How do incentives influence the volume and type of health services received in public district hospitals?

1 Introduction: financial incentives emerging from a mixed financing system

In low-middle income countries, government budgets for public district hospitals are often supplemented by health insurance contributions, user charges and other income-generating mechanisms[1]. Given that in such countries health insurance is rarely universal, and poorer patients may receive exemptions or reductions on user charges, the amount paid by patients utilising public hospitals can vary considerably.

Such a mixed financing arrangement creates financial incentives to treat patients with equal health need unequally. This paper assesses whether physicians respond to these incentives and, if so, what factors mitigate against this. Three sets of hypotheses, using data from the Philippines, are tested. They are grounded within a standard application of the principal-agent model to healthcare, whereby the principal (patient) cannot perfectly observe the agent's (doctor's) actions [2,3], whilst recognising that the patient-doctor interaction may differ because of variation in patient ability/willingness to pay and other patient characteristics:

Hypothesis set 1. Provider payment mechanisms

a. Physicians working in 'access' hospitals (where there is expanded insurance coverage and higher reimbursement ceilings for children) are *less* likely to provide insufficient care.

b. Physicians working in 'bonus' hospitals (who receive bonuses for meeting quality standards) are *less* likely to provide insufficient and inappropriate care[i].

Hypothesis set 2. Patient charges

a. Children paying a higher daily rate for room and board are *less* likely to receive insufficient and inappropriate care.

b. Children who have (and use) PHIC insurance are *less* likely to receive insufficient care, but *more* likely to receive inappropriate care.

[i] Measures of insufficient and inappropriate care are discussed in section 2.2.

Hypothesis set 3. Non-financial aspects

a. Children coming from wealthier households are *less* likely to receive insufficient and inappropriate care (independently of what they pay).

b. Children whose mothers have attained higher education levels are *less* likely to receive insufficient and inappropriate care.

c. Physicians working in hospitals with internal committees monitoring quality of care are *less* likely to provide insufficient and inappropriate care.

d. Physicians working in hospitals with external bodies monitoring quality of care are *less* likely to provide insufficient and inappropriate care.

2 Methods

2.1 Study context and sampling issues

Public district hospitals receive funding from a mix of sources. The majority comes through Local Government Units (LGUs). However, this has rarely been sufficient to cover their operating costs[4]. Public hospitals are therefore reliant on additional income-generating mechanisms, particularly Philippine Health Insurance Corporation (PHIC) contributions and user charges. As PHIC membership is not universal, and given that poorer patients receive exemptions or reductions on user charges, the amount paid by patients utilising public hospitals can vary considerably[5,6].

To assess the impact of this mixed financing on physician behaviour, data from the Philippine Child Health Experiment, known locally as QIDS, was used. This is a large-scale study exploring the impact of policy interventions on provider behaviour and access to healthcare, with a focus on children aged five years or under. The QIDS study randomly sampled thirty districts in the Visayan island group and the northern tip of Mindanao (for a comprehensive discussion of the QIDS methodology, see Shimkhada et al[7]). These were matched into blocks of three districts, each block being similar in terms of socioeconomic and health system characteristics.

Within each block, one district was randomly assigned to the QIDS ‘access’ policy intervention, the second to the QIDS ‘bonus’ intervention, with the third being the control site. In access sites, PHIC membership was made available at no cost to all indigent children under the age of 6 years and their families. Further, the reimbursement ceiling was increased, so that most ordinary pneumonia and diarrhoea cases would have 100% financial coverage. In bonus sites, physicians received increased reimbursement if they met quality standards.

Patient exit, facility and physician surveys were used in this analysis. For the *patient exit survey*, the sample comprised inpatient cases of children aged five years or less. The child's mother (or other carer) was interviewed immediately after the child was discharged from the district hospital. Interviews were conducted for at least 30 children with pneumonia, 30 with diarrhoea, and 30 with other illnesses, on a sequential basis. These were identified from a hospital's daily activity reports. The *facility survey* was undertaken in the district hospital in each of the 30 districts, with the relevant questions being related to the hospital's caseload and input availability. For the *physician survey*, three physicians normally attending paediatric cases (randomly selected) were interviewed per facility. Interviewees were given clinical vignettes – case scenarios testing a physician's ability to correctly diagnose and treat patients[8] – on paediatric pneumonia, diarrhoea and dermatological cases. Questions on their clinical experience and training were also asked.

2.2 Measuring the sufficiency and appropriateness of healthcare

Sufficiency of care: clinical package received[ii]

As part of the patient exit survey, the sick child's parent or other carer was asked which of the following health services the child received during their inpatient admission:

– Laboratory tests; X-ray; Oral medication; Intravenous medication; Other injected medication (intramuscular or, rarely, intracutaneous); Intravenous fluids; GP visit during admission (after initial visit upon admission); Specialist consultation during admission; Lumbar puncture; Intubation

These services were aggregated into 'clinical packages': broad packages of care for pneumonia and diarrhoea cases. This approach was preferred to comparing individual health services (which does not measure the overall sufficiency of services received); unweighted aggregation (which unrealistically assumes that there are no differences in effort required between these health

[ii] Perception variables, reflecting more qualitative measures of the amount of care and/or time provided to a patient were also used to measure sufficiency of care. However, these suffered from insufficient variation (most respondents reporting moderate satisfaction), and thus regressions had limited predictive power. These were therefore not included in this paper.

services); or applying weights to these services (methodologically difficult, given the lack of information on a child's syndrome, etiology and any secondary diagnosis).

Four clinical packages were defined, based on various combinations of these 10 health services (see table 2). They represent sequentially increasing volume of health services.

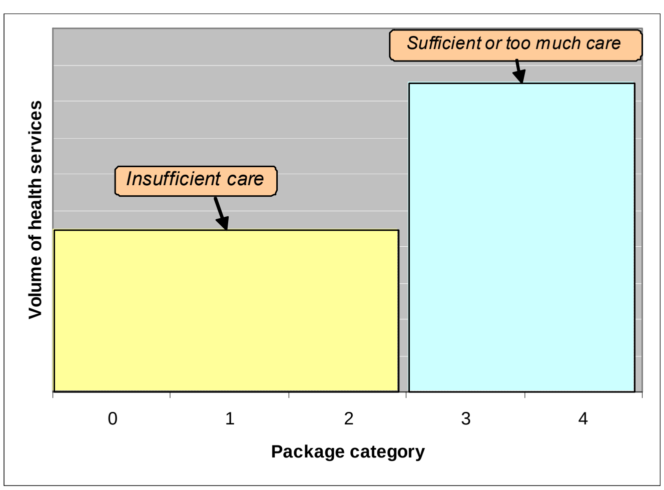
Table 2: Clinical packages for pneumonia and diarrhoea

Package category:	**Package contents:**	
0 Nothing	-	
1 Tests only	Pneumonia: Laboratory test and/or X-ray. Diarrhoea: Laboratory test	
2 Incomplete package	#1+only 1-2 of:	Medication (oral or IV or other injected); IV fluid; GP visit or Specialist consultation
3 Standard package	#1+all of:	Medication (oral *or* IV *or* other injected); IV fluid; GP visit or Specialist consultation
4 Severe case	#3+:	Pneumonia: Lumbar puncture; Intubation. Diarrhoea: Lumbar puncture; Intubation; X-ray

Definition of these packages was based on discussions with local physicians from the Philippines on what constitutes standard care for inpatient pneumonia and diarrhoea cases for children aged five or less, and consequently different packages of 'non-standard' care.

More care as defined by these packages, though, does not necessarily equate to better quality care. However, the approach still defines a standard clinical package. If less than this is provided, it is interpreted as insufficient care. Note though that if more than this is provided, it is not possible to ascertain whether this is unnecessary care or instead reflects more severe cases:

Figure 1 Sufficiency of clinical packages



Appropriateness of care: method of medical administration

This empirical measure involves analysing the method of medical administration given to the sub-sample of patients receiving medication intravenously or by injection. This is because intravenous medication is, for most pneumonia and diarrhoea inpatient cases, preferable to other injected medication in terms of minimising patient discomfort, but is typically more time-consuming. Intravenous medication is, therefore, defined as being a more appropriate method of medical administration than other injected medication.

2.3 Model specification

The general empirical approach can be summarised as follows:

$$E_i = \beta_i \mathrm{X} + \beta_j Y + \mu_{i,j} \qquad [1]$$

where the dependent variable E_i denotes the medical effort patient *i* receives, as measured through Models A and B. Explanatory variables are made up of vectors of patient-related characteristics (*X*) and hospital-related characteristics (*Y*), with $\mu_{i,j}$ a vector of residuals.

To control for case-mix, separate regressions are run for patients with pneumonia and those with diarrhoea in Models A and B. Data comes from two time periods (November 2003-December 2004, and September 2006-June 2007) before and after the QIDS intervention. The effects of most of these explanatory variables are expected to be constant over time, and thus are pooled across the two time periods. However, the model also includes two hospital-level policy interventions introduced after the first time period, as part of the QIDS study (access and bonus interventions: described in section 2.1). The effects of these policy interventions are isolated using a difference-in-difference methodology (see, for instance, Yip and Eggleston[9]):

$$E_i = \beta_{1,j} Access + \beta_{2,j} Bonus + \beta_{3,i} Time + \beta_{4,i} Access * Time + \beta_{5,i} Bonus * Time + \beta_i \mathrm{X}$$

$$+ \beta_j \mathrm{Y} + \mu_{i,j} \qquad [2]$$

This is an expanded form of the more generalised regression model [1] above. *Access* and *Bonus* are dummy variables equalling 1 if the patient is treated in a hospital with one of these policy interventions; *Time* is a dummy variable equal to 1 for the second data period. The coefficients β_4 and β_5 measure the difference over time for access or bonus hospitals, as compared with the difference over time for control hospitals (i.e. the difference-in-difference). This allows for time trends to be accounted for. The interpretation of these and other coefficients are summarised in table 2.

Table 2: The difference-in-difference (DD) approach

	Policy intervention type (hospital level)		
	Access	**Bonus**	**Control**
Before (2003-4, Time=0)	β_1	β_2	
After (2006-7, Time=1)	$\beta_1 + \beta_3 + \beta_4$	$\beta_2 + \beta_3 + \beta_5$	β_3
Difference (After-Before)	$\beta_3 + \beta_4$	$\beta_3 + \beta_5$	β_3
DD (Access *or* Bonus V Control)	β_4	β_5	

2.4 Explanatory variables

1. Provider payment mechanisms variables

These are reflected in the difference-in-difference variables, with *ACCESS*TIME*[iii] and *BONUS*TIME* the variables of interest. The former tests hypothesis 1a, and is expected to have a positive coefficient in Model A. This is because health professionals, when treating such patients, will be less likely to under-provide for patients previously struggling to pay the full costs of healthcare, knowing that a greater volume of services will be reimbursed for these patients than previously / in other hospitals. For Model B, the coefficient is unknown a priori. Table 3 describes this and all other explanatory variables used in the regression analyses.

The coefficient for *BONUS*TIME* tests hypothesis 1b, and is expected to be positive for Model A and negative for Model B. This is because bonus payments are expected to improve a physician's clinical quality, and thus reduce the likelihood of under-provision (Model A) and providing inappropriate care (Model B).

[iii] Note that an alternative set of interaction dummies based on combining the ACCESS dummy with whether a patient had PHIC insurance were also run. These produced near identical results in all model variants.

2. Patient charges variables

Daily charge RB, equal to the daily charge for room and board, tests hypothesis 2a. This was preferred to using total health expenditure, as it is independent of expenditures on actual health services received (such as medications). Thus, unlike total health expenditure, it is exogenous to all of the dependent variable specifications. Its coefficient is expected to be positive for Model A, and negative for Model B, since those paying more for room and board have a higher willingness and/or ability to pay.

PHIC insured, measuring whether a patient has PHIC insurance and has claimed or will make a claim, tests hypothesis 2b. It has an expected positive coefficient in both models. For Model A, its coefficient is expected to be positive because physicians understand that the insured are (typically) able to pay more for healthcare than the non-insured. For Model B, the expected positive coefficient follows a different rationale: administering medication by injection is quicker than intravenous administration, yet reimbursement from PHIC is the same either way, and so physicians are likely to prefer administering medication by injection for such patients.

3. Non-financial aspects variables

HHINCOME, measuring a patient's reported annual household income, is a proxy for a patient's social standing. Income quintiles are used. It tests hypothesis 3a, with its coefficient expected to be positive for Model A, and negative for Model B, assuming doctors are more likely to receive future reciprocal gains from patients with higher income (see, for instance, Fehr and Falk[10], on reciprocity).

EDUCATION, measuring the years of schooling of the patient's mother, is a proxy of the health knowledge of the patient's mother. It tests hypothesis 3b, and is expected to be positive for Model A, and negative for Model B, as mothers with better health knowledge are more likely to recognise insufficient and inappropriate care.

INTERNAL MONITORING, reflecting whether a hospital has a mortality or morbidity review committee, is a proxy for monitoring of a physician's clinical performance. *EXTERNAL*

MONITORING indicates whether a hospital is Sentrong Sigla accredited. Such hospitals have to meet quality standards to be accredited, and then are monitored to ensure this quality is maintained[11]. In both cases, the coefficients are expected to be positive for Model A and negative for Model B, since better monitoring should reduce the likelihood of under-provision (Model A) and providing inappropriate care (Model B). These test hypotheses 3c and 3d.

Variables controlling for a hospital's technical capacity and a patient's severity of illness are also included. See table 3 for details. Case-mix is controlled for by running separate regressions for pneumonia and diarrhoea inpatients.

For all model specifications, the approach was to first estimate a full model. This includes all of the variables described above. Then a restricted model is estimated. This is a reduced (nested) form of the full model, excluding statistically insignificant control variables on the basis of the Akaike Information Criterion (AIC). It reflects the model which best forecasts the dependent variable in Models A and B beyond the sample set. In the results section, only the restricted model is presented.

Table 3 Explanatory variables for regression analyses

Variable	Description	Hypothesis	Model **A**	Model **B**
			Expected coefficient:	
DIFFERENCE-IN-DIFFERENCE VARIABLES				
Access	=1 if hospital is 'access' site, =0 if not	Control	0	0
Bonus	=1 if hospital is 'bonus' site, =0 if not	Control	0	0
Current	=1 if hospital is 'current' (control) site, =0 if not	Control	Ref.	Ref.
Time	=1 if patient treated in (any) hospital after policy interventions, =0 if not	Control	0	0
ACCESS*TIME	=1 if patient treated in 'access' hospital after policy intervention, =0 if not	1a	+	+/-
BONUS*TIME	=1 if patient treated in 'bonus' hospital after policy intervention, =0 if not	1b	+	-
PATIENT CHARACTERISTICS				
DAILY RB CHARGE	daily charge for room and board (i.e. excludes costs of actual treatments)	2a	+	-
PHIC INSURED+CLAIM	=1 if patient has PHIC insurance and will/has claimed, =0 if not	2b	+	+
HHINCOME	reported annual household income	3a	+	-
EDUCATION	=child's mother education, 0=none, 1=<primary, 2=primary, 3=secondary, 4=tertiary+	3b	+	-
#Symptoms	Number of symptoms before hospitalisation, ranging from 0 to 12	Control	+	+
Treatment before	=1 if child treated for condition before being hospitalised, =0 if not	Control	+	+
Age <= 6 months	=1 if child is aged less than 3 months, =0 if not	Control	Ref.	Ref.
Age >6 & <=24 months	=1 if child is aged 3 to 11 months, =0 if not	Control	-	-
Age >24 mths & <=5 years	=1 if child is aged 1 to 2 years, =0 if not	Control	-	-
HOSPITAL CHARACTERISTICS				
INTERNAL MONITORING	=1 if hospital has mortality/morbidity review committee, =0 if not	3c	+	-
EXTERNAL MONITORING	=1 if hospital is Sentrong Sigla accredited, =0 if not	3d	+	-
Input 1_lab services	Number of lab services (needed for pneumonia or diarrhoea), range=1-5	Control	+	+/-
Input 2_sterilizer	Number of sterilizers, range=1-7	Control	+	+/-
Input 3_stethoscope	Number of regular stethoscopes, range=3-10 (10=10+)	Control	+	+/-
Input 4_otoscope	Number of otoscopes, range=0-4	Control	+	+/-
#Beds	Number of beds available in hospital	Control	+	+/-
Caseload	Number of inpatient cases in last month	Control	-	+
Ave. Vigentte score	average vignette score of interviewed hospital physicians	Control	+	-
Ave. Physician age	average age of interviewed hospital physicians	Control	+/-	+/-

2.5 Regression diagnostics

Various diagnostic checks were performed to check for common statistical problems. There is potential *data clustering* at the hospital level[iv]. For all models, this correlation was statistically significant at the 99% level. In addition to hospital-level explanatory variables, clustering was adjusted for in the modelling process. *Multicollinearity* was examined, as was potential *endogeneity* of the independent variable *Caseload*. There was no evidence of high multicollinearity or endogeneity. *Specification errors* were identified in Model B for the pneumonia sub-sample. Removing the most influential observation[v] resolved the problem. There was also evidence of significant *heteroscedasticity* in this sub-sample (affecting the education variable). Thus for this sub-sample, heteroscedasticity-adjusted results are presented. In all other regressions, no observations were markedly influential, nor was there any evidence of significant specification errors or heteroscedasticity.

3 Results

3.1 Descriptive statistics

Facility surveys were conducted in 30 districts, with a total of 6098 patients interviewed. Tables 4a and 4b give some of the main hospital and patient characteristics.

Table 4a Hospital characteristics

	Number of hospitals	%
Internal monitoring[a]	17	57
External monitoring[a]	26	87
	Mean	Median
# Key laboratory services[b]	3.3	3
# Stethoscopes	6.5	7
# Otoscopes	1.4	1
# Sterilizers	2.5	2
# Beds	62.6	55
Inpatient caseload (in last month)	360.8	349

[a] In either or both time periods. [b] This refers to which of 5 lab services are performed in the hospital: fecalysis, CBC, gram stain, electrolytes and bacterial culture.

[iv] There is no separate clustering at the physician level since physician data is averaged at the hospital level.
[v] There was a large jump in the difference of chi-squares for 1 observation in this sub-sample.

Table 4b Patient characteristics

	Number of patients	%
PHIC insurance		
– Yes (and will claim)	1812	30%
– Yes (but won't claim)	190	3%
– Not PHIC member	4096	67%
Education (of child's mother)		
– None (0)	38	1%
– Less than primary (1)	779	13%
– Primary (2)	1214	20%
– Secondary (3)	2666	44%
– Tertiary+ (4)	1348	22%
	Mean	Median
Annual Household Income	65,177 PHP	43,500 PHP
Daily Room and Board Charge	159 PHP	125 PHP

3.2 Clinical packages

Dependent variable

Just over half the sample received insufficient care (55% for pneumonia, 60% for diarrhoea cases).

Figure 1: Clinical package received

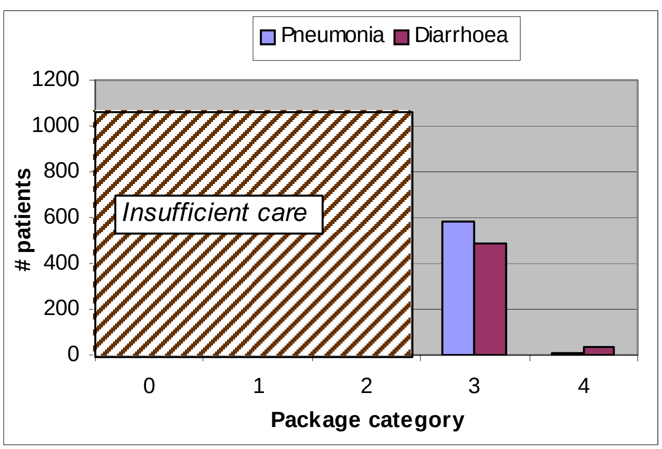


Figure 1 illustrates how the distribution is concentrated around package categories 2 and 3. Note that 11.9% of pneumonia patients and 11.7% of diarrhoea patients did not fit into any of these package categories. These were excluded from the analysis.

Regression results

Regressions showed that children using PHIC insurance are 2.09 (pneumonia cases)-2.46 (diarrhoea cases) times more likely to receive (at least) sufficient care, as compared with children not having or utilising PHIC insurance. Physicians working in hospitals that were Sentrong Sigla accredited (EXTERNAL MONITORING) were 1.9 (pneumonia cases)-2.26 (diarrhoea cases) times more likely to provide (at least) sufficient care, as compared with physicians working in hospitals without Sentrong Sigla accreditation.

For pneumonia cases only, a 100PHP increase in the daily room and board charge increased the probability of receiving (at least) sufficient care by 14% (i.e. 0.0014*100). For diarrhoea cases only, the variable INTERNAL MONITORING was also statistically significant, although its odds ratio was less than one (i.e. reduced the likelihood of receiving sufficient care), contrary to expectations.

Table 6: Model A regression results

Clinical Packages	**Pneumonia cases (n=1525)** Wald chi2=342, Prob>chi2=0.000 Log pseudolikelihood=-855.5 Pseudo R2=0.1598; AIC*n=1757				**Diarrhoea cases (n=1588)** Wald chi2=115, Prob>chi2=0.000 Log pseudolikelihood=-831.7 Pseudo R2=0.1676; AIC*n=1709			
Variable	O.R.	se	z	P>|z|	O.R.	se	z	P>|z|
Access	1.0876	0.707	0.13	0.8970	0.7497	0.450	-0.48	0.6310
Bonus	1.0508	0.587	0.09	0.9290	1.1855	0.574	0.35	0.7250
Time	1.0550	0.641	0.09	0.9300	0.9364	0.684	-0.09	0.9280
ACCESS*TIME	0.5879	0.694	-0.45	0.6530	0.9772	1.129	-0.02	0.9840
BONUS*TIME	0.6176	0.507	-0.59	0.5570	0.8518	0.791	-0.17	0.8630
DAILY RB CHARGE	**1.0014**	**0.001**	**1.70**	**0.0900**	1.0006	0.001	0.58	0.5650
PHIC INSURED+CLAIM	**2.0923**	**0.265**	**5.82**	**0.0000**	**2.4573**	**0.607**	**3.64**	**0.0000**
EDUCATION	0.8786	0.070	-1.63	0.1030	1.0886	0.074	1.24	0.2140
INCOME Q2	0.8612	0.193	-0.67	0.5050	1.0011	0.202	0.01	0.9960
INCOME Q3	1.0829	0.286	0.30	0.7630	0.9188	0.172	-0.45	0.6510
INCOME Q4	1.3284	0.321	1.17	0.2410	0.9660	0.214	-0.16	0.8760
INCOME Q5	1.1319	0.308	0.46	0.6490	0.8043	0.193	-0.91	0.3640
INTERNAL MONITORING	0.9749	0.367	-0.07	0.9460	**0.3849**	**0.170**	**-2.17**	**0.0300**
EXTERNAL MONITORING	**1.9029**	**0.595**	**2.06**	**0.0400**	**2.2597**	**0.812**	**2.27**	**0.0230**
#Symptoms					1.0757	0.038	2.07	0.0380
Treatment before	1.6967	0.295	3.04	0.0020				
Lab services					2.0466	0.704	2.08	0.0370
#Sterilizers	1.3836	0.162	2.78	0.0060	1.6518	0.197	4.21	0.0000
Caseload	1.0037	0.001	3.12	0.0020				

Note: other control variables were included, but only statistically significant (95%) shown here. See table 5.3 for details.

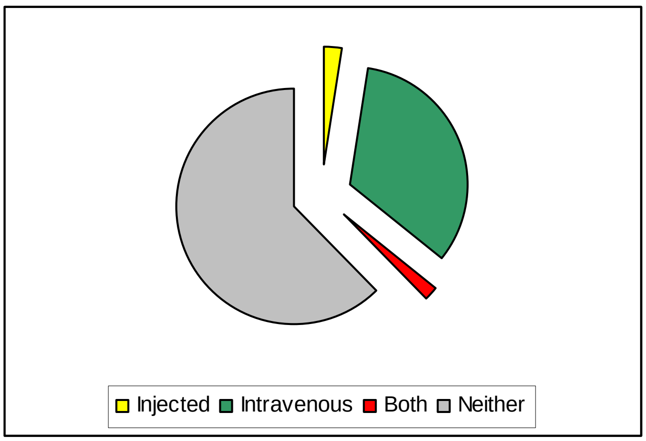
Note: ordered logit specifications produced broadly consistent results.

3.3 Medication administration type

Dependent variable

Of the full sample, 33.3% of children received medication intravenously as compared with 2.5% by injection (with 1.9% receiving both forms, and 62.3% receiving medications orally or not receiving any medication). Proportions were similar for the sub-samples of pneumonia and diarrhoea cases.

Figure 2: Medication administration type (full sample)



Regression results

Regressions found that a number of both hospital- and patient-level explanatory variables were statistically significant, particularly for the pneumonia sub-sample (see table 8). For both pneumonia and diarrhoea cases, physicians working in 'bonus' hospitals were less likely to administer medication by injection rather than intravenously, as compared with those working in 'current' hospitals and after controlling for trend effects. In particular, such physicians were 50.8% and 92.3% less likely to administer medication by injection rather than intravenously (BONUS*TIME). For diarrhoea cases only, the same was true for 'access' hospitals (ACCESS*TIME), with physicians working in such hospitals 87.7% less likely to administer medication by injection than intravenously.

For pneumonia cases only, patients paying higher daily room charges were less likely to receive medications by injection. In particular, a 100PHP increase in charges decreased the probability of receiving medication by injection rather than intravenously by 14%. Further, patients with (and using) PHIC insurance were 39.9% *more* likely to receive medications by injections than patients not using PHIC insurance or being uninsured.

Patients in the bottom income quintile were the most likely to receive medications by injection: see odds ratios for the variables INCOME Q2-Q5. A mother's education was also statistically significant, although its odds ratio was greater than one, contrary to expectations. Physicians working in externally monitored hospitals were 29.3% less likely to administer medications by injection rather than intravenously, as compared with physicians working in hospitals without external monitoring.

Table 8: Model B regression results

Medication administration type	**Pneumonia cases (n=758)** Wald chi2=1735, Prob>chi2=0.000 Log pseudolikelihood=-132.5 Heteroscedastic-adjusted*					**Diarrhoea cases (n=521)** Wald chi2=127, Prob>chi2=0.000 Log pseudolikelihood=-135.7 Pseudo R2=0.1404; AIC*n=313			
Variable	Coeff.*	O.R.*	se	z	P>|z|	O.R.	se	z	P>|z|
Access	-0.027	0.9550	0.159	-0.17	0.8650	1.4188	1.272	0.39	0.6960
Bonus	0.195	1.3931	0.138	1.41	0.1590	0.7743	0.453	-0.44	0.6620
Time	0.097	1.1786	0.113	0.85	0.3930	**6.6322**	**5.922**	**2.12**	**0.0340**
ACCESS*TIME	0.067	1.1206	0.156	0.43	0.6670	**0.1229**	**0.146**	**-1.77**	**0.0770**
BONUS*TIME	**-0.492**	**0.4336**	**0.209**	**-2.35**	**0.0190**	**0.0765**	**0.098**	**-2.01**	**0.0450**
DAILY RB CHARGE	**-0.001**	**0.9986**	**0.000**	**-2.34**	**0.0200**	1.0003	0.001	0.20	0.8450
PHIC INSURED+CLAIM	**0.198**	**1.3994**	**0.078**	**2.53**	**0.0110**	0.9882	0.403	-0.03	0.9770
EDUCATION	**0.168**	**1.3310**	**0.025**	**6.65**	**0.0000**	0.9488	0.112	-0.44	0.6560
INCOME Q2	**-0.180**	**0.7365**	**0.105**	**-1.72**	**0.0850**	0.9080	0.478	-0.18	0.8550
INCOME Q3	**-0.255**	**0.6487**	**0.096**	**-2.66**	**0.0080**	1.2373	0.778	0.34	0.7350
INCOME Q4	**-0.116**	**0.8210**	**0.070**	**-1.67**	**0.0960**	0.9177	0.609	-0.13	0.8970
INCOME Q5	-0.141	0.7870	0.086	-1.63	0.1030	0.3034	0.281	-1.29	0.1990
INTERNAL MONITORING	0.109	1.2044	0.086	1.27	0.2050	0.8628	0.436	-0.29	0.7700
EXTERNAL MONITORING	**-0.204**	**0.7067**	**0.101**	**-2.02**	**0.0430**	0.3871	0.226	-1.63	0.1040
#Symptoms	-0.035	0.9430	0.017	-1.99	0.0460	0.8710	0.054	-2.22	0.0260
Lab services						2.9581	1.085	2.96	0.0030

Note: other control variables were included, but only statistically significant (95%) shown here. See table 5.3 for details.

Note: regressions with patients receiving medication intravenously and by injection gave broadly consistent results.

* For the pneumonia sub-sample, a probit model adjusted for heteroscedasticity in the EDUCATION variable was used. This reports a probit coefficient, and a "logit-equivalent" odds ratio (this is reached by multiplying the probit coefficient by 1.7, to give an approximately equivalent logit coefficient, then taking the exponential of this to acquire the logit-equivalent odds ratio).

4 Discussion

4.1 Evaluation of testable hypotheses

Hypothesis set 1. Provider payment mechanisms

a. Physicians working in ‘access’ hospitals (which have higher reimbursement ceilings for insured children) are *less* likely to provide insufficient care.

- No evidence could be found to support this hypothesis.

b. Physicians working in ‘bonus’ hospitals (who receive bonuses for meeting quality standards) are *less* likely to provide insufficient and inappropriate care.

- Bonus payments based on quality of care were effective in improving the appropriateness of the type of health services provided. Physicians working in ‘bonus’ hospitals, were 51% less likely to administer medication inappropriately for pneumonia cases and 92% less likely for diarrhoea cases. However, there was no evidence that it improved the sufficiency of care.

Hypothesis set 2. Patient charges

a. Children paying a higher daily rate for room and board are *less* likely to receive insufficient and inappropriate care.

- Paying more for room and board improved the sufficiency and appropriateness of care received for pneumonia (but not diarrhoea) patients. For pneumonia cases, a 100PHP increase in the daily room charge increased the probability of receiving (at least) sufficient care by 14%. For pneumonia cases, paying more for room and board also decreased the probability of receiving inappropriate care by 14%.

b. Children who have (and use) PHIC insurance are *less* likely to receive insufficient care, but *more* likely to receive inappropriate care.

- Children who have and use PHIC insurance were 2.1 (pneumonia cases) to 2.5 (diarrhoea cases) times more likely to receive (at least) sufficient care, as compared with children not having or utilising PHIC insurance. For pneumonia, children using PHIC insurance were also 40% more likely to receive inappropriate care than children not using PHIC insurance or being uninsured.

Hypothesis set 3. Non-financial aspects

a. Children coming from wealthier households are *less* likely to receive insufficient and inappropriate care (independently of what they pay).

- Although a child's household income did not have any significant effect on the sufficiency of care received, there was some evidence that it did affect the appropriateness of healthcare. For pneumonia cases, children from the bottom income quintile were 28-35% more likely to receive inappropriate care, as compared with children from the other four income quintiles.

b. Children whose mothers have attained higher education levels are *less* likely to receive insufficient and inappropriate care.

- A mother's education had no effect on the sufficiency of care. It actually increased the likelihood of receiving inappropriate care for pneumonia cases, potentially because education is a weak proxy for health knowledge on the appropriateness of different medication types.

c. Physicians working in hospitals with internal committees monitoring quality of care are *less* likely to provide insufficient and inappropriate care.

- Internal monitoring did not improve the sufficiency or type of care a patient received. Indeed, for diarrhoea cases, it may even have reduced the sufficiency of care received.

d. Physicians working in hospitals with external bodies monitoring quality of care are *less* likely to provide insufficient and inappropriate care.

- External monitoring improved the sufficiency and type of care received. Physicians working in externally monitored hospitals were 1.9 (pneumonia cases) to 2.3 (diarrhoea cases) times more likely to provide (at least) sufficient care, as compared with other physicians. Physicians in externally monitored hospitals were also 29% less likely to administer medications by injection rather than intravenously for pneumonia cases, as compared with other physicians.

4.2 Relation with other findings in the literature

A broad literature has explored the effects of various financial incentives on provider behaviour. Much of this has focused on provider payment mechanisms. Recent reviews of this literature demonstrated that physicians paid by retrospective payment mechanisms provided more services than physicians paid prospectively ([12,13]). However, it was not apparent whether more services reflect better quality and/or unnecessary care. Gertler and Solon[14], examining the effect of PHIC insurance on provider behaviour in the Philippines, found that the way in which providers were reimbursed by PHIC gave them a financial incentive to increase the price-cost margins for insured patients.

Liu and Mills[15] found that bonus payments in Chinese hospitals increased hospital revenue, but at the same time there were marked increases in unnecessary care. Leonard et al[16] found in Tanzania that clinicians operating in organizations using high-powered incentives (ones with greater discretion over human resources and more financial independence) were much more likely to correctly diagnose and treat patients. Similar results were reported in Delhi, India, where doctors paid on a fee-for-service basis were closer to their clinical 'knowledge frontier' than those on a fixed salary[17]. However, this research also noted that doctors paid by fee-for-service were more susceptible to over-treating patients. McNamara[18] found that quality-based payment strategies (bonuses/penalties given if specific performance targets met/not met) in Haiti and Nicaragua had positive impacts on quality: in terms of improving immunization coverage, organisational behaviour and accountability. Soeters and Griffiths[19] found comparable results in Cambodia. Furthermore, Peabody et al[20], in a study in Macedonia, demonstrated how improved clinical quality positively impacted on a population's actual health status.

4.3 Limitations of analysis

Both Model A and B have their limitations. These can be separated into those that are essentially statistical and those that are more substantive. Substantive limitations relate to the assumptions inherent in empirical specifications, particularly the choices of dependent variables and some of the measures of incentives.

Statistical limitations

For Model A, the clinical packages defined only describe 88% of inpatient samples (for both pneumonia and diarrhoea cases) – for the remaining 12%, it is not possible to ascertain the sufficiency of care. Common to both models is the sense that dependent variable specifications are only rudimentary measures of the sufficiency and appropriateness of care. Furthermore, although proxies for severity of illness are included, and separate regressions are run for pneumonia and diarrhoea inpatient cases, these are still likely to be imperfect controls for variation in severity. If there is measurement error in these and other independent variables, results are likely to be biased towards the null. Data clustering also reduces the statistical power of regressions.

Substantive limitations

For Model A, the definition of 'insufficient care' should only be interpreted as insufficient if the child is correctly admitted. For example, if a child only has moderate diarrhoea – and thus should really be seen as an outpatient case – then not receiving medication or IV fluid does not necessarily imply insufficient care. That is, for such cases, a clinical package labelled as insufficient by Model A may actually be sufficient, with sufficient care constituting unnecessary care.

For Model B, there is the assumption that administering medication by injection rather than intravenously is always preferable for the patient, and consequently that physicians only administer medication by injection to save time. However, there may be patients for whom intravenous medication was genuinely not feasible. Although excluding from the model patients who received medication through both methods addresses this, there may still be patients for whom a physician decided on clinical (rather than time-saving) grounds that injected medication was more appropriate.

For both models, some potentially important variations in the intensity of incentives faced across public physicians exist. However, there is no data available on either of these factors. In particular, the intensity of incentives a physician faces will depend on:

– *How able hospital management is to influence physician behaviour.* Physicians income is predominantly salary-based (a prospective payment method), and thus they do not directly face financial incentives to provide more and/or more appropriate services to patients paying more. Still, most public hospital physicians receive professional fees for PHIC insured patients. This implies that, at least for these patients, public physicians face incentives to differentiate between patients for financial reasons.
– *How much financial autonomy hospitals have from LGUs.* LGUs have official discretion over the extent to which public district hospitals can retain revenues generated from health insurance or user charges. Thus hospitals retaining a smaller proportion of these revenues will face a weaker financial incentive to differentiate between patients for financial reasons.

Finally, altruistic concerns for a patient's well-being (a non-financial incentive) are likely to moderate a physician's response to financial and sociological incentives. Variation in altruistic concerns across physicians may well be important in explaining why there is not a systematic response by physicians to financial incentives, but there is no data available to test if this is the case.

5 Conclusions

The volume and type of health services a public physician provides to a patient is influenced by the incentive structure. Most strikingly, this research showed that patients paying more (for room and board) and being treated in externally monitored hospitals were less likely to receive insufficient and inappropriate care. Further, bonus payments based on quality of care were effective in improving the appropriateness of care (though rarely in reducing the likelihood of insufficient care).

Physicians also responded to the financial incentives inherent in patients with (and using) PHIC insurance. Such patients were less likely to receive insufficient care, since physicians understand that these patients are (typically) more able to pay for the costs of care than the non-insured and those not using their PHIC membership. At the same time, patients with and using PHIC insurance were more likely to receive medication by injection rather than intravenously, arguably because reimbursement from PHIC is the same either way, and administering medication by injection is quicker (requires less effort) than intravenous administration.

However, these physician responses to financial incentives were never pervasive across all model variants. This may be because of the limited power inherent in financial incentives faced by public physicians in the Philippines, and some limitations with the dependent variable specifications used in this analysis. It may also simply be due to differences in actual need for healthcare across patients, differences that are not fully captured in the empirical models. Nevertheless, a physician's behaviour is not immune to the incentive structure s/he operates within, and consequently public hospital patients with equal health need are not always treated equally.

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