A little bit about myself...

Daniel Han
UC Berkeley Graduate
Public Health, MCB - CDB II,
Molecular Toxicology Minor
What is Cardiology?
Cardiology

The study of the heart and its functions in health and disease.
Why is Cardiology important?
According to the CDC (2017),...

- More than 647,000 people in the U.S. die from heart-related diseases (1 in 4 deaths)
- #1 cause of death in the U.S. AND globally for both men and women and people of different races
- About 805,000 Americans suffer a heart attack annually
Possible Risk Factors of Cardiac Disease

- Diabetes
- Overweight and Obese
- Poor diet
- Physical inactivity
- Excessive alcohol use
- Pregnancy
- Genetics
Fun Facts About the Heart
Did you know that . . .

1. Heart rate drops while you sleep
2. Heart attack symptoms are different in men and women
3. Number of heart attacks peaks on Christmas, followed by 12/26 and New Year’s
4. A normal heart valve is about the size of a half dollar
5. Heart cancer is very rare, because heart cells stop dividing early in life

If you are interested, you can find more facts in this link

https://www.youtube.com/watch?v=yMorctYmNUs
Cardiac Tumor Extraction
Heart rates differ by age group

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newborn</td>
<td>70</td>
<td>190</td>
</tr>
<tr>
<td>Infants</td>
<td>80</td>
<td>160</td>
</tr>
<tr>
<td>1 - 4 years old</td>
<td>80</td>
<td>120</td>
</tr>
<tr>
<td>5 - 9 years old</td>
<td>75</td>
<td>110</td>
</tr>
<tr>
<td>10+ years old</td>
<td>60</td>
<td>100</td>
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<tr>
<td>athletes</td>
<td>40</td>
<td>60</td>
</tr>
</tbody>
</table>
What actually is the heart?
3 Types of Muscle Tissue

- **Skeletal**: Can be attached to bone
- **Smooth**: Can line esophagus
- **Cardiac**: In heart
Smooth muscle
- has spindle-shaped, nonstriated uninucleated fibers.
- occurs in walls of internal organs.
- is involuntary.

Cardiac muscle
- has striated, branched, uninucleated fibers.
- occurs in walls of heart.
- is involuntary.

Skeletal muscle
- has striated, tubular, multinucleated fibers.
- is usually attached to skeleton.
- is voluntary.
Coronary artery with branch into myocardium

Pericardium (sac around heart)

Heart muscle (ventricular wall)

- Endocardium (inner lining)
- Myocardium (heart muscle)
- Epicardium (outer surface)
Muscle Bundles of the Myocardium

- Cardiac muscle fibers swirl diagonally around the heart in interlacing bundles

*Tortora & Grabowski 9/e ©2000 JWS*
Anatomy of the Heart
The heart is located underneath your sternum, where your ribs connect slightly left of the center of your chest.
Pericardium

Inside the Pericardium which has a fibrous and membranous layer containing the heart.

It helps secure the heart, protect against infection, and contains fluid alleviate friction.

Pericardial Effusion
Pericardial Effusion

The heart is shaped like a water bottle or flask in x-rays.

Chest x-ray of person with normal heart
Chest x-ray of person with pericardial effusion
**Atriums, Ventricles, and Valves**

- **Atriums** the chambers on the top that collect blood from the body
  - They are generally *smaller* and have *thinner* walls

- **Ventricles** are the thicker, longer chambers of the heart that work to pump the blood out of the heart.
  - They are *larger*, and have *thicker* dense tissue needed to pump the blood throughout the body.

- **Tricuspid** (right atrioventricular) valve
  - Facilitates blood flow from *right* atrium to *right* ventricle

- **Bicuspid** (Mitral/left atrioventricular) valve
  - Facilitates blood flow from *left* atrium to *left* ventricle

- The **septum** is the tissue that separates the left and right side of the heart and consists of dense muscle tissue used in contractions.
Pathway of Cardiac Circulation

- Superior Vena Cava
  - From Upper Body
- Pulmonary Artery
  - To Right Lung
- Pulmonary Veins
  - From Right Lung
- Pulmonary Artery
  - To Left Lung
- Pulmonary Veins
  - From Left Lung
- Tricuspid Valve
- Right Atrium
- Right Ventricle
- Pulmonic Valve
- Mitral Valve
- Left Atrium
- Left Ventricle
- Aortic Valve
- Inferior Vena Cava
  - From Lower Body
- Aorta
  - To Lower Body
How does the heart beat?

The heart has two nodes:

- Sinoatrial (sinus) node
- Atrioventricular (AV) node

These two nodes work together to regulate and act as the pacemaker of the heart by sending regulated electric signals throughout the heart.
Sudden Cardiac Attack (SCA)

Anthony van Loo

Miklos Feher
Innervations of the Heart
Branches of the Autonomic Nervous System

Parasympathetic

- Involved with maintaining homeostasis and responsible for the body’s “at rest and digest” activity
- Relaxes the body and slows down many high energy functions

Sympathetic

- Controls the body’s responses to a perceived threat and is also responsible for the “fight or flight” response
- Prepares the body for intense physical activity
“Fight or Flight” Response

MEN’S 200M – HIGHLIGHTS
Introduction to SARS-CoV-2

What exactly is SARS-CoV-2?
What are coronaviruses?

- Single stranded (+)-sense RNA viruses
  - This means that their genome can be translated immediately by host ribosomes
- Characteristics spikes
- Large genome - 27-32kB
What is SARS-CoV-2?

- SARS-CoV-2 is betacoronavirus out of 4 different genus in the family of Coronaviridae
  - Alpha and Beta infects mammals
  - Gamma and Delta mainly infects birds
- Alpha-CoV is responsible for the common cold in humans
- Beta-CoV includes SARS-CoV and MERS-CoV which results in severe lung complications and other symptoms.

Zhou et al. (2020) Nature
ACE2 is expressed in lung epithelia, heart, blood vessels, GI epithelial linings, Liver, kidney, etc.
RAAS System

Renin-angiotensin system

- **Drop in blood pressure**
- **Drop in fluid volume**

- Renin release from kidney
- Angiotensinogen
- Angiotensin II also acts directly on blood vessels, stimulating vasoconstriction (narrowing).

- Renin acts on angiotensinogen to form **angiotensin I**.

- ACE (angiotensin-converting enzyme) release from lungs
- ACE acts on angiotensin I to form **angiotensin II**.

- Angiotensin II acts on the adrenal gland to stimulate release of **aldosterone**.

- Aldosterone acts on the kidneys to stimulate reabsorption of salt (NaCl) and water (H₂O).

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Risk Factors for SARS-CoV-2

1. Age
   a. Increased death rate and hospitalization rate in ages >65

CDC (2020) MMWR.

Verity et al. (2020) Lancet Infect Dis.
2. People with:
- Chronic Lung Disease and severe asthma
- Obesity
- Immunocompromised state
- Cardiovascular disease
- Diabetes
- Chronic kidney disease
- Liver disease

Richardson et al. (2020) JAMA
3. Smoking
   - Strong association between smoking and SARS-CoV-2 severity.
   - OR: 2.25 in progression of SARS-CoV-2

Patanavanich et al. (2020) Nicotine & Tobacco Research
Symptoms of SARS-CoV-2

- Cough
- Shortness of breath or difficulty breathing
- At least two of these symptoms:
  - Fever
  - Chills
  - Repeated shaking with chills
  - Muscle Pain
  - Headache
  - Sore Throat
  - New loss of taste or smell
Cardiovascular effects of SARS-CoV-2

- Elevated serum level of high-sensitivity cardiac troponin I greater than reference range (>28 pg/mL)
- High D-dimer level
- Higher incidence of myocarditis, myocardial infarction, and stroke
- Presence of thrombocytopenia
- Higher levels of troponin, myoglobin, C-reactive protein, serum ferritin, and interleukin-6.

Ruan et al. (2020) Intensive Care Med.
Why does this happen?

Two Major Reasons:
- Viral Entry in the myocardium
- Inflammatory stress that cause damage to the heart

Questions to consider:
1. What is the role of Angiotensin and RAAS system?
2. How does the immune system behave during infection?
Cardiac Injury and ACE2

Viral entry, replication, and ACE2 down-regulation

Vogiliansky et al. (2020) NEJM
Cardiology is keep changing and it is our job to keep up with it...
THANK YOU!!!