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THE HEART

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**VALENTIN FUSTER • ROBERT A. HARRINGTON
JAGAT NARULA • ZUBIN J. EAPEN**

Hurst's
The Heart

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Hurst's The Heart

Fourteenth Edition

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PREFACE

Although we are excited to bring you the fourteenth edition of Hurst's *The Heart* as the book completes its 50 years since the publication of its first edition (1966), we also mourn the sad passing of the first legendary editor of this book, J. Willis Hurst. We will sorely miss his consistent support and encouragement. Through 13 earlier editions of this first multidisciplinary and comprehensive textbook on cardiovascular disease, *The Heart* has always represented a cornerstone of current scholarship in the discipline. Cardiologists, internists, and trainees from around the world have relied on its authority, breadth of coverage, and clinical relevance to keep up to date on advances in the field and to help optimize patient care. The fourteenth edition of *The Heart* continues the standard-setting tradition with numerous new features, chapters, and authors.

The new edition features an enhanced and reader-friendly design and covers need-to-know clinical advances as well as issues that are becoming increasingly vital to physicians practicing cardiology worldwide. The book is now interactive: it is available online and is committed to providing you with timely updates. The interactive models have been developed by numerous young faculty members from the Mount Sinai, Duke University, and Stanford University Schools of Medicine, who look forward to receiving your feedback. The pathology, pathogenesis, and genetics of all diseases have been provided in a concise fashion in colored boxes for your ready reference and provide an entirely new translational experience to busy clinical practitioners. Eloisa Arbustini and Jennifer Hall have edited these boxed enclosures. Smaller color-boxed entries also offer the national and international demographics, prevalence, and incidence statistics of all cardiovascular disorders; these entries have been painstakingly prepared by Gregory Roth, Andrew Moran, and Donald Lloyd-Jones. Through the

16 thematic sections of text, the reader will find the most complete overview of cardiovascular topics available, plus a timely new focus on evidence-based medicine, health outcomes, and health care quality. We also welcome Bryony Mearns, the previous Editor-in-Chief of *Nature Reviews (Cardiovascular Medicine)*, who has helped to completely transform the illustrations. The two volumes of the book have been extensively rearranged.

For this fourteenth edition of *The Heart*, we welcome Jagat Narula and Zubin J. Eapen as new editors. Dr. Richard A. Walsh has retired as one of the editors of *The Heart* after having made enormous contributions to the past editions, and we will miss him. We will also miss the associate editors, Sharon Hunt, Spencer King III, Ira Nash, Eric Prystowsky, Robert Roberts, and Eric Rose. We warmly thank the authors for their extraordinary dedication and commitment to a rigorous time schedule that allowed publication of this edition. We greatly appreciate the steady support and understanding of Maria Fuster, Rhonda Larsen Harrington, Navneet Narula, and Rose John Eapen for the successful completion of the book. The secretarial support of Robinson Santana and Alfred Kemp is greatly appreciated. Finally, we extend our appreciation to James Shanahan and his associates at McGraw-Hill Education, especially Karen Edmonson, for their energetic support and for helping to make the fourteenth edition available promptly all over the world.

The Editors

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ABBREVIATIONS

| | | | | | | | |
|-------------------|--------------------------------------------------------------------------|--------|--------------------------------------------|--------|----------------------------------------------------|--------|----------------------------------------------|
| βARK1 | βAR kinase 1 | ACM | arrhythmogenic | AIVR | accelerated | APVR | anomalous |
| 1D | one-dimensional | | cardiomyopathy | | idioventricular | | pulmonary |
| 2D | two-dimensional | A-CMP | alcoholic | | rhythm | | venous return |
| 3D | three-dimensional | | cardiomyopathy | AKI | acute renal injury | AR | adrenergic |
| 4D | four-dimensional | ACS | acute coronary | AL | allostatic load; | | receptor; aortic |
| 5-HT | 5-hydroxytrypta- mine | | syndrome | | light chain | | regurgitation; |
| ^{99m} Tc | technetium-99m | ACTH | adrenocortico- tropic hormone | ALL | (amyloidosis) | | autosomal |
| AAA | abdominal aortic aneurysm | ACUITY | Acute Catheteriza- tion and Urgent | AMA | acute lymphoblas- tic leukemia | ARB | recessive |
| AAC | American College of Cardiology | | Intervention | AMC | American Medical Association | ARC | angiotensin |
| AACE | American Asso- ciation of Clinical Endocrinologists | AD | Triage Strategy | AME | aorto-mitral | | receptor blocker |
| AAD | antiarrhythmic drug | ADA | autosomal | | continuity | | arrhythmogenic |
| AAR | area at risk | ADA | dominant | | apparent | | right, left, and |
| AAV | antineutrophil cytoplasmic antibody- associated vasculitides | ADCM | American Diabetes Association | AMI | mineralocorticoid excess | ARF | biventricular |
| AAV1 | adeno-associated virus 1 | ADH | atrial dilated | AMP | acute myocardial infarction | ARH | cardiomyopathy |
| ABI | ankle-brachial index | ADHERE | cardiomyopathy | ANA | adenosine | | acute rheumatic |
| ABL | ablation catheter | | antidiuretic | ANCA | monophosphate | ARIC | fever |
| ABR | arterial-bronchial diameter ratio | ADM | hormone | | antinuclear | | autosomal |
| ACA | anterior cerebral artery | ADP | Acute | | antibodies | ARNI | recessive hyper- cholesterolemia |
| ACAT | acyl-coenzyme A: cholesterolacyl- transferase | ADM | Decompensated Heart Failure | | antineutrophil cytoplasmic antibody | | Atherosclerosis Risk in |
| ACC | American College of Cardiology | ADP | National Registry | Ang II | antineutrophil cytoplasmic antibody | ARVC | Communities |
| ACCF | American College of Cardiology Foundation | AED | adrenomedullin | ANP | atrial natriuretic peptide | | angiotensin |
| ACE | angiotensin- converting enzyme | AEC | adenosine | AO | aorta | AS | receptor-neprilysin |
| ACEI | angiotensin converting enzyme inhibitor | AED | diphosphate | AoP | aortic pressure | ASA | inhibition |
| ACHA | Adult Congenital Heart Association | AFL | absolute eosino- philic count | AoV | aortic valve | | arrhythmogenic |
| ACHD | adult congenital heart disease | AHA | automated external defibrillator | AP | anteroposterior | ASCVD | right ventricular |
| | | AHA | atrial fibrillation | APAH | associated pulmo- nary arterial hypertension | | cardiomyopathy |
| | | A-HeFT | atrial flutter | APC | angiogenic | ASD | atherosclerotic |
| | | AHF | American Heart Association | APD | progenitor cell | | cardiovascular |
| | | AHI | American Heart Association | | action potential | ASE | disease |
| | | AHFT | African American Heart Failure Trial | APHRS | duration | | atrial septal |
| | | AIB | acute heart failure | | Asia-Pacific Heart Rhythm Association | ASNC | defect |
| | | AIB | apnea-hypopnea index | apo | apolipoprotein | | American |
| | | AI | aortic insufficiency | apo(a) | apolipoprotein(a) | ASO | Society of |
| | | A-IAB | advanced inter- atrial block | apoE | apolipoprotein E | | Echocardiography |
| | | AIDS | acquired immu- nodeficiency syndrome | APS | antiphospholipid syndrome | ASV | American Society of Nuclear Cardiology |
| | | | | aPTT | activated partial thromboplastin time | AT III | arteriosclerosis |
| | | | | | | AT | obliterans |
| | | | | | | | adaptive servo- ventilation |
| | | | | | | | antithrombin 3 |
| | | | | | | | antithrombin; atrial tachycardia |

| | | | | | | | |
|-------------------|--------------------------------------------------------------|-----------|--------------------------------------------------------------|----------|----------------------------------------------------------------------------------------------------------|----------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ATP | adenosine triphosphate; antitachycardia pacing | BiPAP | bilevel positive airway pressure | CAH | congenital adrenal hyperplasia | CE-CMR | contrast-enhanced cardiovascular magnetic resonance |
| ATPase | adenosine triphosphatase | BM | bone marrow | Cai | intracellular calcium | CE-MRA | contrast-enhanced magnetic resonance angiography |
| ATS | arterial tortuosity syndrome | BMMNC | bone marrow-derived mononuclear cell | CAID | chronic atrial and intestinal dysrhythmia | | |
| ATTR | transthyretin (amyloidosis) | BMP | bone morphogenetic protein | CaMKII | calcium-calmodulin kinase II | CETP | cholesteryl ester transfer protein |
| AU | arbitrary units | BMS | bare metal stent | cAMP | cyclic adenosine monophosphate | CFD | color-flow Doppler; computational fluid dynamics |
| AUC | appropriate use criteria | BMV | balloon mitral valvotomy | CAR | coxsackievirus-adenovirus receptor | CFR | coronary flow reserve |
| AV | aortic valve; arteriovenous; atrioventricular | BNP | B-type natriuretic peptide; brain natriuretic peptide | Carl | cardiac apoptosis-related lncRNA | CGM | continuous glucose monitoring |
| AVA | aortic valve area | BOLD | Burden of Obstructive Lung Disease study | CAS | coronary artery stenting | cGMP | cyclic 3',5'-guanosine monophosphate |
| AVB | atrioventricular block | BP | blood pressure | cath lab | catheterization laboratory | CHA ₂ DS ₂ -VASc | congestive heart failure, hypertension, age \geq 75 years, diabetes mellitus, stroke/transient ischemic attack, vascular disease, age 65-74 years, sex category |
| AVID | Antiarrhythmics Versus Implantable Defibrillators (registry) | BPD | biliopancreatic diversion with or without duodenal switch | CAV | cardiac allograft vasculopathy | | |
| AVM | arteriovenous malformation | BREATHE-5 | Bosentan Randomized Trial of Endothelin Antagonist Therapy-5 | CCA | common carotid artery | | |
| AVNRT | atrioventricular nodal reentrant tachycardia | | | CCB | calcium channel blocker | | |
| A-VO ₂ | arteriovenous oxygen difference | BRS | baroreflex sensitivity; bioresorbable scaffolds | CCS | Canadian Cardiovascular Society; computed tomography-derived coronary artery calcium/calcification score | CHADS ₂ | congestive heart failure, hypertension, age 75 years, diabetes mellitus, stroke |
| AVP | arginine vasopressin | BrS | Brugada syndrome | CCTA | cardiac/coronary computed tomography angiography | CHARM | Candesartan in Heart Failure Assessment of Reduction in Mortality and Morbidity |
| AVR | aortic valve replacement | BSA | body surface area | CD | Chagas disease | | |
| AVRT | atrioventricular reentrant tachycardia | BTT | bridge to transplantation | CDC | cardiosphere-derived cell | | |
| B19V | human parvovirus B19 | BV | biventricular | CDLS | Cornelia de Lange syndrome | | |
| BARC | Bleeding Academic Research Consortium | BVS | bioresorbable vascular scaffold | CDRIE | cardiac device-related infective endocarditis | Chast | cardiac hypertrophy-associated transcript |
| BAT | baroreflex activation therapy | Ca | calcium | CDT | catheter-directed thrombolysis | CHD | congenital heart disease; coronary heart disease |
| BAV | bicuspid aortic valve | CA | cancer antigen | CEA | carcinoembryonic antigen | CHP | capillary hydrostatic pressure |
| BB | β -blocker | CABG | coronary artery bypass graft | | | | |
| BBR | bundle-branch reentry | CACS | coronary artery calcium score | | | | |
| BH4 | tetrahydrobiopterin | CAD | coronary artery disease | | | | |

| | | | | | | | |
|-------|-------------------------------------------------------|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|------------------------------------------------|------------|---------------------------------------------------------------------------------------------------------------------------|
| CI | chronotropic incompetence; confidence interval | CNP | C-type natriuretic peptide | CRIS | Cardiac Risk Index Score | CTRCD | chemotherapy-related cardiac dysfunction |
| | | CNS | central nervous system | CRP | C-reactive protein | | |
| CICR | calcium-induced calcium release | CO | carbon monoxide; cardiac output | CRT | cardiac resynchronization therapy | CURE | Clopidogrel in Unstable Angina to Prevent Recurrent Ischemic Events |
| CIED | cardiac/cardio-vascular implantable electronic device | CO ₂ | carbon dioxide | CS | carcinoid syndrome; coronary sinus | | |
| | | CONCOR | CONgenital CORvitia | CS ₂ | carbon disulfide | CURRENT | Clopidogrel Optimal Loading Dose Usage to Reduce Recurrent Events-Organization to Assess Strategies in Ischemic Syndromes |
| CIN | contrast-induced nephropathy | CoNS | coagulase-negative staphylococci | CSA | central sleep apnea; cross-sectional area | | |
| CIPO | chronic intestinal pseudo-obstruction | COPD | chronic obstructive pulmonary disease | CsA | cyclosporine A | | |
| CK | creatine kinase | | | CSNRT | corrected sinus node recovery time | | |
| CKD | chronic kidney disease | COPE | Colchicine for Acute Pericarditis | CSR | Cheyne-Stokes respiration | CV | cardiovascular |
| CK-MB | creatine kinase myocardial band | COX | cyclooxygenase | | | CV-B3 | coxsackievirus B3 |
| CLI | critical limb ischemia | CP | constrictive pericarditis | CSS | Churg-Strauss syndrome | CVD | cardiovascular disease |
| CLS | closed loop stimulation | CPAP | continuous positive airway pressure | CT FFR | computed tomography fractional flow reserve | CVR | coronary vasodilatory reserve |
| CM | cardiomyopathy | CPB | cardiopulmonary bypass | | | CW | continuous-wave |
| CMAP | compound motor action potential | CPET | cardiopulmonary exercise testing | CT | computed tomography | Cx | circumflex |
| CMD | coronary microvascular disease/dysfunction | CPR | cardiopulmonary resuscitation | CTA | computed tomography angiography | CYFRA 21-1 | cytokeratin 19 fragment |
| CMDS | cardiometabolic disease staging system | CPTP | cyclopentyltriazolopyrimidine | | | CYP | cytochrome P450 |
| | | CPVT | catecholaminergic polymorphic ventricular tachycardia | CTCAE | Common Terminology Criteria for Adverse Events | CZT | cadmium-zinc-telluride (detector) |
| CML | chronic myeloid leukemia | | | | | D2B | Door-to-Balloon Initiative |
| CMP | cardiomyopathy | CR | cardiac rehabilitation | CTEPH | chronic thromboembolic pulmonary hypertension | DAD | delayed afterdepolarization |
| CMR | cardiac/magnetic resonance | Cr | creatinine | | | DAG | diacylglycerol |
| | | CRCD | chemotherapy-related cardiac dysfunction | CTLA4 | cytotoxic T-lymphocyte-associated antigen 4 | DALY | disability-adjusted life-year |
| cMRI | cardiac magnetic resonance imaging | | | | | DAPT | dual antiplatelet therapy |
| | | CREDO | Clopidogrel for the Reduction of Events during Observation; Coalition to Reduce Racial and Ethnic Disparities in Cardiovascular Disease Outcomes | cTn | cardiac troponin | DASH | Dietary Approaches to Stop Hypertension |
| CMS | Centers for Medicare and Medicaid Services | | | cTnI | cardiac troponin I | DBP | diastolic blood pressure |
| | | | | cTnT | cardiac troponin T | DBT | door-to-balloon time |
| cMs | centimorgans | | | CTP | computed tomography perfusion | | |
| CMV | closed mitral valvotomy | | | CTPA | computed tomography pulmonary angiography | DC | direct current |
| CNI | calcineurin inhibitor | | | | | DCA | directional coronary atherectomy |