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Evaluating Cardiac Surgeon Performance:
A Retrospective and Exploratory Study

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ABSTRACT

This paper uses data envelopment analysis to explore how to evaluate physician and hospital clinical efficiency for coronary artery bypass surgery. First, the DEA models (measuring overall technical and scale efficiency partitioned by severity) identified many inefficient surgeons. Regardless of time period studied, relatively few surgeons were found to be on the best-practicing production frontier (DEA efficiency score = 1). The authors offer some evidence that clinical efficiency may be subject to investing in organizational capabilities that arise from operational strategies such as developing open heart surgery as a specialty, years of experience, training, and ultimately, acquiring a cadre of "efficient" surgeons. At a minimum, these findings support including some measures of "superior" organizational capabilities, strategic focus or product specialization, continuing education, and experience in future work.

KEYWORDS

Date Envelopment Analysis, Measuring Physician Efficiency, Physician Performance, Surgical Performance

INTRODUCTION

Cardiovascular disease (CVD) is a leading cause of death and disability around the globe, as well as a major economic burden contributing to unemployment, disability, lost productivity, and rising health costs (Mensah & Brown, 2007; WHO, 2021). In the U.S., the total direct and indirect costs of CVD and stroke were $555 billion in 2016 and projected to rise to $1.1 trillion by 2035. An estimated 45 percent of the U.S. population will have at least one cardiovascular disease condition by 2035 (American Heart Association, 2017).

The first-line treatment for many people with CVD is coronary artery bypass graft (CABG) surgery, which is among the most common and expensive operative procedures (AHRQ, 2021; Del Rizzo et al., 1998; Wilson et al., 2007). It is also one of the most profitable hospital procedures. These CVD facts raise the question of whether these programs and procedures are effective and efficient. Two CABG trends in the U.S. have been reported in the literature: (1) the number of hospitals performing CABGs has been increasing, and (2) the number of CABG procedures performed annually has been

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declining (Wilson et al., 2007). According to the Agency for Healthcare Research and Quality's Healthcare Cost and Utilization project, the annual volume of CABG procedures declined nearly 50% between 2001 and 2011, with 207,300 CABG procedures performed in 2011 declining further to 201,600 by 2018 (Agency for Healthcare Research and Quality, 2021; Weiss & Elixhauser, 2014). Although the efficacy of the CABG procedure has been well-established—it prolongs life for some patients and improves the quality of life for most—the efficiency and productivity changes of hospital CABG programs have not been documented.

Hospital managers and physicians are coping with the growing rivalry for CVD patients by developing new marketing approaches. However, this rivalry and threats of alternative and substitute therapies and medical procedures may mean that hospital and clinical service line managers will soon face even more serious accountability and performance challenges. Hospitals are a good example of a multilevel enterprise with centralized management but different levels of clinical units and collaboration among a diverse array of professionals mobilized to provide specific clinical service lines such as coronary artery bypass graft surgeries, the focus in this paper (Sisodia & Agrawal, 2019, Barhoun et al., 2019; Srivastava, 2021; Barros, 2022).

CABG program performance is coming under sharper scrutiny because recent research studies have uncovered striking differences in cost and quality, and interest groups are using these findings to pressure hospitals to change (Anderson et al., 2003; Cowper et al., 2002; Mensah & Brown, 2007; Nagle & Smith, 2004). Future government policy will be aimed toward supporting CABG programs that are more efficient and more effective. Despite much activity and effort, only a few CABG programs have been singled out as superior. In Pennsylvania, for example, only 5 out of 39 hospitals were designated as superior performers in 1999, as measured by lower costs, mortality, morbidity, and short lengths of stay (HCIA, 1999). Studies of physician performance often reveal wide variations in efficiency levels—some are much more successful than others. Why is it that some physicians perform more effectively than their peers? If a CABG surgeon can get better results, what explains her or his relative effectiveness?

In this paper, to illustrate how to evaluate cardiac surgery at the individual physician level, we explore the performance of CABG surgeons operating in Pennsylvania using historical data from 1994-95 and 2003-4. The research objective is to evaluate the performance and analyze the factors that explain performance using a methodology called Data Envelopment Analysis (Banker et al., 1984; Charnes et al., 1978; Charnes et al., 1994; Chilingerian, 1989; Chilingerian, 1995; Chilingerian & Sherman, 1990; Chilingerian & Sherman, 2011; Cooper et al., 2007; Zhu, 2000; Barros & Aguilera, 2022). To study cardiac surgeon performance, the theory-based mathematic called Data Envelopment Analysis (DEA) is used as a tool for health care policy makers and managers to measure and evaluate the relative performance of clinicians, clinics, and health care organizations. DEA is a powerful performance evaluation methodology that identifies top performers in relation to less effective performers. The methodology can handle multiple, non-commensurate[1] clinical inputs and outputs, including qualitative factors such as patient satisfaction. DEA can measure and evaluate the performance of different clinical decision-making units when the care process involves multiple inputs and outputs (Banker et al., 1984). Most importantly, DEA estimates a single summary measure of relative performance without requiring *a priori* weights.

The study demonstrates how to study complex cardiovascular healthcare services at the individual physician level over two time periods from a retrospective data set. We constructed a study file from an amalgam of databases containing the attributes of individual physicians, patients, hospitals, and the markets in which they operate. Although we have more recent data, obtaining all the physician-level information on characteristics such as years out of medical school, where they trained, and how many continuing medical education hours they achieved became difficult. While all these data exist, matching these characteristics to a unique physician identifier is impossible. As we explored several essential variables in our conceptual model, we could test some exploratory hypotheses with that unique historical data set.