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Hospital-Level Variation in Use of Cardiovascular Testing for Adults With Incident Heart Failure

Findings From the Cardiovascular Research Network Heart Failure Study

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ABSTRACT

OBJECTIVES This study aimed to characterize the use of cardiovascular testing for patients with incident heart failure (HF) hospitalization who participated in the National Heart, Lung, and Blood Institute sponsored Cardiovascular Research Network (CVRN) Heart Failure study.

BACKGROUND HF is a common cause of hospitalization, and testing and treatment patterns may differ substantially between providers. Testing choices have important implications for the cost and quality of care.

METHODS Crude and adjusted cardiovascular testing rates were calculated for each participating hospital. Cox proportional hazards regression models were used to examine hospital testing rates after adjustment for hospital-level patient case mix.

RESULTS Of the 37,099 patients in the CVRN Heart Failure study, 5,878 patients were hospitalized with incident HF between 2005 and 2008. Of these, evidence of cardiovascular testing was available for 4,650 (79.1%) patients between 14 days before the incident HF admission and ending 6 months after the incident discharge. We compared crude and adjusted cardiovascular testing rates at the hospital level because the majority of testing occurred during the incident HF hospitalization. Of patients who underwent testing, 4,085 (87.9%) had an echocardiogram, 4,345 (93.4%) had a systolic function assessment, and 1,714 (36.9%) had a coronary artery disease assessment. Crude and adjusted testing rates varied markedly across the profiled hospitals, for individual testing modalities (e.g., echocardiography, stress echocardiography, nuclear stress testing, and left heart catheterization) and for specific clinical indications (e.g., systolic function assessment and coronary artery disease assessment).

CONCLUSIONS For patients with newly diagnosed HF, we did not observe widespread overuse of cardiovascular testing in the 6 months following incident HF hospitalization relative to existing HF guidelines. Variations in testing were greatest for assessment of ischemia, in which testing guidelines are less certain. (J Am Coll Cardiol Img 2014;7:690–700) © 2014 by the American College of Cardiology Foundation.

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Over the past several decades, advances in the prevention and treatment of cardiovascular disease have led to important declines in age-adjusted, cardiovascular-related mortality (1). At the same time, cardiovascular imaging has proliferated (2,3). A recent review of Medicare billing data revealed a doubling of expenditures on medical imaging, from $6.89 billion in 2000 to $14.1 billion in 2005, approximately one-third of this involved cardiovascular imaging (4). Medicare expenditures for diagnostic imaging have grown more rapidly than any other component of medical care (5). However, relatively few data link cardiovascular imaging to improved patient outcomes, and concern is growing that these tests have been adopted at extraordinary cost with insufficient evidence of benefit (6,7).

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In response to this dramatic growth in imaging, professional groups have promulgated clinical practice guidelines and appropriate use criteria (AUC) (8–12). However, the AUC are not supported by randomized trial evidence, and guidelines rarely consider cost effectiveness (13). AUC are limited in their discussion of how multiple testing modalities are most efficiently combined where multiple overlapping testing indications exist. Noninvasive imaging techniques may be interchangeable in some instances, and diminishing returns to overlapping imaging studies are likely. Therefore, there is a critical need to better understand how imaging combinations are used in clinical practice.

There are more than 1 million hospitalizations for acute heart failure (HF) annually, and the inpatient cost for these patients was estimated at $20.1 billion in 2009 (1,14). Testing and treatment patterns for newly diagnosed HF may differ substantially between providers and may have important implications for the cost and quality of care (15–17). In this study, we describe the type and frequency of cardiovascular testing in the first 6 months following hospitalization for incident HF in a large, diverse cohort of patients derived from the Cardiovascular Research Network (CVRN) Heart Failure study.

METHODS

SOURCE POPULATION. The source population included members from 3 participating health plans within the National Heart, Lung, and Blood Institute (NHLBI) sponsored CVRN (1,18,19). Sites included hospitals participating in the Kaiser Permanente Northern California, Kaiser Permanente Colorado, and Kaiser Permanente Northwest regions. These sites are integrated healthcare delivery systems that provide comprehensive care to ethnically, socioeconomically, and geographically diverse populations across various practice settings. They systematically track care provided and outcomes experienced within and outside of owned facilities. Each site has a virtual data warehouse that serves as the primary data source for patient identification and characterization (19). The virtual data warehouses are comprised of electronic datasets populated with linked demographic, administrative, and healthcare utilization data. Utilization data include ambulatory visits, as well as network and nonnetwork hospitalizations with diagnoses and procedures. Institutional review boards at participating sites approved the study.

Study sample. We identified all persons aged ≥21 years who were hospitalized with newly diagnosed HF from 2005 to 2008. We used the following International Classification of Diseases-9th Edition (ICD-9) codes: 398.91, 402.01, 402.11, 402.91, 404.01, 404.03, 404.11, 404.13, 404.91, 404.93, 428.0, 428.1, 428.20, 428.21, 428.22, 428.23, 428.30, 428.31, 428.32, 428.33, 428.40, 428.41, 428.42, 428.43, and 428.9. Previous studies showed a positive predictive value of >95% for admissions with a primary discharge diagnosis of HF on the basis of these codes compared with chart review and Framingham clinical criteria (20–22). Hospitalizations for HF were identified from each site's virtual data warehouse on the basis of a primary ICD-9 discharge diagnosis for HF. We defined incident HF as an eligible HF hospitalization within the sampling frame that was not preceded by any other inpatient or outpatient HF diagnosis within the previous 5 years.

We excluded patients who did not have continuous health plan membership and pharmacy drug benefits during the 12 months before their index HF admission. We excluded patients who did not have at least 1 outpatient visit within 3 months of their index HF admission to ensure more complete data on post-discharge medical care. Finally, we excluded patients with a diagnosis of systemic cancer, because serial imaging may be indicated to assess the safety of chemotherapy administration, even in the absence of symptomatic HF (**Fig. 1**) (8,23).

We identified all cardiovascular testing that occurred between 14 days before and 180 days after the incident HF hospitalization. Administrative

ABBREVIATIONS AND ACRONYMS

ACC = American College of Cardiology

ACR = American College of Radiology

AHA = American Heart Association

AUC = appropriate use criteria

CAD = coronary artery disease

CTA = computed tomography angiography

CMR = cardiac magnetic resonance

CMS = Centers for Medicare and Medicaid Services

CVRN = Cardiovascular Research Network

HF = heart failure

MPI = myocardial perfusion imaging

NHLBI = National Heart, Lung, and Blood Institute

PET = positron emission tomography

SPECT = single-photon emission tomography

TEE = transesophageal echocardiography

TTE = transthoracic echocardiography