doi: 10.1093/heapol/czg038
HEALTH POLICY AND PLANNING; **18**(3): 316–329

Health Policy and Planning 18(3),

Impact of separating drug prescribing and dispensing on provider behaviour: Taiwan's experience

YJ CHOU,[1] WINNIE C YIP,[2] CHENG-HUA LEE,[1] NICOLE HUANG,[1] YING-PEI SUN[1] AND HONG-JEN CHANG[3]
[1]National Yang-Ming University, Taipei, Taiwan, [2]Harvard School of Public Health, Boston, MA, USA and [3]Bureau of National Health Insurance, Taipei, Taiwan

In many Asian countries, physicians both prescribe and dispense drugs. This practice is hypothesized to have caused high drug expenditure and widespread prescription of antibiotics in Asia. Recently, Taiwan implemented the separation policy on an experimental basis. This paper's objective is to empirically evaluate the impact of Taiwan's reform to separate drug prescribing and dispensing on drug expenditure and total health expenditure.

The research design consists of a pre/post comparison of the experimental with the control sites (difference-in-difference). Separation policy was implemented in Kaohsung and Taipei in March 1997, and expanded to Chia-yi and Taichung in March 1998. Changes in drug prescription behaviour before and after implementation in these two pairs of experimental cities were compared to Hsin-chu and Tainan (control), where separation policy was not implemented during the study period. To reduce resistance, providers in experimental sites were allowed to hire on-site pharmacists and dispense drugs through them if they chose to do so.

Our study sample consists of all outpatient visits to clinics in the study sites between December 1996 and June 1998, with a total of 55.23 million claim records. The drug prescription rate, drug expenditure and total health expenditure per visit were the main outcome measures. We found that the probability of prescription and drug expenditure per visit were, respectively, 17–34% and 12–36% less among visits to clinics without on-site pharmacists, compared with the control sites. However, no difference in total health expenditure was found between these two types of visits. Hence, the separation policy could be effective in reducing *drug* expenditure and affecting prescription behaviour, but is less certain as a policy for reducing *total* health expenditure. We also found that the policy has practically no effect on clinics that have on-site pharmacists.

Key words: pharmaceutical policy, incentives, prescribing behaviour, Taiwan, expenditure

Introduction

In many Asian countries physicians both prescribe and dispense drugs, earning profits that vary with the types and amount of drugs dispensed. This is largely the case in China, Hong Kong, Japan, Malaysia, South Korea, Taiwan and Thailand. Combining prescribing and dispensing creates incentives for physicians to increase drug prescriptions and is hypothesized to be a major cause of high drug expenditure and widespread prescription of antibiotics in Asia (Abe 1985; Yang and Bae 2000). For example, drug expenditure as a share of total health expenditure is approximately 30% for Japan, South Korea and Taiwan, and as high as 52% for China (National Health Economic Institute 2000), compared with an average of 10–14% among OECD countries where, in most cases, prescribing and dispensing are separate activities (OECD 1999). In South Korea, 59% of the patients receive antibiotic treatment, compared to the World Health Organization's (WHO) recommendation of 23% (Yang and Bae 2000). Several surveys in Hong Kong found that antibiotics were prescribed for approximately 60–80% of cold and flu outpatient visits and that the mean number of drugs prescribed was between four and five (Hsiao et al. 1999).

Countries across the world have been searching for effective methods of controlling drug expenditure, including budgetary quotas, prescription guidelines, formularies and information dissemination (Pacey and Li Wan Po 1998). Evidence suggests that many of these methods have limited impact on lowering drug costs (Bloor and Freemantle 1994). For instance, when budgetary restrictions were introduced in Germany in 1993, despite an initial decline in expenditure on prescription drugs by 25%, costs reached pre-1993 levels within a year. In France, the initial success of positive reinforcement of prescribed guidelines did not last for long, and the programme was abandoned in 1999 (Or 2002). Budget quotas and controls also raise the question of what is in the best interest of the patient. Although no rigorous analysis has been conducted, according to Ryan and Bond (1994), 'separation of physician and pharmacist functions is probably safer for patients' since it reduces profiteering incentives for both the pharmacist and the physician.

In recent years, in an effort to control drug expenditure growth and improve appropriate drug prescription, separating the drug prescribing and dispensing functions of physicians has gained popularity in policy debate among Asian countries (Seo 1994; Yang and Bae 2000). However, since very few of these countries have implemented the separation policy, there is limited empirical evidence as to how this policy affects provider behaviour and how effective it is in achieving its intended objectives.

This paper takes an initial step to bridge the gap in our knowledge by empirically evaluating the impact of Taiwan's reform to separate drug prescription and dispensing for outpatient services. In March 1997, Taiwan began implementing a separation policy on an incremental basis. The stated objectives of this policy were to control expenditure and improve physicians' drug prescription practices. However, as a result of resistance from physicians, a concession was made whereby clinics with on-site pharmacists were allowed to dispense their own drugs while those without pharmacists were required to use outside pharmacies. Using a pre-post, control group study design and claims data from the Bureau of National Health Insurance in Taiwan, we analyzed the impact of this separation policy on average drug expenditure, probability of prescription and probability of self-dispensing for each visit, separately for clinics that hired and did not hire on-site pharmacists. Finally, we analyzed whether reducing *drug* expenditure has translated into a reduction in *total* health expenditure. This paper does *not* analyze the impact of separation policy on appropriate drug prescription because information on drug types and dosage were not required for the claim process during the study period, and are thus not available for analysis.

Drug prescribing and dispensing in Taiwan

In March 1995 Taiwan initiated its National Health Insurance (NHI) scheme. The NHI provides universal coverage on all medical expenses (aside from a small co-payment), including prescription drugs. Doctors both prescribed and dispensed drugs, and there was no prerequisite of an on-site pharmacy or in-clinic pharmacist. Since there was no NHI reimbursement if patients chose to directly purchase drugs from pharmacies, patients relied upon their physician for drug dispensing. For each outpatient visit, a physician received reimbursement for the following: consultation; lab tests and diagnostic procedures; the service of dispensing drugs; and drugs dispensed. Fees for the different components were based on a schedule set by the NHI Bureau. Reimbursement for drugs dispensed was based on a per diem basis (NT$30 per day) if the expense was equal to or less than NT$100 (US$3.19) per visit (approximately 3 days). These cases made up about 90% of total claims and yet detailed information on dosages and types of drugs dispensed was not required from physicians. However, for prescriptions above NT$100 (US$3.19) details on type and dosage were required with the claim for approval. Fees for dispensing services were set at NT$10 (US$0.32) per visit.

Drug dispensing has been a profitable activity for physicians in Taiwan. Unofficial estimates suggest that profit represents half of drug fees. In addition, physicians often receive rebates – commonly known as 'kickbacks' – from pharmaceutical companies for dispensing certain drugs. Policymakers have been greatly concerned that under these profit incentives, physicians prescribe and dispense an excessive amount of drugs, above and beyond what is medically necessary. On average, drugs were dispensed in approximately 97% of all outpatient visits from 1997 to 1999. During the same period, drug expenditure increased at an average rate of 12.5% per year, compared to 9% per year for total health expenditure and 5.5% for outpatient expenditure (see Table 1).

Partly as an effort to combat increasing drug expenditure, Taiwan implemented a new policy to separate prescription and dispensing of drugs, beginning on 1 March 1997 and phased in over 4 years. Under this separation policy, physicians are not allowed to dispense drugs (with significant exceptions – see below), thus losing revenue from both the drug reimbursement and the NT$10 (US$0.32) per visit service fee for dispensing. To compensate for this loss of revenue, the consultation fee for each visit has been increased by NT$25 (US$0.80). The separation policy also transfers the reimbursement for dispensing services and drugs to pharmacies. As an incentive to encourage pharmacies to take up this new role, the dispensing service fee was increased from NT$10 to NT$20 (US$0.32 to US$0.64). This design implies that drug reimbursement per visit has to be reduced by at least NT$25 in order to have any savings in total health expenditure.

Table 1. Taiwan's health and drug expenditures (current million US$) and rates of increase (in parenthesis), by year

	1996	1997	1998	1999
Total health expenditure	7 160	7 692 (7.42%)	8 558 (11.26%)	9 281 (8.45%)
Total drug expenditure		1 913	2 171 (13.5%)	2 420 (11.5%)
Outpatient health expenditure	3 952	4 158 (5.21%)	4 606 (10.79%)	4 636 (0.65%)
Outpatient drug expenditure		1 541	1 747 (13.36%)	1 946 (11.40%)
Consumer Price Index	100.00	100.90 (0.90%)	102.60 (1.68%)	102.78 (0.18%)
Number of NHI beneficiaries	20 041 488	20 492 317 (2.25%)	20 757 185 (1.29%)	21 089 859 (1.60%)

Source: National Health Insurance Annual Statistical Report, Bureau of National Health Insurance, Taiwan 1996–1999. Taiwan Statistical Data Book, Council for Economic Planning and Development, Republic of China, 1996–1997.

The reform came after years of contestation and a series of protests by the medical profession.[1] In order to pacify such strong resistance, several concessions were made: physicians were allowed to dispense drugs if patients satisfied certain age or clinical requirements.[2] More significantly, those who hired pharmacists on-site could dispense drugs through them. In this case, physicians pay the pharmacists salaries while they continue to receive drug dispensing service fees and reimbursement for drugs dispensed, whereas physicians without on-site pharmacists must send their patients to outside pharmacies. Although hospitals are regulated in principle by the new policy, de facto, they remain unaffected because they have always had on-site pharmacists.

How does the separation policy change physicians' incentives to dispense drugs? When physicians are allowed to prescribe and earn positive income from dispensing drugs, their income is positively related to the amount of drugs dispensed. This provides incentives for physicians to prescribe and dispense more, and in some cases, too many drugs, compared with a situation where decisions on drug prescription are made purely based on maximizing patients' welfare. The objective of the separation policy is to de-link physician income from drug dispensing activities such that prescription decisions are based primarily on patients' needs. However, when physicians are allowed to dispense drugs through on-site pharmacists, they continue to be the residual claimant for drug profit. Thus their income remains linked to drug dispensing activities and the incentives they face are essentially the same as those faced by physicians in an environment without the separation policy. This leads to two testable hypotheses:

Hypothesis 1: Separation policy will lead physicians to reduce prescription and drug expenditures.

Hypothesis 2: Separation policy will have no impact on the prescription pattern of clinics hiring on-site pharmacies.

International experience has shown that policy interventions aimed at controlling health expenditures, such as fee-reductions, fee-freezes and expenditure caps, have limited effects as physicians respond by increasing the volume of services or changing the treatment modalities. According to the *target income hypothesis*, or more generally, the *demand inducement hypothesis*, physicians could recommend more services than necessary given the asymmetry of information between the physicians and the patients. When physicians' incomes are reduced, they could make up for the losses by inducing demand for other services (Evans 1974; Rice 1983; Gabel and Rice 1985; Fuchs 1986; Dranove 1988; Rice and Labelle 1989; Wedig et al. 1989; McGuire and Pauly 1991; Escarce 1993; Ginsburg and Hogan 1993; Hsiao 1995; Yip 1998). In the case of separation, physicians could increase non-drug related revenue such as lab-tests and diagnostic procedures, or increase the number of visits. Thus our third hypothesis is that,

Hypothesis 3: Separation policy will have no impact on *total* health expenditure because physicians make up for their drug revenue loss by increasing other non-drug revenue.

Methods and data

Our analysis uses a *difference-in-difference* methodology (Gruber 1994; Gruber et al. 1997), or a pre-post design with a control group. We compare the *change* (or difference) in the variable of interest (for example, drug expenditure per visit) before and after implementation of the policy in the experimental group to that of the control group. This method is an improvement over pre-post comparison without a control group because if a trend effect occurs during the same period as policy implementation, a simple pre-post comparison would incorrectly attribute the trend effect to a policy impact. In a difference-in-difference framework, any trend affecting the experimental and control groups equally will be removed and the resulting net difference will be the pure policy effect. For example, since the NHI was implemented nationwide in 1995, its insurance effect on consumers' demand for drugs will be the same for both the experimental and control regions. Differencing the trend in the experimental region from that in the control region will therefore isolate the separation policy from the insurance effect.

Table 2 illustrates the difference-in-difference methodology. Suppose x_1 and x_2 measure average drug expenditure per visit during the periods before and after the separation policy in the experimental region; c_1 and c_2 measure average drug expenditure per visit for the same periods in the control region. Δx measures the change in average drug expenditure per visit as a result of the separation policy and other trend factors. Δc measures the change in average drug expenditure per visit as a result of only trend factors. The difference between Δx and Δc thus removes the changes in average drug expenditure that are caused by the trend effects, isolating the pure effect of the separation policy.

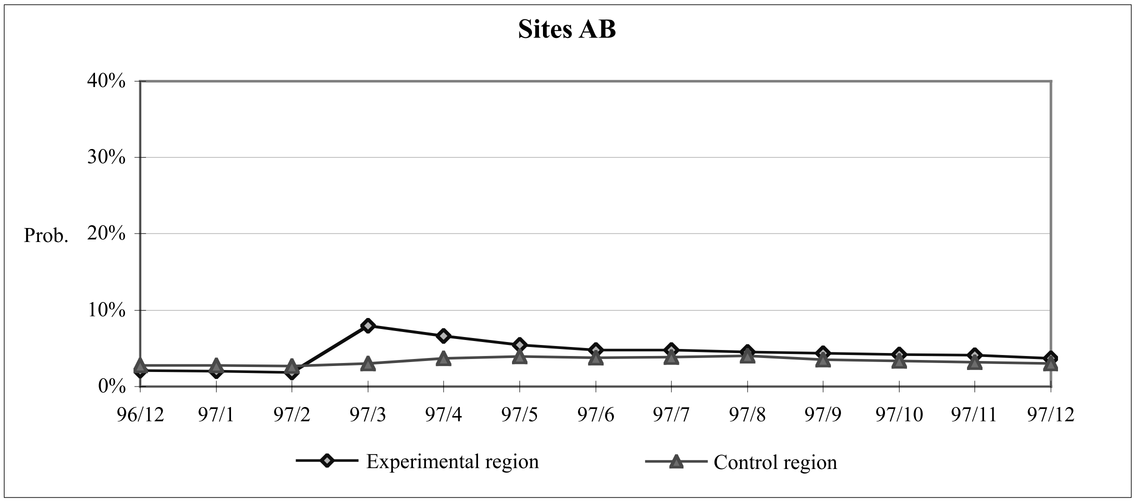
In Taiwan, separation policy was phased in between 1997 and 2000, starting from regions that satisfied a 3:1 clinic-to-pharmacy ratio in order to assure sufficient supply of pharmacies. This gradual implementation provides a set of natural experiments that can be used to examine the impact of the policy.

Table 2. The difference-in-difference methodology

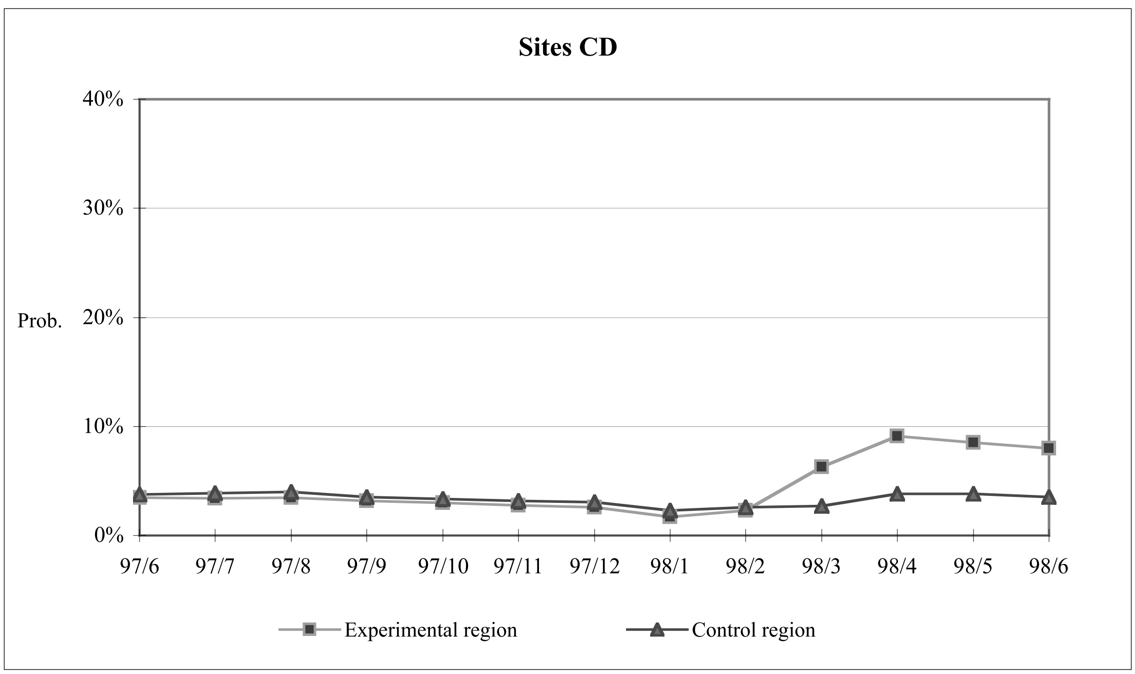
	Before reform	After reform	Difference (after – before)
Experimental group	x_1	x_2	$\Delta x = x_2 - x_1$
Control group	c_1	c_2	$\Delta c = c_2 - c_1$
Difference-in-difference			$(x_2 - x_1) - (c_2 - c_1) = \Delta x - \Delta c$

The six sites included in this study are: Kaohsung (A), Taipei (B), Chia-Yi (C), Taichung (D), Hsin-Chu (E) and Tainan (F). The policy was first implemented in March 1997 in Kaohsung and Taipei (A-B). It was then expanded to Chia-Yi and Taichung (C-D) in March 1998. These two pairs form the experimental sites. Hsin-Chu and Tainan (E-F), which had not been subject to any separation policy during the study period, serve as the control group. Hsin-Chu and Tainan (E-F) were chosen as the control sites because they had similar patterns of drug expenditure and prescription rates in the pre-separation period to the experimental sites, so that comparisons between the experimental and control groups in the post-separation period would not be confounded by baseline differences between the two groups.

Using the difference-in-difference framework, we analyze the impact of the separation policy on the three hypotheses stated in the previous section. To test Hypothesis 1, we define the probability of having no prescription as α; the probability of on-site dispensing as β; and the probability of off-site dispensing as γ, where $\alpha + \beta + \gamma = 1$. Average drug expenditure per visit is then: ($\beta \times$ average drug expenditure per self-dispensing visit) + ($\gamma \times$ average drug expenditure per off-site pharmacy dispensing visit). We define drug expenditure as expenditure for the drug dispensed only, and have not included the dispensing service fee. This is because we want to isolate changes in drug-related expenditures that are due to behavioural responses from those that are due to policy design. Dispensing service fee is analyzed, however, as part of total health expenditure under Hypothesis 3. Drug expenditure includes both the physicians' reimbursement from the Bureau of NHI and the co-payment they receive from patients.



Note: Experimental region: Taipei, Kaohsung. Control Region: Hsin-Chu, Tainan.



Note: Experimental region: Taipei, Kaohsung. Control Region: Hsin-Chu, Tainan.
Figure 1. Experimental and control regions comparison: probability of no prescription

To test Hypothesis 2, we separate the visits in experimental sites into those clinics that hire on-site pharmacists and those that do not hire on-site pharmacists, and compare them to the control regions separately. Clinics with and without on-site pharmacists are classified based on their status in the post-separation period. In the pre-separation period, almost all clinics had not hired on-site pharmacists and physicians dispensed the drugs themselves.

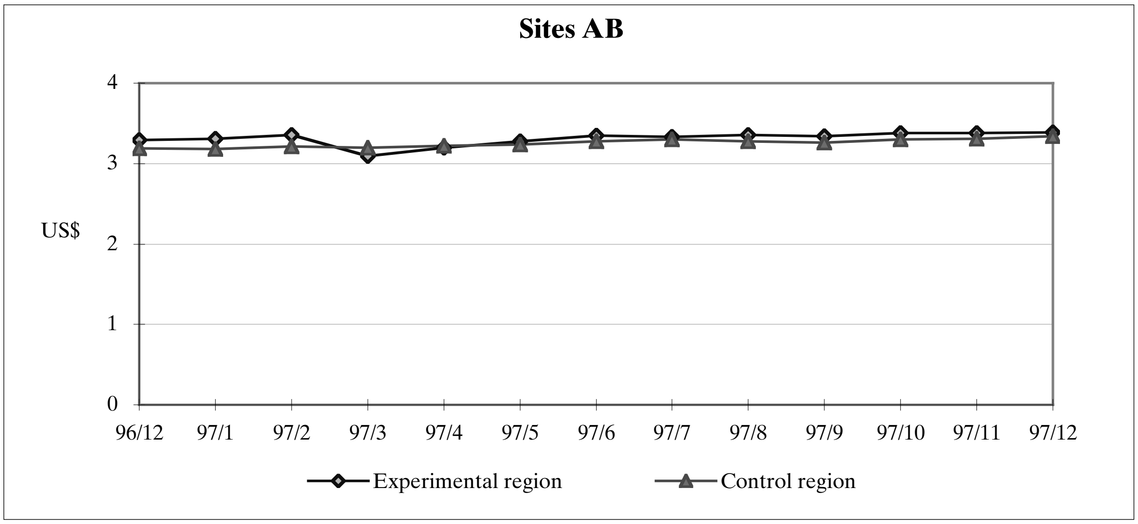
Finally, in testing Hypothesis 3, we examine the difference-in-difference estimates of *total* expenditure and its components per visit. These components include drug expenditure, treatment expenditure, drug dispensing fees and consultation fees. In addition, we analyze whether there are changes in the total number of visits per clinic.

The main sources of data are claims filed with the NHI Bureau by clinics and pharmacies between December 1996 and June 1998. All visits to clinics and pharmacies in the six sites under the study form the universe of our sample.[3] Our unit of observation is an outpatient visit, and altogether there are about 55.23 million claim records. Outpatient departments of hospitals are not included in the study because the separation policy did not affect them.

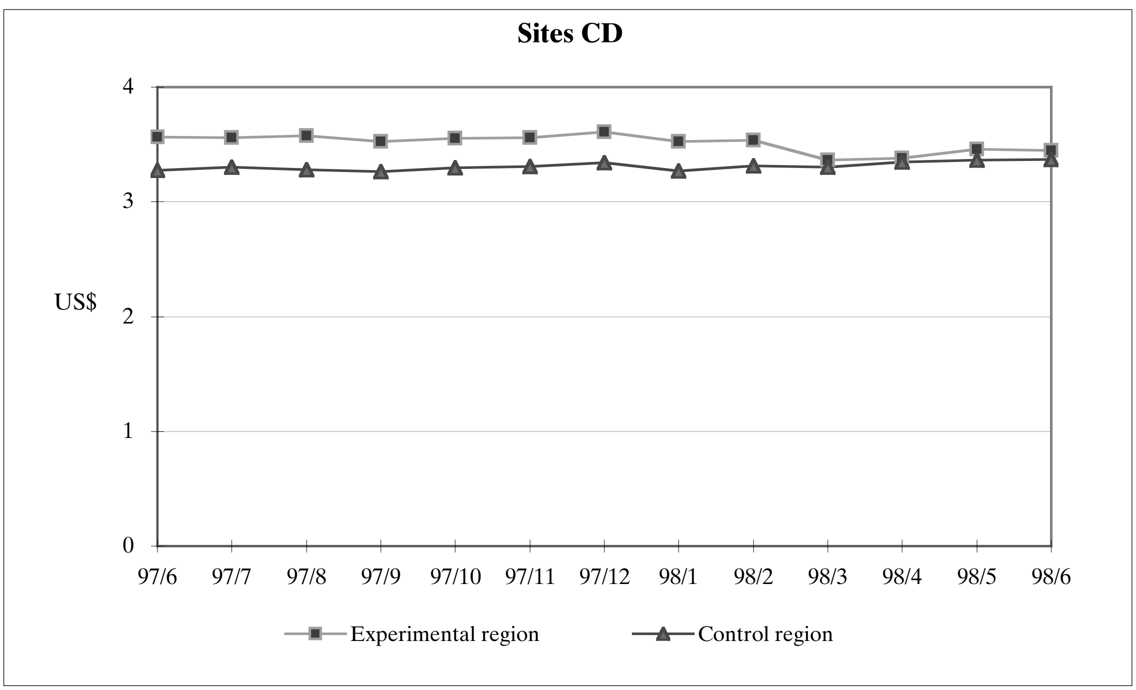
Results

Hypothesis 1: impact of the separation policy on drug prescription and expenditure

Figures 1 and 2 compare trends in the probability of no



Note: Experimental region: Taipei, Kaohsung. Control Region: Hsin-Chu, Tainan.



Note: Experimental region: Taichung, Chia-Yi. Control Region: Hsin-Chu, Tainan.

Figure 2. Experimental and control regions comparison: average drug expenditure per visit

prescription and average drug expenditure, respectively, for the control and experimental regions. The upper and lower panels present results for sites AB and sites CD, respectively. In both sites, trends in the pre-separation period were very similar for the control and experimental regions. This shows that sites EF are valid comparison groups for the experimental regions. In looking at the post-separation trends, we find very few discernible differences between the experimental and control regions, suggesting that the separation policy has little impact on drug use. After the implementation of the separation policy, drugs are still prescribed in more than 90% of cases. We also found that the majority of prescriptions are still dispensed by physicians rather than at off-site pharmacies in the regions subject to the separation policy.

Hypothesis 2: differential impact of the separation policy on clinics with and without on-site pharmacists

The separation policy has led to a significant increase in the number of clinics hiring on-site pharmacists. Table 3 shows the proportion of clinics in the experimental regions that hire on-site pharmacists, by volume of patient visits of the clinic. In the pre-separation period, almost no clinic hired on-site pharmacists. In the post-separation period, close to 60% of clinics hired on-site pharmacists. Clinics with larger patient volume are more likely to hire on-site pharmacists, probably because hiring on-site pharmacists is costly and is only profitable when there is sufficient patient volume.

Figures 3 and 4 compare the trends in probability of no-prescription and average drug expenditure per visit for the control and experimental regions, separating visits in experimental regions to clinics with and without on-site pharmacists. For visits to clinics without on-site pharmacists, the probability of no-prescription increased sharply after the implementation of the separation policy in both sites AB and CD, while trends for clinics with on-site pharmacists were almost the same as for the control clinics. A similar pattern was also found for average drug expenditure.

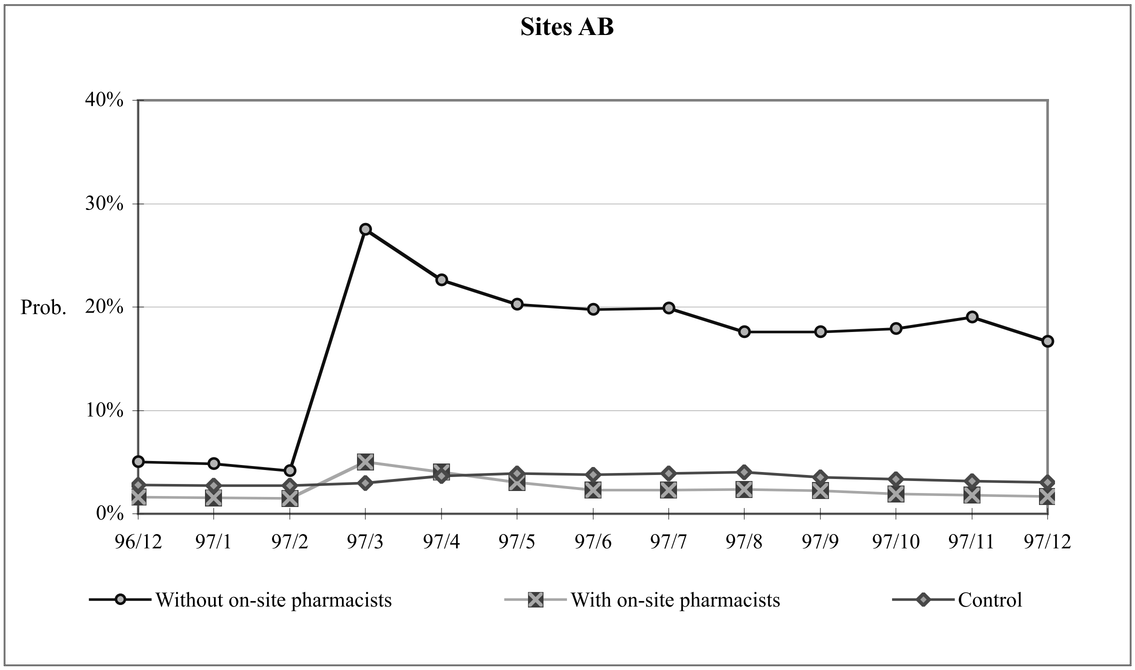
Tables 4 and 5 present the difference-in-difference comparisons between the control and experimental regions, distinguishing visits to clinics with and without on-site pharmacists. For both experimental sites AB and CD, before and after averages were calculated over the 3 months before and after implementation of the separation policy. We found that separation policy primarily impacted visits to clinics without on-site pharmacists. For visits to such clinics without on-site pharmacists in sites AB, average drug expenditure decreased by US$0.33 after the separation policy, compared to an increase of US$0.05 for visits to clinics in the control region. Thus drug expenditure was US$0.38 (12%) less (difference-in-difference) for visits to clinics without on-site pharmacists than for those in the control regions.

Reductions in sites CD are more dramatic. Compared to the control region, visits in the experimental regions at clinics without on-site pharmacists showed a US$1.21 (almost 36%) difference-in-difference estimated reduction. In contrast, there was almost no difference in drug expenditure between visits to clinics with on-site pharmacists and those in the control regions. This is true for both sites AB and CD. The difference in magnitude of impact observed in sites AB and CD may be attributed to differences in specialty distribution of clinics in the two sites. Taipei and Kaohsung (sites AB) have a higher concentration of specialist clinics, while Chia-Yi and Taichung (sites CD) have a higher concentration of general clinics. Perhaps general clinics have more flexibility to change their prescription patterns than specialists. Another plausible explanation is that since the separation policy was implemented in sites CD later than in sites AB, potential lessons could be learnt from sites AB to make the implementation more effective. Unfortunately, our data do not allow us to test for this hypothesis.

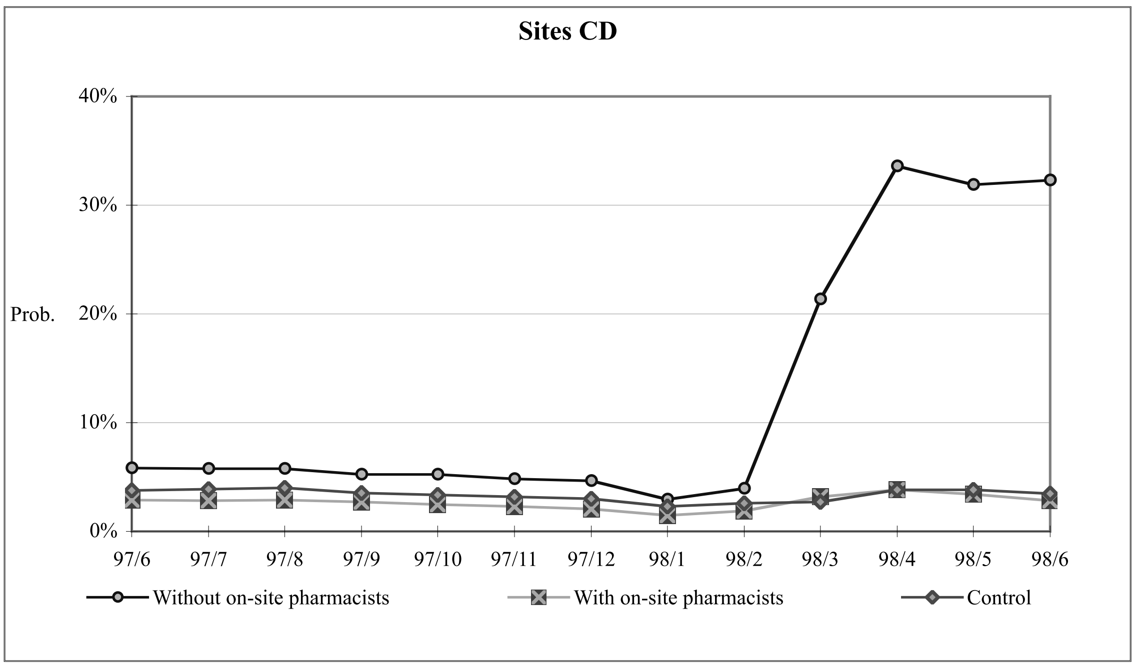
As for the probability of no prescription, visits to clinics in sites AB without on-site pharmacists saw an increase from 4.7 to 20.9%. In contrast, visits to clinics with on-site pharmacists exhibited a pattern almost identical to those in the

Table 3. The distribution of clinics with on-site pharmacists post-separation in experimental regions

Visits per month	Sites AB			Sites CD		
	Without on-site pharmacists	With on-site pharmacists	Total	Without on-site pharmacists	With on-site pharmacists	Total
<400	158 (90.29%)	17 (9.71%)	175	85 (96.59%)	3 (3.41%)	88
400–799	133 (61.29%)	84 (38.71%)	217	75 (67.57%)	36 (32.43%)	111
800–1199	61 (35.88%)	109 (64.12%)	170	38 (44.19%)	48 (55.81%)	86
1200–1599	30 (18.18%)	135 (81.82%)	165	26 (29.89%)	61 (70.11%)	87
1600–1999	16 (12.21%)	115 (87.79%)	131	5 (8.06%)	57 (91.94%)	62
≥2000	18 (4.86%)	352 (95.14%)	370	14 (7.69%)	168 (92.31%)	182
Total	416 (33.88%)	812 (66.12%)	1228	243 (39.45%)	373 (60.55%)	616



Note: Experiment: Taipei, Kaohsung. Control: Hsin-Chu, Tainan.

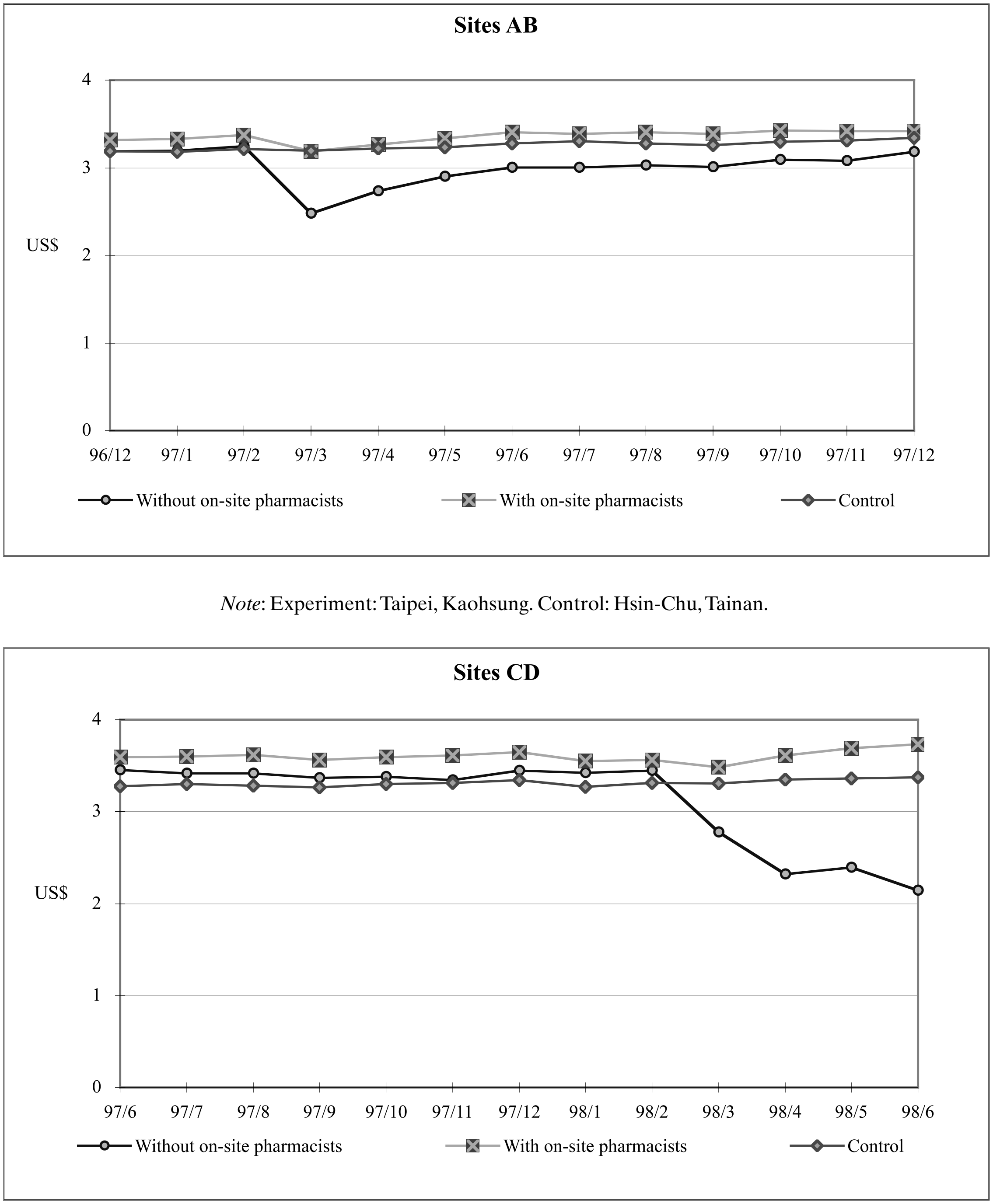


Note: Experiment: Taichung, Chia-Yi. Control: Hsin-Chu, Tainan.

Figure 3. Comparing visits to clinics with and without on-site pharmacies in the experimental region: probability of no prescription

control region – probability of no prescription increased minimally from 1.6 to 3.2%. For sites CD, visits to clinics without on-site pharmacists increased their probability of no prescription from 3.9 to 32.6%, while those to clinics with on-site pharmacists showed an increase from 2.6 to 3.7%, a pattern similar to the control regions.

The difference-in-difference estimates also show that the policy has reduced the probability of self-dispensing for visits to clinics without on-site pharmacists by almost half, difference-in-difference reductions of 42.9 and 57.5% for sites AB and CD, respectively, compared with reductions of 2.3 and 1.2%, respectively, for visits to experimental clinics with on-site pharmacists. These differences in response for clinics with and without pharmacists were not driven by unobservable differences between these two types of clinics since their



Note: Experiment: Taichung, Chia-Yi. Control: Hsin-Chu, Tainan.

Figure 4. Comparing visits to clinics with and without on-site pharmacies in the experimental region: average drug expenditure per visit

pre-separation trends were very similar, as indicated in Figures 3 and 4.

Hypothesis 3: the impact of separation on total health expenditure

To test if the observed reduction in *drug* expenditures for visits to clinics without on-site pharmacists translates to reduction in *total* health expenditure, Table 6 shows the difference-in-difference estimates of total expenditure per visit and its four components: reimbursement for drugs dispensed; lab tests and diagnostic procedures; the service of dispensing drugs; and consultation. In 1999 each component's share of total outpatient charges to the NHI was 28%, 17%, 4% and 51%, respectively.

We found that total expenditure per visit did not decrease as a result of the separation policy. Reductions in drug expenditure were compensated by an increase in dispensing service and consultation fees. Since dispensing service and

Table 4. Difference-in-difference results for drug expenditure, probability of no prescription and self-dispensing: Sites AB

		Probability of no prescription (α)		Probability of on-site dispensing (β)		Probability of off-site dispensing (γ)		Average drug expenditure per visit (US$)	
		Mean	S.E.	Mean	S.E.	Mean	S.E.	Mean	S.E.
Experimental region:									
With pharmacists on-site	Before (y_1)	0.0156	(0.0014)	0.9841	(0.0014)	0.0003	(0.0002)	3.34	(0.07)
(n = 812)	After (y_2)	0.0315	(0.0023)	0.9606	(0.0029)	0.0079	(0.0018)	3.33	(0.07)
	$\Delta Y = y_2 - y_1$	0.0159	(0.0027)	–0.0235	(0.0032)	0.0076	(0.0018)	0.00	(0.10)
	p-value	0.000		0.000		0.000		0.975	
Without pharmacists on-site	Before (z_1)	0.0468	(0.0063)	0.9516	(0.0063)	0.0016	(0.0010)	3.21	(0.08)
(n = 416)	After (z_2)	0.2090	(0.0145)	0.5088	(0.0172)	0.2822	(0.0166)	2.88	(0.10)
	$\Delta Z = z_2 - z_1$	0.1622	(0.0156)	–0.4429	(0.0180)	0.2807	(0.0162)	–0.33	(0.12)
	p-value	0.000		0.000		0.000		0.007	
Control region:									
(n = 382)	Before (c_1)	0.0274	(0.0043)	0.9682	(0.0047)	0.0045	(0.0022)	3.19	(0.07)
	After (c_2)	0.0379	(0.0048)	0.9542	(0.0058)	0.0078	(0.0035)	3.24	(0.08)
	$\Delta C = c_2 - c_1$	0.0106	(0.0064)	–0.0139	(0.0075)	0.0033	(0.0041)	0.05	(0.11)
	p-value	0.100		0.062		0.817		0.652	
Difference-in-difference:									
With pharmacists on-site	$(\Delta Y - \Delta C)$	0.0054	(0.0059)	–0.0096	(0.0070)	0.0042	(0.0039)	–0.05	(0.17)
	p-value	0.368		0.172		0.276		0.769	
Without pharmacists on-site	$(\Delta Z - \Delta C)$	0.1516	(0.0157)	–0.4289	(0.0182)	0.2773	(0.0148)	–0.38	(0.17)
p-value		0.000		0.000		0.000		0.027	

Note: Y1, Z1, C1 take the mean from Dec 1996 to Feb 1997; Y2, Z2, C2 take the mean from April to June 1997.

Table 5. Difference-in-difference results for drug expenditure, probability of no prescription and self-dispensing: Sites CD

		Probability of no prescription (α)		Probability of on-site dispensing (β)		Probability of off-site dispensing (γ)		Average drug expenditure per visit (US$)	
		Mean	S.E.	Mean	S.E.	Mean	S.E.	Mean	S.E.
Experimental region:									
With pharmacists on-site	Before (y_1)	0.0181	(0.0026)	0.9774	(0.0036)	0.0045	(0.0033)	3.58	(0.11)
(n = 373)	After (y_2)	0.0335	(0.0034)	0.9654	(0.0035)	0.0011	(0.0005)	3.68	(0.11)
	$\Delta Y = y_2 - y_1$	0.0154	(0.0043)	–0.0120	(0.0050)	–0.0034	(0.0033)	0.09	(0.15)
	p-value	0.000		0.017		0.310		0.539	
Without pharmacists on-site	Before (z_1)	0.0385	(0.0076)	0.9130	(0.0127)	0.0485	(0.0113)	3.44	(0.13)
(n = 243)	After (z_2)	0.3259	(0.0244)	0.3257	(0.0167)	0.3484	(0.0237)	2.29	(0.17)
	$\Delta Z = z_2 - z_1$	0.2874	(0.0250)	–0.5873	(0.0209)	0.2999	(0.0259)	–1.15	(0.21)
	p-value	0.000		0.000		0.000		0.000	
Control region:	Before (c_1)	0.0261	(0.0040)	0.9732	(0.0040)	0.0007	(0.0008)	3.31	(0.08)
(n = 382)	After (c_2)	0.0370	(0.0044)	0.9609	(0.0046)	0.0020	(0.0015)	3.36	(0.08)
	$\Delta C = c_2 - c_1$	0.0109	(0.0059)	–0.0123	(0.0061)	0.0014	(0.0017)	0.05	(0.11)
	p-value	0.065		0.045		0.427		0.629	
Difference-in-difference:									
With pharmacists on-site	$(\Delta Y - \Delta C)$	0.0045	(0.0072)	0.0003	(0.0079)	–0.0048	(0.0039)	0.04	(0.19)
	p-value	0.535		0.970		0.217		0.830	
Without pharmacists on-site	$(\Delta Z - \Delta C)$	0.2764	(0.0202)	–0.5750	(0.0180)	0.2986	(0.0184)	–1.21	(0.24)
	p-value	0.000		0.000		0.000		0.000	

Note: Y1, Z1, C1 take the mean from Dec 1997 to Feb 1998; Y2, Z2, C2 take the mean from April to June 1998.

Table 6. Comparison of total health expenditure and its components for visits to clinics without on-site pharmacists and control

		Average drug expenditure per visit		Average treatment expenditure per visit		Average dispensing fees per visit		Average consultation fees per visit		Total expenditure per visit	
		Mean	S.E.	Mean	S.E.	Mean	S.E.	Mean	S.E.	Mean	S.E.
Sites AB[a]											
Experimental region:											
Without pharmacists on-site	Before (z_1)	3.21	(0.08)	2.47	(0.50)	0.31	(0.00)	6.68	(0.03)	12.67	(0.52)
(n = 416)	After (z_2)	2.88	(0.10)	3.36	(0.56)	0.44	(0.01)	7.13	(0.03)	13.81	(0.57)
	$\Delta Z = z_2 - z_1$	–0.33	(0.12)	0.89	(0.75)	0.13	(0.01)	0.45	(0.04)	1.14	(0.77)
	p-value	0.007		0.236		0.000		0.000		0.140	
Control region	Before (c_1)	3.19	(0.07)	1.72	(0.25)	0.33	(0.00)	6.12	(0.04)	11.35	(0.28)
(n = 382)	After (c_2)	3.24	(0.08)	2.08	(0.28)	0.34	(0.01)	6.28	(0.04)	11.95	(0.30)
	$\Delta C = c_2 - c_1$	0.05	(0.11)	0.36	(0.38)	0.02	(0.01)	0.17	(0.06)	0.60	(0.41)
	p-value	0.652		0.337		0.007		0.002		0.146	
Difference-in-difference	$(\Delta Z - \Delta C)$	–0.38	(0.17)	0.53	(0.81)	0.11	(0.01)	0.28	(0.08)	0.55	(0.85)
	p-value	0.027		0.512		0.000		0.000		0.518	
Sites CD[b]											
Experimental region:											
Without pharmacists on-site	Before (z_1)	3.44	(0.13)	1.52	(0.32)	0.35	(0.01)	6.87	(0.04)	12.18	(0.34)
(n = 243)	After (z_2)	2.29	(0.17)	2.01	(0.31)	0.43	(0.02)	7.37	(0.05)	12.09	(0.34)
	$\Delta Z = z_2 - z_1$	–1.15	(0.21)	0.49	(0.45)	0.08	(0.02)	0.50	(0.07)	–0.08	(0.48)
	p-value	0.000		0.275		0.001		0.000		0.859	
Control region	Before (c_1)	3.31	(0.08)	1.53	(0.22)	0.39	(0.01)	6.23	(0.04)	11.46	(0.25)
(n = 382)	After (c_2)	3.36	(0.08)	1.95	(0.24)	0.40	(0.01)	6.37	(0.04)	12.09	(0.26)
	$\Delta C = c_2 - c_1$	0.05	(0.11)	0.43	(0.33)	0.01	(0.01)	0.14	(0.06)	0.64	(0.37)
	p-value	0.629		0.198		0.161		0.014		0.084	
Difference-in-difference	$(\Delta Z - \Delta C)$	–1.21	(0.24)	0.07	(0.65)	0.07	(0.02)	0.35	(0.11)	–0.72	(0.71)
	p-value	0.000		0.918		0.006		0.001		0.312	

[a] Sites AB: Z1, C1 take the mean from Dec 1996 to Feb 1997; Z2, C2 take the mean from April 1997 to June 1997.
[b] Sites CD: Z1, C1 take the mean from Dec 1997 to Feb 1998; Z2, C2 take the mean from April 1998 to June 1998.

consultation fees are fixed for each visit by the health authority, their increase cannot be attributed to a physician's *behavioural* response to compensate for loss in drug revenue, as we had hypothesized. Rather, they represent the government's explicit effort to improve providers' acceptability of the separation policy. There is no evidence of physicians engaging in behaviours such as increasing the provision of lab-tests and diagnostic procedures to compensate for the reduced drug revenue. We also analyzed the impact of the separation policy on the average number of visits for clinics that do not hire on-site pharmacists. Again, we did not find any evidence of increase in visits.

Conclusion and policy implications

Although the separation of drug prescribing and dispensing has gained popularity as a policy to combat health expenditure growth and improve appropriate drug use, especially among Asian countries, there is limited evidence on its effectiveness in achieving these objectives. Our empirical results from Taiwan suggest that a separation policy could be effective in reducing drug expenditures, primarily through reducing the probability of prescription. We also found that physicians did not make up for revenue losses due to the separation by increasing non-drug treatments or quantity of visits. This result suggests a positive outlook for the effectiveness of separation policy as an intervention to reduce drug expenditure.

The efficacy of the separation policy in reducing total health expenditure, however, at least as shown by the evidence in Taiwan, is less optimistic. It should be stressed that this is not due to physicians inducing demand; rather, it is the result of a conscious policy-decision. To reduce resistance from providers, Taiwan increased the consultation fee for physicians. Fees for dispensing services were also increased to provide incentives for pharmacists to assume their new role. Both measures mitigate the separation policy's impact on reducing total health expenditure, as the results presented in Table 6 show. Taiwan policymakers probably have weighted the benefits of the separation policy in promoting more rational drug prescription behaviour against the need to increase consultation and dispensing fees to facilitate the passage of the policy. As policymakers in other countries contemplate adopting the separation policy, it is important to for them to consider the counter-balancing effects of reduced drug expenditures and increased cost of physician and pharmacy fees on the overall health expenditure. This is an important distinction that needs to be made while developing policy objectives and the methodologies to meet those objectives.

Taiwan's experience also demonstrates that the impact of any reform policy is highly dependent on the details of its design. When Taiwan allowed physicians to hire on-site pharmacists, through whom the physicians dispense drugs, the effectiveness of the separation policy was greatly reduced. As the physician's income is, in practice, still linked with drug prescription and dispensing activities, the physician's financial incentives do not change whether he/she is subject to the separation policy or not. What additional savings in drug expenditures could be achieved if no on-site pharmacies had been allowed? Using the results from both sites AB and CD, and an estimated 170 million visits per year, we predict that prohibiting all clinics from dispensing drugs through on-site pharmacists would save Taiwan approximately US$64.4–205.7 million (3.5–12%) a year in outpatient drug expenditure. This simple calculation assumes that clinics with on-site pharmacists in the sample have the same behavioural response in drug prescription as those without on-site pharmacists. This may not be a valid assumption, as clinics with on-site pharmacists may be different from those without. For example, as Table 3 shows, clinics with on-site pharmacists tend to have larger visit volume and it may be more feasible for them to induce demand, thus reducing the effectiveness of the separation policy. We therefore repeated the difference-in-difference analysis for those clinics with more than 800 visits per month. Our qualitative conclusions remain unchanged. In terms of magnitude, the results found in sites CD are practically the same as those presented in Tables 4, 5 and 6. For sites AB, the reductions in drug expenditure and drug prescription probability among larger clinics are approximately half of those in the entire sample. However, there is no evidence that physicians induce demand in non-drug related services or the number of visits to make up for the revenue loss.

These results confirm once again that the separation policy could be effective in reducing drug expenditure. Even for large volume clinics that may have better potential to induce demand, there does not seem to be any evidence of such behaviour. However, there seems to be suggestive evidence that the impact of the separation policy could vary by market or organizational factors that are not examined or controlled for in this analysis, such as specialty type, solo versus group practices, competitiveness of the market, etc., which may warrant further investigation in order to maximize the results of a separation policy.

In addition to expenditure control, proponents of the separation policy believe the policy may improve appropriate drug prescription. Drug use patterns in Asia have caused concerns among public health professionals and policymakers as to what extent drug prescriptions are justified by clinical effectiveness criteria. For example, about half of all outpatient visits in Taiwan are for the common cold or flu and the antibiotics prescribed for these cases account for 65% of total antibiotic use in outpatient settings. Overuse of antibiotics leads to anti-microbial resistant strains of disease that no longer respond to existing antibiotic treatment, thus putting the health of the patient at risk (Belongia and Schwartz 1998).[4] Given data constraints, we could not analyze the impact of the separation policy on over/unnecessary-prescription directly in this study. However, in light of the extent of overuse under no separation, we may infer from the drug prescription results that the separation policy has reduced the extent of overuse and is beneficial to the health outcome of patients. Beginning in August 1999, Taiwan required details on types of drugs and dosage of each prescription to be filed in *all* claim forms. This new data, when made available, will provide an excellent opportunity to expand the current analysis to examine the impact of the separation policy on drug prescription pattern and appropriateness of drug use, and ultimately on health outcome and status.

Certain caveats are in order when interpreting our results. First, due to data availability, our difference-in-difference analysis is limited to 3 months before and after the implementation of policy. Whether expenditure reduction will persist in the long term requires further analysis. When we repeated the analysis for sites AB (Table 4) using 9 months of data post-implementation, the increase in the probability of no prescription and the reduction in expenditure per visit were smaller than those for 3 months (0.14 vs. 0.15; US$ –0.29 vs. US$ –0.38). Perhaps over time physicians without on-site pharmacists have developed ways to collude with off-site pharmacists, such as by sending patients to specific pharmacists while receiving a payment in return. More in-depth analyses are required to study whether this phenomenon is an issue to be concerned with, and to what extent. Nonetheless, given the dearth of evidence on the impact of separation policy and its growing popularity as an intervention to control expenditure growth, this study provides important lessons for other countries contemplating implementation of this reform.

Endnotes

[1] The most recent example of physician opposition is the series of physician demonstrations and strikes in South Korea in response to reform that has been under consideration since 1994 (OECD 1999). Since implementation in July 2000 there have been four general strikes, each lasting for over a week. In November 2000, partial strikes continued as the government, physicians and pharmacists were negotiating.

[2] The official list includes: under the age of 3; over the age of 65; pregnant; having severe diarrhoea, vomiting, dehydration, headache, backache, joint pain or toothache; vomiting or urinating blood; severe external bleeding; poisoning; severe allergic reaction; highly fluctuating body temperature; breathing difficulty; delirium or fainting; severe eye, ear, breathing, digestive or urinary obstructions; serious psychological problems threatening the safety of the patient and/or others; post-traumatic stress disorder.

[3] The majority of clinics in Taiwan are individual private practices.

[4] A 1999 Hong Kong study found 90% of common antibiotics to be ineffective against *Streptococcus pneumonae*, and tetracycline – used to treat a wide range of infections – to be useless for 90% of infected patients (Hsiao et al. 1999). In South Korea and Thailand the penicillin resistance rate of pneumococcal bacteria is 75 and 63%, respectively, compared to 10 and 15% for the USA and UK.

References

Abe M. 1985. Japan's clinic physicians and their behavior. *Social Science and Medicine* **20**: 335–40.

Belongia E, Schwartz B. 1998. Strategies for promoting judicious use of antibiotics by doctors and patients. *British Medical Journal* **317**: 668–71.

Bloor K, Freemantle N. 1996. Fortnightly review: lessons from international experience in controlling pharmaceutical expenditure II: influencing doctors. *British Medical Journal* **312**: 1525–7.

Dranove D. 1988. Demand inducement and the physician/patient relationship. *Economic Inquiry* **26**: 281–98.

Escarce J. 1993. Effects of lower surgical fees on the use of physician services under Medicare. *Journal of American Medical Association* **269**: 2513–52.

Escarce J. 1993. Medicare patients' use of overpriced procedures before and after the Omnibus Budget Reconciliation Act of 1987. *American Journal of Public Health* **83**: 349–55.

Evans RG. 1974. Supplier-induced demand: some empirical evidence and implications. In: Perlman M (ed). *The economics of health and medical care*. New York: Wiley. pp. 162–73.

Fuchs VR. 1986. Physician induced demand: a parable. *Journal of Health Economics* **5**: 367.

Gable JR, Rice T. 1985. Reducing public expenditures for physician services: the price of paying less. *Journal of Health Politics Policy Law* **9**: 595–609.

Ginsburg PB, Hogan C. 1993. Physician response to fee changes, a contrary view. *Journal of American Medical Association* **269**: 2550–2.

Gruber J. 1994. The incidence of mandated maternity benefits. *American Economic Review* **84**: 622–42.

Gruber J, Adams K, Newhouse J. 1997. Physician fee policy and Medicaid program costs. *Journal of Human Resources* **32**: 611–34.

Hsiao WC. 1995. Abnormal economics in the health sector. *Health Policy* **32**: 301–9.

Hsiao WC, Yip W et al. 1999. *Improving Hong Kong's health care system: why and for whom?* Special Report #5: Hong Kong Patient Studies Summary Report. Hong Kong: Government Printing Department.

McGuire TG, Pauly M. 1991. Physician response to fee changes with multiple payers. *Journal of Health Economics* **10**: 385–410.

National Health Economic Institute. 2000. *National Health Accounts*. Beijing, China.

OECD (Organization for Economic Co-operation and Development). 1999. *Health Data 99: a comparative analysis of 29 countries*. Paris: OECD.

Or Z. 2002. Labour market and social policy – improving the performance of health care systems: from measures to action (A review of experiences in four OECD countries). Occasional papers no. 57, Paris: OECD

Pacey S, Li Wan Po A. 1998. A review of methods of drug cost management in hospitals. *Journal of Clinical Pharmacy and Therapeutics* **23**: 171–7.

Rice T. 1983. The impact of changing Medicare reimbursement rates on physician-induced demand. *Medical Care* **21**: 803–15.

Rice T, Labelle R. 1989. Do physicians induce demand for medical services? *Journal of Health Politics Policy Law* **14**: 587–600.

Ryan M, Bond C. 1994. Dispensing physicians and prescribing pharmacists: economic considerations for the UK. *Pharmacoeconomics* **5**: 8–17.

Seo T. 1994. Prescribing and dispensing of pharmaceuticals in Japan [Editorial]. *Pharmacoeconomics* **6**: 95–102.

Wedig G, Mitchell JB, Cromwell J. 1989. Can price controls induce optimal physician behavior? *Journal of Health Politics Policy Law* **14**: 601–20.

Yang B, Bae J. 2000. Reforming drug distribution system in Korea: correcting the economic incentives. Annual meeting, Allied Social Science Association. New Orleans.

Yip W. 1998. Physicians' response to Medicare fee reductions: changes in the volume and intensity of supply of coronary artery bypass graft (CABG) procedures for the Medicare and private sectors. *Journal of Health Economics* **17**: 675–99.

Acknowledgements

This study is supported by a grant from the Department of Health, Taiwan, Republic of China. The views expressed in the paper are the authors' and do not represent those of the Department of Health.

We would like to thank Michael Reich for comments on an earlier draft.

Biographies

Yiing-Jenq Chou, MD, Ph.D., is a lecturer at the Department of Social Medicine, National Yang-Ming University, Shih-Pai, Taipei, 11221 Taiwan.

Winnie C Yip, Ph.D., is an Associate Professor at the Harvard School of Public Health, 124 Mount Auburn St, Suite 410 South, Cambridge, MA 02138, USA.

Cheng-Hua Lee, MD, DrPH, is an Associate Professor at the Department of Social Medicine, National Yang-Ming University, Shih-Pai, Taipei, 11221 Taiwan.

Nicole Huang, MPH, is a Research Associate at the Department of Social Medicine, National Yang-Ming University, Shih-Pai, Taipei, 11221 Taiwan.

Ying-Pei Sun, MPH, is a Research Associate at the Department of Social Medicine, National Yang-Ming University, Shih-Pai, Taipei, 11221 Taiwan.

Hong-Jen Chang, MD, MPH, MS, is CEO and President of the Bureau of National Health Insurance, Department of Health, Republic of China, 15 Fl, No. 140, Section 3 Hsinyi Road, Taipei 106, Taiwan.

Correspondence: Winnie Yip, Harvard School of Public Health, 124 Mount Auburn St. Suite 410 South, Cambridge, MA 02138, USA.