Table E1. Image processing and image biomarker extraction based on the Image Biomarker Standardization Initiative (IBSI) reporting guidelines.

Patient					
Region of interest	Myocardium				
Patient preparation	Breath-hold instructions given to volunteers and patients prior to image acquisition				
Contrast agent	No contrast agent was administered to the volunteer/patient				
Comorbidities	No comorbidities that effect imaging quality				
Acquisition					
Acquisition protocol	Standard clinical cardiac MRI imaging protocol was used				
MR imaging unit type	3T Siemens Vida (Siemens Healthineers, Erlangen, Germany)				
Imaging modality	MRI				
Static and dynamic imaging	Scans were static except for cine-bSSFP				
	Acquisition time per time frame for cine-bSSFP: 49.92 msec				
	No temporal modeling technique was used				
MRI unit calibration	Weekly and annual phantom testing and Siemens preventive services				
Patient instruction	Patients were given instructions for breath holding during acquisition				
Anatomic motion correction	ECG-gated; breath-hold				
Examination duration	~1 hour for healthy volunteers and ~30 min for patients				
RF coil	18-channel body coil (Siemens Healthineers, Erlangen, Germany)				
Magnetic field strength	3 T				
Imaging sequence	Cine-bSSFP	MOLLI 5s(3s)3s	T2 map	T1-weighted	T2-weighted
Repetition time (msec)	3.12	2.47	3.09	4.57	718
Echo time (msec)	1.41	1.02	1.3	2.46	50
Echo train length					177
Flip angle (deg)	40	35	12	15	180
Acquisition type	Tfi 2D trufi	Tfi 2D trufi	Tfl 2D Gre	Fl 2D Gre	2D TSE
k-space traversal	Linear	Linear	Centric	Centric	. . .
Number of averages	1	1	1	1	1
In-plane resolution (mm^2)	0.9 × 0.9	1.7 × 1.7	1.7 × 1.7	0.5 × 0.5	1.4 × 1.4
Image section thickness (mm)	8	8	8	8	8
Image section spacing (mm)	16	16	16	16	16
Reconstruction model (Factor)	GRAPPA (2)	GRAPPA (2)	GRAPPA (2)	GRAPPA (2)	GRAPPA (2)
Image Processing					
Registration method	Siemens in-line motion correction was used for parametric mapping				
Data conversions	Siemens in-line parametric mapping reconstruction was used				
Postacquisition processing					
Antialiasing	None				
Noise suppression	None				
Nonuniformity correction	None				
Image normalization	mean ± 3SD normalization for cine-bSSFP, T1-weighted, T2-weighted				
Other postacquisition processing methods	None				
Segmentation					
Segmentation method	Manually; 3 independent experts; JJ (4 years of experience in cardiac MRI), JM (6 years of experience in cardiac MRI), SK (5.5 years of experience in cardiac MRI); no consensus, independent reading				
Conversion to mask	MATLAB poly2mask				

Image processing–image interpolation	
Interpolation method	SimpleITK sitkBSpline
Voxel dimensions	1 × 1 × 1 mm^3
Image processing–ROI interpolation	
Interpolation method	SimpleITK sitkNearestNeighbor
Partially masked voxels	N/A
Image processing resegmentation methods	Absolute; Cine-bSSFP, T1-weighted, T2-weighted: [0, 255]; T1 map: [0, 2000]; T2 map: [0, 200] for in-vivo [0, 400] for phantom
Image processing–discretization	Fixed bin size (FBS); 1 for T2 map, exponential, and LBP images, 5 for the rest; the lowest intensity in the first bin for FBS discretization is set by range resegmentation
Image processing-filter	Original = {}, Wavelet = {}, Square = {}, SquareRoot = {}, Logarithm = {}, Exponential = {binCount: 50}, Gradient = { }, LBP2D = {binWidth: 1}
Image biomarker computation	
Biomarker set	Intensity-based statistics (IS), gray level co-occurrence matrix (GLCM), gray level run length matrix (GLRLM), gray level size zone matrix (GLSZM), gray level distance zone matrix (GLDZM), neighborhood gray tone difference matrix (NGTDM)
IBSI compliance	Compliant with the IBSI benchmarks
Robustness	Test/retest analysis and inter/intraobserver analysis
Software availability	PyRadiomics 2.1.2
	Numpy 1.16.2
	SimpleITK 1.2.0
	PyWavelet 1.0.2
	Python 3.6.8
Image biomarker computation–texture parameters	
Texture matrix aggregation	2.5D, direction-merged
Distance weighting	No weighting
CM symmetry	Symmetric
CM distance	Chebyshev distance of 1
SZM linkage distance	Chebyshev distance of 1
DZM linkage distance	Chebyshev distance of 1
DZM zone distance norm	Manhattan distance
NGTDM distance	Chebyshev distance of 1

Table E2. Demographics, clinical indications and diagnosis of 51 patients who were referred for clinical cardiac MRI.

Age	Sex	Indications	Diagnosis
64	M	Cardiomyopathy, ARVC	Normal
72	M	Thrombus	Ischemic cardiomyopathy, No left ventricular thrombus
56	M	Cardiomyopathy, Pre-ICD implantation	Mixed ischemic and nonischemic cardiomyopathy
59	M	Cardiomyopathy, Sarcoidosis	Not suggestive of cardiac sarcoidosis
62	F	Cardiomyopathy, Hypertrophic cardiomyopathy, LVOT obstruction	Hypertrophic cardiomyopathy
66	M	Cardiomyopathy, Coronary artery disease	Nonischemic cardiomyopathy
68	F	Systolic dysfunction/cardiomyopathy, Coronary artery disease versus myocarditis	Nonischemic cardiomyopathy
39	F	Stroke, Patent foramen ovale	Normal
57	F	Thrombus, Left ventricular function	Ischemic cardiomyopathy without left ventricular thrombus
35	F	Cardiomyopathy, Abnormal ECG	Concerning for ARVC or other nonischemic cardiomyopathy
62	F	Cardiomyopathy, Hemochromatosis	Not suggestive of cardiac hemochromatosis
28	M	Aortic valve disease, Aorta, LV size and function	Bicuspid aortic valve with moderate to severe aortic regurgitation
53	M	LV non compaction	Not suggest left ventricular noncompaction.
49	M	Evaluation of the aorta, and LV	Mild dilation of the aortic sinus without dilation or dissection, normal LV

60	F	Constrictive pericarditis, perimyocarditis	Early and late gadolinium pericardial enhancement without evidence of constriction
63	M	MVP, Hx of NSVT Evaluate for scar	Nonischemic cardiomyopathy
67	M	Left ventricular function	Normal left ventricular cavity size with dyssynchrony and mild global hypokinesis
42	M	Cardiomyopathy, Sarcoid	No CMR findings of cardiac sarcoidosis or cardiomyopathy
42	M	Cardiomyopathy	Mild nonischemic cardiomyopathy
39	M	Cardiomyopathy, LV Function, Thrombus	Severe left ventricular cavity dilation, and severe global systolic dysfunction.
25	M	Cardiomyopathy, Hypertrophic cardiomyopathy	Athletic heart
50	F	Source of VT, Scar/fibrosis	Normal
65	M	Cardiac mass versus thrombus	Moderate mitral annular calcification without overlying mass
56	M	Bicuspid AV, Ascending aorta aneurysm, Cardiomyopathy, Fibrosis/scar	Nonischemic cardiomyopathy
28	F	Cardiomyopathy, Fibrosis/Scar	Mildly increased left ventricular cavity size with low normal systolic function
65	F	RA, Progressive DOE. Rule out pericarditis/constriction	Pericarditis and/or pericardial scarring but not constriction
75	M	Evaluation of pericardial constriction	Large pericardial effusion with no evidence of tamponade or early/late pericardial enhancement
58	M	Suspicion of myocarditis	Nonichemic cardiomyopathy
64	M	Ventricular tachycardia, premature ventricular contractions	No evidence of cardiomyopathy
67	M	Hypertrophic cardiomyopathy	Hypertrophic cardiomyopathy with fibrosis (LGE = 5% of LV myocardium) and LVOT obstruction
47	M	Suspicion of infiltrative cardiomyopathy	Nonischemic dilated cardiomyopathy. No evidence of LGE
79	M	Investigation of dilated cardiomyopathy	Nonischemic dilated cardiomyopathy with patchy midwall fibrosis
52	F	History of sarcoidosis	No findinds to suggest cardiac sarcoidosis
37	M	Investigation of dilated cardiomyopathy	Nonischemic dilated cardiomyopathy with patchy midwall fibrosis
68	F	Investigation of dilated cardiomyopathy	Nonischemic dilated cardiomyopathy with no evidence of scar
63	F	Investigation of dilated cardiomyopathy	Nonischemic dilated cardiomyopathy with no evidence of scar
43	M	Investigation of dilated cardiomyopathy	Normal
45	F	Hypertrophic cardiomyopathy	Hypertrophic cardiomyopathy with fibrosis and LVOT obstruction
74	F	Investigation of dilated cardiomyopathy	Nonischemic dilated cardiomyopathy with no evidence of scar
55	M	Suspicion of cardiomyoapthy	Normal
34	M	History of pulmonary sarcoidosis	Cardiac sarcoidosis (Midwall early and late gadolinium enhancement)
51	F	Suspicion of myocarditis	Left ventricular hypertrophy with no evidence of edema, scar or dysfunction
76	M	Suspicion of noncompaction cardiomyopathy	Normal (there is no evidence of LGE or noncompaction)
79	M	Suspicion of cardiac contusion	Normal (no evidence of LGE or edema)
52	M	Suspicion of ischemic cardiomyopathy	Transmural apical infarct with severely dilated left ventricle and moderate systolic dysfunction (Ischemic cardiomyopathy)
42	M	Suspicion of coronary artery disease	Transmural apical infarct (Ischemic cardiomyopathy)
65	F	Suspicion of pericarditis	Pericarditis without constriction
72	M	Suspicion of myocarditis	Mildly dilated left ventricle with preserved ejection fraction. No evidence of scar.
55	M	Suspicion of myocarditis	Nonischemic dilated cardiomyopathy with patchy midwall fibrosis
65	M	Transient atrioventricular blockage	Normal
60	M	History of pulmonary sarcoidosis	Cardiac sarcoidosis (Epicardial and midwall early and late gadolinium enhancement

Table E3. Test-retest reproducibility results of phantom study summarized for all image filters and feature family.

	Reproducible Image Filter	Reproducible Feature Family
Apple, Within-Session Repeatability		
Cine-bSSFP	Wavelet-HL (n = 84; ICC 0.98 ± 0.04)	GLCM (n = 196; ICC 0.98 ± 0.03)
T1-weighted	Gradient (n = 71; ICC 0.98 ± 0.04)	GLCM (n = 190; ICC 0.98 ± 0.03)
T1 map	Wavelet-HL (n = 73; ICC 0.96 ± 0.04)	GLCM (n = 168; ICC 0.96 ± 0.04)
T2-weighted	Gradient (n = 90; ICC 0.99 ± 0.02)	GLCM (n = 232; ICC 1.0 ± 0.01)
T2 map	Wavelet-HL (n = 53; ICC 0.92 ± 0.05)	GLCM (n = 102; ICC 0.92 ± 0.05)
Apple, Between-Session Reproducibility		
Cine-bSSFP	Wavelet-LH (n = 29; ICC 0.83 ± 0.03)	GLCM (n = 17; ICC 0.84 ± 0.03)
T1-weighted	Squareroot (n = 2; ICC 0.9 ± 0.06)	GLRLM (n = 5; ICC 0.9 ± 0.07)
T1 map	Logarithm (n = 16; ICC 0.85 ± 0.03)	GLCM (n = 36; ICC 0.85 ± 0.03)
T2-weighted	LBP-2D (n = 6; ICC 0.88 ± 0.05)	GLCM (n = 7; ICC 0.86 ± 0.03)
T2 map	Square (n = 15; ICC 0.87 ± 0.04)	GLCM (n = 17; ICC 0.88 ± 0.05)
Lime, Within-Session Repeatability		
Cine-bSSFP	Wavelet-LL (n = 80; ICC 0.99 ± 0.02)	GLCM (n = 163; ICC 1.0 ± 0.02)
T1-weighted	Wavelet-LL (n = 76; ICC 0.98 ± 0.03)	GLCM (n = 172; ICC 0.97 ± 0.05)
T1 map	Exponential (n = 72; ICC 0.95 ± 0.04)	GLCM (n = 189; ICC 0.95 ± 0.05)
T2-weighted	Gradient (n = 85; ICC 0.99 ± 0.03)	GLCM (n = 221; ICC 1.0 ± 0.01)
T2 map	Exponential (n = 65; ICC 0.94 ± 0.05)	Firstorder (n = 93; ICC 0.95 ± 0.04)
Lime, Between-Session Reproducibility		
Cine-bSSFP	Original (n = 23; ICC 0.85 ± 0.04)	GLCM (n = 27; ICC 0.86 ± 0.04)
T1-weighted	Wavelet-LL (n = 53; ICC 0.85 ± 0.03)	GLCM (n = 117; ICC 0.87 ± 0.05)
T1 map	Exponential (n = 44; ICC 0.9 ± 0.04)	GLCM (n = 90; ICC 0.87 ± 0.04)
T2-weighted	Original (n = 35; ICC 0.84 ± 0.03)	GLCM (n = 47; ICC 0.85 ± 0.03)
T2 map	Logarithm (n = 28; ICC 0.89 ± 0.04)	GLCM (n = 36; ICC 0.9 ± 0.04)
Onion, Within-Session Repeatability		
Cine-bSSFP	Logarithm (n = 65; ICC 0.99 ± 0.02)	Firstorder (n = 114; ICC 0.99 ± 0.01)
T1-weighted	Original (n = 61; ICC 0.98 ± 0.03)	GLCM (n = 145; ICC 0.96 ± 0.04)
T1 map	Logarithm (n = 71; ICC 0.98 ± 0.03)	Firstorder (n = 137; ICC 0.99 ± 0.01)
T2-weighted	Wavelet-HL (n = 74; ICC 0.99 ± 0.02)	GLCM (n = 168; ICC 0.99 ± 0.02)
T2 map	Square (n = 51; ICC 0.98 ± 0.02)	Firstorder (n = 101; ICC 0.97 ± 0.03)
Onion, Between-Session Reproducibility		
Cine-bSSFP	Square (n = 26; ICC 0.88 ± 0.04)	Firstorder (n = 43; ICC 0.87 ± 0.04)
T1-weighted	Original (n = 38; ICC 0.88 ± 0.03)	GLCM (n = 39; ICC 0.87 ± 0.04)
T1 map	Squareroot (n = 23; ICC 0.85 ± 0.04)	Firstorder (n = 63; ICC 0.87 ± 0.05)
T2-weighted	Logarithm (n = 7; ICC 0.83 ± 0.03)	GLCM (n = 10; ICC 0.84 ± 0.03)
T2 map	Square (n = 13; ICC 0.83 ± 0.02)	Firstorder (n = 33; ICC 0.85 ± 0.04)