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EDITORIAL COMMENT

Imperfect Data Can Still Provide Important Answers*

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In this issue of *iJACC,* Herzog et al. (1) report on trends in cardiac stress testing from 2008 to 2012 in Medicare beneficiaries. They show that the overall rate of stress testing declined over this period but was consistently higher in patients with chronic kidney disease (CKD) than for non-CKD patients. More than 80% of these stress tests used nuclear imaging. There was an increased likelihood of stress testing with worsening CKD stage. This editorial will try to assist the reader in interpreting this important study by answering several questions.

WHY USE MEDICARE CLAIMS DATA FOR SUCH A STUDY?

Herzog et al. (1) used Medicare claims data for this study because those are the best data available. We unfortunately do not have national registries to address many important clinical questions. This is a long-recognized deficiency (2). In contrast, Sweden and Denmark have well-regarded national registries that capture most of the cardiovascular care in those countries. The available U.S. registries are much more limited in scope and are thus unable to answer questions regarding overall care in the country. Therefore, the best available data are administrative datasets such as the Medicare claims data used by Herzog et al. (1). These claims data are national and contain a large number of patients with their individual demographic variables and comorbidities.

Unfortunately, these claims data have several limitations. Medicare Advantage patients are excluded (3). Medicare claims data exclude most patients younger than 65 years of age. Although some patients may qualify for Medicare at a younger age based on a disability or end-stage renal disease, their numbers are generally small. Claims data do not include symptoms or details regarding the resting electrocardiogram (ECG). International Classification of Diseases codes can be used as a "surrogate" for patient symptoms but generally do not capture all of the information (such as the resting ECG) that should be reviewed by a clinician before he or she orders a diagnostic test.

DOES THE STUDY ADDRESS AN IMPORTANT CLINICAL AND PUBLIC HEALTH QUESTION?

Yes. As indicated by Herzog et al. (1), there has been a common perception for many years that patients with CKD are underdiagnosed with respect to cardiovascular disease. Although CKD has not usually been included in risk calculators for asymptomatic patients, it nevertheless contributes to increased cardiovascular events and an increased progression of atherosclerosis, which is complex, multifactorial, and not always fully understood (4). Ischemic cardiovascular events increase the morbidity and mortality of both renal transplantation and chronic dialysis. Therefore, it is critical to evaluate patients with CKD for atherosclerotic cardiovascular disease so that they can be properly treated with both optimal medical therapy and, if necessary, revascularization to improve the outcomes of treatment for their CKD. A conservative "wait-and-see" approach to atherosclerotic cardiovascular disease in patients with CKD is not reasonable. Patients with end-stage renal disease who present with acute coronary syndromes have worse outcomes, including higher

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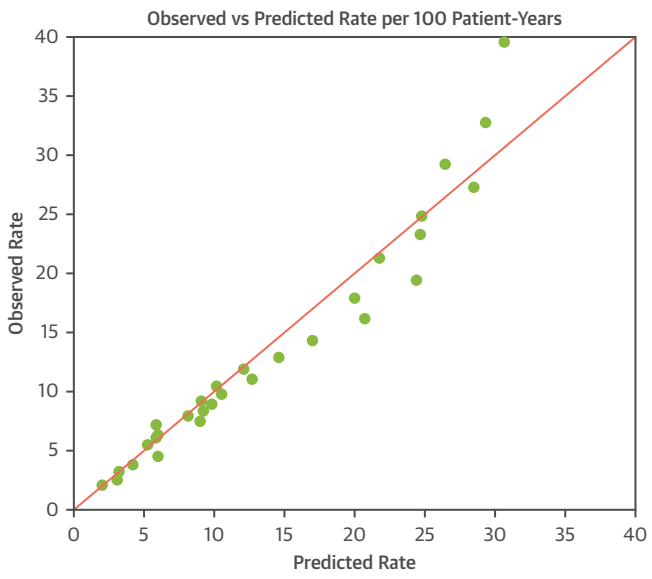
FIGURE 1 Observed Versus Predicted Rate per 100 Patient-Years for the Poisson Model Developed by Herzog et al. (1)



The **diagonal line** represents the line of identity. Only modest deviation from this line occurred at the very highest rates.

mortality and greater bleeding, than patients without CKD (5).

DID THE STUDY USE RIGOROUS SCIENTIFIC AND STATISTICAL METHODS?

Yes. Herzog et al. (1) used a 12-month baseline to establish the presence of comorbidities. This is standard approach in studies based on Medicare claims data (which explains the age range of "66 years or older"). They excluded patients with a previous history of coronary revascularization and a coronary syndrome within the preceding 60 days. The timing of the follow-up and the assignment of patients to specific stress tests followed a rigorous detailed methodology. A Poisson regression model was used to adjust for demographics and comorbid conditions before comparing CKD with non-CKD patients. Their Methods section summarizes a series of very careful steps to test the validity of the model. A scatter plot of the observed rates versus predicted rates that was provided by Herzog et al. (1) in their comments to the reviewers is included here to increase the reader's confidence in the statistical rigor of their paper (**Figure 1**).

ARE THERE OTHER LIMITATIONS BEYOND THE ABSENCE OF SYMPTOMS AND RESTING ECG DATA (INTRINSIC TO ADMINISTRATIVE DATASETS) THAT THE READER SHOULD CONSIDER IN INTERPRETING THE RESULTS?

Yes. To their credit, Herzog et al. (1) stated in the Conclusions paragraph of their abstract that "the effect of screening algorithms for transplant candidates was unknown." Too often, critical limitations of a paper are described in a single paragraph or sentence in the discussion, but not in the abstract, so they are easily overlooked (6). This sentence will alert readers to this limitation; it is not the authors' responsibility, but rather a fault of the administrative dataset they used. Many centers now routinely perform cardiac stress testing in the evaluation of potential renal transplant candidates, despite the variation in practice guidelines regarding this issue (7). Many of the cardiac stress tests included in this claims database may have been ordered for this purpose. This could well contribute to the predominance of nuclear cardiology tests in the belief that pharmacological nuclear stress testing provides a more sensitive evaluation of the potential presence of underlying coronary artery disease. The relationship of the likelihood of stress testing to CKD stage might have provided further insight into this issue, if there was a clear "threshold" effect with a very great increase at stage 4 or 5 nondialysis, when most patients might be evaluated for transplantation. However, that is not what the authors observed. There was an increase in testing at all stages, including stages 1 to 2 and stage unknown. As the authors indicate in their Discussion section, these data must be interpreted cautiously because CKD severity does not seem to have been coded accurately. Many patients were missing a code. It is difficult to believe that only 7% of the patients were in CKD stage 1 or 2. This strongly suggests undercoding, which all of us (including me) could potentially improve in our daily practice.

SHOULD WE BE CONCERNED ABOUT THE APPARENT DIFFERENCE IN THE RATE OF STRESS TESTING BY SEX AND RACE?

I think not. Although it is clearly important to avoid any sex or racial disparities in health care, I believe that the evidence here is not strong enough to suggest a true problem. The adjusted differences are 11% by sex and 6% by race. Unfortunately, because of the limitations of administrative datasets described previously,

the authors did not have access to information about patient symptoms or resting ECGs. Therefore, the "fully adjusted model" could not adjust for these factors. Modest sex and racial differences in these factors could account for the differences measured by race and sex in the model.

WHAT SHOULD AN EVIDENCE-BASED CLINICIAN CONCLUDE FROM THIS STUDY?

Despite the limitation of claims data, this was a rigorously conducted study that contradicts the long-standing perception that cardiovascular disease is under-recognized in patients with CKD. The authors have answered an important clinical and public health question.

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