



OPI-ESRC Seminar Series on Health Services Productivity Regulation and the diffusion of health care technology

**Alistair McGuire & M.Raikou LSE
and F.Windmeijer, IFS**

Summary

The evidence from the treatment of acute myocardial infarction in 20 countries suggests that, while technological innovation has been rapid and widely adopted everywhere, capital intensive treatments have been adopted less rapidly in countries where the regulatory regime has focussed on cost containment, such as Scotland and Canada, rather than on treatment outcomes such as the US. However, treatment success has improved markedly in all the countries studied, irrespective of treatment regime, at almost the same rates when environmental, genetic and behavioural factors are taken into account.

Background

This presentation drew on work being undertaken by the 'Technological Change in Health Care' (TECH) research network, a multidisciplinary, international collaboration of researchers from 16 developed countries to study the relationship between changes in technology and costs, incentives, and outcomes. The analysis of treatment innovations for Acute Myocardial Infarction (AMI) or 'heart attacks', using data from 1985 to 1999, was used to explore the rate of technology diffusion in relation to the regulatory framework.

The sample was divided into two 'tiers' depending on whether it permitted time series analysis. For Tier I, the analysis was based on individual hospital admissions and focussed on short-run treatment outcomes. All 16 countries provided such data. For Tier II, the analysis was based on data in a subset of countries that offered administrative data with unique patient identifiers that allowed a cohort of patients to be followed for a period of time.

AMI treatments were chosen since the disease itself can result in both morbidity and mortality outcomes and because treatment innovations have been rapid over the past two decades. In general, clinicians and their patients now have a choice of two surgical procedures, angioplasty (opening a blocked coronary artery) and bypass surgery, with or without newer medical treatments based on drugs to reduce vascular spasm and 'clot-busting' drugs. Cardiac catheterization can also be used to define more precisely the cause and site of coronary occlusion.

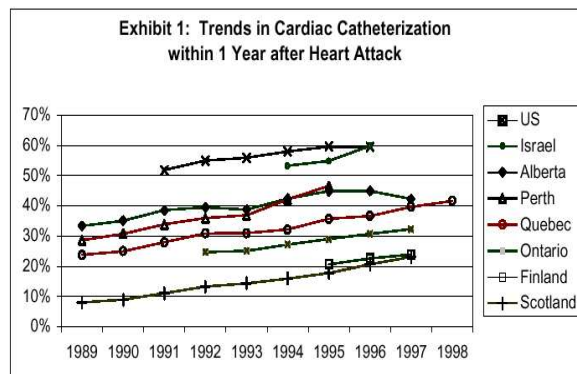
Although all of the countries sampled were relatively wealthy, they possessed different health care systems in terms of both funding and regulation, allowing the rate of treatment innovation to be related to the incentive regime. It is noted that the UK was represented by Scotland, which had around 500,000 patients according to the Scottish Medical Data Linkage Set (1981-present), and that Canada was represented by two provinces.

Definition of AMI Cohort

For the purposes of this analysis, the AMI Cohort was defined according to five criteria. First, the diagnosis was defined using ICD9 410, ICD9-CM: 410 unless 5th digit = "2" (equivalent codes for ICD8, ICD10). Second, the length of stay needed to be greater than or equal to 3 days, unless the patient transferred or died. Third, cases that were admitted as transfers, from another hospital, together with "elective" or "booked" admissions were excluded to avoid double counting, since these were probably not new AMIs and should have been accounted for in the first hospital of admission. The cohort was drawn from the eight "Tier II" countries with longitudinal data. Finally, the study design required that there be no hospitalisation for AMI in the year prior to first admittance. All of the data obtained was standardised using the 1995 US age and sex distribution.

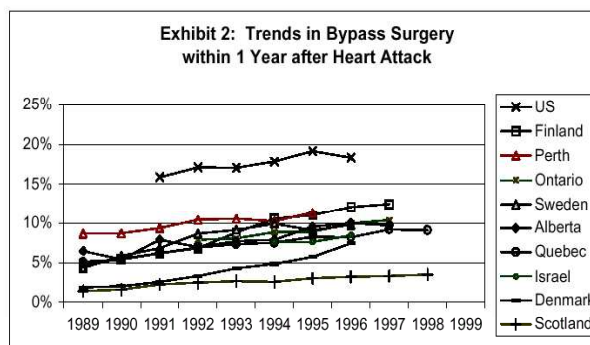
Procedure results

The rate at which five AMI treatment options were adopted in Tier II countries was analysed. The trend data on cardiac catheterization within one year of a heart attack showed that the use of this diagnostic tool in Scotland and Finland were significantly lower than in the US and Israel, although in both cases its use increased (Exhibit 1). In the case of Scotland, for example, cardiac catheterization increased from about 9 per cent to 24 per cent over the period 1989 to 1997, while in the US, there was an increase of about 10 per cent over the 5-year period 1991 to 1996.



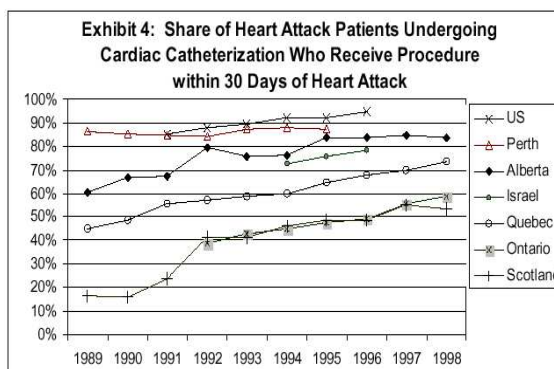
while in the US, there was an increase of about 10 per cent over the 5-year period 1991 to 1996.

In the case of bypass surgery, within one year of a heart attack (Exhibit 2), there was a similar trend in Scotland and the US. Over the period 1991 to 1996, for example, the rate of intervention increased by a modest 2 per cent in both countries, from about 16 to 18 per cent in the US and from around 2 to 4 per cent in Scotland.

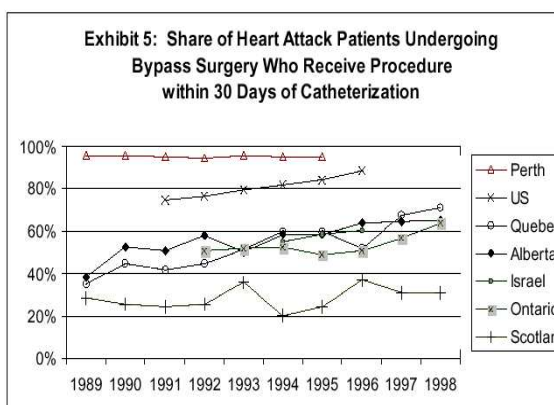


In the case of the second treatment option, angioplasty, the US showed the largest increase, from about 5 to 12 per cent over the period 1991 to 1996. In Scotland, by comparison, the use of angioplasty increased from about 0 per cent in 1989 to 5 per cent in 1997, while in Ontario it increased from about 0 to 1 per cent over the same period.

The fourth option analysed was the share of heart attack patients undergoing cardiac catheterisation within the first 30 days of the episode (Exhibit 4). In the US the use of this treatment increased from about 85 to 95 per cent over the 5-year period 1991 to 1996. On the other hand, the intervention rate in Scotland increased from about 18 to 52 per cent between 1989 and 1998, almost exactly the same as the growth of this treatment in Ontario between 1992 and 1997.

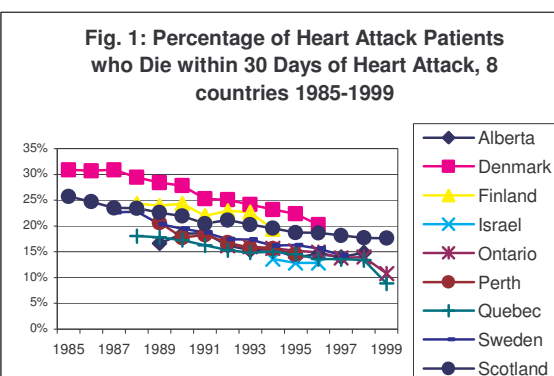


The final procedure that was analysed was the incidence of bypass surgery within 30 days of catheterisation (Exhibit 5). In this case, Perth showed an almost constant rate of around 95 per cent over the period 1989 to 1995, the US showed a consistent increase from about 75 to 90 per cent during 1991-1995, and while in Scotland treatment rates fluctuated over the period 1989 to 1998, the rates at the start and the end of the period were almost the same, at about 30 per cent.



Outcome results

The proportion of patients with heart attacks who died within 30 days declined in all of the eight countries in the sample between 1985 and 1999, irrespective of treatment (Fig. 1). For example, in Denmark, the country with the highest rate of AMI, mortality declined by about 10 per cent over a 10-year period. This decrease in mortality rates are attributable to an increase in the number of available treatment options, an improvement in medical management, together with the increased use of newer non-surgical treatments, such as β blockers.



In the case of Scotland, medical management may have had the largest impact since it is cheaper than surgical interventions and there may have been higher preference for this form of intervention. In terms of the share of heart attack patients who were re-admitted with cardiac diagnosis within one year of a heart attack, there was generally a slight increase perhaps reflecting the fact that patients suffering from more severe cases of CHD were being kept alive for longer. Furthermore, although the mortality rates in Scotland were slightly higher than the rest of the sample, it is possible that this can be attributed to genetic and the environment factors rather than to a lack of resources to adopt more expensive interventions.

Regression results

OLS regression was used to model the annual growth in treatment uptake rates using three dichotomous dependent variables: catheterisation on admission, percutaneous transluminal coronary angioplasty (PTCA) and coronary artery bypass grafting (CABG), while controlling for confounding factors such as age, sex and co-morbidities. In the example of results shown in Figure 2, the UK showed the lowest up-take rate and the US showed the highest adoption rates for both PCTA and CABG treatments.

Fig. 2: Regression Results	
•Catheterisation:	USA 2.38% France 3.36% Scotland 0.27%
•PTCA:	USA 1.48%; UK 0.26%
•CABG:	USA 0.96%; UK 0.01%

Table 1 groups the countries in the sample according to OLS estimates of average annual growth rates of catheterisation for diagnosis and of revascularisation (PCTA): the rapid innovators (greater than 3 per cent per annum), the medium innovators (between 2 and 3 per cent per annum) and the low innovators (less than 2 per cent per annum). After controlling for confounding variables, the US drops from the high to the medium group both for catheterisation and revascularisation. The UK and some of the Scandinavian countries had a later start and a slower uptake rate compared with countries such as the US and Israel.

Table 1	Catheterisation (Diagnosis)	Revascularisation (Treatment)
High (greater than 3%)	Israel Italy Australia Japan France	Sweden Israel Belgium Japan
Medium (between 2% and 3%)	Alberta, Canada Switzerland USA	Australia Alberta, Canada Italy USA
Low (less than 2%)	Belgium, Quebec, Canada UK Manitoba, Canada Ontario, Canada	Switzerland, UK Ontario, Canada Manitoba, Canada Finland Quebec, Canada Korea

Conclusions

The results show that new treatments for AMI is on the increase across all types of health systems and that they have had an impact on the outcomes of CHD. However, the data provided indicative evidence of an inverse relationship between the regulatory framework and technology diffusion. In general, the rate of diffusion was found to be lowest in countries with more binding regulation.

The results showed marked differences in the countries sampled, with uptake shown to be dependent on the particular health care system. Overall, the use of capital intensive techniques, such as PCTA and CABG, is higher and has grown more rapidly in countries such as the US and France where the technical innovations are not regulated and where additional reimbursement is provided for new treatments. Correspondingly, the rate of technological innovation was not as high in countries with highly constrained hospital budgets, such as the UK and Denmark, where incentives for technical innovation were weak. The UK NHS, for example, there was both a late start in up-take and low diffusion rates. This may have been due to the fact that there have been regulated rates of return on capital, access to capital markets and the level and structure of prices. Thus, there has been a bias towards managing current expenditure flows, little incentive to invest and reduced incentives for long-term productivity gains. As a result, there has been a general under-investment in new technologies if they are capital intensive. These observations support the notion that there is a relationship between the regulatory regime and the rate of technical innovation.

However, there were a number of exceptions. First, some increases were quite asymmetric due possibly to idiosyncrasies in a specific country, as in the case of Japan and PTCA. In other countries, pressure from patients and physicians for increased funds for heart patients was the main driver for technical innovation, even if the way public expenditure was managed created weak incentives. In Denmark for example, the "The Heart Plan 1993" project, aimed to increase funding, precisely in order to double the number of revascularization procedures over a period of 3 years.

In addition, although this study focused on capital intensive procedures, the use of newer drugs was also found to be on the increase. In this regard, there was little difference across countries. In terms of outcomes, short-run mortality rates for AMI have fallen across all countries during the study period, irrespective of the treatment regime. In terms of cost-effectiveness, capital intensive technical innovation may not have unambiguously greater rates of return. If so, less binding regulatory regimes may not be unambiguously superior. These questions remain for further enquiry.

Discussion

During the discussion it was suggested that being a technological leader might account for the higher rates of diffusion and of intervention in some countries. Another question related to whether the rate of technological diffusion within a country is fairly constant or changes over time and the possible influence on the results presented. In addition, it was held that since this study tracked only surgical procedures, it is possible that in a number of cases, surgical interventions were being substituted for medical management, since this may have been both cheaper and more effective. The fact that the Scottish PFI was both late and small was cited as a possible explanation for late and slow rate of technical innovation in Scotland. The speaker acknowledged that these factors might have had an impact and said that there were plans to investigate whether uptake rates were affected by the efficacy of medical versus surgical interventions and their substitution rates, the higher density of surgeons in a particular area, and differences in waiting times, particularly in Scotland. **Rianna Lisa Mohammed**
University of Cambridge
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Acknowledgments: The figures are taken from Alistair McGuire's presentation at the seminar. Further details can be obtained by contacting Alistair McGuire on A.J.Mcguire@lse.ac.uk.