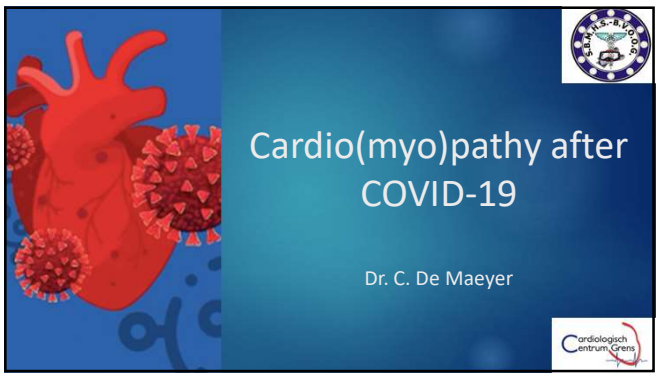
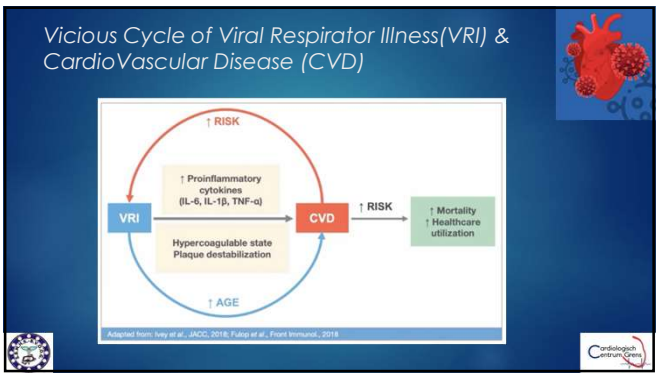
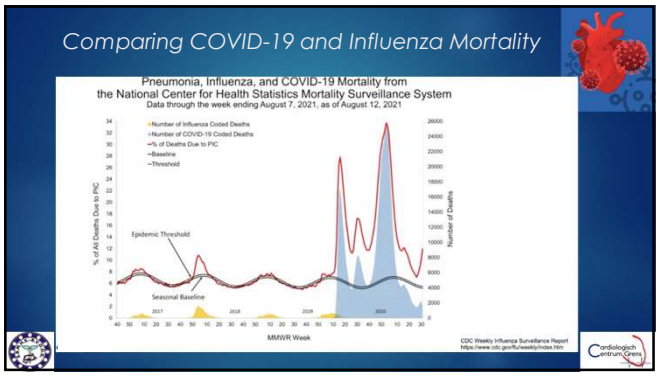

Cardio(myo)pathy after COVID-19
Dr. C. De Maeyer

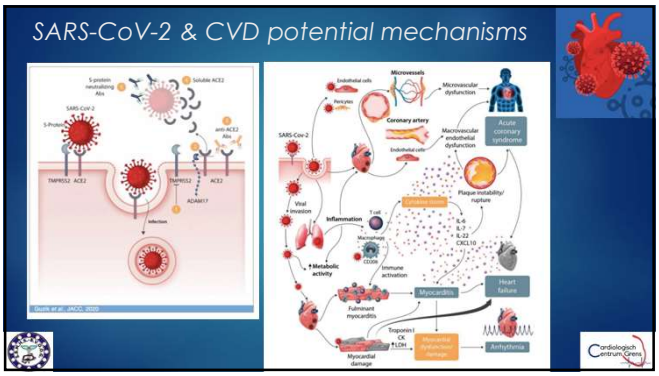
1


Vicious Cycle of Viral Respirator Illness(VRI) & CardioVascular Disease (CVD)
↑ RISK
↑ Proinflammatory cytokines (IL-6, IL-1β, TNF-α)
VRI
CVD
↑ RISK
↑ Mortality
↑ Healthcare utilization
Hypercoagulable state
Plaque destabilization
↑ AGE

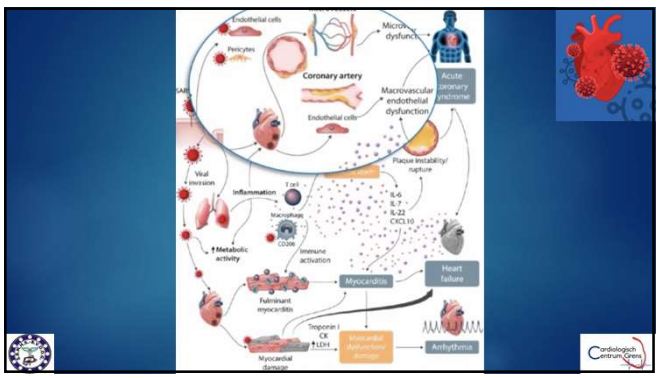
2


Comparing COVID-19 and Influenza Mortality
Pneumonia, Influenza, and COVID-19 Mortality from the National Center for Health Statistics Mortality Surveillance System
Data through the week ending August 7, 2021, as of August 12, 2021
Epidemic Threshold
Seasonal Baseline
MMWR Week

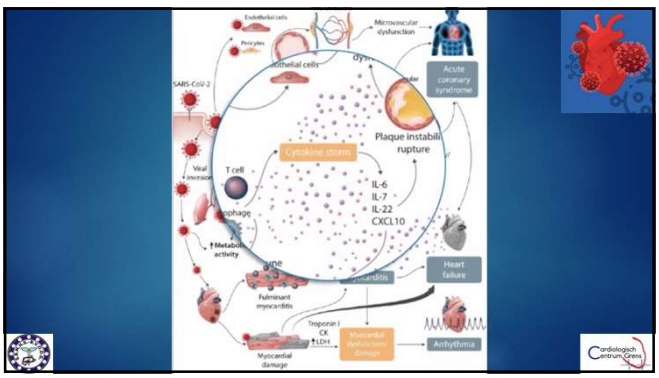
3


SARS-CoV-2 & CVD potential mechanisms

4

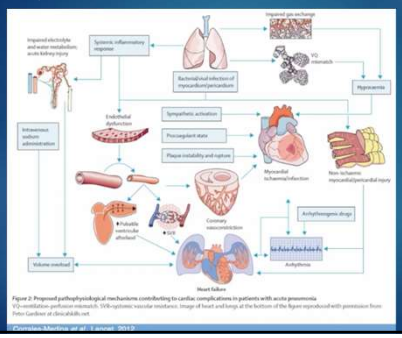

Coronary artery
Acute coronary syndrome
Plaque instability/ rupture
Myocarditis
Heart failure
Arrhythmia

5


Acute coronary syndrome
Plaque instabili rupture
IL-6
IL-7
IL-22
CXCL10
Heart failure
Arrhythmia

6

Flu, Pneumonia & CVD Mechanisms



7

CV Risk Factors ⬆ COVID-19 Complications

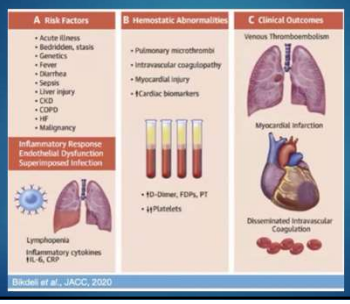
- Versus influenza:
  - ~10-fold higher hospitalizations
  - ~5-10 times higher mortality rate
- Patients with cardiac injury have 50% mortality rate
  - Multivariable adjustment ~4-fold HR
  - Many patients die of multiple organ failure, shock, ARDS, myocarditis, HF, arrythmias

Condition	Death rate	Confirmed cases
Cardiovascular disease	10.5%	873
Diabetes	7.3	1,102
Chronic respiratory disease	6.3	511
Hypertension	6	2,683
Cancer	5.6	107
None	0.9	15,536

Kennedy Elliott, National Geographic; from WHO, 2020

8

Spectrum of COVID-19 inflammatory & prothrombotic syndromes



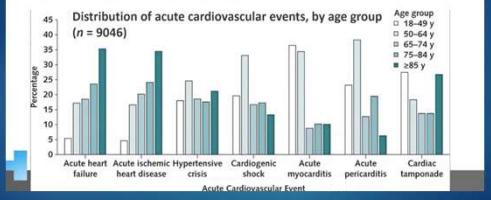
Bikdeli et al., JACC, 2020

9

Annals of Internal Medicine — ORIGINAL RESEARCH

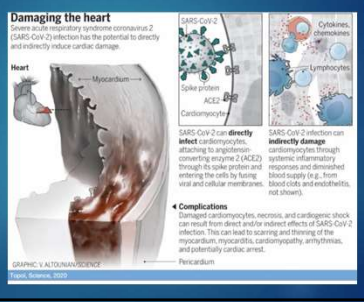
Acute Cardiovascular Events Associated With Influenza in Hospitalized Adults
A Cross-sectional Study

Cross-sectional analyses of 61,856 admissions with influenza



10

Among survivors, cardiac injury may persist



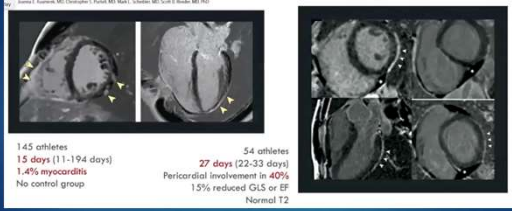
11

EuroCMR2021

JAMA Cardiology | Brief Report

Evaluation for Myocarditis in Competitive Student Athletes Recovering From Coronavirus Disease 2019 With Cardiac Magnetic Resonance Imaging

High Prevalence of Pericardial Involvement in College Student Athletes Recovering From COVID-19

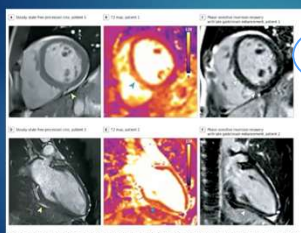


145 athletes
15 days (11-194 days)
1.4% myocarditis
No control group

54 athletes
27 days (22-33 days)
Pericardial involvement in 40%
15% reduced GLS or EF
Normal T2

12

Cardiovascular Magnetic Resonance Findings in Competitive Athletes Recovering form COVID-19 Infection



- 26 competitive athletes, 19.5 years
- 12 with mild symptoms, 14 no symptoms
- 11-53 days post infection
- 15% had myocarditis using LLC
- 42% had LGE
- T2 higher than normal range

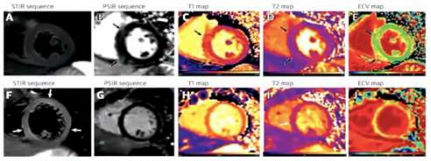
Lake Louise Criteria in Myocarditis
the primary purpose of LLC is to gauge the pretest likelihood to engage with endomyocardial biopsy, and not guiding treatment
Caforio et al EHJ2013

Rajpal, et al. JAMA Cardiol. Published online September 11, 2020. doi:10.1001/jamacardio.2020.4916

13

Cardiac Involvement in Patients Recovered From COVID-2019 Identified Using Magnetic Resonance Imaging

- 26 patients (age median **38 years**; IQR: 32-45; 10 male)
- Hospitalization due to COVID-19 pneumonia
- All received antiviral and antibiotic therapy
- Oxygen support was given to 21 (81%) patients
- **CMR 47 days (IQR: 36 to 58 days)** from ED in patients with new cardiac symptoms



T2W: 14 (54%) LGE: 15 (58%) Elevated T1 p=0.01 Elevated T2 p=0.03 Elevated ECV p=0.03

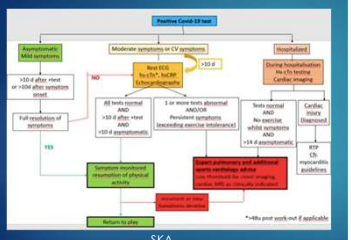
58% has Lake Louise Criteria based myocarditis

No significant difference of LV function

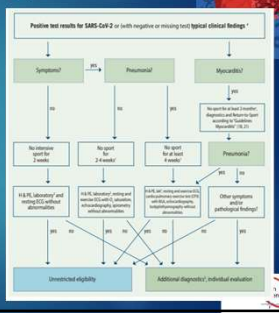
JACC CVI 2020

14

Return to sports after Covid-19



SKA



GJSM

15

Long COVID – history in the making

- Patient created term
- constellation of symptoms experienced by patients > 6-12 weeks from acute infection
- Multiorgan involvement suspected

nature

Long COVID: let patients help define long-lasting COVID symptoms

The terminology for long-lasting COVID symptoms – and the definition of recovery – must incorporate patients' perspectives.

LongCovidSOS

LONG COVID SUPPORT facebook

16

Manifestations of Cardiac Long COVID

Manifestations of Cardiac Long COVID

- ***Struggling to regain fitness***
- ***Dyspnea on minimal exertion***
- ***Palpitations***
- ***Tachycardia, hypertension***
- ***Burning chest pain***

Sudden attacks of

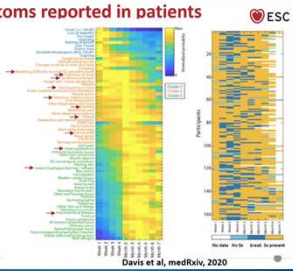
- Delayed onset ~ 2 months ('I should be fit by now!')
- ***Fatigue, siesta syndrome, joint pains, tinnitus, recurrent fever***
- Fluctuation (good and bad days)
- Not only those with severe acute COVID or hospitalised

17

More than 200 symptoms reported in patients post-COVID-19

ESC

- 3762 respondents from 56 countries
- International web-based survey
- 79% women
- At six months: Fatigue (77%), post exertional malaise (72%), cognitive dysfunction (55%)
- 10 cardiac symptoms (arrows)



Davis et al, medRxiv, 2020

18

Follow-up study of hospitalised patients

THE LANCET
6-month consequences of COVID-19 in patients discharged from hospital: a cohort study

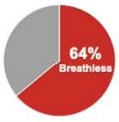
- 1733 PCR+patients
- Fatigue (63%), sleep difficulties (26%)
- abnormal chest CT (54%), DLCO (upto 56%)
- Age, female sex and diseases severity were predictors of persistent fatigue
- Use of specific therapies including steroids were not associated with ongoing symptoms

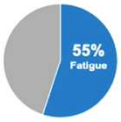
Huang et al, Lancet, 2021

19

Persistent breathlessness and fatigue in COVID-19 survivors

- 64% experienced symptoms of breathlessness (MRC dyspnoea score ≥2)
- 55% reported moderate to severe fatigue (FSS ≥4)



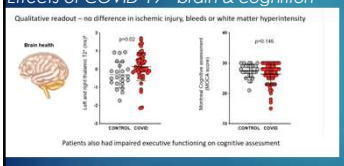


Raman et al, Eclinical Medicine, 2021

PHOSP-COVID C-MORE

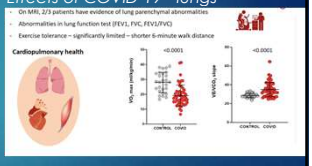
20

Effects of COVID-19 - brain & cognition



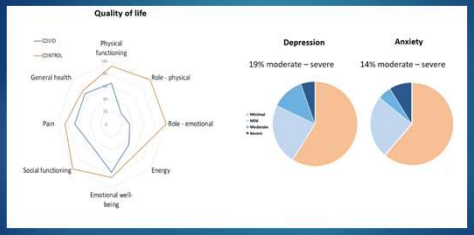
Effects of COVID-19 - lungs

- On MRI, 2/3 patients have evidence of lung parenchymal abnormalities
- Abnormalities in lung function test (FEV1, FVC, FEV1/FVC)
- Exercise tolerance – significantly limited – shorter 6-minute walk distance



21

Effects of COVID-19 on QoL and mental health



22

Annals of Internal Medicine — Original Research

Acute Cardiovascular Events Associated With Influenza in Hospitalized Adults
A Cross-sectional Study
2020

New study of more than 80,000 adults hospitalized with flu found serious, sudden heart complications were common.

ONE in EIGHT patients had sudden heart complications.

Of these patients, almost one-third were admitted to the ICU and 7% died.

Get a FLU VACCINE to reduce the risk of flu complications, including sudden onset of cardiac disease.

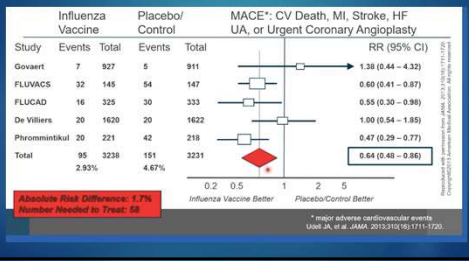
Older age, tobacco use, underlying cardiovascular disease, diabetes, and renal disease were significantly associated with higher risk for aHF and aIHD in adults hospitalized with laboratory-confirmed influenza.

FluSurv-Net: https://www.cdc.gov/flu/spotlights/2019-2020/cardiac-events-flu.htm

WWW.CDC.GOV/FLU

23

Influenza vaccination was associated with a lower risk of major CV events in a meta-analysis of small RCT's



24

mRNA Vaccines

- Pfizer-BioNTech BNT162b2:
  - Approved in many jurisdictions 12y+
  - 2 doses: d1, d21
  - Clinical trial efficacy:
    - 16+ yrs → 95% effective @ 1w following 2nd dose
    - 12-15 yrs → 100% protection
- Moderna mRNA-1273:
  - Approved in some jurisdictions 18y+
  - 2 doses: d1, d30
  - Clinical trial efficacy:
    - 94.1% effective @ 2w following 2nd dose

25

Viral Vector-Based Vaccines

- AstraZeneca ChAdOx1:
  - Approved 18y+
  - 2 doses: d1, d2 @ w4 to 12
  - 62% effective @ 2w following 2nd dose
- Janssen/JnJ:
  - Approved 18y+
  - 1 dose
  - 66% effective @ 2w following single dose

26

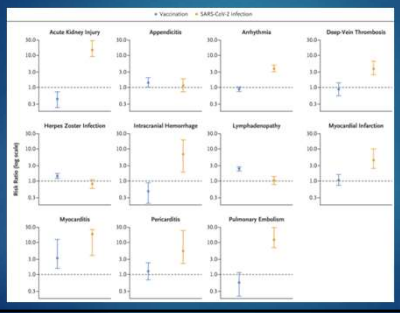
Comparing Clinical Trials versus Real-World Studies of mRNA & Viral Vector-BasecVaccines

BNT162b2 and mRNA-1273 COVID-19 vaccines	BNT162b2 mRNA and ChAdOx1 vaccines	BNT162b2 mRNA vaccine	BNT162b2 mRNA vaccine	BNT162b2 mRNA vaccine
Thompson et al., MMWR, March 29, 2021	Vasileiou et al., Lancet, April 23, 2021	Abu-Raddad & Butt., NEJM, May 5, 2021	Dagan et al., NEJM, April 15, 2021	Haas et al., Lancet, May 5, 2021
USA ➢ HEROES-RECOVER network ➢ 3950 1st responders, frontline/essential, HCPs ➢ Dec 2020 to Mar 2021	Scotland ➢ EAVE II database ➢ 5.4m people ➢ d1 only ➢ Outcome: C19 hospitalizations ➢ Dec 2020 to Feb 2021	Qatar ➢ d1: 385,853 persons, d2: 265,41 persons ➢ B.1.1.7 variant started mid-Jan, peaked early Mar ➢ B.1.351 variant started mid-Feb, peaked mid-Mar ➢ Dec 2020 to March 2021	Israel ➢ 1.14 million people ➢ Matched 1:1 vaccinated & unvaccinated ➢ Endpoints: a range of outcomes across diverse populations in a noncontrolled setting ➢ Dec 2020 to Feb 2021	Israel ➢ N = 232 268 SARS-CoV-2 infections ➢ 94.5% of infections B.1.1.7 variant ➢ By April 3, 2021, 72·1% of people 16+ were fully vaccinated with 2 doses ➢ Jan to April 2021
Authorized mRNA COVID-19 vaccines are effective for preventing SARS-CoV-2 infection, regardless of symptom status, among working-age adults in real-world conditions (90%)	Substantial reductions in the risk of hospital admission due to COVID-19 in Scotland (Pfizer: 91%, AZ: 88%) using a mass roll-out program.	Vaccine effectiveness against the B.1.1.7 and B.1.351 variants were 89.5% and 75% respectively, however was 97.4% effective in preventing severe disease.	The vaccine is effective for a wide range of Covid-19–related outcomes, and consistent with that of the randomized trial (at 95%).	Two doses of BNT162b2 are highly effective across all age groups (95-97%), with marked and sustained declines in SARS-CoV-2 incidence corresponding to increasing vaccine coverage.

All findings are consistent with evidence to suggest that COVID-19 vaccination can help to control the pandemic.

27

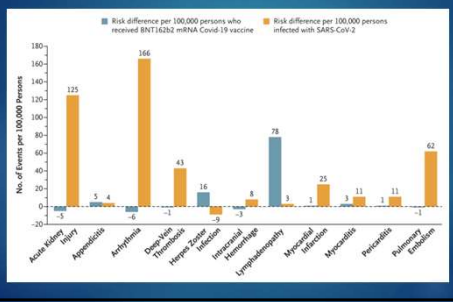
Risk Ratios for Adverse Events after Vaccination or SARS-CoV-2 Infection



Barda N et al. NEJM 2021; 385:1078-1090

28

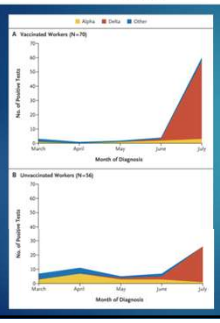
Absolute Excess Risk of Various Adverse Events after Vaccination or SARS-CoV-2 Infection



Barda N et al. NEJM 2021; 385:1078-1090

29

Resurgence of SARS-CoV-2 Infection in a Highly Vaccinated Health System Workforce



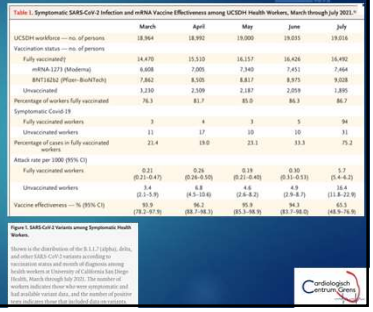


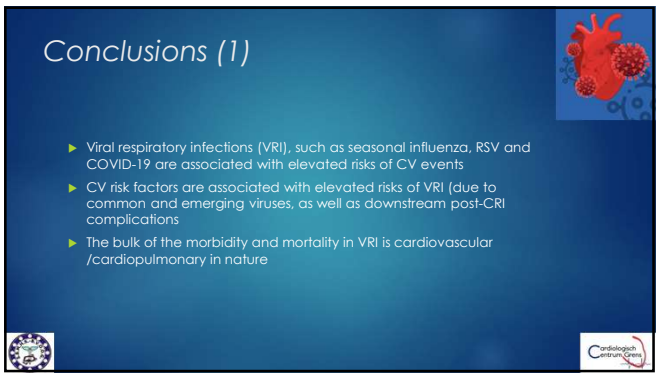
Table 1. Symptomatic SARS-CoV-2 Infection and mRNA Vaccine Effectiveness among UCSDH Health Workers, March through July 2021.*

	March	April	May	June	July
UCSDH workforce — no. of persons	18,964	18,992	19,000	19,035	19,016
Vaccination status — no. of persons					
Fully vaccinated†	14,470	15,510	16,157	16,426	16,492
mRNA-1273 (Moderna)	6,608	7,005	7,340	7,451	7,464
BNT162b2 (Pfizer–BioNTech)	7,862	8,505	8,817	8,975	9,028
Unvaccinated	3,230	2,509	2,187	2,059	1,895
Percentage of workers fully vaccinated	76.3	81.7	85.0	86.3	86.7
Symptomatic Covid-19					
Fully vaccinated workers	3	4	3	5	94
Unvaccinated workers	11	17	10	10	31
Percentage of cases in fully vaccinated workers	21.4	19.0	23.1	33.3	75.2
Attack rate per 1000 (95% CI)					
Fully vaccinated workers	0.21 (0.21–0.47)	0.26 (0.26–0.50)	0.19 (0.21–0.40)	0.30 (0.31–0.53)	5.7 (5.4–6.2)
Unvaccinated workers	3.4 (2.1–5.9)	6.8 (4.3–10.6)	4.6 (2.6–8.2)	4.9 (2.9–8.7)	16.4 (11.8–22.9)
Vaccine effectiveness — % (95% CI)	93.9 (79.2–97.9)	96.2 (88.7–98.3)	95.9 (85.3–98.9)	94.3 (83.7–98.0)	65.3 (48.9–76.9)

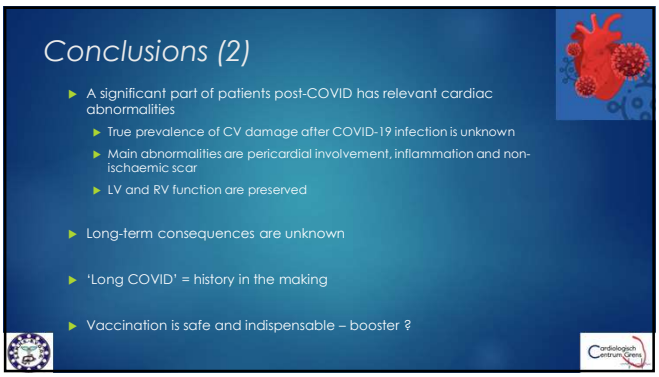
Figure 1. SARS-CoV-2 Variants among Symptomatic Health Workers.

Shown is the distribution of the B.1.1.7 (alpha), delta, and other SARS-CoV-2 variants according to vaccination status and month of diagnosis among health workers at University of California San Diego Health, March through July 2021. The number of workers indicates those who were symptomatic and had available variant data, and the number of positive tests indicates those who provided data on vaccination

30



31



32