



## Research Article

# Maternal and fetal outcome of comparative study between old & adopted new value of screening of Gestational Diabetes Mellitus in tertiary centre in Saudi Arabia

Gehan Farid\*, Reem Mohammed Kamal\*, Mohamed AH Swaraldahab and Sarah Rabie Ali

Department of Obstetrics and Gynecology Security Forces Hospital, Saudi Arabia

**\*Address for Correspondence:** Dr. Gehan Farid, Department of Obstetrics and Gynecology Security Forces Hospital, Email: Faridgi@yahoo.com

Dr. Reem Kamal Mohamed, Department of Obstetrics and Gynecology, Security Forces Hospital, Saudi Arabia, Email: Reemkamal2002@hotmail.com

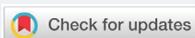
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**Abbreviations:** GDM: Gestational Diabetes Mellitus; FBS: Fasting Blood Sugar; NIDDM: Non-Insulin Dependent Diabetes Mellitus; IDDM: Insulin Dependent Diabetes Mellitus; NICU: Neonatal Intensive Care Unit; RDS: Respiratory Distress Syndrome; ANOVA: One-way Analysis of Variance; LGA: Large for Gestational Age; PNMR: Post-Neonatal Mortality Rate; ENND: Early Neonatal Death; SGA: Small for Gestational Age; HMD: Hyaline Membrane Disease; TTN: Transient Tachypnea of Neonate; PET: Positron emission tomography; CS: Caesarean Section; BMI: Body Mass Index; PIH: Pregnancy Induced Hypertension; SFH: Security Forces Hospital; PET: Preeclamptic Toxemia; IADPSG: International Association Of Diabetes and Pregnancy Study Groups; ADIPS: Australian Diabetes In Pregnancy Society; IOL: Induction of Labor; 2 hpp: 2 hour post prandial; OGTT: Oral Glucose Tolerance Test; BSL: Blood Sugar Level



## Abstract

**Objectives:** To check if there is any significant difference in the immediate outcome of pregnancy with diabetes using the new values of FBS & 2hrs post prandial with 75g OGTT for 1 year (from 1st June 2013-31st May 2014) in comparison to the previous data done in the same institute with other values and with international figures.

The data in our study included fetal, maternal morbidities, intra partum and postnatal outcomes, in order to help, if possible, on deciding the best values to use for screening for gestational diabetes mellitus. Furthermore, to know the new percentages of gestational diabetes mellitus in SFH by utilizing the new values of Blood Sugar readings.

**Design:** Retrospective cohort study

**Setting:** Security Forces Hospital-Riyadh-Saudi Arabia

**Patients:** Done (from 1st June 2013 – 31st May 2014), on patients who had attended Security Forces Hospital, Riyadh, Saudi Arabia. This chosen year's data was compared with data collected in the three previous years using different figures.

Main Outcome measured: Average age of mother, maternal aspects of parity, history of GDM, number of abortions, estimated blood loss in labor, associated medical disorder, complications of previous pregnancies, methods of control of GDM, gestational age for IOL and associated intrapartum complications. Immediate neonatal outcome in cases of GDM, comparison of birth weights of babies & any specific congenital abnormalities and delayed causes of admission to NICU in the 4 years studied were also reviewed.

**Results:** The percentage of diagnosed cases of gestational diabetes mellitus (GDM) after screening was 24 % as compared with 14.5% in previous study of 2003-2004 & with the number of screened patients amounting to 93% out of the total number of deliveries between 2013-2014 (in both years universal method of screening was used). The multidisciplinary set up of our GDM specialized clinic which was composed of dieticians, diabetic educators, endocrinologists and obstetric physicians operating together, helped to reduced the use of insulin in combination with diet to only 24% in comparison to 76% of patient using diet and exercise alone. The study showed a mean age of 33years and weight of 77kg. It was also noted that 16% of the patients diagnosed with GDM were multiparous averaging 1-5 deliveries. Almost 62% of patient didn't give any history of GDM and no history of previous medical diseases. The majority of the patient with GDM delivered without complications during labor, with 30% having vaginal lacerations & 73% of patient had an estimated blood loss of less than 500cc. NICU admissions secondary to hyperbilirubinaemia averaged almost 17% in comparison to previous studies and only one baby expired in a GDM patient. Our study revealed a good fetal and maternal out come with less delivery complications and less incidence of postpartum hemorrhage (5.7%).

**Conclusion:** It is concluded that Universal Screening of Pregnant women whether with previously used glucose value or new ones for gestational diabetes mellitus is a better option, which has proven to improve both maternal and fetal outcomes. The 75 OGTT test is a cost effective test and with both easy accessibility and good screening pick up number (92.5%) of the patients in Security Forces Hospital, Riyadh.

**Recommendation:** We recommend annual follow up for patients, both the mother and the baby after postpartum, to prevent the development of type 2 diabetes.



## Introduction

Gestational Diabetes Mellitus is defined as any degree of glucose intolerance that occurs with pregnancy or was first discovered during pregnancy. GDM is a common medical complication associated with pregnancy which imposes risks on the mother, the fetus and the newborn. Such risks can continue throughout the life time of both the mother and her child. In our study we compared maternal and fetal outcome with the previous three years that had been already studied at Security Forces Hospital using different values in (June 1993-May 1994), (June 1996-May 1997) and (June 2003-May 2004) to a newer study done in (2013-2014) with new values of FBS=5.1 mmol/L and 2 hrpp value of 8.5 mmol/L after 75 gms of OGTT. This new value is in accordance with the International Association of Diabetes in Pregnancy Study Group (IADPSG) after the 2010 agreed consensus of screening and diagnosis of gestational diabetes, which are based on a Randomized Controlled study (HAPO study).

## Objectives

To check if there is any significant difference in the immediate outcome of pregnancy with diabetes using the new values for 1 year (from 1<sup>st</sup> June 2013-31<sup>st</sup> May 2014) in comparison to the previous data done in the same institute and in comparison with international studies. The data in our study includes that of fetal, maternal morbidities, intra partum and postnatal outcomes, in order to help, if possible, in deciding the best values to use for screening for gestational diabetes mellitus. Furthermore, to know the new percentages of gestational diabetes mellitus in SFH using such new values of Blood Sugar readings.

## Material and Methods

A retrospective cohort study, conducted on a number of patients who delivered in Security Forces Hospital, Riyadh, Saudi Arabia in the period between (June/2013-May/2014). A retrospective study comparing the immediate outcome of pregnancy on fetal and maternal aspects of diagnosed cases of gestational diabetes mellitus, and after exclusion of all cases of NIDDM and IDDM, to three previous different years studied using different values for screening for GDM, in the same hospital, same Saudi population of Dependents of Ministry of Interior & comparing it to international figure.

The data of years compared were after twelve months of implementation of the stated policies and as agreed upon by 3 different held committees

- SFH is an almost exclusive institute for Dependents of The Ministry of Interior.
- No agreement from ethical committee in the hospital was needed.
- With the use of 75 g glucose OGTT, any value of FBS  $\geq$  5.1 mmol/L and 2hrs after glucose load  $\geq$ 8.5 mmol/L was considered as abnormal and the patient was diagnosed as a Gestational Diabetes Mellitus patient.
- The patient who are known diabetics (NIDDM and IDDM) were excluded from the study.
- The data was obtained through computerized Medical Record Viewers (MR Viewer).
- The immediate outcome of pregnancy, both fetal and maternal, of diagnosed cases of gestational diabetes mellitus were compared to already existing data in Security Forces Hospital and compared with international data.
- The characteristics of patient studied included the following:
  - o Ages of patients, parity, mode of delivery, and whether induced or not, with



the approximate gestational age for induction was calculated by date and ultrasonographic findings.

- o Previous history of GDM and associated medical disorder were noted.
- Furthermore, associated maternal complications such as postpartum hemorrhage noting the estimated blood loss of different modes of deliveries, vaginal trauma, shoulder dystocia & other associated complications.
- The control of GDM done whether by diet only or diet and insulin, was recorded.
- The outcome of pregnancy which included birth weights, and adverse outcomes such as admissions to NICU, macrosomia, birth injuries, metabolic disorders and RDS were compared to previous years studied and compared to international data.
- Percentages were used for the one year study of 2013-2014 for statistical analysis and were broadly compared to the previous data studied over 3 years where One Way ANOVA Test was used Graph 1.

## Results

The total number of deliveries between 2013-2014 was 6849 patient and the total number of patient screened was 6340 (92.5%). The diagnosed cases of gestational diabetes mellitus (GDM) after screening was 1516 patients, representing 23.9% of the total number of patients screened and after exclusion of all cases of IDDM and NIDDM. Table 1 shows the number of patients screened and percentage of diagnosed cases of GDM in SFH in four different years.

The patient characteristics was composed of age ,weight and height for the studied years of & (2013-2014) with a mean age of 33years, weight of 77 kg and height 156cm as shown in table 2. The highest frequency of parity of (1-5) deliveries made up 65% (983pt) of the total population and with 16% of parity of 6-10 and nulliparous patients on each side of this range. Grand multiparous with more than 10 deliveries made up 2.4% of patients. Almost 62% of the patient didn't give any history of GDM and no history of previous abortion table 3.

**Graph 1:** Years Studied In Security Forces Hospital & BSL used for screening

Year	FBS	2 H PP
June 1993-May 1994	5.8	8.3
June 1996- May 1997	5.6	9.5
June 2003 – May 2004*	5.3	7.8
June 2013- May 2014	5.1	8.5

\*Combination of Australian Diabetes in Pregnancy Society (ADIPS) and WHO criteria for Diagnosis and classifications of Diabetes Mellitus

**Table 1:** Table 1 shows the number of patients screened and percentage of diagnosed cases of GDM in S.F.H

Study year	Total number of patients screened	Total number of Deliveries	numbers of Diagnosed GDM cases of GSM	Percentage
1993 - 1994	3847	6411	383 (5.9 %)	60.0
1996 -1997	5619	6501	604 (9.3 %)	6.4
2003 – 2004	5842	6282	917 (14.5 %)	92.9
2013 – 2014	6340	6849	1516 (23.9 %)	92.5

**Table 2:** shows the patient characteristics of age, weight and height for 2013 – 2014 study.

	N	Mean	Sed. Deviation
Actual age	1508	32.52	6.64
Maternal weight	1497	77.23	16.37
Maternal height	1485	155.7	6.16



**Table 3:** shows the percentage of parity, previous history of GDM and abortions.

Parity	Frequency	Percent
PO + 0	248	16.4
1-5	983	64.8
6-10	247	16.3
≥ 10	37	2.4
Total	1516	100.0
<b>History of GDM</b>		
Yes	546	36.0
No	947	62.5
Total	1516	100.0
<b>Previous history of Abortion</b>		
Yes	589	38.9
No	925	61.0
Total	1516	100.0

The number of non-induced patients made up 58% of admitted patient and as shown in table 4 a good number of patients were booked for induction of labor but came in spontaneous labor. Almost (three quarters) of patients (74%) were delivered between (37-40) weeks. The 7% of the patient delivered before 37w was mostly due to premature spontaneous labor. Beyond 40 weeks of pregnancy, accounted for 18.6% and of cases, mostly due to non appearance at previously scheduled time of delivery. Although 27% made up the percentage of deliveries by cesarean section, (in comparison to 71.0% of SVD and 2.4% of instrumental delivery), which is considered to be higher than the previous years in SFH and the cause of which is not due to GDM only but is due to a group of factors e.g. repeated c/s, severe PET, etc. as is shown in table 4.

The set-up of GDM clinic including dietician, a diabetic educator, endocrine & obstetrics teams operating concomitantly together helped to reduce the use of insulin & hence 76% of patients were controlled by diet and exercise only. Being gestational diabetes case only (after exclusion of diabetic patient) associated medical disorders was seen in 30% of the cases, major amongst which was hypothyroidism (Table 5). The majority of the patients with GDM delivered without complications during labor with 30% having vaginal lacerations. The estimated blood loss of 73% of patient was less than 500cc (table 6) with an average length of stay of 1-2 days in the majority of cases (83.0%).

The number of the babies admitted to NICU was 6.5% of all babies& RDS occurred in 12% of cases table 7. Most of babies with metabolic disorder, made up (6.3%) of deliveries, injury only 1% and macrosomia made up (3.7%) (Table 8). Table 9 shows that the percentage of congenital abnormalities account of 9.5% and only 1.2% baby delivered with still birth. Table 10 shows that delayed causes of admission to NICU in the year of our study, as compared to the three years studied from before in SFH , Hyperbilirubinemia accounted for 3.48% of babies admitted to NICU with an increased incidence compared to the previous three years as shown in table 10. Out of the total expired babies (67 babies) between (2013-2014) there was only one baby expired due to GDM mother (Table 11).

## Discussion

GDM is a common problem with varying controversial issues with regards screening, its timing and values to use. Is a disease in pregnancy causing maternal and fetal mortality and morbidity and also several short and long term consequences and if neglected not only lead to compromise of health but also increases the financial burden and social problems in the community. The prevalence of GDM varies from 2.4% to 22.3% worldwide depending on the population studied, screening procedure and the type of diagnostic test employed [1]. GDM confers a 7-fold risk for future type 2 diabetes and up to one third of women with type 2 diabetes have previously been diagnosed with GDM [2,3]. To prevent adverse outcomes of GDM, optimal screening and diagnostic criteria must be adequate, timely, efficient, least expensive and easily implementable.



**Table 4:** Shows the percentage of induced pregnancies, its timing and mode of delivery.

Number of Induced labor	Frequency	Percent
Induced	635	42.0
Not induced	881	58.0
Total	1516	100.0
<b>Weeks of delivery</b>		
< 37	107	7.1
37 – 40 weeks	1125	74.2
> 40	281	18.6
Total	1516	100.0
<b>Mode of delivery</b>		
SVD	1069	70.5
Cesarean Section	410	27.0
Instrumental	37	2.40
Total	1516	100.0

**Table 5:** Shows the type of control of GDM and other associated medical disorders

Type of Control	Frequency	Percent
Diet only	1147	75.7
Diet + insulin	369	24.3
Total	1516	100.0
<b>Other associated medical disorders</b>		
	Frequency	Percent
Yes	448	29.6
No	1064	70.2
Total	1516	100.0

**Table 6:** Shows the associated complications during labor, estimated blood and hospital stay days

Maternal Complication	Frequency	Percent
Postpartum hemorrhage	86	5.7
Vaginal laceration	454	30.0
Shoulder dystocia	41	2.7
Others	42	2.7
None	893	58.9
Total	1516	100.0
<b>Estimated blood loss</b>		
< 500 c.c	1102	72.7
≥ 500 c.c	414	27.3
Total	1516	100.0
<b>Number of Days</b>		
1-2	1260	83.0
3-4	156	10.0
≥ 5	100	7.0
Total	1516	100.0

**Table 7:** Shows the average Apgar score, percentages of RDS and Admission to NICU.

Apgar Score	Frequency	Percent
≥ 9	1150	70.7
≥ 7	476	29.3
Total	1626	100.0
<b>Cases with RDS</b>		
	Frequency	Percent
Yes	199	12
No	1427	88
Total	1626	100.0
<b>NICU admissions</b>		
	Frequency	Percent
Yes	105	6.5
No	1526	93.8
Total	1626	100.0



**Table 8:** Shows the percentage of Macrosomic babies, those with Injuries and Metabolic disorders.

Macrosomic babies	Frequency	Percent
Yes	60	3.7
No	1566	96.01
Total	1626	100.0
<b>Due to injuries</b>	Frequency	Percent
Yes	17	1.0
No	1609	99.0
Total	1626	100.0
<b>Metabolic Disorders</b>	Frequency	Percent
Yes	101	6.3
No	1525	93.7
Total	1626	100.0

**Table 9:** Shows the percentages of Congenital Abnormalities and Still Births.

Congenital Abnormalities	Frequency	Percent
Yes	154	9.5
No	1472	91.0
Total	1626	100.0
<b>Still Births</b>	Frequency	Percent
Yes	19	1.2
No	1607	98.8
Total	1626	100.0

**Table 10:** Delayed causes of admissions to NICU

Cause	1993-1994 n=518	1996 – 1997 n = 524	2003 – 2004 n = 613	2013-2014 N= 574
Thrombocytopenia	1 (0.19 %)	1 (0.19 %)	0	2 (0.35 %)
Hypoglycemia	14 (2.70%)	13 (2.48 %)	17 (2.77 %)	19 (3.31%)
Hyperbilirubinaemia	1 (0.19 %)	6 (1.15 %)	6 (0.98 %)	*20 (3.18 %)
Preterm	3(0.58%)	0	3 (0.49 %)	11 (1.96 %)
SGA	5(0.97%)	1 (0.19 %)	5 (0.82 %)	18 (3.14 %)
LGA	6(1.2%)	1 (0.19 %)	7 (1.14 %)	10 (1.74%)
R.D due to HMD	2(0.39%)	1 (0.19 %)	12 (1.95 %)	**11(1.92%)
Meconium aspiration	0	2 (0.38%)	2 (0.33 %)	0
TTN	0	3 (0.57%)	8 (1.31 %)	4(0.69%)
Sepsis	1 (0.19 %)	5 (0.95%)	5 (0.82 %)	1 (0.17 %)
Asphyxia	0	2 (0.38%)	2 (0.33 %)	1(0.17 %)
Polycythemia	1 (0.19 %)	2 (0.38%)	0	3 (0.52 %)
ABO incompatibility	1 (0.19 %)	0 (0.19%)	1 (0.16 %)	3 (0.52%)
Erb's palsy	0	1 (0.19 %)	0	0
Congenital Abnormalities	12(2.31%)	6(1.15%)	10 (1.63 %)	***75.0(13.1%)
Total	47 (9.071 %)	42 (8.02%)	68 (11.1 %)	178(31.0%)

\*Out of total of 101 cases, not all needed admission to NICU.  
 \*\*RDS due to HMD, other are non HMD cases in NICU (total 199 cases).  
 \*\*\*75 cases out of total of 154 diagnosed cases of congenital anomalies.

**Table 11:** NICU admissions and Percentage of expiry in Babies with GDM

Causes	1993-1994	1996- 1997	2003-2004	2014-2015
Total no. of deliveries	6411	6501	6282	6262
Total NICU admission	518	524	613	574
Babies whose mother are GDM	20 (3.82%)	34 (8.82%)	57 (9.29 %)	178(31.0%)
Total expired babies	34 (8.82%)	52	47	67
Expired babies of GDM mother	0 (0%)	3 * (5.76%)	3 (6.38%)	1 (1.50%)

\* Case of Asphyxia

In our study the new value for modified glucose tolerance test (MGTT) was used for screening with universal method for early detection of GDM, its cause and prevention.

Since 2004 & in the USA, 96% of obstetricians routinely screened for GDM, hence universal screening is the most common practice (7) to overcome the confusion of selective screening. This fact strongly agrees with our practice in Security Forces Hospital which was started since 2003 & continued to the present date (2015). In the



USA, The prevalence of GDM ranged from 1.1-25.5% (3&4) being representative of different ethnic populations. In our diagnosed cases the incidence was 24.0% which tend to fall within this range, and is high because of the studied population is mainly Middle-Eastern population, which is one of the high risk criteria with inherent high incidence of Diabetes Mellitus type 2. 6.7% of females have a fasting blood sugar of 5.3mmol according to Carpenter and Custom criteria in North America. With IADPSG values, 17.8% were diagnosed because of lower glucose threshold used to diagnose GDM. This agrees with our experience & the percentage of diagnosed cases was 23.9%, like already mentioned.

Gillman et al., stated that the incidence of GDM has increase over the past decade in parallel with increased obesity [5]. This agrees with our study where the incidence has almost doubled from 14.5% in 2005 to 23.9% in 2015.

The increasing rate of obesity in our population likely contributed to the increasing prevalence of GDM and as it is known that uncontrolled gestational diabetes is associated with increased risk of spontaneous abortion, fetal macrosomia and neonatal hypoglycemia, hypocalcemia and hyperbilirubinemia according to Hillier et al. [6], Since the year 2000, [7] showed that the rates of large for gestational age (LGA) infants has increased in GDM pregnancies on diet with FBS of 5.3-5.8 mmol/L, unlike those with FBS<5.3mmol/L (namely 5.1mmol/L) and which corresponded to the new values adopted in the screening and follow-up of patients in our study.

Similarly the value of less than 7.0mmol/L, used for 2hr postprandial, also used in our study, in blood sugar series and which correlated to reduction of macrosomia, neonatal hypoglycemia and cesarean section rate due to cephalopelvic disproportion, was also used. The above fact proved to be correct as seen by our study & by using these values, the percentage of macrosomia was definitely reduced, as well as hypoglycemic. Of course cesarean section rate is a not judgment of success since it is mostly for obstetric causes, rather than the presence of GDM perse.

The data published on studies using the new recommended figures by IADPSG of 2010 were meagre. Our results are promising but too premature to conclude whether the figures used in the diagnosis are the most optimal to use or otherwise. The strong success of our study was because of the big number of patient studied, well organized homogenous set up of concomitant care of endocrinologist, obstetricians, diabetic educator and dietician functioning in the same setting, on same day, and with standardized figures and management option. This form of (One Stop Clinic) that has been going on for more than thirteen years which helped us withdraw robust conclusions from uniform studies based on comparison of old values of screening initially made of combination of values of WHO and ADIPS to the newly applied one according to IADPSG value of 2010.

Rehder et al., predicted that the application of IADPSG value using one figure for diagnosis will lead to an increased diagnosis of GDM in the range of 18-20% of the entire ethnic obstetrics population [8]. This is in fact the case with our population, where a percentage of 23.9 % was reached, far above the speculated figure. Wendland et al., demonstrated that on using the WHO criteria for diagnosis of Gestational Diabetes there was an increase in perinatal mortality in comparison to the IADPGS criteria [9]. This fact was noticed in our study where three out of 47 deaths related to GDM in. babies admitted to NICU in the 2003-2004 study, where WHO criteria was used, occurred, unlike the one death out of 67 admission to NICU in 2014-2015 study using IADPGS criteria.

In both studied years the perinatal mortality was much less than that quoted by [10]. This could be explained by the above mentioned system of care adopted by our units. It's believed that screening using IADPSG results in increased cases of



gestational diabetes being diagnosed & until further data are available, some authors like [8] advocated to continue using the old method of 3 hour OGTT recommended by the ADA (11) for screening and that it's thought that there is no need to change the already existing cut off limits. The use of universal screening in our present and previous studies i.e. over a period of 13 years helped in the ease of running the clinic smoothly with fixed policy. The method was also cost effective. This type of universal screening was supported in earlier studies by [11] (in the year 2000) and recently by [12] and [13] etc.

The fact that almost 76% of cases were controlled by diet only and with the good outcome and reduced macrosomia, is a reflection of great effect of Dietician as well as Diabetic Educator. Our findings agree with those of [14] which showed that lifestyle modification improved pregnancy outcome in Chinese women with GDM. An important fact that needs to be noted is the high incidence of admission of the babies with hyperbilirubinemia to NICU in comparison to previously studied years in our hospital & other institutes. It is to be noted that pre-mature deliveries was not much exaggerated neither was induction of labor less than 38 completed weeks. The increased pick-up rate of congenital abnormalities can be explained by universal type of screening, better ultrasound service, since the number diagnosed is more than previously studied population of 2003-2004 (the number of patient studied were in the same range).

In areas that have a high background incidence of diabetes, waiting to diagnose the patient at 24-28 weeks maybe somewhat late & it seems logical to screen such a population earlier in pregnancy at time of booking to avoid long term complications. Werner et al., suggested and this was also partly proposed by the IADPSG that at the first pre-natal visit a fasting blood sugar of greater than 5.1 mmol [15]. (92 mg/l) the patient is diagnosed as diabetic, whereas if it was normal then the patient can do 75 OGTT test at 24-28 weeks of pregnancy. To complete the picture and target of screening and management, in our unit and which agrees with [15-21], postpartum screening was done with a repeat 75 OGTT and if patient were normal then one to three yearly follow up was done with modification of lifestyle and exercise. Otherwise the patient was to be treated as diabetic and with special care for the body.

## Conclusion

- Screening using IADPSG values has the advantage of increased number of diagnosed cases of Gestational Diabetes but up till now there are not enough studies to justify continuation on using it or use already tried figures like those of ADA or our previous one in our institute; so further studies are awaited.
- Special method of screening is suggested for areas with high background of diabetes.
- To close the ring and reach the target of outcome of screening and management and long term effect on mother and baby, patient should be monitored by postpartum follow up and there after regular check up to avoid development of diabetes in mother & offspring with all its consequences.
- Furthermore, more studies are needed to explain the noted association of increased number of babies with hyperbilirubinemia after the newly adopted IADPSG method of screening was started.

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