THE EPIDEMIOLOGY AND CONTROL OF TYPE 2 DIABETES MELLITUS IN NORTH SULAWESI PROVINCE, INDONESIA

Sekplin A.S. Sekeon
Indonesia

THE EPIDEMIOLOGY AND CONTROL OF TYPE 2 DIABETES MELLLITUS IN NORTH SULAWESI PROVINCE, INDONESIA.

A thesis submitted in partial fulfilment of the requirement for the degree

of Master of Public Health

By

Sekplin A.S. Sekeon

Indonesia

Declaration:
Where other people's work has been used (either from a printed source, internet or any other source) this has been carefully acknowledged and referenced in accordance with departmental requirement.
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Abstract.

The increasing of type 2 diabetes (T2DM) in Asia is predicted to be higher and faster than other continent. Indonesia is also experiencing the trend of growing of T2DM. The prevalence of T2DM in Indonesia was 1.5 in 1981 and currently is 14.7% in 2001. Similar with other countries in South-East Asia, most of the T2DM patients are in younger age than observed in developed countries. T2DM in South-East Asia region, including Indonesia is also commonly occurred at lesser body weight people than in developed countries.

North Sulawesi is one of the most progressive development provinces in Indonesia. Globalization, urbanization and other social determinants have been influencing people lifestyle, especially on diet and physical exercise. Change in diet and physical exercise in interaction with inadequate respons of health system and healthcare provider can be considered as the main contributing factors of influencing the increasing of T2DM in North Sulawesi, and Indonesia as well.

Experience from other countries and from many studies has provided best practice methods in diabetes prevention and control. While comparing T2DM prevention and control in North Sulawesi with these best practices methods, it is concluded that T2DM prevention and control in Indonesia, in particular North Sulawesi is still sub-optimal. It is recommended to start the T2DM prevention and control program with upstream, midstream and lowstream approaches.

List of abbreviations and Indonesian glossary.

ADA   : American Diabetes Association.
APPG   : Asia-Pacific Type 2 Diabetes Policy Group.
ASEAN   : Association of South-East Asia Nations.
BMI   : Body Mass Index
BPS   : Balai Pusat Statistik (Bureau of Statistic Center).
CHC   : Community Health Center.
CHCsub : Community Health sub-Center.
COPD   : Chronic Obstructive Pulmonary Diseases.
CU5   : Children Under 5-year.
CVD   : Cardiovascular Diseases.
EU   : European Union.
FPG   : Fasting Plasma Glucose
GDM   : Gestational Diabetes Mellitus.
HbA1c   : Glycated haemoglobine.
HDI   : Human Development Index.
ICCC   : Interantional Care for Chronic Conditions.
IDF   : International Diabetes Foundation.
IFG   : Impaired Fasting Glucose.
IGT   : Impaired Glucose Tolerance.
IMR   : Infant Mortality Rate.
IPD   : Infectious and Parasitic Diseases.
KIT   : Royal Tropical Institute.
KPAN   : Komisi Nasional Penanggulangan AIDS (National
             Commission for AIDS Control).
MCHC   : Maternal and Child Health Control.
MMR   : Maternal Mortality Rate.
MOH   : Ministry of Health.
NCD   : Non-communicable Diseases.
NCNCD : National Centre for Chronic and Non-communicable Diseases
             Prevention and Control.
NDEP   : The National Diabetes Education Program.
OGTT   : Oral Glucose Tolerance Test.
OHA   : Oral Hypogycaemic Agent.
PDRB   : Pendapatan Domestik Regional Bruto (Gross Regional
             Domestic Product).
Perkeni : Persatuan Endokrinologist Indonesia (Indonesia
             Endocrynologist Association).
Persadia : Persatuan Diabetes Indonesia (Indonesia Diabetes
             Association)
PCOS   : Polycystic Ovarian Syndrome
PHO   : Provincial Health Office.
PPM   : Pemberantasan Penyakit Menular (Communicable Diseases
             Prevention and Control).
PRDK   : Professor. Dr. R.D. Kandou.
QALY   : Quality-adjusted Life-years.

RPG	: Random Plasma Glucose.
SEA	: South-East Asia.
Sulut	: Sulawesi Utara (North Sulawesi/North Celebes).
T2DM	: Type 2 Diabetes Mellitus.
UK	: United Kingdom.
UNSRAT	: Sam Ratulangi University.
VU	: Vrije Universiteit.
WHO	: World Health Organization.
WHR	: Waist-Hip Ratio.

| **1** | **Introduction** |

As a new lecturer in Faculty of Medicine, Sam Ratulangi University, I had been directed by the faculty's management to be an academic staff in School of Public Health (*Program Studi Ilmu Kesehatan Masyarakat/PS IKM*). I am officially working in this one of the study programs of the Faculty of Medicine since 2006. Other study programs in the faculty are Medicine, Dentistry and Nursery.

PS IKM was established in 2001 and has 6 departments: Epidemiology, Biostatistics, Health Administration and Management, Health Environment, Nutrition and Health Promotion. Officially, PS IKM has only 7 academic staffs which recently are responsible to 325 students. Due to the scarcity of human resources, PS IKM has collaborated with other public health practitioners, commonly from Department of Public Health of Faculty of Medicine and North Sulawesi Provincial Health Office. One of the mid terms planning for PS IKM is to be a Faculty of Public Health.

Recently, PS IKM has no official lecturer in the Department of Epidemiology, especially for non-communicable diseases. Expert in this department is needed to fill the need of students on non-communicable disease epidemiology modules. The students are expected to apply the skill and knowledge to the community where they will work later. One of the most frequent non-communicable disease in North Sulawesi province is diabetes mellitus. In 1982, the prevalence of diabetes in North Sulawesi was the highest in Indonesia. However, there is very limited research on this subject in North Sulawesi province. Diabetes mellitus is a good model of chronic non-communicable diseases in term of its epidemiology, burden and prevention/control program. Researches on diabetes mellitus are important to find the diseases pattern, what the problem is and how to intervene the problem. I hope, this thesis will be a good and informative starting point for further researches on diabetes prevention and control in Indonesia, in particular in North Sulawesi. In addition, the thesis development was a good experience for me in upgrading my skill and knowledge on this topic to answer the need of students and, in general, people of North Sulawesi.

| **2** | **General information about North Sulawesi** |

General information.

North Sulawesi is one of the provinces located in eastern part of Indonesia. The province, which is only 0.75% (13.830 km^2) of the total area of Indonesia, has 9 districts and 4 municipalities. Manado is the capital city. The province is bordered directly with The Republic of Philippines. Geographically, the province is a mountainous region, which consists of low and high scenery. The climate is tropical and consists of two seasons, which is rainy season in October to April and dry season in April to October. The province has several ethnic groups of which Minahasa is the largest ethnic group (33,2%). Christian is the most dominant religion in the province (Bureau of Statistic Center/BPS, 2008; Sulut, 2007).

Demography situation.

In 2006, North Sulawesi had 2.1 million people. Population density was 141 people/km^2 in 2007; which was the third most populated province in eastern Indonesia. Sex ratio among the population is about 1:1. Annual growth rate of population in during 2000-2006 was 1.29. Total fertility rate is 1.91 per-year. Life expectancy both for male and female is higher than national level. Male life expectancy at birth is 68 years (national: 64) and female life expectancy at birth is 72 years (national: 67). Based on life expectancy in 2007, the province was ranked in the 3rd position after Jakarta and Jogjakarta, two big regions in Indonesia (BPS, 2008; Provincial Health Office/PHO, 2006). It was estimated that life expectancy will be 74.5 during 2010-2015. Majority (68%) of people in North Sulawesi are in the productive age (15-64 age group). Dependency ratio was declined from 0.83 in 1980 to 0.46 in 2005. The population pyramid has been changing "from traditional shape to one of more cylindrical shape" (PHO, 2006; Sondakh, 2003).

Economic situation.

North Sulawesi is one of the most progressive development provinces in Indonesia, especially after the implementation of regional autonomy policy in 2001 (Sondakh, 2003). The economic growth was 2.13% in 2001 and increased to almost 5% in 2005 (BPS, 2005 as cited by Sondakh, 2003). The gross regional domestic product (PDRB) increased 60% between 2000 and 2005 (BPS, 2005 as cited by PHO, 2006). The economic growth is mostly coming from agriculture sector which contributes 20% to the total of PDRB. Transport and communication sectors are in the second rank (14.5%); trade, hotels and restaurants (12.6%), followed by construction, manufacturing and mining (4.75%).

According to Akita and Alisjahbana (2002) as cited by Sondakh (2003), the province is the wealthiest province in Sulawesi island.

Transportation.
As one of the 15 main entrances to Indonesia, North Sulawesi has one international airport which serve direct flight from several high-income countries such as Singapore, Japan and Taiwan. Also, there is one international sea-port (Sulut, 2007). The strategic position of North Sulawesi in the Pacific region has affected the way of interaction between indigenous people with foreigners. The interaction is more common and easily conducted compared to other provinces. The condition is encouraged by the basic character of the people in the province which is well-known as open-minded and as very accommodating to western culture (Jones, 1977 as cited by Sondakh, 2003).

Educational situation.
The National Socio-Economic Survey in 1999 showed that, almost all of the children age 7-12 (93.6%) were enrolled in primary school and more than three-fourth (76.7% of children age 13-15 were enrolled in the junior high school (BPS, 2007). Adult literacy rate in 2006 was 99.1 (male) and 98.9 (female) while national adult literacy rate was 94.56 (male) and only 88.39 (female). The contribution of educational sector to the development of human resources in North Sulawesi has been presented in the good grade of Human Development Index (HDI) of the province which had increased from 67.1 (1999) to 74.4 (2006). The HDI of North Sulawesi was second rank after Jakarta, the capital city of Indonesia (BPS, 2008; PHO, 2006). Currently, there are two international high schools, two state universities, one international private university, two church-based universities and several local private universities in North Sulawesi. Sondakh (2003) predicted that North Sulawesi will be one of the important educational centers in the eastern part of Indonesia.

Health sector situation.
Health infrastructures.
Concerning the health sector, primary care is provided mostly through community health center (CHC). There are 128 CHC in North Sulawesi and each CHC has 3-4 community health sub-center (CHCsub) in 2005. Totally there are 532 CHCsub. In North Sulawesi one CHC serves 17.000 people (national average is 1 CHC for 30.000 people). The CHC is well-distributed at sub-district level. Secondary and tertiary care are mostly provided through hospitals. There are 28 hospitals in the province, 10 of which are government's hospitals; on of these called Prof. dr. RD Kandou General Hospital (PRDK Hospital), located in the capital city of the province, is a major teaching hospital. PRDK Hospital is the biggest hospital in the eastern part of Indonesia. The hospital serves the patients not only from North Sulawesi but also from several neighbor provinces in the eastern Indonesia (PHO, 2006).

Health workers.
Total numbers of formal health workers in North Sulawesi in 2005 were 5.715 workers; most of them (72.86%) were nurses and midwives. Another group of health workers were medical doctors (12.93%), sanitarians (6.07%), pharmacists (2.92%) and nutritionists (2.57%). The ratio between doctor and population served is 1:2800 (national average is 1:6000). There is only one endocrinologist in the province (PHO, 2006).

Health status situation.
Based on data from BPS in 2003, the Infant Mortality Rate/IMR for North Sulawesi province was 25/1000 live births compared to 63/1000 live births in 1990. It was estimated that IMR for North Sulawesi during 2005-2010 will be 13.8/1000 live births while for Indonesia it will be 26.9 (BPS, 2008; BPS, 2003 as cited by PHO, 2006). Children under-five (CU5) mortality rate were 33/1000 lives birth in 2003 (national average was 46/1000 lives birth in 2003) and maternal mortality rate/MMR was 150/100.000 lives birth in 2005 (national average was 307/100.000 lives birth in 2005). Communicable diseases such as tuberculosis, leprosy, diarrhea, dengue and malaria are still dominant in North Sulawesi. HIV/AIDS has been increasing since detected for the first time in 1997. In 2003 there were 7 cases of HIV positive. The number doubled in 2004 with 15 cases. In 2005 it was already 53 cases detected by PHO Surveillance Unit. Most of the cases were found among housewives and college students (PHO, 2006).

Non-communicable diseases.
There is very limited data about non-communicable diseases patterns in North Sulawesi. However, data from PRDK Hospital showed that non-communicable diseases (such as cardiovascular diseases, diabetes, and stroke) are going to be the major public health issues in the region. The most leading cause of death in the hospital during 2006 was cardiovascular diseases. Diabetes mellitus was only in 9th position of the most common treated disease in hospital wards during 2004. It became in 7th position in 2005 and 5th position in 2006 (PRDK, 2007).

Problem statement.

Recently, at least 171 million of people around the globe are affected by diabetes. By the year 2025-2030 the number will be in between 300-380 million; of which, 298 will live in developing countries (King, 1998; Wild, 2004). Among the top ten countries contributed to the total number of adults living with diabetes by 2025, 41.4% of which will come from India, China, Indonesia, Pakistan, and Japan (King, 1998). A study from Pacific region by Foliaki (2003) also revealed that the prevalence of diabetes in the Pacific region has increased dramatically since 1965 when the prevalence of diabetes was studied for the first time. The region is "struggling" with the remarkable growing of diabetes which is turning into a "worse case scenario" (Cockram, 2000).

The impact of the increasing of diabetes in Asia-Pacific will be serious because diabetes may result in both micro-vascular and macro-vascular complications (Vinik, 2003). In the advanced stadium, of both time of onset and/or the level of hyperglycaemia, patients may develop of blindness, kidney diseases, leg ulceration, erectile dysfunction, bladder dysfunction, nocturnal diarrhea, cerebrovascular and cardiovascular diseases/CVD. Besides clinical complications, there is also economic impact of diabetes to the patients, community and health system. In India (Ramachandran, 2007), 17.5% of the total income of patient will be spent to in-patient diabetes care compared to 7.7% for the out-patient care. Should the patient need surgery, it will cost 16.3% of the total patient's income. According to Brown (2005) every dollar lost in patients' income, there is 0.36 USD less income for the community. From health system perspective, the issue is how to allocate the scarcity of resources to provide better health services to type 2 diabetes/T2DM patients because T2DM patients with complication will increase the health service utilization (Colagiuri, 2002). In addition, there is more death attributable to diabetes in developing countries, including South-East Asia/SEA countries, than in developed countries. Globally, the total death attributable to diabetes was 2.9 million in 2000 and the specific productive age group of 50-54, is the most vulnerable age group to die of diabetes in SEA region. Among all death of men aged 30-69 years in 1990, 289 thousand were caused by CVD, compared to 147 thousand by infectious and parasitic disease (Yusuf, 2001). So, for Indonesia and other poor countries in Asia, T2DM is a big problem, not only for the patients but also for the nations, due to the limited resources available to face the burden of diabetes.

In Indonesia, the total number of diabetes patients in rural area is estimated to increase from 5.5 million in 2003 to 8 million in 2030. In the urban areas, it will increase from 8.2 million in 2003 to 12 million in 2030 (BPS, 2006 cited by Soewondo, 2006). In 2004, diabetes mellitus was on the 7th rank from the total of out-patient service in hospital and was ranked at 4th position of the main leading cause of death among non-communicable diseases (Ministry of Health/MOH, 2006). It was in the top ten of main cause of death both in 2005 and 2006 (MOH, 2007a; MOH, 2007b). WHO (2002) reported that diabetes contributed to 3% of the total number of deaths in Indonesia. The situation of diabetes in Indonesia is even bigger than HIV/AIDS in term of current and estimated number of population affected. The accumulative number of people living with AIDS since 1987 when the first ADIS case was diagnosed until the end of 2006 is 13 424 cases. The estimated total number of people with HIV/AIDS in 2020 will be less than 2 million people (MOH, 2007b; National Commission for AIDS Control/KPAN, 2007). Even though Indonesia is currently ranked at 4th position among 10 countries with the biggest diabetes cases in 2000 and will still in that position in 2030 (Wild, 2004), the attention to the growing of diabetes is still inadequate.

Due to the growing epidemic of diabetes, the study on the epidemiology and prevention of diabetes can help to provide information about diabetes prevention and control in Indonesia. Later, the information can be used to find effective diabetes interventions which appropriate to the resources available and local community characteristic. Setting the diabetes intervention with available health care resource is important aspect in managing diabetes (International Diabetes Foundation/IDF, 2005). Due to limited data about diabetes in developing countries (Narayan, 2006a), studies are needed to transfer the effective diabetes interventions designed in developed countries to be implemented in developing countries. Considering that North Sulawesi is one of the most progressive development areas since the change of the political system in Indonesia (Sondakh, 2003), it is interesting and important to study the prevention and control of diabetes in North Sulawesi. Understanding the local characteristic of diabetes situation can help achieving better diabetes prevention and control (Engelgau, 2003).

Objectives.

General objective.
To explore the epidemiology of type 2 diabetes in Indonesia and other South-East Asia (SEA) countries, the determinants of type 2 diabetes mellitus in North Sulawesi province and review the diabetes prevention and control in Indonesia and in particular in North Sulawesi province.

Specific objectives:

1. To describe the prevalence of type 2 diabetes mellitus in Indonesia and SEA countries.
2. To describe the determinants of type 2 diabetes mellitus in Indonesia, focusing on North Sulawesi; and SEA countries.
3. To describe the best practice for prevention and control of T2DM.
4. To describe and review the current health care organization for T2DM prevention and program in North Sulawesi.
5. To provide recommendation and describe feasibility on T2DM prevention and control.

Methodology

1. Study design:
   Descriptive study (Literature review).

2. Study method:
   Search strategy
   Data were searched from internet, KIT land VU library. References from internet were primarily obtained from Google Scholar, PubMed, Yahoo Directory, WHO website, Diabetes care, The Lancet and DCPP website. References in books and journals were collected from KIT and VU library. Original data on diabetes in Manado were taken directly from North Sulawesi Health Profile and Sam Ratulangi University in Manado. Some analyses in some part of the thesis were based on personal communication with several researchers.

   Key words
   Key words used were "diabetes mellitus" in combination with: type 2, prevalence, risk factors, prevention, control, intervention, complication, determinant, cost-effectiveness, food-pattern, obesity, overweight, metabolic syndrome, culture, development, economic, globalization, social, manado, north sulawesi, indonesia.

   Exclusion criteria:
   Only literatures written in English or Indonesia language which published in internet were reviewed.

Framework of study.

4 | Epidemiology of T2DM in Indonesia and South-East Asia
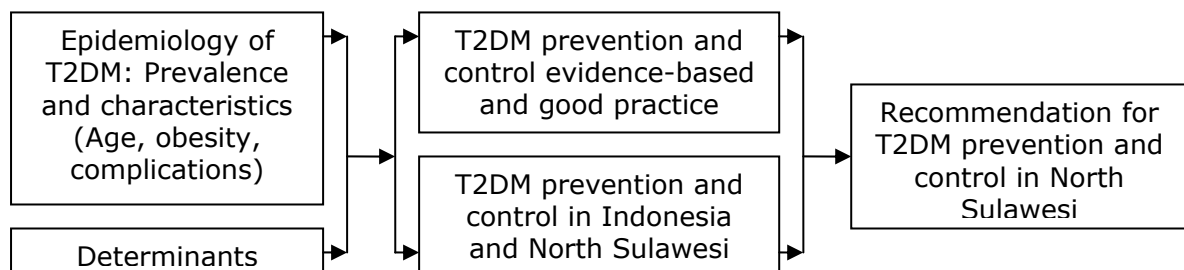
Prevalence.

Asia countries, including South-East Asia, will be affected more by the increasing of diabetes prevalence than developed countries. Both King (1998) and Wild (2004) estimated that the number of diabetes in between 2025 and 2030 will come prominently from Asia continent. Two countries that are usually mentioned regarding this issue are India and China. However, several Asia countries such as Indonesia, Bangladesh, Philippines and Japan were also grouped on a "list of countries with highest number of estimated cases of diabetes for 2000 and 2030" (Wild, 2004). Similarly, the "list of top ten for estimated number of adults with diabetes in 1995 and 2025" (King, 1998), also consist of several Asia countries including Indonesia, Japan and Pakistan.

Indonesia and Philippines are countries that committed themselves in a regional association so called ASEAN (Association of South-East Asia Nations) together with Singapore, Thailand, Malaysia, Vietnam, Cambodia, Brunei Darussalam, Laos and Myanmar. This association is, in some level, identical to the European Union (EU). In Vietnam, Trung Le (2005) reviewed a 2.5 times higher prevalence of T2DM from 2.5% in 1993 to 6.9% in 2001. According to the review, in middle-age group of Vietnamese, there was an increased of high blood glucose level from 1.6% in 1997 to 6.1% in 2003. Cambodia has a 5% of prevalence of T2DM in one of the poor rural area and 11% in semi-urban area (King, 2005). In Thailand, a survey called National Examination Health Survey showed that the prevalence of diabetes and impaired fasting glucose in 2004 was 6.7% (Aekplakorn, 2003). The methodology which was performed in Cambodia and Thailand were identical. Fasting Plasma Glucose/FPG was performed in Thailand and 2-hour plasma glucose in Cambodia. The prevalence of diabetes in rural area in Cambodia was quite similar with the prevalence of diabetes in Thailand, which is economically better than Cambodia (King, 2005). All the studies showed that the prevalence of diabetes in South-East Asia region is similar with the prevalence in developed country like in USA (Cowie, 2006 as cited by Aekpakorn, 2003). Prevalence of T2DM in Asia seems similar with other continents, but the growth is faster (Yoon, 2006; Cockram, 2000).

In Indonesia, the publication on the prevalence of T2DM is very limited. According to Yach (2006) as cited by Ng (2006), diabetes prevalence in Indonesia will increase from 6.7% in 2000 to 10.6% in 2030. Data from WHO, which supported several studies and collected several data on non-communicable disease in Indonesia, showed the trend of the growing of the prevalence of diabetes. A community-based study in Depok (West

Java) found the prevalence of diabetes in Depok (West Java) was 13.6% (table 1) (WHO InfoBase, 2008). It was higher than the prevalence in Vietnam, Cambodia and Thailand.

Table 1.   The prevalence of diabetes in Indonesia 1981-2005.

Year	Detection method, criteria and additional informations		P1 (%)	P2 (%)
1981*	Coverage of study	Sub-national		1.5
	Setting	Makassar, South Sulawesi		
	Other information	NA		
1982*	Coverage of study	Sub-national		1.6
	Setting	Jakarta		
	Other information	NA		
1982*	Coverage of study	Sub-national		**6.1**
	Setting	**Manado, North Sulawesi**		
	Other information	NA		
1991*	Coverage of study	Sub-national		1.4
	Setting	Surabaya, West Java		
	Other information	NA		
1992*	Coverage of study	Sub-national		5.7
	Setting	Jakarta		
	Other information	NA		
1997**	Coverage of study	Sub-national		7.2
	Urban/rural	NA		
	Setting	Health center in 10 sub-district of South Jakarta		
	Sample size	80		
	Respons rate	NA		
	Detection method	Fasting blood glucose		
	Criteria code	7.84 mmol/L		
	Sex	Female (n=142)	7.7	
		Male (n=80)	6.3	
	Age group (year)	60-80 (n=222)	7.2	
1998*	Coverage of study	Sub-national		3.5
	Setting	Makassar, South Sulawesi		
	Other information	NA		
2001**	Coverage of study	National (Health Survey)		NA
	Urban/rural	Both		
	Setting	NA		
	Sample size	4081		
	Respons rate	NA		
	Detection method	Fasting blood glucose		
	Criteria code	125 mg/dl		
	Sex	Female, aged 25+	3.3	
		Male, aged 25+	4.2	
2001*	Coverage of study	Sub-national		14.7
	Setting	Jakarta		
	Other information	NA		
2003**	Coverage of study	Sub-national		13.6
	Urban/rural	Both		
	Setting	Community-based survey; Depok, West Java		
	Sample size	1855		
	Respons rate (%)	92.7		
	Detection method	2-h plasma glucose		
	Criteria code	11.1 mmol/L		
	Sex	Female, aged 25-65	12.3	
		Male, aged 25-65	15.2	
	Age group (year)	25-35	7.4	

		36-45	7.1	
		46-55	15.8	
2005*	Coverage of study	Sub-national		
	Setting	Makassar, South Sulawesi		12.5
	Other information	NA		

P1 = Age and/or sex specific prevalence rate; P2 = Overall prevalence; NA = Not available
Source:
  * Soewondo. 2006. Diabetes mellitus in Indonesia. University of Indonesia.
  **WHO. 2008. WHO info base. Available online at www.who.int/infobase.

Table 3 showed that before 1982, diabetes was more prevalent in Manado, the capital city of North Sulawesi province, than Jakarta (the capital city of Indonesia) and Makassar (the capital city of South Sulawesi province; the most industrious city in the eastern part of Indonesia). In 2001, the prevalence of diabetes in Jakarta had already reached 14.7%; higher that the prevalence in Makassar which was 12.5% in 2005. It means, the increasing of diabetes in 2 major cities in Indonesia, is probably occurred also in North Sulawesi province. Unfortunately, there are no recent publications about diabetes prevalence from North Sulawesi province.

Age structure.
The distribution of diabetes shows a different pattern between developed and developing countries. In developed countries, with better economic wealth and quality of health service, the prevalence of diabetes is highest in the oldest-age group. In contrast, the prevalence of diabetes is dominated by 45-64 age-groups in developing countries. This pattern is expected to be the same in 2025-2030 (Wild, 2004; King, 1998; Day, 2001). Diabetes will commonly be found in the elderly people for developed countries, in the middle age people for the Asia and in the young age people for the Sub-Saharan Africa by 2025 (King, 1998). In Thailand Aekplakorn (2003) found that the highest percentage of patients with T2DM was at 55-64 age groups. The result of the study in Depok showed that diabetes is more prevalent in age group of 46-55 year (WHO, 2008). Data from several Asia countries showed that highest prevalence of diabetes was in age group of 30-49 years (Yoon, 2006). In Manado, most of the T2DM patients treated in PRDK Hospital in 2008 are in group age of 51-60 (44%) and the mean age of all patients is 57 years (*primary data from PRDK Hospital*). This indicated that diabetes is affecting the most productive population group in Asia.

Complications.
Ramachandran (2007) reviewed several studies of these complications in patients with T2DM and found that the prevalence of retinopathy and cardiovascular diseases in India was 23.7% and 11.4% respectively. In Singapore, the study on the different ethnic groups showed that the percentage of ischemic heart disease was 13-22%, stroke was 3-8%, and

retinopathy was 15-17% among the three Malay, India and Chinese ethnics (Hong, 2004). Another study conducted by Chuang et all (2005) in several Asia contries and Lee et all (2001a; 2001b) in Singapore also showed the prominent micro-vascular complications of T2DM. In Manado, primary data from PRDK Hospital showed that heart diseases is the most common complication (23%) of T2DM in all patients aged above 20 years. One-third T2DM patients in Manado (35%) have more than one T2DM complications.

Overweight/obesity.
Acccording to Hadi (2005), the increasing of prevalence of diabetes in Indonesia are associated with the increasing prevalence of obesity/overweight. In Indonesia, the prevalence of obesity for men was 4.2% in 1982 and 6.8% in 1996. For women, the prevalence was 17.1% in 1987 and 13.5% in 1996 (Hadi, 2005; Sutanegara, 2000). In 2005, the prevalence overweight among adult male and female was 14.9% and 24.0%, respectively (Atmarita, 2005). The relation of prevalence of overweight and obesity with the prevalence of T2DM in this Asia region was reviewed by Yoon in 2006. The review showed that among several South-East Asia countries like Philippines, Malaysia and Thailand there is a relation between the prevalence of overweight (16.9-28.3%) and the prevalence of diabetes (5.1-11.9%).

In Indonesia, including North Sulawesi, the obesity/overweight situation and its impact to diabetes is also being worst by the current high prevalence of obesity/overweight in adolescent and children (Hadi, 2005). The prevalence of obesity among children in elementary school (usually in group age of 6-12, *author*) was 9.7% in 1999 and 15.8% in 2002 (Ismail, 1999 and Padmiari, 2002; both studies cited by Hadi, 2005). In 2004, the prevalence of obesity among youth in junior secondary school (usually in group age of 13-15, *author*) was 7.8% in urban area and 2% in rural area (Hadi, 2004 cited by Hadi, 2005). Recent data showed that the prevalence of obesity in adolescent in Indonesia was 11% in 2002 (Adhianto, 2002). The prevalence is similar with the prevalence of obesity in Singapore, Bangkok and Australia for the age group of 11-18 years (Samsudin, 1993 cited by Adhianto, 2002).

There is a different pattern of association between obesity and diabetes in Asia and other continents. "Diabesity" is the term that was introduced by Sims in 1970s (cited by Haslam, 2005) to describe the close relationship between obesity and diabetes. In developed countries, diabetes commonly occurs in overweight people (BMI 25-30 kg/m^2) and obesity (BMI >30 kg/m^2). However, several reviewed shows that in Asia, including South-East region, diabetes commonly presented in people with lesser BMI (Haslam, 2005; Yoon, 2006). Trung Le (2005), who reviewed the prevalence of T2DM in Vietnam, showed that in Vietnam most of the T2DM had normal BMI but high waist-hip ratio (WHR) as a representative of body fat and abdominal fat. In Singapore, almost all of the patients in a study conducted by Lee et all (2001a; 2001b) had normal BMI.

Food pattern.
The increase of overweight and diabetes can partly be explained by a change in food patterns. Minahasa people have a broad-spectrum and wide-variety of meat consumption habit (Kawilarang, 2007). However, this is not specific to North Sulawesi people. In Indonesia, obesity has been associated with prosperity and better social-economic status (Ng, 2006). Eating too many fats from animals and changing the traditional food, which consist of high natural-fibre component, are one of the characteristics of the current food pattern in developing countries (Popkin, 2006). It is strongly believed that the increasing prevalence of obesity and overweight in Indonesia is caused by the shifting food intake from "dietary deficit and food insecurity to over-consumption" and the increasing of obesity/overweight will lead to the shifting of the epidemiology of chronic non-communicable diseases (Lipoeto, 2004).

Physical inactivity.
Physical inactivity might also be one of the supporting factors in increasing the prevalence of T2DM and its complications in North Sulawesi. Data from National Household Health Survey (SKRT, 2004) showed that 68% of total population aged above 10 years in Indonesia had no regular physical exercise. More than three-forth (79%) of all population aged above 10 years in North Sulawesi were categorized as "low physical active" (SKRT, 2001 as cited by Kandou, 2007). The situation is not different from 2 other countries in Asia. A community-based survey in Korea found that more than half (66%) of the total of 5 844 eligible subjects did not exercises et all (Kim et all, 2006). In Singapore, only 17% of the population of Singapore exercised regularly (Singapore National health Survey, 1998 as cited by Wee, 2002). Physical inactivity in Asia might be triggered by more modern facilities (for example motorcycle, internet and telephone) available than before (Yoon, 2006). One study conducted by Prentice and Jebb in 1995 (cited by Hadi, 2005) showed the relation between the increase of obesity and physical inactivity in adult and children. In that study, physical inactivity was related to sedentary life-style including watching television and using car as a main transportation.

Party-oriented and social-prestige.
Tradition and culture may also contribute to the increased prevalence of T2DM in Indonesia and North Sulawesi. In relation to highly consumption of dietary fat (animal-based food), people in North Sulawesi have an tradition of parties which are celebrate annually. These celebrations have close relation with consuming meat as a symbol of prosperity. Thanksgiving Day is the best example of the tradition. The tradition is a "massive" party because it is celebrated by every household in every village in one sub-district. People from other sub-districts will be invited during the day. On the next week, another sub-district will also be arranged their own Thanksgiving Day and will invite people and relatives

from other sub-districts. The tradition is usually being held in the mid-year. Eeuwijk (2005) noted that during the day, one household may in total, spent 1-2 million rupiah (111-200 USD). Another example is celebrating village anniversary. In this celebration, every household in the village will prepare and share the food with other households. The celebration usually is being arranged in the village hall. There are many celebrations and ceremonies in North Sulawesi's culture which almost always go together with party and animal-based food: Celebration of birth, baptism, wedding, new house, new job, and new car; and even during death ceremony (personal observation). Majority of the people in North Sulawesi consider the social-prestige is more important than health investment. They tend to give more attention to clothes and parties than to health expenditure (Eeuwijk, 2005).

Globalization and accommodating culture.
According to Beaglehole (2003) globalization is one of the key factors affecting the epidemic of non-communicable diseases. Vinicor (2004) wrote that economic is not the only issue in globalization, the spreading of diabetic epidemic can also be considered as the impact of globalization. Manado has an advantage in its strategic position to the several major cities in East Asia countries. There is direct flight from Manado to several countries in this Asia region: Singapore, Philippine, Japan and Taipei; and also the sea transportation through Bitung international port. This advantage leads to the "increasing of globalization" in the region, especially after regional autonomy policy in 1999 (Sondakh, 2003). Through global trading mechanism, several big industry companies, including food and beverages industries, have also targeted North Sulawesi as a potential market and a main gate to enter the market in the eastern part of Indonesia (Sondakh, 2005). This might also contribute to the change of food pattern in North Sulawesi.

People of North Sulawesi have been recognised as very accommodating to westernization (Jones, 1977 as cited by Sondakh, 2003). Sondakh also indicated that the people are very welcome with other life-style especially with the new and modern life-style. This permissive characteristic may contribute to the creation of modern life-style that characterized by "instant process" including in food-pattern. The transition from traditional to modern life-style (for example food processing) can be found in the capital city of Manado and several semi-urban areas. There are many shopping centers and food-centers that offer junk-food, full of fat (most of them are animal-food) and sugar. It leads to the development of new culture called "convenience food" in North Sulawesi; which means, people prefer to buy and consume food from these food-centers than from their home (Personal communication with a researcher from Basel University, Swiss). Changing in "food processing, shopping practices and food consumption outside own home" is considered as an impact of globalization (Beaglehole, 2003) where young people are the most

affected (Yoon, 2006). In combination with its "accommodating to western" culture (Jones, 1977 as cited by Sondakh, 2003), globalization might contribute to the change of life-style, including food-pattern in North Sulawesi.

Urbanization.
During 1980-2005 there was an increasing of percentage of people living in urban area of North Sulawesi. In 1980, only 16.8% of the total population lived in urban area and this had increased to more than one-fourth of total population in 2005 (Sondakh, 2003). The rapid urbanization is considered as one of the contributing factor of the raising prevalence of diabetes in Asia (Yoon, 2006). Several researches from Cambodia, South Korea and India showed a difference prevalence diabetes rate in urban and rural area (King, 2005; Yoon, 2006).

Genetic susceptibility and life expectancy.
Ethnicity.
According to WHO (1994), the combination between genetic susceptibility and environmental factors are likely to be the starting point in the natural history of T2DM. There is no publication about the relation of prevalence of T2DM and ethnicity in Indonesia, especially in North Sulawesi. However, it is important to note that Minahasa's ascendants were originally coming from China land (Sondakh, 2005). As China currently has been experiencing high prevalence of T2DM, it is considerable to expect that North Sulawesi might experience the similar situation. To what extent the ethnicity's influences the development of T2DM in North Sulawesi is not being studied yet. But, there are reasons to conduct the study. Boedhi-Darmojo (1992) as cited by Kandou (2007) reported that North Sulawesi is one of the provinces in Indonesia which have high mortality due to CVD.

Increasing number of elderly population.
The prevalence of chronic diseases including diabetes mellitus also is being affected by the increasing number of elderly population and life expectancy. Shashikiran (2004) reported that the prevalence of T2DM increase with age. According to data from MOH (MOH, 2006) North Sulawesi is in the first rank that has elderly population (5.7% of all the total population in the province) and in the third position in Indonesia that has life expectancy above the national level.

Health Service determinants.
Priority of health development policy.
There is inadequate effort to put Non-communicable Diseases/NCD in top agenda of health service policy in Indonesia, at least in primary care level. The most prominent primary health care in Indonesia is CHC. As the first line in health service in Indonesia, CHC is responsible for health development not only in urban but also in rural and remote area. CHC has

4 priority/obligatory programs: Maternal and child health (MCHC), environmental health, communicable diseases prevention and control (P2M), health promotion, basic treatment and nutrition (Hatmoko, 2006). All of the health development efforts are focusing in these programs including the financial support. It means, more resources are being directed to these programs. Therefore, the resources needed to NCD prevention and control is very limited. In term of health workers' motivation, the policy also tends to motivate health workers to focus only on the obligatory programs due to the more adequate incentive and facilities they will received (personal observation).

Shortage of diabetes educator.
There is limited expert in T2DM in Indonesia and, especially, North Sulawesi. Soewondo (2006) revealed that there are only 47 endocrinologist and 22 residents who are being trained to an endocrinologist in Indonesia. Data from PHO showed that only 1 (one) diabetes specialist (diabetologist) in North Sulawesi. No nurse that specialist in T2DM management (PHO, 2006). Diabetes educator is important in prevention and control efforts. The educator will give information for the family regarding the natural history, cause, treatment and complication of T2DM. The educator can also be an agent of change for the community by actively giving information, skill and knowledge for the community about T2DM. Through the diabetes educator, community participation can be established. The community participation is now one of the important efforts in T2DM prevention and control.

*Lack of diagnostic facilities.*
Diagnostic procedures of T2DM are primarily based on laboratory result (WHO, 2006), besides diabetes specific symptoms (American Diabetes Association/ADA, 2004). Considering that most of T2DM cases are asymptomatic, laboratory examination is important to detect T2DM (IDF, 2005). Based on primary data which was obtained from PRDK Hospital in Manado, most of the T2DM patients have duration of illness between 1-5 years (28%) and mean duration for T2DM was 9 years. Most of them were asymptomatic and admitted to the hospital because of other diseases' symptoms or medical condition. It might be reflections of the majority of people in North Sulawesi rely on their symptoms before seeking treatment and laboratory examination. Tu (1993) explained that although monitoring blood glucose is one important aspects of diabetes self-care, but diabetes patients always consider about the price of the diagnostic tools and the benefit they can get from it. In Manado, glycaemic control facilities are relatively expensive and not available in every health provider, especially in primary care level.

| **6** | **T2DM intervention** |

Natural history of T2DM

For better understanding of the intervention aspect of T2DM, it is important to review the natural history of T2DM (Annex 4). The interaction between genetic and environmental factors is considered as the starting point of the development T2DM. People with strong family history of diabetes are more likely to develop the disease. Physical inactivity, body weight and fat distribution, nutritional factors and other factors such as severe/prolonged stress and drugs/hormones are the several environmental factors that can contribute to the development of T2DM. The interaction of genetic and environmental factors contributes to the pathogenesis of diabetes, which basically are insulin resistance or lack of insulin secretion. Pre-diabetes condition (Impaired Glucose Tolerance/IGT and Impaired Fasting Glucose/IFG) will precede the onset of diabetes. Commonly, hypertension and dyslipidaemia co-exist with the high blood glucose level of diabetes. In an advanced stadium, several macro- and micro-complications will develop. Dependent on the intervention received, these complications will lead to disability and death (WHO, 1994).

Based on understanding of the natural history of T2DM, intervention can be aimed at 3 levels: 1) the level in which T2DM is not developed yet; 2) is developed but without comorbidities; and 3) is already in advance stage. Different intervention strategies are needed at different levels. The range of intervention of diabetes is from preventing, detecting and controlling the disease (Narayan, 2006b). These methods are known as primary prevention (preventing), secondary prevention (early detecting) and tertiary prevention (treating and rehabilitating). WHO (1994) proposed the three different levels of intervention of diabetes (figure 1).

Figure 1. The window opportunities in the prevention of T2DM and its complication.
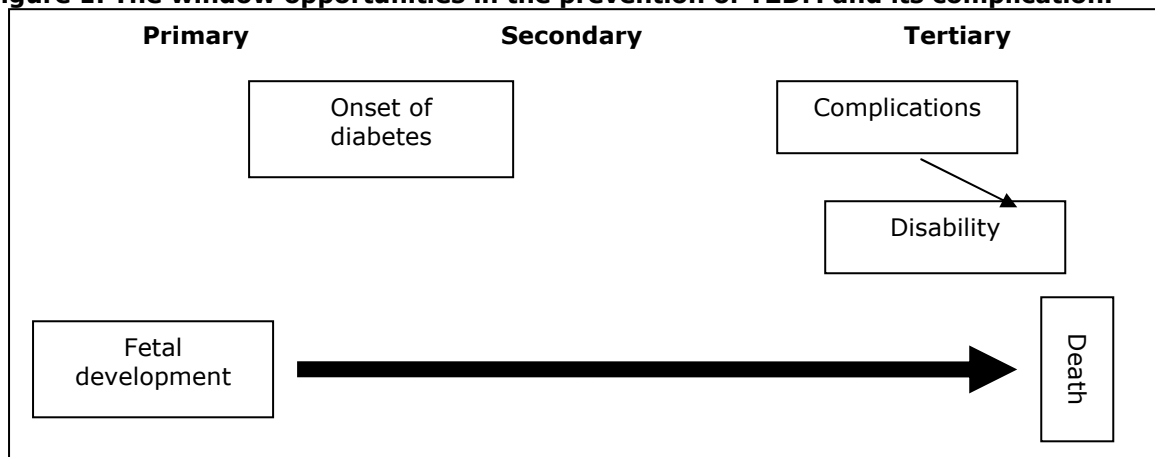
Source:WHO. 1994. Prevention of diabetes mellitus. Switzerland. 1994.

Diabetes Intervention.

Pre-requisite factors.

According to McKinlay (2000), diabetes intervention should not only focus on bio-physiological level, but also on the other spectrums. As multi-factorial determinants contribute to diabetes development, multidisciplinary perspective should be integrated into the diabetes interventions. A multi-level approach was introduced to complete the primary, secondary and tertiary level of diabetes interventions (annex 5). McKinlay identified bio-physiological, lifestyle, environmental and social structure influenced the development of T2DM. Intervention on T2DM should, then, target all these levels.

Similar with McKinlay, Yoon (2006) also emphasized the importance of systematic, well-targeted and adequate government policies to prevent and control T2DM. Yoon concluded that since lifestyle intervention is "notoriously resistance to change", very strong, clear, comprehensive and integrated public health policies are an urgent need. Bonita (2006) used different terminology, "primordial prevention", to describe the importance to address the "underlying economic, social and environmental conditions leading to causation". Primordial prevention targets total population and/or specific target group.

All of these approaches are in line with "stepwise framework for preventing chronic diseases", including diabetes, proposed by WHO (Jordan, 2005). The core of this framework is to start from government commitment to establish "unifying framework" that provide supportive actions in every level by every stakeholder. Assessing current risk factors and burden of diseases, formulating and adopting prevention and control policies, and identifying the most effective intervention to be implemented are 3 steps in the framework. These 3 steps then should be followed by implementation action. As a starting point, "core implementation" consists of several interventions that feasible and appropriate with the existing resources available. Later, core implementation can be upgrade to the "expanded" and "desirable" implementation. The concept of upstream, primordial prevention and stepwise framework can be classified as a foundation to start action with conducting primary, secondary and tertiary preventions. Inter-sectoral collaboration, interdisciplinary cooperation, political will; together with community participation are the pre-requisite factors that needed in NCD intervention (Beaglehole, 2004 as cited by Ng, 2006), specifically diabetes prevention and control.

In relation to the distribution of risk to develop diabetes, McKinlay (2000) divided the intervention into three categories based on Gaussian curve (annex):

1. *Upstream policy (healthy public policy)*
    This category depends primarily on the rules, regulations and policies which provide supportive and encouragement for diabetes

intervention. Government as policy-maker is in the front row to make policy that can affect all population. For example national health insurance, tax incentive for private sector screening.

2. *Midstream policy (prevention)*
Secondary and primary prevention can be classified in this cacegory. For example environmental programs to facilitate exercise, community-based primary prevention (diet and exercise) and work-site risk reduction.

3. *Downstream policy (curative).*
Diabetes curative efforts will be likely classified in this category.

T2DM prevention and control methods.

The combination of several ideas in T2DM prevention and control methods that based on several studies (McKinlay, 2005; Jordan, 2005; Bonita, 2006; Narayan, 2006b), are described as follow:

1. *Up-stream (primordial prevention/healthy public policy).*
Level of action: National/provincial policy-maker level.
Program: Primarily based on stepwise approach:
- Step 1: Assessing current risk factors and burden of diseases
- Step 2: Formulating and adopting prevention and control policies
- Step 3: Identifying the most effective intervention.
In this level, political support, inter-sectoral cooperation, multi-perspective collaboration and community participation should be initiated. Macro level on chronic diseases management of Innovative Care for Chronic Conditions (ICCC) developed by WHO also can be considered as this level (Jordan, 2004). On the macro level of ICCC, the efforts including:
- Provide leadership and advocacy.
- Integrate policies.
- Promote consistent financing.
- Develop and allocate human resource.
- Support legislative framework.
- Strengthen partnership.

2. *Mid-stream (prevention).*
Level of action: Environment and community-based.
Program: Primary and secondary prevention.

Primary prevention.
The main objective of this type of prevention is to prevent the developing of the diseases by controlling specific cause and risk factors (Simpson, 2003; Bonita, 2006). This type of prevention "denotes the prevention of the onset of the disease, before any signs of the disease developed (Yarnell, 2007). The action can be conducted through personal and communal efforts (Bonita, 2006). Lifestyle change

including physical exercise, weight loss program, healthy diet and cautious use of diabetogenic drugs are the efforts that can be conduct in this phase (IDF, 2008; WHO, 1994). According to Yoon (2006), "prevention of weight gain and obesity are probably more cost effective than treatment of the consequences such as diabetes". The most important measure that should be conduct in this type of prevention is health promotion program. A study in India (Mohan, 2005) found that even though India is now a giant in epidemic of diabetes, but 25% of the population study does not know anything about diabetes. Unfortunately, the diabetes patients themselves still do not understand what diabetes is.

Target group.
In this level, identifying the high risk group of population is important. By identifying this group, we can prevent them to the possibility of undergoing costly diabetes care and avoid the treatment for diabetes complications as well (IDF, 2008). McKinlay (2000) describe the importance of action in this level because most of the population, based on Gaussian curve, has normal glucose blood status (figure 2). Acting on this level of prevention, might give smaller impact specifically for diabetes, but overall, broader influence on health sector. Acting on lowstream will only targeted established or complicated cases.

Figure 2. The normal distribution of plasma glucose concentration in population.
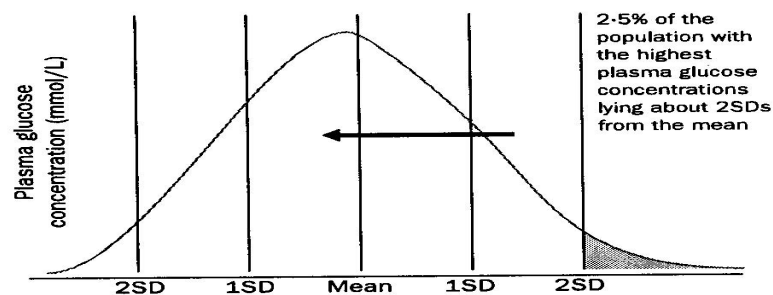
Source: McKinlay. 2000. US public health and the 21st century: Diabetes mellitus.

Not only targeting high risk group, the intervention methods in primary prevention should also consider targeting total population.
1. The population approach.
   Regardless the risk status on the individual level, the prevention aimed to modify the environmental and behavioural factors. Targeting this group will influence the population attributable risk of diabetes.
2. The high-risk approach.
   Special attention are given to the high risk population who more likely to develop the disease than other people. Targeting this group will influence the relative risk of people to develop diabetes.

It is important to note that according to Rose Paradox (Rose, 1992 as cited by McKinlay et all, 2000) treatment only the small group with very high risk to develop disease, has less impact than treating whole population all of whom have a small risk.

To decide in which target group the intervention will be delivered, WHO (1994) proposed 2 approaches (figure 3):

Figure 3. Consideration in choosing population and high risk approach

Population	High-risk
- Appropriate to the population with high genetic risk to develop diabetes. - If there is uncertainty whether the risk factors and disease is truly causal. - If risk factors are spread broadly in the community.	- Appropriate to the low to medium genetic risk. - Also in the community where diabetes is the most common non-communicable disease. - The risk factors are cluster to individuals, families or sub-set of community.

Source:WHO. 1994. Prevention of diabetes mellitus. Switzerland. 1994.

The parameters using in deciding whether population or high-risk approach will be performed, can only be provided by understanding the distribution pattern of diabetes and contribution factors. Therefore, preliminary research/survey is important.

Primary prevention methods.
General (WHO, 1994):
- Lifestyle change including physical exercise, weight loss program, healthy diet and cautious use of diabetogenic drugs are the efforts that can be conduct in this phase.
- Health promotion program.
- Identifying the high risk group of population.
- Environmental program to facilitate exercise.
- Physician/health provider education/training.
- Surveillance of T2DM risk factors.

Individual approach
(adapted from Saskatchewan, 1999; Dehgan, 2005):
The programs are ranging from informing people to restrict fat consumption, the importance of fruit and vegetables diet, and of physical exercise 30 minutes/day, providing instruction sheet for seniors and providing diabetes information for high risk people, restricting television watching and reducing eating in front of television.

Population approach
(adapted from Saskatchewan, 1999; Dehgan, 2005):
The methods are broader and more proactive, including:
- Influencing the food industry to reduce the total amount of fat

- Guarantying the availability and affordability of fresh and nutritious fruits and vegetables.
- Promoting healthy eating in school, workplace, lunch bars and the community.
- Providing fitness program for seniors.
- Providing safe and free access to community public open spaces, sport, and recreational facilities.
- Providing safe walking path and cycling route.
- Implementing broad multi-strategies including mass media and stores.
- Developing a school-based program about physical activities, healthy diet and family involvement.
  - Promoting healthy food in school.
  - School reports card to make the parents aware of their children's weight problem.
  - Enhancing active mode to school by walking, cycling or using public transport.
- Ban or restriction on television advertising to children.

Secondary prevention.

Secondary prevention focuses on "early diagnosis and treatment to reduce the more serious consequences of diseases" (Bonita, 2006). The pre-diabetic condition known as IGT and IFG are the phase which secondary prevention could be conducted before the patients enter the diabetes mellitus diagnosis. Identifying people with pre-diabetic as early as possible prevents the development of diabetes complication (Blonde, 2005). Screening for people who have no symptom and sign of diabetes, is the method using in this type of prevention for T2DM (WHO, 1994). Other methods in this level of intervention are control of blood glucose, blood pressure and lipid profile (IDF, 2008) A combination of life style change and pharmacological intervention has given good result in preventing the developing of type-2 diabetes (Blonde, 2005; Simpson, 2003). According to IDF, secondary prevention that is taken in the beginning phase of diabetes gives benefit to patients' quality of life and economic aspect (IDF, 2008).

Screening in secondary prevention.
The next information needed is to define the high-risk group to whom the screening should be conducted. ADA (2004) recommends screening people with several characteristics:
1. Men and women $\geq$ 45 years of age, particularly in those who have BMI $\geq$ 25 kg/m^2.
2. Younger individuals with BMI $\geq$ 25 kg/m^2 with additional risk factors.
There are several considerations which is crucial to think before conducting the screening. In the implementation of the screening program, consideration of the cost and clinical implication should be

recognized. In addition, the benefit of the screening should be clear. Therefore, WHO recommends screening program "is justified on the grounds that early detection allows effective early intervention and hence diminished the likelihood of the development of complications" (WHO, 1994).

3. Low-stream (curative and rehabilitation).
Level of action: T2DM patients.
Program: Tertiary prevention (primarily based on diabetes care).

Tertiary prevention.
Tertiary prevention is aimed at "reducing the progress or complications of established disease and is an important aspect of therapeutic and rehabilitation medicine" (Bonita, 2006). The prevention "denotes the prevention of major consequences of the natural history of a disease once its effects in a patient have become established" (Yarnell, 2007). In T2DM case, tertiary prevention means "every action taken to prevent or delay the development of acute and chronic complications" which involves (WHO, 1994):
- strict metabolic control
- education focusing on changing health behavior
- effective treatment
- screening for early stage of complications

Since the tertiary prevention has close relation to the rehabilitation efforts, the important aspect of this prevention is "to restore the patient ability to work and earn a livelihood" (Bonita, 2006). In clinical view, especially from family medicine, tertiary prevention is "a care designed to avoid or delay the consequences and complications of a clinical illness in patients who exhibit symptoms of that illness". A care for diabetes should follow the chronic care model and consist of lifestyle modifications and pharmacologic treatment. This intervention also needs a good communication between patients and health provider in order to follow the program's guidelines and target of care (Asia-Pacific Type 2 Diabetes Policy Group/APPG, 2005). This is why it is better performed at primary care level where provider has a more holistic perspective on the patients in her/his environment.

Diabetes care.
Diabetes care, therefore, can be considered as a form of secondary and tertiary prevention. The aim of diabetes care must not focus on diabetes alone but also on the several risk factors that constituted the metabolic syndrome (APPG, 2005). Technically, it is important to manage T2DM by a team consist of health professionals and diabetes patients. Through the team, health education will be delivered to the patient in order to reach the optimum self-care program. Another important aspect in diabetes management is glycaemic control especially by the patient him/herself.

Regularly checking the glycated haemoglobin/HbA1c or FPG is important to control the patients' glycaemic status. As an integral part of the diabetes management, food planning and physical activity should be considered as important as the previous aspects. In specific situation, for instance there is a crisis hyperglycaemic, pharmacological intervention will be useful to achieve the target of diabetes management. However, diabetes management should be adjust with the resource provided in the countries (APPG, 2005).

The important aspects in managing diabetes developed by the Asia-Pacific Policy Group are similar with the guidelines released by IDF called Global Guideline for Type-2 Diabetes in 2005. The guidelines are based on "cost-effective evidence-based care" and are categorized into 3 (three) levels of cares. What the appropriate level of care will depend on the resource in the countries that adopted the guideline. The 3 level of cares are: Standard care, Minimal care and Comprehensive care. Standard care is an "evidence based care" and cost-effective in countries who already have a well-established and well-financing health system. Minimal care is "the lowest level of care that anyone with diabetes should receive". Minimal care has the same target with standard care but practicing in low-resource setting countries. Comprehensive care is aimed to achieve the best possible target with best technology (IDF, 2005). The classification, therefore, is useful for countries to adjust the appropriate diabetes prevention and care for the community. For example in detecting people with diabetes, fasting laboratory plasma glucose and if possible confirmed with Oral Glucose Tolerance Test/OGTT should be done in standard care. In comprehensive care setting, the diagnosis can be confirmed with antibody and other sophisticated marker. But, in minimal care level, fasting capillary plasma glucose can be used in detecting high risk people. Another example, HbA1c examination might be necessary in both standard and comprehensive care, but in minimal care level, measurement of plasma glucose alone is acceptable for glycaemic control.

Diabetes care for developing countries.
Narayan (2006b) studied about diabetes intervention and treatment for developing countries. The study showed several interventions for T2DM based on cost effectiveness, feasibility to conduct and priority rank to be implemented (table 2). Narayan divided the intervention into 3 levels. Level 1 is the first priority to be implemented because on this level, the intervention is both cost saving and feasible. In level 2, although some interventions is still cost saving, or have cost less than 1500 USD/QALY, but the feasibility is not as adequate as level 1. Level 3 has the lowest intervention due to its relatively high cost and "pose significant feasibility challenge" (Narayan, 2006b).

Table 2. Cost effectiveness of interventions for preventing and treating diabetes and its complications in East Asia and Pacific.

Interventions	Cost/DALY in 2001 $	Feasibility	Implementing priority
Level 1			
Glycaemic control in people with HbA1c >9%	Cost saving	++++	1
Blood pressure control in people with BP > 160/90 mmHg	Cost saving	++++	1
Foot care in people with a high risk of ulcers	Cost saving	++++	1
Level 2			
Preconception care for women of reproductive age	Cost saving	++	2
Lifestyle intervention for preventing type 2 diabetes	80	++	2
Influenza vaccination among the elderly for type 2 diabetes	220	++++	2
Annual eye examination	420	++	2
Smoking cessation	870	++	2
ACE inhibitor for diabetes people	620	+++	2
Level 3			
Metformin intervention for preventing T2DM	2 180	++	3
Cholesterol control for people with total cholesterol > 200 mg/dL	4 420	+++	3
Intensive glycaemic control with people with HbA1c >8%	2 410	++	3
Screening for undiagnosed diabetes	5 140	++	3
Annual screening for microalbuminuria	3 310	++	3
Feasibility was assessed based on difficulty of reaching the population, technical complexity, capital intensity and cultural acceptability. ++++= feasible for all four aspects; +++= feasible for three of four, ++= feasible for two of four; +=feasible for one of the four. 1= highest priority; 3= the lowest priority.			

Source: Narayan et all. 2006. Diabetes: The pandemic and potential solution.

According to Narayan (2006b), data on prevention and control from community- or population-based is not as adequately available as data from clinical-based. Diabetes education to T2DM patients can be considered as one of the cost effective strategy for developing countries.

Lesson learned from other countries.

China and India are the examples of countries which already started the comprehensive intervention of diabetes. In China, based on several preliminary research projects, the government established "community-based" sites which providing activities targeting on community diagnosis, prevention and control of NCD, including diabetes. Following the program, a National Centre for Chronic and Non-communicable Disease Control and Prevention (NCNCD) in national level was established in 2002. This institution is responsible for NCD surveillance and intervention. Currently, NCNCD is also established in every provincial level (Wang, 2005). In India, integrate national program for prevention and control of diabetes and CVD has already being initiated. Several state government already put chronic disease in their to priority agenda. India also established

several national programs that aimed to prevention and control specific NCDs. There is also a integrated diseases surveillance in national level which integrate the elements of chronic diseases (Reddy, 2005). Even though the impact of these efforts has not been measured yet, but the efforts are already be a foundation for future prevention and control programs.

7	**Diabetes prevention and control in North Sulawesi:**
	"Where are we now? What can be done?"

Upstream policy.

In general, there is relative lack of attention to non-communicable diseases (NCD) in North Sulawesi. Based on the structure of organization of North Sulawesi provincial health office, there is a disease control and sanitation division which is responsible for the health planning, monitoring and evaluation of all NCD programs in North Sulawesi (PHO, 2006). However, in practice, there is no real implementation of NCD programs in North Sulawesi. Based on data from Minahasa DHO, NCD is not included in 10 health development programs in Minahasa (DHO, 2005). The 10 health development activities are health insurance, nutrition, communicable diseases prevention and immunization, community empowerment, environment health, family and reproduction health, road accident and safety, health information system, essential drugs and narcotic and psychotropic misuse. The situation is more likely similar with other districts in North Sulawesi.

Lack of attention to NCD, including diabetes, in North Sulawesi might be influenced by inadequate support for NCD programs in national level. Although there is a Sub-Directorate of Diabetes and Metabolic Diseases which is responsible for diabetes mellitus prevention and control programs in Indonesia, the practical function is not clearly seen at community level. Among 4 main health efforts conducted by MOH during 2006, there was no NCD programs reported (MOH, 2007b). From all 10 priority programs to reach Healthy Indonesia 2010, as a national program based on MOH decree number 1202 in 2003, there is no specific program for diabetes and/or other NCD (MOH, 2004). Diabetes prevention and control also is not being covered by Minimum Standard Health Service (MSHS), consisting of 26 health programs, which were proposed by MOH through MOH decree number 1457 in 2003. In addition, among 18 main health services (Hatmoko, 2006) that should be delivered to the community by CHC, there is no program specifically targeting diabetes or other NCD. The only one positive effort made by MOH regarding diabetes and NCD is when a Non-communicable Surveillance System (NcSS) is being integrated in Health Management Information System (HMIS) (MOH, 2004) in 2002.

The contribution of non-government organization.
The limited role and attention of formal government health institution to diabetes issue, has given opportunity to other non-government institution to develop diabetes programs. There are 3 diabetes institutions that have well-established national network and international collaboration. Indonesia Diabetes Association (Persadia), Indonesia Association of

Endocrinologist (Perkeni), and Indonesia Diabetes Educator Association are non-government institutions that provide diabetes programs for community, especially for health workers (Perkeni, 2008; Persadia, 2008).

Persadia
Established in 1986, Persadia has branches in 10 provinces of Indonesia. Every branch has their unit/club. The membership of Persadia is consists of not only medical officers but also other health workers and people interested in diabetes. The smallest level of Persadia, called "unit" is available in every government office, private office, hospital and CHC. Regularly, in every unit/club, Persadia conducted physical exercise every 1-2 times a week and diabetes education through diabetes educator form Persadia. In provincial and national level, Persadia conducted seminar/training and actively involved in every international or national diabetes event. Persadia is also actively advocating policy-maker by arranging several national diabetes meeting. In North Sulawesi, Persadia has 5 branches located in 5 major cities, while Perkeni has only one branch located in the capital city of Manado.

Perkeni.
Perkeni was established in 1978 and the membership is only for endocrinologist and other medical officer interested in endocrine issue. There are several activities of Perkeni: Scientific meetings, researches and publications, develop cooperation with other national and international endocrine-related organizations, developing national guidelines and trainings. National and international seminars, workshops, trainings, and researches are routinely conducted by this institution. National Guidelines on Diabetes Mellitus Management and Diabetes Education Kit are examples of the efforts by Perkeni. Currently, Perkeni already trained 583 diabetes educators on diabetes education topics, 539 general practitioners on primary diabetes care modules and 125 internists on advanced diabetes management modules. Currently, Perkeni in collaboration with MOH and supported by World Diabetes Foundation, is conducting a project on increasing capacity of health worker especially in primary care level.

Perkeni and Persadia also provide online diabetes consultation in their website. The most important function of these 3 institutions is conducting advocacy and developing community participation (Perkeni, 2008; Persadia, 2008). In short, Persadia can be classified as diabetes institution that focus on prevention while Perkeni focus on clinical side of diabetes.

Health care organization.
At the national level, directorate general of disease control and sanitation is responsible for diabetes and other NCD prevention and control

programs (MOH decree number 1575/2005). In more operational level, there is a directorate for NCD and, at the lowest level, sub-directorate of diabetes and endocrine. At the provincial and district level, there is disease control and sanitation division who responsible for diseases prevention and control. However, there is no specific section for NCD. At the community level, in CHC, there is no specific unit for diabetes and NCD (figure 4).

Figure 4. Organization of health authority for diabetes in Indonesia.
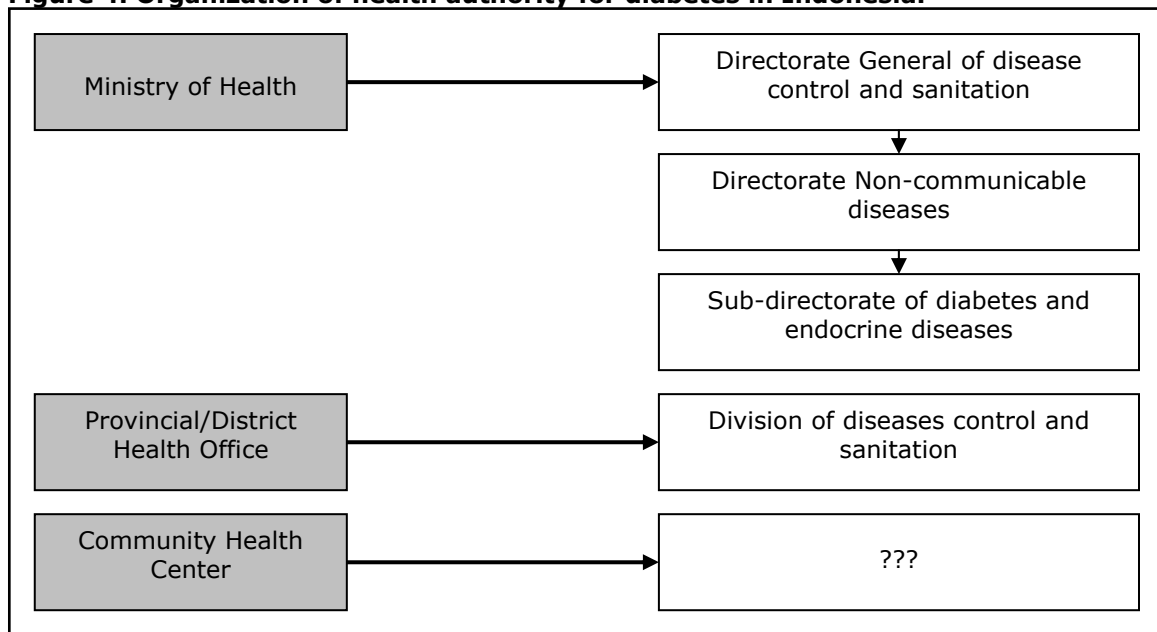
Source: Author.

The role of CHC.

Since the implementation of decentralization policy in 2001, the form of health care organization in Indonesia was totally changed. Before decentralization policy, health policies and resources allocation were determined by central government and will be implemented in every province, regardless the local-specific need of local community. In decentralization era, local governments have more authority to develop health policy and allocate health resources. Health problem identification and priority of intervention are mainly the responsibility of local government. The role of central government now is to developing national health standards, regulations and policies (MOH, 2003 as cited by PHO, 2006).

CHC is still the most popular primary health care in Indonesia. The main functions of CHC are to be a center of health development, to conduct community participation and to deliver comprehensive and integrative basic health services for community (MOH, 2004 cited by Hatmoko, 2006). As a center of health development, CHC is responsible for implementing both national and district health programs for the community. As a center of community participation in health programs, CHC is responsible for providing training on basic health service for health

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cadres. Health cadres are the people who are interested to be a partner for CHC in implementing health programs. "Posyandu/Integrated health service post" is a place where health cadre helps CHC in arranging health service activity, mostly for maternal and child programs. As a center of health service means, CHC provides basic health service for the community in coverage area. Most of NCD program in CHC is focused on basic curative aspects. There are 7.413 health centers in Indonesia, of which 2.177 have bed for in-patient treatment. In North Sulawesi province, it was 30-45% of all people in the province visited CHC for outpatient care in 2006 (MOH, 2007a).

CHC and T2DM prevention and control.
As the first line of health service for community, services for non-communicable disease is also provided in CHC. Even though there is no specific programs for NCD in CHC level, but several services are available. In term of *primary prevention*, CHC provide regular health promotion activities to community. One of the programs in CHC is "Healthy School Program" which provide health education for the students and teachers as well, about healthy lifestyle and environment. Information on nutrition topic in relation to overweight/obesity; healthy diet, smoking and alcohol are available. The head of CHC, in capacity as a health expert in sub-district level, is also regularly conducting health promotion and education to community through several social meeting. Social and religious meeting is one of the most effective health promotion methods in Indonesia (MOH, 2003). Therefore, advocacy to the head of ethnic group, religion and sub-district regarding the health problem is also an important role of CHC in sub-district level. In term of *secondary prevention*, detecting high risk patients is done while examining patients in out-patient and in-patient service. Patients with high risk of developing T2DM (annex 8) are usually advised to check their blood glucose level. The majority of CHC in Indonesia do not have laboratory facilities to examine plasma blood glucose, but CHC in urban area, especially in big cities has their laboratory facilities. Patients' relatives will also be advised as well if there are indications to check the blood level. In CHC level, if there is facility to check the glucose level, screening can be conducted. In term of *tertiary prevention*, some patients who already diagnosed with T2DM in district or provincial hospital will be returned back to be managed by CHC. In this situation, diabetes care will be provided by CHC. Diabetes education, foot and eye examination, blood pressure examination and simple laboratory to detect albuminuria are available. In addition, one of the programs in CHC, called "outreach services" is provided to visit patients lived in remote area. Through outreach service, diabetes care can be delivered to the patients. T2DM patients can also be referred back to the hospital if there is indication to treat the patients in the hospital.

Most of the patients with diabetes mellitus are treated in the provincial/district hospital and/or modern private clinic/hospital. Both types of providers operate in urban area and specifically at the capital city

of the province. Therefore, lack of access due to geographical and financial barrier might be occurred among T2DM patients.

What do we have?	
	1. Disease control division and sanitation that also responsible for diabetes prevention and control programs both in national and provincial levels. 2. Adequate support from non government organization interested in diabetes prevention and control. 3. Well-organized health authority institutions. 4. Strategic role of CHC.
What can be done?	
	1. Establishment of national/provincial commission on NCD prevention and control. 2. Integrate the diabetes prevention and control program to the existing health care system. 3. Strengthening the good relationship with non-government organization. Asking their advice and recommendation. 4. Initiate STEPWise approach and ICCC programs. 5. Strengthening the role of CHC in diabetes prevention and control program.

Midstream policy.

Primary prevention.
At national level, health promotion and diabetes education addressing lifestyle change aimed at reducing body weight and improving healthy diet are conducted by MOH, Perkeni and Persadia (MOH, 2007b; Perkeni, 2008; Persadia, 2008). Diabetes campaign through mass media, especially internet, is also available in their website. Diabetes education can also be found in brochure, poster, radio, and television. However, the efforts are limited in term of programs and target due to resource limitation. Health promotion by MOH is commonly conducted through internet-based information which will only reach specific segments of community. Perkeni activities, especially in training and researching, are limited to specific target group, especially primary health provider, due to limited human and financial resource (Perkeni, 2008; Soewondo, 2006).

Documented program about primary prevention of diabetes, both from PHO/DHO and private institutions in North Sulawesi, was not found during study period (PHO, 2006; DHO, 2005). There is no real systematic and organized program reported or published. Systematic, integrated and comprehensive diabetes or NCD prevention and control programs were also not found in several PHO profile in neighbouring provinces (Central Sulawesi PHO, 2004; South Sulawesi PHO, 2007). Furthermore, public health researches and population-based survey on primary prevention on diabetes were also un-detected. There are several education institutions that annually providing health promotion to community. However, health promotion campaign is not primarily focus on diabetes issue, but in general diseases.

In relation to primary prevention, there is a program, called "Healthy City" in Indonesia. The program was started in 1998 which aimed to providing healthy environment and encouraging healthy life-style for the community. Healthy City program is mostly funded by each city government. Several stakeholders are also involved in the program, such as department of internal affair and autonomy, education, environment, culture and transportation. The main strategies in Healthy City program are identifying health problems, advocacy, community participation, inter-sectoral cooperation, and partnership with private sectors (Surjadi, 2003).

Secondary prevention.
There is limited data either published or obtained about screening program for high risk group in North Sulawesi and Indonesia. Perkeni, MOH and local pharmaceutical industry once conducted a mass screening to one million people in Jakarta from 2003-2005. Random blood glucose (RPG) was conducted at that time. From the total samples, 8.2% have RPG >200mg/dl, which was diagnosed as diabetes based on national guidelines on diabetes management in Indonesia (MOH, 2005). There is no specific mass screening in North Sulawesi province. However, it is a common practice among primary care providers, especially in CHC, to advice the patients with specific symptoms of diabetes to undergo laboratory examination.

What do we have?	
	1. Well-established health promotion in national level.
	2. Availability of diabetes education for health provider.
	3. Contribution of other institution addressing health problems.
	4. Referral and laboratory system are well-established.
What can be done?	
	1. Broadening health promotion coverage.
	2. Facilitation of diabetes education to health provider especially in primary care level.
	3. Inter-sectoral collaboration in health education and health promotion to the community.
	4. Improving surveillance system for risk factors of T2DM.
	5. Conduct researches on primary and secondary prevention on diabetes.
	6. Advocacy to policy-maker to provide healthy choice on environment (i.e: Providing park, cycle route, etc)

Lowstream.

Tertiary prevention.
In general, people in North Sulawesi tend to focus more on curative than preventive efforts of diabetes and/or other NCD. Most of the diabetes care in North Sulawesi is provided by hospital or private clinic. Provincial, district and several private hospitals provide diabetes care in their service. Not like China and India (Wang, 2005; Reddy, 2005) there is no specific diabetes and/or NCD clinic in North Sulawesi. Due to limited resources, the position of CHC is only in detecting diabetes case based on characteristic symptoms of diseases and referring the suspected diabetes

patients to the district, private or provincial hospital. In CHC level, only diabetes education, blood pressure control and generic diabetes drugs will be provided (personal observation).

CHC is not the only health provider in primary care level. General practitioner and nurse/midwives are the other health providers in this level (MOH, 2007b). If there is indication, the patients will be referred to secondary primary care such as specialist (annex 6). Only if there are some medical indications, the patients will be transferred to district/provincial hospital. For diabetes patients, the scheme is similar. However, in practice, patients' method of payment will determined in which way they will undertake the health service, including diabetes care service (annex 7). Patients with social insurance or social security scheme for poor family need to go to CHC to receive initial diabetes control and management. In this level, minimal diabetes care is provided: Blood glucose control (not every CHC has this facility), blood pressure control, generic oral anti-hypoglycaemic agent (OAH) and basic diabetes education. Depend on the facility in CHC and severity of diabetes, the patients might be referred to both secondary or tertiary level. Patients without insurance have more opportunities. They can directly go directly to hospital without visiting CHC or other primary care providers.

Among several diabetes prevention and treatment suggested by Narayan (2006b), there is no data obtained from cost-effectiveness analysis on diabetes prevention and treatment in Indonesia, in particular North Sulawesi.

What do we have?	
	1. Well-established referral system. 2. Well-equipped district and provincial hospital. 3. Well-trained medical workers. 4. Insurance system and social security scheme for poor familiy.
What can be done?	
	1. Diabetes centers which can provide both prevention and control service. 2. Improving diabetes diagnostic facilities in primary care level. 3. Training on basic diabetes care for health primary care providers. 4. Broad range of diabetes care-related researches should be started. Measuring quality of diabetes care, economic study on diabetes cost, T2DM health-seeking behaviour, inequalilty in diabetes service, etc; are the main research that need to be conducted.

T2DM prevention and control based on level of healthcare.

Based on description above, the availability of T2DM prevention and control in Indonesia, in particular North Sulawesi, can be categorized based on the healthcare level (table 3):

Table 3. T2DM prevention and control by level of healthcare in Indonesia.

No	Level of healthcare	T2DM prevention and control		
		Primary	**Secondary**	**Tertiary**
1.	Community level - Persadia - Perkeni - School. - Private institution. - NGO.	- Health promotion through mass media available - Health education to health provider. - Routinely physical exercise in every Persadia unit. - Seminar/workshops. - Healthy school program. - Healthy city program. - Diabetes mellitus group. - NCD care group.	- Mass screening in 2003-2005 by Perkeni.	- Data not available
2.	Primary care level - CHC (including posyandu, CHCsub). - GPs.	- Health promotion to patient and community. - Healthy school program. - Advocacy by head of CHC to head of sub-district and religion/community leaders. - Identifying high risk people.	- Blood glucose examination (not available in every CHC, GPs)	- Only managed T2DM patient referred back by hospital.
3.	Secondary care level - Internist. - Endocrinologist	- Health education to patients. - Pharmacological interventions.	- Blood glucose examination. - Encouraging physical exercise and healthy diet. - Pharmacological intervention.	- Treatment and control of T2DM patients. - Diabetes care.
4.	Tertiary care level - District/provincial hospital. - Private clinics.	- Diabetes education. - Pharmacological interventions.	- Laboratory examination. - Screening for complication. - Pharmacological interventions	- Treatment and control of T2DM and its complications. - Rehabilitation. - Diabetes care.

Source:
- Perkeni. 2008. Bulletin Perkeni. (*refer to reference*).
- Persadia. 2008. Persadia profile. *(refer to reference)*.
- Hatmoko. 2006. Basic health service in community health center *(refer to reference)*.
- South Jakarta Health Office. 2008. Non-communicable diseases *(refer to reference)*.
- Primary data from PRDK Hospital and personal observation.

Study strength and limitations.

This study is the first study of diabetes prevention and control in North Sulawesi. In this study, public health aspect of diabetes prevention and control is the main focus, rather than curative aspect. This is important in order to get broader picture of diabetes prevention and control. Due to the limited study on public health aspect and government policy on diabetes in North Sulawesi, the study can be used as a starting point for bringing diabetes issue to the top agenda of the policy-maker.

This study has several limitations. Due to very limited publication about diabetes, in particular T2DM in Indonesia, the information provided in this study is might be not up to date. This limitation was reduced by conducting a communication with one of the endocrinologist in North Sulawesi. Other limitation is the information about health care organization for diabetes was mainly based on personal observation and experience. This might lead to bias opinion and conclusion. However, the limitation was reduced by obtaining data from several neighbouring provinces' health profile (Central Sulawesi and South Sulawesi).

| **8** | **Conclusion and recommendation** |

Conclusion

This study describes the epidemiological aspects, challenges and possibilities of T2DM prevention and control in Indonesia, especially in North Sulawesi. The small North Sulawesi of Indonesia, is not the exception of the global fast growth and serious impact of T2DM.

- Prevalence of T2DM is growing in Indonesia and SEA countries. The growing of T2DM in SEA countries mostly occur in younger people with normal body weight.
- Several determinants and risk factors influence the increasing prevalence of diabetes in Indonesia, in particular North Sulawesi: changes in food pattern and physical activity, in interaction with genetic susceptibility, growing elderly population, globalization, permissive culture and in-adequate health service attention.
- There is a sub-optimal T2DM prevention and control program in Indonesia, especially in North Sulawesi. Health care organization for T2DM intervention is not established yet. But, there are several modalities to start diabetes prevention and control programs.
- From public health point of view, to successfully implement T2DM prevention and control in order to reduce the growing and impact of T2DM, pre-requisite factors need to be addressed simultaneously with primary, secondary and tertiary T2DM preventions.

Recommendation

For Provincial/District Government.

1. This thesis attempts to illustrate the opportunities of T2DM prevention and control, preferably for North Sulawesi province. Considering the common risk factors found in T2DM and NCD, especially CVD, and a local formal commission in provincial level should be established to be responsible for the coordination of NCD prevention and control. The commission should have a formal structure which have direct link to local government body. This commission will also be responsible for developing local strategies to prevent and control NCD, including developing community participation, inter-sectoral coordination and multi-perspective collaboration. The establishment of the commission will be a representative of political commitment to NCD prevention and control. It will be a good and solid starting point to the next primary, secondary and tertiary T2DM prevention.

2. Given the relatively well-distributed health providers, North Sulawesi province has also advantaged by its population better health and

educational status compared to other provinces in Indonesia. Eventhough the proportion of health workers and population is not reach ideal composition yet, the situation is far better than most of the provinces in Indonesia. Therefore, local government should start a comprehensive T2DM prevention and control efforts by integrating the efforts to the existing health system and health care service, especially CHC. This institution has strategic position to approach the community due to the daily contact with community, both in urban and rural area. Integrating T2DM, with other NCD, program as one of the priority in CHC health service, will motivate staff to be more serious in managing diabetes. Prevention program, especially diabetes education, can be conducted on the daily basis.

3. So far, government policy to address T2DM and other NCD is sub-optimal in North Sulawesi. Lack of political commitment might be due to inadequate advocacy by health sector institutions. Low of both awareness and knowledge on T2DM issue might be the cause of inadequate approaches to the local government. Therefore, continuing education through training for health human resources on T2DM topic should be conducted regularly. Especially for district health authorities, training on prevention and control of T2DM can help them to increase their capacity to identify risk factors, impact and consequences of T2DM; and how to prevent and control it.

For Provincial/District Health Authority.
1. The implementation of T2DM prevention and control from developed countries should be adjusted with local situation and resources. Lifestyle intervention focusing on improving healthy diet and reducing body as the core of primary prevention should be encouraged to the community through full and adequate diabetes education. Primary care provider (CHC, general practitioners and nurse practitioners) should be encouraged, motivated and re-trained to take responsibility in educate community and T2DM patients and their family. Youth should also be involved in the primary prevention campaign. Studies showed that T2DM in Asia is commonly affected younger people (Yoon, 2006). Therefore, involving them in primary prevention efforts will be useful to prevent them from developing T2DM. Local government should put more effort on primary prevention of T2DM because most of the population has normal blood glucose (McKinlay, 2000).

2. There are several determinants of T2DM in North Sulawesi. Depend only on health sector to face the challenge and solve the problem is an impossible mission. Cooperation and coordination with other sectors, such as education, industries, agriculture and community participation should be conducted. They can be involved in the preliminary efforts to develop the national/provincial commission on NCD/T2DM. They are expected to share ideas and commitment as well for the

implementation of T2DM prevention and control programs. They should be integrated in this commission in planning, implementing and evaluating phases. Implementation of T2DM prevention and control will attract the pro and cons opinion. Therefore stakeholders' analysis should also be conducted. Provincial health authority should aware and ready to tackle these efforts. NCD division in provincial health office should be prepared to handle this challenge. Should NCD prevention and control be established, this job should be one of top priority agenda.

3. Strengthening the existing surveillance system, mostly for communicable diseases, with T2DM and other NCD will be useful in identifying the growing of T2DM and choose the effective intervention. CHC, general practitioners and nurse practitioner can be involved in this surveillance system for NCD. Data from CHC, GPs and nurse practitioners should regularly send to local health administration to be a foundation for making decision.

For educational/research institution
Data and information on T2DM in North Sulawesi is relatively limited. Basic researches are needed to identify the magnitude of T2DM in North Sulawesi and to know the local T2DM characteristic in population. A population-based study and surveillance should be implemented to obtain data. It is important for health provider as information for health planning.

For community.
Increasing awareness through diabetes campaign education both is important. Before expecting public participation and community empowerment, they should understand the impact of diabetes and how to prevent the consequences. Diabetes campaign and education can be conduct through several channels available such as mass-media, religion institutions, schools, public places and healthcare facilities.

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**But, Jesus immediately said to them:
"Take courage! It is I. Don't be afraid."**

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Annexes.

ANNEX 1. WHO 2006 DIAGNOSTIC CRITERIA FOR DIABETES, IGT AND IFG.

Diabetes	
Fasting plasma glucose	≥7.0mmol/l (126mg/dl)
	OR
2–h plasma glucose*	≥11.1mmol/l (200mg/dl)
Impaired Glucose Tolerance (IGT)	
Fasting plasma glucose	<7.0mmol/l (126mg/dl)
	AND
2–h plasma glucose*	≥7.8 - <11.1mmol/l
	(140mg/dl - 200mg/dl)
Impaired Fasting Glucose (IFG)	
Fasting plasma glucose	6.1 - 6.9mmol/l
	(110mg/dl to 125mg/dl)
	AND
2–h plasma glucose*	(if measured)
	<7.8mmol/l (140mg/dl)

*Venous plasma glucose 2–h after ingestion of 75g oral glucose load
*If 2–h plasma glucose is not measured, status is uncertain as
  diabetes or IGT cannot be excluded

Source: WHO and IDF 2006. Definition and Diagnosis of Diabetes Mellitus and Intermediate Hyperglicemia.

ANNEX 2. FEATURES TO DIFFERENTIATE TYPE 1 AND TYPE 2 DIABETES IN YOUNG PEOPLE.

Onset	Type 1 diabetes	Type 2 diabetes
	Acute-symptomatic	Slow-often asymptomatic
Clinical picture	Weight loss Polyuria Polydipsia	Obese Strong family history of T2DM Ethnicity-high prevalence population Acanthosis nigricans PCOS
Ketosis	Almost always present	Usually absent
C-peptide	Low/absent	Normal/elevated
Antibodies	ICA positive Anti GAD positive ICA 512 positive	ICA negative Anti GAD negative ICA 512 negative
Therapy	Insulin invariably	Lifestyle, OHA or insulin
Associated autoimmune disease	Yes	No

GAD=Glutamic Acid Decarboxylase; ICA=Islet Cells Antibody; PCOS= Polycystic Ovarian Syndrome; OHA=Oral Hypogycaemic Agent.
Source: Asia-Pacific Type 2 Diabetes Policy Group (APPG). 2005. Type 2 diabetes practical target and treatment.

**ANNEX 3. INDIAN DIABETES RISK SCORE**

Particulars	Score
Age (year)	

<35 (reference)	0
35-49	20
>50	30
Abdominal obesity	
Waist <80 (female), <90 (male) (reference)	0
Waist ≥80-89 (female), ≥90-99 (male)	10
Waist ≥90 (female), ≥100 (male)	20
Physical activity	
Vigorous exercise of strenuous (manual) labour at home/work	0
Mild to moderate exercise or mild to moderate physical activity at home/work	20
No exercise and sedentary activity at home/work	30
Family history	
No family history (reference)	0
Either parent	10
Both parent	20
Minimum score	*0*
Maximum score	*100*

Source:
Mohan V, Deepa R, Deepa M, Sommanavar S, Datta M. 2005. A simplified Indian diabetes risk score for screening for undiagnosed diabetic subject; cited by Mohan V, Sandeep S, Deepa R, Shah B, Varghese C. 2007. Epidemiology of type 2 diabetes: Indian scenario. Indian J Med Res.
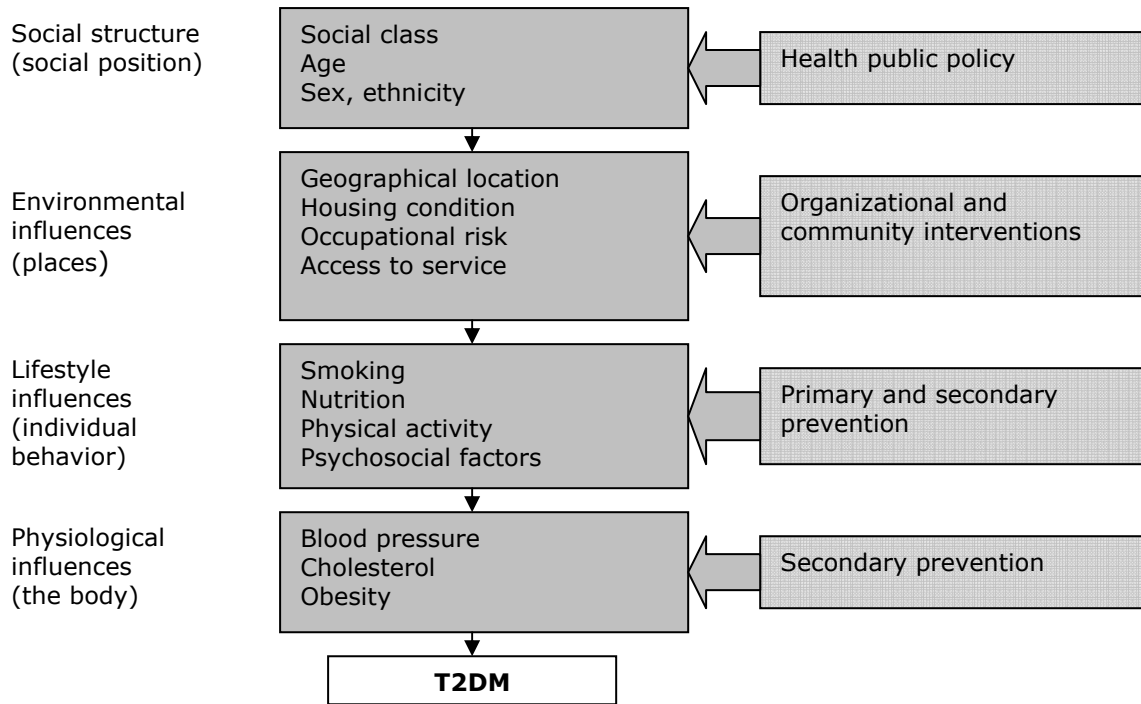

ANNEX 4. THE NATURAL HISTORY OF T2DM.
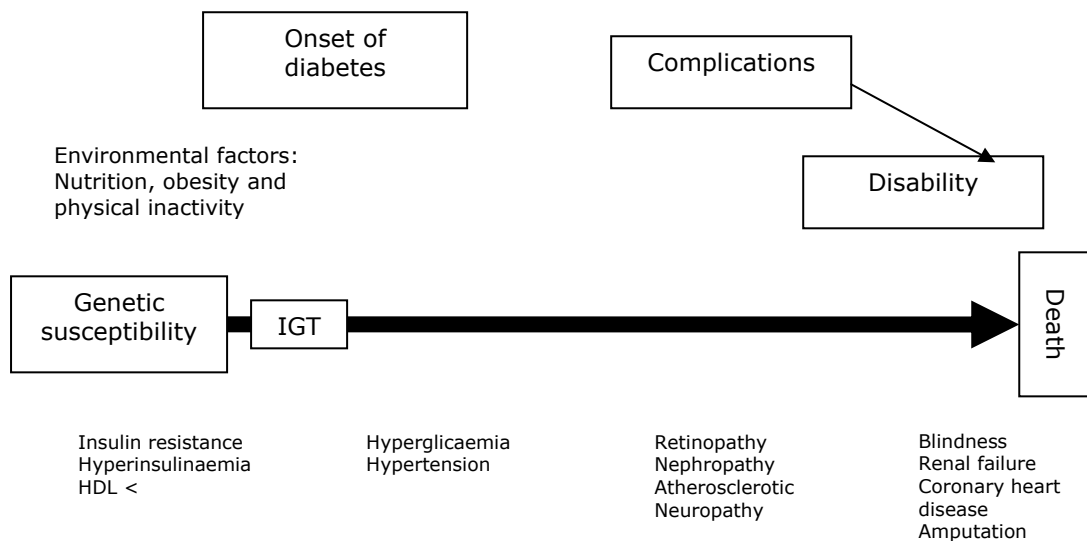
*Source:WHO. 1994. Prevention of diabetes mellitus. Switzerland. 1994.*

**ANNEX 5. LEVEL OF CAUSATION AND CORRESPONDING TYPES OF HEALTH INTERVENTION.**

Social structure (social position)	Social class Age Sex, ethnicity	←	Health public policy
Environmental influences (places)	Geographical location Housing condition Occupational risk Access to service	←	Organizational and community interventions
Lifestyle influences (individual behavior)	Smoking Nutrition Physical activity Psychosocial factors	←	Primary and secondary prevention
Physiological influences (the body)	Blood pressure Cholesterol Obesity	←	Secondary prevention
	T2DM		

Source: McKinlay. 2000. US public health and the 21st century: Diabetes mellitus. The Lancet, 356.

ANNEX 6. HEALTH CARE ORGANIZATION IN INDONESIA
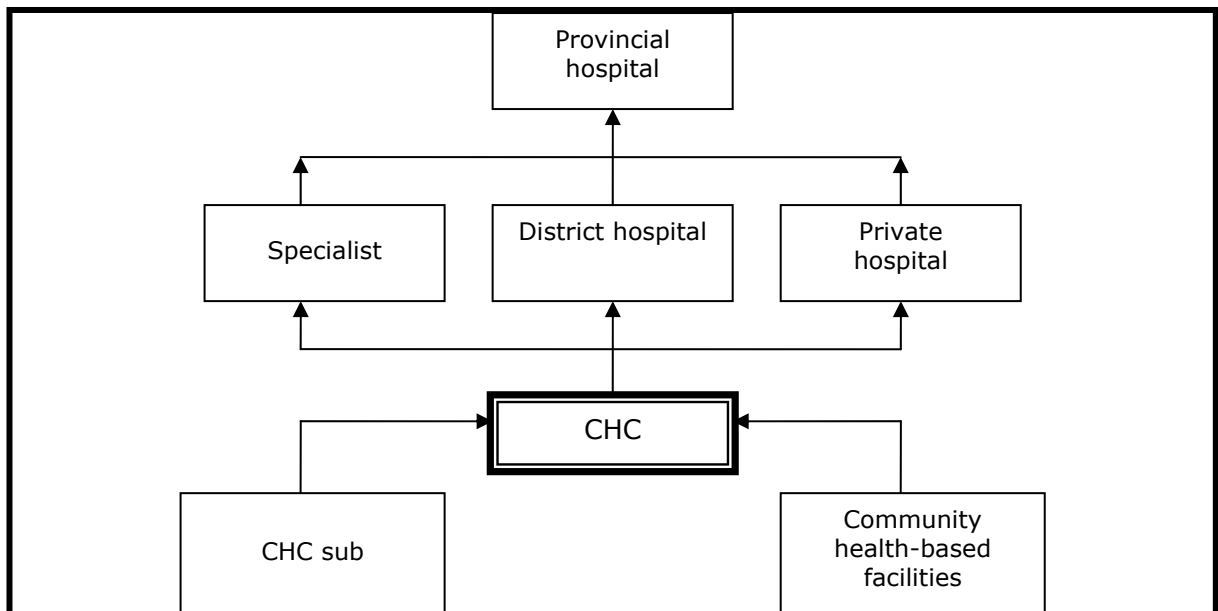
Source: Author

ANNEX 7. DIABETES MANAGEMENT SCHEME IN NORTH SULAWESI PROVINCE, INDONESIA
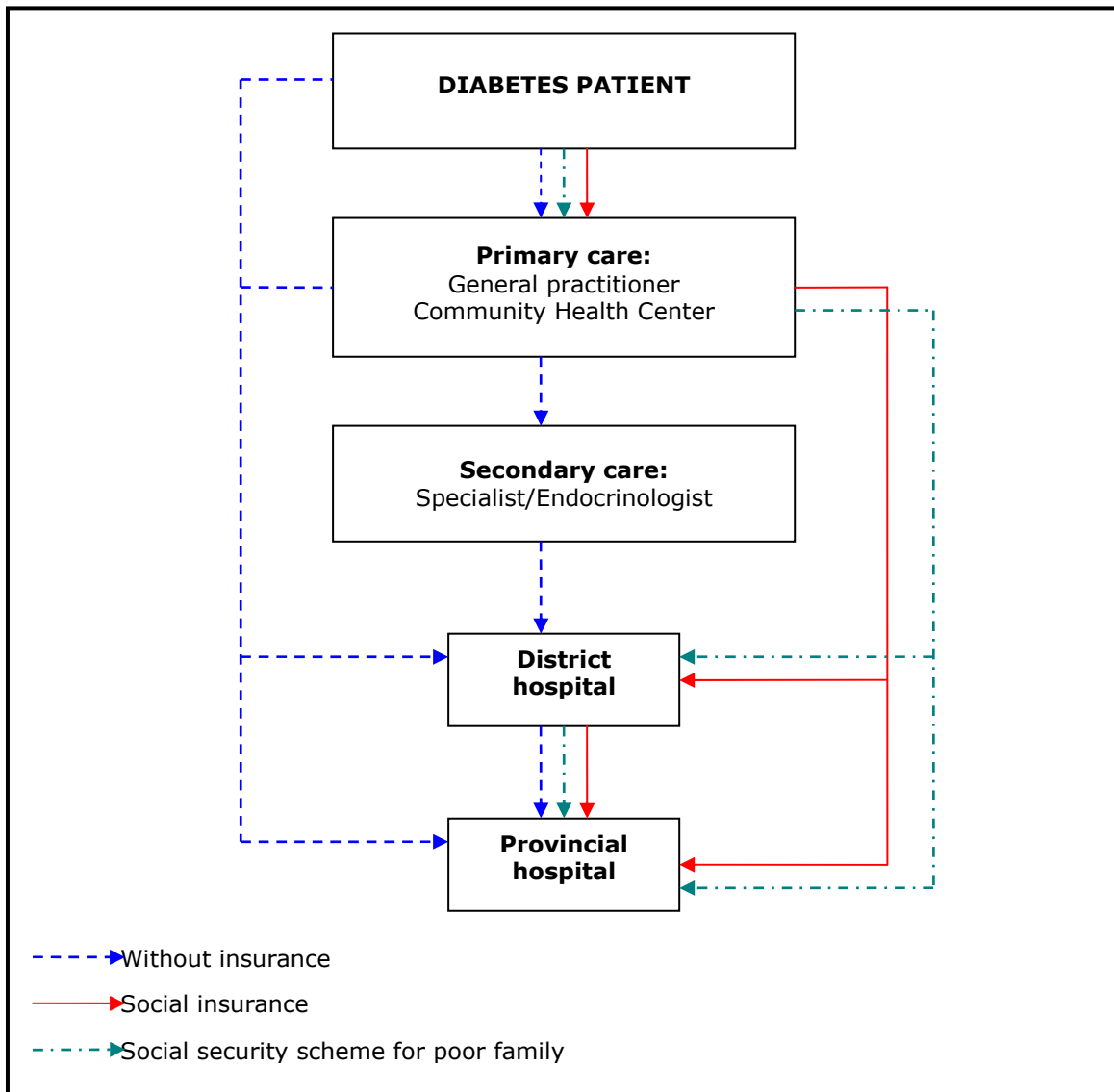
Source: Author

ANNEX. 8. PERKENI CRITERIA FOR SCREENING FOR TYPE 2 DIABETES.

Perkeni (2006) describes the risk factors for T2DM as follow:
1. Age ≥ 45 years.
2. Overweight (BMI ≥ 23 kg/m^2).
3. First degree relative with diabetes.
4. Habitual physical inactivity.
5. Member of a high-risk ethnic population (i.e: Pacific islander, Asia America, etc).
6. Previously identified pre-diabetes (IGT and IFG).
7. History of GDM.
8. Hypertensive (≥ 140/90 mmHg).
9. HDL cholesterol level ≤35 mg/dL and/or trygliceride level ≥250 mg/dL.
10. Have PCOS (Polycystic Ovarial Syndrome).
11. History of vascular diseases.

ANNEX 9. MAP OF INDONESIA

ANNEX 10. MAP OF NORTH SULAWESI (NORTH CELEBES).