



## Review article

## Do waiting times affect health outcomes? Evidence from coronary bypass

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## ARTICLE INFO

## Article history:

Received 9 November 2015

Received in revised form

20 May 2016

Accepted 30 May 2016

Available online 30 May 2016

## Keywords:

England

Coronary bypass

Health outcomes

Hospitals

Waiting times

## ABSTRACT

Long waiting times for non-emergency services are a feature of several publicly-funded health systems. A key policy concern is that long waiting times may worsen health outcomes: when patients receive treatment, their health condition may have deteriorated and health gains reduced. This study investigates whether patients in need of coronary bypass with longer waiting times are associated with poorer health outcomes in the English National Health Service over 2000–2010. Exploiting information from the Hospital Episode Statistics (HES), we measure health outcomes with in-hospital mortality and 28-day emergency readmission following discharge. Our results, obtained combining hospital fixed effects and instrumental variable methods, find no evidence of waiting times being associated with higher in-hospital mortality and weak association between waiting times and emergency readmission following a surgery. The results inform the debate on the relative merits of different types of rationing in healthcare systems. They are to some extent supportive of waiting times as an acceptable rationing mechanism, although further research is required to explore whether long waiting times affect other aspects of individuals' life.

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## 1. Introduction

Long waiting times for elective services are a prominent health policy issue in several OECD countries. They are prevalent in countries that combine public health insurance with low patient cost-sharing and constraints on capacity. They act as a non-price rationing mechanism which brings together the demand for and the supply of health services (Siciliani et al., 2013; Martin and Smith, 1999). Long waiting times may induce some patients to receive treatment in the private sector more swiftly at a positive price or to give up the treatment, therefore reducing the demand for public treatment. Similarly, if waiting times are long, individuals may prospectively buy private health insurance and opt for the private sector. On the supply side, when waiting times are high, providers may work harder if motivated by altruistic concerns or subject to performance targets (Cullis et al., 2000; Iversen and Siciliani, 2011).

A key concern with rationing by waiting is that waiting times may worsen health outcomes. Koopmanschap et al. (2005) provide

alternative scenarios describing how waiting times may affect patients' health. For example, a patient may experience a health loss while waiting but her health might be restored if the treatment is effective. Alternatively, waiting times may affect not only patient's health, but also reduce treatment efficacy. If the patient waits too long, her health condition may have deteriorated so that treatment becomes less effective and health gains are reduced.

Analysing the effect of waiting times on health outcomes while on the list is important to understand whether patient's health deteriorates during the wait but does not inform us if patient's ability to benefit from surgery is also affected. Our analysis complements previous literature (reviewed below) which looks at the effect of waits on patients health while on the list (e.g. if the patient dies while waiting or is admitted to hospital as an emergency before planned CABG surgery) by investigating the effect of long waiting times on post-operative health outcomes. We measure health outcomes in terms of probability of (a) in-hospital mortality once admitted to the hospital for surgery, and (b) being admitted as an emergency for any cause in the 28 days following discharge from hospital after surgery.

The study contributes to the policy debate on the relative merits of different types of rationing in healthcare systems. If waiting

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times affect health outcomes, policymakers should consider alternative rationing mechanisms or introduce policies which further encourage effective prioritisation.

We focus on elective patients in need of a coronary bypass (CABG) in the English National Health Service (NHS). CABG is a common procedure for patients with serious heart conditions. Focusing on CABG is advantageous because (a) health outcomes can be unambiguously interpreted, as the risk of mortality and readmission is not negligible (more than 1% and about 4% respectively) and (b) CABG is nearly exclusively provided in the public sector, with the private sector performing only 2% of all heart surgeries, including CABG (Ludman, 2012). Therefore selection effects due to the private sector are likely to be negligible.

We employ a large sample of all patients receiving coronary bypass during 2000–2010. During this period, waiting times dramatically reduced from 220 to 50 days (Fig. 1). Such reductions, unique to the United Kingdom, are the result of several policies that combined additional resources with stringent maximum waiting-times targets (Smith and Sutton, 2013). Below we argue that such policies generated changes in waiting times over time and across hospitals and provide a unique opportunity to assess whether long waiting times are associated with worse health outcomes. Although the reduction in waiting times through penalties may have also affected the referral criteria of patients added to the list, we control for patients' severity with a range of indicators and by employing an instrumental-variable approach.

Our analysis relies on three empirical strategies. First, for each year, we estimate patient-level linear probability models to analyse whether the probability of dying after admission (or being readmitted as an emergency) depends on waiting. Hospital fixed effects are included to control for variations in hospitals' resources and protocols which may act as confounders. A key issue for identification relates to prioritisation (Gravelle and Siciliani, 2008b): more severe patients wait less and have higher risk of in-hospital mortality. We address this issue introducing a range of controls. Nonetheless, we cannot exclude that unobserved severity remains, correlated with waiting times and health outcomes. This limitation is addressed with our other approaches.

Our second strategy exploits significant variations of waiting times over the years and across providers. We build a long panel with repeated observations at hospital level over eleven years. We test whether hospitals that experienced sharper reductions in waiting times resulted in better health outcomes by employing fixed-effects panel-data models, which control for time-invariant unobserved hospital heterogeneity. We account for time-varying unobserved factors by adopting an instrumental-variable approach.

Our third strategy involves patient-level models exploiting the whole panel. Waiting times are again potentially endogenous due to unobserved severity. We instrument patient-specific waiting times with the waiting time at hospital level for CABG and for Percutaneous Transluminal Coronary Angioplasty (PTCA), a less

invasive procedure. Waiting times for PTCA should be correlated with waiting times for CABG, but not with CABG health outcomes, once we control for hospital characteristics.

Our results from panel-data models suggest no association of CABG waiting times with in-hospital mortality. Instead long CABG waiting times are associated with an increase in emergency readmission rates (although this effect has weak statistical significance). This is also generally the case when we employ patient-level regressions.

### 1.1. Literature

Limited evidence exists on whether waiting times affect post-surgery health outcomes of elective patients. Most studies are from the medical literature and focus on CABG. They tend to be small-scale studies with samples from selected providers. Légaré et al. (2005) and Carriér et al. (1993) find that CABG waiting times in Canada do not predict the probability of dying during hospitalization or other adverse outcomes (i.e. length of stay in intensive care units). Sari et al. (2007) compare health outcomes for CABG patients who waited less or more than 7 days and find no difference in morbidity, in-hospital mortality and adverse cardiac events. Sampalis et al. (2001) employ a sample of 266 patients in three hospitals and find no association between waits and mortality after surgery but evidence of reduced physical functioning, vitality and other indicators for long waiters (more than 97 days). Rexus et al. (2005) conclude that there is no evidence that prolonged CABG waits increase post-operative mortality in two Swedish hospitals. We follow the medical literature in measuring health outcomes as in-hospital mortality and probability of a post-surgery emergency admission. However, we employ a much larger sample, which includes the whole population of CABG patients over eleven years in England.

Sobolev and Fradet (2008) provide a review of the literature for CABG and suggest that long waits may worsen symptoms and clinical outcomes. Waits may also increase the probability of pre-operative death (while waiting) and unplanned emergency admission (Rexus et al., 2004; Sobolev et al., 2006, 2012; Sobolev and Kuramoto, 2010). The main difference of these studies with ours is the focus on the experience of patients while waiting, as opposed to their health once admitted for surgery, which is instead our focus.

There is an analogous literature that investigates the impact of waits for hip or knee replacement (Hajat et al., 2002; Fielden et al., 2005; Hirvonen et al., 2007a; Tuominen, 2013), suggesting that long waits are not associated with higher mortality and this is due to the low mortality risk. Some analyses find however an effect of long waits on quality of life. The systematic review by Hoogeboom et al. (2009) concludes that there is strong evidence that pain does *not* worsen during a six-month wait (Hirvonen, 2007b, for an earlier review). Self-reported functioning also does not deteriorate for patients awaiting a hip replacement, while the evidence is conflicting for knee replacement. While most studies have modest sample size, Nikolova et al. (2015) employ all patients undergoing four common procedures (hip and knee replacement, varicose veins and inguinal hernia) in English NHS hospitals for which Patient-Reported Outcome Measures (PROMs) are available and linked to HES. They find that long waits reduce health-related quality of life for hip and knee replacement patients. No evidence is found for varicose veins and inguinal hernia.

In the economics literature, Hamilton et al. (1996) analyse the impact of waits following hip fracture on the probability of death and further hospitalization in Canada, finding no effect. A similar result for England is obtained by Hamilton and Bramley-Harker (1999). Hamilton et al., (2000) compare waiting times and

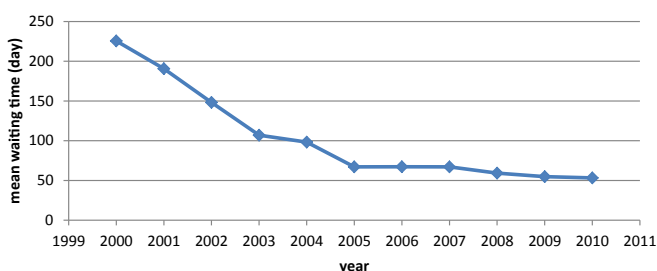


Fig. 1. Mean waiting times for CABG patients.

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