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EDITORIAL

# Gestational diabetes mellitus: An update on the current international diagnostic criteria

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## Abstract

The approach to screening and diagnosis of gestational diabetes mellitus (GDM) around the world is disorderly. The protocols for diagnosis vary not only in-between countries, but also within countries. Furthermore, in any country, this disparity occurs in-between its hospitals and often exists within a single hospital. There are many reasons for these differences. There is the lack of an international consensus among preeminent health organizations (*e.g.*, American College of Gynecologists and World Health Organization). Often there is a disagreement between the country's national diabetes organization, its local health society and its regional obstetric organization with each one recommending a different option for approaching GDM. Sometimes the causes for following an alternate approach are very obvious, *e.g.*, a resource strapped hospital is unable to follow the ivory-tower demanding recommendation of its obstetric organization. But more often than not, the rationale for following or not following a guideline, or following different guideline within the same geographic area is without any perceivable explanation. This review is an attempt to understand the problems afflicting the screening and diagnosis of GDM globally. It traces the major temporal changes in the diagnostic criteria of (1) some respected health organizations; and (2) a few selected countries. With an understanding of the reasons for this disparity, a way forward can be found to reach the ultimate goal: a single global guideline for GDM followed worldwide.

**Key words:** Gestational diabetes; Criteria; Screening; Diagnosis; Global



**Core tip:** Globally, the screening and diagnosis of gestational diabetes mellitus (GDM) is idiosyncratic. This disarray is independent of whether a country is affluent (*e.g.*, Denmark) or relatively poor (*e.g.*, Bangladesh). The reason is that not just the international but also the national medical and obstetric organizations in a country advise a multitude of approaches to GDM. This confuses the primary providers of obstetric care, who need one clear, evidence-based, global recommendation. Despite all the differences, in the near future, the light at the end of the tunnel for providing such a universal global GDM guideline is bright.

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## INTRODUCTION

Since it is one the commonest metabolic problems of pregnancy, an accurate diagnosis of gestational diabetes mellitus (GDM), *i.e.,* high plasma glucose first identified during pregnancy, is critical to the care of pregnant women. Five decades ago, GDM was used to detect pregnant women who were at a higher risk of developing type 2 diabetes mellitus (DM2) after childbirth[1]. Currently, GDM is used to predict morbidity in index pregnancy; many trials have confirmed that it is related to multiple maternal and fetal complications like preeclampsia, caesarean sections and birth injuries[2]. Thus, missing GDM has grim implications, personal for individual women and epidemiological for the entire population. Women with diabetes mellitus who become pregnant have more harmful complications (due to the severe hyperglycemia since early pregnancy) compared to pregnant women developing mild hyperglycemia in late pregnancy. The former have diabetes in pregnancy while the latter are diagnosed with GDM. Thus, GDM implies a milder form of hyperglycemia seen generally in late pregnancy, which usually, but not always, reverts to normal after delivery.

The screening of GDM is done by assessing the clinical risk factors or by the 50-g glucose challenge test (GCT).The diagnosis of GDM is made by the 75-g or 100-g oral glucose tolerance test (OGTT). A screen followed by the diagnostic OGTT (in screen positive patients) is called the two-step approach, while OGTT directly without screen is called the one-step approach. The two-step and the one-step screening methods are also known as the selective and universal screening methods, respectively. The various preeminent health organizations recommend different glucose cut-offs for the OGTT; as a result, there many international diagnostic criteria are available for diagnosis[3]. More often than not, the gynecologic, medical and health associations within any one country support distinctly diverse schemes for GDM causing major differences in the approach to GDM. Thus, the scourge of gestational diabetes mellitus (GDM) is the diversity of processes accessible for its screening and diagnosis. The variation in the diagnostic thresholds advocated by these venerable organizations, when applied to the same OGTT, results in major discrepancies in prevalence and the women classified with GDM[3]. Misclassifying women with GDM will result in excessive treatment of many women without GDM and no treatment of many women with GDM again iterating the need for correct classification.

This review traces the progress in the major international diagnostic criteria worldwide. It looks at the changes in practices of GDM screening and diagnosis in selected countries of the world to show that most countries face similar problems caused by the multitude of criteria available. An understanding of the reasons for the disparity is critical to formulate plans for the ideal goal: a single global approach to GDM.

## MAJOR GDM DIAGNOSTIC CRITERIA: DEVELOPMENT

### *World Health Organization criteria*

The World Health Organization (WHO) provides guidelines for numerous communicable and non-communicable diseases. GDM is no exception and due to the worldwide reach and authority of the WHO, the WHO criteria for GDM[4] are popular globally. In 1965, the WHO Expert Committee on Diabetes Mellitus published the first guideline on diabetes mellitus. They defined gestational diabetes as "hyperglycemia of diabetic levels occurring during pregnancy". After these initial attempts to define GDM, new follow-up WHO guidelines were published in 1980, 1985, 1999 and 2013.

In 1980, the WHO recommended the OGTT for diagnosis of DM2 in non-pregnant adults using 2 values: fasting plasma glucose and the 2-h plasma glucose levels after 75-g of oral glucose. For convenience, common thresholds were applied to both pregnant women and non-pregnant adults; thus, the diagnosis of GDM was applied if a woman was pregnant instead of DM2 for the non-pregnant. In 1985, the glucose values were made more precise by rounding to the nearest tenth of a millimole (rather than the nearest millimole). In 1997, for the diagnosis of diabetes, the ADA lowered the fasting plasma glucose (FPG) cut-off to 7.0 mmol/L (from 7.8 mmol/L). In 1999, the WHO followed suit applying the same FPG criteria as recommended by the ADA to the OGTT. The WHO has always applied the same criteria to the pregnant and non-pregnant women even though common thresholds for pregnant and non-pregnant have been shown to be erroneous[5]. However, due to the ease of use, simplicity and global clout, the WHO criteria for have remained popular in most countries of the world.

The current global diabetes epidemic has resulted in many younger women in the child bearing age to get DM2. Due to the more severe fetal and maternal complications resulting from such diabetes mellitus antedating pregnancy, in 2013, the WHO[6] has divided hyperglycemia in pregnancy as follows: (1) Diabetes in pregnancy: Pre-gestational diabetes (PGD) or

pregnancy occurring in a women with known diabetes, and Overt diabetes - diabetes first detected during pregnancy; and (2) Gestational diabetes mellitus.

Essentially, this latest WHO 2013 guideline has endorsed the International Association of Diabetes and Pregnancy Study Groups (IADPSG 2010) criteria (see below).

### *International Association of Diabetes and Pregnancy Study Groups criteria*

In 1998, the International Association of Diabetes and Pregnancy Study Groups (IADPSG) were created to find a common consensus between many national and international groups addressing diabetes in pregnancy. Delegates from over 40 countries met to review the results of the elaborate Hyperglycemia and Adverse Pregnancy Outcome (HAPO) study[7].

In 2010, IADPSG recommended universal screening of all pregnant women with the 75-g oral glucose tolerance test (OGTT)[8]. They used 1.75 odds of having complications seen in the HAPO study and proposed new thresholds for the 75-g OGTT. Thus, the IADPSG criteria had the possibility to be accepted all by the preeminent medical, endocrine and health organizations worldwide. However, as of 2014, as will be pointed out, despite the IADPSG guideline being agreed to by many global health groups, one worldwide guideline remains elusive.

### *American Diabetes Association criteria*

Due to its geographical location and authority, the American Diabetes Association (ADA) criteria are widely used in United States, Canada and Mexico. In 1964, O'Sullivan and Mahan[9] recommended using the 4 sample, 3-h 100-g OGTT for diagnosis of GDM; the glucose thresholds were established from a cohort involving 752 women. With time, as glucose measuring techniques evolved, Carpenter and Coustan (C and C)[10] modified O'Sullivan's recommended glucose thresholds by adjusting for (1) the non-glucose reducing elements in blood; and (2) converting whole blood glucose values to the higher plasma glucose values. So the C and C thresholds were modified to be aligned to the newer glucose enzymatic methods for quantifying plasma glucose. The ADA incorporated the C and C thresholds for the 100-g, 3-h OGTT in their recommendations in 2000. Thus, a two-step approach was popular in North America, *i.e.,* 50-g GCT screen followed by 100-g OGTT if the screen GCT was positive. In 2003, the ADA also accepted the one-step approach of using the 75-g OGTT for the screening and diagnosis of GDM, especially in high-risk populations, since it was deemed more cost-effective. For the thresholds, the C and C cut-offs were used leaving the 3-h glucose value of the 100-g OGTT, which is not collected in the 2-h, 75-g OGTT. In 2011, the ADA accepted the recommendations of the International Association of Diabetes and Pregnancy Study Groups (IADPSG)[8], *i.e.,* using the 75-g OGTT on all women as a one-step screening and diagnostic method eliminating the need for the 50-g GCT. In 2013, after the American College of Obstetricians and Gynecologists (ACOG)[11] refused to accept the IADPSG criteria at the conference organized by the National Institute of Health[12]; in 2014, the ADA relented reversing its earlier stance and accepted both the one-step and two-step as a methods to screen and diagnose GDM agreeing with the ACOG (see below) and IADPSG recommendations.

### *ACOG criteria*

The ACOG has always endorsed the two-step approach to GDM. In 1986, ACOG recommended the 50-g 1-h screening test for "women at risk," which in 2001 was changed to "all" women but excluding women at very low risk. In 2011, though the ADA approved the IADPSG; the ACOG had concerns that GDM prevalence would rise from 5%-7% to 18% - a three-fold increase. The ACOG had doubts that the increase in prevalence would have clinically significant improvements in maternal and neonatal outcomes in the "additional" women identified and treated with GDM. So, in its August 2013 bulletin, it has retained the two-step procedure using the thresholds (for the 100-g OGTT) of the National Diabetes Data Group (NDDG)[13] or C and C criteria for the100-g OGTT[10].

### *Canadian criteria*

In Canada, the Canadian Diabetes Association (CDA)[14] and the Society of the Obstetricians and Gynecologists of Canada (SOGC) publish recommendations for GDM. Like the ADA and the ACOG in United States, their approaches have been dissimilar though they have shared many common ideas. CDA has been regularly using the latest research to update their recommendations - their latest guidelines were released in 2013[15]. The SOGC recommendations of 2002 have not been modified; therefore, the SOGC has lagged behind in providing recommendations for GDM after 2002. It advocated either no screening as an option or using screening with a 50-g GCT with women having positive screens to undergo an OGTT (100-g or 75-g). These guidelines are completely out of date and need an update using research from the recent trials.

The CDA has consistently advocated screening all (*i.e.,* universal screening) women as any form of risk-factor screening, though cheaper, would always miss some patients with GDM. The 75-g OGTT CDA thresholds have been much higher than the C and C criteria originally approved by the ADA; thus, the strict CDA criteria for the 75-g OGTT always identified less women with GDM when compared to other criteria[3]. The latest guideline, CDA 2013, recommends scr-

**Table 1 Comparison of screening and diagnostic criteria of gestational diabetes[58]**

| Area | Advising body | Year | Advise for screening | Method of screening (positive cut-off ⩾) | Glucose load, g | Glucose thresholds (mmol/L) | | | | Number of OGTT values for diagnosis ⩾ |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Fasting | 1-h | 2-h | 3-h | |
| North America | NDDG | 1979 | None | 50-g GCT (7.8) | 100 | 5.8 | 10.5 | 9.2 | 8.0 | 2 |
| | ADA | 2003 | All but for those at low risk | 50-g GCT (7.8) | 100 | 5.3 | 10.0 | 8.6 | 7.8 | 2 |
| | | | | | 75 | 5.3 | 10.0 | 8.6 | - | 2 |
| | C and C | 1982 | None | - | 100 | 5.3 | 10.0 | 8.6 | 7.8 | 2 |
| | IADPSG | 2010 | All | 75-g OGTT | 75 | 5.1 | 10.0 | 8.5 | | |
| | CDA | 2003 | All | 50-g GCT (7.8) | 75 | 5.3 | 10.6 | 8.9 | - | 2 |
| | CDA | 2013 | | 50-g GCT (7.8) | 75 | 5.3 | 10.6 | 9.0 | - | 1 |
| | SOGC | 2002 | All except low risk | 50-g GCT (7.8) | 100 | 5.3 | 10.0 | 8.6 | 7.8 | 2 |
| | | | | | 75 | 5.3 | 10.0 | 8.6 | - | 2 |
| South America | BSD | 2007 | All | FPG (4.7) | 75 | - | 7.0 | | 7.8 | 1 |
| | BSD | 2014 | All | FPG (4.7) | 75 | 5.1 | 10.0 | 8.5 | | 1 |
| Europe | NICE | 2015 | Clinical risk | 75-g OGTT | 75 | 5.6 | - | 7.8 | - | 1 |
| | EASD | 1991 | NS | NS | 75 | 5.5 or 6.0 | | | 9.0 | 1 |
| Asia | JDS | 2013 | All | 50-g GCT (7.8) | 75 | 5.1 | 10.0 | 8.5 | - | 2 |
| | DIPSI | 2009 | - | - | 75 | - | - | 7.8 | | |
| Australasia | ADIPS | 2014 | All, unless resources limited | 75-g OGTT | 75 | 5.1 | 10.0 | 8.5 | - | 1 |
| | NZSSD | 1998 | All | 50-g GCT (7.8) 75-g (8.0) | 75 | 5.5 | - | 9.0 | - | 1 |
| Global criteria | WHO | 2013 | All | 75-g OGTT | 75 | 5.1 | 10.0 | 8.5 | - | 1 |

ADA: American Diabetes Organization; ADIPS: Australian Diabetes in Pregnancy Society; BSD: Brazilian Society of Diabetes; CDA: Canadian Diabetes Association; C and C: Carpenter and Coustan; EASD: European Association for the Study of Diabetes; DIPSI: Diabetes in Pregnancy Study group in India; IDF: International Diabetes Federation; FPG: Fasting plasma glucose; JDS: Japan Diabetes Society; NDDG: National Diabetes Data Group; NZSSSD: New Zealand Society for the Study of Diabetes; NICE: National Institute for Health and Care Excellence; NS: Not specified; RPG: Random plasma glucose; SOGC: Society of Obstetricians and Gynecologists of Canada; WHO: World Health Organization.

eening high-risk women with the 50-g GCT in early pregnancy. All women should undergo the GCT between 24-28 wk, and if between 7.8-11.0 mmol/L, they should undergo the 75-g OGTT using thresholds recommended by them (Table 1).

The cut-offs of CDA 2013 are similar to the IADPSG 2010 thresholds since they use the odds ratio of 2.0 and 1.75, respectively, based on adverse outcomes of the HAPO data. In their latest guideline[15] the CDA claims that their 2003 and 2013 thresholds are very similar. However, their resulting prevalence will be very different. The reason for the disparity is that, though the thresholds are similar, the number of thresholds needed for diagnosis are different (one *vs* two) - a fact not so obvious in their guideline.

Thus, it can be seen the CDA has kept with the evolution of GDM research, suggesting higher thresholds for diagnosis. Though it has reluctantly agreed with the IADPSG as an alternative some of its members have been very skeptical of the IADPSG guidelines[16]. CDA also differs in that it recommends a 50-g GCT screen on all women followed by the 75-g OGTT.

### *European Association for the Study of Diabetes criteria*

In 1991, the European Association for the Study of Diabetes (EASD) published diagnostic criteria for GDM[17]. It accepted the 1996 the Pregnancy and Neonatal Care Group[18] glucose thresholds of the 75-g OGTT (either FPG ⩾ 6.0 mmol/L or 2-h plasma venous glucose ⩾ 9.0 mmol/L) for GDM diagnosis. Nevertheless, the EASD has not recommended any changes in their diagnostic criteria for GDM despite new epidemiological data and numerous randomized trials; thus, the EASD recommendations have not been modified or changed since the last 20 years. Unfortunately, they still are used in some countries of Europe[19].

### *Australasian Diabetes in Pregnancy Society criteria*

In 1991, the Australasian Diabetes in Pregnancy Society (ADIPS) endorsed its first directives for GDM[20]. They modified the popular WHO GDM for 75-g OGTT based on opinion of the experts. Subsequently, their recommendations were modified in 1998[21]. The ADIPS accepted both selective (if the resources were limited) or universal screening (if the resources were adequate) with a 50-g GCT or 75-g OGTT (Table 1). In 2013, the ADIPS issued new guidelines after considering the available evidence like HAPO study and other clinical trials. In fact, they accepted the WHO 2013 (same as IADPSG 2010) with a few caveats. They recommend not using the term "Overt diabetes" as suggested by the IADPSG for marked hyperglycemia first discovered in pregnancy. At booking, they have a list of risk factors for diabetes and recommend that all women with these risk factors undergo a 75-g OGTT and clinical judgment should be used for further work-up[22].

### *New Zealand Society for the Study of Diabetes criteria*

Until recently, the Australasian (ADIPS) 1998 guidelines were common for both Australia and New Zealand. The excessive number of women diagnosed with GDM would strain the limited resources of New Zealand. So, to diagnose less women with GDM, the New Zealand Society for the Study of Diabetes (NZSSD) raised the 2-h cutoffs for the 75-g OGTT from 8.0 mmol/L to 9.0 mmol/L. This change shows how many changes in the criteria were made on an "ad-hoc" basis.

In 2014, The New Zealand Ministry of Health published a clinical practice guideline: Screening, Diagnosis and Management of Gestational Diabetes in New Zealand[23]. Twenty international and national guidelines and position statements were identified and critically appraised. Their recommendation: a HBA1c should be ordered at booking and at 24-28 wk, depending on the result of the HBA1c, a 50-g GCT or an OGTT may be done ( cut-offs F $\geqslant$ 5.5 mmol/L or 2-h $\geqslant$ 9.0 mmol/L) (Table 1). Thus, they have not accepted the WHO 2013/IADPSG 2010 criteria for GDM like the ADIPS, which has accepted them.

### *Japan Diabetes Society criteria*

In Japan, the Japan Diabetes Society (JDS) has kept up with the new research in diabetes and GDM. It published new guidelines three times between 1970-1995 critically evaluating guidelines of major organizations like ADA and WHO. Originally, JDS adhered to local Japanese criteria (derived from healthy pregnancies) suggested by the Committee for Nutrition and Metabolism of the Japan Society of Obstetrics and Gynecology (JSOG)[24] and the JDS continued endorsing this approach to GDM established in the early 1980s[24]. In 2013, the JDS released Evidence-based Practice Guideline for the Treatment for Diabetes in Japan 2013[25]. Essentially, it accepted the IADPSG criteria for the diagnosis of GDM. Hence it can be appreciated that Japan has kept up with the latest developments on GDM something not done by many modern European countries (like Sweden).

### *Brazilian Society of Diabetes criteria*

The Brazilian Society of Diabetes (BSD) accepted the fasting plasma glucose (FPG) as a screening test for GDM at booking and at 24-28 wk gestation[26]. These recommendations were based on a landmark study published in a preeminent diabetes journal[27]. As per these recommendations, a FPG $\geqslant$ 4.7 mmol/L and < 5.0 mmol/L needed a diagnostic OGTT using the C and C criteria for diagnosis. In 2010, a Brazilian Consensus guideline endorsed these guidelines[28]. The use of FPG in Brazil has been recently been authenticated by a recent Brazilian study[29]. The IADPSG has been accepted as the diagnostic method in Brazil[30].

### *International Diabetes Federation guidelines*

In 2009, the International Diabetes Federation (IDF)[31] acknowledged that many strategies were available. It logically stated that any GDM definition must take into account 3 risk factors: perinatal morbidity and mortality in index pregnancy, the mother developing type 2 diabetes, and intra-uterine epigenetic programming of the developing fetus. At that time, it accepted both the two-step or one-step methods of the ADA and WHO, respectively. However, the IDF had a preference for the 75-g OGTT because it used less glucose and was of shorter duration. Currently, they have accepted the current WHO 2013/IADPSG criteria[30].

## GDM APPROACH: CONTINENTS AND SELECTED COUNTRIES

The differences in algorithms for GDM by major international bodies translate into variation in the practices within individual countries. Similar trends are found in most countries for the screening and diagnosis of GDM. The practices in some specific selected countries, segregated by continents, are discussed below.

### *Europe*

Buckley *et al*[19] reviewed the screening practices all over Europe. They looked at 185 sources of information from 23 European countries. The screening methods varied from risk-factor screening (Norway); 50-g universal GCT (Finland, Poland, Austria); random plasma glucose (United Kingdom, Plymouth). Most countries used WHO 1999 criteria or the Carpenter and Coustan criteria for diagnosis as applied to the 75-g or 100-g OGTT. Some countries (like Hungary) used the universal one-step, 75-g OGTT (WHO 1999) for diagnosis while others (like Italy) used universal one-step, 100-g OGTT (C and C) for diagnosis. The authors conclude that global agreement on screening and diagnostic methods would lead to better detection and treatment; only more well-designed research would inform us about the best practice methods in screening and diagnosis of GDM.

### *United Kingdom*

The national guidelines for GDM in United Kingdom were established only after 2008. The clinician had to decide if screening was needed or not[32]. The National Institute for Health and Clinical Excellence (NICE) guidelines were originally issued in March 2008. These have been replaced by recommendations in February 2015[33] and essentially, the NICE does not accept the IADPSG criteria. They continue to recommend using clinical risk factors for screening. GDM is diagnosed if on a FPG $\geqslant$ 5.6 mmol/L or a 2-h glucose after a 75-g OGTT is $\geqslant$ 7.8 mmol/L (Table 1). The OGTT should be done in the first or second trimester depending on the clinical need. These guidelines have been motivated by

the latest research and cost of treatment of GDM[33].

The Scottish Intercollegiate Guidelines network (SIGN) in their 2010 recommendations advise (at booking) screening with clinical risk factors, with HBA1c or fasting glucose; at 24-28 wk, while all high-risk women should undergo a 75-g OGTT with the IADPSG criteria used for diagnosis; All low risk women at 24-28 wk, should undergo the fasting plasma glucose[34].

In January 2011, the Royal College of Obstetricians and Gynaecologists discussed the overall strategies for GDM including NICE and IADPSG. However, they do not provide any recommendations on how to screen and diagnose GDM[35].

This inconsistency of multiple approaches to GDM is reflected in practices at ground level. In an older United Kingdom survey by mail[36], the screening practices were very varied: fasting and random plasma glucose and glycosuria were all used showing the heterogeneity in screening for GDM. Various cutoffs were used for diagnosis using the 75-g OGTT - a fact iterated in the latest 2015 NICE guidelines[33]. Thus, it can be seen that in a country like United Kingdom, which has well-developed health system, there is no consistency in the approach to GDM. However, with time there should be more uniformity in the approach to GDM once there is more international agreement.

### Italy

Many Italian organizations like Italian Society of Diabetology (SID) and the Italian Association of Diabetologists (AMD) set standards for diabetes in Italy in 2007[37]. They agreed to use the C and C criteria for diagnosis, which were also endorsed by the ADA. Currently, the Italian Institute of health recommends using risk-factors for screening of GDM. Thus, even recently, whether universal or risk factors screening should be done has been debated in Italy[38]. However, currently, the IADPSG guidelines have been accepted in Italy[31].

### Sweden

The screening and diagnostic criteria for GDM in Sweden have been evolving over time. In 1985, repeated random blood glucose measurements were popular for GDM diagnosis. Since 1991, the hand-held Hemocue spectrophotometers have been popular in Sweden. These use capillary whole blood for measuring glucose; even the OGTT samples, instead of plasma venous glucose, tend to utilize capillary whole blood for convenience. Currently, there is no consensus in Sweden and over 4 methods are used to screen and diagnose GDM as shown by a recent study[39]; the authors recommend that IADPSG should be adapted. Thus in Sweden, even in 2015, there is a huge variation in the approach to GDM; furthermore, popular use of Hemocue complicates the diagnosis of GDM. Thus, Sweden is no different when compared to other European countries in having no consistency for the diagnosis of GDM.

### Belgium

A survey (May 2012-January 2013) of 45 obstetrical centers from Belgium showed that 56% used screening before 24 wk based on clinical methods[40]. At 24 wk, the commonest strategy (56%) was the two-step method (GCT + 100-g OGTT) with C and C (52%) or NDDG (4%) criteria for diagnosis. The remaining used IADPSG (33%) or WHO 1999 (2%) or C and C (9%). Belgium, like other European countries, also has no uniformity in the approach to GDM.

### Germany

Like most other countries, the screening and diagnosis of GDM in Germany has been inconsistent. The German Society of Obstetrics and Gynecology and the German Diabetes Association (DDG) made some attempts at formulation guidelines for GDM in 2001. However, obstetricians either do not screen, or often carry on risk factor screening. Currently, the IADPSG has been approved formally in Germany by the German Diabetes Association[41]. This should result in consistency in screening and diagnosis of GDM in Germany over time.

### Asia

Tutino *et al*[42] recently reviewed the situation of diabetes and pregnancy in Asia. Since the prevalence in Asia varies extensively due to lack of uniform diagnostic criteria, the authors stress the importance of a unified approach to GDM. Hyperglycemia in pregnancy has its highest prevalence in South-Est Asia, where one-fourth pregnancies are affected *vs* one-seventh, globally. Asians develop GDM at a lower BMI and type 2 DM occurs at a much younger age. With urbanization, GDM prevalence is becoming an epidemic. The IADPSG has been adapted by some Asian countries, although it remains a challenge to implement in low-resource settings. So, local modifications have been suggested.

### China

The Ministry of health in China published its guidelines for testing and diagnosis of gestational diabetes in 2011[43]. It recommends the fasting plasma glucose or 2-h venous glucose post 75 g OGTT at the first prenatal visit to rule out diabetes antedating pregnancy using standard diagnostic criteria for diagnosis of diabetes in the non-pregnant.

The diagnosis of GDM is made by a single step 75-g 2 h. OGTT done between 24 and 28 wk of gestation. The cut points for diagnosis of GDM are those of the IADPSG.

To reduce the number of OGTTs, it has been suggested that the FPG test may be done first - a

concept originally described by us, which was adapted by the Chinese Ministry of Health. If the FPG value is less than 4.4 mmol/L no further testing is needed. For values above 5.1 mmol/L a diagnosis of GDM is made without an OGTT. Pregnant women with fasting glucose values between 4.4 and 5.1 mmol/L must undergo a 75-g OGTT to further rule in or rule out GDM. This concept has been tested in China[44]. Using this algorithm, only half of pregnant women would be required to undergo the formal OGTT.

### *India*

Asian Indians are considered to be at the highest risk for gestational diabetes. In India there is a (1) high burden and a rising prevalence of diabetes; (2) constraint of resources; and (3) high rate of deliveries (27 million/year). Considering these factors and using local studies, the Diabetes in Pregnancy Study group in India (DIPSI) has developed practical usable recommendations for diagnosis of GDM in the community[45]. This guideline has been recognized by the Ministry of Health, Government of India, the Federation of Obstetrics and Gynecological Societies of India (FOGSI) and the Association of Physicians of India (API).

Testing for GDM is recommended twice during antenatal care. The first testing should be done during first antenatal contact as early as possible in pregnancy. The second testing should be ideally done during 24-28 wk of pregnancy if the first test is negative. If women present beyond 28 wk of pregnancy, only one test is to be done at the first point of contact.

A single step is recommended by measuring plasma glucose 2 h after ingestion of 75-g glucose irrespective of the last meal (fasting or non-fasting). In the absence of available laboratory facilities a standardized glucometer may be used to evaluate plasma glucose. A glucose level of $\geqslant$ 7.8 mmol/L is the cut off for diagnosis of GDM. This test is called the DIPSI Test.

The older WHO 1999 criteria are very popular in many Asian countries[46,47]. The latest guidelines of Sri Lanka recommend either the DIPSI or the IADPSG guidelines[48]. However, other countries like Thailand use mostly use the two-step approach (the diagnostic criteria of the NDDG or C and C) or WHO 1999 criteria (75-g OGTT)[49]. As can be appreciated in Asia, like the rest of the world, the approach between and within countries is not uniform.

### *Australia*

As detailed earlier, the latest guidelines in Australia have been modified in November 2014. Essentially, with a few caveats, the ADIPS has accepted the guidelines of IADPSG.

### *Africa*

The data from Africa about GDM is limited. Like Asia, due to its global reach and acceptance, the WHO 1999 criteria are widely used in many African countries[50-53]. Recently, Macaulay *et al*[54] reviewed GDM in Africa. They found 14 useful papers from 60 studies. Six African countries, representing 11% of African continent, were Ethiopia, Morocco, Mozambique, Nigeria, South Africa and Tanzania. Major variation in methods was present between countries. Morocco used 100-g OGTT with C and C criteria. Mozambique used their own diagnostic criteria. Much heterogeneity between countries was present within countries. Six studies from Nigeria used 75 or 100-g OGTT for diagnosis with varying criteria. One center used 50-g GCT for diagnosis of GDM. Similar heterogeneity was found in 4 studies from South Africa. The authors conclude that there is a paucity of information about GDM from Africa and stress the importance of more research. This is crucial given the public health burden of obesity and diabetes. Only then, effective public health measures can be planned.

### *Nigeria*

In 2011 (modified 2013), a national guideline on diabetes was published in Nigeria[55]. The recommendations include (1) risk assessment at booking; (2) A one-step (75-g OGTT) or two-step method (50-g GCT with 100-g OGTT) using C and C criteria for diagnosis. Despite the availability of a guideline on GDM, practice varies across obstetric units in Nigeria. There are many gaps in the guideline as it is not appropriate for use in all circumstances; there is no recommendation on the screening/diagnostic approach for women outside tertiary care facilities as GCT/OGTT are not available in primary health care settings.

Thus, Nigeria reflects some of the problems seen with GDM screening in Africa and stresses the importance of addressing the specific needs of the sub-Saharan Africa region. The critical gaps were potentially due to only endocrinologists in the guideline development team. It also emphasizes that international guidelines cannot just be applied to poor countries in Africa.

### *South America*

Like Africa, there is little published data from South America, which consists of 14 independent countries. However, much data comes from Brazil and Chile, and Argentina[27,56,57]. In fact, Brazil is the leader in diabetes and gestational diabetes research. A literature search from individual countries from South America (Venezuela, Columbia, Peru, Uruguay, Ecuador, Bolivia, Paraguay) yields almost no results. Thus, it is difficult to get information on the approach to screening and diagnosis to GDM in South America.

## WAY FORWARD

As can be appreciated, the availability of multiple criteria for the screening and diagnosis of GDM have resulted in an almost ad-hoc approach to GDM. Most (but not all) organizations have been updating their

criteria over time; however, the hospitals following recommendations of a preeminent association often lag behind in updating their approach to follow the latest guideline. This adds to the already disorderly situation. Major international bodies are aware of this problem. Thus, some of these organizations are working to convince all the major international professional organizations to come to a consensus. A major effort has been undertaken by the International Federation of Gynecology and Obstetrics (FIGO), which has members from 125 gynecology and obstetric organizations worldwide, to achieve consensus on GDM. Ideally, the answer may lie in a well-funded trial like the HAPO. Till that happens, the approach will have to be by consensus. As of 2015, worldwide, the most accepted criterion is of the IADPSG 2010[30] and as it becomes more approved - we may achieve the much desired consensus for one guideline.

## CONCLUSION

As can be appreciated from this review, the screening and diagnostic criteria for GDM throughout the world are summarized by one word: chaotic. Many international and regional guidelines have lagged behind the current research. The need for a single global guideline has been repeatedly stressed[57] and this consistency is essential to avoid confusing primary care-givers of GDM. The primary care-givers of pregnant women look to the authorities and expert committees for guidance. Unfortunately, the experts continue to provide no clarity. With over five decades of research and hindsight, we must develop a single useful guideline for GDM: it is high-time.

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