



## The impact of therapeutic procedure innovation on hospital patient longevity: Evidence from Western Australia, 2000–2007

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### ABSTRACT

Assessing the benefits of medical innovation—its impact on health outcomes—is as important as assessing the costs—its impact on health expenditure. Most formal studies have focused on the expenditure impacts of medical technology, partly because costs are more easily identified and quantified than are benefits. Moreover, most quantitative research relating to the impact of broad categories of technology on health outcomes has focused on pharmaceuticals. This is the first study that investigates the benefits and costs of another broad category of medical innovation—inpatient therapeutic procedure innovation—using data on over one million hospital discharges.

We investigate the effect of therapeutic procedure innovation in general on the longevity of Western Australia (WA) hospital patients with a variety of medical conditions. We can measure survival for a period as long as 8 years after admission. We know the date each procedure was added to the Medicare Benefits Schedule (MBS). First, we perform an analysis using cross-sectional patient-level data, controlling for the patient's age, sex, Diagnosis Related Group (DRG, over 600 categories), Aboriginal status, marital status, insurance coverage (whether or not the patient had private insurance), postcode (over 400 postcodes), year of hospital admission, and number of procedures performed. The estimates indicate that therapeutic procedure innovation increased the life expectancy of WA hospital patients (whose mean life expectancy was about 10 years) by almost 3 months between 2000 and 2007.

Estimates based on longitudinal DRG-level data also indicate that therapeutic procedure innovation increased the life expectancy of WA hospital patients, but the implied increase may be smaller—about 2 months. In either case, therapeutic procedure innovation in WA hospitals appears to have been remarkably cost-effective, because it increased the cost of medical procedures by a negligible amount.

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### Introduction

A number of studies (e.g. Congressional Budget Office, 2008a; Kaiser Family Foundation, 2007; Mohr, 2001; Smith, Heffler, & Freeland, 2000) have attempted to assess the overall impact of medical innovation—the introduction and use of new drugs, devices, and procedures—on health expenditure. As Smith et al. (2000) observed, several approaches have been used to assess this impact, including (1) the *residual approach*, where the impact of changes in other factors (such as prices, income, population growth and demographic changes, and utilization) is quantified, and the residual not accounted for is attributed to changes in technology; (2) the *proxy approach*, where a proxy (such as research and development spending, or time) is used to measure the impact of technology; and (3) *case studies of specific technologies*, although

it is difficult to generalize from them to an aggregate or national level.

Many of these studies have concluded that medical innovation has been the main reason for the rise in health care costs. For example, the Congressional Budget Office (2008a, Preface) stated that “the largest single factor driving spending growth [is] the greatly expanded capabilities of medicine brought about by technological advances in medical science over the past several decades.” However, some studies may have not fully accounted for spillovers across episodes of care or medical conditions. For example, a recent study of a cohort of US Medicare beneficiaries aged 65 years and older with a diagnosis of cataract found that patients who had cataract surgery had lower odds of hip fracture within 1 year after surgery compared with patients who had not undergone cataract surgery (Tseng, Yu, Lum, & Coleman, 2012). Also, Lichtenberg (2011) found that U.S. states that adopted new drugs and diagnostic imaging procedures more rapidly did not have larger increases in per capita medical expenditure, controlling for other factors.

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As noted by the [Australian Productivity Commission \(2005\)](#), even if advances in medical technology drive increased health care expenditure, the critical question is whether the benefits outweigh the costs. In other markets, increased expenditure generally would indicate increased consumer benefits. But because the direct purchase of health care is mostly undertaken by third parties—governments and private health insurers—normal market tests for ensuring value for money generally do not apply.

Although assessing the benefits of medical innovation—its impact on health outcomes—is as important as assessing the costs—its impact on health expenditure—the [Australian Productivity Commission \(2005, p. 99\)](#) noted that “most formal studies...have focused on the expenditure impacts of medical technology, partly because costs are more easily identified and quantified than are benefits.” The Australian Government therefore asked the Commission, an independent agency that is the government’s principal review and advisory body on microeconomic policy and regulation, to investigate the net impact of advances in overall and individual health technologies on economic, social and health outcomes as well as on health expenditure.

The Commission conducted a comprehensive literature review and produced a 604 page report. It noted that “most quantitative research relating to the impact of broad categories of technology [on health outcomes] has focused on pharmaceuticals, in part reflecting the greater availability of data relative to other technologies” (p. 113). Much of this research was performed by [Lichtenberg \(2011, 2012\)](#) and colleagues ([Lichtenberg & Duflos, 2008](#); [Lichtenberg, Grootendorst, Van Audenrode, Latremouille-Viau, & Lefebvre, 2009](#)), who investigated the impact of pharmaceutical innovation on longevity and functional status using patient-level and aggregate data from the U.S. and other countries. [Lichtenberg \(2011, 2012\)](#) also studied the impact of diagnostic imaging innovation (CT scanners and MRI units) on longevity in the U.S. and Germany using longitudinal state-level data.

In this study, we will investigate the effect of another broad category of medical innovation—inpatient therapeutic procedure innovation—on the longevity of *all* hospital patients, i.e. patients with a variety of medical conditions. The analysis will be based on data on over one million discharges from public and private hospitals in Western Australia (WA) during the period 2000–2007. The hospital discharge data are linked to WA Death Registration data up until March 1, 2008, so we can measure survival for a period as long as 8 years after admission.

Section 2 describes the general approach we will use and the econometric models of patient survival we will estimate. Descriptive statistics are presented in Section 3. Empirical results are presented in Section 4. The cost-effectiveness of therapeutic procedure innovation is assessed in Section 5. Section 6 provides a summary.

## Methodology

### General approach

Innovation may be defined as “the introduction of a new idea, method or device” (<http://www.merriam-webster.com/dictionary/innovation>). Our measures of innovation will be based on the mean *vintage* of the procedures used to treat a patient or group of patients. One definition of vintage is “a period of origin or manufacture (e.g. a piano of 1845 vintage)” (<http://www.merriam-webster.com/dictionary/vintage>). [Solow \(1960\)](#) introduced the concept of vintage into economic analysis; this was one of the contributions to the theory of economic growth that the [Royal Swedish Academy of Sciences \(1987\)](#) cited when it awarded

Solow the 1987 Alfred Nobel Memorial Prize in Economic Sciences. Solow’s basic idea was that technical progress is “built into” machines and other goods and that this must be taken into account when making empirical measurements of their roles in production. Lichtenberg and colleagues used a drug’s initial FDA approval date as a measure of its vintage.

Each hospital discharge record in WA’s Hospital Morbidity Data System (<http://www.health.wa.gov.au/healthdata/resources/hmds.cfm>) includes up to eleven procedure codes. Since 1 July 1999, procedures have been coded using the International statistical classification of diseases and related health problems, 10th revision, Australian modification (ICD-10-AM). An important feature of ICD-10-AM was the addition of a classification of procedures based on the Commonwealth Medicare Benefits Schedule (MBS), ([Roberts, Innes, & Walker, 1998](#)), which is a listing of the Medicare services subsidized by the Australian government. New procedures are added to the MBS each year. In order to be included in the MBS, new medical technologies and procedures must be assessed by the Medical Services Advisory Committee (MSAC, <http://www.msac.gov.au/>), an independent scientific committee comprising individuals with expertise in clinical medicine, health economics and consumer matters. The MSAC undertakes a rigorous and transparent assessment of new medical technologies in consultation with the applicant, and advises the Minister for Health and Ageing on whether new medical services should be publicly funded based on an assessment of their safety, effectiveness and cost-effectiveness, using the best available evidence. Each procedure in the MBS has a “start date,” i.e. the date the procedure was added to the MBS. As of 1 November 2010, the MBS included 5756 items (procedures). As shown in [Fig. 1](#), 40% of the items included in the 1 November 2010 MBS were added by the end of 1992, 59% were added by the end of 1999, and 79% were added by the end of 2004. Henceforth we will refer to the year in which a procedure was introduced into the MBS as the vintage of the procedure.

We will investigate the effect of therapeutic procedure innovation (which account for about 90% of the procedures (and procedure fees) included in WA’s Hospital Morbidity Data Collection) on hospital patient longevity in two different ways. First, we will investigate the effect of therapeutic procedure vintage on patient survival using cross-sectional patient-level data. (Ethical approval for use of the data was not needed because patient identifiers were encrypted.) We will control, in a very unrestrictive manner, for the patient’s age, sex, Diagnosis Related Group (DRG, over 600 categories), Aboriginal status, marital status, insurance coverage (whether or not the patient has private insurance), postcode (over 400 postcodes), year of hospital admission, and number of procedures performed.

These variables should control, to a very great extent, for social determinants of health and the patient’s underlying health status and mortality risk prior to treatment. For example, old men from poor regions receiving large number of procedures face higher mortality risk than young women from wealthy regions receiving fewer procedures. Nevertheless, there may be unobserved heterogeneity of patients with respect to mortality risk, which could bias our estimates of the effect of therapeutic procedure vintage on patient survival. One study indicated that fundamentally healthier individuals tend to be given newer treatments. [Lleras-Muney and Lichtenberg \(2010\)](#) found that more highly educated people (who tend to live longer) are more likely to use drugs more recently approved by the FDA. However, both our own data and evidence from another study suggest that the sickest patients tend to receive the newest treatments. A regression of mean procedure vintage on all of the variables listed above indicates that (1) mean vintage is positively correlated with the number of procedures performed; (2) procedures used on uninsured patients are newer than those used

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