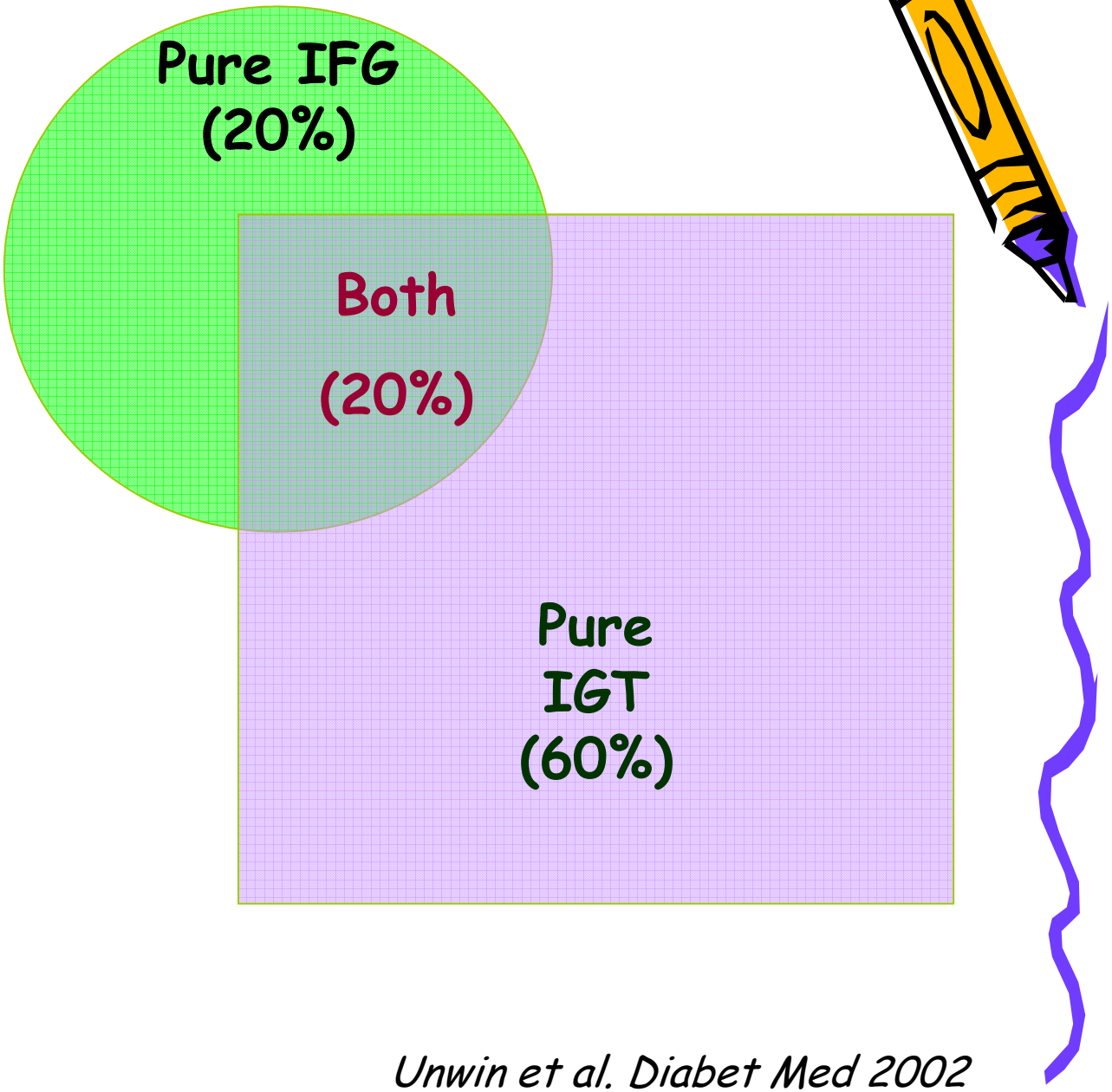


DECODE Study. BMJ 1998



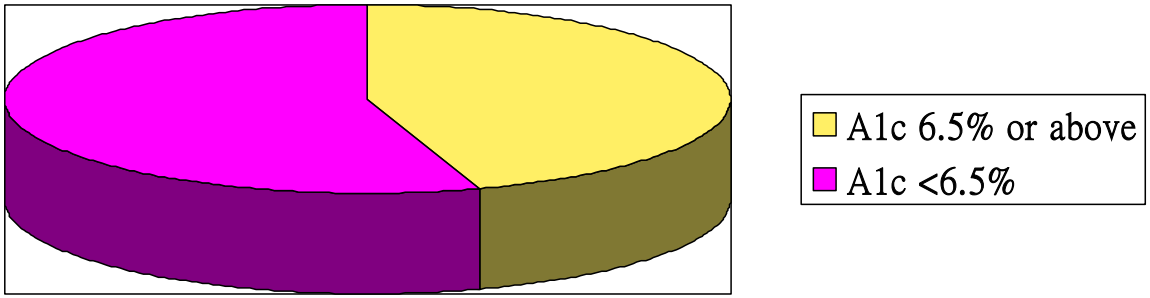
US NHANES III study: King H et al. Diabetes Care 1998

Pre-Diabetes



Unwin et al. Diabet Med 2002

DM with FPG ≥7 mmol/L

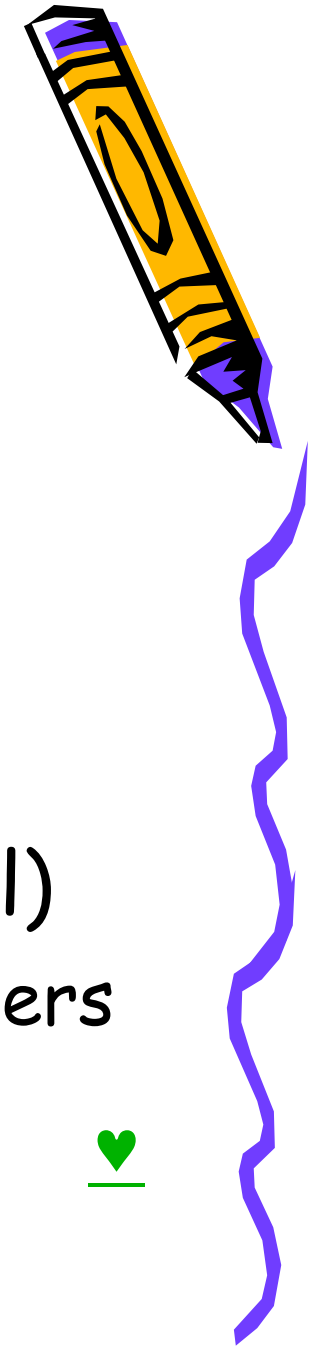


- A1c ≥6.5% for the Dx of DM based on FPG
  (NHANES data)
  - Sensitivity = 42.8-44.3%
  - Specificity = 99.6%

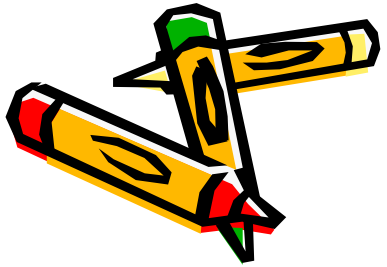
Buell C et al. Diabetes Care 2007
Saudek C et al. J Clin endocrinol Metab 2008

A1c: UNDER-diagnose "DM"

Other A1c assay

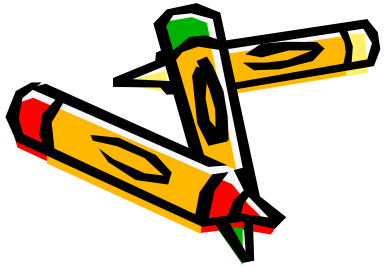


- DCCT not aligned yet
- "Point of care" A1c methods
  - Exempted from CAP quality standardization
- Modification of A1c units (mmol/mol)
  - Potential marked confusion to pts & users



'Discrepancy' between A1c and PG

OVER-Dx by A1c ("falsely" high A1c value)	UNDER-Dx by A1c ("falsely" low A1c value)
Fe deficiency	*Hemoglobinopathies
Following splenectomy	Pregnancy
Elderly	Uremia; on hemodialysis
Black subjects	HIV infection (antiretroviral drugs)
	"general populations"



*HbS, HbC, HbE, HbD, … traits

- >10% Africans, Asians, …

NGSP. A1c & Hb variants. 2009 www.ngsp.org/

	A1c	FPG	2hrPG
Assay standardization	√√	√	√
Reproducibility: Intra-CV	3.6%	5.7%	16.6%
Lab to lab differences	+/- Large	Less	Less
Easy to measure	√√√	√	-
Cost	-	√√√	√
Global availability	√	√√√	√√
Overall glycemia	√√	-	-
Predicting long-term complications	√√	√√	√√√
DM monitoring/ Chronic Mx	√√√	√√	- / √
Overlap with diagnosis by 2hr PG	Limited	Limited	"Gold standard"
Clinical limitations	*RBC lifespan abnormalities; Fe def; pregnancy; age; ethnicity	Fasting; to be analyzed promptly	75g glucose loading; to be analyzed promptly; gastric surgery

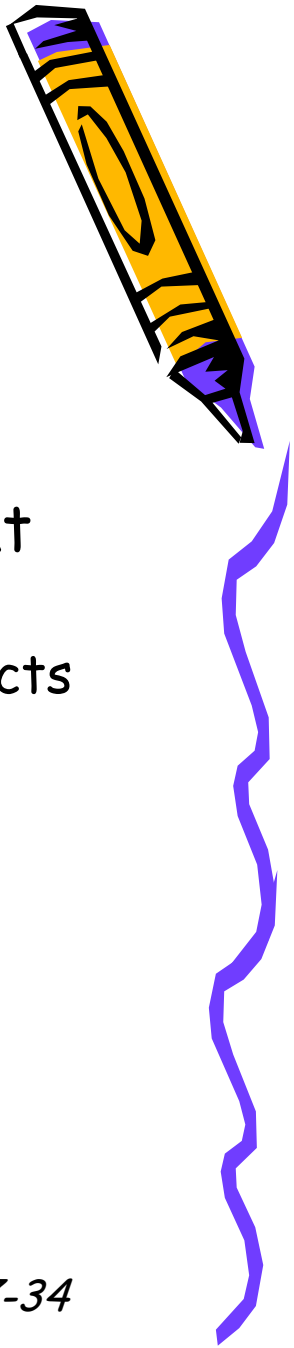
*Hemolytic disorders, carbamylated Hb in uremia, thalassemia/ hemoglobinopathies, …

International Expert Committee on role of A1c assay in the diagnosis of DM, 2009

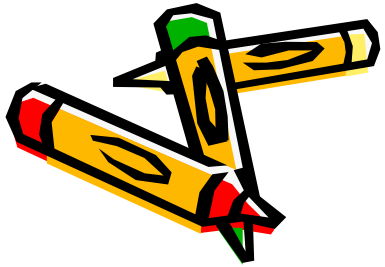
IEC. Diabetes Care 2009;32: 1327-34

IEC members (appointed by ADA, EASD and IDF) convened in 2008

IEC 2009



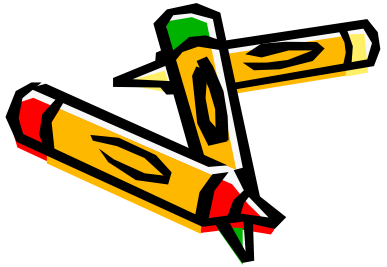
- Diabetes should be diagnosed when:
  - HbA1c ≥6.5%
    - Diagnosis should be confirmed with a repeat A1c test
      - Confirmation not required in symptomatic subjects with PG ≥11.1 mmol/l
    - If A1c testing not possible, previously recommended methods on FPG &/or 2hr PG are acceptable
    - No age- or race-specific values (yet)



IEC. Diabetes Care 2009;31:1327-34

IEC 2009

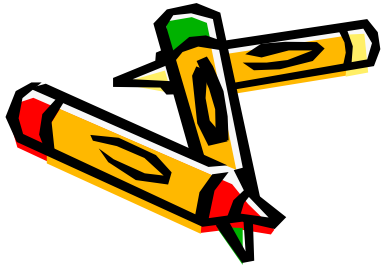
- Special groups:
  - Children:
    - A1c is also indicated if DM is suspected, and classic symptoms and a casual PG >11.1 mmol/l are not found
  - Diagnosis of DM in pregnancy:
    - Changes in RBC turnover make the A1c assay problematic, will continue to require PG
  - Other condition that changes RBC turnover e.g. hemolytic anemia, blood transfusion, etc
    - Continue to use PG



IEC. Diabetes Care 2009;31:1327-34

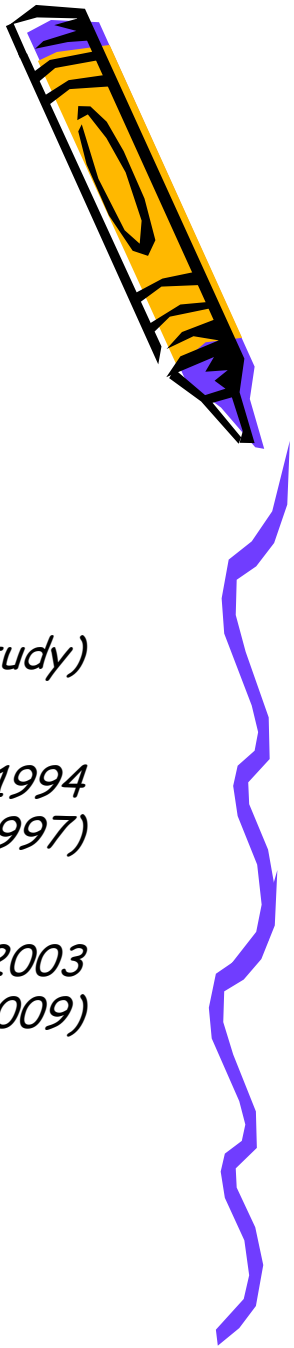
IEC 2009

- High risk subjects:
  - "pre-diabetes" (IFG, IGT):
    - Will be phased out of use as A1c replace PG measurements
  - A1c ≥6 and <6.5%:
    - Likely at the highest risk for progression to DM
    - Should receive preventive interventions
  - A1c <6%:
    - May still be at risk
    - To see other DM risk factors



IEC. Diabetes Care 2009;31:1327-34

Why 6.5%



- Risk of retinopathy, significantly rise if
  - 2hr PG ≥11.1 mmol/L

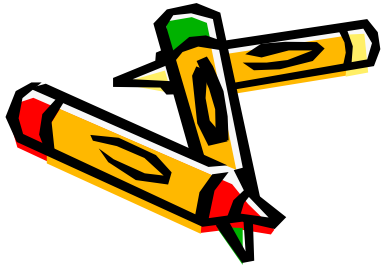
(Whitehall Survey, Bedford Study)

  - FPG ≥7.0 mmol/L

(McCane DR et al. BMJ 1994
Engelgau MM et al. Diabetes Care 1997)

  - A1c ≥6.5%

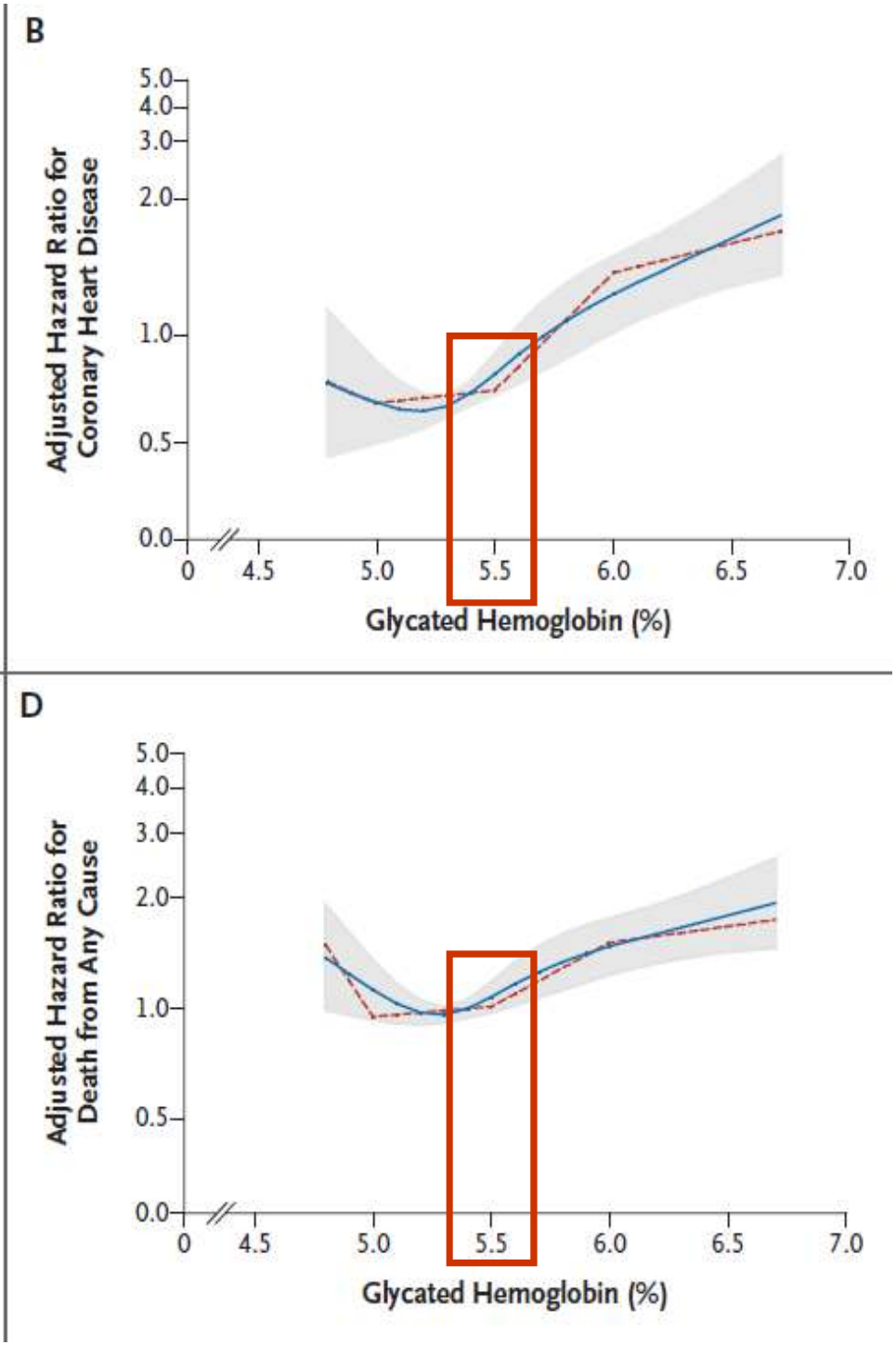
(DETECT-2. Diabetes Voice 2003
Sabanayagam C et al. Diabetologia 2009)



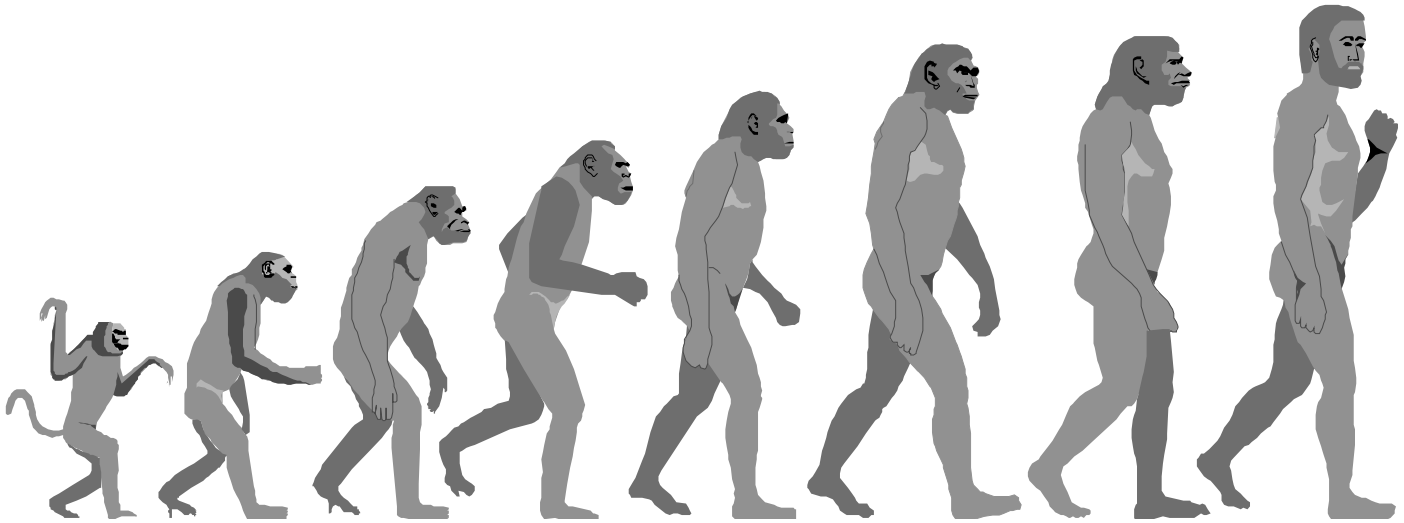
Risk of CHD, stroke & death significantly rise if:

- FPG ≥7.0 mmol/L
- A1c ≥5.5%

Selvin E et al. NEJM 2010;362:800-11



DM - DIAGNOSIS



- IEC stressed the CONTINUUM of risk for diabetes with all glycemic measures

ADA Position Statement 2010

- Dx & Csf of DM

ADA. Diabetes Care 2010;33: S62-S69

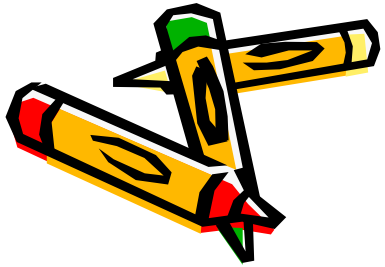
Criteria for DM Dx

Either one of the below:			
Random PG	≥11.1 mmol/l	& with symptoms	
FPG	≥7.0 mmol/l	Fasting >8 hrs	To be confirmed by repeat testing, if no unequivocal hyperglycemia
2hr PG (OGTT)	≥11.1 mmol/l		
A1c	≥6.5%	NGSP certified; DCCT assay standardized	

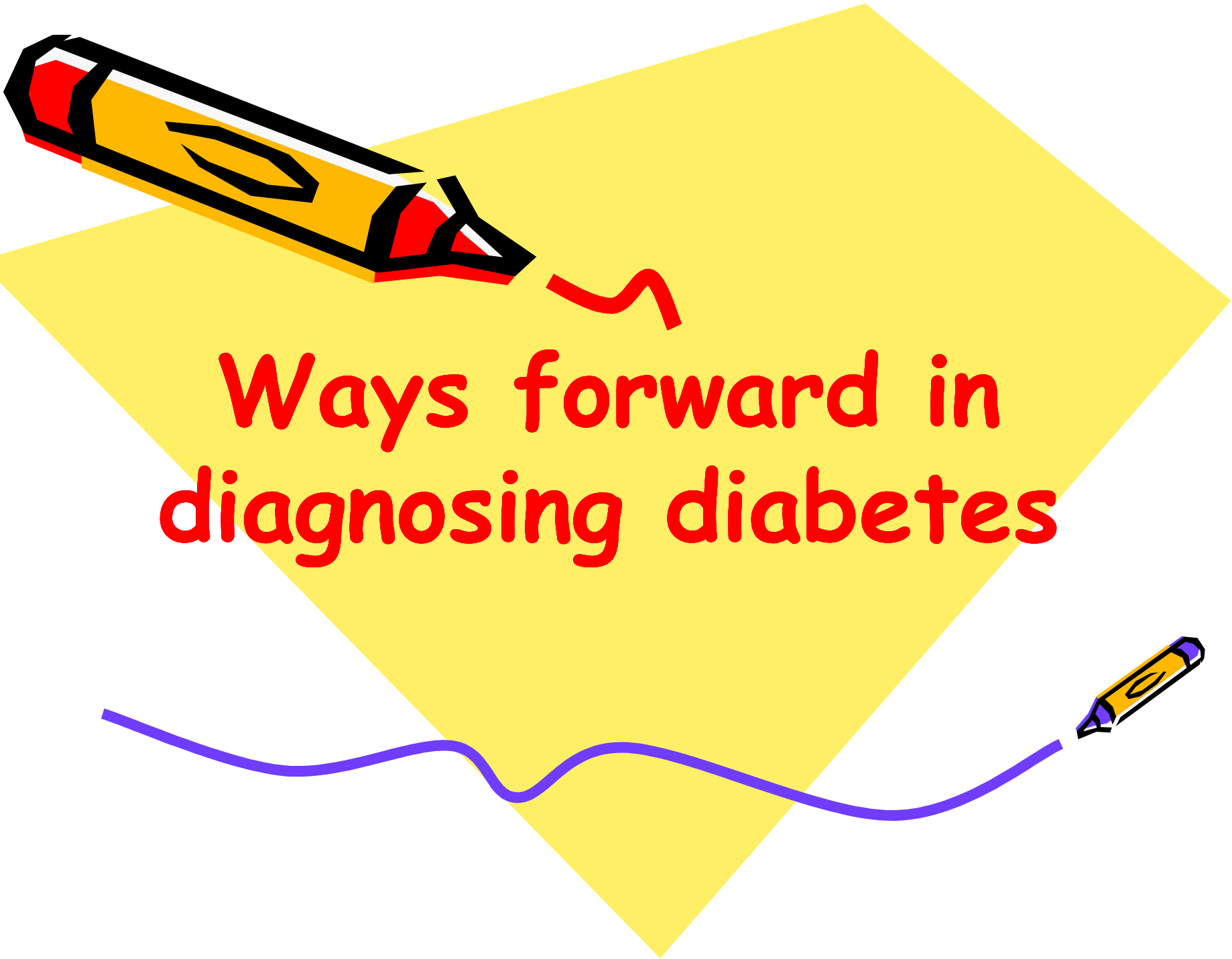
ADA. Diabetes Care 2010;33 (Suppl 1):S62-9.

Categories of increased risk for DM

FPG	≥5.6 – 6.9 mmol/l	Fasting >8 hrs	* Continuous risk, extending below the lower limit of the range and becoming disproportionately greater at higher ends of the range
2hr PG (OGTT)	≥7.8 - 11.0 mmol/l		
A1c	≥5.7 - 6.4%	NGSP certified; DCCT assay standardized	

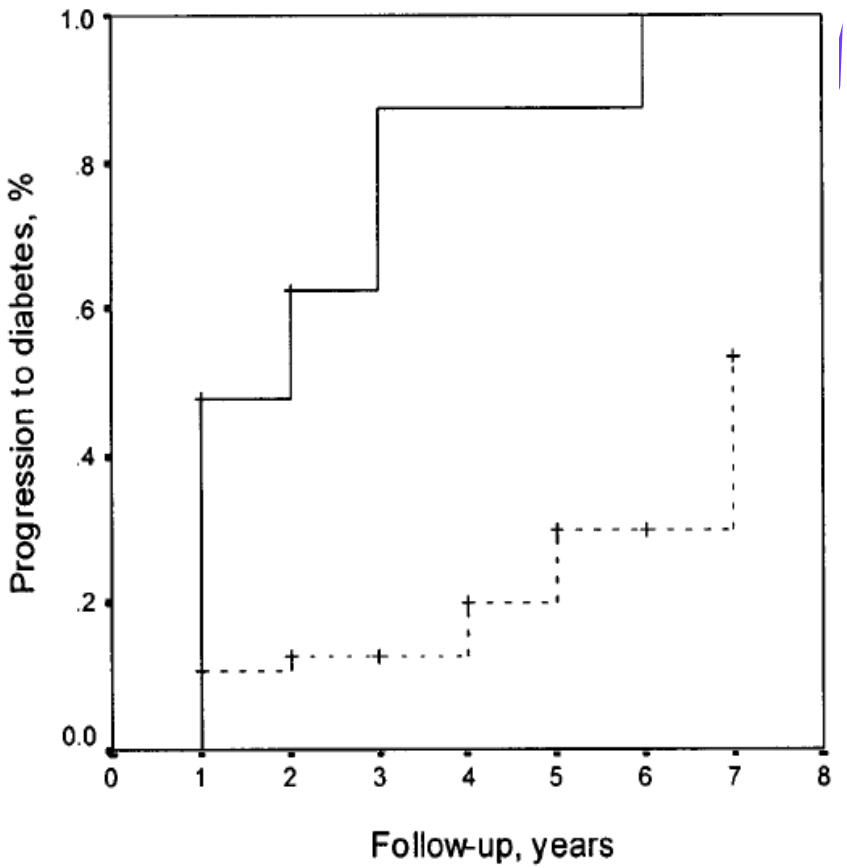


ADA. Diabetes Care 2010;33 (Suppl 1):S62-9.


Ways forward in diagnosing diabetes

HK Chinese subjects with risk factors for DM:

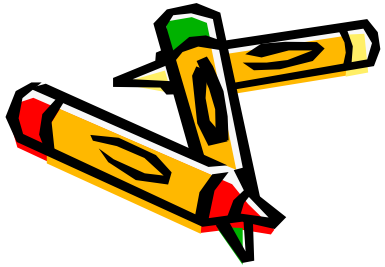
			LR	Prog to DM, %/yr
FPG	A1c	No.	DM	ADA
≥6.1	≥6.1	21	9.32	44.1
≥6.1	<6.1	18	1.06	17.4
<6.1	≥6.1	36	0.90	13.7
<6.1	<6.1	133	0.58	8.1
Total		208	-	13.2



Ko GT et al. Diabetes Care 2000;23: 1770-3

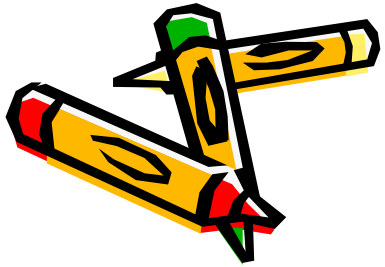
FPG & A1c 'predicting' DM

			OGTT			LR	
FPG	A1c	No.	Normal	IGT	DM	*Abn	DM
HK Chinese subjects with risk factors for DM							
≥5.6	≥5.5	880	132	221	527	7.03	5.36
≥6.1	≥6.1	551	25	96	430	17.2	12.8
HK Chinese subjects from community (ADA criteria)							
≥6.1	≥6.1	18	1	4	13	141.9	74.7



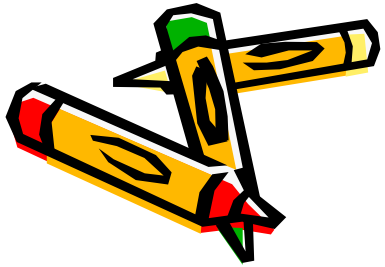
Ko GT et al. Diabetes Care 1998:21: 1221-5
Ko GT et al. Diabetes Care 1998;21: 2032-3
Ko GT et al. Diabetes Care 1999;22: 1908-9

Categories	Choice of test
Diagnosing diabetes e.g. symptomatic pts	Fasting or random PG (on 2 separate occasions)
Epidemiological survey	Fasting or 2 hour PG after OGTT (one value only)
Diabetes screening:	
1. no risk factor	Fasting PG
2. risk factor present e.g. FH +ve	OGTT, or paired test of FPG + HbA_{1c}
Selected subjects:	
1. pre-DM i.e. IGT or IFG	OGTT
2. FPG ≥5.6 mmol/L & HbA_{1c} ≥5.5%	OGTT



Ko GT. Diagnosing diabetes mellitus in the Asian population. HK Med J 2000;6:53-9.

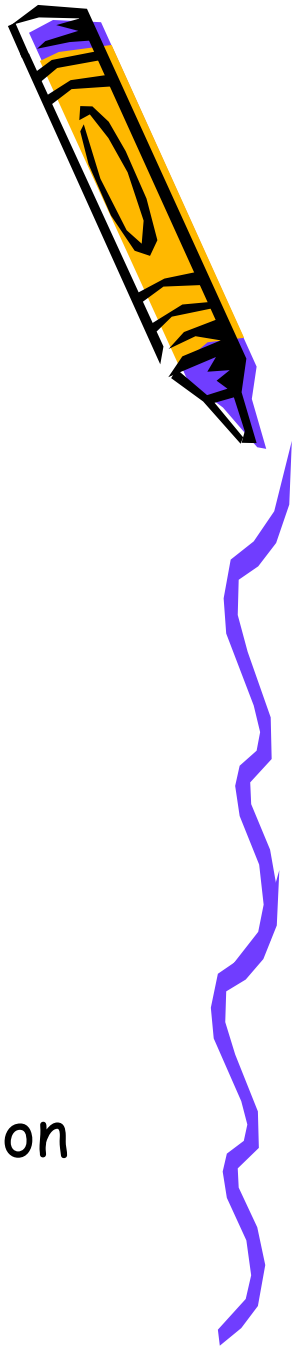
Categories	HK	ADA / IEC
Diagnosing diabetes	FPG or RPG (twice)	RPG / FPG / 2hPG / A1c (twice)
Epidemiological survey	FPG or 2hPG (once)	Not clear (? FPG / A1c, once)
Diabetes screening:		
1. no risk factor	FPG	FPG or A1c
2. at risk e.g. pre-diabetes; hx of borderline high A1c	OGTT, or FPG + HbA_{1c}	FPG / 2hPG / A1c (twice)



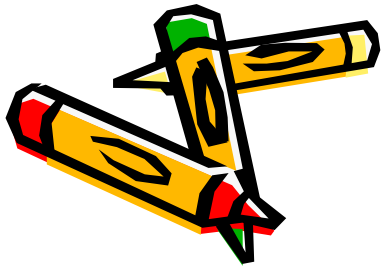
Ko GT. HK Med J 2000;6:53-9.

ADA. Diabetes Care 2010;33 (Suppl 1):S62-9.

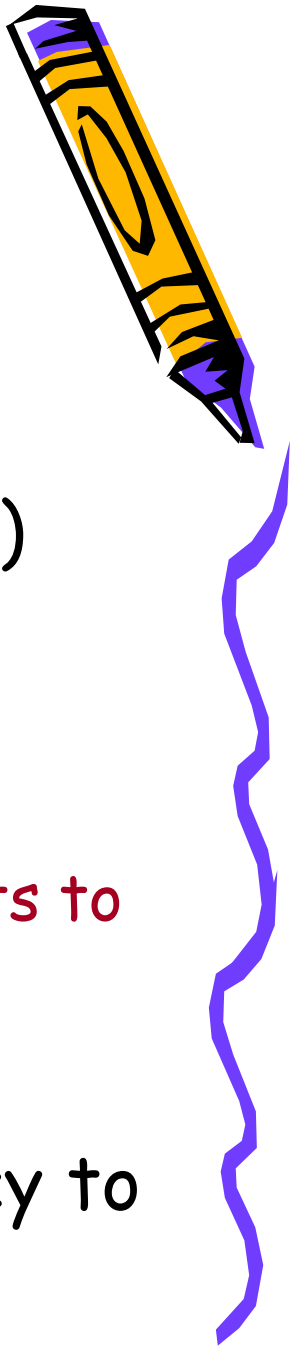
Decision on DM Dx test (I)



- Clinicians
  - Understanding on the tests
- Patients
  - Medical conditions e.g. hbopathy
  - Degree of DM Risk
  - Availability for vs. Preference to a test
- Test options
  - Availability vs. Practicality
  - Resources of testing centers
    - ? Further evidence-based information on the tests e.g. diagnostic cut-off level, confounders …

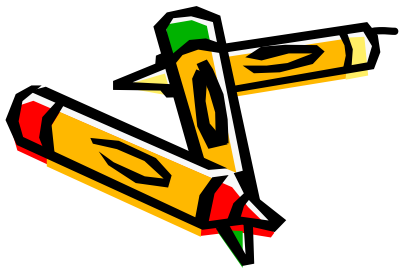


Decision on DM Dx test (II)

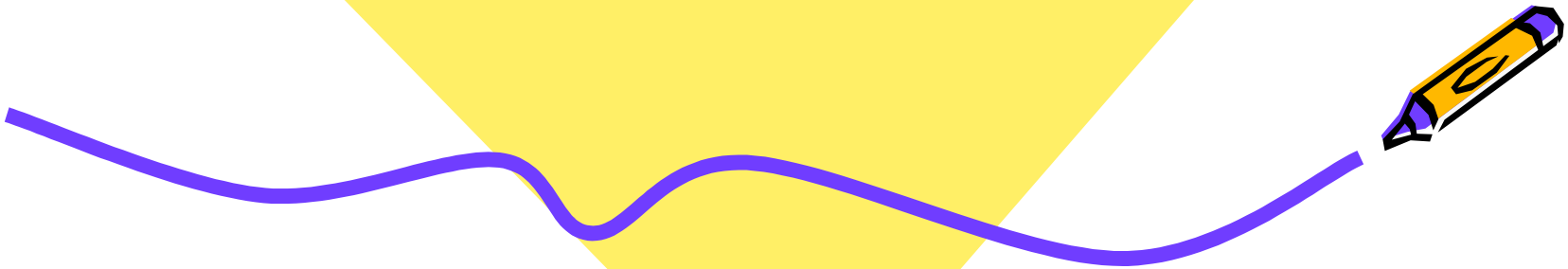


- Most cases
  - FPG or RPG or A1c
  - Repeat testing (the abnormal test)
    - ± 2hr PG with OGTT
- At risk patients

  (i.e. high chance of the need for 2 tests to confirm Dx)
  - FPG + A1c
  - Higher the risk, more the tendency to check 2 tests at the same time



Thank You For Your Attention



Dx of hyperglycemic disorders in pregnancy

First prenatal visit				
Measure FPG, A1c, or RPG on all or only high-risk women				
	FPG	A1c	RPG	
Either one:	≥7 mmol/l	≥6.5%	≥11.1 mmol/l (+ confirmation by FPG/A1c)	Overt DM
	≥5.1-6.9 mmol/l	-	-	GDM
24-28 wks' gestation (2hr 75g OGTT)				
	FPG	1hr PG	2hr PG	
	≥7 mmol/l	-	-	Overt DM
Either one:	≥5.1 mmol/l	≥10 mmol/l	≥8.5 mmol/l	GDM

Int Asso of DM & Pregnancy Study Groups (IADPSG). Diabetes Care 2010;33:676-82.