SUMMER TRAINING REPORT UNDER THE GUIDANCE OF DR. NEETU PUROHIT

BY –

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1038, SECTION C

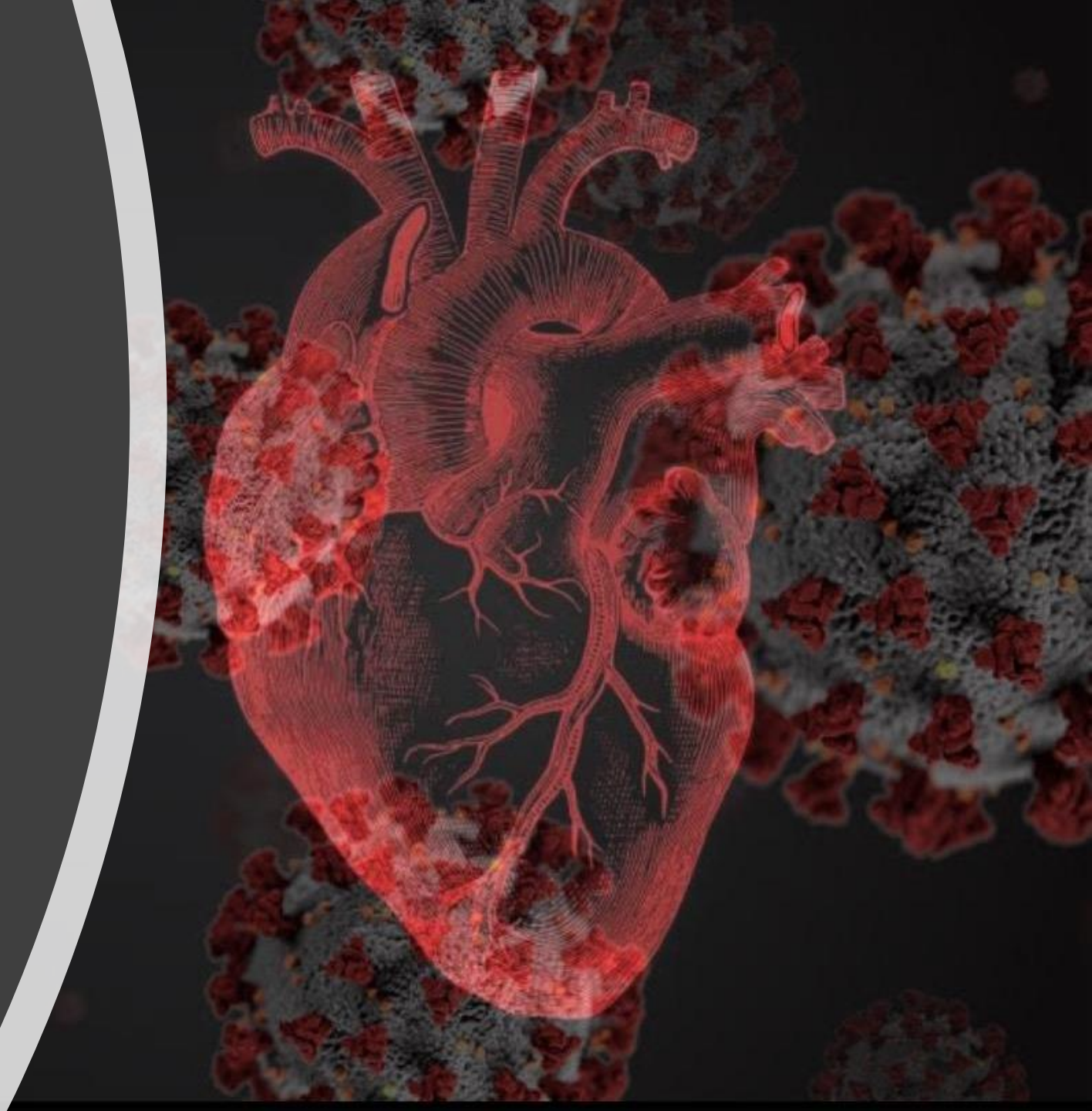
MBAHM-24

IIHMR UNIVERSITY

PART 1 – RESEARCH PAPER

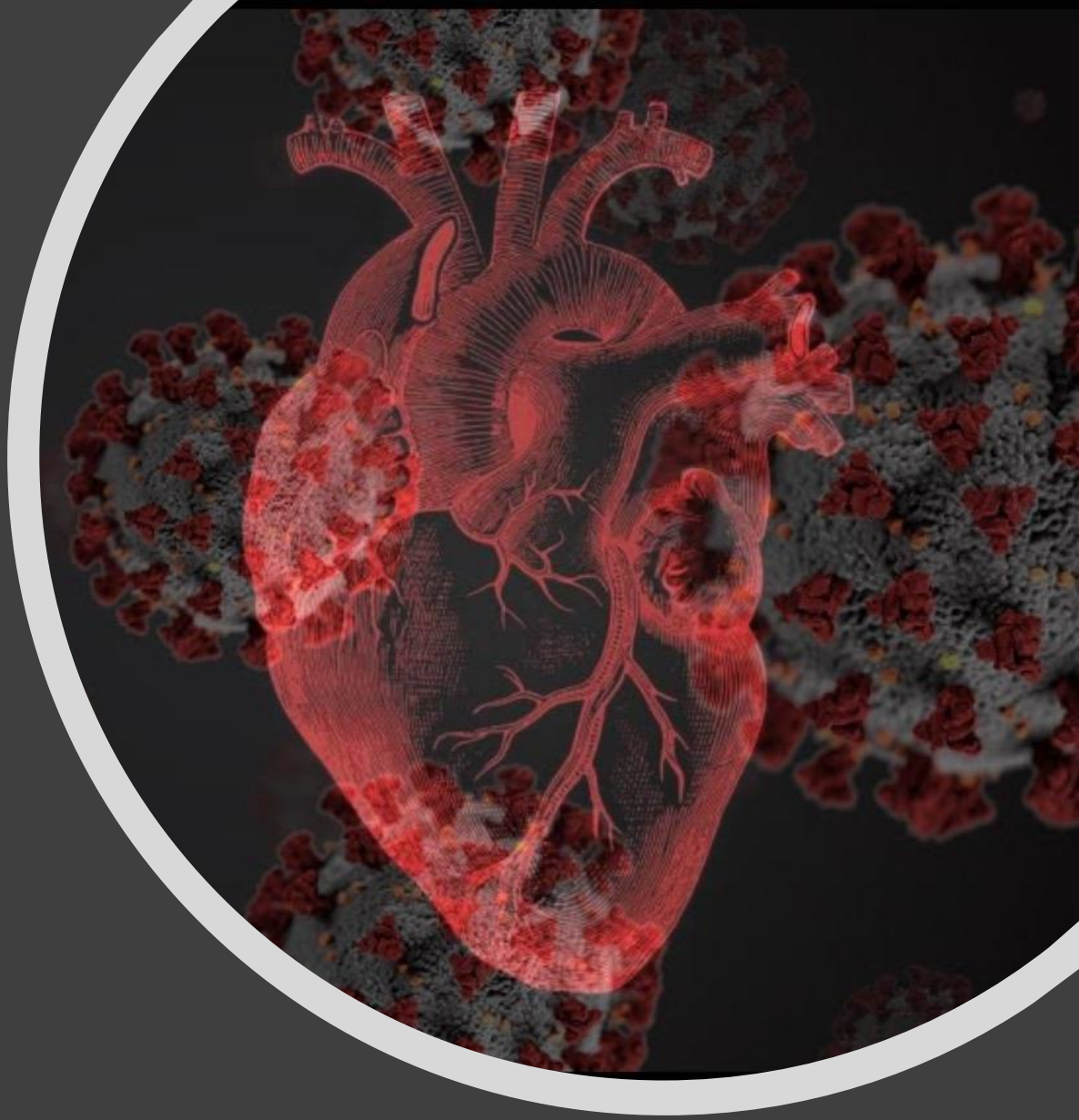
CARDIOVASCULAR SYSTEM INVOLVEMENT IN COVID-19 PATIENTS: A REVIEW

- Introduction
- Rationale
- Research Question
- Objective
- Methodology
- Discussion
- Recommendations and Conclusion
- References

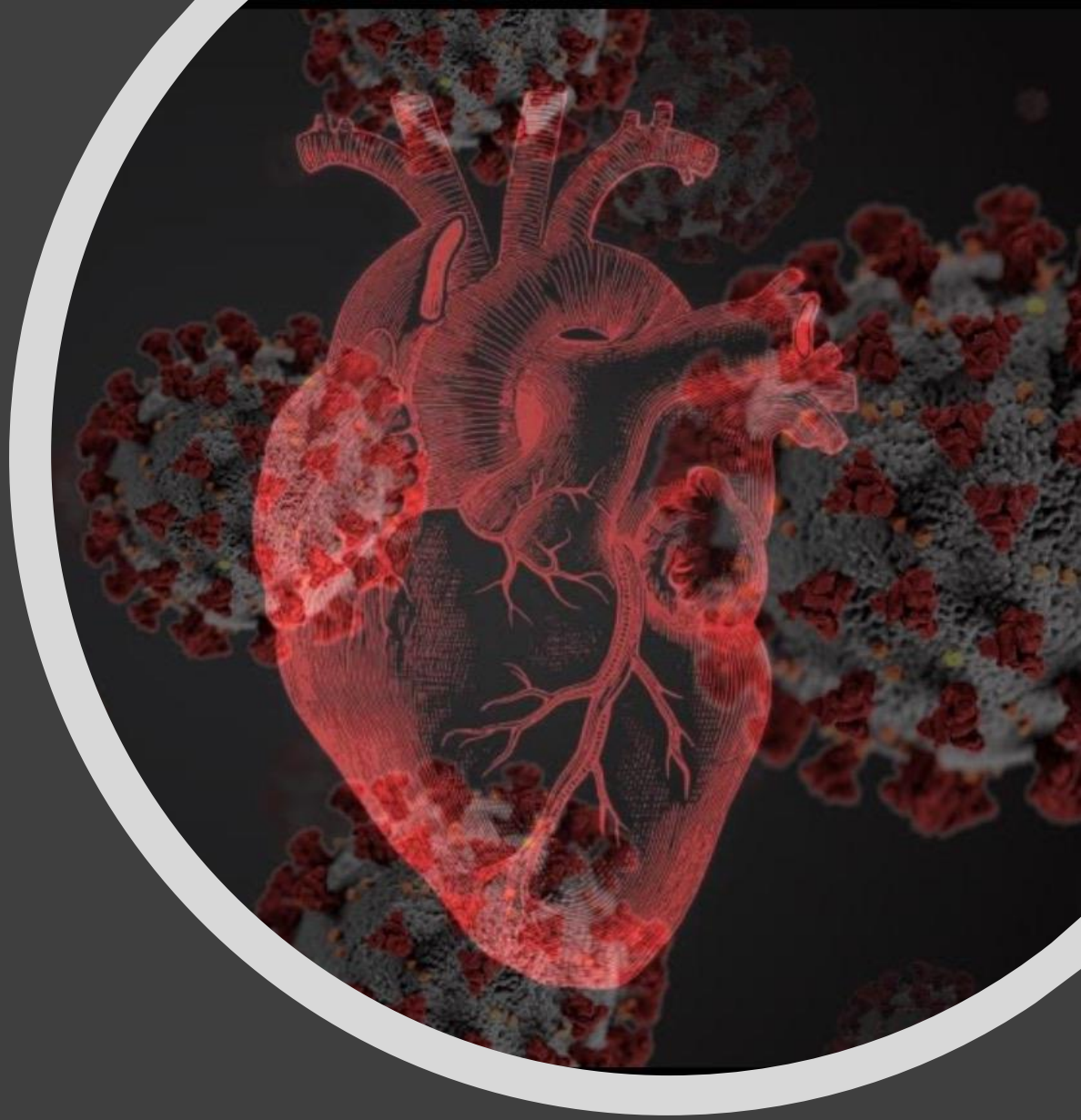


INTRODUCTION

- The world has been brought to a stand-still by the COVID-19 pandemic that has affected 216 countries, areas, and territories. There have been 4,801,202 confirmed cases and 318,935 deaths globally as of 20th May,2020 since the origin of coronavirus pandemic.
- U.S.A, Brazil, Russia, Peru, Chile, Spain, Mexico, China and U.K. are the most severely affected countries in the world.
- Coronavirus disease belongs to a wide family of viruses, such as ‘Severe acute respiratory syndrome’ (SARS) and ‘Middle East respiratory syndrome’ (MERS) causing less serious common cold to more serious diseases .

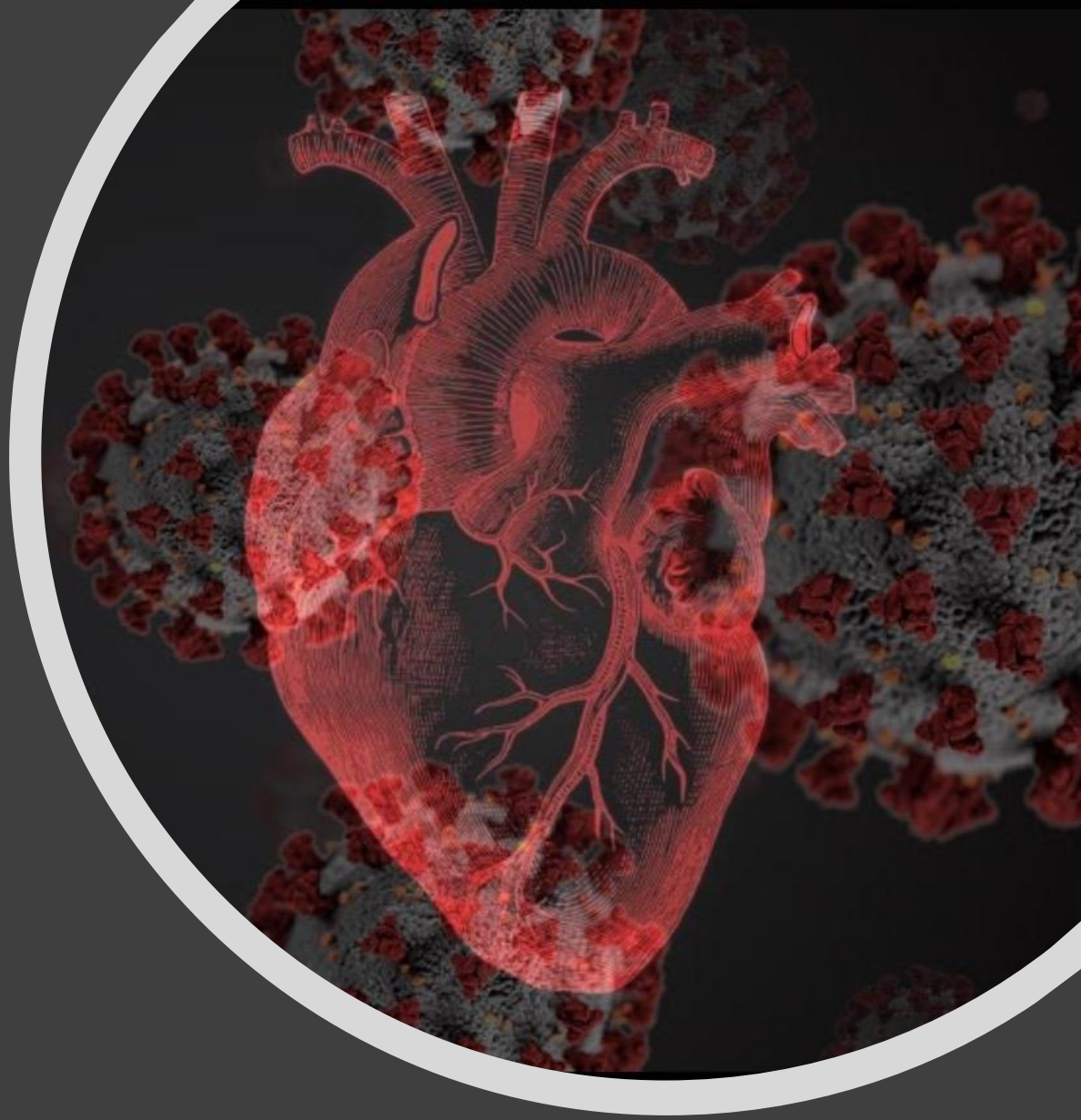


- Although the hallmark of COVID 19 is respiratory symptoms but this novel coronavirus attacks the human body more than any other virus in different ways, especially among those with chronic diseases.
- Individuals at any age can get COVID-19 although certain people are at elevated risk of serious symptoms. It is most likely to be fatal in patients who suffer from heart failure, because they tend to be more susceptible to the infection being severely ill. More current research shows that older adults and individuals with underlying health problems which includes CVD, are at increased risk from COVID-19-related morbidity as well as mortality than the general population.
- The immune system of healthy individuals might develop antibodies to fight off with infections caused by virus. However, in patients with heart diseases, the functioning of vital organs and immune system's responses are compromised making them more vulnerable to COVID 19 infection.



RATIONALE

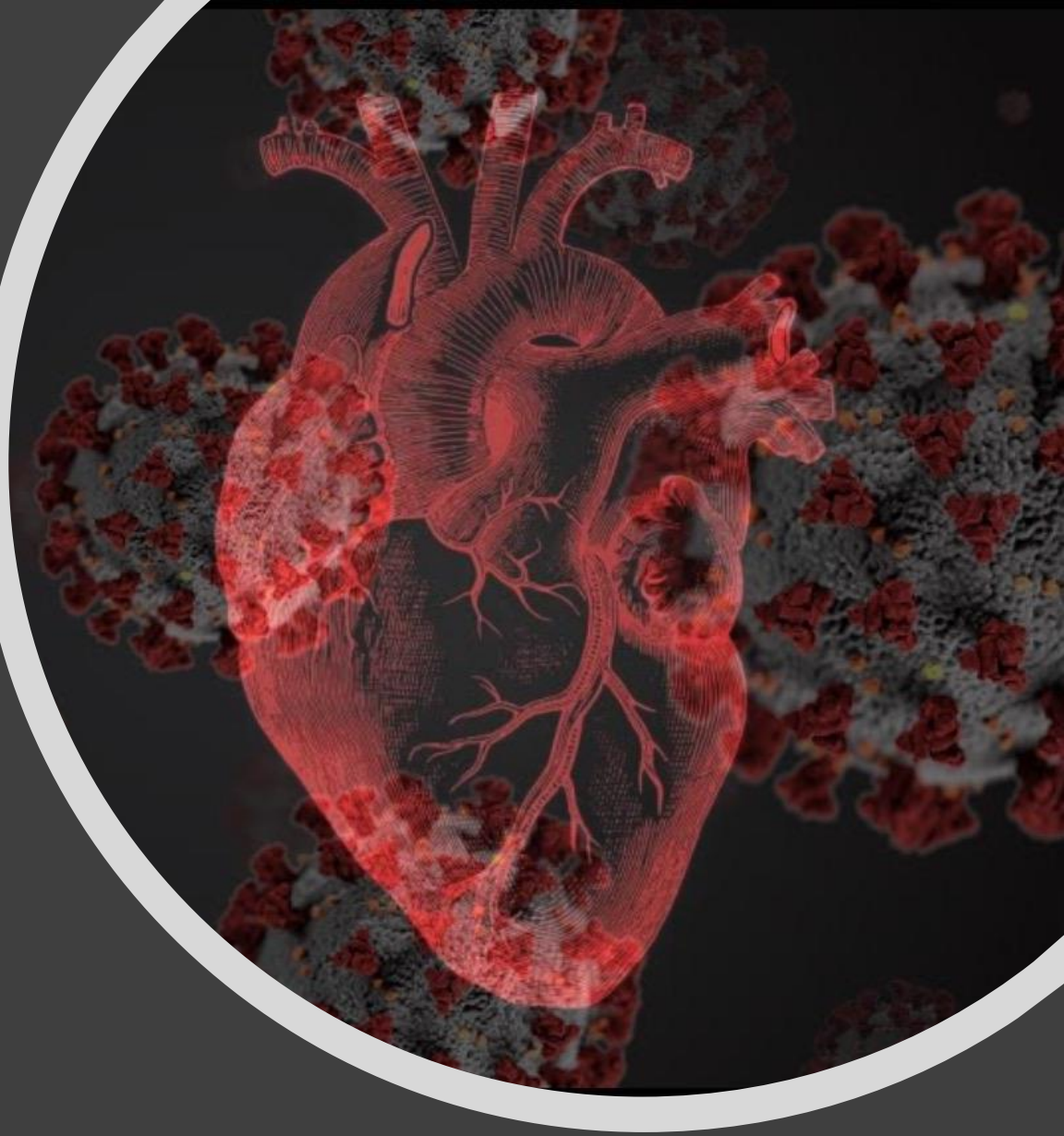
- This study is important as an extremely large and increasing number of patients have been diagnosed with COVID-19, therefore identification of prognostic factors associated with morbidity and mortality are crucial to save the world globally.
- While COVID-19's clinical manifestations are predominated by respiratory symptoms, some patients suffer from significant cardiovascular injury. In addition, some patients with underlying cardiovascular diseases (CVDs) may have an increased risk of death. The cardiovascular system is affected, with complications including myocardial injury, myocarditis, acute myocardial infarction, heart failure, dysrhythmias, and venous thromboembolic events.
- Therefore understanding the damage caused by COVID-19 to the cardiovascular system and the basic pathways are of the highest significance, such that the treatment of these patients can be done timely and effectively to reduce the mortality worldwide.
- And thus the recent pandemic COVID-19 underlines the need for greater awareness of the immediate and long-term cardiovascular effects of virus infection to reduce mortality rate and also to eliminate the gap in existing pool of literature that future research will need to address.



RESEARCH QUESTION

a) What is the prevalence and significance of cardiac injury in patients with COVID-19?

a) What are the risk factors and complications associated with cardiovascular system in COVID-19 patients ?



OBJECTIVES

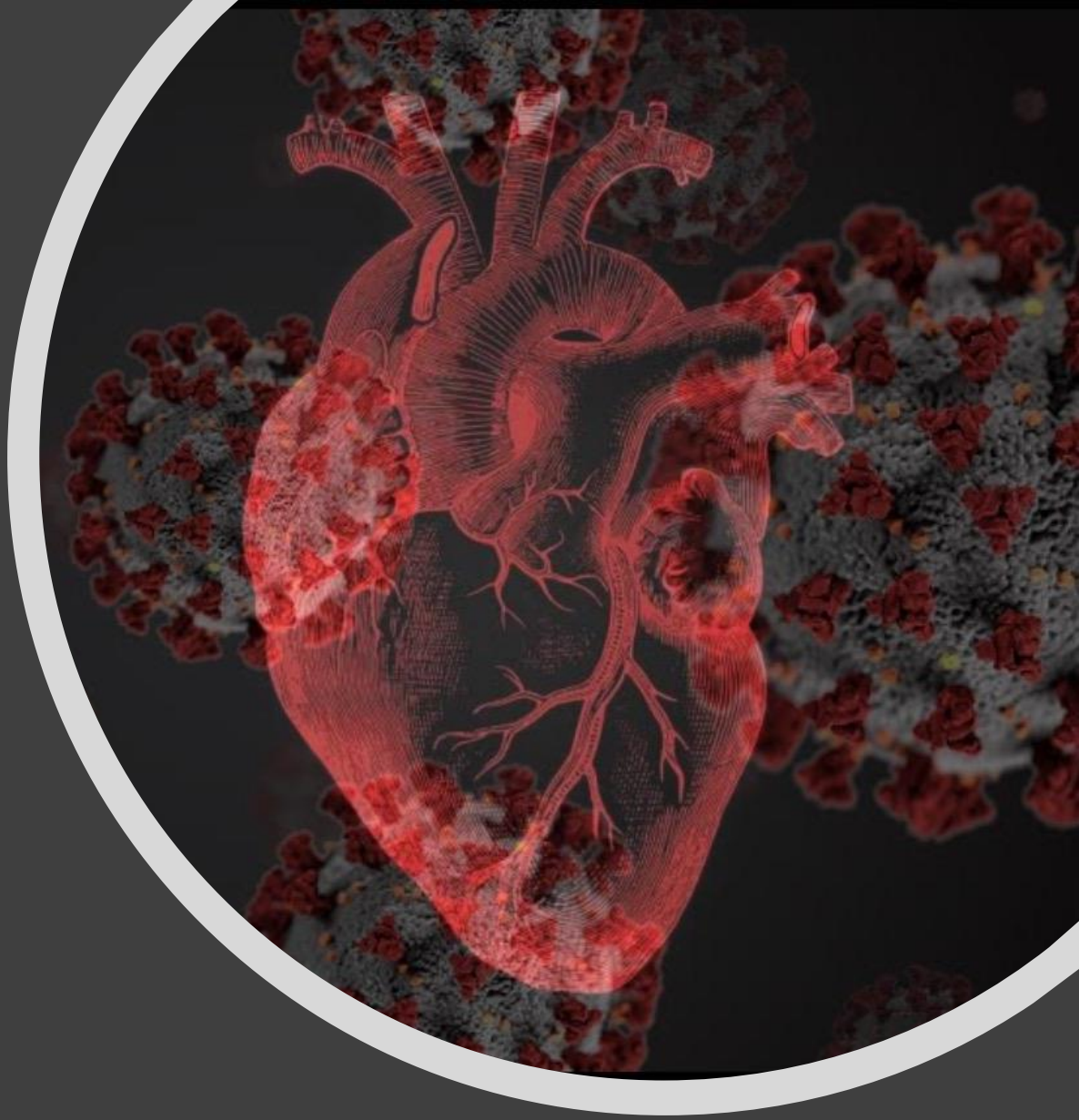
- **BROAD OBJECTIVE** - The paper objective is to review the literature and describe cardiovascular risk factors and its complications during and after COVID-19 infection, its potential implications for diagnosis and treatment options in patients and key implications for patients, health workers, researchers and physicians which will help them to acknowledge and address these issues and to have better understanding of current pandemic COVID-19 which is affecting health globally.
- **SPECIFIC OBJECTIVES** –

a) To find out the Prevalence of CVD in Patients With COVID-19.

b) To determine the risk factors and complications associated with cardiovascular system in COVID-19 patients.

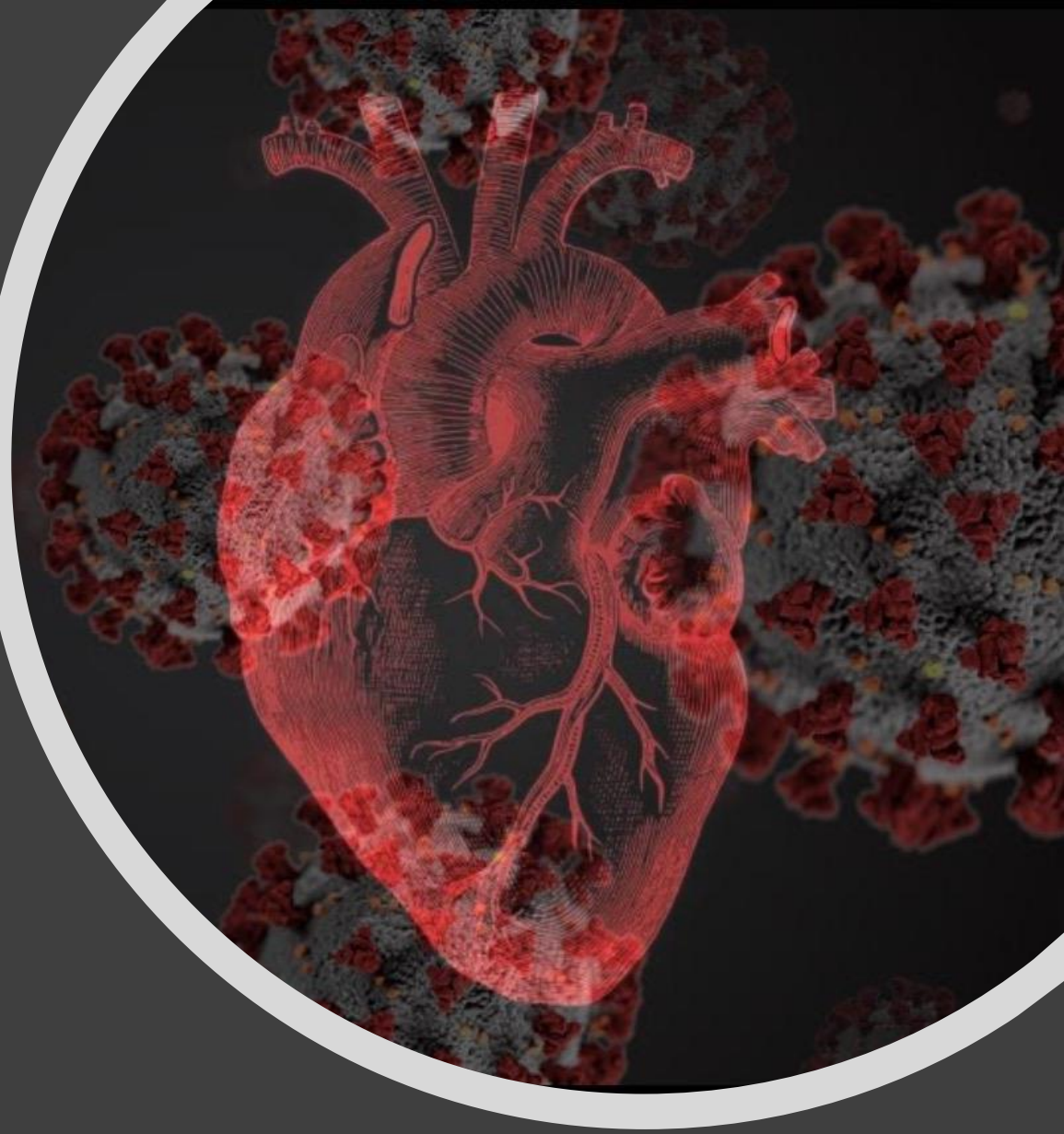
c) To know the diagnostic tests and medications available for cardiac patients affected with COVID-19 .

d) To enlist the key implications and precautionary measures which should be taken by patients, health care workers and health systems during COVID-19.



METHODOLOGY

- It is a review-based paper.
- To obtain a better understanding of the cardiac impact caused by COVID-19 virus, a variety of academic reports, medical studies, newspaper articles, numerous national, state and local government documents, books, newspapers, articles and numerous documents of foreign governments and their subordinate organizations are reviewed.
- The paper also reviewed and referred to case papers, observational and prospective articles, longitudinal assessments and meta-analyses, clinical and global recommendations, and narrative assessments based on pathophysiology, cardiovascular symptoms, complications in COVID-19 patients.
- The keywords for literature search includes coronavirus, pandemic, COVID-19, epidemiology, cardiovascular disorders, cardiovascular system, cardiac, SARS-CoV-2 and the database used was Google Scholar.
- 33 odd studies have been reviewed and focused to answer the Research Question and objectives.



DISCUSSION

❖ COMPARATIVE ANALYSIS

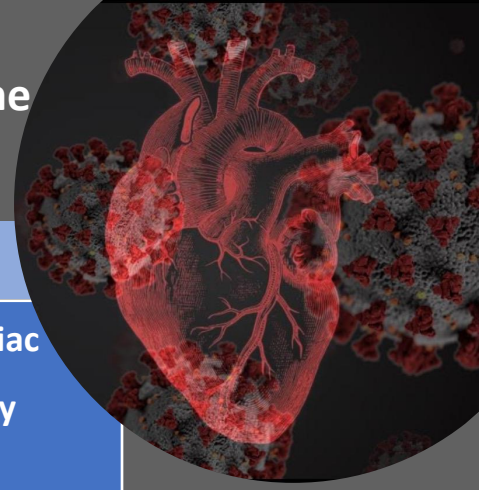


Table 1– Comparative Analysis of Studies using same variables

					Comorbidities		Complications		
Studies	**Total Cases**	**Median Age**	**Men**	**Women**	**CVD**	**Hypertension**	**Arrhythmias**	**Shock**	**Cardiac Injury**
Wang et al.	138	56	75	63	20	43	23	12	10
							Lymphocytopenia		
Liu et al.	137	56	61	76	10	13	99		
							MI		
Huang et al.	41	49	30	11	6	6	5		
							Myocardial Injury	Heart Failure	
Zhou et al.	191	56	119	72	15	58	33	44	

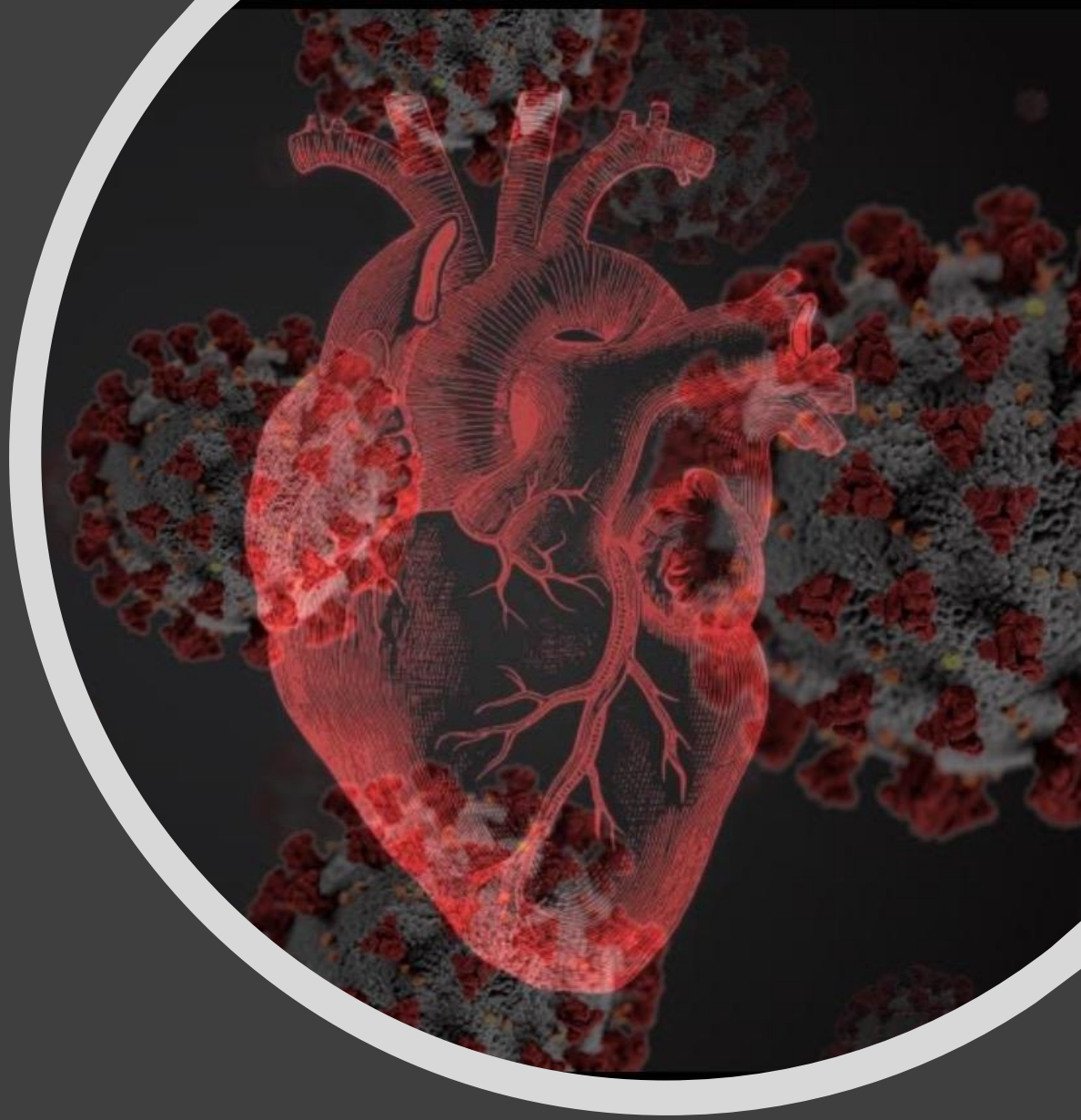
*(Source: Prepared by the Author based on review)

❖ PATHOPHYSIOLOGY –

- Spike proteins of SARS-CoV-2 bind sensitive cellular receptors to mediate penetration of their target cells, after which viral replication starts in the cytoplasm.

- According to European Society of Cardiology – “Coronavirus infection pathobiology requires SARS-CoV-2 binding to the angiotensin-converting enzyme 2 (ACE2) of the host receptor for the initiation of cell entry”.

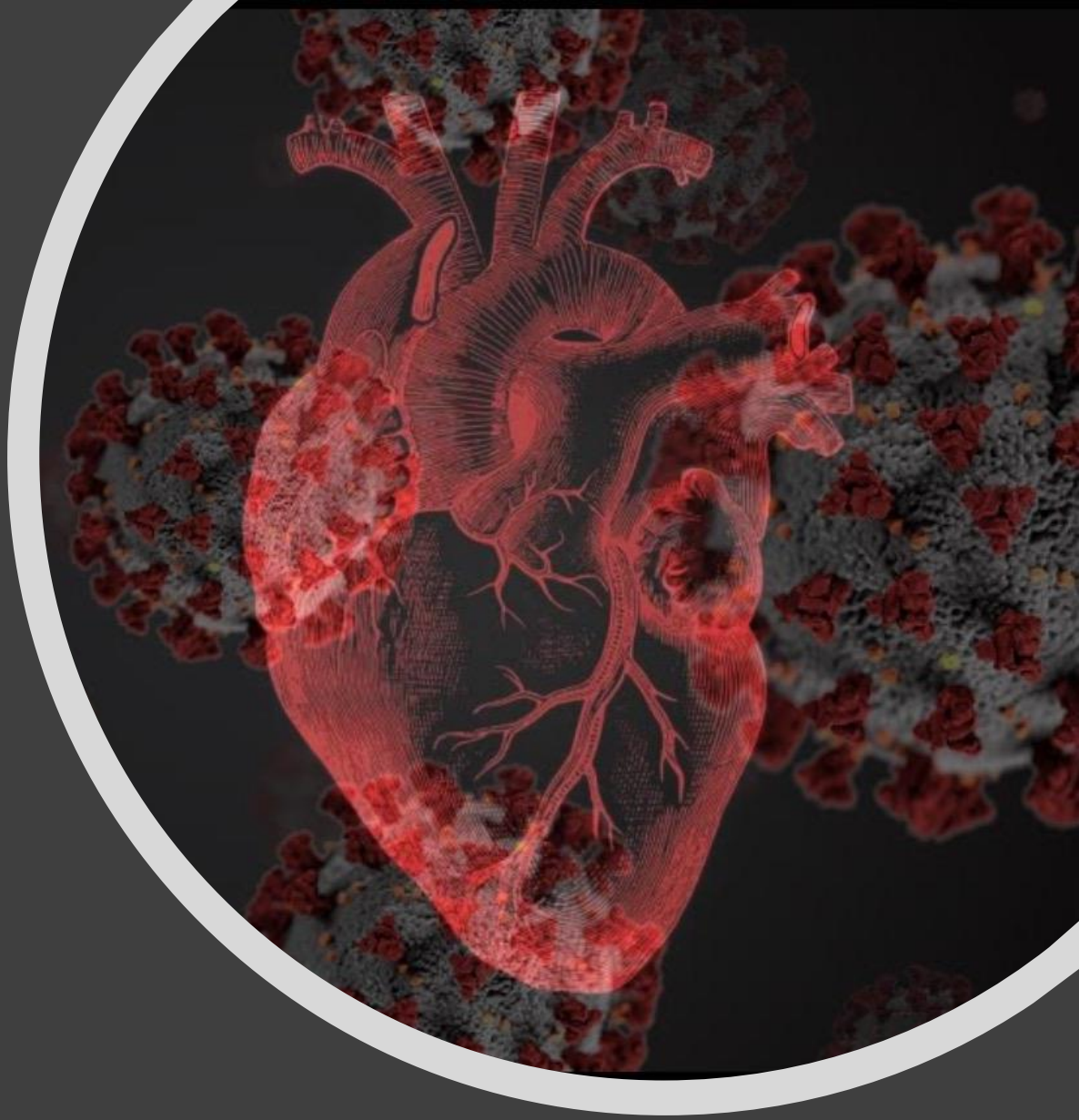
- In CVD pathophysiology, ACE2 is very important and a central component of the “Renin angiotensin system” (RAS) present in the heart, blood vessels and lungs. RAS/ACE2 system dysregulation due to coronavirus infection and comorbidities such as high blood pressure relates CVD to COVID-19.



- Another study was done to demonstrate that COVID-19 uses the serine endopeptidases enzyme ‘TMPRSS2’ for S protein priming .

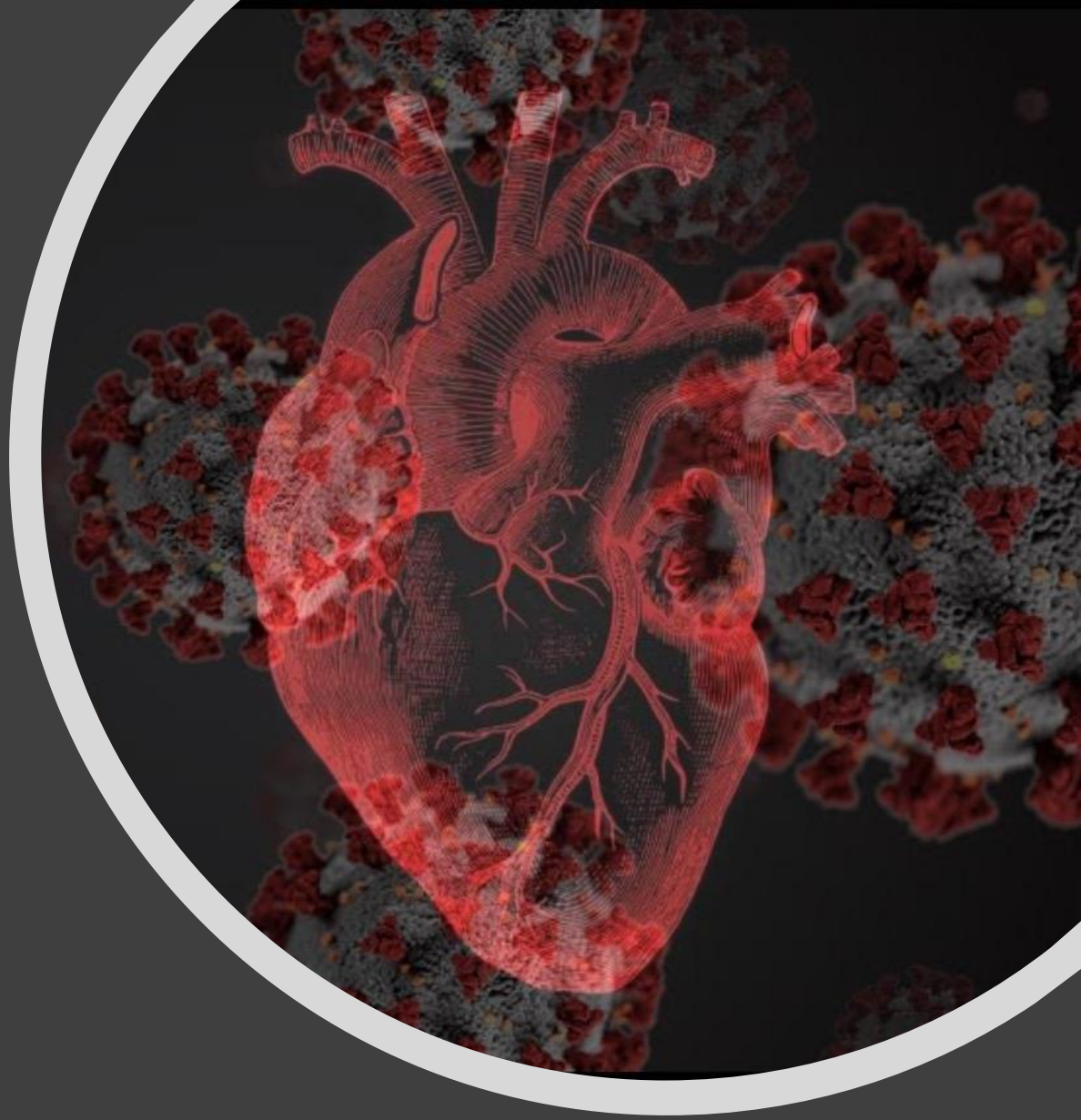
- Cytokine storm lead to CVD in COVID-19 which is triggered by imbalance of T lymphocytes cell activation with dysregulated release of interleukin IL-6, IL-17 and other cytokines.

- ACE2 are strongly expressed in adult human heart pericytes, which revealed an underlying core vulnerability to SARS-CoV-2 infection. Patients of chronic heart disease have been found to have increased ACE2 production and could have a significant risk of cardiac attack and development to serious disorder after infection.

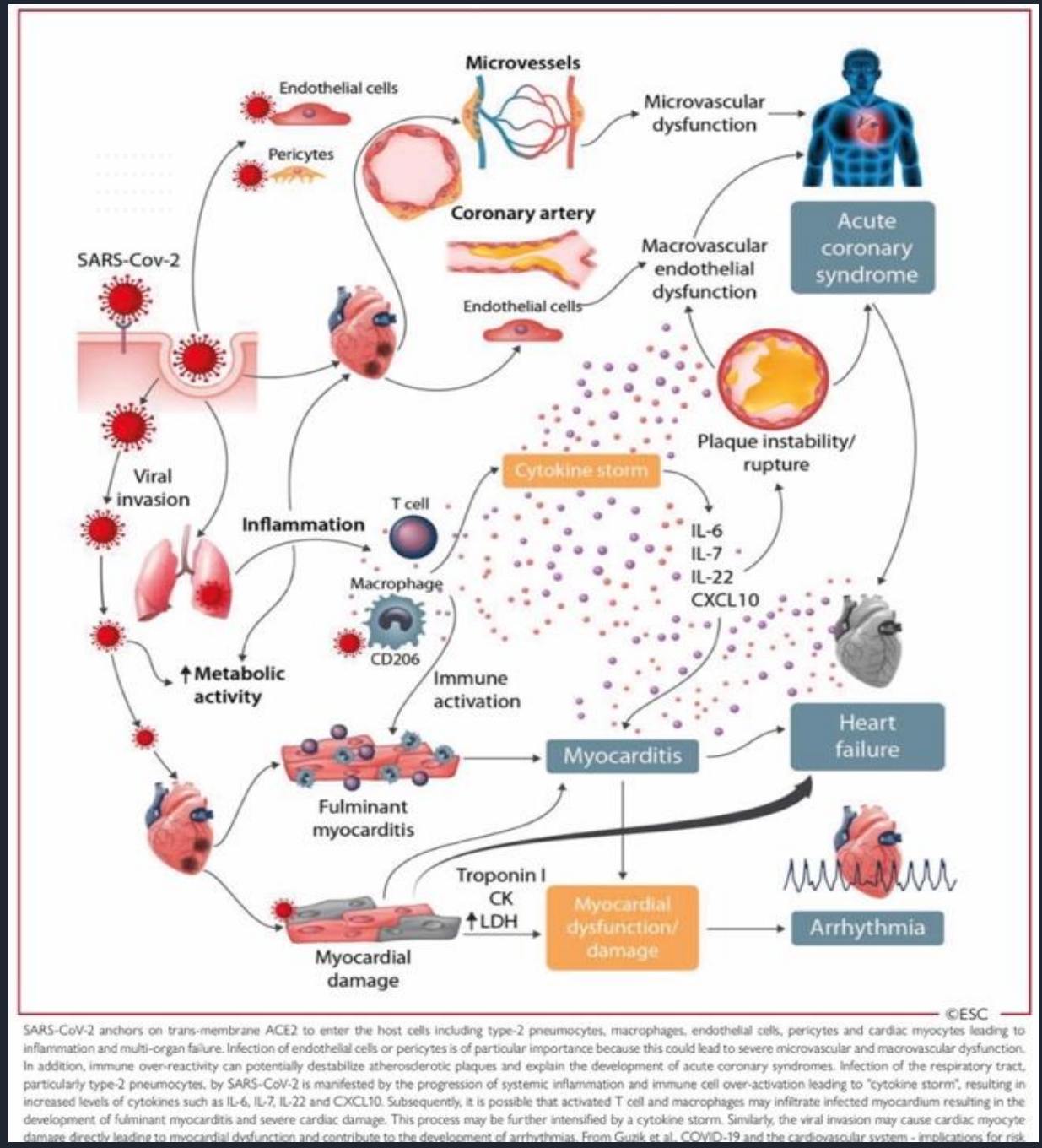


❖ ACE/ARBs DRUGS

- As per WHO, there is no significant evidence that address the potential benefits and harms of initiating ACE inhibitors or ARBs as treatment for patients with COVID-19.
- Earlier it was theoretically stated that these drugs increases ACE2 receptor density. Higher ACE2 receptor expression could mean a higher viral load and a more severe infection.
- However, later in a retrospective analysis on a group of 1,128 Covid-19 patients , it was found that the all-cause mortality for the 188 patients on ACE inhibitors or ARBs was lower than those not on those drugs (adjusted hazard ratio, 0.42 [95% CI, 0.19–0.92].
- Therefore, study findings do not support discontinuation of ACEI/ARB medications that are clinically indicated in the context of the COVID-19 pandemic.



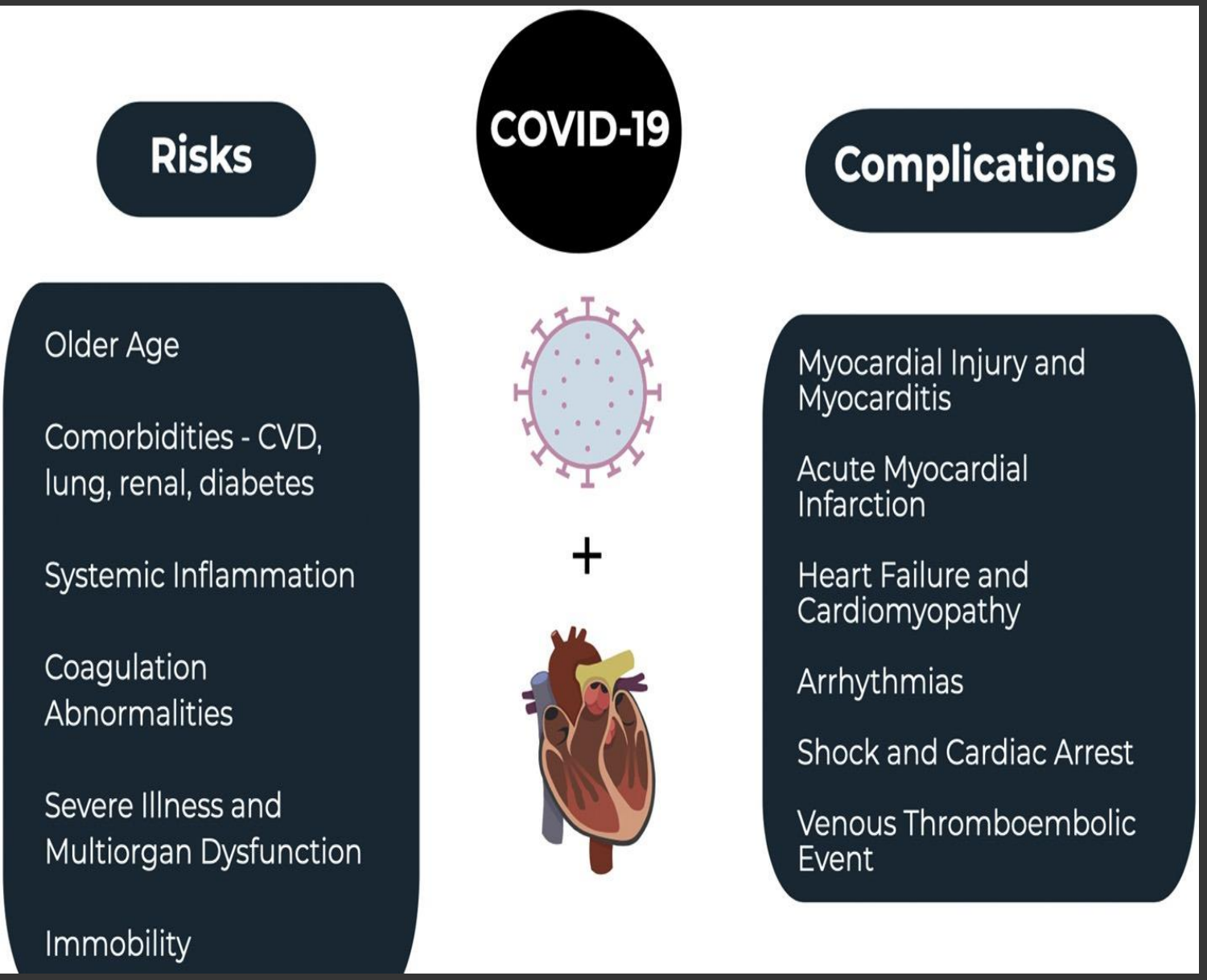
Key manifestation and hypothetical mechanism-cardiovascular involvement in COVID-19

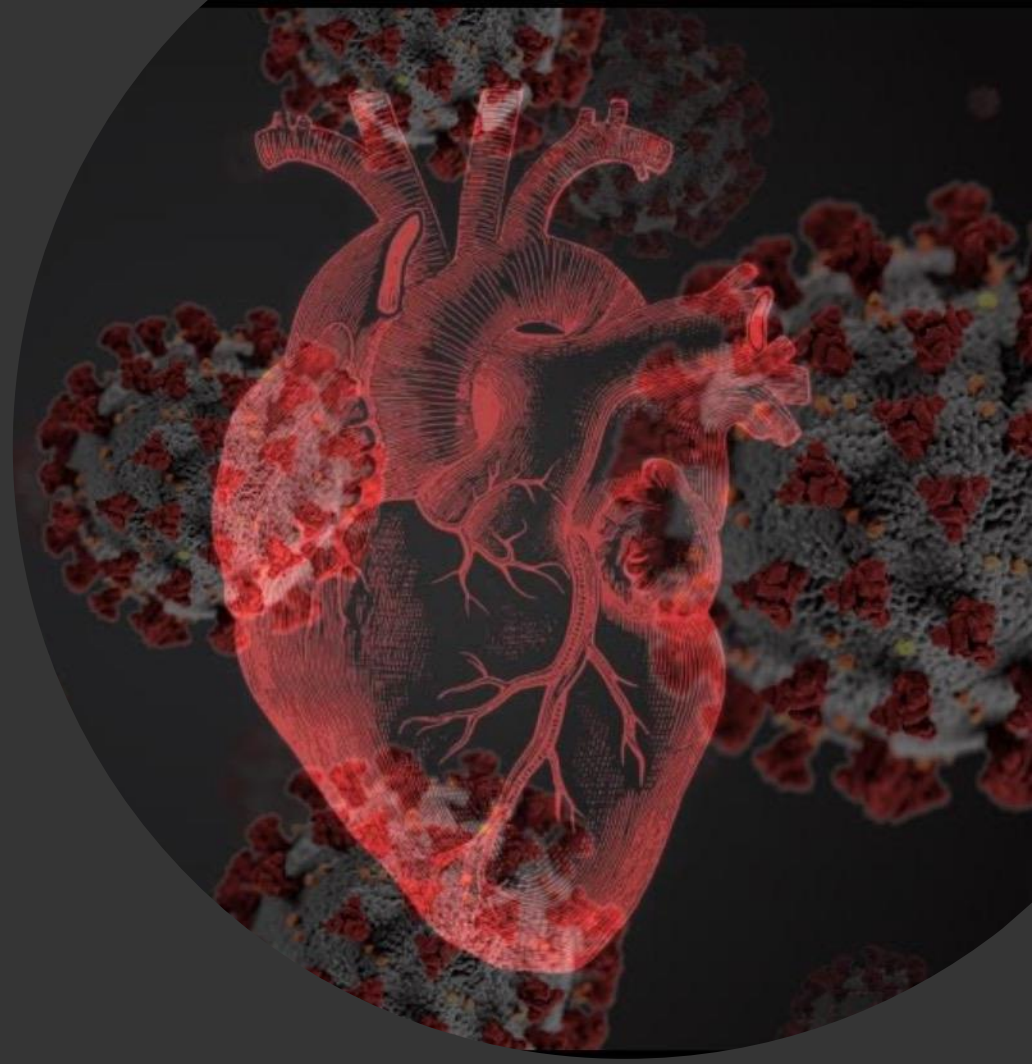


SARS-CoV-2 anchors on trans-membrane ACE2 to enter the host cells including type-2 pneumocytes, macrophages, endothelial cells, pericytes and cardiac myocytes leading to inflammation and multi-organ failure. Infection of endothelial cells or pericytes is of particular importance because this could lead to severe microvascular and macrovascular dysfunction. In addition, immune over-reactivity can potentially destabilize atherosclerotic plaques and explain the development of acute coronary syndromes. Infection of the respiratory tract, particularly type-2 pneumocytes, by SARS-CoV-2 is manifested by the progression of systemic inflammation and immune cell over-activation leading to "cytokine storm", resulting in increased levels of cytokines such as IL-6, IL-7, IL-22 and CXCL10. Subsequently, it is possible that activated T cell and macrophages may infiltrate infected myocardium resulting in the development of fulminant myocarditis and severe cardiac damage. This process may be further intensified by a cytokine storm. Similarly, the viral invasion may cause cardiac myocyte damage directly leading to myocardial dysfunction and contribute to the development of arrhythmias. From Guzik et al., COVID-19 and the cardiovascular system - implications for risk

Image Source: ("ESC Guidance for the Diagnosis and Management of CV Disease during the COVID-19 Pandemic", 2020)

❖ COVID-19 and the cardiovascular system – A Bidirectional Effect





(Image Source: Long et al. , Cardiovascular complications in COVID-19, 2020)

S.NO.	OUTBREAKS	AUTHOR	CARDIOVASCULAR SYMPTOMS	OUTCOMES
1.	SARS	Yu et al.	Hypotension, tachycardia, bradycardia, cardiomegaly, and arrhythmia	Mostly transient
		Pan et al.	Cardiac Arrest	Death
		Li et al.	Subclinical diastolic disability, without systolic involvement on echocardiography intervention	Reversible on clinical recovery
2.	MERS	Alhogbani	Acute-onset heart failure and Severe myocarditis	Regain Health (Recovered)
3.	COVID-19	Huang et al.	Myocardial injury	Patients required comprehensive care
		Wang et al.	Acute cardiac injury , shock , and arrhythmia	Patients required comprehensive care

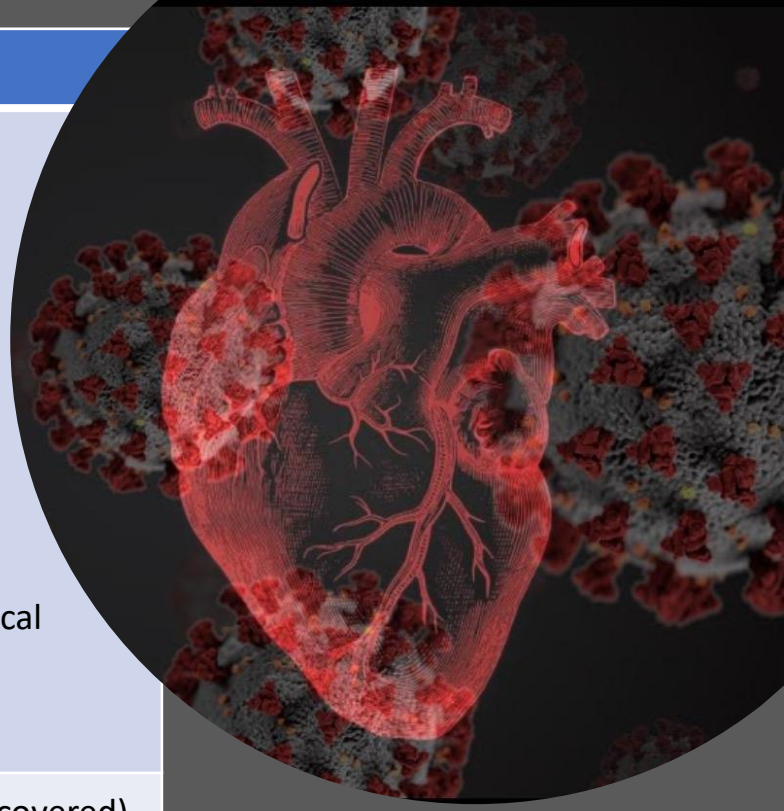
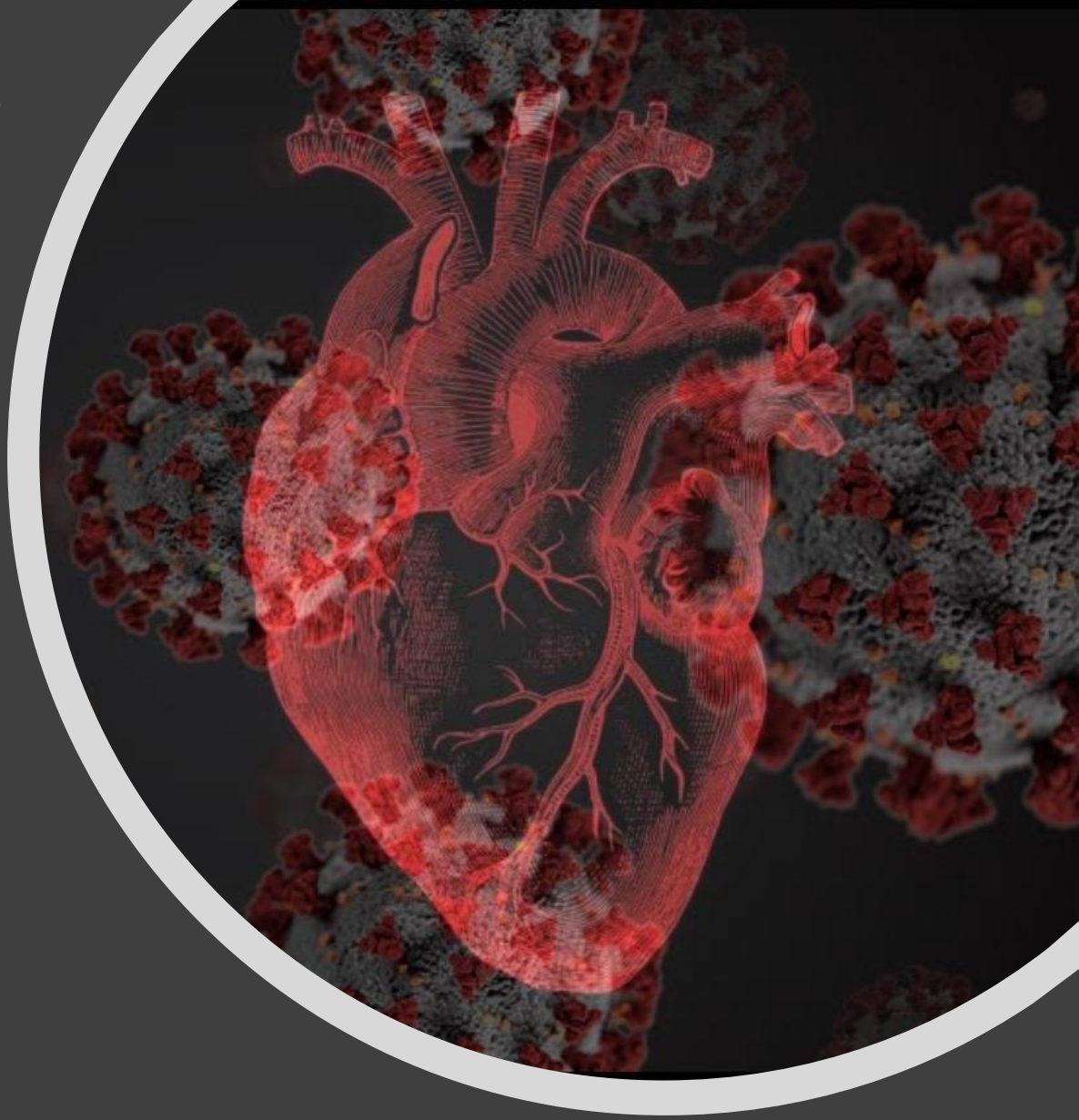


Table 1- Cardiovascular Manifestations in Viral Outbreaks

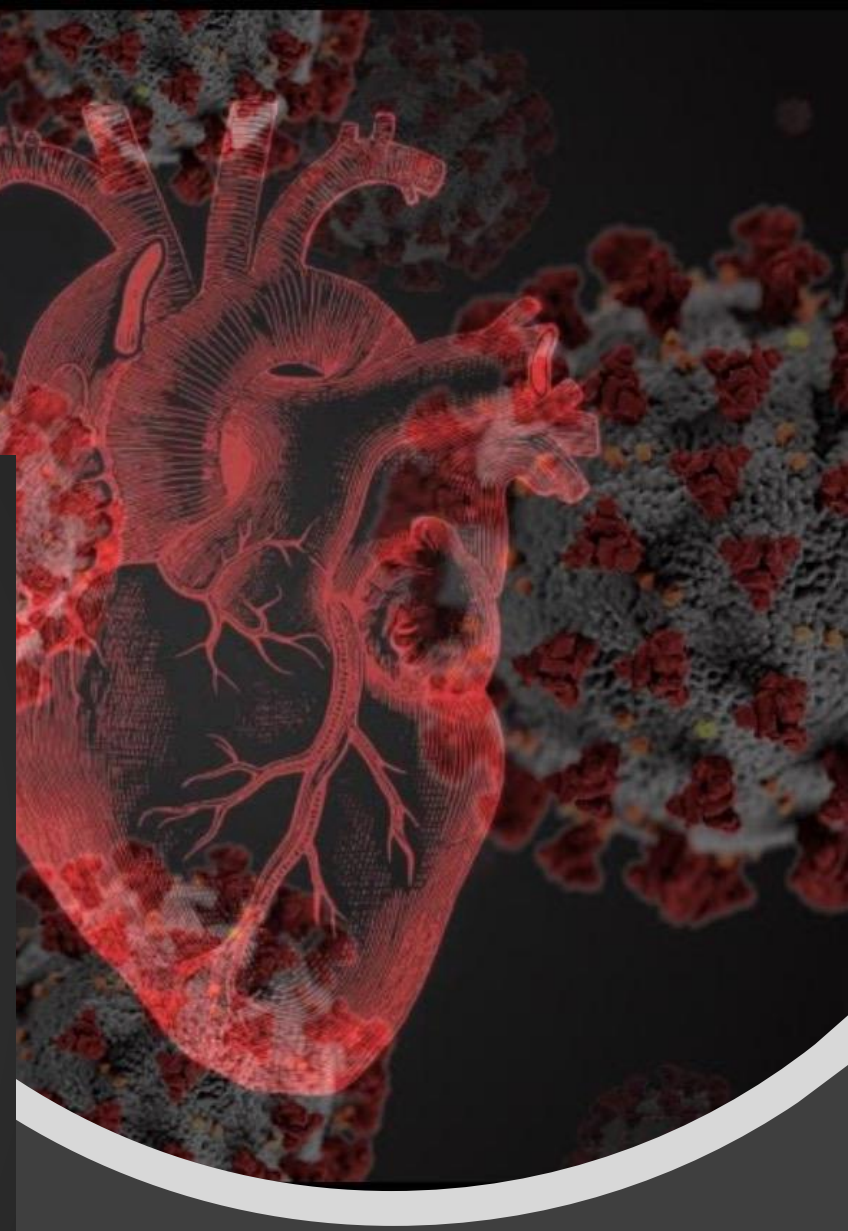
Table Source: Xiong et al. , Coronaviruses and the cardiovascular system: acute and long-term implications, 2020

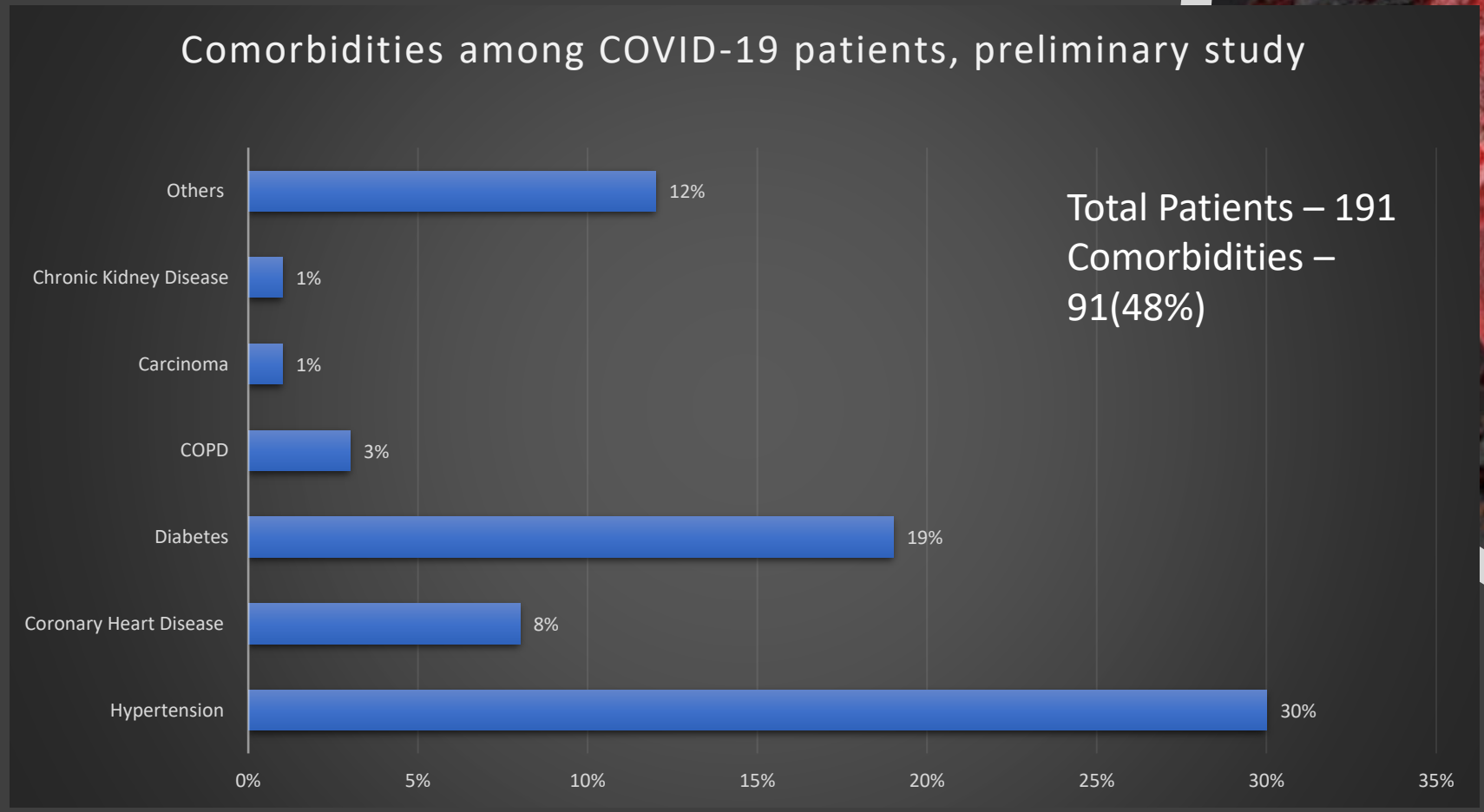
❖ CARDIOVASCULAR RISK FACTORS IN COVID-19 PATIENTS

- The major comorbidities for COVID-19 include coronary heart disease, hypertension, diabetes, obesity and asthma. Cardiac risk factors that predict susceptibility to infection with coronavirus and seriousness of disease have been identified.
- The risk factors can lead to complications such as Myocardial injury and myocarditis, acute myocardial infarction, heart failure and cardiomyopathy, arrythmias, venous thromboembolic event , shock and cardiac arrest.
- Recently, the Chinese CDC published the COVID-19 case series in mainland China, which reported that the total fatality incidence was 2.3% (1023 deaths from 44,672 documented cases), but that the mortality risk for patients with known cardiovascular diseases was 10.5% .
- Another research performed with 44672 documented cases in Hubei Province has found that crude mortality levels in patients with unreported comorbidities are approximately 0.9%, while mortality rates in patients with comorbidities are far higher, 10.5% in patients with cardiovascular disorders, 6.0% with hypertension.



- Based on another research performed in China with 1527 people, it was found that the prevalence of hypertension, cardiac-cerebrovascular disease and diabetes in serious or ICU cases was found to be nearly double, triple and double respectively greater.
- According to a study done by Zhou et al., it was found that the almost half of the COVID-19 patients were sufferers of underlying diseases as shown below in a graph.





*(Source: Prepared by the Author based on review)

	STUDY	PATIENTS	RESULT
Arrhythmia	Wang 2020 , single-centre case series, retrospective	138 Patients admitted to hospital	Total cases: 23 (16.7%) Number of Patients in ICU : 16 (44.4%) Non-ICU Patients: 7 (6.9%), p<0.001
	Liu 2020, retrospective, nine- tertiary hospitals (cohort)	137 Patients admitted to hospital	Total cases: 10 (7.3%)
Myocardial injury (elevated cTnI)	Huang 2020 , cohort study, retrospective	41 Patients admitted to hospital	Total cases: 5 (12%) Number of Patients in ICU patients : 4(31%) Non-ICU patients : 1 (4%), p=0.017
	Wang 2020 , single centre case series, retrospective	138 Patients admitted to hospital	Total cases: 10 (7.2%) Number of Patients in ICU:8 (22.2%) Non-ICU patients : 2 (2.0%), p<0.001
	Zhou 2020, multicentre cohort study, retrospective	191 Patients admitted to hospital	Total cases: 33 (17%) Number of Survival Patients: 1 (1%) Number of Non- Survival Patients: 32 (59%), p<0.0001

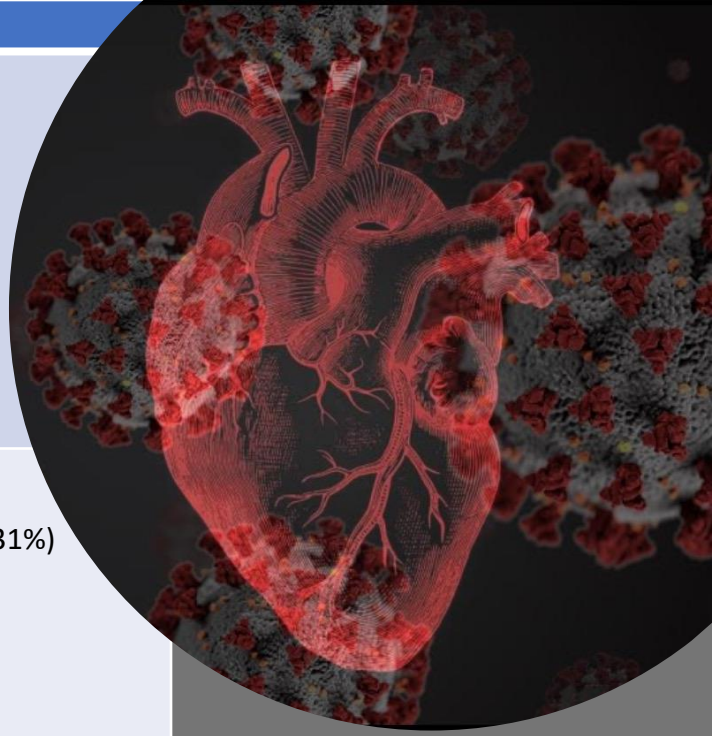


Table 2- Cardiovascular complications in COVID-19 patients

Myocarditis	**Ruan 2020 , multicentre study, retrospective,**	**68 deaths of 150 hospital admitted patients**	**7%(n=5) deaths because of myocardial infarction, heart failure** **33% (n=22) deaths because of myocardial infarction, respiratory illness**
Heart Failure	Zhou 2020 , multicentre cohort study, retrospective	191 Patients admitted to hospital	Total Cases: 44 (23%) Number of Survival Patients: 16 (12%) Number of Non-survival Patients: 28 (52%), p<0.0001

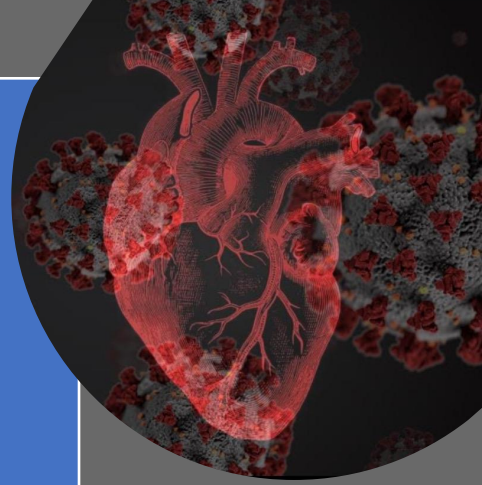
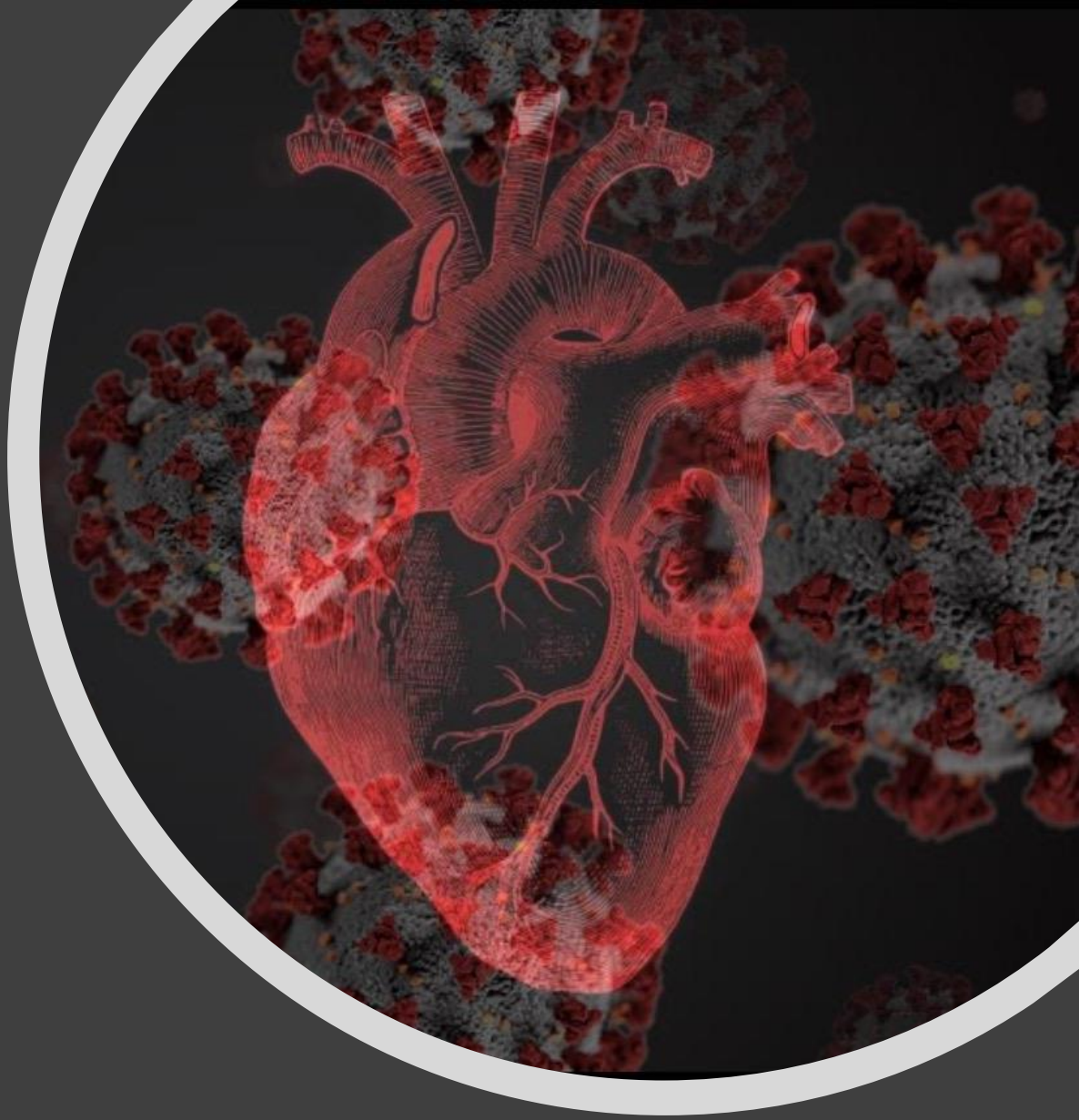


Table source- (Vlachakis, 2020)

❖ CARDIOVASCULAR COMPLICATIONS IN COVID-19 PATIENTS

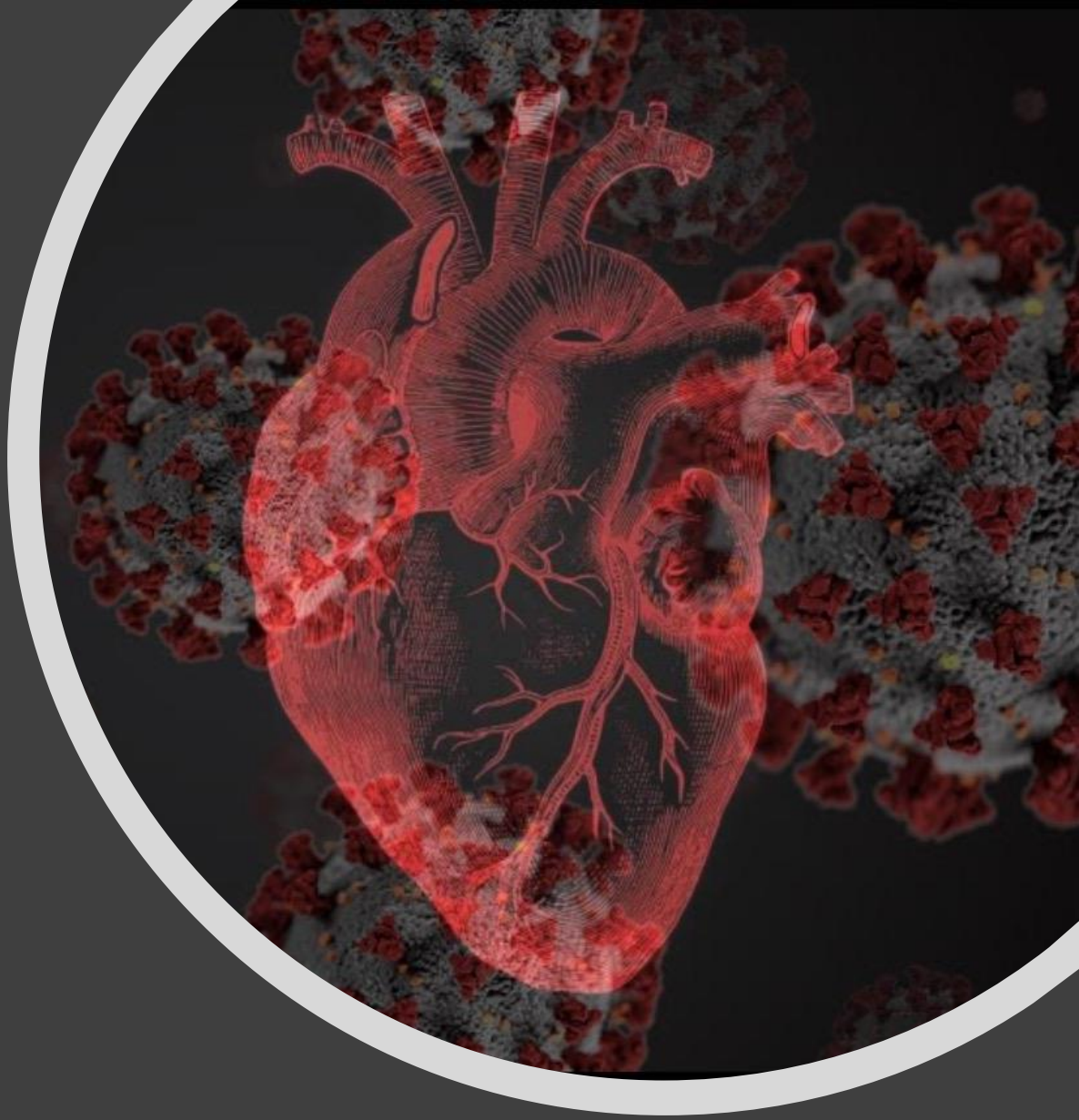
- There is also a clear correlation between cardiac illness and fatality of COVID-19 cases.
- A research of 416 hospitalized COVID-19 patients was performed in March, which found that individuals suffering from cardiac disease had a higher death rate (51.2 per cent) than people without cardiac injury (4.5 per cent).
- Furthermore, this was also examined using the Cox correlation model that cardiac insufficiency in patients remain at elevated risk of death, both from the onset of symptoms (“hazard ratio, 4.26”) and from diagnosis to the end point (“hazard ratio, 3.41”) than patients without cardiac failure.
- Thus concluded that Cardiac damage is a frequent occurrence for COVID-19 hospitalized patients and is correlated with an elevated risk of in-hospital mortality .



- **1) Arrhythmia-** High occurrence of arrhythmia in patients with or without pre-existing cardiac disorders of viral disease can be partially due to metabolic disease, ischemic hypoxia, or neurohormonal or inflammatory tension.

- **2) Myocardial injury and Myocarditis-** Evidence has found that myocardial injury is more probable during COVID 19 to arise in patients with chronic CVD and another comorbid diseases. Myocardial damage was observed in 5 out of 41 patients, specifically as a rise in elevated cardiac troponin I levels as one of the clinical characteristics in COVID-19 patients.

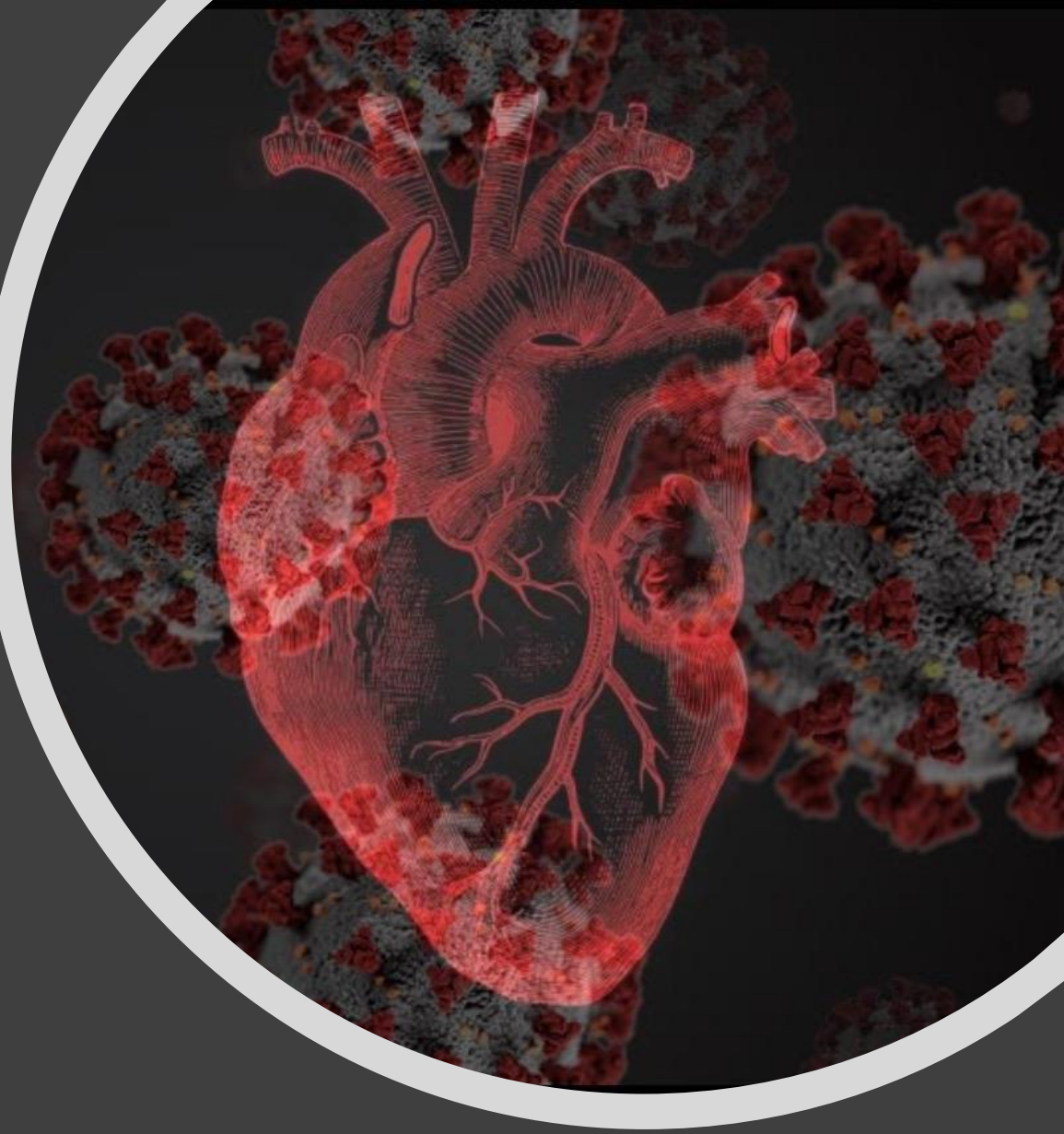
- **3) Acute Myocardial Infarction-** The possibility of AMI is possibly present in COVID-19 patients due to severe inflammation and hypercoagulability.



- **4) Heart Failure and Cardiomyopathy-** COVID-19 patients newly diagnosed cardiomyopathy vs. severe exacerbation of recurrent cardiac disease was reported. The existence or non-existence and severity of cardiomyopathy is important in managing patients with shock.

- **5) Venous Thromboembolic event-** Important factors contributing to the elevated risk of VTE include systemic inflammation, impaired coagulation status, multi-organ impairment and critical illness. Studies reveal significant defects in the COVID-19 patients' coagulation system, including high D-dimer levels.

- **6) Shock and Cardiac Arrest-** Occurrence of Cardiogenic shock and multiple organ failure can be seen . There was also a 77.4% increase in COVID-19 cases of cardiac out-of-hospital arrest observed in the four Italian province.



❖ DIAGNOSTIC TESTS IN COVID-19 PATIENTS WITH CARDIAC INVOLVEMENT

- In Wuhan , a study of 138 COVID-19 patients was done and it was analysed that the rates of Myocardial injury biomarkers were considerably higher in patients.
- In another study involving 191 patients there were 32 cTnI rates strongly linked in the univariate analysis to increased mortality.
- Myocardial injury patients was mainly expressed as rise in elevated levels of cardiac troponin I.
- Therefore COVID-19 hospital surveillance must include multiple clinical diagnostic tests to confirm the diagnosis of cardiovascular diseases in patients.

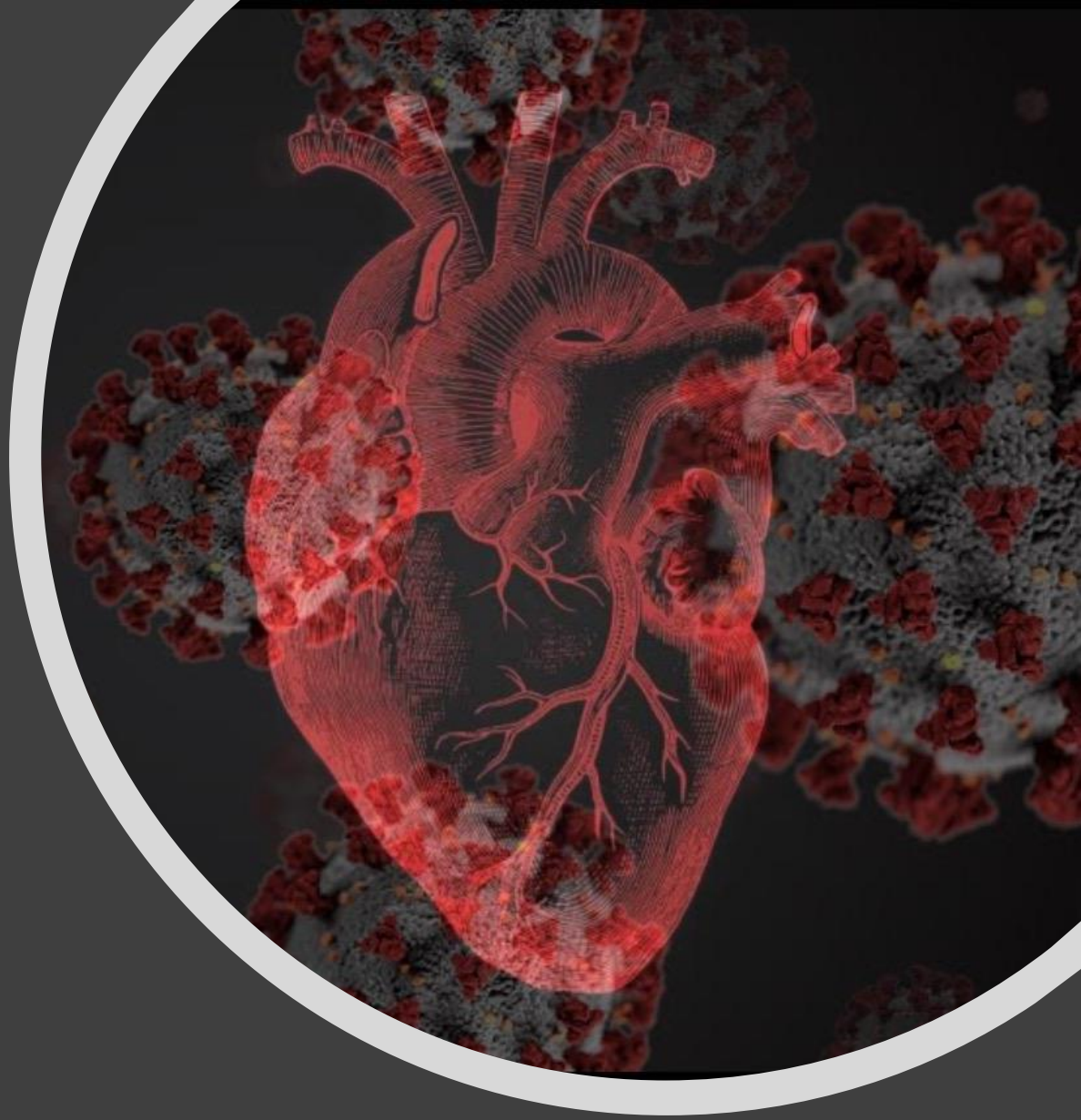
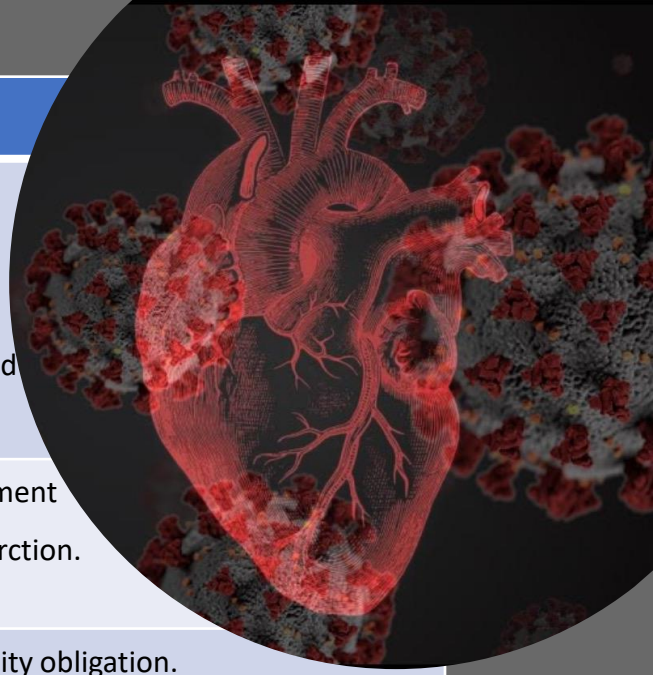


Table 4- Diagnostic Test considerations in COVID-19 patients

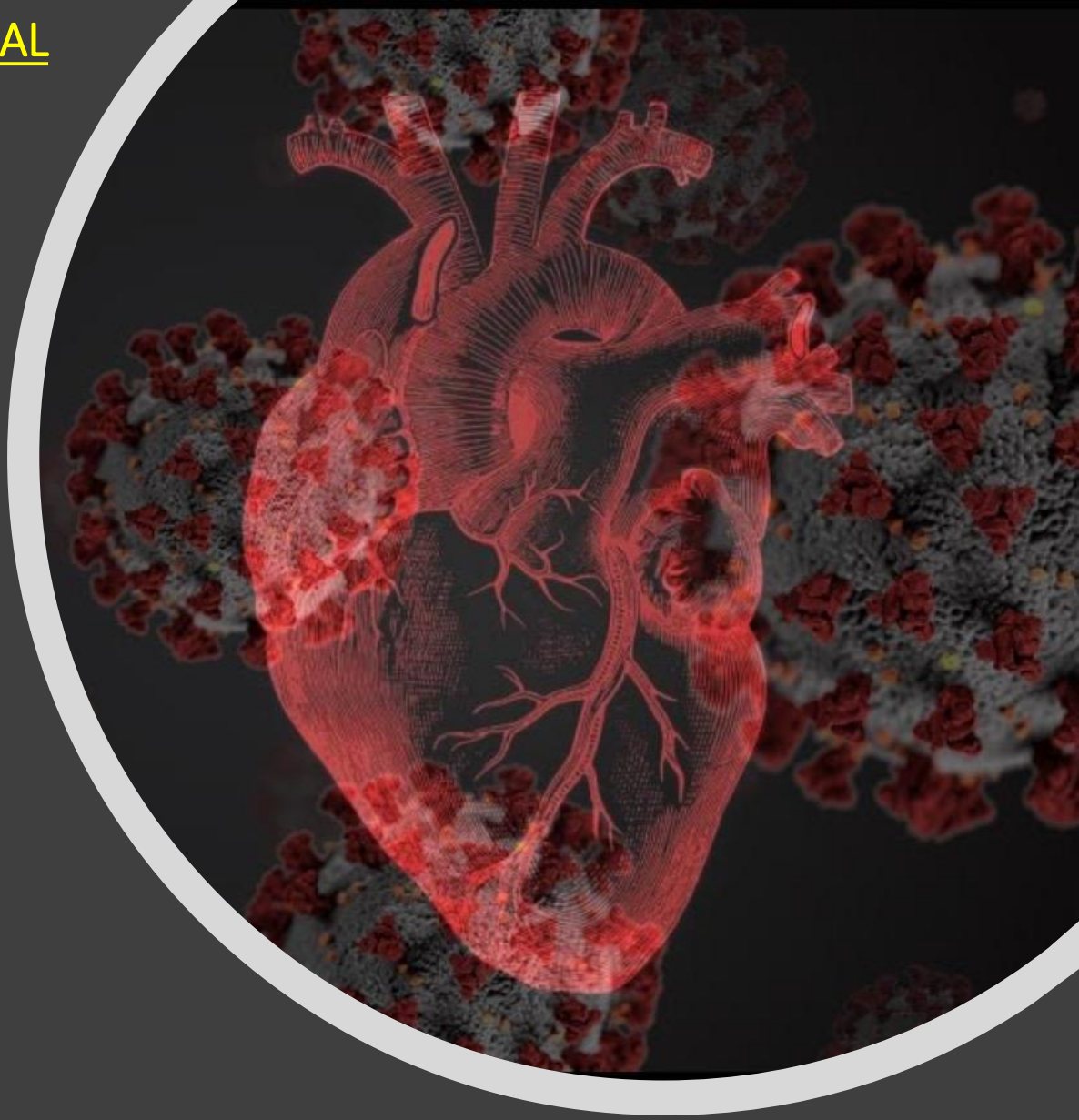
TEST	DIAGNOSTIC CONSIDERATIONS IN COVID-19 PATIENTS
NT-pro BNP/BNP test	Information varying about NT-pro BNP. NT-proBNP was increased In a MERS-CoV cohort, but it is found to be normal in patients suffering from COVID-19. In the Chinese cohort, higher NT-proBNP rates are correlated with an enhanced need intensive care treatment.
Troponin assay test	High-sensitivity troponin assay can be beneficial in patients needing ICU treatment and in the identification of people who are silent illness to the myocardial infarction.
D-dimer test	Data from China indicate a crucial connection of an ICU treatment with mortality obligation.
Procalcitonin- "A bacterial infection marker"	It is more likely to rise in patients needing intensive care treatment.
Full Blood Count analysis	Often exhibits neutropenia and decrease in lymphocytes Low platelet count is associated with severe outcomes.
IL-6 count	There is an association between large concentrations and undesirable outcomes.
Ferritin marker test	A predictor of bad outcome; very significant changes identified in coronavirus infected patients.
Cardiac CT Scan	It is done in patients with increased troponin levels
Electrocardiograph(ECG)	The ECG in MERS-CoV usually indicates a diffuse T wave inversion in patients with myocardial activity ; in COVID-19 patients this may be complex.
Echocardiography ("Diagnostic Cardiac Ultrasound")	Demonstrate widespread myocardial malfunction internationally or regionally with or without accumulation of fluid in pericardial activity



Source: Guzik et al., COVID-19 and the cardiovascular system: implications for risk assessment, diagnosis, and treatment options,2020

❖ MEDICATIONS USED FOR COVID-19 PATIENTS : “POTENTIAL CARDIOVASCULAR MECHANISM, INTERACTIONS AND TOXICITIES”

- It is necessary to evaluate the potential side effects on cardiovascular system and Interactions with other cardiovascular medications.
- Many of the recently researched medications are commonly correlated with certain cardiovascular therapies, which includes drugs like anticoagulants, antiplatelets and statins, antivirals, antihypertensive, antiarrhythmic.
- Chloroquine/hydroxychloroquine and azathioprine have recently been suggested as possible therapeutic alternatives based on preliminary data. All these medications can cause disturbances of the electrolyte, cardiotoxicity and prolonged QT intervals.
- Lopinavir/ritonavir also has possible association with antiplatelets, anticoagulants and statins. They prevents replication of RNA virus and demonstrates synergistic activity in vitro with ribavirin and may cause QT and PR prolongation.



MEDICATION	MECHANISM	CARDIOVASCULAR ADVERSE EFFECTS
Remedesivir	Nucleotide-analog RNA polymerases inhibitor	- Arrhythmias, Hypotension
Ribavirin	Inhibitor of replication of RNA and DNA virus	-Anticoagulants drugs interaction -Hemolytic drug induced anemia
Lopinavir/ritonavir	Protease inhibited by Lopinavir CYP3A metabolism inhibited by Ritonavir	-Interaction with anticoagulants drugs, antiplatelets drugs , statins, antiarrhythmics drugs -Altered cardiac conduction: -Prolongation of QTc, AV blocks, TdP
Favipiravir	RNA replicase "(RNA-dependent RNA polymerases)" inhibitor	- Interaction with Anticoagulants drugs, antiarrhythmics or statins drugs - anemia induced by drug
(i) Chloroquine **(ii) Hydroxychloroquine**	Elevate pH of endosomal or organelle	- Interaction of antiarrhythmics medications with these drugs - Bundle branch obstruction, AV obstruction, ventricular arrhythmias, due to myocardial toxicity; degrading cardiomyopathy and altering cardiac conduction
Azithromycin	Protein synthesis interference, attaches to 50s ribosome	- Interaction with other medications which includes statins, anticoagulants, antiarrhythmics, other QT prolongation agents - Dysrhythmias, prolonged QT interval, TdP

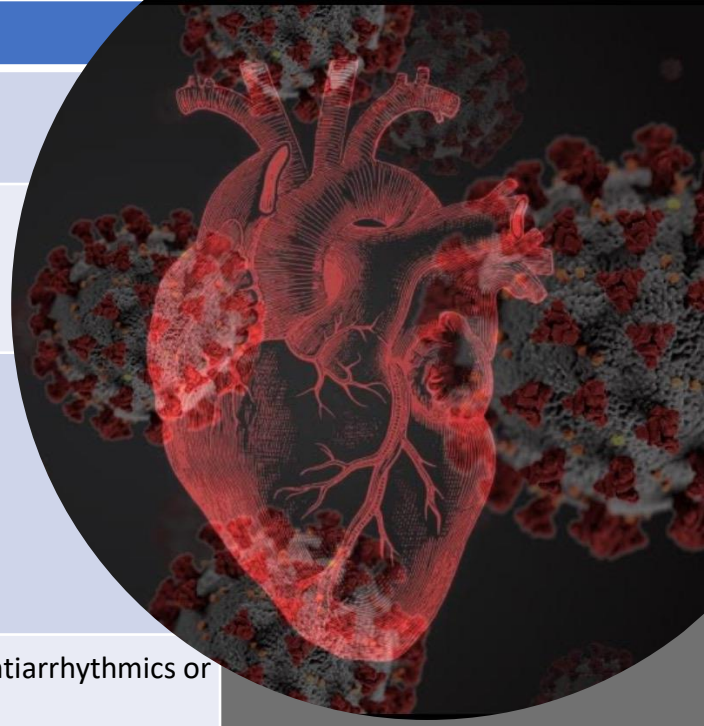
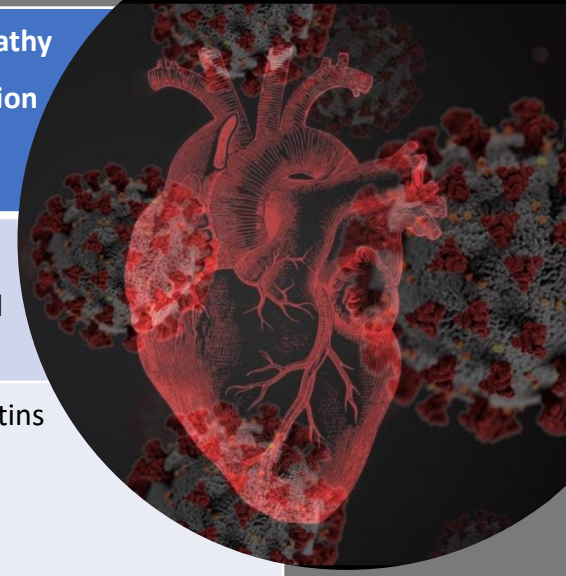
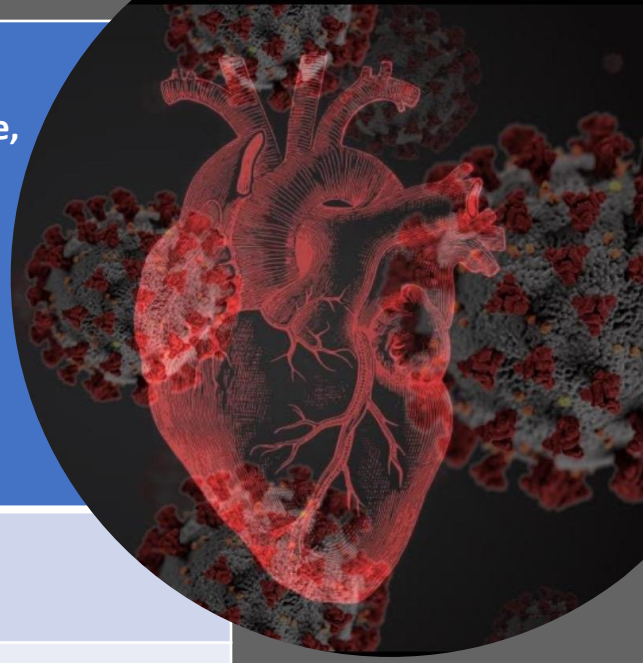


Table 5 - Medications and the Cardiovascular system

Interferon-alpha, beta	**Activate Immune system**	**- Active myocardial toxicity; cardiomyopathy** **- deterioration; heart conduction alteration** **-Hypotension or ischemia of heart**
Methylprednisolone	Reduce inflammation by altering gene expression	- anticoagulants drugs interaction - Electrolyte shift , fluid accumulation and - hypertension
Tocilizumab	IL-6 receptor inhibitor	- Boost the secretion of drugs including statins -High Blood pressure
Anakinra	IL-1alpha and IL-1beta blocker	-None
Bevacizumab	Vascular Endothelial Growth Factor(VEGF) inhibitor and reduces vascular or capillary permeability and fluid accumulation	- Myocardial risk and aggravation of recurrent myocardiopathy, elevated blood pressure, blocking of a blood vessel
Colchicine	Inhibits SARS-COV-2's pathogenic process with its Anti-inflammatory properties	-None
Eculizumab	Inhibition of Complement activation and avoids dynamic membrane attack development	- Tachycardia, systemic edema, stroke or hypotension



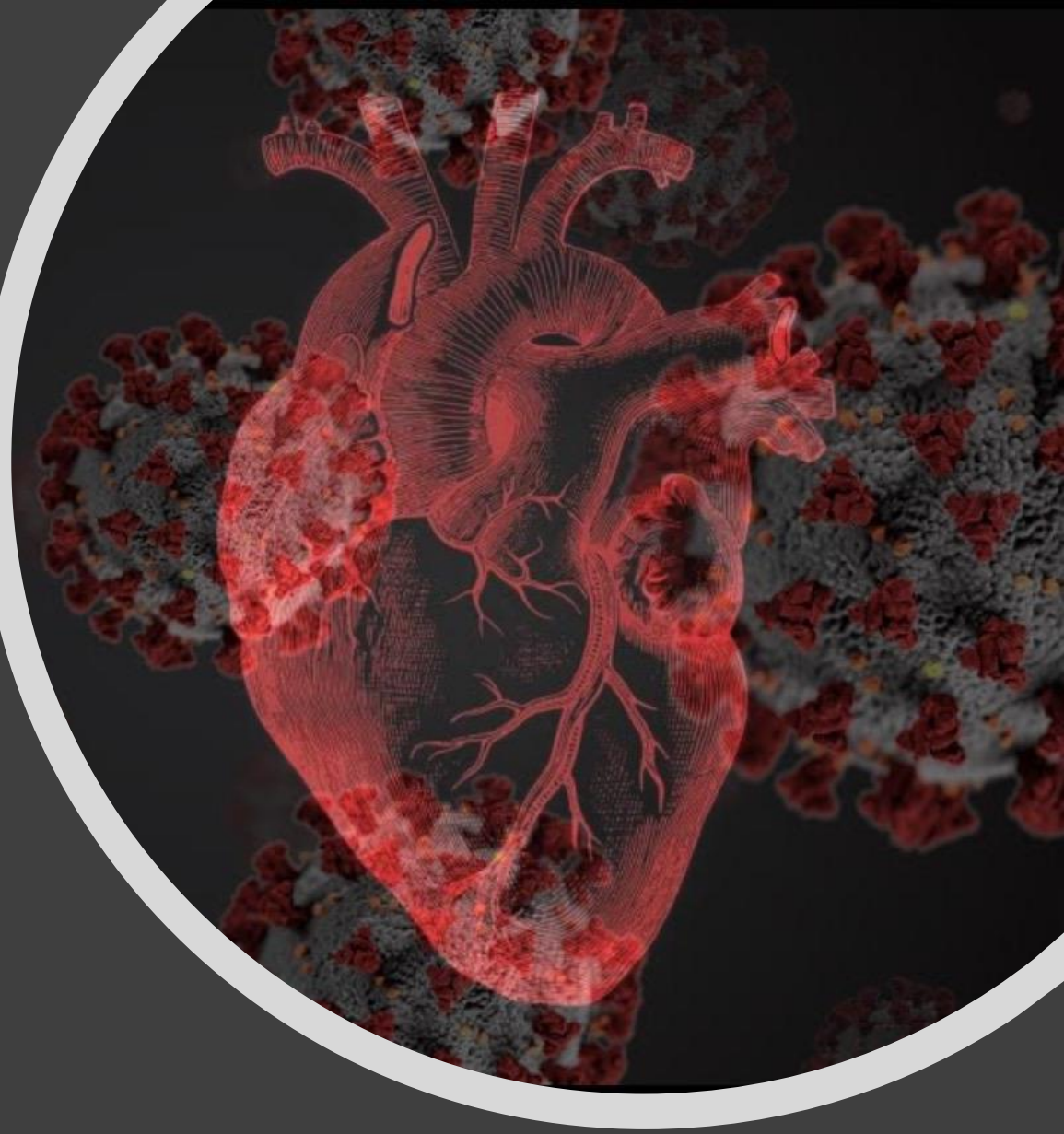
Fingolimod	**Regulation of sphingosine-1 phosphate which inhibits lymphocytes**	**-High Blood Pressure , bradycardia, "Atrioventricular block"- first degree, second degree** **-prolongation of QTc interval**
Pirfenidone	Antifibrotic ability	-None
Sarilumab	Inhibition of signalling by binding to soluble or membrane-bound IL-6Rs	-Unknown
Tranexamic acid	Reduction in infectious nature of the virus by decreasing the conversion of plasminogen to plasmin	-Thromboembolism and Venous and arterial thrombosis



(Source: Long et. al., 2020 ; Driggin et al., 2020)

❖ KEY IMPLICATIONS FOR HEALTH CARE WORKERS AND PATIENTS

- Hospital systems should anticipate a significant increase in patients with COVID-19 while maintaining general health services for acute and severe chronic illnesses.
- Information on the most up-to-date evidence surrounding management and treatment of patients with COVID-19 should be widely disseminated and freely available.
- Health care workers have a large risk of acquiring the infection, as Wu et al. has shown, suggesting that 3.8 % were healthcare workers among infected patients (i.e. 1,716 among 44,672 infected patients).
- For healthcare workers, WHO has recommended personal protective equipment (PPE) and those who are at highest risk, they should use additional PPE including controlled or powered air purifying respirators (CAPR / PAPR) while performing aerosol-generating procedures like trans-oesophageal echo, endotracheal intubation, cardiopulmonary resuscitation



1)Cardiovascular procedures-

- Minimize staff ratio in urgent cases.
- Use negative pressure catheterization.
- Consider fibrinolysis in case PCI not feasible.
- Optimization of medicines
- Elective Procedures can be rescheduled

2) Echocardiography-

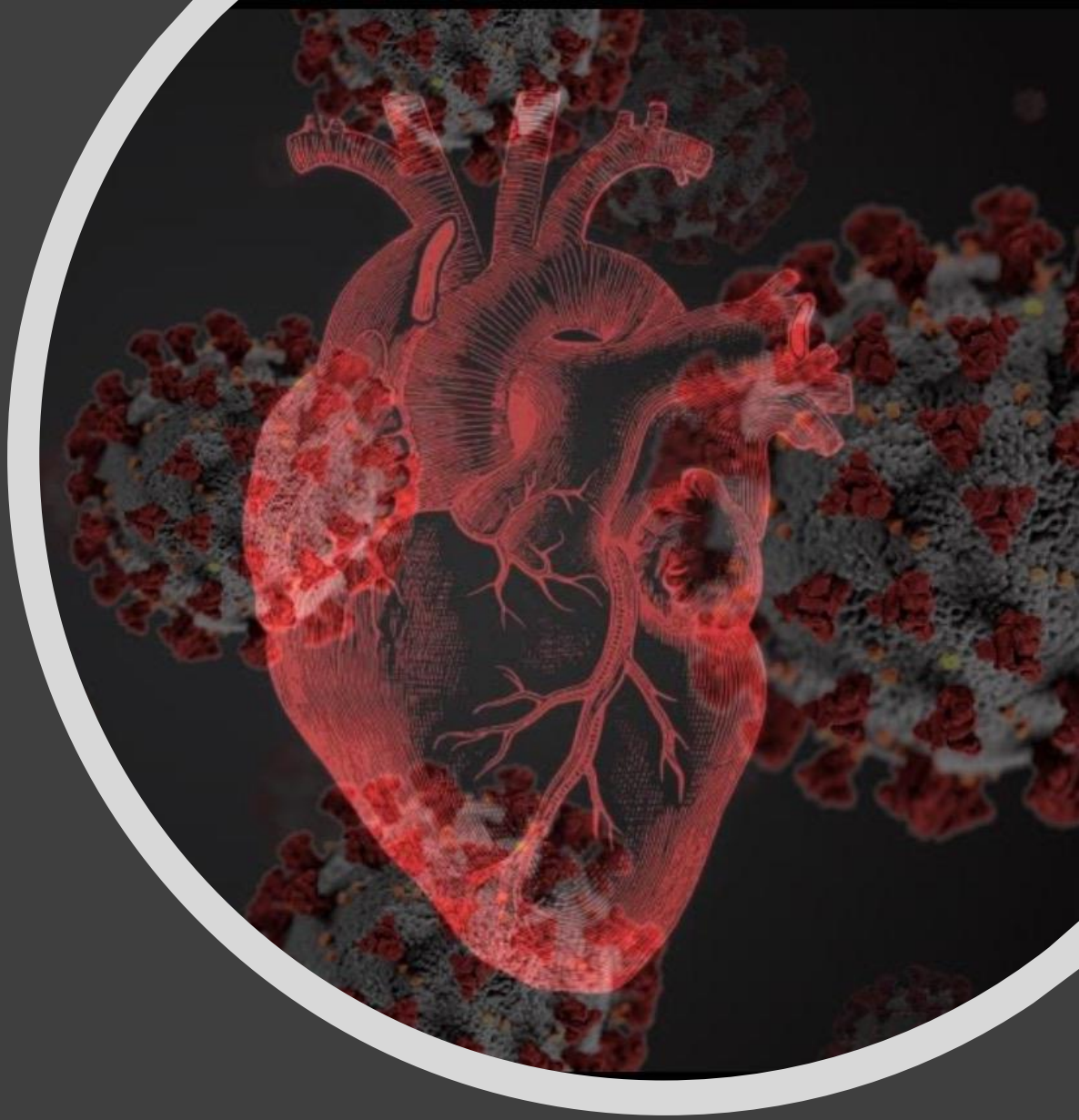
- Use airborne PPE with transesophageal echocardiography (TEE)
- Take less time for examination
- Clean the machines and probes properly before and after use

3) Outpatient or Inpatient cardiology-

- Prefer telemedicine
- Reschedule visits

4) Cardiology teaching services-

- Avoid large group discussions and gatherings
- Minimize non-essential staff
- Prefer online classes and conferences

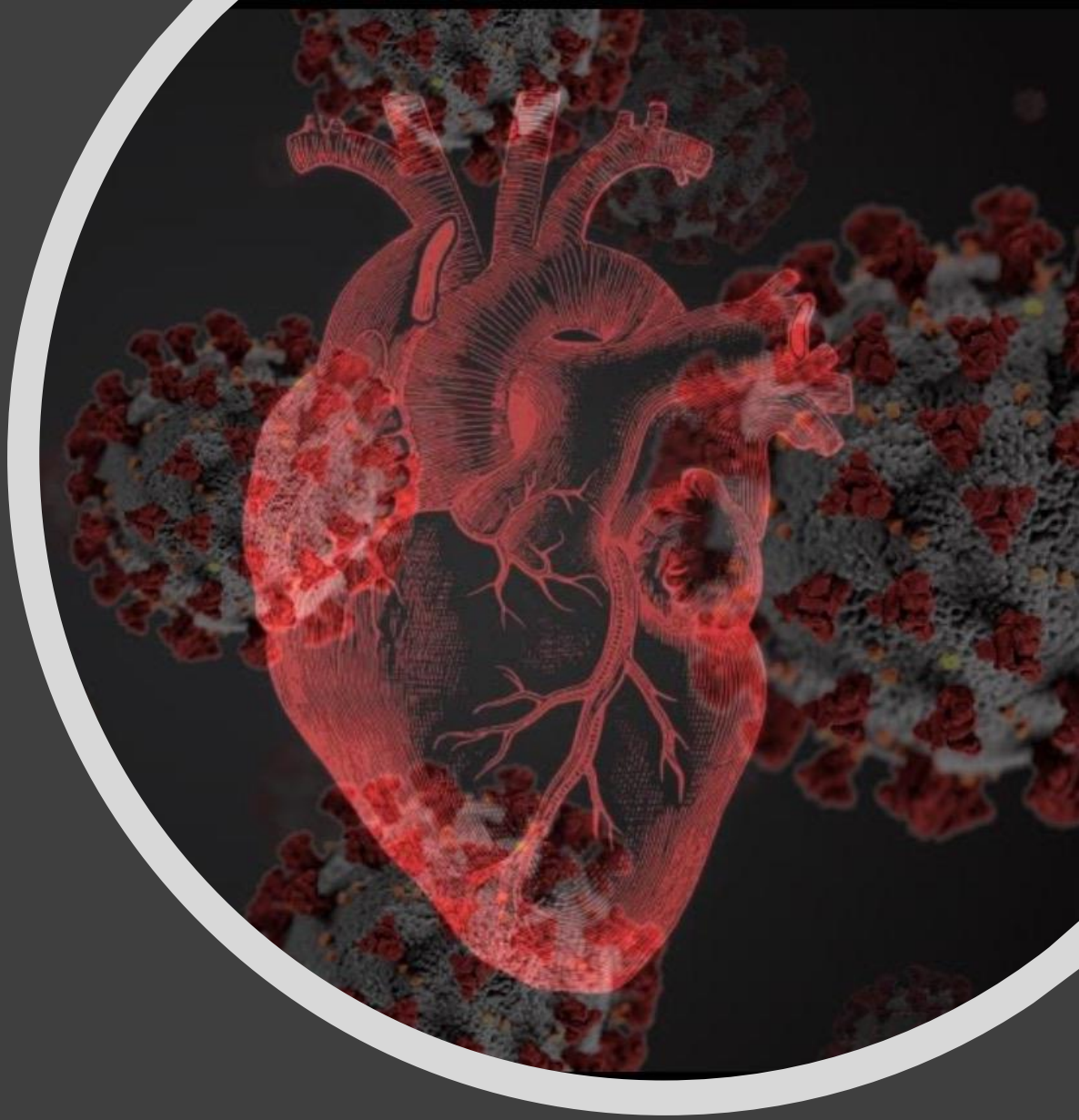


RECOMMENDATIONS

- The general treatment guidelines regarding COVID-19 patients who have CV complications or who have pre-existing CVD are the same as with every other non-COVID-19 case. There are, indeed, a few significant aspects that need to be considered:-

1. For more effective treatment and indirect reduction in severity of viral infections, proper patient history should be taken to observe any underlying comorbidity.

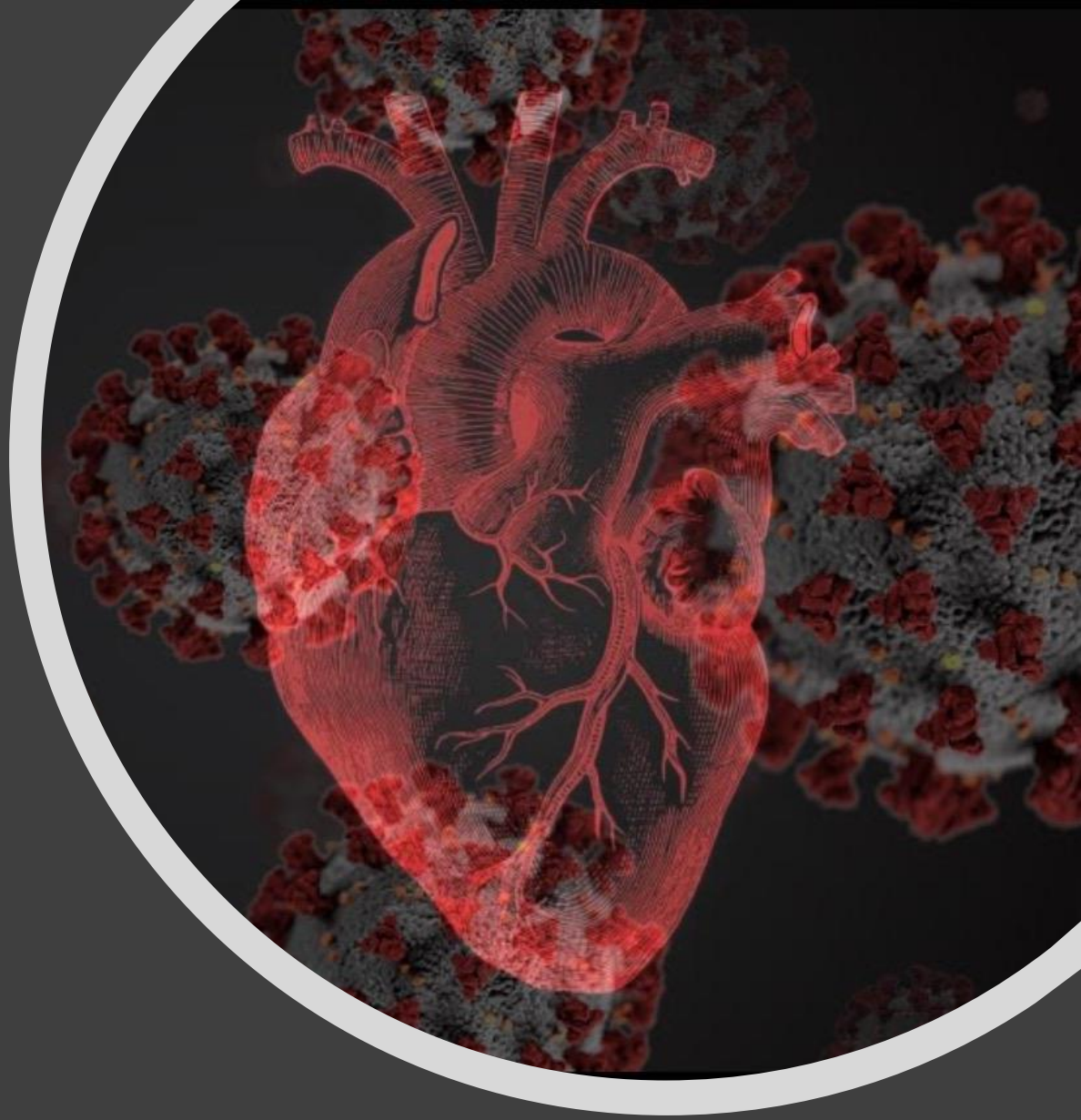
2. The greatest duty as health workers is to prevent themselves from being contaminated when treating these patients. All of them should be trained in donning, usage, and doffing of the personal protective equipment in accordance with the existing practice guidelines.



3.The comorbid patients should be the priority of the hospital authorities and must be treated immediately.

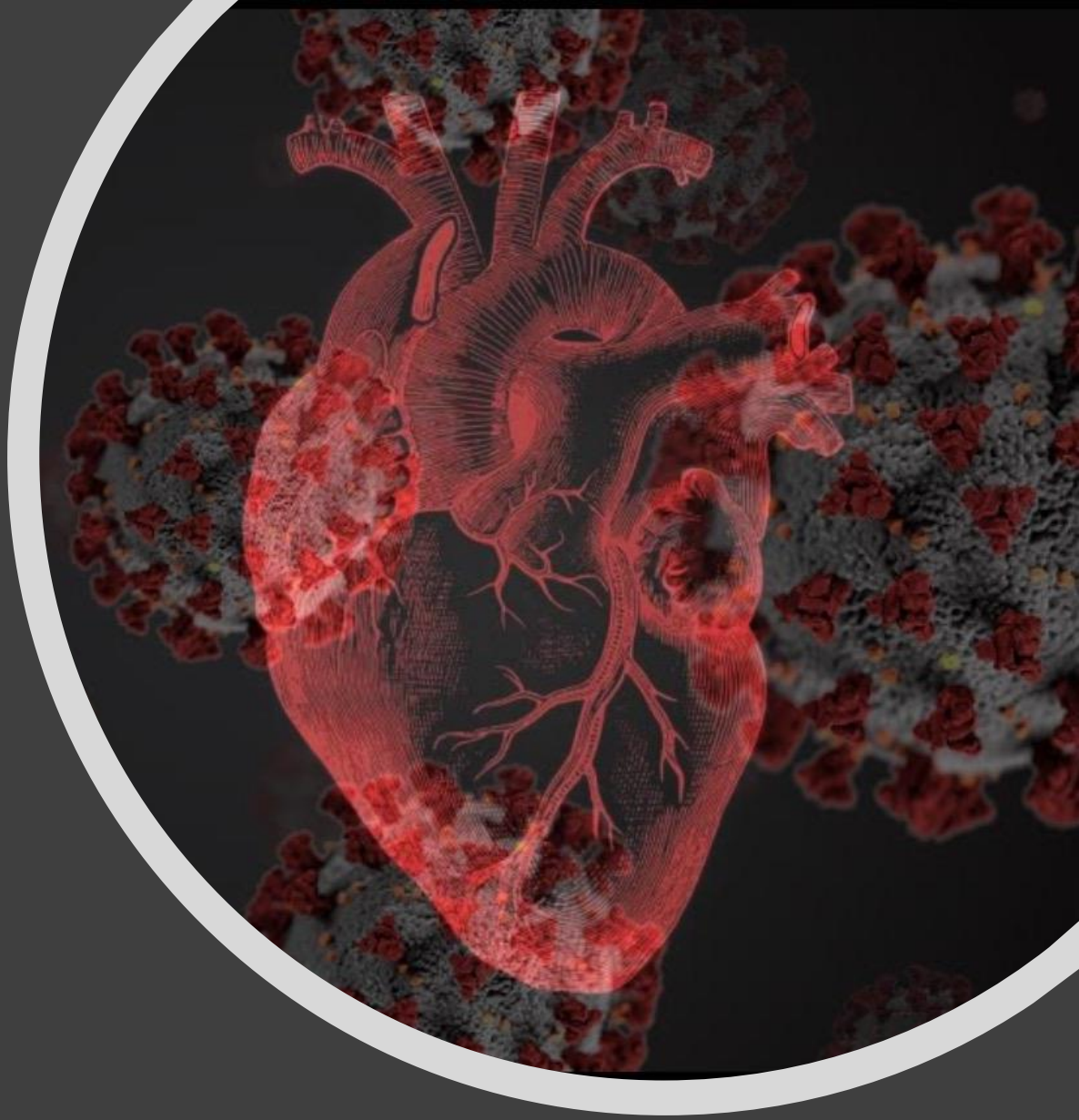
4.Healthcare workers who might be suffering from co-morbidities should be a part of administration instead of working in the frontline.

5.Regular monitoring of QT and PR interval should be done if drugs like Chloroquine/hydroxychloroquine, lopinavir/ritonavir are being prescribed.



CONCLUSION

COVID-19 is correlated with several cardiovascular disorder which includes myocardial infarction AMI, heart failure, dysrhythmia, myocarditis, shock and venous thromboembolic cases. Underlying cardiac diseases can trigger harmful outcomes. Early medical results and viral infections may have long-term impacts on cardiovascular health. Different diagnostics are used to confirm the cardiovascular involvement in COVID-19 patient. Various medications which are used in treating COVID-19 do have possibility of heart risks and toxicity. It is critical for health care professionals to be mindful of these risks when handling COVID-19 patients. There are some major key considerations which should be followed by patients and health care workers to prevent transmission of COVID-19.



Future should hold evidence and scientific based research.

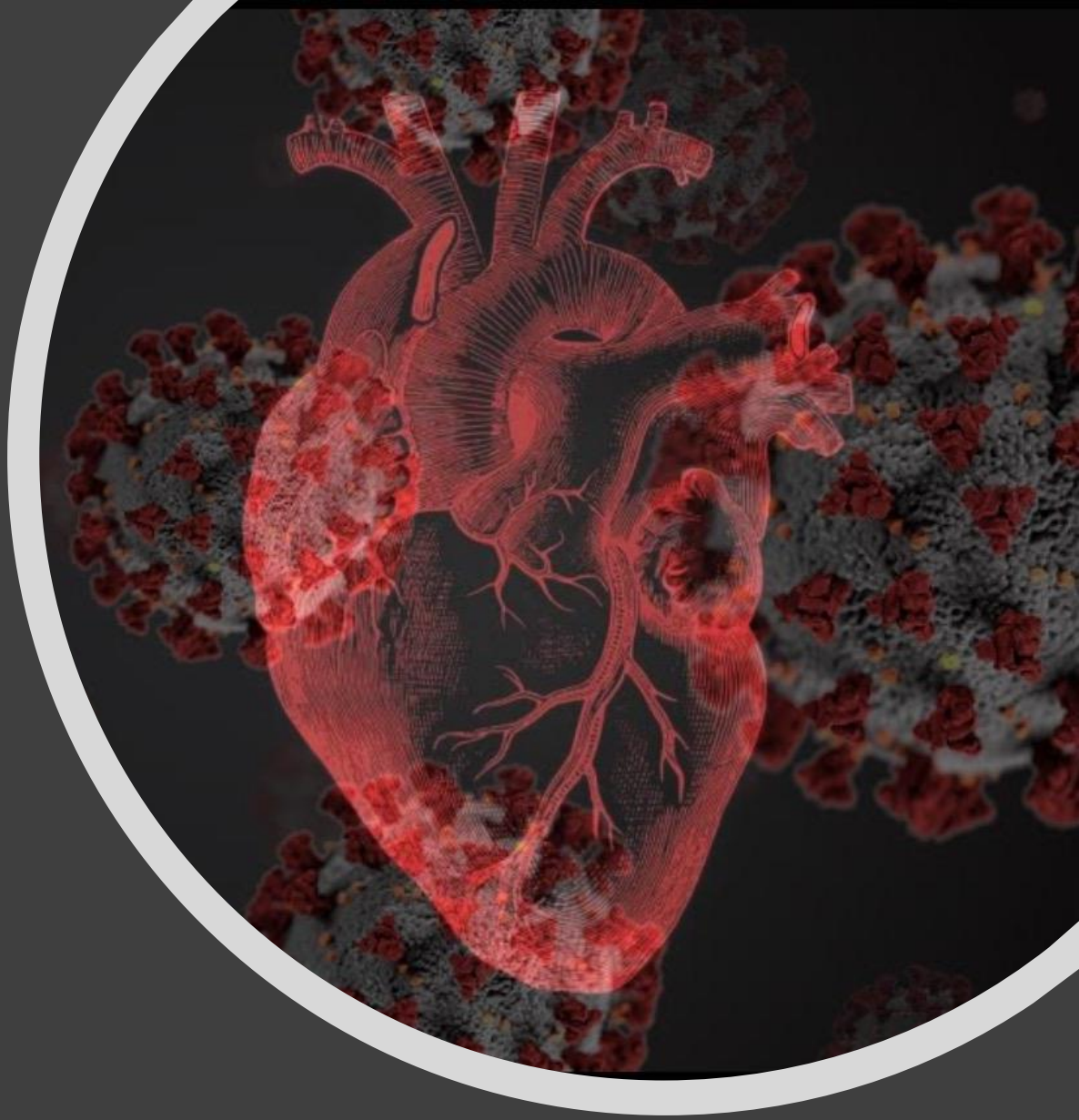
Vaccine development research should be vigorous.

New technologies such as artificial intelligence and big data Biosecurity should come at forefront.

Health system should develop an integrated approach to combine life science, biotechnology and medical science.

Advanced research must be done to support the health system development, resilience and capacity building and to assist treatment of critically ill patients.

Strengthening of information exchange system to connect virtually and communicate effectively in the time of global crisis.



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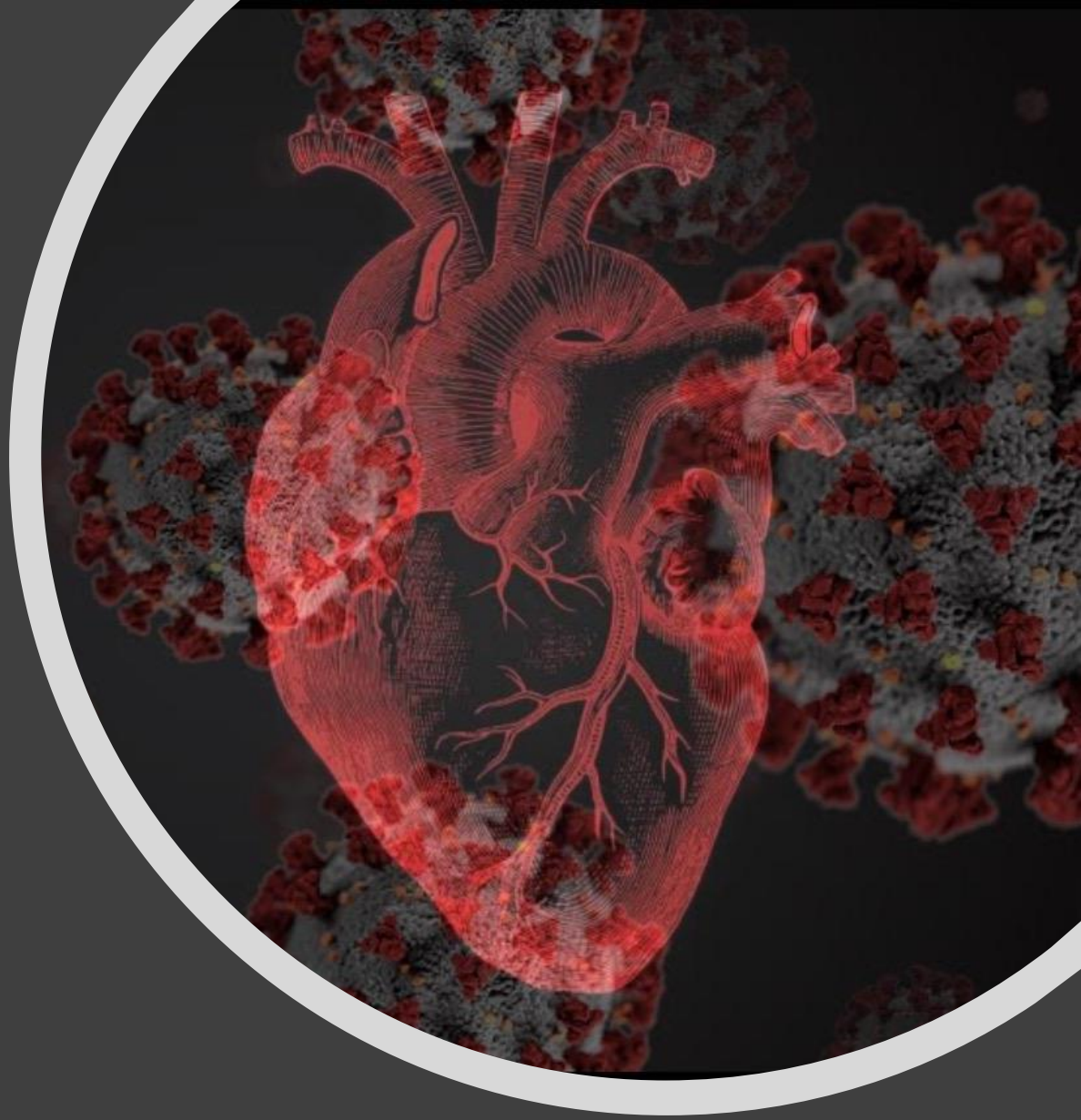

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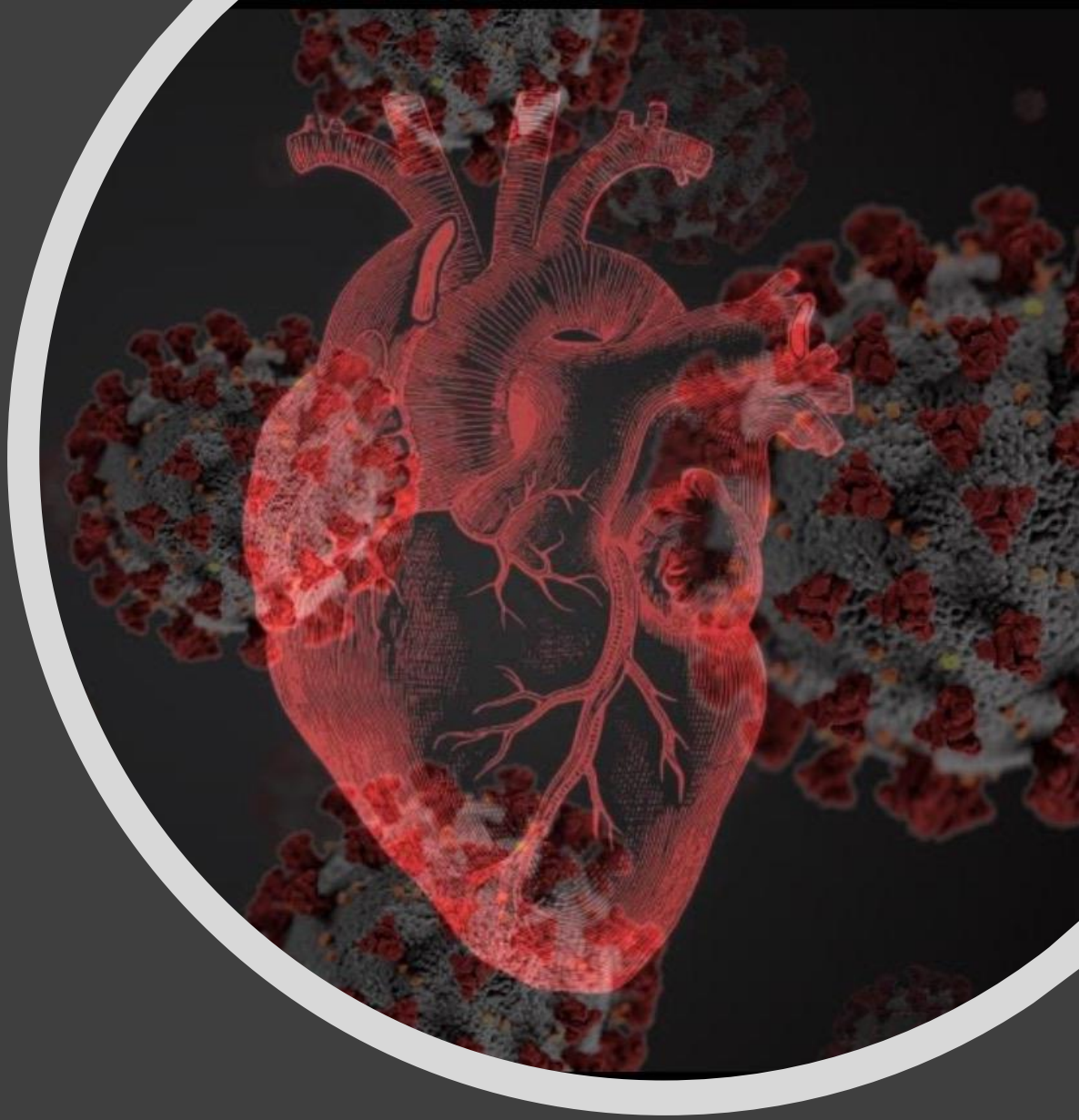


PART 2 – ONLINE COURSE

eHEALTH: MORE THAN JUST AN ELECTRONIC RECORD

by The University of Sydney

- Course Description
- Objectives of the Course
- Course Content
- Learning Methodology
- Key Learnings from the Course

coursera

❖ COURSE DESCRIPTION

- “eHealth: More than just an electronic record!, is multidisciplinary in nature, and aims to educate the global audience of health clinicians, students, managers, administrators, policy makers and researchers about the importance of eHealth and it’s reflection on the overall impact of care and well-being of the individuals”. It discusses the scope of technological use, existing and emerging trends, and also highlights eHealth experience, study and research both at the local and international levels.
- The instructor of the course is Professor Tim Shaw . He is inaugural Professor of eHealth, Director of Research in Implementation Science and eHealth Group (RISe) at The University of Sydney.
- The entire eHealth Course comprises of 5 modules and takes about 15 hours to complete.
- Duration: It is a Self-paced 5-week course
- Study time : 3 hours in a week
- Evaluating Units : Assignment 1 in Module 2 and Assignment 2 in Module 5 having 40% and 60% weightage, respectively.

❖ OBJECTIVES OF THE COURSE

- To know about the fundamentals of eHealth and its future aspect.
- To enlist the type of health data we are currently gathering and its impact on the transformation of healthcare in the future.
- To know the participation of health consumers in their own healthcare using new technologies.
- To determine how eHealth can enhance the coordination and effectiveness of healthcare.
- To enlist the barriers and challenges that are preventing the use of eHealth in practices.
- To know about the application of eHealth principles and technologies be professional practices.

COURSE CONTENTS

- **"Module 1 - What is eHealth?"**
- **Key question**: What are the fundamentals of eHealth and where is it heading?
- **"Module 2 - Health in our Hands"**
- **Key question**: How are new technologies helping consumers 'participate' in healthcare?
- **"Module 3 - Data and the "Quantified Self""**
- **Key question**: What kind of health data do we collect now and how will it transform healthcare in the future?
- **"Module 4 - Interacting with Health Professionals using New Technologies"**
- **Key question**: How can eHealth improve the coordination and efficiency of healthcare and what are the barriers?
- **"Module 5 - eHealth in Professional Practice"**
- **Key question**: How can eHealth principles and technologies be applied in my own professional practice?

❖ LEARNING METHODOLOGY

- There are various methodologies used in the to make the course most effective and learning.

➢ **Lectures,**

➢ **Videos,**

➢ **Ungraded learning activities like quizzes, and discussion prompt questions,**

➢ **Peer Graded Assignments and**

➢ **Reading materials**

➢ **Case Studies**

- Peer Graded Assignments I and II carrying weightage 40% and 60% respectively were used for evaluation.

❑ The **assignment I** is based on the rating and reviewing of health app using MARS Scale

❑ The **assignment II** is based on solving a practice-based eHealth case

KEY LEARNINGS FROM THE COURSE

Meaning of eHealth from both health consumers and healthcare professionals –

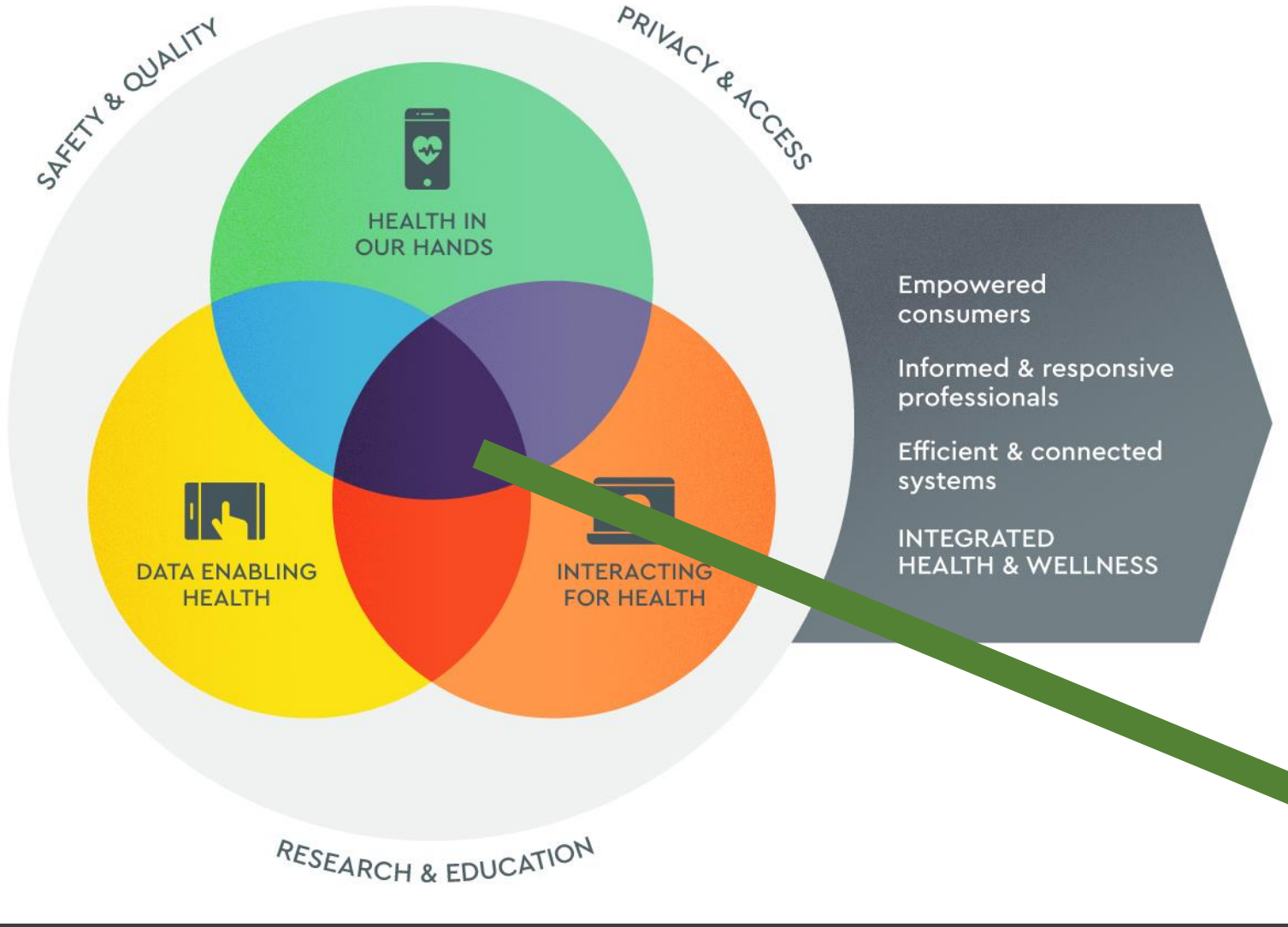
- Traditionally perhaps, many people refer thinks of eHealth as the use of electronic health records or devices, preferably in the acute sector which includes Hospital Care, Ambulatory Care Facility, Home Health Agency or Hospice.
- However this is not the complete context now, how people are using technology nowadays to foster communication and interaction between healthcare providers and consumers is one of the trending areas of eHealth.
- Perhaps the most rapidly expanding and evolving area of eHealth is known as ‘health in the hands of consumers. This includes the use of mobile apps, websites, social media, and wearable devices like Fitbit.
- eHealth empower both healthcare professionals and consumers to actively participate in their own ongoing health and well-being management effectively and efficiently.

❑eHealth Domains

- **Firstly, health in the hands of consumers**. This includes the growing usage of wearable devices, apps and social media among healthcare consumers to monitor and report on their health and wellbeing.
- **Secondly, how health professionals interact** and communicate with each other as well as with patients with the help of technology. This has conventionally been called as Telehealth, but it is far more than a regional video conferencing for rural patients.
- **Thirdly, data records in the quantified self**. This includes storage of data in traditional medical records through storage of data associated with devices and apps.

- Ideally any healthcare program being developed in future should consider or combine one or more aspects of these three domains for maximum health impact.
- The spot where all the three domains intersect and perhaps have the greatest impact on heath is known as the sweet spot.

❑ eHealth Model



SWEET SPOT

Image Source: (Shaw T, McGregor D, Brunner M, Keep M, Janssen A, Barnet S, 2017)" JMIR Publication

❑Improving Care: Ten eHealth advantages

1- Improved customer access

2- Care stays local

3- Benefit smaller centres

4- Expand provider reach

5- Diagnosis on the move

6- More service delivery option

7- Fast track diagnosis

8- Integrates care and daily life

9- Supports professional development

10- Offers professional flexibility

- **The Challenges and the Future -** There are many challenges faced by both healthcare professionals and consumers in implementing eHealth solutions nowadays and one must work through those through education, mentoring and training. Telemedicine and telehealth is bringing things to people in their homes virtually and this is going to be a big paradigm shift for healthcare services.

- **mHealth -** The use of apps, mobile devices, sensors, et cetera for health-related purpose is commonly referred to as mHealth or Mobile Health and it represents a significant and ever-changing component of eHealth.

- **Designing and evaluating eHealth solutions**

  eHealth depends entirely on the effectiveness of the interface that each of the users see while using the app. Co-design and building the interface shares vision of the app. The rating and reviewing of health app using MARS Scale is an important step.

- **Telemedicine-** Telemedicine is another technology that is ready to make practices increasingly profitable, improve patient outcomes, and give providers exceptional adaptability. Leading a few visits remotely utilizing telemedicine technology has huge upside potential for practices.

- **Predictive and Precision Medicine -** Professionals really need to endeavour to predict and collect individuals' data in a more personalized and precise way to deliver healthcare more effectively. This is called as precision medicine.

- **Electronic health records** - An electronic health record (EHR) is a digital version of a paper chart related patient's health. It improves the overall quality of care by enabling a patients' history to be tracked over time, monitoring patients' vital signs and alerting patients for routine or follow up consultations.

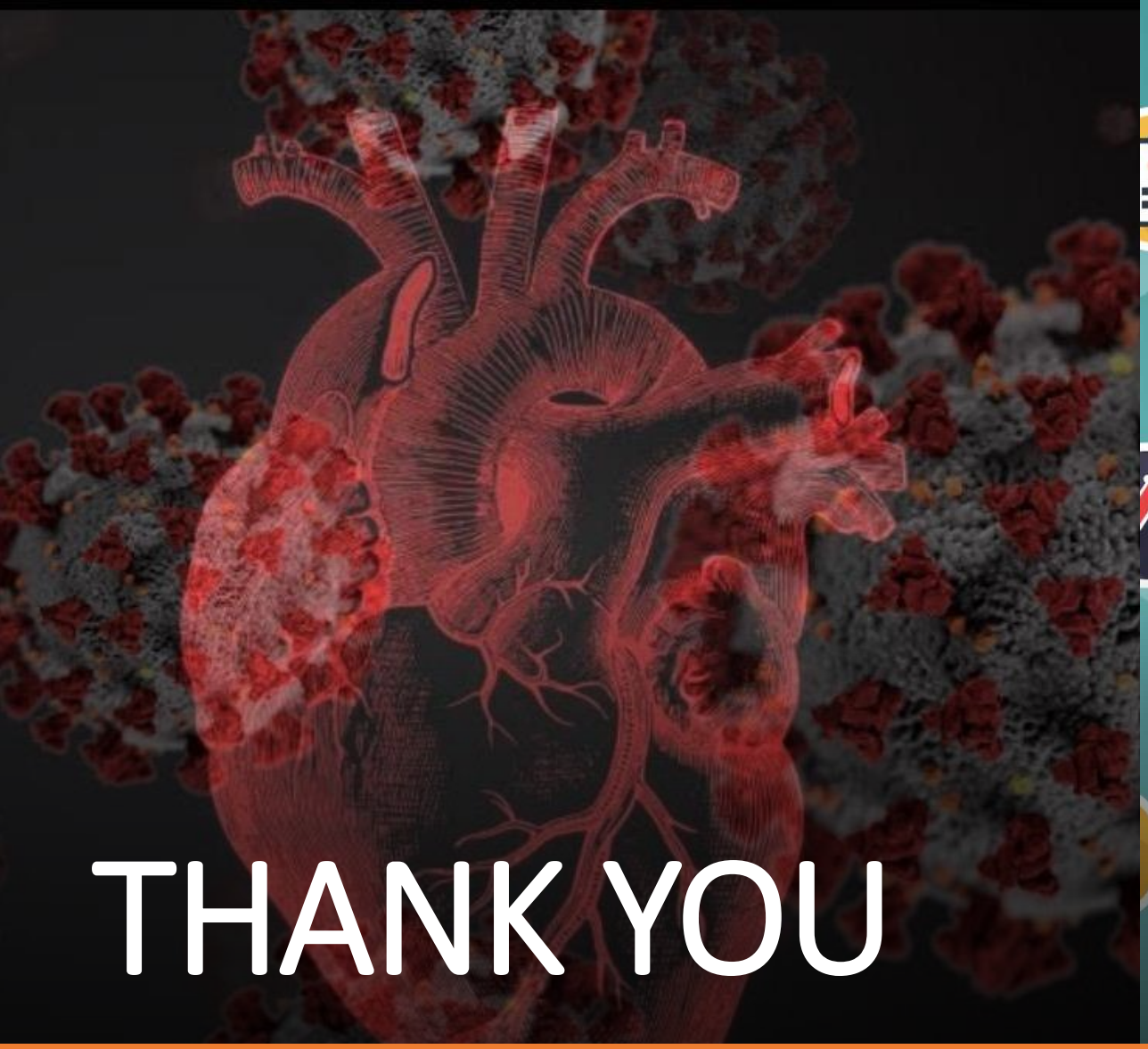
❑ Public Health Lessons

Here are a few of the eHealth benefits from a perspective of public health professional -

1. Reduce Cost thereby working towards equity and affordable healthcare.
2. Improved Patient Health Outcomes which helps in reduction of global burden of diseases.
3. Prevent Risk of Infection as evidenced recently during pandemic COVID-19.
4. Enhancement of collaboration spirit.
5. The eHealth tools allow information to easily and readily be accessed in one place, making healthcare more efficient.
6. Improving Patients Safety and reducing errors.
7. Supporting patients to become informed consumers who take an active role in their own healthcare.
8. Improve communication among healthcare stakeholders.
9. Encourage disease prevention and wellness.
10. Maintenance of independent living for those with chronic illness, and a reduction in the use of secondary care.

❑ INDIA SHOULD PROGRESS TOWARDS

- Our home should be the hospital of the future- home care
- Digital hospitals
- ‘Synergy’ like online hub for mental health and wellbeing
- The ‘My Home Dialysis Program’
- Digital eHealth games
- More mHealth – Development of apps
- Electronic Records supporting remote care
- Awareness among individuals about Telemedicine or Telehealth.



THANK YOU