

# On Diabetes, Insulin and You

## Diabetes Mellitus : A Growing Global Concern

**M**OST readers are familiar with diabetes, more correctly known as diabetes mellitus. This disease is prevalent in all populations and in all parts of the world. It is characterized by profuse and frequent urination and the passage of sugar in the urine — the two features, which give the condition its name, derived from two Greek words — "diabete" or crossing over or passing through; and "mel" meaning honey, thereby indicating the presence of sugar in the urine. Thus this relatively frequent condition is distinguished from a very rare and an entirely different condition — "diabetes insipidus", in which the urine is insipid, since it is free of sugar, but also profuse (because of deficiency of the anti-diuretic hormone, secreted from the posterior (back) part of an endocrine organ called the pituitary gland, situated in the base of the brain).

### BLOOD GLUCOSE LEVELS AND SPILLAGE IN URINE

In the fasting state, a healthy individual has a blood glucose level between 70-120 mg (3.88 to 6.66 units) per 100 ml blood; two hours after breakfast the level is maintained within 180 mg (10 units) per 100 ml blood. A healthy normal individual does not pass glucose with the urine, since the tubules in the kidney can usually reabsorb sugar, when the level does not exceed 180 mg per 100 ml blood. Beyond this point, however, glucose usually passes into the urine. Due to the osmotic action exerted by glucose, a lot of water is also carried over into the tubules. This explains the profuse urination. (Osmosis is the diffusion of a solvent through a semi-permeable membrane into a more concentrated solution). Because of the abundant loss of water with the urine, the patient feels thirsty. Sodium and potassium salts are also lost along with the urine, so that the patient may feel weak.

### SYMPTOMS OF DIABETES MELLITUS

Why does the blood glucose level rise in diabetes mellitus? The basic problem may be a poor supply or inefficient action of insulin, a hormone secreted by the pancreas, an organ within the abdomen. As a result, there is a derangement of carbohydrate metabolism. In the absence of enough insulin action, blood glucose levels keep rising; however, glucose, which is the principal fuel in maintaining the varied functions of the body, cannot be used by the cells and the tissues. Because of the loss of glucose with the urine and the inability of the tissues to use carbohydrates, the patient feels hungry. Thus the four main symptoms of a patient of diabetes mellitus — profuse urination, increased thirst and also hunger and weakness can all be explained. Prolonged glucose starvation of tissues will cause incomplete combustion of fats, so that the patient may become emaciated (cachectic).

### INSULIN AND THE CONTROL OF BLOOD SUGAR

Insulin is a polypeptide hormone (molecular weight 5734), secreted by a specialised group of cells (Beta or B cells) in the islets of Langerhans of the pancreas. The total weight of the islets in man is only one gram and they produce about 2mg insulin per day. What profound effects can be exerted on the body metabolism by this tiny

Considerably more than 30 million individuals are affected globally by diabetes mellitus.

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Like a thermostat maintains a constant temperature within a refrigerator, so also the normally functioning pancreas responds to every fluctuation in the blood sugar content.

Several clinical studies have shown that good control of blood sugar in diabetes mellitus favorably influences the rates of the complications from the disease.

bit of tissue and what serious problems can result from its deficient action (see two adjacent figures) ! Insulin produces a decrease in the level of blood glucose by two main mechanisms: one, it enables the cells to take up glucose, and two, it stimulates the process of synthesis of glycogen from glucose in the liver. There is another hormone, glucagon, a smaller polypeptide, which is secreted by the alpha or A cells, also in the islets of Langerhans of the pancreas. Glucagon exerts an action opposed to that of insulin, in that it helps in the breakdown of glycogen and raises the level of blood glucose. There is yet a third hormone, somatostatin secreted by the delta or D cells of the islets. Along with insulin, glucagon and somatostatin are deposited into the blood stream via the tiny blood vessels that surround these cells. All these three hormones play important roles in maintaining a normal level of blood glucose.

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Prof Habibuz Zaman

mally functioning pancreas responds to every fluctuation in the blood sugar content. When there is an excess of blood sugar after a meal, more insulin is secreted into the blood. On the other hand, in the absence of enough glucose in the blood, glucagon (from the A cells) stimulates the liver to release glucose from the glycogen, stored within the liver. When enough has been secreted, the process is turned off as a result of the intervention of somatostatin (from the D cells of the islets).

It has therefore been suggested that the hormones insulin, glucagon and somatostatin act in concert to control the flow of nutrients into and out of the circulation. The relative concentrations of these hormones regulate the rates of absorption and peripheral disposal of substances such as glucose, amino acids and fatty acids (end products of the digestion of carbohydrates, proteins and fats, respectively). It is known that the A B and C cells lie in close proximity in the islets of Langerhans. Is this anatomic closeness significant? Perhaps somatostatin and glucagon situation influence the secretion of each other (paracrine relationship) and both affect the rate of release of insulin, it has been suggested.

### DIAGNOSIS OF DIABETES MELLITUS

After having a meal, reach in carbohydrates, the normal

blood sugar level is restored in normal individuals within 2-3 hours. This fact is taken into account in confirming the diagnosis of diabetes mellitus. Since diabetes mellitus is a life-long disease and demands much attention, care and thought on the part of the patient to look after himself, it is important that the diagnosis is based not only on the detection of sugar in the urine, but also on definite findings of increased levels of blood glucose both in the fasting state as well as two hours after a meal. The results must be confirmed on at least two occasions. For a definite diagnosis of diabetes mellitus, the following numbers are generally used.

Fasting blood glucose : 140 mg per 100 ml blood and above (7.8 units and above).  
Blood glucose 2 hours after a meal : 200 mg per 100 ml blood and above (12.2 units and above).

### IMPAIRED GLUCOSE TOLERANCE

There are group of individuals, who have an impairment of tolerance to glucose, that is, their blood glucose level, after a carbohydrate rich meal, may be just marginally above the normal range. These individuals are to be watched, since they may develop diabetes mellitus in course of time. These individuals may have the following findings : Fasting blood glucose : between 115 to 140 mg / 100 ml blood. Blood

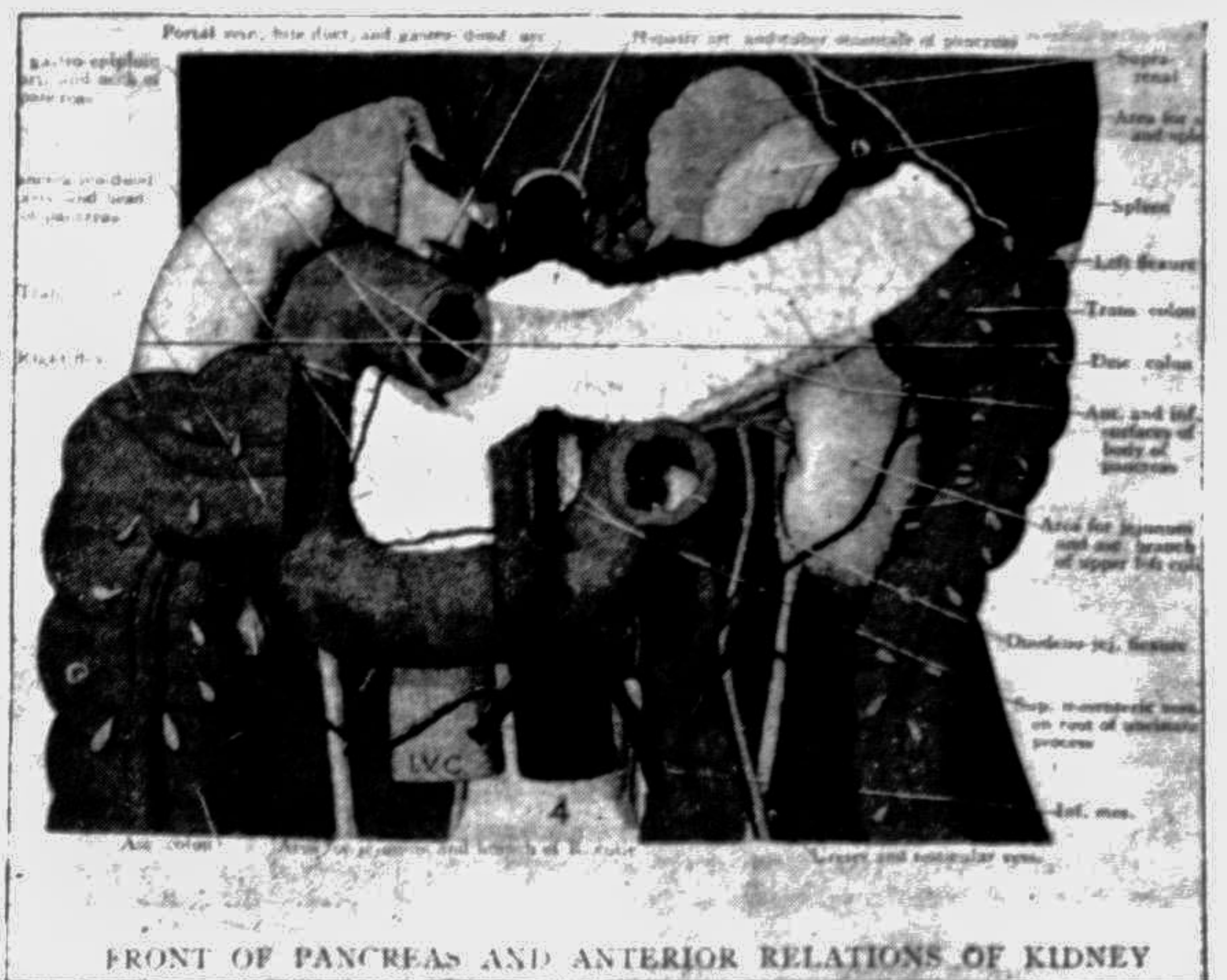
glucose 2 hours after a meal : 140-200 mg/100 ml blood (7.8 -11.1) units).

### JUVENILE, TYPE I OR INSULIN DEPENDENT DIABETES MELLITUS

There are two main types of diabetes. The more severe form, also known as Type I generally occurs in young individuals — in children and young adults. This type I form has a sudden onset, a rapid course and, in the absence of insulin treatment, these patients can end up fatally within months. This was the usual situation prior to the discovery of insulin.

### DISCOVERY OF INSULIN

Although the islets of Langerhans had been described in 1869, it was in 1921 that Banting and Best injected an extract of the pancreas of a male bull (steer) into a diabetic dog and found that the dog's blood sugar was promptly lowered. After trying the extract on themselves and waiting for 24 hours, they injected the same extract (from a steer) into a 12-year old male diabetic, who was facing a certain death. The boy made a dramatic recovery after receiving a number of injections. With this success, the outlook for patients, of diabetes mellitus was rapidly altered. Banting and his professor Macleod at Toronto University, Canada were awarded the Nobel prize for medicine in 1923 for isolating insulin from pancreatic



FRONT OF PANCREAS AND ANTERIOR RELATIONS OF KIDNEY

tissue and thus discovering a treatment for diabetes. Banting gave half of his share of the prize to Best, with whom he had collaborated. These type I diabetes have usually suffered some damage to the B (beta) cells of the islets. The extent of the damage determines the severity of the disease. Many patients may have had a prior viral infection — even mumps has been incriminated. In addition to other viruses, an immunologic mechanism may be involved. These patients require treatment with injections of insulin throughout their life time, and therefore this condition is known as insulin dependent

diabetes mellitus (IDDM). Fortunately, only about 15 percent of cases of diabetes mellitus belong to type I. **MATURITY ONSET OR TYPE II NON-INSULIN DEPENDENT DIABETES MELLITUS** In the type II cases, enough insulin is produced, but this insulin does not seem to be fully effective. Many of these cases may be obese and yet others, as also seen in Bangladesh, are malnourished. Most of these cases can be treated by correction of diet, exercise and weight reduction.

Some may need the use of oral hypoglycaemic drugs; only a few may require insulin injections, especially at times of stress as with other severe illnesses, surgical procedures or pregnancy. Type II cases are seen generally in older adults and the elderly, usually above the age of 40. Many of these cases have a slow onset and a long course. They are often detected accidentally on routine medical checkups; through laboratory tests in the course of diagnosis of other illnesses; and not infrequently, after the onset of some complication of diabetes mellitus, such as infections or vascular problems, eg. coronary thrombosis (heart attacks), cerebrovascular accidents (stroke) or ulcers in the foot. There is a demonstrable genetic factor in the case of type II diabetes, so that the disease does run in families. Since type II cases do not usually require treatment with insulin, these are also known as non-insulin dependent diabetes mellitus (NIDDM). Almost 85 per cent cases of diabetes mellitus fall in this category.

**GOOD CONTROL OF BLOOD SUGAR REDUCES COMPLICATIONS** In many developing third world countries, many untreated or poorly controlled cases of diabetes mellitus die early of infections and diabetic coma. Those, who live longer with the disease, may develop vascular complications and die of a heart attack, stroke, kidney failure, or gangrene of a lower limb or of infections following painless ulcers of the foot. Several clinical studies have shown that good control of blood sugar in diabetes mellitus favorably influences the rates of these complications.

**Front of Pancreas** The elongated organ, lying across the mid-portion of the illustration is the pancreas. The head of the pancreas is surrounded by the curve of the duodenum, the part of the gastro-intestinal tract, immediately below the stomach. The great bulk of this soft, fleshy organ produces the pancreatic juice, which enters the duodenum through the pancreatic duct (not shown) and is important in the digestion of fats and proteins.

Only a small bit of the organ (1 gram) is accounted for by the islets of Langerhans, the B cells in which produce insulin, a hormone so very important in the maintenance of normal levels of blood glucose, and the uptake and utilization of glucose by the cells. The islets also secrete two other hormones — glucagon and somatostatin (see Text). **Key to abbreviation :** AO = Aorta, IVC = Inferior Vena Cava. Prof Zaman is a retired Regional Advisor of the World Health Organisation for the South East Asia Region, New Delhi.

## Non-Surgical Method Developed to Detect Sudden Heart Attacks

It feels like half-cooked noodle, but the catheter detects malignant arrhythmia, a form of irregular heartbeat which can be fatal. by Tang Qingzhong

**S**OME heart patients carry an additional burden — they fear sudden death from heart attack. Not all patients with heart disease suffer such sudden heart arrest. Such a condition — which strikes more than 1.8 million Chinese patients a year — is caused by malignant arrhythmia, a form of irregular heartbeat.

Detecting this condition in time to offer preventive care has long been a challenge to medical researchers. In the 1970s scientists from various countries developed successful detection techniques requiring surgery or at least a hospital stay.

Now a new method developed at Hangzhou No. 2 Hospital enables doctors to detect malignant arrhythmia with a simple 15-minute examination. The only thing the patient does is to swallow a thin piece of catheter.

The accuracy of the new test equal that of the older invasive techniques and allows measurement of each heartbeat. And patients seem to prefer it.

months. "It feels like a piece of half-cooked noodle. I feel no pain or irritation. I feel secure after each checkup, because I know the doctors would treat me if they found a problem," he says.

The test was developed by Dr. Zheng Chang, 37, head of the hospital's research group. He has been studying detection methods since 1984.

"The occurrence of malignant arrhythmia is closely related to abnormal actions of the ventricles," Dr. Zheng said. "These abnormal actions are called ventricular late potentials, the measurement of which helps doctors evaluate the case."

Two of the most common tests to measure ventricular late potentials are "invasive" — they require some form of surgical incision. In one method, a cardiac catheter is inserted into the heart chambers through the femoral artery (chief artery of the thigh). In the other method, the heart cavity is opened.

In the mid-1970s American

researchers developed a non-invasive method called SA-ECC, or Signal Average Electric Cardiogram, to measure ventricular late potentials. Introduced in to China at the end of 1987, the test relies on signals measured through the skin to determine how the heart of a patient is functioning.

Although the test is non-invasive and therefore more popular with patients than the previous tests, doctors at Hangzhou No. 2 Hospital were dissatisfied with its accuracy and sensitivity. The biggest problem, they felt, was the impediment of the skin.

"The accuracy of the recording is inevitably impeded by the skin," Dr. Zheng said. "With the SA-ECC, results are obtained through the accumulated information from 150-300 heartbeats and the method fails to record the abnormal conditions of every beat to detect the ventricular late potentials."

For their test, Dr. Zheng and his colleagues focused on

the esophagus, which they chose for its location near the heart. Encouraged by earlier successful measurements of other heart functions through the esophagus, Dr. Zheng and his team studied this approach.

Their test uses a catheter 2.5 millimeters thick. One end of the catheter, with six poles for receiving electric signals from different locations in the heart, is introduced through the mouth or nostril into the esophagus.

It is placed behind the heart for electrographic monitoring. Through the use of a micro-computer, electric signals of every heartbeat are measured and recorded on paper at speeds of 50, 100 or 250 millimeters per second.

Dr. Zheng said the esophageal test compares favourably in accuracy with invasive methods and the SA-ECC technique.

Researchers from Hangzhou Cardiovascular Disease Institute, Zhejiang Hospital and the First Hospital attached to Beijing Medical University have joined Dr. Zheng's tests.

The Chinese achievement was not unexpected. In the late 1980s, Professor H. Klein of the Federal Republic of Germany predicted that improved recording and measuring technology would lead to a non-invasive test to measure ventricular late potentials. Dr. Zheng's group made the prediction come true.

**P**ILIKWE in east-central Botswana is the kind of settlement where, as one villager says, everybody knows everybody else's business. So when Kabo's mother died during his birth 12 years ago, it concerned everybody.

Today Kabo is taken care of by a local primary school teacher and is in his sixth year of school. His mother is dead and buried but the story of his birth and her death still lives.

Doctors could have saved her life by terminating her pregnancy, but it is a criminal offence in Botswana to perform abortions regardless of circumstances.

The government intends to amend the penal code this year to make abortion legal in cases like this.

Also included under the new law will be cases of pregnancy as a result of incest, rape or defilement. Abortions will only be carried out within 18 weeks of conception where two doctors have given their approval in writing that abortion is immediately necessary to save the life of the mother, or to prevent grave injury to her physical or psychological health.

The minister for presidential affairs and public administration, Lt. General Mompoti Merafhe, is crisscrossing the country telling people that according to the World Health Organisation (WHO) at least 500,000 women die every year as a result of childbirth complications. In Africa alone, the number is 150,000 and in Botswana, 200. That may not include all deaths because some women still prefer to deliver at home.

Half of all African countries have severely restricted

## Botswana Liberalises Abortion Law

Although in half of all African countries abortion is illegal or severely restricted, Botswana is amending its law to make abortion legal in cases deemed threatening to the mother's life or health. Many Botswana fear moral decay and believe that treatment by traditional medicine men is still necessary, but as Gemini News Service reports, most people seem to favour change. by Marx Garekwe

the carrying out of abortions, as do most South American countries and the Indian sub-continent. Battles between pro and anti-choice groups rage on in the United States and Canada. Poland's new president wants to introduce abortion legislation which would be the most strict in all of Europe except for Ireland.

The minister, who is also responsible for law and order in Botswana, emphasised that under the new law termination of a pregnancy will only be performed at the request of the affected mother or her legal guardian when she is unable to make the request herself.

The opinion of the husband will not be sought. In the past, women's lives have been lost because of men who believed they had the right to decide for their female partners. The government wants to put those days in the annals of history.

In most kgotla (village gathering place) meetings the people (Botswana) supported the idea and thanked the gov-

ernment for consulting them before the bill was made law. Botswana is one of the few countries that has maintained a multi-party system and ideological pluralism since independence in 1966.

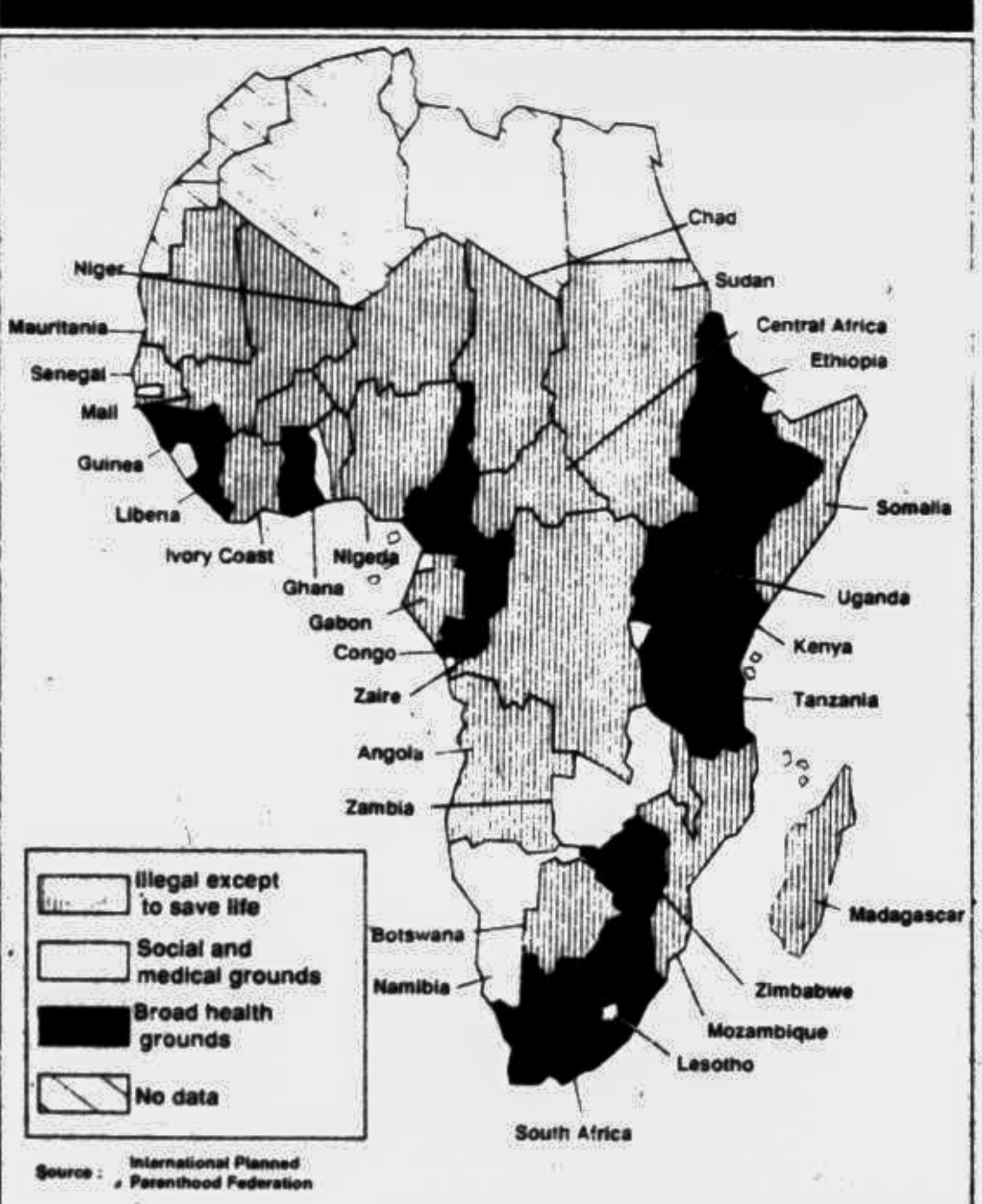
The minister encountered mild opposition in the southern part of the country, mostly on religious grounds.

Apart from a few African religions, Botswana is predominantly a Christian society. Many argue that when the Bible says, "thou shalt not kill", it applies to the unborn child as well. The government responds that those opposed can choose not to have abortions.

Illegal abortions have caused many deaths because they are performed by untrained people often in unclean environments.

However, the new law is unlikely to help that problem because most are done for economic and social rather than for medical reasons and so would not qualify under the regulations. Some women would like

## Access to abortion in Africa



to continue with their education, some cannot afford to feed an extra mouth or simply are not prepared to change their lives to accommodate a baby. Sometimes babies are abandoned by their mothers at birth.

Despite the government's efforts to explain the bill in the clearest and simplest terms, in rural areas, where news from the government is often regarded with suspicion, some think the government is just opening the floodgates for

abortion and moral decadence. They think young women from cities and villages will use abortion as a form of contraception.

In Setswana beliefs and customs, a woman who has had a miscarriage or abortion and has not been treated by a traditional medicine man will cause any man who sleeps with her to die. Many people, a lot of them elderly, are afraid of the number of deaths they believe this would bring to young men.

**MANILA :** The "mirror nature" of AIDS and TB is likely to increase the incidence of tuberculosis — or TB — in Southeast Asia, Africa and Latin America.

When people infected with TB are also infected with HIV, the human immunodeficiency virus which causes AIDS, tuberculosis is more likely to become active because of the weakened immune system.

"Countries with the highest rates of HIV infection and high numbers of TB carriers are recording explosive rates of TB," says Dr Arata Kochi, chief medical officer of the tuberculosis Unit of the World Health Organisation (WHO).

"It is becoming a parallel epidemic and it is this trend that has public health officials worried," says Dr Hiroshi Nakajima, WHO Director-General.

The WHO estimates that 200,000 people in Asia are infected with both HIV and TB. The WHO estimates that worldwide three million people with HIV infection are also infected with TB.

In most developing countries, particularly in the Indian subcontinent and sub-Saharan Africa, the incidence of TB has been declining. But in absolute numbers, it is increasing as the population increases.

Countries with the largest number of TB cases are Bangladesh, Brazil, China, India, Indonesia, Nigeria, Pakistan, the Philippines and Vietnam. Most of the TB deaths occur in developing countries. In Asia there are about 1.8 million TB deaths, concentrated among adults aged 15-59, the most economically active population group.

## TB Spreading in Tandem with AIDS

By George Javier

'Explosive' rates of new tuberculosis cases are being recorded in countries with the highest rates of HIV infection.

Each year, nearly three million people die from tuberculosis. This is a death rate higher than for any other infectious diseases. And each year, the WHO estimates, there are eight million new cases of TB.

Tuberculosis is a disease of the lungs and other organs caused by a bacterium. About four million TB cases are infectious. It is transmitted through the air when infected persons cough or sneeze.

In some developed countries, decades of declining TB rates have come to a stop, as in the United States. There TB declined for 32 consecutive years until 1984. It is now on the increase. In industrialised countries, there are now about 42,000 TB deaths, annually, mostly among the elderly, ethnic minorities and migrants.

One of the main reasons for the comeback of TB is undoubtedly the spread of the HIV virus.

In some countries in central Africa — where over half the adult population is infected with TB — the HIV epidemic is associated with sharp increases in TB cases. The WHO expects over 250,000 extra TB cases in Uganda because of the frequency of simultaneous HIV and TB infection.

With the upsurge in TB incidence, greater attention is being paid to the control of the infectious disease. The new short-course chemotherapy lessens the duration of treatment from 12 months to six months with the addition of the drugs rifampicin and pyrazinamide to the standard chemotherapy of isoniazid and streptomycin.

With this additional treatment, those with infectious TB stop excreting bacilli within two months instead of six, sharply reducing the rate of transmission. Pulmonary experts have stated that curing TB requires a six to 12 month treatment course with daily administration of drugs. If treatment and drug therapy are done properly, about 98 per cent of those infected can be cured, with the chain of transmission cut off.

Compared with the previous treatment, which sometimes requires the painful injectable streptomycin, the short-course regimen is less expensive.

Furthermore, patients are treated for a much shorter duration. TB patients and health workers can see a fast and dramatic improvement. The visible and rapid change in their condition encourages the patient to improve.