



# **Coronary Heart Disease (Sakit sa Puso) in the Philippines: A Guide to Patient Education, Prevention, and Treatment**

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## **Case Presentation**

A 52 year old Filipino man presented to the emergency room with severe substernal chest pain, shortness of breath, and dizziness. The chest pain was described as heaviness and squeezing in character. On physical examination, the patient had a blood pressure (BP) of 80/50 mmHg and a heart rate of 120 bpm with cold, clammy skin. An electrocardiogram (ECG) revealed changes suggestive of a massive heart attack. Serum troponin<sup>1</sup>, a cardiac enzyme detected by a blood draw, was 10 times the upper limit of normal, suggesting significant heart muscle injury. On the way to the cardiac catheterization laboratory<sup>2</sup>, the patient's BP and pulse were barely appreciable, hence advanced cardiac resuscitation was administered. He was pronounced dead an hour later.

This mode of presentation of a heart attack is common in the Philippines, where people with unrecognized and undiagnosed preventable cardiovascular diseases often present late in their disease. Nationally, basic medical care is lacking, with a paucity of resources available for prevention, education, and consistent treatment. Families commonly sell their possessions, including their homes, to pay for medical needs such as emergency room visits, hospitalization, and procedures. Medications are not adhered to as basic needs, whereas others like food, take priority. Economic losses are compounded from loss of productivity by the patient and family members who will need to take care of the patient after a stroke, heart attack or heart failure.

### **Paper objectives for target audience: medical practitioners, students, and patients**

1. To enhance awareness of coronary heart disease (CHD) causes, manifestations, risk factors, prevention, diagnosis, and treatment to help individuals modify their lifestyle to prevent or reduce the progression of CHD.

<sup>1</sup>Troponin: a protein of muscle that together with tropomyosin forms a regulatory protein complex controlling the interaction of actin and myosin and that when combined with calcium ions permits muscular contraction; significant increase denotes death of heart muscle

<sup>2</sup>Catheterization laboratory (cath lab): a specialized area in the hospital where doctors perform minimally invasive tests and advanced cardiac procedures to diagnose and treat cardiovascular disease

2. To promote earlier diagnosis of CHD so intervention can occur.
3. To help shape public policies and direct resources to areas with the most significant need.

## **Introduction**

Cardiovascular diseases (CVD) are the leading causes of mortality globally, causing approximately 18 million deaths each year (World Health Organization, 2021), representing about 32% of all global deaths. Of these deaths, 85% were due to heart attack and strokes. Over 75% of CVD deaths occur in low and middle income countries. Men are more commonly affected than women, and incidence usually starts around the fourth decade of life, increasing with age. In the United States, a person dies from CVDs every 36 seconds, accounting for 1 of every 4 deaths. Coronary heart disease (CHD), a common subset of CVDs, is the most common heart disease in the United States across all gender and racial groups (CDC, 2020).

In the Philippines, the top three causes of death in 2021 included CHD, other cerebrovascular diseases or stroke, and cancers. Over half a million CHD cases were reported in 2021, contributing to approximately 19% of the total deaths in the country. This number increased from less than half a million CHD cases in the first six months of 2020, contributing to approximately 17% of total deaths in the country (Philippine Statistics Authority, 2021). It is unclear if the increased number of total deaths could be attributed to decline in care and treatment due to COVID. Overall from 2015 to 2021, CHD ranked as the number one cause of death and disability in the Philippines.

CHD is also one of the most common non-communicable diseases (NCD) affecting patients worldwide. NCDs, which also include hypertension, diabetes, dyslipidemia, chronic obstructive

pulmonary disease (COPD), heart diseases (CHD), stroke, chronic kidney disease, and cancer, cause approximately 71% of deaths annually (WHO, 2021). NCDs cause approximately 3 out of 4 deaths, and these diseases affect mostly low and middle-income countries.

**Table 1**

*Number and Rank of Registered Deaths, Percent Shares, and Ranks by 50 Leading Causes of Death, Philippines: January to June, 2020-2021 (Abridged).*

<b>Cause of Death</b>	<b>Prevalence number in 2021</b>	<b>Rank</b>	<b>Percent Change of Cases from January 2020 - January 2021</b>
Total	595,626		
Ischemic Heart Diseases (Coronary Heart Disease)	56,757	1	17.4
Cerebrovascular Diseases or Stroke	30,796	2	0.7
Cancers	17,343	3	-16.3
Diabetes Mellitus	19,802	4	10.2
COVID-19 virus identified	17,156	5	1,300.5
Hypertensive diseases	16,146	6	8.3
Pneumonia	13,738	7	-32.3
Other heart diseases	10,615	8	9.3
COVID-19 virus not identified	9,594	9	28.4
Chronic lower respiratory infections	9,248	10	-15.6
Remainder of diseases of the genitourinary system	8,527	11	-0.1

*Despite improvements in intervention for CHD and acute coronary syndrome, CHD still remains as the top cause of mortality. Probable causes for this increase include prevalent risk factors such as diabetes, hypertensive diseases and other heart diseases (all CV diseases).*

Major contributing and modifiable risk factors for CHD include dyslipidemia, smoking, hypertension, abdominal obesity, diabetes, lifestyle factors like dietary lack of fruits and vegetables, and a sedentary lifestyle. These are also noted as the main drivers for most deaths and disabilities. Recent studies comparing the relationship between atherosclerotic-related risk factors and diseases in the Philippines have shown an increasing prevalence of hypertension, diabetes, dyslipidemia, smoking, and central obesity.

**Table 2**

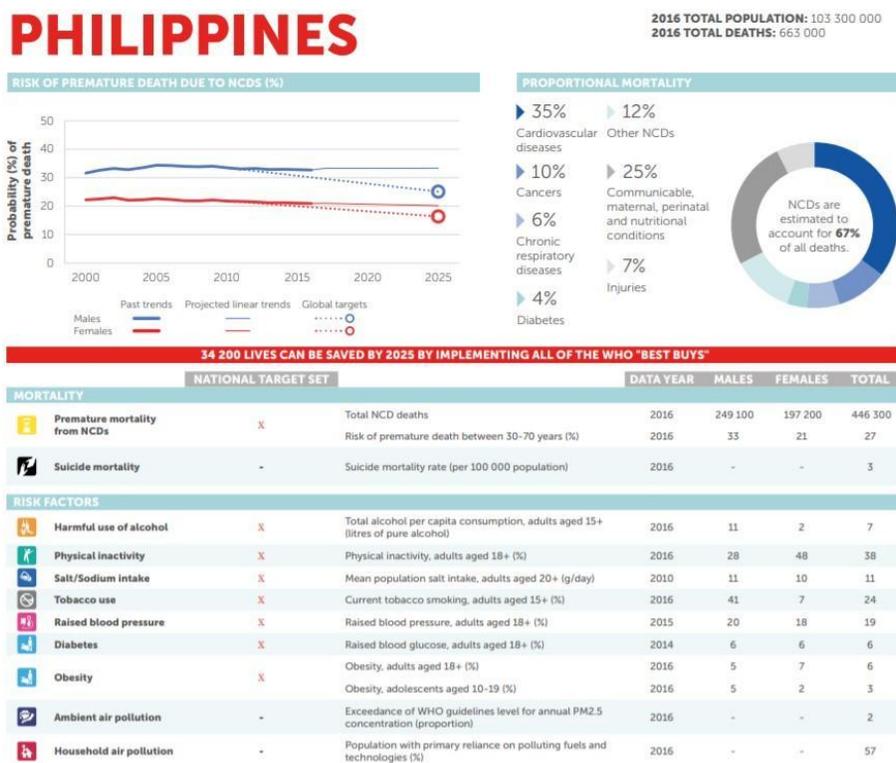
*Trends of the Top 10 Leading Causes of Deaths in the Philippines from 2010 to 2022 (Philippine Statistics Agency).*

No.	2010	2022
1	Diseases of the Heart	Ischemic Heart Diseases
2	Cerebrovascular Diseases	Cerebrovascular Diseases
3	Malignant Neoplasms	Neoplasms
4	Pneumonia	Diabetes Mellitus
5	Tuberculosis	Hypertensive diseases
6	Chronic Lower Respiratory Diseases	COVID-19 Virus Identified
7	Diabetes Mellitus	Pneumonia
8	Nephritis, Nephrotic Syndrome and Nephrosis	Other heart diseases
9	Assault	Chronic Lower Respiratory Diseases
10	Certain Conditions Originating During the Perinatal Period	Remainder of diseases of the genitourinary system

*Ischemic heart diseases, cerebrovascular diseases, and neoplasms have remained the top 3 leading causes of deaths. Notable changes in rankings include that diabetes have since moved rank from #7 to #4, and hypertensive diseases novelly moved onto the top 10 leading causes of death list to rank to #5.*

**Figure 1**

*Non-Communicable Disease Country Profiles: The Philippines (World Health Organization)*



*There is an increasing incidence of NCDs in the Philippines. However, by implementing treatments and prevention programs, it is predicted that the probability of premature death will decrease significantly in males and females by 2025.*

## Coronary Heart Disease (CHD)

CHD is a disease in which the arteries that carry blood to the heart (coronary arteries) become narrowed from atherosclerosis plaque build-up caused by risk factors (Blumenthal, 2020).

Rupture of a plaque causing complete blockage of a coronary artery results in an acute myocardial infarction (heart attack) which can be fatal. If the blockage is not complete or has progressed over time, other conditions can occur, such as angina pectoris, arrhythmias, heart failure and eventual myocardial infarction.

**Angina pectoris**, more commonly known as angina, is chest pain or discomfort due to insufficient blood being delivered to the heart. It is a mismatch between supply and demand. It is frequently described as squeezing, pressure, burning sensation or heaviness on the chest sometimes described as “an elephant sitting on my chest” or “a brick on my chest”. Some may describe it as the feeling of a tight band around the chest, heartburn or gas. The location of the pain is usually in the chest area but the sensation may also be felt from the ear lobe, back, neck, jaw, arms and upper abdomen all the way to the navel. It is usually brought on by exertion, stress, or anxiety and is relieved by rest or nitroglycerin. It may be caused by coronary atherosclerosis or spasm of the coronary arteries which can compromise blood flow. The prevalence of angina varies across populations around the globe. National statistics on angina in the Philippines have not been recently collected, however smaller studies on angina have been conducted in Filipino sub-populations. In a 2011 study, approximately 80% of all patients admitted to the Philippine General Hospital emergency room for acute coronary syndromes had a chief complaint of angina (Alcover et al., 2011).

In women, angina presentation can differ. In addition to typical symptoms, women can also experience nausea, vomiting, upper extremity pain, abdominal pain, dizziness, and shortness of breath (American Heart Association, 2021). These atypical presentations may lead to a delay in diagnosis and treatment. Women also tend to have more dysfunction of the small arteries (microvascular dysfunction) rather than blockage of major coronary arteries.

**Arrhythmias** are irregular or abnormal heartbeats. Common arrhythmias that can occur with coronary heart disease include premature atrial or ventricular beats, atrial fibrillation (AF), atrial flutter, and heart blocks. Atrial fibrillation is the most common arrhythmia globally (Mkoko et

al., 2015). Atrial fibrillation occurs in 2% of Filipinos above 70 years of age according to the Philippines Department of Health and the Food and Nutrition Research Institute in 2017. It can sometimes occur in younger individuals (Gervacio, 2017).

**Heart failure** is the inability of the heart to pump a sufficient amount of blood for the body's needs. Patients with heart failure usually present with shortness of breath, fatigue, weakness, cough, or swelling of the legs. A 2017 study of patients admitted from age 19 and older across 17 regions in the Philippines determined the prevalence of heart failure was 16 out of 1000 patients (Tumanan-Mendoza et al., 2017). This rate is comparatively higher than in other Asian countries.

**Myocardial infarction**, more commonly known as heart attack or "**Atake sa Puso**" in the Philippines, is caused by a complete blockage of a coronary artery, leading to interruption of blood flow to the heart, resulting in injury, ischemia, or death of the heart muscle being supplied by the affected artery. About 45% of heart attacks are "silent," meaning people may have muted symptoms, no symptoms of the heart attack at all, or the symptoms were not given attention (Harvard Health, 2020). These heart attacks are sometimes identified much later when compared to an old ECG. In the US, someone dies from a heart attack every 36 seconds, and annually 805,000 Americans experience a heart attack, 605,000 of which are first heart attacks and 200,000 are second heart attacks. In 2019, ischemic heart disease was the leading cause of death in the Philippines with approximately 58,000 and 39,000 deaths in men and women respectively (Statista 2021).

Generally, the preceding statistics for angina, arrhythmias, heart failure, and heart attack in the Philippines are often underreported due to several socio-cultural factors. For example, many Filipinos often die at home or outside of the hospital due to a lack of access to care. Furthermore, many of them have not seen a healthcare provider for several years. Many institutions in the Philippines are just recently implementing electronic medical records, and many are still using paper charts. Therefore, reporting deaths and/or causes of deaths may not be accurate. Health care providers tend to ask family members what the person was experiencing prior to death, and their best assumption will be entered on the death certificate.

## **Causes of CHD**

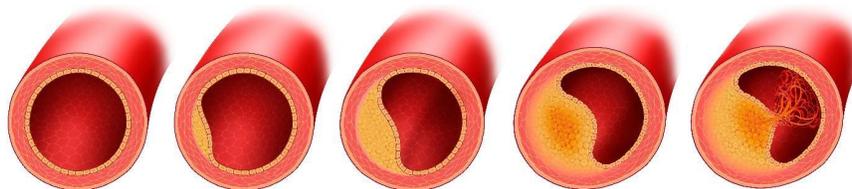
Most commonly, the main cause of CHD is plaque build-up on the lining of the arteries, a disease process known as atherosclerosis (Figure 2). This plaque build-up contributes to instability and narrowing of the artery's lumen, leading to reduced blood flow to the heart. This process does not occur instantly, and it may take years for the plaque to build up. Therefore, early intervention in modifying these risk factors is crucial. Modifiable risk factors including unhealthy lifestyle habits, namely physical inactivity, improper nutrition, and smoking, can lead to atherosclerosis. Other risk factors include hypertension, diabetes, and hyperlipidemia. Since atherosclerosis can develop in different arteries, prevention and treatment can prevent complications in other organs including the brain (stroke), the kidneys (kidney failure), eyes (vision loss) and limbs (peripheral artery disease).

The development of atherosclerosis usually begins with excessive cholesterol levels that can build up in the thin innermost layer of the artery (endothelium). Further endothelial injury, often due to inflammation, effects of blood pressure elevation, diabetes, or exposure to toxins, such as

toxins from cigarettes, can cause the further build-up of the plaque. Over time, white blood cells, low-density lipoprotein (LDL) cholesterol, and calcium travel to the injury site in the endothelium. The growth of plaques narrows the artery and decreases blood flow, akin to a pipe being plugged up over time. This reduction of blood flow and subsequent ischemia may manifest as angina or chest pain initially. When the plaque ruptures, platelets (fragments of cells that help form blood clots) rush to plug the source of what is interpreted by the body to be bleeding or injury. This is followed by the formation of a thrombus or clot, a response to plug the "bleeding site" and the blood vessel leading to a heart attack (myocardial infarction).

## **Figure 2**

*Development of atherosclerosis (Shutterstock)*



*In patients with coronary artery disease risk factors, atherosclerotic plaque can build up in the lining of the blood vessel. If the risk factors are not controlled, plaque can continue to build-up and decrease blood flow to the heart muscle cells. The last figure depicts a heart attack in which the plaque ruptures causing a bleed in the lining of the heart artery. A blood clot forms to stop the bleeding, which can completely block the blood flow to the heart muscle cells which can die if the blood flow is not restored within less than 90 minutes.*

## **Manifestations of CHD**

CHD manifestations are variable. The presentation can range from asymptomatic (no symptoms), to vague symptoms such as fatigue, dizziness, feeling unwell, and shortness of breath, or may present as chest pain, similar to stable or unstable angina or heart attack.

## **Stable Angina**

Angina is chest or heart pain due to reduced blood supply to the heart. Symptoms occur when the increased demand for oxygenated blood is not met due to the narrowing of blood vessels caused by atherosclerosis, endothelial dysfunction, or spasm of the coronary arteries. Stable angina is predictable chest pain caused by activities that increase demand on the heart like running, walking, sexual activity, bowel movements, or emotional stress. Chest pains may be described as pressure, tightness, squeezing, aching, or burning on the chest or breast bone and may radiate to the neck, jaw, back, shoulders, or arms. Sometimes people will describe it as gas or heartburn, and it is dependent on the physician to interpret the patient's symptoms. Chest pain generally lasts for a few minutes and is predictably relieved by rest or medication that can improve the blood flow of the artery, such as nitroglycerin. Some people curtail or decrease their activities to prevent these chest pains or take medications such as long-acting nitrates, beta-blockers, or calcium channel blockers.

In women, symptoms may be more variable or vague, including heaviness in the chest, abdominal discomfort, fatigue, nausea, lightheadedness, weakness, “not feeling well” or sleep disturbance. These presentations are sometimes not recognized as heart disease symptoms and lead to a delay in diagnosis and intervention in women.

## **Unstable angina**

Unstable angina, sometimes referred to as crescendo angina or accelerated angina, is chest or heart pain resulting from reduced blood supply to the heart that is unpredictable or increasing in intensity or frequency. Unstable angina is also referred to as rest, vasospastic, or Prinzmetal angina. Many believe that its classification is sandwiched between stable angina and a heart

attack and that its occurrence predicts a heart attack. Chest pain occurs at rest, with minimal exertion, or after angioplasty (a procedure to open up coronary arteries). Pain accelerates rapidly, lasts longer than a few minutes and may not be relieved by rest or repeated administration of nitrates. Like stable angina, symptoms occur when there is an increased blood demand to the heart and there is inadequate supply due to the narrowing of the arteries. The pathophysiology is thought to be secondary to vasospasm in an already partially occluded coronary artery or arteries. It is considered a signal that a heart attack or acute coronary syndrome is imminent.

**Table 3**

*Differences between unstable angina from stable angina*

	<b>Stable angina</b>	<b>Unstable angina</b>
<b>Pathophysiology</b>	Decrease coronary blood flow	Vasospasm in an already compromised blood flow
<b>Chest pain</b>	Chest pain is predictable	Unpredictable and accelerates
<b>Trigger</b>	With increasing activities, stress	May occur at rest
<b>Relief</b>	Relieved by rest or nitrates	May occur at rest or not relieved by rest or nitrates
<b>Duration</b>	Shorter few minutes	Persist and longer duration 5 to 20 minutes
<b>Intensity</b>	Variable	May be more intense

The symptoms of unstable angina call for urgency and should be immediately seen by a cardiologist or cared for in an emergency room. In general, if a heart attack is excluded and the patient is deemed to have unstable angina, they are placed on observation and evaluated for possible coronary arteriography (injecting dye into the coronary artery to detect obstruction) and intervention.

## **Myocardial infarction (Atake sa Pusong)**

Myocardial infarction or a heart attack can occur when the coronary blood flow is completely obstructed. This occurs when plaque on the walls of the coronary arteries ruptures and ultimately causes blood clots to form. The rupture of these plaque causes blood clots to block off the artery downstream, causing the cessation of blood flow. When this occurs, the oxygen-depleted heart muscles become damaged and eventually die, which is called "infarction". The decreased contractility from the damaged area then leads to decreased cardiac output (amount of blood propelled to the body with each heart contraction) eventually causing heart failure. Many people who develop a heart attack have a history of angina or chest pains. Others may not have warning signs and may even have a heart attack without symptoms, coining the term "silent heart attack" or have a fatal arrhythmia called sudden cardiac arrest.

Some heart attacks are not caused by a complete blockage of the artery and lead to less severe damage to the heart. These can be caused by spontaneous blood clot resolution, coronary artery spasms, or microvascular disease (disease of the heart's smaller arteries).

## **Risk Factors of CHD**

Risk awareness and lifestyle modifications can make a difference in preventing CHD. Many people are not aware of their risks. It is essential to see a doctor to review family and personal history to determine risk factors. There are modifiable and unmodifiable risk factors for CHD (see Table 4). One should consider the multiplier effect, which suggests that the more risk factors one has, the greater the chance of developing CHD. One can calculate someone's total risk for CHD using ASCVD Risk Estimator Plus, a digital risk calculator by the American College of Cardiology. This program can be accessed here:

<https://www.acc.org/tools-and-practice-support/mobile-resources/features/2013-prevention-guide/lines-ascvd-risk-estimator>.

**Table 4**

*Summary of CHD Risk Factors*

<b>Unmodifiable Risk Factors</b>	<b>Modifiable Risk Factors</b>
Age	Cigarette smoking
Sex	Hypertension
Family history	Abnormal Levels of Blood Lipids/Cholesterol
Personal history of cardiovascular disease	Obesity
	Metabolic syndrome
	Diabetes
	Physical Inactivity
	Mental conditions: stress, depression, and Type A personality
	Sleep apnea
	Toxins/air pollution

### **Unmodifiable Risk Factors**

The following are the risk factors that cannot be modified but are worthwhile to know to calculate the risk for CHD.

**Age:** Age and CHD risk are strongly correlated. The risk of CHD will continuously increase after age 45 in men and after 55 in women. The rate of CHD is expected to increase as the population ages and as the incidence of obesity, diabetes, hyperlipidemia

and hypertension increase globally. Four out of five people who die of coronary heart disease are over 65. In 2021, approximately 5% of the total population in the Philippines were individuals 65 and over (PopulationPyramid, n.d.).

**Sex:** More men than women develop coronary heart disease. CHD among women tends to occur a decade later than in men. However, after menopause, the risk approaches that of men. This phenomenon is believed to be secondary to a decline in estrogen and the concomitant effect of increased LDL ("bad" cholesterol) and decreased HDL ("good" cholesterol). Changes in weight and lifestyle further modulate the risk.

**Family history:** A family history of CHD before age 55 in men and age 65 in women is also a risk factor. The more family members with CHD, the more elevated the risk. Attention to family history of other CVD such as stroke and diabetes is also important.

**Personal history of cardiovascular disease:** Since atherosclerosis affects arteries beyond the coronaries, diseases of other blood vessels like stroke, peripheral artery disease (narrowing of blood vessels in the limbs), or renal artery disease (narrowing of renal vessels) all increase CHD risk.

### **Modifiable Risk Factors**

The following are the risk factors for CHD that one can change, control, or modify. In the Philippines, initiatives have been implemented to address each of these risk factors, with varying success levels.

**Cigarette Smoking:** Cigarette smoking is a significant risk factor for CHD because it decreases HDL cholesterol levels ("good" cholesterol), damages the lining of the arteries,

and promotes atherosclerosis and blood clot formation by promoting the stickiness or aggregation of platelets.

Smoking also contributes to arrhythmias, cancers, and COPD. Second-hand smoke is also a risk. If one stops smoking, their CHD risk can dramatically decrease by 50% within even a year of quitting. Smoking is common in the Philippines, with 22.7% of the population smoking tobacco. Vaping (e-cigarettes) use is increasingly used by the younger population as well. The long-term effects of vaping on heart health are still unclear. Many adults and children are exposed to second-hand smoke in the workplace, in public areas, and at home. Approximately 110,000 Filipinos die yearly from tobacco-related diseases (Campaign for Tobacco-Free Kids, 2020). Several initiatives have been taken to address this smoking epidemic, including the signing of Executive Order 26 in 2017 by President Rodrigo Duterte of the Philippines. This order bans smoking in all public places in the Philippines, including schools, medical practices, government facilities, food service areas, public transportation, and more.

Additionally in 2012, the Philippines government passed the "Sin Tax," which increased the tax on tobacco from 2.72 PHP (Philippine Peso) to 30 PHP (Campaign for Tobacco-Free Kids, 2017). By 2017, the average price per pack of cigarettes more than doubled, and the number of adult Filipino smokers decreased from 28.3% in 2009 to 22.7% in 2015. More recently, the Philippines branch of the international company Johnson & Johnson has partnered with the Philippines College of Chest Physicians to provide quitting assistance and education to Filipino smokers. These services will train healthcare providers on how to treat smokers who decide to quit smoking through

educational smoking cessation programs. Such a program, a comprehensive webinar, can be accessed here:

[https://www.facebook.com/watch/live/?ref=watch\\_permalink&v=515741793624467](https://www.facebook.com/watch/live/?ref=watch_permalink&v=515741793624467)

This will serve as a helpful resource to Filipino smokers, in addition to the already available Department of Health mobile hotline that provides professional help, free educational materials, and nicotine replacement therapy products as well as initiatives by the Philippine College of Physicians and the Philippine Heart Association (Manila Bulletin, 2021).

**Hypertension:** High blood pressure (BP), or hypertension, is another risk factor for CHD because it damages blood vessels, setting the stage for atherosclerosis. Hypertension often does not present symptomatically and can therefore remain undetected while causing changes in the blood vessels ("silent killer") unless people regularly check their BP. Adults should check their BP regularly by age 18 or earlier if they have a family history of hypertension or other risk factors, and then yearly after 40 or more frequently if their BP is elevated. The earlier the diagnosis, the better it can be treated and controlled before further damage occurs in blood vessels. Lowering BP decreases the risks of CHD, heart attack, stroke, heart failure, and kidney disease.

**Table 5**

*Classification of blood pressure category per different professional organizations*

<b>Stages</b>	<b>ACC/AHA</b>	<b>ESC/ESH</b>	<b>ISH</b>	<b>PHA/PSH</b>
<b>Normal</b>	<120/<80	120-129/80-84	<130/<85	<120/<80

<b>Elevated</b>	120-129/<80	130-139/85-89	130-139/85-89	120-129/80-89
<b>Stage 1</b>	130-139/80-89	140-159/90-99	140-159/90-99	140-159/90-99
<b>Stage 2</b>	≥140/ ≥90	160-179/100-109	≥160/ ≥100	160-179/100-109
<b>Hypertensive crisis</b>	>180/>120	≥180/≥110	≥180/≥110	≥180/≥110

*Acronyms: ACC/AHA = American College of Cardiology/American Heart Association, ESC/ESH = European Society of Cardiology/European Society of Hypertension, ISH = International Society of Hypertension, PHA/PSH = Philippines Heart of Association/Philippines Society of Hypertension*

In 2017, the American Heart Association announced new blood pressure guidelines to encourage earlier hypertension detection and prevention. A BP of 121-129/71-80 mmHg is now considered elevated. A BP above 130/80 mmHg is now considered hypertension and lifestyle modification is recommended as an early intervention. However, the European Society of Cardiology and Hypertension, the International Society of Hypertension, and the Philippine Society of Hypertension regard 140/90 mmHg and above as hypertension. BP readings may vary based on whether they are taken in the clinic, office or at home. BP readings may also vary with the time of day they are taken, influenced by caffeine and salt intake, stress, anxiety etc. Therefore, it is crucial to have several data points. As BP increases, especially in the presence of other risk factors such as diabetes, smoking, kidney disease, heart disease, or stroke, the more aggressive control of BP is indicated. Lifestyle modifications like increasing physical activity, smoking cessation, and dietary changes (decreasing salt intake and alcohol, increasing fruits, vegetables, and fiber) are recommended as early treatment for elevated BP or Stage 1

hypertension. These lifestyle changes help enhance pharmacologic intervention to control BP.

Hypertension in the Philippines continues to rise. A recently reported study by the Philippine Heart Association found hypertension in 38.6% of the hospitalized Filipino population. However, this statistic may be a major underestimation as many Filipinos are not seen by medical practitioners. It is thought that the number of individuals with hypertension may actually be higher in the adult Filipino population (possibly 45-50% of the adult population) since the threshold of hypertension was changed in 2017.

Few people in the Philippines have their own BP machines or have access to clinics where BP is routinely checked. It is an important public health measure to have accessible kiosks or clinics to check people's BP routinely. To promote awareness and education on such a prevalent issue, the Philippine Society of Hypertension, the Philippine Council for Health Research and Development, the Philippines Department of Health, and the International Society of Hypertension celebrate May as "Hypertension National Awareness Month." An argument can be made that hypertension awareness should be stressed each time any patient is seen.

**Abnormal Levels of Blood Lipids:** Cholesterol and triglycerides (types of fats) are carried through the bloodstream on proteins called lipoproteins. Two specific lipoproteins that transport blood cholesterol from the liver to the tissues are low-density lipoprotein (LDL) and high-density lipoprotein (HDL). If one has elevated blood levels of total cholesterol, LDL, small dense LDL particles and triglycerides or low HDL levels, the risk for CHD increases. High levels of other blood cholesterol such as lipoprotein (a) (a

modified LDL particle) and apolipoprotein B (the main component of VLDL and LDL), correspond to high LDL and VLDL, have also been linked to an increased risk of a heart attack and stroke.

Elevated total cholesterol and LDL levels increase the likelihood that cholesterol will be deposited within the artery walls, thus making people more susceptible to CHD. For primary prevention (no history of CHD), LDL should be below 130 mg/dL but above 100 mg/dL for those with diabetes. For secondary prevention (history of CHD), LDL should be below 70 mg/dL but above 55 mg/dL for those with severe atherosclerotic vascular disease. However, not all cholesterol is harmful or increases CHD risk. HDL cholesterol is often called "good" cholesterol because it transports fat molecules out of the arterial walls and reduces macrophage accumulation, thus helping prevent or regress atherosclerosis. Therefore, HDL is known to be protective against CHD.

During physical activity, blood flow to the heart is crucial. High levels of triglycerides interfere with needed coronary dilatation through their association with atherogenic particles that lead to the thickening of the arterial walls (arteriosclerosis) (Talayero and Sacks, 2012). Normal triglyceride levels are below 150 mg/dL, and a level below 100 mg/dL is desirable. High triglycerides pose a greater risk in women than in men, and the risk of CHD is even higher if a person also has low levels of HDL, high levels of LDL, hypertension, obesity or high insulin levels, or the so called "metabolic syndrome". In people with high levels of triglycerides, one should look for secondary causes like uncontrolled diabetes, metabolic syndrome, alcoholism, obesity, hypothyroidism and a

high carbohydrate diet. Medications like estrogens, progestins, diuretics, retinoids, steroids, some HIV medications, and immunosuppressants can also increase triglycerides.

In the Philippines, there are high rates of dyslipidemias. In 2013, the Philippines' National Nutrition and Health Survey found that 72% of adults 20 years old and older had one or more abnormal lipid levels. Specifically, approximately 47% had borderline to high total cholesterol, 47% had borderline to high LDL, 71% had low HDL, and 39% had increased triglyceride content (Lin et al., 2018). Efforts to decrease dyslipidemia in Filipinos include the publication of the Executive Summary of the 2020 Clinical Practice Guidelines for the Management of Dyslipidemia in the Philippines, in which medical experts list holistic, non-pharmacological, and pharmacological treatment recommendations (Gonzalez-Santos et al., 2020).

**Obesity:** Obesity is an escalating epidemic, defined as a body mass index (BMI)  $\geq 30$ ; overweight is defined as a BMI  $\geq 25$ . BMI is calculated by dividing weight in pounds by height in inches squared and multiplying by 703. In Asians, a BMI of 23 or greater is associated with an increased risk of CHD and diabetes.

A better measure of risk for CHD is waist circumference. The INTERHEART study showed that the waist-hip ratio correlates better than BMI for risk for myocardial infarction (Schneider et al., 2006). Waist circumference is measured by placing a tape measure around the waist just above the hip bone at the level of the umbilicus.

Abdominal obesity increases CHD risk and has been linked to high troponins and risk for heart failure (Journal of the American College of Cardiology: Heart failure). Abdominal obesity is defined as a waist circumference of above 35 inches in women and above 40

inches in men. For Southeast Asians, the cut-off for men is 35 inches and 30 inches for women (International Diabetes Federation). People with insulin resistance and large abdominal circumference are more predisposed to developing diabetes, which is often accompanied by high triglycerides and low HDL, further increasing the risk for CHD. Excess weight around the waist and abdomen is a marker of visceral adiposity and is associated with insulin resistance. Visceral adiposity can be better evaluated with a CT scan or ultrasound.

Obesity in the Philippines has been steadily increasing, with 6.9% of all adults in 2015 and 9.3% of all adults in 2019 being obese (Global Obesity Conservatory, 2021). The Philippines was given a national obesity risk score of 6/10 by the Global Obesity Observatory, indicating moderate risk nationally. Some programs tackle the growing obesity crisis, including the Philippine Plan of Action For Nutrition 2017-2022 by the Philippines Department of Health. This six-year plan includes twelve programs with eight nutrition-specific programs, three enabling support programs, and one nutrition-sensitive program designed to enact better nutritional outcomes nationally.

**Metabolic syndrome:** Metabolic syndrome (MS), or syndrome X, initially coined by Gerald Reaven at Stanford University, is defined by an cluster of abnormalities that includes abdominal obesity (excess fat in the stomach area), a high triglyceride level, a low HDL cholesterol level, high blood pressure, insulin resistance and high fasting blood sugar. The X in syndrome X refers to the unknown significance of insulin resistance. These conditions are associated with an increased risk of CHD, and a longitudinal clinical study in the Philippines observed an overall prevalence of metabolic syndrome in 51% of

1367 adult patient participants (Mata and Jasul, 2017). Lifestyle changes like exercise, weight loss, a high fiber diet, a low-fat diet, and control of other risk factors like high cholesterol, high BP, and high glucose can significantly prevent MS.

**Diabetes Mellitus:** Diabetes mellitus (diabetes) is a disease in which glucose levels in the blood are elevated due to the inability of the pancreas to secrete enough insulin or the inability of the body to dispose of glucose due to an inappropriate response to insulin (insulin resistance). Fasting blood glucose of 100-125 mg/dL indicates pre-diabetes and 126 mg/dL or higher indicates diabetes (CDC, 2019). There are multiple types of diabetes. Type 1 diabetes, formerly called insulin-dependent diabetes, is characterized by the failure of the pancreas to secrete insulin. Type 2 diabetes, formerly called non-insulin-dependent diabetes, is the most common type of diabetes characterized by insufficient insulin production by the pancreas or cells that are refractory to the effects of insulin (insulin resistance). Once uncommon in adolescents and children, Type 2 diabetes is now emerging in younger age groups, primarily driven by increasing childhood obesity. About 80-90% of people with Type 2 diabetes are obese. Other, less common types of diabetes which will not be discussed here.

Several CHD risk factors, including abnormal cholesterol levels and high blood pressure, are common in individuals with diabetes. Risk factors for diabetes include a family history of diabetes, obesity, gestational diabetes, polycystic ovary syndrome (PCOS), aging, race, ethnicity, and metabolic syndrome. All of these can compound the risk of CHD. Diabetes can be prevented by lifestyle changes, such as better nutrition and

increased physical activity, and by actively monitoring glucose blood levels if a person is at risk for diabetes.

Diabetes is advancing in ranking to the top five leading causes of death in the Philippines. In 2020 in the Philippines, 6.3% of adults had diabetes, or 3,993,300 cases (International Diabetes Federation, 2020). The Philippine Center for Diabetes Education Foundation is one organization that has several initiatives to address the growing number of Filipinos with diabetes. Such programs include an intensive diabetes training course for healthcare providers, an annual diabetes awareness week, and Camp COPE (Children Overcoming Diabetes Problems Everywhere), a summer camp for children with Type 1 diabetes.

**Sleep Apnea:** Sleep apnea is a disorder in which one's breathing is abnormal during sleep and is characterized by decreased oxygen levels in the blood. A person with sleep apnea can experience abrupt stopping and starting of breathing during sleep and may also experience snoring, choking, or gasping during sleep, morning headaches, awakening with a dry mouth, tiredness, irritability, and difficulty focusing. Sleep apnea is related to several CHD risk factors, including hypertension and abnormal heart rhythms. A global data analysis study in 2020 found that approximately 16 million Filipinos (6.25% of the total population, which is an underestimate if age is adjusted) aged 39-60 years old experience sleep apnea based on an apnea-hypopnea index (AHI) cut-off value of five or more events per hour of sleep (Benjafield et al., 2019). However, there are currently no prevalent studies on sleep apnea in the Philippines, and awareness is low; sleep apnea may be underdiagnosed in the Philippines. One of the few sleep apnea campaigns in the Philippines is the Sleep Apnea Forum, hosted by the Sleep Society of the Philippines and

Centuria Medical Makati in 2017. This forum consisted of lectures and treatment demonstrations to educate healthcare providers on sleep apnea (Patasongkram, 2017).

**Physical inactivity:** Physical inactivity can lead to other CHD risk factors, such as hypertension, abnormal blood lipid levels, obesity, and the risk of subsequent conditions such as a heart attack. Generally, physical activity can decrease CHD and help one maintain a healthy lifestyle. The indigenous population in the Philippines is leaner since they walk more and are generally active in farming and hunting. However, in urban poor and affluent areas, people are more sedentary. In 2019, the WHO found that the Philippines had an overall physical inactivity prevalence of 93.4%. Filipino youth have been particularly noted to be highly inactive, and in a 2016 study, Filipino adolescents were ranked as the second most physically inactive teens in the world (World Health Organization, 2019).

As a result, obesity in young people is rising in the Philippines. Campaigns to promote physical activity have been implemented, including programs that have shifted to accommodate exercise at home in response to the COVID-19 pandemic. In May 2020, the Philippines Department of Health and the Philippines Sports Commission (PSC) launched "Wais Papawis" (Wise Exercises), an educational campaign that includes readily accessible at-home exercises. Similarly, in 2021, the PSC announced: "Igalaw Galaw Ating Katawan" (Move Your Body), a solo dance contest to encourage exercise through art.

**Mental health:** Mental health issues, particularly stress, anxiety, and depression, can contribute significantly to CHD. Stress can directly lead to CHD and subsequently

unstable angina or heart attack through the body's physiological responses to stress.

When stressed, the body releases hormones such as cortisol and epinephrine that increase blood pressure and heart rate and cause narrowing or spasm of the coronary arteries, promoting CHD. Long-term stress has also been linked to inflammation, which can also predict CHD. Specifically, significant biomarkers of systemic inflammation, including IL-6 and CRP, are elevated in different life stages and are thought to be signs of atherosclerosis (Liu et al., 2017).

Depression and its pharmacologic treatment are associated with an increased risk of CHD. Directly, depression can cause decreased parasympathetic or increased sympathetic autonomic nervous activity, promoting increased blood pressure and blood cholesterol levels, and can cause myocardial ischemia, ventricular tachycardia, ventricular fibrillation, or heart attack (Skala et al., 2006). Indirectly, depression can lead to decreased adherence or follow-up to medications and less engagement with healthy lifestyle habits, potentially increasing CHD risk. Generally, depression and anxiety have been associated with a 25% increased risk of heart disease.

Type A Behavior Pattern (TABP) is a characteristic term for individuals who are ambitious, competitive, anxious, highly focused, or impatient. In the 1950s, American cardiologists Meyer Friedman and Ray Rosenman presented the idea that TABP is related to increased risk for CHD (Petticrew et al., 2012). Conflicting studies on this relationship show a lack of significant association, leading to ambiguity about this theory.

Specifically, results from the Western Collaborative Group Study in 1970 in the GAZEL

(French men) and JHPC (Japanese individuals) cohorts showed that TABP is not a predictive risk factor for French or Japanese individuals.

Mental illness ranks as the third most common disability in the Philippines, with approximately 6 million Filipinos suffering from depression and/or anxiety (Martinez et al., 2020). Despite the high prevalence, help-seeking attitudes toward mental illness amongst Filipinos and support from the Philippine government remain low.

Approximately 10.72% of Filipinos demonstrate help-seeking behavior, and only 0.22% of total health expenditures are spent on mental health by the Philippines government.

This could be attributed to the Filipino cultural taboo around mental illness and the fact that many Filipinos see mental illness as a sign of weakness or contradictory to the preferred happy mindset. However, some mental services include free or discounted telemedicine services, hotlines, clinics, foundations, and various support groups. The Philippines also recently passed its first Mental Health Act to improve mental health service access (Lally et al., 2019).

**Air pollution:** Air pollution can increase CHD risk, particularly if subjected to it long-term and with simultaneous experience of other CHD risk factors. Air pollution cardiotoxicity can lead to increased blood pressure, blood clotting, and atherosclerosis, leading to CHD (Simkhovich et al., 2009). Avoiding time outside where air pollution is high or wearing a recommended face mask can help reduce CHD risk. In 2018, 43.3 out of 100,000 deaths in the Philippines were air pollution-related (ABS-CBN News, Philippines, 2020). In 2020, the Philippines had an average Air Quality Index (AQI) ranking of 52, 1.3 times the WHO recommended AQI value (IQAir, 2021). Little

legislative action has been taken to combat increasing air pollution levels, but some local commitments have been made. Private organizations like ABS-CBN, under the leadership of Gina Lopez, fought to clean the environment by taking on negative contributions from the mining, fishing and home-building industries. Additionally, in 2019, Manila City, the capital of the Philippines, became a part of the BreatheLife campaign, a program that promotes public health and climate change education to decrease air pollution (BreatheLife, 2020).

Despite such efforts, many factors continue to contribute to the low air quality in the Philippines, such as the sale of single cigarettes and pollution from the public transportation system like jeepneys and buses. Local salespersons and stores commonly sell single cigarettes to all, including minors (Villamor, 2017). These sales make the acquisition of cigarettes and smoking very accessible, thus constantly increasing air pollution levels. Additionally, the growing use of motor vehicles has heavily contributed to many pollutants. Jeepneys are the Philippines' most popular form of public transportation, with approximately 180,000-270,000 jeepneys actively in use (Westerman, 2018). They are also known as intense polluters, and studies have shown that diesel-based jeepneys have been responsible for 15% of air toxins in Metro Manila. Efforts are ongoing to decrease the number of jeepneys in Metro Manila.

### **Prevention of CHD**

Prevention is especially crucial for people at risk for CHD. There are several methods to prevent CHD.

**Awareness of Risk:** An individual can use a calculator to estimate CHD risk in the next 10 years, which can guide risk reduction. However, a specific estimate has not been made for the Filipino population. Conducting regular screenings for BP, blood sugar and cholesterol in people at risk for CVD diseases can improve awareness.

**Healthy Diet:** Adoption of a healthy diet can lower CHD risk. A healthy diet, which should include less processed foods, refined carbohydrates, saturated and trans fats, and sweetened beverages should be at the forefront. It should contain increased monounsaturated and polyunsaturated fats and omega-3 fatty acids found in fatty fish like herring, sardines, and salmon. The value of plant-based foods, which are rich in complex carbohydrates and fiber, including fruits, vegetables, whole grains, and proteins found in plants, fish, and lean meat should be emphasized.

Socialization in Filipino culture is primarily organized around food and can symbolize love, friendship, and respect. The diet of Filipino adults mainly consists of refined rice, pork, fats, oils, chicken, and bread with a low intake of vegetables, fruits, and dairy. Fried food, salty seasonings such as "patis" (fish sauce, "bagoong" (shrimp paste) , and "toyo" (soy sauce), preserved foods with high salt content due to a lack of refrigeration, processed foods, and regular soda are also highly consumed. In a recent study observing food intake in Filipino adults, nutrient inadequacy was high, and very few nutrient-dense foods were consumed (Agdeppa and Custodio, 2020). These nutrition inadequacies are often found in older adults, females, and people of lower socioeconomic status. Incorporating low-cost, healthy recipes tailored to the Filipino diet is highly desirable to help mitigate the risk of CHD.

**Physical Activity:** Regular exercise has shown benefits in controlling weight, raising HDL cholesterol, reducing BP, and relieving stress. The American Heart Association recommends that adults engage in at least 30 minutes of moderate-intensity aerobic exercise with a heart rate of 120 bpm five days a week. Muscle-strengthening activities should also be incorporated on nonconsecutive days at least twice a week. Common exercises aligned with the Filipino culture can be incorporated to meet these recommended guidelines. Physical activities like dancing, team sports, and household chores are suitable for moving, stretching, and burning calories. For example, sweeping, mopping, cleaning furniture, washing the dishes, and doing the laundry can help strengthen bones, joints, and muscles. Even carrying grocery bags from the market is a form of resistance exercise (Rappler, 2021). Education on the necessity for physical activity and possible exercises should start in a child's primary school education and at home to help combat childhood and youth obesity which is rising in the Philippines.

**Stress Management:** Stress reduction is also important for cardiac health. Finding effective coping techniques and activities such as regular aerobic exercise, yoga, or meditation, can help an individual manage stress. Historically there has long been a stigma on mental health in the Philippines. Increased awareness of the importance of mental health can better encourage Filipinos to address their own mental health positively.

**Quit Smoking:** Quitting smoking has many positive benefits for heart health, even for patients who have already experienced CHD or a subsequent condition. Smoking encompasses cigarettes, tobacco chewing, e-cigarettes, or vaping. Smoking education, counseling, support groups, hotlines, and making a plan are some effective ways to guide smoking cessation. Nicotine replacement and prescriptions like varenicline (Chantix) and bupropion (Zyban), which can

reduce craving and withdrawal symptoms, are not highly prescribed in the Philippines and are not readily available. Counseling to stop smoking is also not a usual part of a doctor-patient encounter. However, in the Philippines, the promotion of governmental protocols against smoking, such as Executive Order 26 and the "sin tax law," or legislature that raises taxes on alcohol and tobacco products have helped reduce the incidence of bad habits after just a few years of implementation.

**Weight:** Losing weight and maintaining it at a healthy level is highly effective in lowering triglyceride levels, raising HDL cholesterol, lowering blood pressure, and preventing and treating Type 2 diabetes. Historically in the Philippines, being overweight is a sign of wealth and health. It is changing as more people are now aware of the benefits of limiting weight gain.

### **Diagnosis of CHD**

A careful history taken by a physician is essential. This information should include a risk assessment that evaluates medical history, family history of hypertension, stroke, heart attacks, diabetes, hyperlipidemia, and social history, including alcohol, smoking, recreational drug use, lifestyle, physical activity, and diet profile. The physician will then ask about symptoms such as fatigue, shortness of breath with exertion, chest pain, palpitations, and other cardiac symptoms like swelling of the legs, nausea, indigestion, etc. If appropriate, many diagnostic tools are at a physician's disposal, including blood tests for sugar, cholesterol, and kidney function, ECG and cardiac stress tests, and imaging tests.

## **Blood Tests**

**Blood Chemistry Test:** A blood chemistry test is a blood test that measures the amount of various types of chemicals in the blood. This test often checks electrolytes and can detect abnormalities contributing to some heart rate irregularities or arrhythmias. A specific type of blood chemistry test, a creatinine test, measures how well the kidney filters the blood. Creatinine tests are also important since kidney dysfunction is another risk factor for CHD.

**Complete Blood Count (CBC):** A complete blood count is a common blood test that measures the number of cells in the blood, including platelets, red blood cells, and white blood cells. CBC can detect a wide range of conditions and provide important health information. For example, CBC determines if one has anemia, which may contribute to fatigue and shortness of breath by decreasing the oxygen-carrying capacity of the blood.

**Cholesterol Test ("Lipid Profile"):** A cholesterol test, or lipid profile, is a blood test that measures the number of various types of fats in the blood. This test often checks for total cholesterol, high-density lipoprotein (HDL) "good" cholesterol, low-density lipoprotein (LDL) "bad" cholesterol, triglycerides, and other fat types. Cholesterol tests are important for assessing CHD risk since abnormal levels are one of the major risk factors for myocardial infarction globally.

**Thyroid Tests:** Thyroid blood tests measure the amount of thyroid hormones in the blood. These tests often check for hormones such as thyroid-stimulating hormones (TSH)

and thyroid hormones T3 and T4. Thyroid tests may help evaluate causes of palpitations and arrhythmias or CHD symptoms like fatigue or shortness of breath.

## **Stress Tests**

Close monitoring during stress tests is conducted since they carry a small risk of heart attack or cardiac arrest, especially in individuals with advanced CHD.

**Electrocardiogram (ECG):** An ECG records the electrical activity of the heart. It can be done while at rest or as part of a cardiac exercise stress test. It is a painless procedure where sensors called electrodes are placed on the arms, legs, and chest to record the electrical heart rhythm. It can help diagnose arrhythmias, irregularities of the heartbeats, heart attacks, or any signs of enlargement like hypertrophy or heart block. It is limited, as it is done at rest, so it may be difficult to evaluate coronary blood flow in an exercising state when the demand on the heart increases. Therefore, an ECG is also done during stress tests. In some stress tests where patients cannot exercise, medications or radioisotopes are administered to the patient to add to the diagnostic accuracy of the tests.

**Exercise Stress Test:** A standard exercise stress test requires a patient to walk on a treadmill or pedal a stationary bicycle while an ECG records electrical signals from the heart. This test can help detect CHD by determining if significant blockages affect blood flow in the coronary arteries during physical activity. Speed and incline are adjusted to at least 85% of the patient's maximum target heart rate, which can be calculated by subtracting their age from 220. Tests may be stopped when the maximum target heart rate is achieved, or if the patient experiences chest pain, fatigue, shortness of breath,

dizziness, or significantly irregular heartbeat. Accuracy can be improved if done alongside myocardial perfusion imaging or echocardiography before and immediately after exercise.

**Nuclear Medicine Stress Test:** If a standard stress test shows no apparent abnormalities despite symptoms suggesting CHD, a nuclear medicine imaging stress test can be additionally done to pinpoint which heart regions have compromised blood flow. The nuclear medicine stress test can add to the accuracy of the standard exercise stress test by up to 90% versus 75-80% for a stress test without imaging. It follows the same procedure as a standard stress test, but when a target heart rate is reached, a radioactive tracer (technetium) is injected into a vein in the arm. A special camera detects the radioactive tracer as it travels to the heart via the bloodstream. Areas of the heart that have narrowed arteries will have less radioactive material. The test can be repeated at rest on the same day, and if flow normalizes at rest, that suggests compromised blood flow to that segment of the heart with stress. Some clinicians will select an exercise echocardiogram to decrease exposure to radioactive substances.

**Pharmacologic Stress Test:** If a patient is unable to walk on a treadmill or pedal a bicycle (for reasons including musculoskeletal disability, neurodegenerative disorders like Parkinsons or Multiple Sclerosis, deconditioning, or being frail), a pharmacologic stress test can be done instead of the exercise stress tests. Dobutamine, a drug that can simulate the effects of physical exercise, is injected into a vein in the arm, and the electrical signals can be monitored while the patient remains seated or lying down. Some

nausea or shortness of breath may be experienced. Other drugs, such as regadenoson, a coronary vasodilator, are also useful for radionuclide myocardial perfusion imaging.

**Resting and Exercise Echocardiography:** Echocardiography is another mode of imaging that takes live images of the heart while the patient is at rest and during the peak of exercise. A transducer, a tool that reflects sound waves, is pressed against the chest and abdomen of a patient lying down on their left side. This data can indicate abnormal heart function, valvular abnormalities, heart defects, and fluid around the sac of the heart.

### **Anatomic Assessments of the Heart Arteries**

**Coronary Artery Calcium Scans (CAC):** Coronary artery calcium scan measures the quantity of calcium in the coronary arteries using a rapid CT imaging technique. Calcium is typically a component of calcified plaques, and calcium presence is abnormal in healthy arteries. In less than 10 minutes, a CT scan of a patient lying down is taken, and a computer generates the calcium score. Calcium in the coronary arteries will appear as white areas on the CT scan. Scores are calculated from 0 to thousands. CAC is the preferable method of detecting CHD in patients who do not have CHD symptoms but are at intermediate risk. People with a CAC score of <100 may not benefit from statins as much as those with at least 100. A study found that the higher the CAC scores, the higher the risk associated with sudden cardiac death.

**Coronary Angiography:** Coronary angiography takes images of the coronary arteries to detect blockages. A contrast substance is injected into a catheter placed into an artery.

The X-ray machine rapidly takes a series of images (angiograms), enabling the

cardiologist to see the blood flow of that artery. Blockages in the coronary arteries can then be identified. Coronary angiography is the preferred method for evaluating blockages in the coronary arteries in patients with symptoms. In men, this test specifically correlates well with symptoms. In women, results of the coronary angiogram may be misleading as women tend to have involvement in the smaller vessels. Coronary angiography is a preferred diagnostic (to diagnose) procedure to determine blockage because it can also be used as a therapeutic procedure to relieve the occlusion.

**Computed Tomography Angiography (CTA):** Computed tomography angiography is non-invasive angiography where 3-D images of the coronary arteries are taken. A contrast substance is injected into a peripheral vein to allow the CT machine to capture images of the blood flow through the coronary arteries. CTA is a method for detecting blockages in the coronary arteries. It may help eliminate the possibility of CHD in low or moderate-risk patients following inconclusive stress test results. CTA helps rule out heart attacks in the ER in patients with symptoms when an ECG and blood test results are inconclusive. American guidelines have recommended using CTA to exclude atherosclerotic plaque and obstructive CAD in patients complaining of chest pain with now known CHD. Disadvantages of CTA are exposure to radioactive substances and contrast dye (problematic in patients with kidney abnormalities) and the inability to treat the observed blockage. Treatment of such blockage can be done during coronary angiography which is advantageous for both diagnostic and therapeutic relief of the occlusion.

**Magnetic Resonance Imaging (MRI):** Magnetic resonance imaging takes detailed images of the heart using powerful magnets and radiofrequency waves. It can detect the size and thickness of the heart's chambers and determine heart function, heart damage, aneurysms, and blockage of coronary arteries. An advantage is the lack of exposure to radiation and contrast dye. A drawback is the inability to use this in patients with implanted pacemakers, defibrillators, and other metallic devices.

## **Treatment of CHD**

There are several types of treatment for CHD. Medications can work effectively however, the severity of the condition may require interventions, such as angioplasty (with or without stenting) or coronary artery bypass graft surgery. These interventions can result in long-lasting effects and better quality of life if healthier lifestyle changes are adopted as well. Treatment also involves managing coexisting diseases that may multiply the effect of CHD and consequential conditions of CHD, including angina pectoris, arrhythmias, heart failure, and myocardial infarction.

### **Medications**

There are four categories of medications to prevent and treat CHD. These include antiplatelet, anticoagulant, blood-pressure-lowering, and lipid-lowering medications. Lifestyle modification augments the effects of these medications.

**Antiplatelet Medications:** Antiplatelet drugs are prescribed to reduce the risk of blood clots. They work by preventing platelets, a blood component, from clumping together to form a blood clot that can rapidly result in a heart attack or stroke. Common antiplatelet

medications are aspirin and clopidogrel (Plavix). Aspirin rapidly reaches peak activity in 30-40 minutes and can be bought over-the-counter. Clopidogrel is more expensive but less likely to produce gastrointestinal symptoms and complications. There are also relatively newer antiplatelet medications like ticagrelor (Brilinta) and prasugrel (Effient), that are used in combination with other antiplatelet medication with drug-eluting stents. The use of two antiplatelet drugs can result in an increased risk of bleeding. These are commonly used after coronary stents.

**Anticoagulant Medications:** Anticoagulant medications also reduce the risk of blood clots by interfering with fibrin formation. The traditional anticoagulants are warfarin, unfractionated heparin, and low-molecular-weight heparin. More recently marketed anticoagulants, or direct-acting oral anticoagulants referred to as NOAC (novel oral anticoagulants) include dabigatran, rivaroxaban, apixaban and edoxaban. These drugs decrease the risk of stroke in patients with atrial fibrillation or are used in treating embolisms.

**Blood Pressure-Lowering Medications:** When a patient's blood pressure is 140/90 mmHg or higher, a physician will most likely prescribe medications to lower it in addition to lifestyle modification. Studies have found that lowering systolic blood pressure to around 120 mmHg systolic and 80 mmHg diastolic was associated with fewer heart attacks, strokes, and deaths compared to a systolic blood pressure of about 135 mmHg to 140 mmHg. There are several classes of blood pressure-lowering medications: diuretics, beta-blockers, renin-angiotensin-aldosterone-system blockers, namely angiotensin-converting enzyme (ACE) inhibitors, and angiotensin II receptor blockers

(ARBs), calcium channel blockers, and alpha-2 agonists like clonidine and alpha-methyldopa. The generic names for some classes of blood pressure medications end as follows: "-pril" like enalapril for ACE inhibitors, "-sartan" like losartan for ARBs, "-olol" like metoprolol for beta-blockers, and "-pine" like amlodipine for calcium channel blockers. Ace inhibitors and Angiotensin receptor blockers have kidney-protecting qualities and therefore are preferred in patients with hypertension and diabetes. Currently, endothelin receptor antagonists, which are vasodilators like Bosentan, Ambrisentan, and Macitentan, are emerging for the treatment of hypertension but are very expensive.

**Lipid-Lowering Medications:** Lipid-lowering medications reduce LDL cholesterol, the primary lipid-lowering medications are statin drugs. Statins work by blocking the action of an enzyme required for the liver to produce cholesterol. As a consequence of blocking this action, the liver makes less cholesterol and more LDL receptors, or receptors that remove LDL from the blood. Statins include: simvastatin (Zocor), atorvastatin (Lipitor), pravastatin (Pravachol), rosuvastatin (Crestor), fluvastatin (Lescol, Lescol XL), lovastatin (Altoprev), and pitavastatin (Livalo). In the Philippines, simvastatin, atorvastatin, and rosuvastatin are most commonly used. Aggressive therapy may be needed beyond statins when LDL is still above 70 mg/dL in high-risk patients or above 55 mg/dL in very high-risk patients. Such therapies are now available such as ezetimibe (Zetia) and the new, potent injectable Proprotein convertase subtilisin/kexin type 9 (PCSK9) inhibitors such as evolocumab (Repatha) and alirocumab (Praluent).

## **Revascularization Treatments**

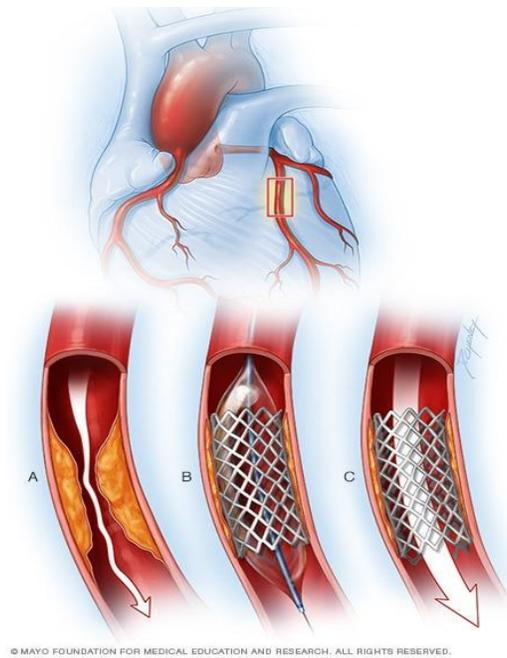
Revascularization of coronary arteries with blockages improves blood supply to the heart.

Revascularization is considered if medications do not control a patient's symptoms. It is also considered during a heart attack to salvage the myocardium. There are two approaches: percutaneous coronary intervention (PCI), done by interventional cardiologists, which includes balloon angioplasty with or without stenting, and surgical coronary artery bypass graft surgery, which is done by cardiovascular surgeons. Lifestyle changes and medications, which are used prior to these vascular intervention procedures are essential after these procedures as they do not prevent the progression of atherosclerosis.

**PCI - Balloon Angioplasty/Coronary stents:** Angioplasty opens a clogged coronary artery by widening the artery with a balloon on the tip of a catheter. The catheter is inserted through the femoral artery or the radial artery. An angioplasty is not done in an operating room but rather in a cardiac catheterization lab. The procedure can last between thirty minutes to two hours, depending on the anatomy. An angioplasty is typically combined with the insertion of a stent, which is a small, mesh-like tube. The stent is placed where the plaque obstruction is. Some stents keep the artery open by releasing a substance that will reduce or prevent injury reaction that produces re-stenosis or recurrent obstruction.

### Figure 3

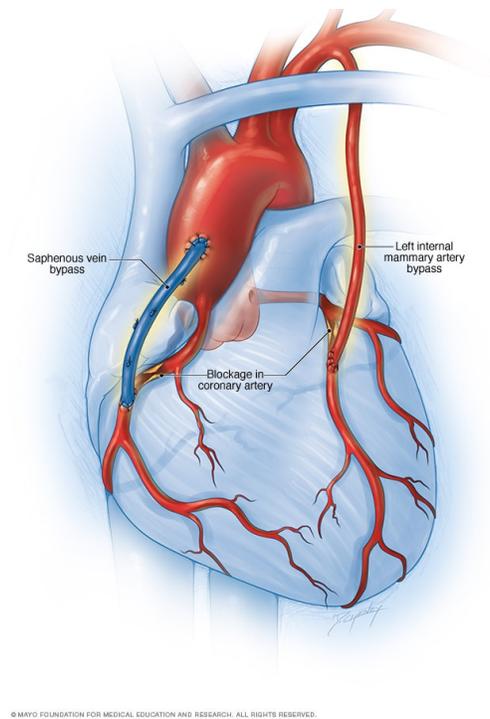
*Coronary artery stent (Johns Hopkins School of Medicine, n.d.)*



**Coronary Artery Bypass Graft Surgery:** A cardiologist may determine that coronary artery bypass graft surgery is better than PCI if the left main artery or multiple arteries have significant blockages. The surgery involves rerouting blood around a blocked coronary artery using a blood vessel harvested from elsewhere in the body. This blood vessel is usually a vein harvested from the legs or an artery, such as the internal mammary artery, from the chest. Arteries are preferred due to their durability, resulting in a higher percentage of patency after several years compared to vein grafts. Bypass surgery is more invasive than PCI, can take three to five hours in the operating room, require general anesthesia and heart-lung bypass, a more extended hospital stay, and several months of recovery.

## Figure 4

*Coronary artery bypass graft surgery (Johns Hopkins School of Medicine, n.d.)*



**Bypass Surgery versus Angioplasty:** Bypass surgery is considered the better option than PCI when there is significant narrowing of the left main coronary artery or narrowing of ostial or proximal segments of three or more vessels (diffuse coronary artery disease), often seen in patients with diabetes or severe atherosclerosis.

## Management of Consequences of CHD

**Angina:** Angina is chest pain or discomfort due to insufficient amount of blood being delivered to the heart. Its description may be different between people and gender.

Nitrates (Isosorbide, nitroglycerine), beta-blockers (Metoprolol, Atenolol), and calcium channel blockers (Diltiazem/Cardizem) are the three main types of drugs used to treat

angina. Newer medications include ranolazine. These medications decrease the heart's demand for oxygen and increase its blood supply, which can help relieve angina.

**Arrhythmias:** Arrhythmias are irregular or abnormal heartbeats, also known as "skipped beats or palpitations". Several groupings of antiarrhythmic drugs are used to treat arrhythmias. These medications can help alleviate symptoms that may have manifested from CHD or valvular heart disease, drug use (nicotine, stimulants, and other drug side effects), thyroid dysfunction, electrolyte imbalance, or stress. Such symptoms include palpitations, rapid or slow heartbeat, skipped beats, fatigue, syncope (loss of consciousness), dizziness, shortness of breath, or chest pains. Antiarrhythmic drugs include Class I drugs: flecainide and other less utilized medications such as quinidine, procainamide, lidocaine, and mexiletine, that work on the myocardial cell's sodium channels. Class II drugs: beta-blockers, including metoprolol and carvedilol, inhibit the sympathetic effect on the myocardial cells. Class III drugs: potassium channel blockers, including amiodarone, dronedarone, and sotalol. Class IV drugs: calcium channel blockers, including verapamil and diltiazem. Additional drugs include upstream target modulators like ARBs, ACE inhibitors, endothelin antagonists, Omega 3 fatty acids, and statins. Non-pharmacologic treatments are pacemakers, ICDs (implantable cardiac defibrillators), or biventricular pacing devices. Treatment is typically guided by a cardiologist or cardiac electrophysiologist and depends on symptoms and the presence or absence of heart disease.

**Heart Failure:** Heart failure is the inability of the heart to pump sufficient amounts of blood for the body's needs. It may be caused by CHD or other structural diseases of the

heart like valvular dysfunction, hypertrophy, infection like viral myocarditis or cardiomyopathy, or drug toxicity. Symptoms are usually brought on by exertion, stress, dietary indiscretion, or anxiety and are relieved by rest and pharmacologic intervention. Several types of drugs are used to treat heart failure. These medications can help alleviate symptoms such as shortness of breath, fatigue, decreased energy, cough, edema or swelling, and wheezing. The medications can also reduce hospitalization and mortality. Diuretics like furosemide (Lasix) decrease blood volume overload and relieves congestion, ACE inhibitors like enalapril and captopril, ARBs (angiotensin receptor blockers) like losartan, candesartan, valsartan, telmisartan, and combined angiotensin receptor blocker valsartan and neprilysin receptor inhibitor sacubitril (ARNI), reduce symptoms, hospitalization for heart failure, and mortality. Beta-blockers such as metoprolol, carvedilol, bisoprolol, and nebivolol help the heart beat more slowly and less forcefully by decreasing sympathetic stimulation. Slowing heart rate will allow more filling of the ventricles. The new sodium-glucose Cotransporter-2 SGLT2 inhibitors (dapagliflozin and empagliflozin) are diabetes medications found to reduce mortality, cardiovascular events like heart failure, and kidney failure in patients with or without diabetes. Vasodilators, such as hydralazine in combination with nitrates, may also treat heart failure, especially in African Americans. Besides pharmacologic management, other treatments include implantable cardioverter-defibrillators (to prevent sudden cardiac death) and cardiac resynchronization therapy in patients with conduction abnormalities, especially left bundle branch block, which can improve the left ventricular ejection fraction.

## **Coronary Heart Disease Initiatives in the Philippines**

Since 1973, February has been celebrated as Heart Month in the Philippines (TANGGAPAN NG PANGULO NG PILIPINAS, 1973). During this month, the Department of Health (DOH) and the Philippine Heart Association (PHA) implement various events across the country to promote cardiovascular health and CHD awareness. The DOH campaigns with the slogan “*Mahalin mo ang Pusong nagmamahal*” (Love the Heart that loves). This slogan aims to encourage people to implement healthier lifestyle habits such as eating right, managing stress, avoiding alcohol, maintaining a healthy weight, and quitting smoking. To educate on the goals of their Heart Month slogan, specific initiatives hosted by the PHA and DOH include walkathons and other public activities. These events also typically offer screening services such as ECG, blood pressure, heart rate, and BMI monitoring so that individuals can better understand their heart health. Additionally, in 2013, the DoH launched the Pilipinas Go4Health campaign (Randa, 2013). This project focused on four cornerstones: Go Smoke-Free, Go Slow *sa Tagay* (moderate alcohol consumption), Go *Sustansya* (eat a nutritious and proper diet), and Go *Sigla* (exercise more). The keyword "Go" repetition emphasized the importance of leading an active lifestyle. Similarly, initiatives by the PHA include hosting an annual Heart Fair. Traditional Heart Fair activities include Zumba dancing, lectures on healthier living, CPR demonstrations, and interactive booths (Philippine Heart Association, 2015).

## Figure 5

*Department of Health Heart Month (Philippines Department of Health, 2018)*



Local hospitals also host events during Heart Month. In February 2020, Green City Medical Center in San Fernando held its Heart Month celebration. Like the DOH and PHA events, they focused on raising awareness of heart disease through health screenings and lectures (GreenCity Medical Center, 2020). Also, in 2020, the Maria Reyna Xavier University Hospital in Cagayan de Oro celebrated Heart Month using the slogan "One Heart, One Nation, One Music." The hospital offered 30% discounts on ECGs and had free lectures hosted by cardiology professionals on various cardiac health topics (Maria Reyna-Xavier University Hospital, 2020).

Apart from the annual Heart Month celebrations, the Philippines actively works to address and improve the cardiovascular health of its citizens. The Philippines is a part of the WHO HEARTS project that aims to help countries improve CVD management through primary health care (NCD Management Screening, Diagnosis and Treatment, 2018b). The HEARTS project guides health authorities in the prevention, detection, and treatment of CVDs, identifying problems and addressing barriers to care. For example, the project highlighted the irregular availability of NCD medicine, particularly for CVDs, and inaccessible health supplies. It also underscored the limited

capacity of health workers to counsel patients and families on healthy life choices and how to recover from a heart attack (World Health Organization, 2017).

### **ABC's for Global Health**

ABC's for Global Health, a nonprofit organization, has several initiatives to educate and bring awareness about CHD and its risk factors, prevention, and subsequent complications. For example, ABC's for Global Health has conducted several studies on CHD and related conditions. Most recently, projects include "The Effectiveness of Lifestyle with Diet and Physical Activity Education Program Among Pre Hypertensives and Stage 1 Hypertensives in an Urban Community Setting (ENLIGHTEN) Study", which studied the efficacy of a monthly heart health educational program. This program included materials on maintaining a healthy diet and adequate physical activity to lower blood pressure. For six months, a control group and intervention group were studied. The intervention group participated in the monthly educational program. After six months, systolic blood pressure was significantly lower in the intervention group than in the control group. Moving forward, similar educational programs could provide low-cost, sustainable heart health intervention.

Additionally, the "Philippine Chronic Disease Prevention Project" is an ongoing project studying chronic disease prevention methods. Because pharmacological treatments are generally expensive and inaccessible, practices for a healthy diet and regular exercise are promoted in this study to specifically improve hypertension, a common risk factor for CHD. For a period of six months, a group will be educated on hypertension, a healthy diet, and physical activity to learn how these factors are related to improving chronic disease conditions. In the future, focusing on

the sustainability of such programs may provide improved health outcomes for those with hypertension and even diabetes.

Presentations of similar projects by ABC's for Global Health include "If We Build It, Will They Come? Deploying a Medical Mobile Clinic In The Philippines" at the 2015 Consortium of Universities for Global Health (CUGH) convention in San Francisco (Figure 6). This project detailed the deployment of mobile medical clinics in some of the Philippines' poorest and most underserved communities. A sequel to this project, "We Built It And They Came" was presented at the 2021 CUGH convention in Washington DC (Figure 7). This project described the successful launch of mobile medical clinics in eighteen underserved communities in the Philippines.

**Figure 6**

*If We Build It, Will They Come?*

**IF WE BUILD IT, WILL THEY COME? DEPLOYING A MEDICAL MOBILE CLINIC IN THE PHILIPPINES**  
 Dr. Julieta Gabiola<sup>1</sup>, Nathalie Chan<sup>2</sup>, Adrian Maglaqui<sup>3</sup>, Jessy Rojina<sup>4</sup>, Jade Verdeflor<sup>4</sup>  
<sup>1</sup>Stanford School of Medicine, <sup>2</sup>California State University, East Bay, <sup>3</sup>University of California, Berkeley, <sup>4</sup>Stanford University

**BACKGROUND/NEED**  
 According to the World Health Organization (WHO) and the Institute of Medicine (IOM), chronic diseases such as diabetes and hypertension are the leading cause of death in both developed and developing countries. In the Philippines, the 2008 National Nutrition and Health Survey II (NNHHS) found that 1 in every 4 Filipinos are hypertensive. This finding was confirmed in several medical missions conducted by ABC's for Global Health, a nonprofit organization that aims to address health challenges using culturally sensitive approaches. The organization found that 20-25% of patients seen had hypertension and 8-10% had diabetes.

While successful in the surgical realm, medical mission approaches in treating chronic diseases are not "band-aid" solutions. To address the large burden of chronic diseases in the Philippines, ABC's for Global Health, in conjunction with community partners, is leading a sustainable medical intervention to address non-communicable chronic diseases prevention, inequity in health care access, and will also enhance community health education and research in the hope of changing public policies.

**PROJECT OBJECTIVE**  
 In an effort to mitigate the Philippines' most preventable diseases, a medical mobile clinic (MMC) will drive to the heart of the some of the poorest communities and provide continuous, cost-effective care with an emphasis on collaboration, prevention, and health education.

**COMMUNITY PARTNERS**

- ABC's for Global Health, a nonprofit organization that aims to address health challenges using culturally sensitive approaches.
- Archdiocese of San Fernando
- San Francisco Premier Lions' Club/Actus Group
- Provincial government of Pampanga
- Restoring Vision
- GHIF-Global Health Research Foundation
- Philips Foundation Academic Institutions: Stanford University, Far Eastern University, Assumption University, Manila Doctors Hospital, Holy Angel University, Angeles University

**METHODOLOGY**

- The MMC will operate 20 days out of the month and offer services to a village for one day each month (20 days to 20 villages).
- The proposed bus will have its presence in 20 villages, poised to serve about 40,000 people in Pampanga, Luzon, year-round for the life of the bus, which can be anywhere from 10-15 years.
- Each MMC will have a coordinator from both the United States and the Philippines, as well as a team consisting of a physician, nurse, driver, added volunteers and trainees locally and from the United States.
- Community members will be recruited by the local government as health workers.
- Local community members' involvement will contribute to the sustainability of the clinic.
- Patient information, laboratory results, and biometrics will be collected and uploaded into the Stanford School of Medicine REDCap database as in an open EMR system.
- Data collection and analysis will be conducted for research with the hope of improving public health outcome.

**COST ANALYSIS**

	MMC	Medical Mission
Cost:	\$150,000	\$190,000
What it Covers:	Cost to construct the bus, personnel, medicine & supplies	75 volunteers, medicines and supplies
Length of Operation:	15 years	1 week
Serves:	40,000 patients in 20 villages	3,000 patients in one location

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**Proportional mortality (% of total deaths, all ages, both sexes)**

Category	Percentage
Cardiovascular	28%
Diabetes	10%
Other NCDs	12%
Injuries	10%
Communicable, maternal, neonatal, and nutritional	10%
Chronic respiratory	8%

Total deaths: 571,000  
 NCDs are estimated to account for 67% of total deaths.

*"Impact of Chronic Diseases in the Philippines" World Health Organization (2015)*

**Medical missions and limited treatment options**

**MMC will emphasize preventing the complication of chronic diseases such as amputations due to diabetes**

Figure 7

We Built It And They Came

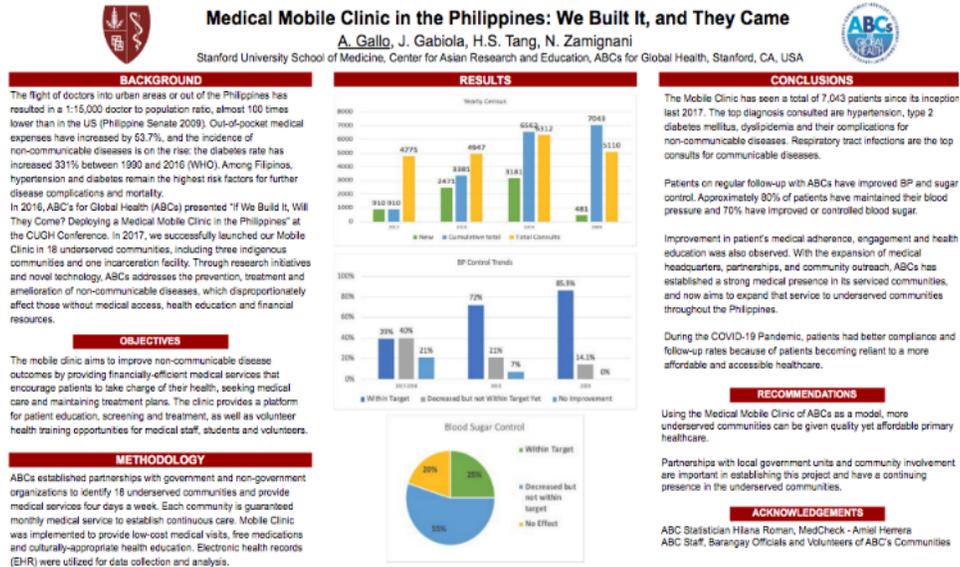
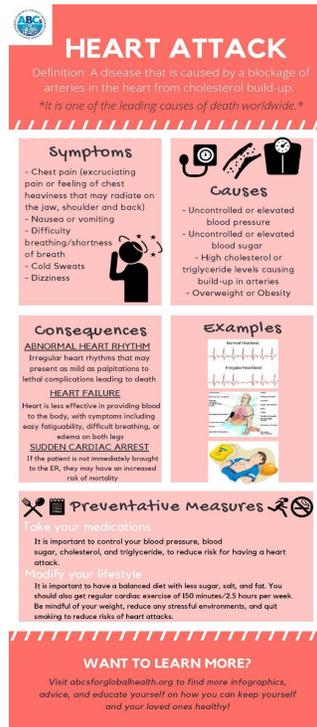


Figure 8

ABC's for Global Health Brochures and Infographics



In 2017, ABC's for Global Health worked on "doctorgram," a telemedicine pilot project by Stanford Med Scholars that can extend care to people with limited access to care. This project became instrumental during the COVID-19 pandemic, where telemedicine was the only available healthcare resource for many people. DoctorGram is a digital app that can collect patient health data and connect patients virtually with health care providers (Figure 9). This program was piloted in 2017 by Stanford medical student Steve Ko to serve the indigenous populations. Currently, ABC's for Global Health has four communities using telemedicine and also partners with several medical schools for implementation. The vision is to expand the use of this technology to reach out to more communities.

**Figure 9**

*ABC's for Global Health DoctorGram*



## **Conclusion**

Coronary heart disease is the leading cause of death in the Philippines and globally. This white paper aims to increase awareness of the causes, manifestations, risk factors, diagnosis and prevention of CHD to improve outcomes through treatment and lifestyle modifications. Through collaboration, education, and advocacy, we will decrease CHD's prevalence and its contributing risk factors.

This white paper has resources for any reader, though specifically intended for patients with CHD, treating physicians, and involved community partners. We hope that for patients with CHD, this paper can serve as a general informational guide for personal use and to be shared with their providers. Treating physicians then may use this paper as a guiding resource to provide care. Furthermore, community partners in any capacity, including but not limited to healthcare providers, government officials, public health workers, and educators may utilize this paper to raise awareness and even implement community-wide initiatives to decrease CHD. We intend to update this paper regularly so that all readers may be updated.

Though our paper is a meaningful step in the right direction, we aim to emphasize that advocacy for CHD awareness goes beyond temporary efforts. It will take persistent measures for the most powerful impact, and sustained endeavors should be spotlighted. Through such universal collaboration, we hope to improve people's quality of life and help mitigate CHD worldwide.

***“Mahalin mo ang Pusong nagmamahal”***

Philippines Department of Health

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