Supplemental Online Content

Epidemiology of Myocarditis Following COVID-19 or Influenza and Use of Diagnostic Assessments

List of Codes

eTable 1: Diagnoses

Diagnosis	ICD-10 Code
Influenza	J09.X Influenza due to identified novel influenza A virus • J09.X1 …… with pneumonia • J09.X2 …… with other respiratory manifestations • J09.X3 …… with gastrointestinal manifestations • J09.X9 …… with other manifestations J10.0 Influenza due to other identified influenza virus with pneumonia • J10.00 Influenza due to other identified influenza virus with unspecified type of pneumonia • J10.01 Influenza due to other identified influenza virus with the same other identified influenza virus pneumonia • J10.08 Influenza due to other identified influenza virus with other specified pneumonia • J10.1 Influenza due to other identified influenza virus with other respiratory manifestations • J10.2 Influenza due to other identified influenza virus with gastrointestinal manifestations J10.8 Influenza due to other identified influenza virus with other manifestations • J10.81 Influenza due to other identified influenza virus with encephalopathy • J10.82 Influenza due to other identified influenza virus with myocarditis • J10.83 Influenza due to other identified influenza virus with otitis media • J10.89 Influenza due to other identified influenza virus with other manifestations J11.0 Influenza due to unidentified influenza virus with pneumonia • J11.00 Influenza due to unidentified influenza virus with unspecified type of pneumonia • J11.08 Influenza due to unidentified influenza virus with specified pneumonia • J11.1 Influenza due to unidentified influenza virus with other respiratory manifestations

Epidemiology of Myocarditis Following COVID-19 or Influenza and Use of Diagnostic Assessments: Supplementary Online Content

	• J11.2 Influenza due to unidentified influenza virus with gastrointestinal manifestations J11.8 Influenza due to unidentified influenza virus with other manifestations • J11.81 Influenza due to unidentified influenza virus with encephalopathy • J11.82 Influenza due to unidentified influenza virus with myocarditis • J11.83 Influenza due to unidentified influenza virus with otitis media • J11.89 Influenza due to unidentified influenza virus with other manifestations
COVID-19	• U07.1 COVID-19, virus identified • B97.29 Other coronavirus as the cause of diseases classified elsewhere • J12.82 Pneumonia due to coronavirus disease 2019 • Z86.16Personal history of COVID-19
Myocarditis	• I40.0 Infective myocarditis • I40.1 Isolated myocarditis • I40.8 Other acute myocarditis • I40.9 Acute myocarditis, unspecified • I41 Myocarditis in diseases classified elsewhere • I51.4 Myocarditis, unspecified

Epidemiology of Myocarditis Following COVID-19 or Influenza and Use of Diagnostic Assessments: Supplementary Online Content

eTable 2: Diagnostic assessments

Diagnostic Assessment	CPT & ICD Codes	Description
Electrocardiogram		
	93000	Electrocardiogram, routine ECG with at least 12 leads; with interpretation and report
	93005	Electrocardiogram, routine ECG with at least 12 leads; tracing only, without interpretation and report
	93010	Electrocardiogram, routine ECG with at least 12 leads; interpretation and report only
	93040	Rhythm ECG, 1-3 leads; with interpretation and report
	93041	Rhythm ECG, 1-3 leads; tracing only without interpretation and report
	93042	Rhythm ECG, 1-3 leads; interpretation and report only
Echocardiography		
	93306	Echo Tthrc R-T 2d W/Wommode Compl Spec&Colr D (CPT)
	93307	Echo Transthorac R-T 2d W/Wo M-Mode Rec Comp (CPT)
	93308	Echo Transthorc R-T 2d W/ Wo M-Mode Rec F-Up/Lmtd (CPT)
	93320	Doppler Echocard Pulse Wave W/Spectral Display (CPT)
	93325	Dop Echocard Color Flow Velocity Mapping (CPT)
	B244ZZZ (Ultrasonography of Right Heart), B24DZZ4 (Ultrasonography of Pediatric Heart, Transesophageal), B24DYZZ (Ultrasonography of Pediatric Heart using Other Contrast), B244ZZ4 (Ultrasonography of Right Heart, Transesophageal),	Diagnostic Ultrasound Of Heart (ICD-10-PCS)

Epidemiology of Myocarditis Following COVID-19 or Influenza and Use of Diagnostic Assessments: Supplementary Online Content

	B24DZZZ (Ultrasonography of Pediatric Heart), B245ZZ4 (Ultrasonography of Left Heart, Transesophageal), B246ZZ4 (Ultrasonography of Right and Left Heart, Transesophageal), B245YZZ (Ultrasonography of Left Heart using Other Contrast), B244YZZ (Ultrasonography of Right Heart using Other Contrast), B245ZZZ (Ultrasonography of Left Heart), B246ZZZ (Ultrasonography of Right and Left Heart), B246YZZ (Ultrasonography of Right and Left Heart using Other Contrast)	
Blood tests		
	83880	BNP
	86140	C-reactive Protein
	84484	Troponin, quantitative
	84485	Troponin, qualitative
	85651	Sedimentation Rate, Erythrocyte, Non-Automated
	85652	Sedimentation Rate, Erythrocyte, Automated
	86255	Myocardial Antibody Screen with Reflex to Titer
	86256	Myocardial Antibody Screen with Reflex to Titer
FDG-PET		
	78459	Myocardial imaging, PET, metabolic evaluation study (including ventricular

Epidemiology of Myocarditis Following COVID-19 or Influenza and Use of Diagnostic Assessments: Supplementary Online Content

		wall motion[s], and/or ejection fraction[s], when performed), single study
	78429	With concurrently acquired CT transmission scan
	78491	Myocardial imaging, PET, perfusion study (including ventricular wall motion[s], and/or ejection fraction[s], when performed); single study, at rest or stress (exercise or pharmacologic)
	78430	Myocardial imaging, PET, perfusion study (including ventricular wall motion[s], and/or ejection fraction[s], when performed); single study, at rest or stress (exercise or pharmacologic), with concurrently acquired CT transmission scan
	78492	Multiple studies at rest and stress (exercise or pharmacologic)
	78431	Myocardial imaging, PET, perfusion study (including ventricular wall motion[s], and/or ejection fraction[s], when performed); multiple studies at rest and stress (exercise or pharmacologic), with concurrently acquired CT transmission scan
	78432	Myocardial imaging, PET, combined perfusion with metabolic evaluation study (including ventricular wall motion[s], and/or ejection fraction[s], when performed), dual radiotracer (eg, myocardial viability)
	78433	With concurrently acquired CT transmission scan
	78434	AQMBF, PET, rest, and pharmacologic stress (list separately in addition to code for primary procedure)
Invasive Coronary Angiography (ICA)		
	93451	Right heart catheterization
	93452	Left heart catheterization
	93453	Right and left heart catheterization
	93454	Coronary angiography
	93455	Coronary angiography with bypass grafts

Epidemiology of Myocarditis Following COVID-19 or Influenza and Use of Diagnostic Assessments: Supplementary Online Content

	93456	Coronary angiography with right heart catheterization
	93457	Coronary angiography and bypass grafts, with right heart catheterization
	93458	Coronary angiography with left heart catheterization
	93459	Coronary angiography and bypass grafts, with left heart catheterization
	93460	Coronary angiography with right and left heart catheterization
	93461	Coronary angiography with bypass grafts, right and left heart catheterization
Endomyocardial biopsy		
	93505	Endomyocardial biopsy
	02BK3ZX	Excision of Ventricle, Right, Percutaneous Approach, Diagnostic
	02BL3ZX	Excision of Ventricle, Left, Percutaneous Approach, Diagnostic
Cardiac MRI non-contrast enhanced (CMR-nCE)		
	75557	Cardiac magnetic resonance imaging for morphology and function without contrast material;
	75558	with flow/velocity quantification
	75559	with stress imaging
	75560	with flow/velocity quantification and stress
Cardiac MRI contrast enhanced (CMR-CE)		
	75561	Cardiac magnetic resonance imaging for morphology and function without contrast material(s) followed by contrast material(s) and further sequences;

Epidemiology of Myocarditis Following COVID-19 or Influenza and Use of Diagnostic Assessments: Supplementary Online Content

	75562	with flow/velocity quantification
	75563	with stress imaging
	75564	with flow/velocity quantification and stress
Gadolinium based contrast agents		
	A9575	Injection, gadoterate meglumine (Dotarem), 0.1 ml
	A9576	Injection, gadoteridol, (Prohance multipack), per ml
	A9577	Injection, gadobenate dimeglumine (Multihance), per ml
	A9578	Injection, gadobenate dimeglumine (Multihance multipack), per ml
	A9585	Injection, gadobutrol (Gadovist), 0.1 ml
	A9583	Injection, gadofosveset trisodium (Ablavar), 1 ml
	A9581	Injection, gadoxetate disodium (Primovist), 1 ml
	A9579	Injection, gadolinium-based magnetic resonance contrast agent, not otherwise specified (not otherwise specified), per ml

Epidemiology of Myocarditis Following COVID-19 or Influenza and Use of Diagnostic Assessments: Supplementary Online Content

eTable 3: Covariates

Demographics	
Age Age at index date	Age is computed from the patient's date of birth.
Gender Gender at index date	This variable categorizes the gender of the patient (Male or Female).
Race Race at index date	This variable categorizes the patient's race (White, Asian, Black, Hispanic, or Unknown).
Comorbidities	
Hypertension Occurrence of hypertension during the baseline period	This variable is defined using any of the following ICD-9/ICD-10 codes in any position in inpatient or outpatient setting ● ICD-10: "H35.039", "I10", "I11.0", "I11.9", "I12.0", "I13.11", "I15.0", "I15.9", ● ICD-9: "401", "401.0", "401.1", "401.9", "402", "402.0", "402.00", "402.1", "402.10", "402.9", "402.90", "403", "403.0", "403.00", "403.01", "403.1", "403.10", "403.11", "403.9", "403.90", "403.91", "404", "404.0", "404.00", "404.01", "404.02", "404.03", "404.1", "404.10", "404.11", "404.12", "404.13", "404.9", "404.90", "404.91", "404.92", "404.93", "405", "405.0", "405.01", "405.09", "405.1", "405.11", "405.19", "405.9", "405.91", "405.99" List of codes provenance: Tonelli et al., 2016 (5)
Hyperlipidemia Occurrence of hyperlipidemia during the baseline period	This variable is defined using any of the following ICD-9/ICD-10/CPT/HCPCS codes in any position in inpatient or outpatient setting ● CPT/HCPCS Procedure Code: "0556F", "G8585" ● ICD-10: "E78.1", "E78.2", "E78.4", "E78.5" ● ICD-9: "272.0", "272.1", "272.2", "272.4" List of codes provenance: Bellows et al., 2017 (6)
Tobacco use Occurrence of tobacco use during the baseline period	This variable is defined using any of the following ICD-9/ICD-10 codes in any position in inpatient and outpatient setting: ● ICD-10: "F17.200", "Z87.891" ● ICD-9: "305.1", "V15.82" List of codes provenance: Kadri et al., 2021 (7)

Epidemiology of Myocarditis Following COVID-19 or Influenza and Use of Diagnostic Assessments: Supplementary Online Content

Obesity Occurrence of obesity during the baseline period	This variable is defined using any of the following ICD-9/ICD-10 codes in any position in inpatient or outpatient setting: ● ICD-10: "E66.01", "E66.2", "E66.3", "E66.9", "R63.5", "R93.9", "Z68.30", "Z68.31", "Z68.32", "Z68.33", "Z68.34", "Z68.35", "Z68.36", "Z68.37", "Z68.38", "Z68.39", "Z68.41", "Z68.42", "Z68.43", "Z68.44", "Z68.45" ● ICD-9: "278.0", "278.00", "278.01", "278.02", "278.03", "783.1", "793.91", "V85.3", "V85.30", "V85.31", "V85.32", "V85.33", "V85.34", "V85.35", "V85.36", "V85.37", "V85.38", "V85.39", "V85.4", "V85.41", "V85.42", "V85.43", "V85.44", "V85.45" List of codes provenance: Ammann et al., 2019 (8)
History of coronary artery disease (CAD) Occurrence of CAD during the baseline period	This variable is defined using any of the following ICD-9/ICD-10 codes in any position in inpatient or outpatient setting: ● ICD-10: "I20.0", "I20.1", "I20.8", "I20.9", "I21.09", "I21.11", "I21.19", "I21.29", "I21.3", "I21.4", "I24.0", "I24.1", "I24.8", "I25.10", "I25.2", "I25.3", "I25.41", "I25.42", "I25.5", "I25.810", "I25.811", "I25.812", "I25.82", "I25.83", "I25.84", "I25.89", "I25.9" ● ICD-9: "410", "410.0", "410.00", "410.01", "410.02", "410.1", "410.10", "410.11", "410.12", "410.2", "410.20", "410.21", "410.22", "410.3", "410.30", "410.31", "410.32", "410.4", "410.40", "410.41", "410.42", "410.5", "410.50", "410.51", "410.52", "410.6", "410.60", "410.61", "410.62", "410.7", "410.70", "410.71", "410.72", "410.8", "410.80", "410.81", "410.82", "410.9", "410.90", "410.91", "410.92", "411", "411.0", "411.1", "411.8", "411.81", "411.89", "412", "413", "413.0", "413.1", "413.9", "414", "414.0", "414.00", "414.01", "414.02", "414.03", "414.04", "414.05", "414.06", "414.07", "414.1", "414.10", "414.11", "414.12", "414.19", "414.2", "414.3", "414.4", "414.8", "414.9" List of codes provenance: Peterson et al., 2012, Bertuccio et al., 2011 (9,10)

Epidemiology of Myocarditis Following COVID-19 or Influenza and Use of Diagnostic Assessments: Supplementary Online Content

History of myocardial infarction (MI) Occurrence of history of MI during the baseline period	This variable is defined using any of the following ICD-9/ICD-10 codes in any position in inpatient or outpatient setting: ● ICD-10: "I25.2" ● ICD-9: "412" List of codes provenance: Bayer
Diabetes type 1 and 2 Occurrence of diabetes type 1 or 2 during the baseline period	This variable is defined using any of the following ICD-9/ICD-10 codes in any position in inpatient or outpatient setting ● ICD-10: "E08.01", "E08.10", "E08.11", "E08.21", "E08.311", "E08.319", "E08.36", "E08.39", "E08.40", "E08.41", "E08.42", "E08.43", "E08.44", "E08.49", "E08.51", "E08.610", "E08.618", "E08.620", "E08.621", "E08.622", "E08.628", "E08.630", "E08.638", "E08.641", "E08.65", "E08.69", "E08.8", "E08.9", "E09.01", "E09.10", "E09.11", "E09.21", "E09.311", "E09.319", "E09.36", "E09.39", "E09.40", "E09.41", "E09.42", "E09.43", "E09.44", "E09.49", "E09.51", "E09.610", "E09.618", "E09.620", "E09.621", "E09.622", "E09.628", "E09.630", "E09.638", "E09.641", "E09.649", "E09.65", "E09.69", "E09.8", "E09.9", "E10.10", "E10.11", "E10.21", "E10.29", "E10.311", "E10.319", "E10.36", "E10.39", "E10.40", "E10.51", "E10.618", "E10.620", "E10.621", "E10.622", "E10.628", "E10.630", "E10.638", "E10.641", "E10.649", "E10.65", "E10.69", "E10.8", "E10.9", "E11.00", "E11.01", "E11.21", "E11.29", "E11.311", "E11.319", "E11.36", "E11.39", "E11.40", "E11.51", "E11.618", "E11.620", "E11.621", "E11.622", "E11.628", "E11.630", "E11.638", "E11.641", "E11.649", "E11.65", "E11.69", "E11.8", "E11.9", "E13.00", "E13.10", "E13.11", "E13.39", "E13.40", "E13.41", "E13.42", "E13.43", "E13.44", "E13.49", "E13.59", "E13.620", "E13.621", "E13.622", "E13.628", "E13.638", "E13.641", "E13.649", "E13.65", "E13.69", "E13.8", "E13.9" ● ICD-9: "250", "250.0", "250.00", "250.01", "250.02", "250.03", "250.1", "250.10", "250.11",

Epidemiology of Myocarditis Following COVID-19 or Influenza and Use of Diagnostic Assessments: Supplementary Online Content

	"250.12","250.13","250.2","250.20","250.21", "250.22","250.23","250.3","250.30","250.31", "250.32","250.33","250.4","250.40","250.41", "250.42","250.43","250.5","250.50","250.51", "250.52","250.53","250.6","250.60","250.61", "250.62","250.63","250.7","250.70","250.71", "250.72","250.73","250.8","250.80","250.81", "250.82","250.83","250.9","250.90","250.91", "250.92", "250.93", "249", "249.0", "249.00", "249.01", "249.1", "249.10", "249.11", "249.2", "249.20","249.21", "249.3", "249.30", "249.31", "249.4", "249.40", "249.41", "249.5", "249.50", "249.51", "249.6", "249.60", "249.61", "249.7", "249.70","249.71", "249.8", "249.80", "249.81", "249.9", "249.90", "249.91" List of codes provenance: Tonelli et al., 2016 (5)

Epidemiology of Myocarditis Following COVID-19 or Influenza and Use of Diagnostic Assessments: Supplementary Online Content

eTable 4: Charlson/Deyo comorbidity index

Disease category	ICD10 Code
1. Myocardial Infarction	I21, I22, I252
2. Congestive Heart Failure	I43, I50, I099, I110, I130, I132, I255, I420, I425, I426, I427, I428, I429, P290
3. Peripheral Vascular Disease	V434, I70, I71, I731, I738, I739, I771, I790, I792, K551, K558, K559, Z958, Z959
4. Cerebrovascular Disease	G45, G46, I60, I61, I62, I63, I64, I65, I66, I67, I68, I69, H340
5. Dementia	F00, F01, F02, F03, G30, F051, G311
6. Chronic Pulmonary Disease	J40, J41, J42, J43, J44, J45, J46, J47, J60, J61, J62, J63, J64, J65, J66, J67I278, I279, J684, J701, J703
7. Connective Tissue Disease-Rheumatic Disease	M05, M32, M33, M34, M06, M315, M351, M353, M360
8. Peptic Ulcer Disease	K25, K26, K27, K28
9. Mild Liver Disease	V427, B18, K73, K74, K700, K701, K702, K703, K709, K717, K713, K714, K715, K760, K762, K763, K764, K768, K769, Z944
10. Diabetes without complications	E100, E101, E106, E108, E109, E110, E111, E116, E118, E119, E120, E121, E126, E128, E129, E130, E131, E136, E138, E139, E140, E141, E146, E148, E149
11. Diabetes with complications	E102, E103, E104, E105, E107, E112, E113, E114, E115, E117, E122, E123, E124, E125, E127, E132, E133, E134, E135, E137, E142, E143, E144, E145, E147
12. Paraplegia and Hemiplegia	G81, G82, G041, G114, G801, G802, G830, G831, G832, G833, G834, G839
13. Renal Disease	V420, V451, V56, N18, N19, N052, N053, N054, N055, N056, N057, N250, I120, I131, N032, N033, N034, N035, N036, N037, Z490, Z491, Z492, Z940, Z992
14. Cancer	C00, C01, C02, C03, C04, C05, C06, C07, C08, C09, C10, C11, C12, C13, C14, C15, C16, C17, C18, C19, C20, C21, C22, C23, C24, C25, C26, C30, C31, C32, C33, C34, C37, C38, C39, C40, C41, C43, C45, C46, C47, C48, C49, C50, C51, C52, C53, C54, C55, C56, C57, C58, C60, C61, C62, C63, C64, C65, C66, C67, C68, C69, C70, C71, C72, C73, C74, C75, C76, C81, C82, C83, C84, C85, C88, C90, C91, C92, C93, C94, C95, C96, C97
15. Moderate or Severe Liver Disease	K704, K711, K721, K729, K765, K766, K767, I850, I859, I864, I982
16. Metastatic Carcinoma	C77, C78, C79, C80

Epidemiology of Myocarditis Following COVID-19 or Influenza and Use of Diagnostic Assessments: Supplementary Online Content

17. AIDS/HIV	B20, B21, B22, B24

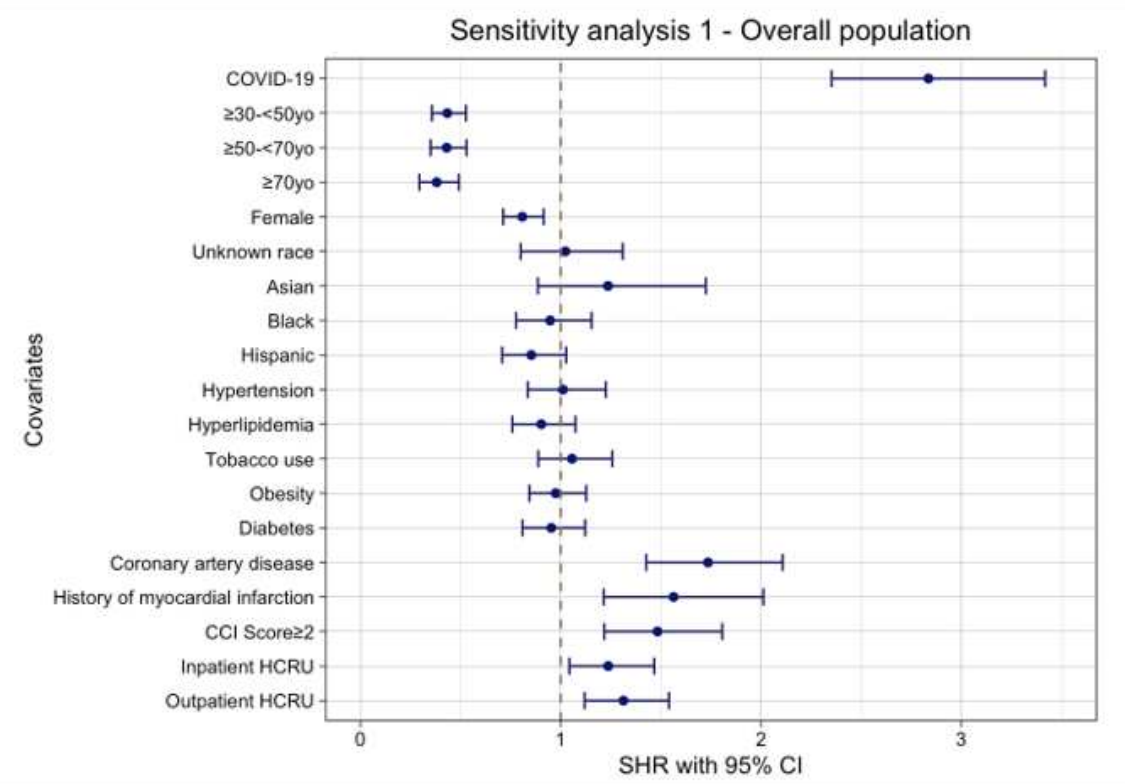
Butler O, *et al*. *Open Heart* 2024; 11:e002947. doi: 10.1136/openhrt-2024-002947

Epidemiology of Myocarditis Following COVID-19 or Influenza and Use of Diagnostic Assessments: Supplementary Online Content

Additional Analyses

Sensitivity Analysis: Health Care Resource Utilization (HCRU).

Two additional covariates (inpatient/outpatient HCRU) were added to the original Step 2 subdistribution hazard (SHR) model.

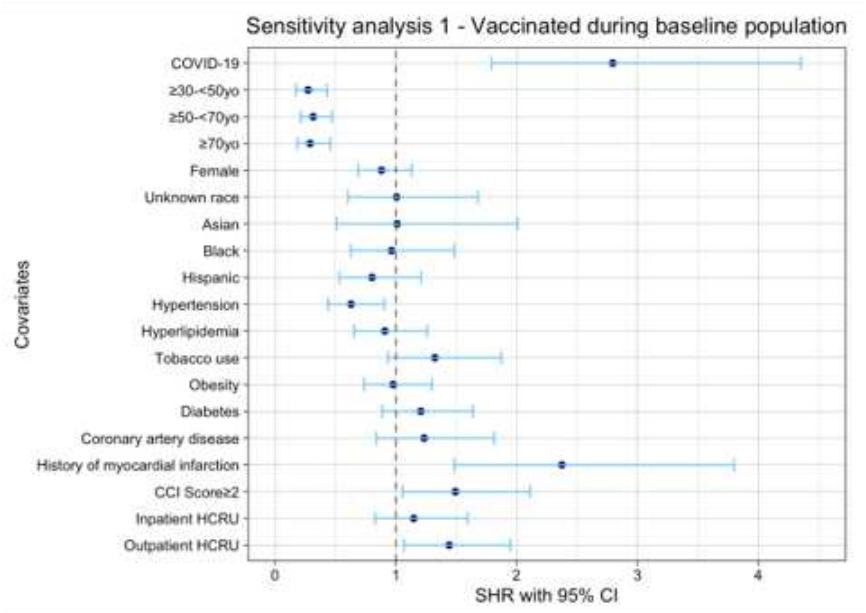


eFigure 1: Health Care Resource Utilization (HCRU)

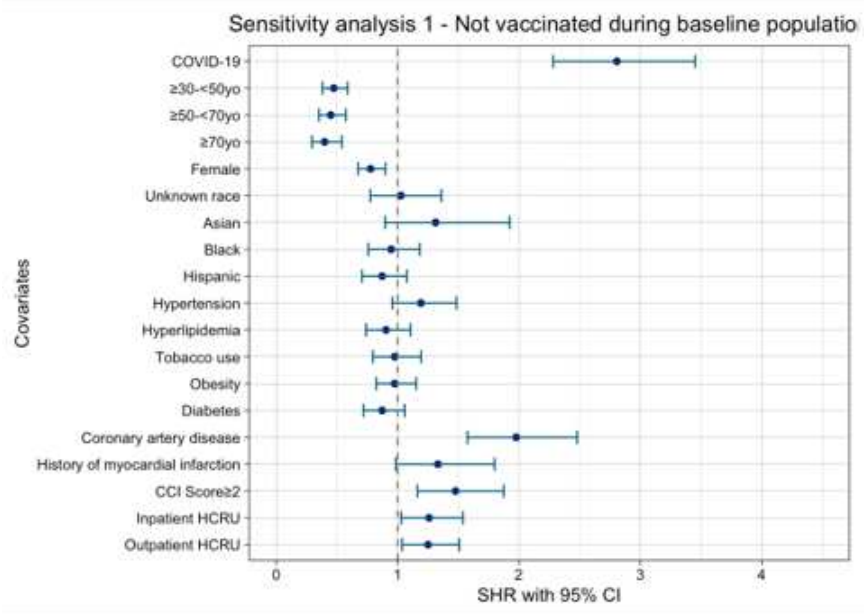
Epidemiology of Myocarditis Following COVID-19 or Influenza and Use of Diagnostic Assessments: Supplementary Online Content

Sensitivity Analysis: Health Care Resource Utilization (HCRU) and influenza vaccination status

Two additional covariates (inpatient/outpatient HCRU) were added to original SHR model and populations were stratified by influenza vaccination status at baseline.



eFigure 2a: HCRU and Influenza vaccinated at baseline.

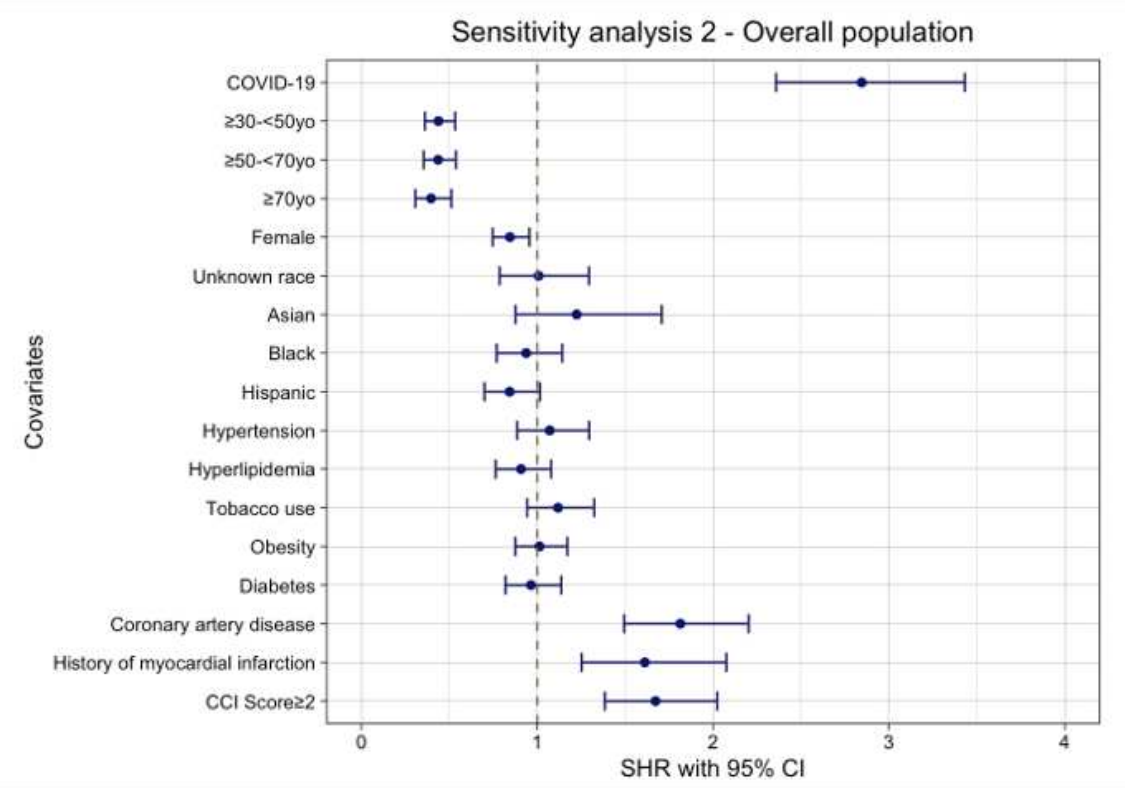


eFigure 2b: HCRU and Influenza unvaccinated at baseline.

Epidemiology of Myocarditis Following COVID-19 or Influenza and Use of Diagnostic Assessments: Supplementary Online Content

Sensitivity Analysis: Influenza diagnosis censoring in exposure group.

SHR model where the exposure group (COVID-19) was censored on influenza diagnosis

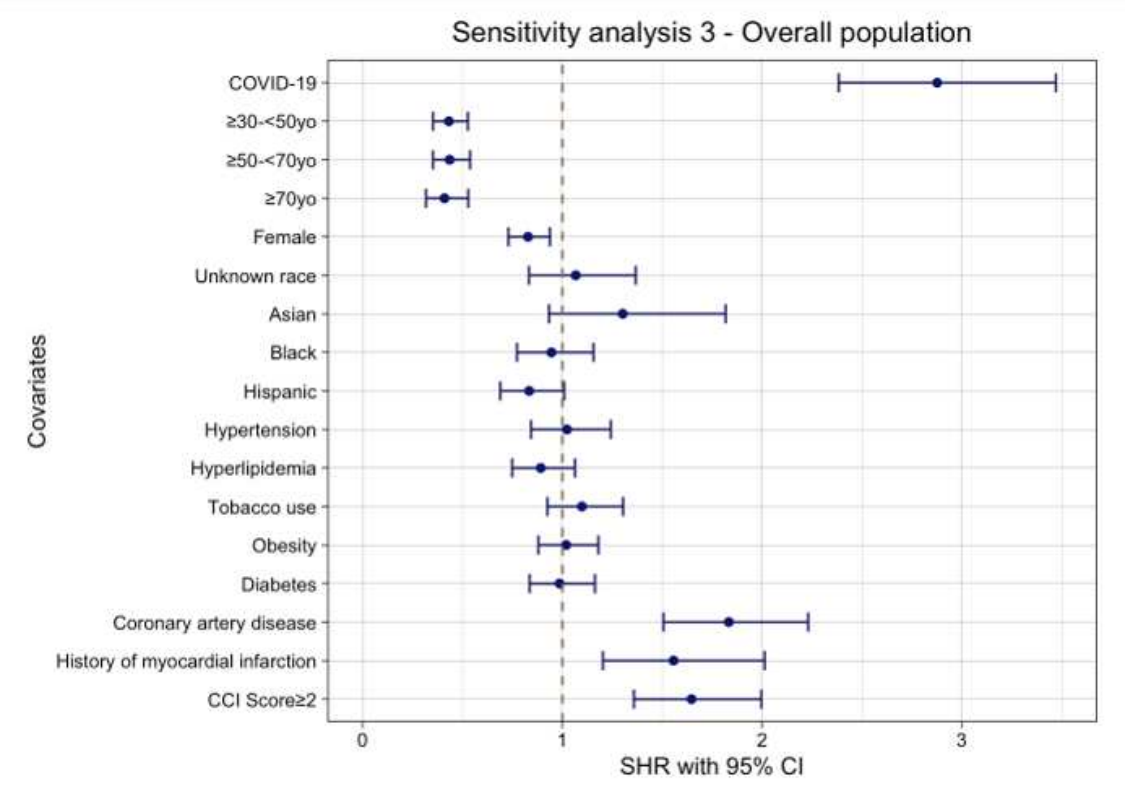


eFigure e3: COVID-19 population censored on influenza diagnosis.

Epidemiology of Myocarditis Following COVID-19 or Influenza and Use of Diagnostic Assessments: Supplementary Online Content

Sensitivity Analysis: COVID-19 vaccination censoring in exposure group.

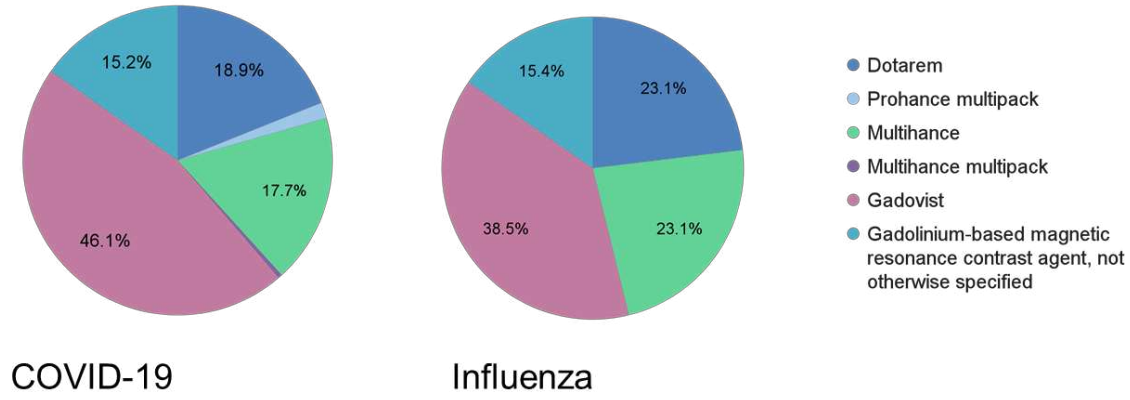
SHR model where patients of the exposure group were excluded based on prior COVID-19 vaccination during baseline and censored on COVID 19 vaccination during follow-up.



eFigure 4: COVID-19 population excluded or censored based on COVID-19 vaccination..

Epidemiology of Myocarditis Following COVID-19 or Influenza and Use of Diagnostic Assessments: Supplementary Online Content

Use of Contrast Media



eFigure 5: Recorded use of gadolinum-based contrast agents among adult patients having myocarditis in the year after COVID-19 (n=150) or influenza diagnosis (n=12).