

Trends in Mortality, Incidence, Hospitalisation, Cardiac Procedures and Outcomes of Care for Coronary Heart Disease in Singapore, 1991-1996

T P Ng,**FAMS, MD, MFPHM*, K H Mak,***FAMS, FRCP, FACC*, K H Phua,**PhD*, C H Tan,****FAMS, MBBS, M Med (PH)*

Abstract

In this study, we used Singapore population-based data from 1991 to 1996 to examine recent trends in mortality, incidence and hospitalisation for acute myocardial infarction (AMI), and explored the roles of primary prevention and medical care interventions in explaining these trends. We examined trends in medical interventions, namely coronary angiography (catheterisation), coronary artery bypass graft (CABG), and percutaneous transluminal coronary angioplasty (PTCA), length of stay, and payment methods, and explored the roles of technological, healthcare financing and delivery, and regulatory factors in influencing the diffusion and outcomes of these medical interventions.

During the period 1991 to 1996, there were parallel declines in resident population rates of mortality, incidence and hospitalisation for AMI. The rates of angiograms, CABG and PTCA among residents also increased greatly, with the greatest increase among elderly aged 60 years and above. The rates of invasive cardiac procedures for AMI were all lower in females than in males. The population case-fatality rate of AMI declined slightly only for persons below 40 years of age. The case-fatality rate was higher in females than in males.

The number of hospitalisations and cardiac procedures all rose sharply, and was phenomenal for PTCA (247%). The increase in volume of resource use was starkly greater in private hospitals than in restructured hospitals. The ratios of PTCA to CABG from 1991 to 1996 for private and restructured hospitals showed a greater rate of technology substitution in restructured hospitals than in private hospitals. The average length of stay (LOS, 6.7 days) was fairly constant in restructured hospitals. For private hospitals, LOS declined from 7.6 days in 1991 to 5.6 in 1996. LOS varied little among individual restructured hospitals, but widely among private hospitals. The most common method of payment for AMI hospitalisation was Medisave alone (50%), but for CABG surgery, the proportion of payment made through this method was only 12%. Out-of-pocket payments, Medisave, Medishield and private insurance have increased steadily.

These data indirectly suggest that primary prevention and medical care interventions might have begun to succeed in reducing the rates of coronary heart disease in Singapore. The sharp increases in cardiac procedures may be explained by changing supply and demand factors for care of AMI and chronic ischaemic heart disease, including consumer preference for cardiac procedures, overuse of medical intervention, and technological change. More studies are needed to test these hypotheses.

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Introduction

In line with trends in many high-income countries, Singapore has experienced some declines in mortality from coronary heart disease (CHD) since the 1980s. Whether this can be attributed to reduced population levels of risk factors for CHD, declining incidence and severity of disease, changes in medical care, or even artifacts in coding of cause of deaths in death certificates is uncertain. There are, however, evidence that the declines in the USA in the 1970s to 1990s can be explained by declining incidence of myocardial infarction and

improved survival of patients with myocardial infarction.¹ Whether this might also hold true for Singapore is a moot point, but no data are yet available to examine this issue, even in the most preliminary way.

The use of more medical technologies is the principal cause of rising expenditures for medical services in high-income countries.² Many unusual features of the health care industry—including medical uncertainty, health insurance, and subsidisation—support an environment of health care production that encourages wasteful technological changes.³ The chief concern in many countries

* Associate Professor
Department of Community, Occupational and Family Medicine, National University of Singapore

** Consultant
Department of Cardiology, Tan Tock Seng Hospital

*** Director
Human Resources, Ministry of Health, Singapore (Previously, Clinical Standards Unit, Ministry of Health, Singapore)

Address for Reprints: A/P Ng Tze Pin, Department of Community, Occupational and Family Medicine, National University of Singapore, Lower Kent Ridge Road, Singapore 119260. E-mail: cofngtp@nus.edu.sg

is that the overuse of new technologies and the continued use of minimally effective technologies will lead to inefficiency, and low and falling marginal gains from health care expenditure.

The objectives of this study were: to examine recent trends in mortality, incidence, and hospitalisation for acute myocardial infarction (AMI), and to explore the roles of primary prevention and medical care interventions in explaining these trends. We examined trends in medical interventions, namely coronary angiography (catheterisation), coronary artery bypass graft (CABG), and percutaneous transluminal coronary angioplasty (PTCA), length of stay, and payment methods, to explore the roles of technological, healthcare financing and delivery, and regulatory factors in influencing the diffusion and outcomes of these medical interventions.

Materials and Methods

We obtained national data from government central claims processing of payments of hospital care of acute myocardial infarction (AMI) in Singapore for the period when these first became available from 1991 to 1996. The yearly numbers of hospitalisation discharges, coronary angiograms (SD014H), PTCA (SD015h), and CABG (SD016H) were broken down by residential status (foreign and residents), gender, 10-year age groups, individual hospitals and hospital types (private and public restructured), length of hospital stay and payment methods. Additional secondary source data on mortality and incidence of AMI (ICD 410) were obtained from published reports of the Registry of Births and Deaths, the Singapore Myocardial Infarction Registry, and the Population Census Department. Annual rates for local residents were calculated using denominator data of the mid-year population estimates for individual years from 1991 to 1996.

As it was not possible to calculate directly the case-fatality rates from longitudinal data of AMI cases, the method used in the World Health Organization MONICA Study⁴ was used to estimate the population case-fatality rates from AMI.

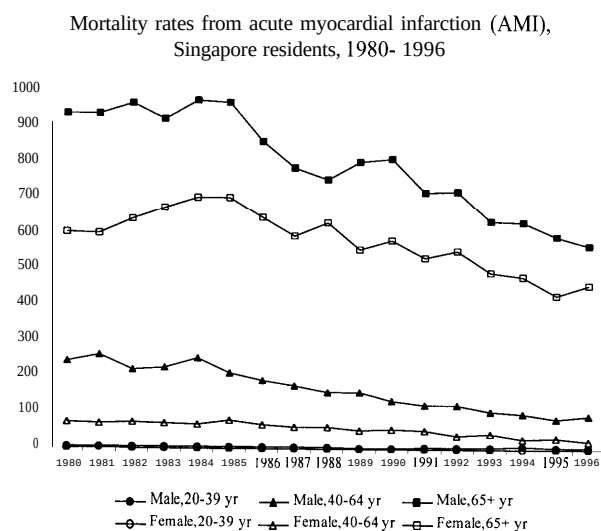
Results

Data on mortality from AMI (ICD 9th revision 410) from 1980 to 1996 showed clearly a downward trend from 1985 onwards (Fig. 1). From 1991 to 1996, while the resident population of persons aged 40 years and above increased by 7.5%, the mortality rate from AMI among residents decreased by 17.5%. The incidence rate of AMI also appeared to show a slight decline during the same period.

During the period 1991 to 1996, there was an average yearly number of 2642 hospital discharges for AMI, 4492 coronary angiograms, 1129 CABG surgeries and 1267 PTCA in Singapore. Private hospitals treated 12% of all

AMI hospital inpatients, but performed 38% of the total number of coronary angiograms, 41% of CABGs, and 36% of PTCA. Foreign patients accounted for 9 % of AMI hospitalisations, 26% of all coronary angiograms, 35% of all CABG surgeries, and 29% of all PTCA. For foreign patients, private hospitals treated 39% of AMI hospital inpatients, performed 76% of angiograms, 73% of CABGs, and 69% of PTCA.

From 1991 to 1996, the total number of AMI hospitalisations increased 12%, with larger increase (28%) in private hospitals and smaller increase (10%) in public restructured hospitals (Fig. 2). The number of coronary angiograms increased 70% (291% in private hospitals, 8% in public restructured hospitals). The number of CABG surgery increased 41%. In private hospitals, this increase was 248%. In contrast, the number of CABG actually decreased (minus 15%) in public restructured



Age-standardised AMI incidence rates, resident population aged 20-64 years, 1988- 1996

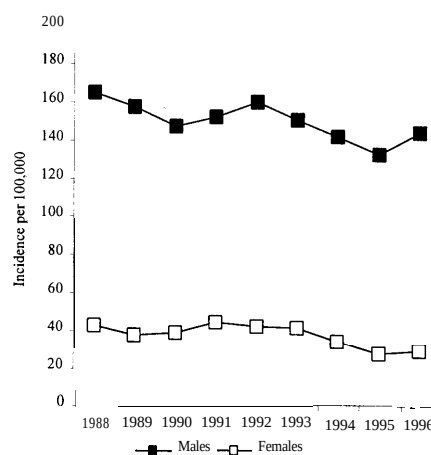


Fig. 1. Trends in AMI mortality and incidence in Singapore.

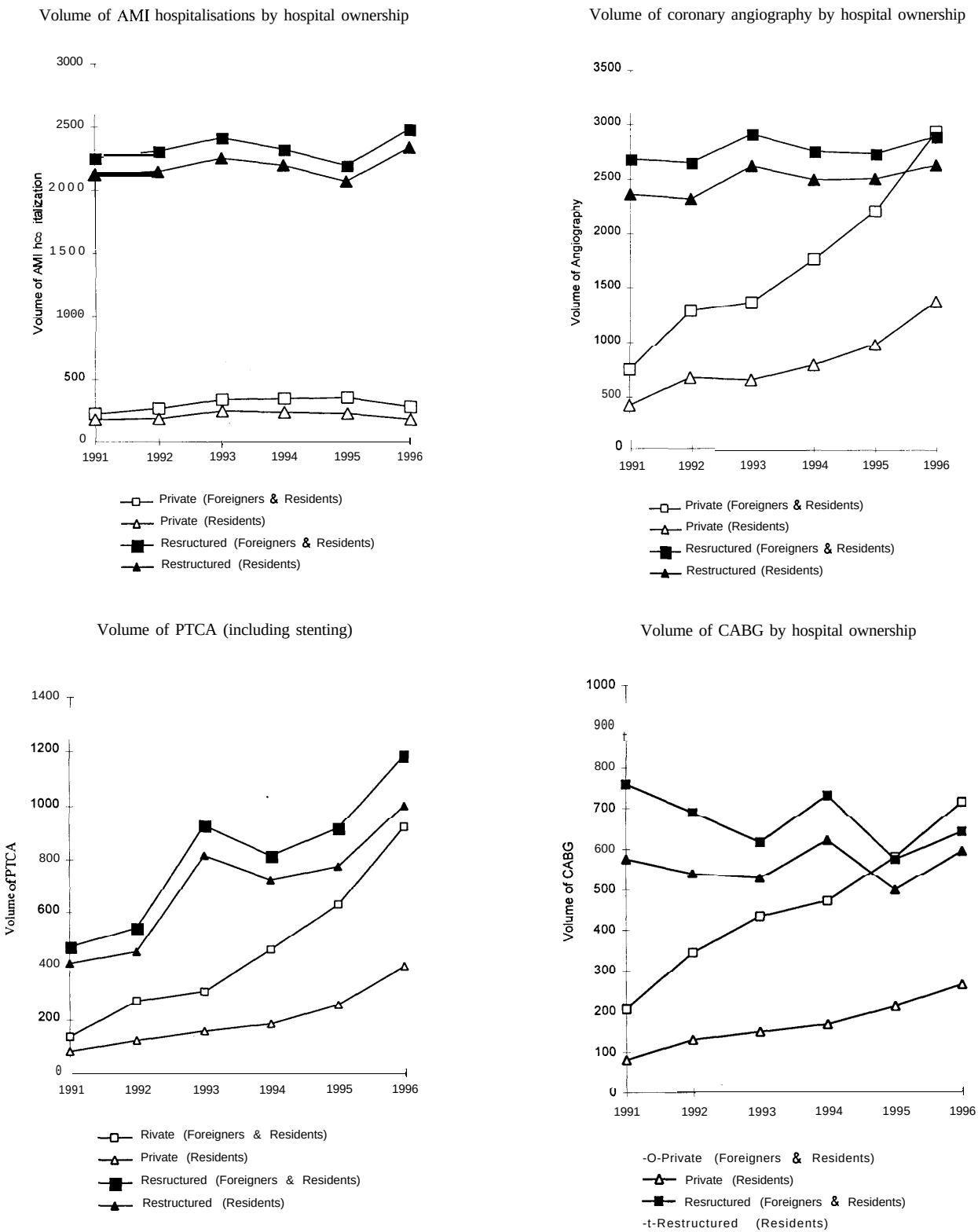


Fig. 2. Volumes of medical care interventions for AMI in Singapore, 1991-1996.

hospitals. The number of PTCA's increased 247% (570% in private and 152% in public restructured hospitals). Similar increase in numbers were observed for both foreigners and residents in private hospitals.

The rates in the resident population of Singapore of AMI hospitalisations decreased 11% (Fig. 3). The rates of angiograms (Fig. 3), PTCA (Fig. 4) and CABG (Fig. 4) among residents generally increased, with the greatest

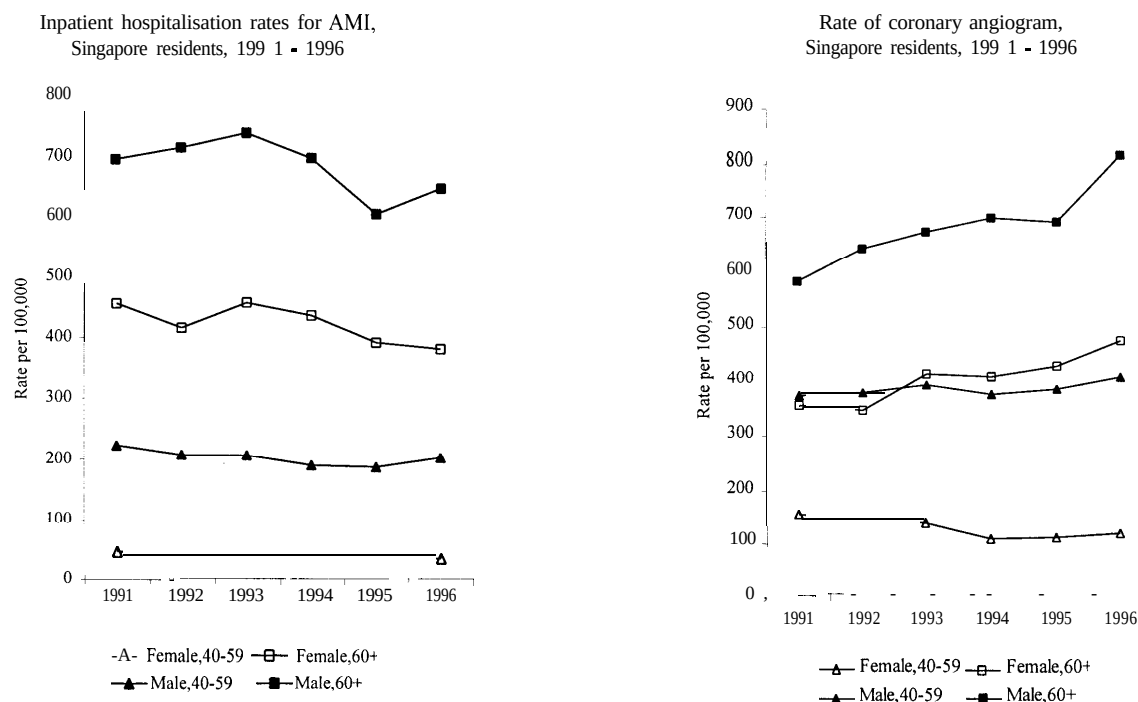


Fig. 3. Rates of hospitalisation and coronary angiogram in Singapore, 1991-1996.

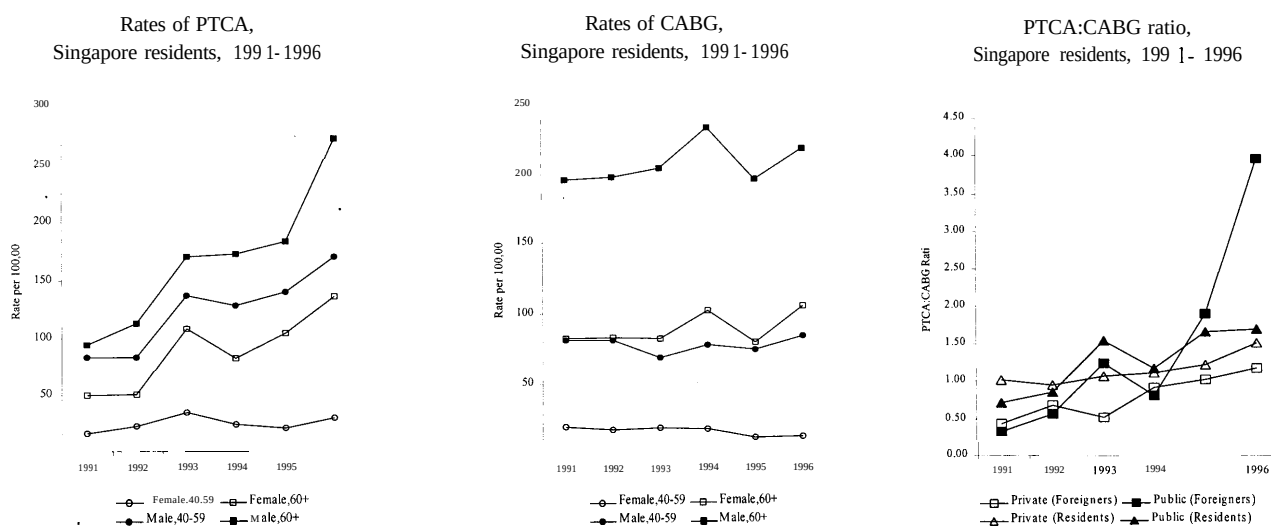


Fig. 4. Rates of PTCA, CABG and PTCA:CABG ratio for AMI in Singapore, 1991-1996.

increase among elderly aged 60 years and above (angiograms 38%, CABG 17% and PTCA 186%). The rates of invasive cardiac procedures for AMI were all lower in females than in males.

The ratios of PTCA to CABG (Fig. 4) from 1991 to 1996 for private and restructured hospitals showed a greater rate of technology substitution in restructured hospitals than in private hospitals (Fig. 4).

The population case-fatality from AMI appeared to

show a slight decline during this period for persons below 40 years of age (Fig. 5). It is interesting to note that case-fatality rate was higher in females than in males.

The average length of stay (LOS, 6.7 days) was fairly constant in restructured hospitals (Fig. 6). For private hospitals the average length of stay was higher in 1991 (7.6 days) and has steadily declined to 5.6 days in 1996. There was little variations in LOS across individual restructured public hospitals, but there was markedly

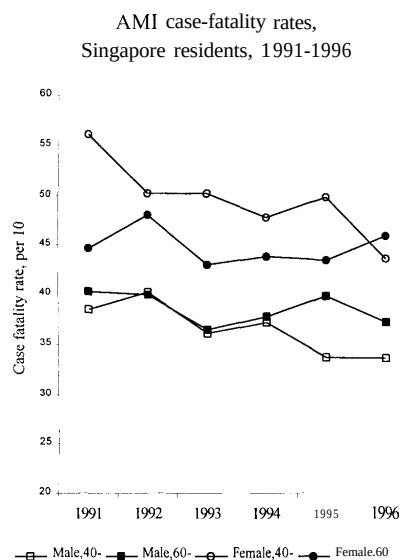
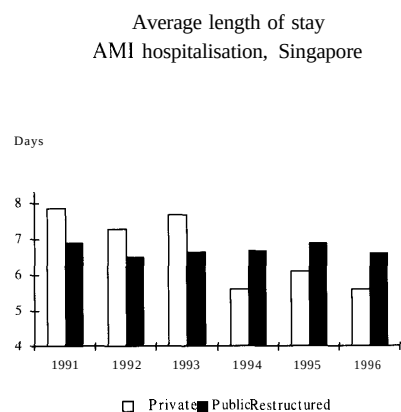


Fig. 5. Population-based case-fatality rate of AMI in Singapore, 1991-1996

wider variations in private hospitals.

The most common method of payment for AMI hospitalisation after deductibles was Medisave alone (50%), but for CABG surgery, the proportion of payment made



Average length of stay for AMI patients in private hospitals, Singapore

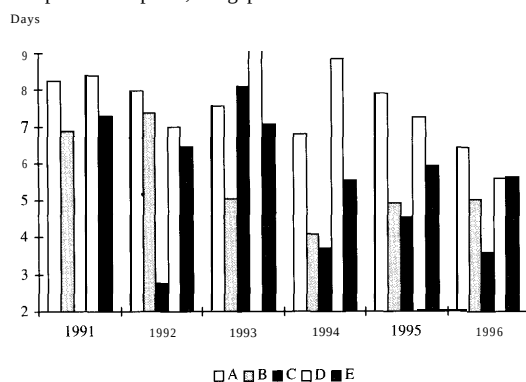


Fig. 6. Length of hospital stay for AMI patients, Singapore, 1991-1996.

through this method was only 12% (Fig. 7). Various combinations of out-of-pocket payments, Medisave, Medishield, and private insurance were more common for CABG surgery, and have increased steadily for both CABG and AMI hospitalisation. As expected, the most common method of payments among foreigners was out-of-pocket (50% for hospitalisation and 70% to 80% for cardiac procedures).

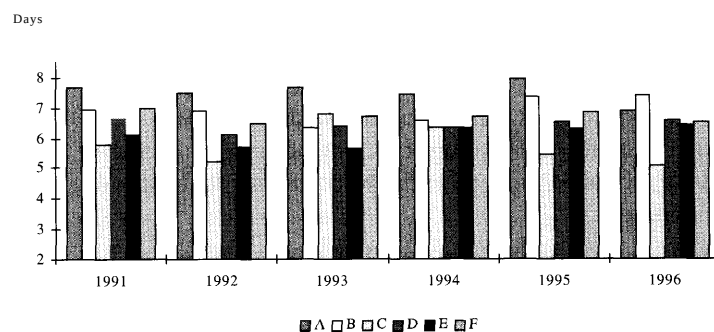
Discussion

The parallel declines in AMI mortality, incidence and hospital admissions in Singapore during the period from 1991 to 1996 suggest that primary prevention efforts aimed at reducing the population levels of risk factors for coronary heart disease have begun to succeed in reducing the number of coronary heart disease. Except for the elderly, the decline in hospitalisation rates for AMI is very slight, but it is possible that an increase in rates of re-admission for recurrent AMI among increasing numbers of survivors could explain why hospital discharge rates have not declined more.

In the United States, where mortality rates from CHD have shown much earlier declines in the 1970s, the national discharge rates for AMI have begun to show some decline in the late 1980s in some communities in the USA.^{5,6} In the Minnesota Heart Survey,⁶ the rates of hospitalisation for AMI in the twin-city of Minneapolis-St Paul declined by 5% to 10% between 1985 and 1990. The Minnesota data suggest that the effects from acute medical care on trends in CHD mortality are much stronger than primary care measures. However, we do not have data to separate out-of-hospital deaths from CHD from in-hospital deaths from CHD, which would allow us to separate the effects of primary prevention measures from advances in acute medical care.

The increases in rates of cardiac catheterisation, CABG and PTCA observed in this study have also been reported in many countries.⁷ The dramatically large increases in PTCAs parallel that in many countries, as is expected of a recent technology. The rate of increase

Average length of stay for AMI patients in public/restructured hospitals, Singapore



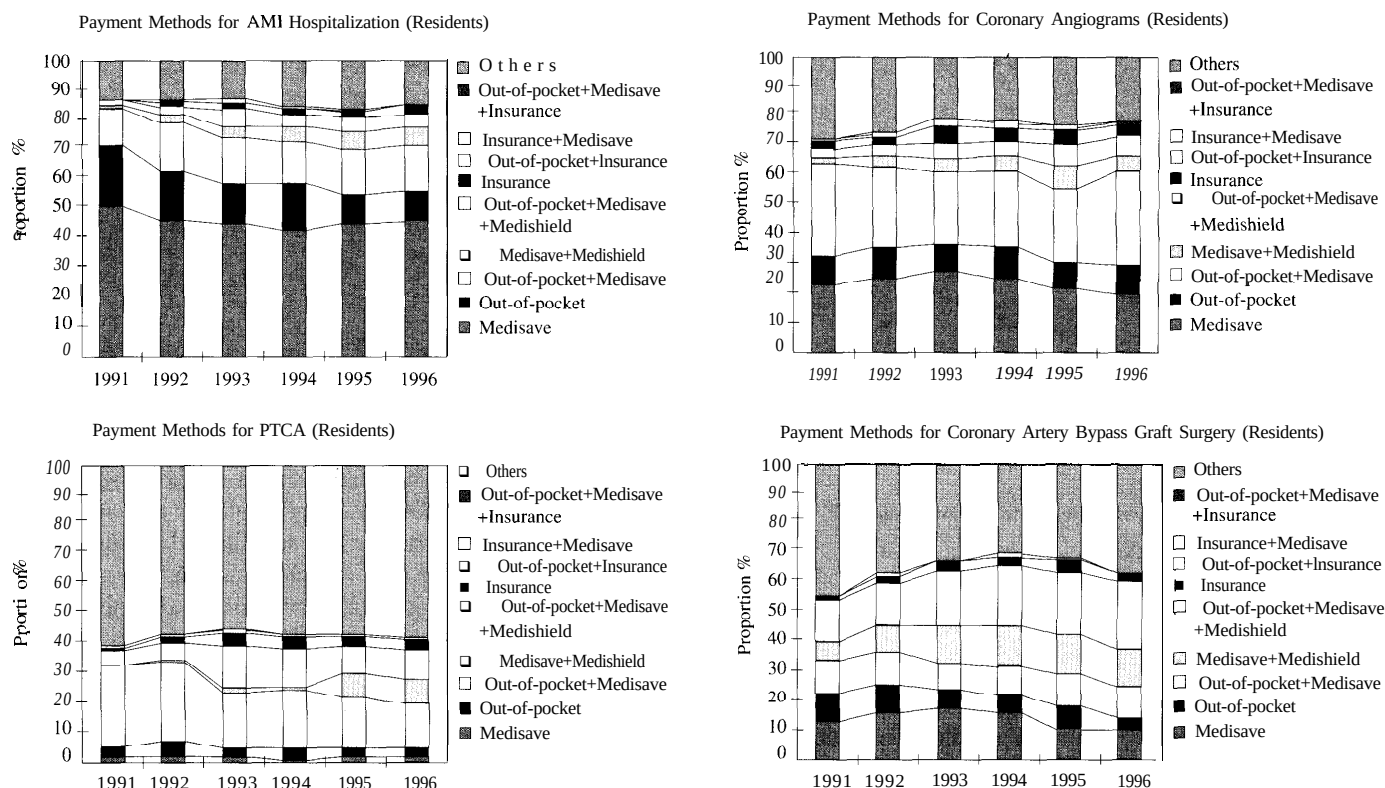


Fig. 7. Methods of payments for medical interventions for AMI, residents

(250%) is much higher than in Sweden where the increase was only 150% over the same period, but is lower than in Denmark, where the increase was 300% over the same period. In Israel, however, PTCA rates, after increasing by 140% from 1991 to 1994, have stabilized from 1994 to 1996. It is however, difficult to determine which is an appropriate rate of technology use.⁸

It is interesting to observe the higher rates of catheterisation, CABG and PTCA in the elderly in both men and women. This was also noted in the USA,^{9,10} and indicates an increasing and greater propensity of physicians to diagnose coronary obstruction and perform revascularization procedures in the elderly.

The lower rates of cardiac procedures in women than in men have also been observed in the US, which are disproportionate to differences in coronary disease prevalence, mortality or AMI fatalities.^{4,11} Questions about gender differences in access to surgical care have been raised about this discrepancy, dubbed the 'Yentyl syndrome', attributed to a higher medical decision threshold for physicians to investigate coronary obstruction for females.

Private hospitals performed a disproportionately greater numbers of cardiac procedures than public restructured hospitals. There is evidence from this study to show that this might be partly due to the greater

numbers of foreigners seen in private hospitals. However, there are other possible reasons, since the total number of residents undergoing these procedures in private hospitals have also increased (although not as markedly as foreigners). One possible reason is an increase in the number of senior cardiologists and cardiac surgeons who have gone into private practice between 1991 and 1996, and hence in the number of patients who preferred to have the procedures done in private rather than public hospitals.

We saw no evidence of CABG being replaced with the newer PTCA technology. The rates of CABG continued to increase during this period, especially among the elderly (17%). We observed that the number of CABG actually decreased in restructured hospitals. This could reflect technological substitution as more PTCAs were performed, but this is by no means certain. The numbers of CABG in restructured hospitals and population rates showed a few fluctuations during this period. There are some reasons to believe that this could be explained by an exodus of a few cardiac surgeons from the public sector to the private sector. However, the number of CABG in private hospitals continued unabated during this period.

The trends in cardiac interventions may thus reflect changing supply and demand factors related to the

investigation and treatment of coronary artery disease (both AMI and non-AMI patients with chronic ischaemic heart disease). These supply and demand factors include consumer preference for cardiac procedures, overuse of medical interventions, and the force of technological change itself. The present study contrasts the disproportionately higher volume and increased rate of use of cardiac procedures in private hospitals compared to restructured hospitals. We believe that revenue caps in restructured hospitals has an effect in curbing excessive and inappropriate use of medical interventions for AMI, whereas the use of balance-billing permits financial self-interest to induce demand for services.

Data from other studies^{1,12} suggest that large increases in the rates of use of fibrinolytic therapy, aspirin and anticoagulants, with proven effects on survival of patients with AMI,^{13,14} may account for between a quarter to half of the declines in in-hospital mortality. Unfortunately, we do not have data to determine the trends in usage of these pharmacological agents in Singapore. More data of a longitudinal nature from cohort studies are also needed to determine directly the inputs and outcomes of acute hospital care for myocardial infarction in Singapore. These should include, among other things, the directly estimated risks of death within three years after hospitalisation for AMI, to determine actual improvements of outcome from medical care.

While the present study provides data that suggest many possible explanations for the observed trends in disease occurrence, cardiac procedures, and outcomes of care, it is difficult to make definitive conclusions because of a lack of primary data on individual patients. These include data on the demographic and clinical profiles of patients undergoing cardiac procedures in both private and restructured hospitals. More detailed studies are therefore needed.

Conclusion

These preliminary data indirectly suggest that primary prevention and medical care interventions might have begun to succeed in reducing the rates of coronary heart disease in Singapore. The sharp increases in medical interventions for AMI may be explained by changing

supply and demand factors for AMI care, including consumer preference for cardiac procedures, overuse of medical intervention, and technological change. These need to be further investigated.

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