



The medical game: social preferences and financial incentives in a multitasking environment

Mylène Lagarde, London School of Hygiene & Tropical Medicine

Duane Blaauw, University of Witwatersrand

Overview



- Introduction
 - Motivation
 - Related literature
 - Contribution of this paper
- Experimental design
- Results
- Conclusions

Motivation



- Remuneration mechanisms provide key incentives to providers
 - Level of medical services provided
 - Health care expenditures
 - Quality of care provided
- Several ways to pay individual providers
 - Low-powered incentives for quantity of medical services provided
 - Salary
 - Capitation
 - High-powered incentives for quantity of medical services provided
 - FFS

Mixed evidence



- Evidence from field studies is limited (Gosden et al 2001, Scott et al 2012)
 - Some evidence that FFS leads to over-provision of medical services
 - Lack of experimental evidence limits ability to establish causal effect
 - Many confounding factors: institutional characteristics, contextual factors
 - Payment characteristics (e.g. rates)
 - Difficulty to observe some outcomes
 - “Quality” of care provided?
- Altruistic doctors?
 - Isolating impact of patient’s welfare on doctor’s decisions is impossible

Experimental health economics



- Many advantages of laboratory experiments
- Nascent literature in health economics
 - Following Hennig-Schmidt 2011 (JHE)
- All following similar experimental design – chosen effort experiment

Experimental literature on incentives



- Chosen effort experiments
 - Participants choose hypothetical level of effort, for which they will be remunerated according to a specified rate and method
- Real effort experiments
 - Simple tasks: e.g. additions, counting letters, data entry
 - Actual effects of real effort: boredom, intrinsic motivation (van Dijk et al. 2001)
 - Closer to real life?
 - people ignore their production function, do repetitive tasks during set period of time – cost of time

This study



- Real effort experiment
 - Data entry over short period of time
 - Framing related to medical world (data entry of medical test results)
- Seeks to mimic more dimension of medical work
 - Multi-tasking environment : quantity of effort and quality of output (substitutes)
 - Some choice over patients seen
 - Differentiated capitation rates
- Explicit evaluation of the impact of the presence of benefits to others

Experimental design overview



- Real effort experiment
 - The “medical effort” task
- Within- and between-subject design
- Experimental procedures

The medical effort task



LABORATORY REPORT			
		REF. NUMBER 3	
HAEMATOLOGY AND BIOCHEMISTRY RESULTS			
Test	Result	Units	Reference Range
Full Blood Count			
RED BLOOD CELLS	3.8	x 10 ¹² /L	4.5 - 6.5
HAEMOGLOBIN	12.0	g/dL	13.8 - 18.8
HAEMATOCRIT	34.8	%	40 - 56
MCV	91.6	fL	79 - 100
MCH	31.6	pg	27 - 35
MCHC	34.5	g/dL	29 - 37
WHITE BLOOD CELLS	3.0	x 10 ⁹ /L	4.0 - 12.0
PLATELETS	134	x 10 ⁹ /L	150 - 450
U&E			
SODIUM	142.6	mmol/L	135 - 150
POTASSIUM	4.9	mmol/L	3.5 - 5.1
CHLORIDE	101.4	mmol/L	98 - 107
BICARBONATE	28.2	mmol/L	21 - 29
UREA	6.4	mmol/L	2.1 - 7.1
CREATININE	90.3	µmol/L	80 - 115
Liver Function Test			
BILIRUBIN - TOTAL	25.6	µmol/L	2 - 26
BILIRUBIN - CONJUGATED	5.9	µmol/L	1 - 7
ALT	17.3	IU/L	0 - 40
AST	15.4	IU/L	15 - 40
ALKALINE PHOSPHATASE	95.2	IU/L	53 - 128
TOTAL PROTEIN	65.0	g/L	60 - 80
ALBUMIN	40.7	g/L	35 - 50
GLOBULIN	24.3	g/L	19 - 35

Long reports: 22 test results to enter

10 out of 15 reports handed out are long (in a given data entry period)

The medical effort task



LABORATORY REPORT

HAEMATOLOGY AND BIOCHEMISTRY

Test
Full Blood Count
RED BLOOD CELLS
HAEMOGLOBIN
HAEMATOCRIT
MCV
MCH
MCHC
WHITE BLOOD CELLS
PLATELETS
U&E
SODIUM
POTASSIUM
CHLORIDE
BICARBONATE
UREA
CREATININE
Liver Function Test
BILIRUBIN - TOTAL
BILIRUBIN - CONJUGATED
ALT
AST
ALKALINE PHOSPHATASE
TOTAL PROTEIN
ALBUMIN
GLOBULIN

In this first period, you are paid R1 for each number you enter.

You will be paid for each number you enter irrespective of whether or not it is correct, and irrespective of whether or not it has already been entered on the system.

Your earnings

LAB REPORT - DATA ENTRY		REF. NUMBER:	3
Full Blood Count		Data already entered	Data to be entered
	RED BLOOD CELLS		<input type="text"/>
	HAEMOGLOBIN		<input type="text"/>
	HAEMATOCRIT		<input type="text"/>
	MCV		<input type="text"/>
	MCH		<input type="text"/>
	MCHC		<input type="text"/>
	WHITE BLOOD CELLS		<input type="text"/>
	PLATELETS		<input type="text"/>
U&E			
	SODIUM		<input type="text"/>
	POTASSIUM		<input type="text"/>
	CHLORIDE		<input type="text"/>
	BICARBONATE		<input type="text"/>
	UREA		<input type="text"/>
	CREATININE		<input type="text"/>
Liver Function Test			
	BILIRUBIN - TOTAL		<input type="text"/>
	BILIRUBIN - CONJUGATED		<input type="text"/>
	ALT		<input type="text"/>
	AST		<input type="text"/>
	ALKALINE PHOSPHATASE		<input type="text"/>
	TOTAL PROTEIN		<input type="text"/>
	ALBUMIN		<input type="text"/>
	GLOBULIN		<input type="text"/>

RECORD DATA

The medical effort task



LABORATORY REPORT			
		REF. NUMBER	2
HAEMATOLOGY AND BIOCHEMISTRY RESULTS			
Test	Result	Units	Reference Range
Full Blood Count			
RED BLOOD CELLS	3.8	$\times 10^{12}/L$	4.5 - 6.5
HAEMOGLOBIN	12.0	g/dL	13.8 - 18.8
HAEMATOCRIT	34.8	%	40 - 56
MCV	91.6	fL	79 - 100
MCH	31.6	pg	27 - 35
MCHC	34.5	g/dL	29 - 37
WHITE BLOOD CELLS	3.0	$\times 10^9/L$	4.0 - 12.0
PLATELETS	134	$\times 10^9/L$	150 - 450
U&E			
SODIUM	142.6	mmol/L	135 - 150
POTASSIUM	4.9	mmol/L	3.5 - 5.1
CHLORIDE	101.4	mmol/L	98 - 107
BICARBONATE	28.2	mmol/L	21 - 29
UREA	6.4	mmol/L	2.1 - 7.1
CREATININE	90.3	$\mu\text{mol}/L$	80 - 115

Short reports: 14 test results to enter

5 out of 15 reports handed out are short (in a given data entry period)

The medical effort task



Remaining time [sec]:

In this first period, you are paid R1 for each number you enter.

You will be paid for each number you enter irrespective of whether or not it is correct, and irrespective of whether or not it has already been entered on the system.

Your earnings so far: R 0

	LAB REPORT - DATA ENTRY	REF. NUMBER: 2
HAEMATOLOGY Full Blood Count RED HAEM HAEM MCV MCH MCHC WHIT PLAT U&E SODI POTASSIUM CHLORIDE BICARBONATE UREA CREA	Full Blood Count	Data already entered
	RED BLOOD CELLS	<input type="text"/>
	HAEMOGLOBIN	<input type="text"/>
	HAEMATOCRIT	<input type="text"/>
	MCV	<input type="text"/>
	MCH	<input type="text"/>
	MCHC	<input type="text"/>
	WHITE BLOOD CELLS	<input type="text"/>
	PLATELETS	<input type="text"/>
	U&E	
SODIUM	<input type="text"/>	
POTASSIUM	<input type="text"/>	
CHLORIDE	<input type="text"/>	
BICARBONATE	<input type="text"/>	
UREA	<input type="text"/>	
CREATININE	<input type="text"/>	

The medical effort task



LABORATORY REPORT

REFERENCE NUMBER 42

Remaining time [sec]: 430

HAEMATOLOGY AND BIOCHEMISTRY

In this first period, you are paid R1 for each number you enter.
You will be paid for each number you enter irrespective of whether or not it is correct, and irrespective of whether or not it has already been entered on the system.

Your earnings so far: R 0

Every other report some data is already entered on the system: it is **UNNECESSARY** to enter it again

Objective: detecting over-servicing

LAB REPORT - DATA ENTRY

REF. NUMBER: 1

Food Count

Data already entered

Data to be entered

RED BLOOD CELLS		
HAEMOGLOBIN		
HAEMATOCRIT		
MCV		
MCH		
MCHC		
WHITE BLOOD CELLS		
PLATELETS		
SODIUM	143.4	
POTASSIUM	4.9	
CHLORIDE	105.1	
BICARBONATE	25.1	
UREA		
CREATININE		

Liver Function Test

BILIRUBIN - TOTAL	
BILIRUBIN - CONJUGATED	
ALT	
AST	
ALKALINE PHOSPHATASE	
TOTAL PROTEIN	
ALBUMIN	
GLOBULIN	

RECORD DATA

BICARBONATE
UREA
CREATININE

Liver Function Test

BILIRUBIN
BILIRUBIN
ALT
AST
ALKALINE PHOSPHATASE
TOTAL PROTEIN
ALBUMIN
GLOBULIN

35.2 g/L 35 - 50
21.7 g/L 19 - 35

Performance measures

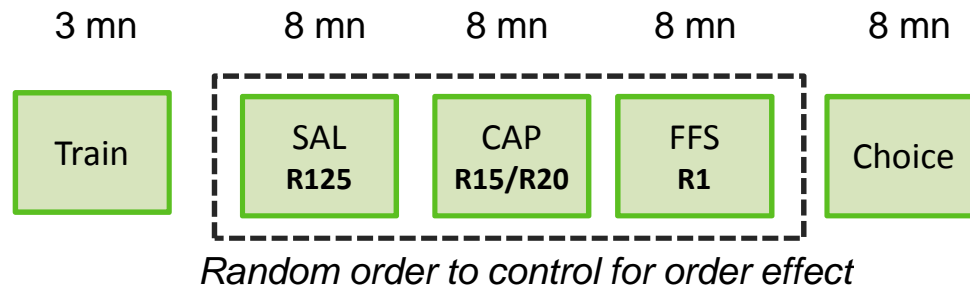


- Quantity of effort
 - Number of items entered
 - Number of reports completed
- Quality of output
 - Number of correct (and necessary) entries
 - % of correct entries made (quality index)
 - Number of forms for which less than 90% of entries are correctly made (shirking behaviour)
- Unintended consequences
 - Over-servicing: number of unnecessary entries
 - Cheating: dummy =1 when at least 80% of data entries were made with the same single-digit number
 - Cream-skimming: dummy detecting propensity to prioritise basic reports first

Experimental design



- Within-subject



- Between subject: 3 x 2 design

	No Patient Benefit	Patient Benefit
No quality-enhancing intervention	BASELINE	PATIENT

Payment schemes - doctor



- Fee-for-service
 - ZAR 1 (USD0.10) for each number entered
“irrespective of whether or not it is correct, and irrespective of whether or not it has already been entered on the system”
- Capitation
 - ZAR 12 (USD1.93) /R15 (USD1.45) for basic/extended report done
“irrespective of whether or not individual entries are correct, and irrespective of whether or not some information has already been entered”
- Salary
 - ZAR125 (USD12.1) for the period
“does not depend on the number of reports or individual entries you make”

Benefits to patients



- Social benefit treatment only
- R0.50 (USD0.05) for each number entered correctly
- Choice of a list of 6 charities (cancer, TB, HIV, children)
- Money to treat patients

Hypotheses



1. FFS leads to highest quantity of services, CAP and salary lead to low quantity of services
2. Salary leads to higher quality (low-powered incentive)
3. FFS leads to over-servicing
4. Adjusted CAP does not yield cream-skimming
5. Patient benefit treatment increases quality

Experimental procedures



- Recruitment of medical students
 - Leaflets, advert on web page, invitation in person
- Total of 19 sessions (about 70mn), in a computer lab
- Unique experimenter introducing session, then on-screen instructions
- Average payouts:

	ZAR	USD
Per participant	183.13*	17.20
Total to charities	3551	333.5

*In addition to a ZAR50 (USD4.83) show-up fee

Subject pool



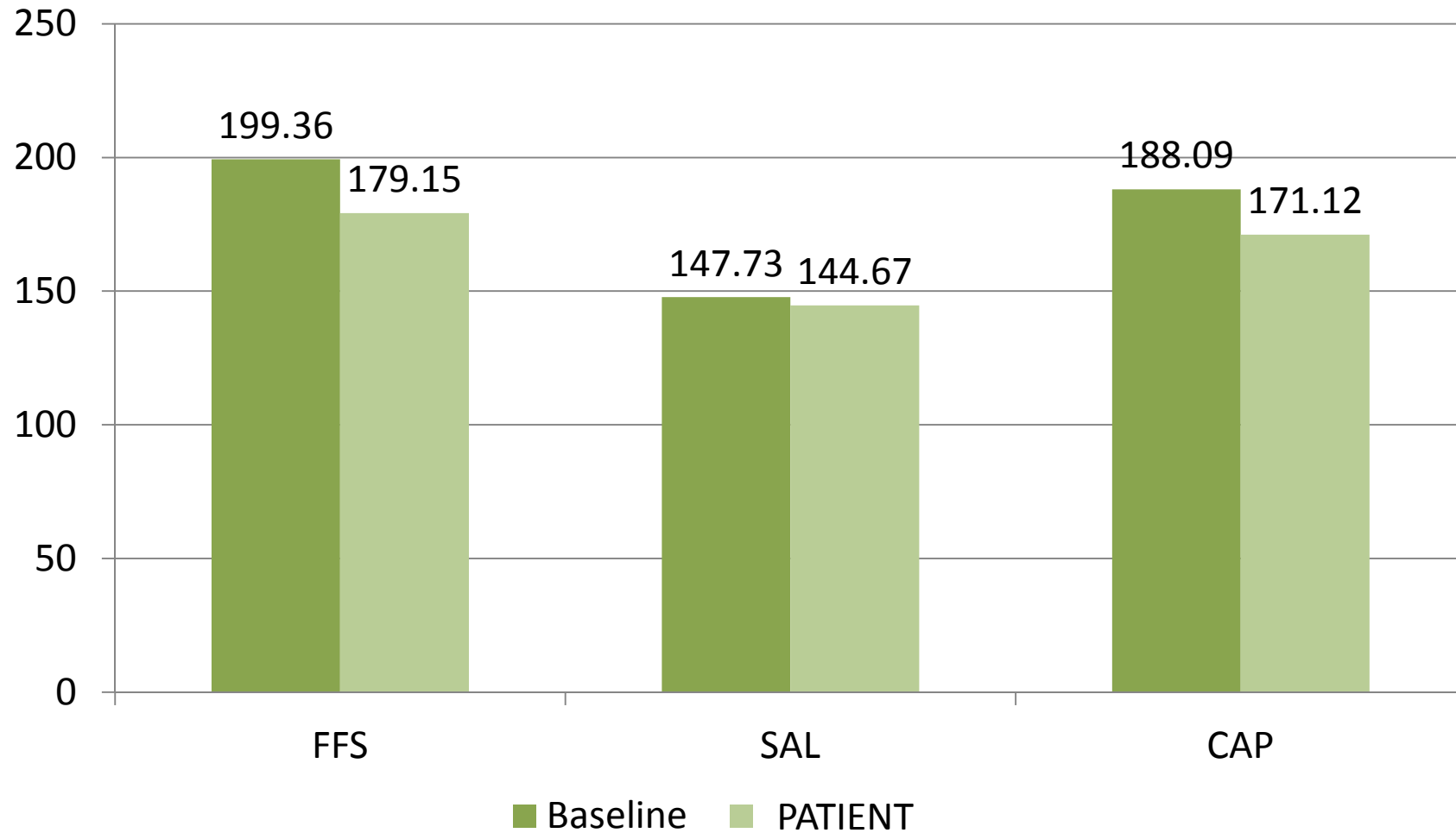
- N=361
- 3rd and 4th year medical students, University of Witwatersrand, Johannesburg (SA)

	Social Benefit	No Social Benefit
No quality-enhancing intervention	N=66	N=66



Results

Impact of doctor compensation scheme on quantity of effort provided



Impact of doctor compensation scheme on quantity of effort provided



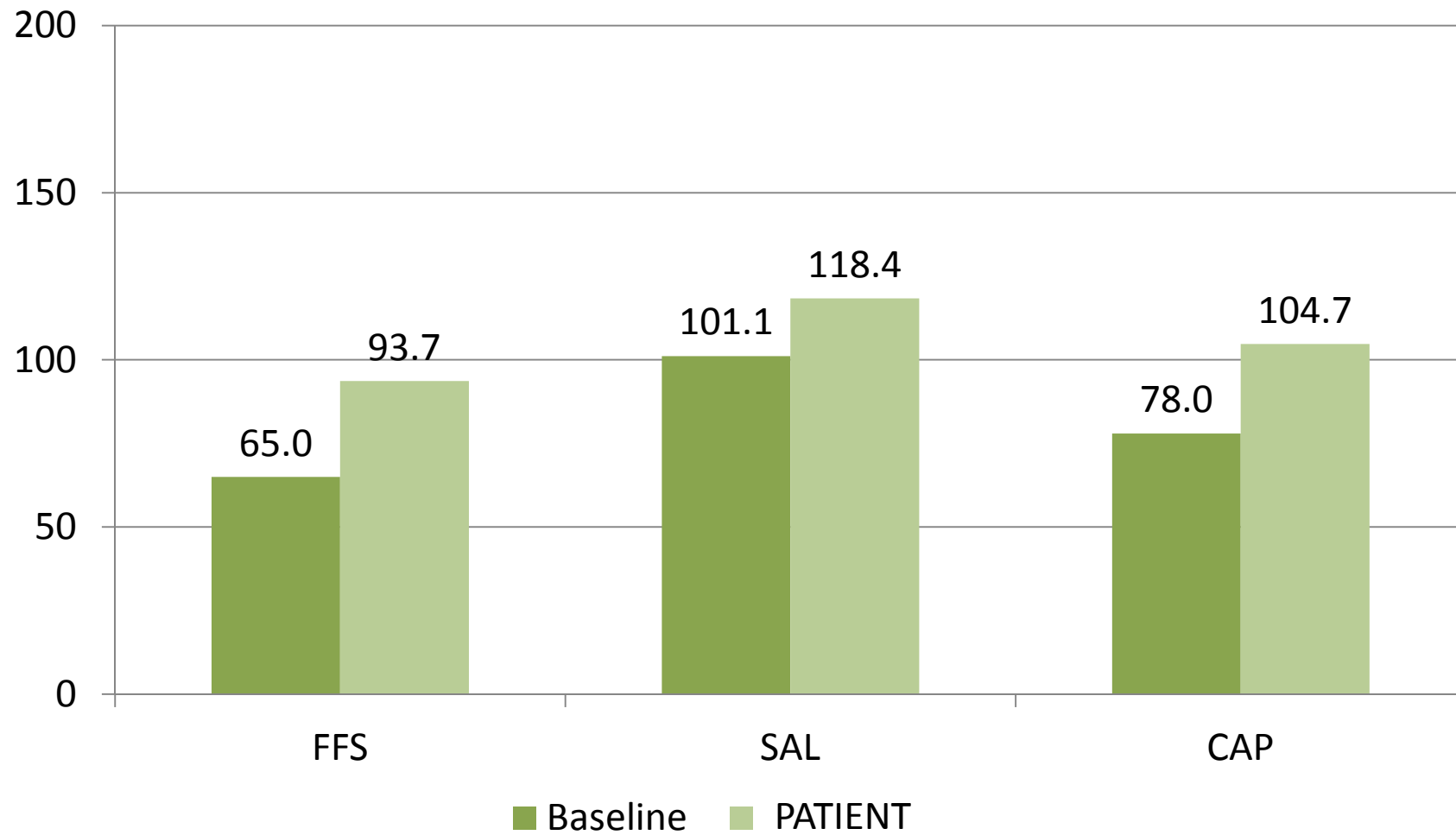
	Number of items entered		Number of reports completed	
	(1)	(2)	(3)	(4)
SAL	-51.636*** (10.235)	-51.636*** (9.591)	-2.045*** (0.619)	-2.045*** (0.590)
CAP	-11.273 (10.679)	-11.273 (9.291)	-0.318 (0.468)	-0.318 (0.399)
Period 2		22.455** (7.007)		1.061** (0.332)
Period 3		22.182*** (5.696)		1.212** (0.376)
Constant	199.364*** (6.536)	184.485*** (5.011)	10.682*** (0.336)	9.924*** (0.360)
Observations	198	198	198	198
R ²	0.255	0.312	0.209	0.284

Impact of doctor compensation scheme on quantity of effort provided

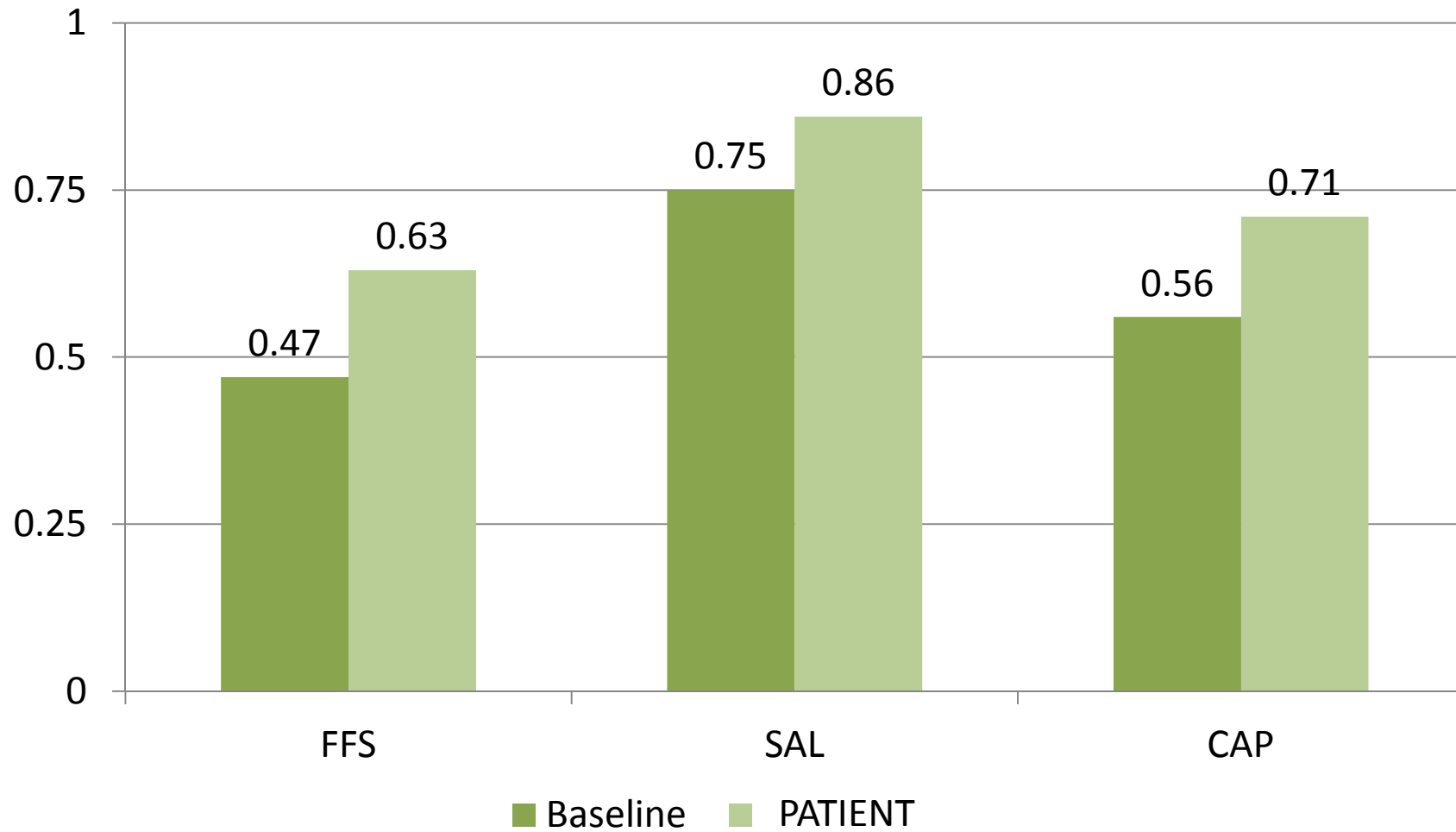


	Number of items entered			Number of reports completed		
	(1)	(2)	(3)	(4)	(5)	(6)
SAL	-43.061*** (8.426)	-51.636*** (10.248)	-51.636*** (9.520)	-1.826*** (0.488)	-2.045*** (0.620)	-2.045*** (0.586)
CAP	-9.652 (6.958)	-11.273 (10.692)	-11.273 (9.140)	-0.197 (0.292)	-0.318 (0.469)	-0.318 (0.392)
PATIENT	-13.414 (12.317)			-0.818 (0.596)		
PATIENT * FFS		-20.212 (15.742)	-20.212 (15.687)		-1.045 (0.714)	-1.045 (0.709)
PATIENT * SAL		-3.061 (11.320)	-3.061 (11.869)		-0.606 (0.585)	-0.606 (0.615)
PATIENT * CAP		-16.970 (13.342)	-16.970 (12.572)		-0.803 (0.684)	-0.803 (0.639)
Period 2			25.902*** (6.700)			1.295*** (0.318)
Period 3			24.773*** (3.945)			1.386*** (0.180)
Constant	195.965*** (18.320)	199.364*** (19.910)	182.472*** (19.178)	10.568*** (0.883)	10.682*** (0.964)	9.788*** (0.956)
Observations	396	396	396	396	396	396
R ²	0.211	0.220	0.308	0.189	0.191	0.304

Quality of output



Accuracy rate



Impact of doctor compensation scheme on quality of output



	Number of correct entries		Quality index		Shirking behaviour	
	(1)	(2)	(3)	(4)	(5)	(6)
SAL	15.868*** (4.276)	14.613*** (4.490)	0.095*** (0.027)	0.096** (0.030)	-1.225*** (0.358)	-1.144** (0.376)
CAP	8.572* (4.536)	8.298* (4.304)	0.045 (0.026)	0.046 (0.027)	-0.547 (0.351)	-0.534 (0.338)
Period 2		3.700 (5.316)		-0.007 (0.031)		-0.203 (0.238)
Period 3		10.525 (7.363)		0.001 (0.044)		-0.667 (0.396)
Entries made	-0.393** (0.128)	-0.417** (0.135)	-0.004*** (0.001)	-0.004*** (0.001)		
Completed reports					1.423*** (0.139)	1.463*** (0.122)
Constant	143.267*** (24.047)	143.372*** (24.585)	1.186*** (0.161)	1.185*** (0.162)	-7.370*** (1.468)	-7.505*** (1.351)
Observations	198	198	198	198	198	198
R ²	0.403	0.419	0.617	0.618	0.786	0.793

Impact of doctor compensation scheme on quality of output

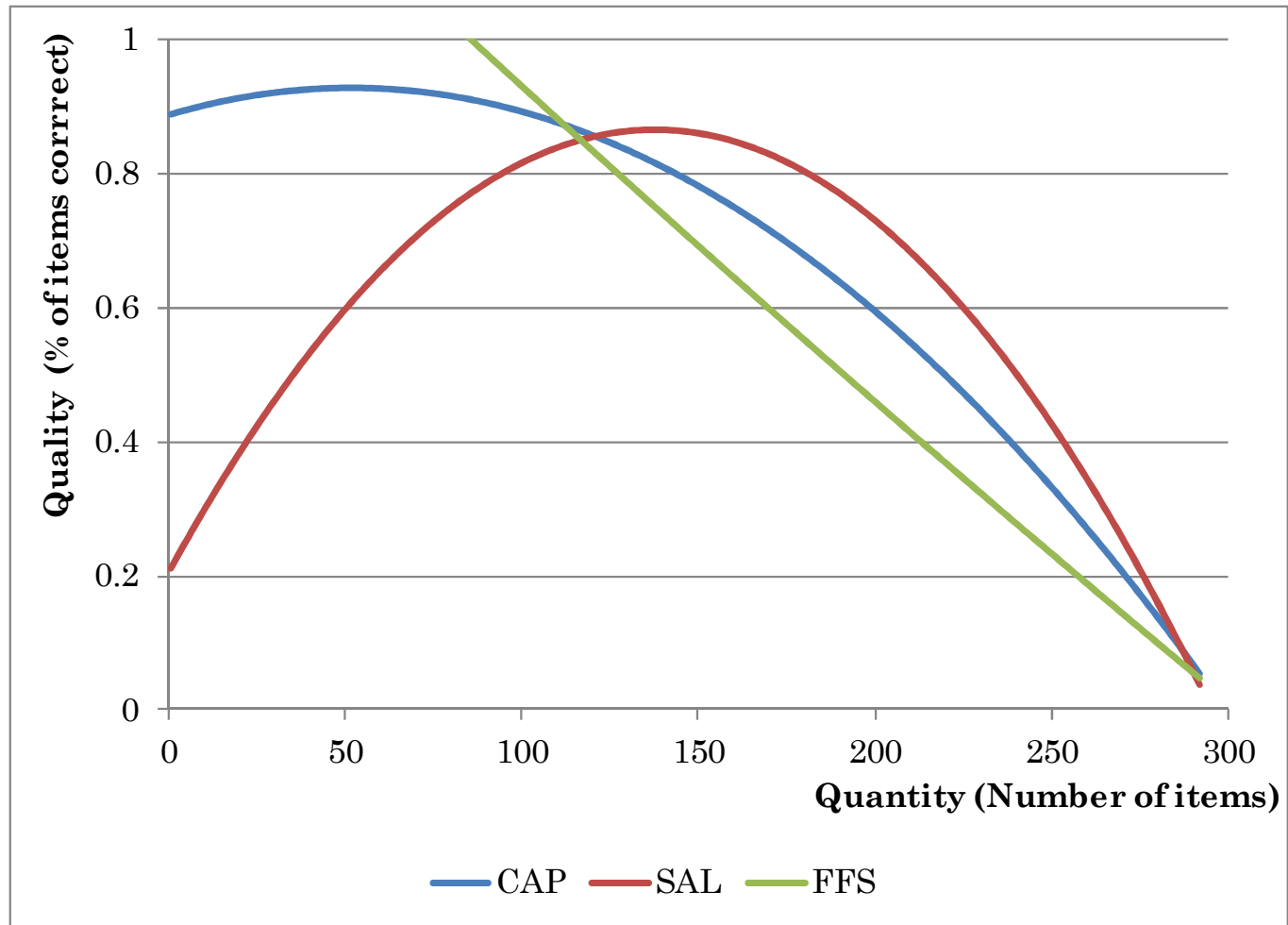


	Number of correct entries			Quality index			Shirking behaviour		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
SAL	16.089*** (1.991)	19.100*** (5.463)	17.482*** (5.731)	0.092*** (0.016)	0.082*** (0.032)	0.081** (0.032)	-1.298*** (0.160)	-1.520*** (0.345)	-1.456*** (0.364)
CAP	8.816*** (3.137)	9.277** (4.019)	8.924** (3.748)	0.048*** (0.016)	0.043* (0.025)	0.042* (0.024)	-0.619*** (0.177)	-0.593* (0.322)	-0.583* (0.316)
PATIENT	19.769*** (6.240)			0.088*** (0.026)			-0.957** (0.379)		
PATIENT * FFS		22.022*** (7.769)	21.389*** (7.869)		0.078** (0.034)	0.077** (0.033)		-1.087*** (0.333)	-1.054*** (0.336)
PATIENT * SAL		16.247* (8.777)	16.151* (9.064)		0.097** (0.041)	0.097** (0.041)		-0.649 (0.571)	-0.630 (0.587)
PATIENT * CAP		21.154*** (6.632)	20.622*** (6.475)		0.088*** (0.028)	0.088*** (0.027)		-1.139** (0.487)	-1.114** (0.486)
Period 2			5.183* (2.974)			-0.004 (0.016)			-0.159 (0.145)
Period 3			13.282*** (3.912)			0.018 (0.025)			-0.635** (0.264)
Entries made	-0.333*** (0.070)	-0.330*** (0.067)	-0.362*** (0.070)	-0.004*** (0.000)	-0.004*** (0.000)	-0.004*** (0.000)			
Completed reports							1.281*** (0.066)	1.279*** (0.064)	1.310*** (0.062)
Constant	132.455*** (10.982)	130.790*** (9.406)	130.880*** (10.011)	1.231*** (0.055)	1.237*** (0.050)	1.236*** (0.050)	-5.914*** (0.652)	-5.830*** (0.564)	-5.898*** (0.559)
Observations	396	396	396	396	396	396	396	396	396
R ²	0.407	0.408	0.448	0.684	0.685	0.687	0.787	0.788	0.797

Quantity-quality trade-offs



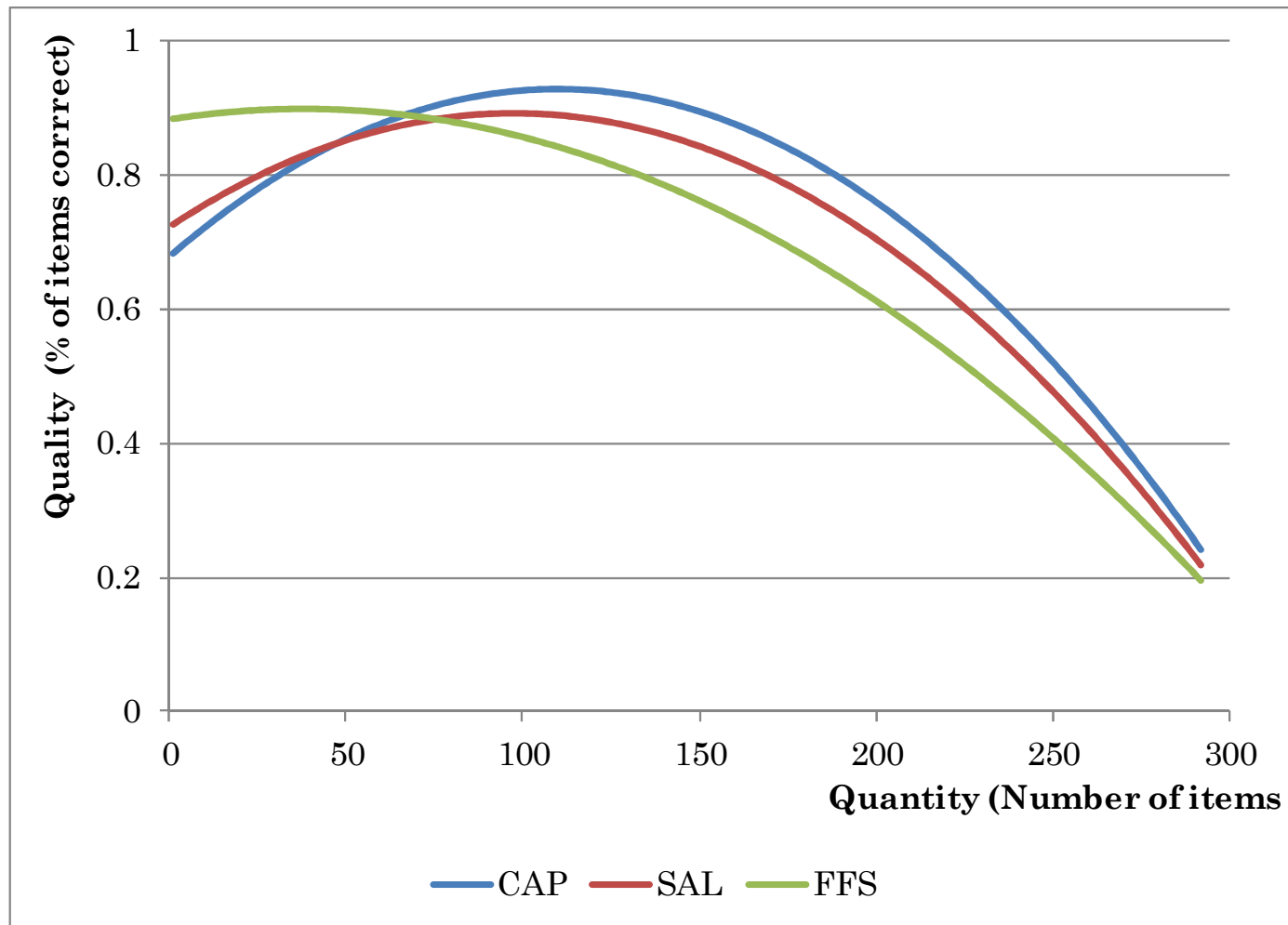
A – Baseline



Quantity-quality trade-offs



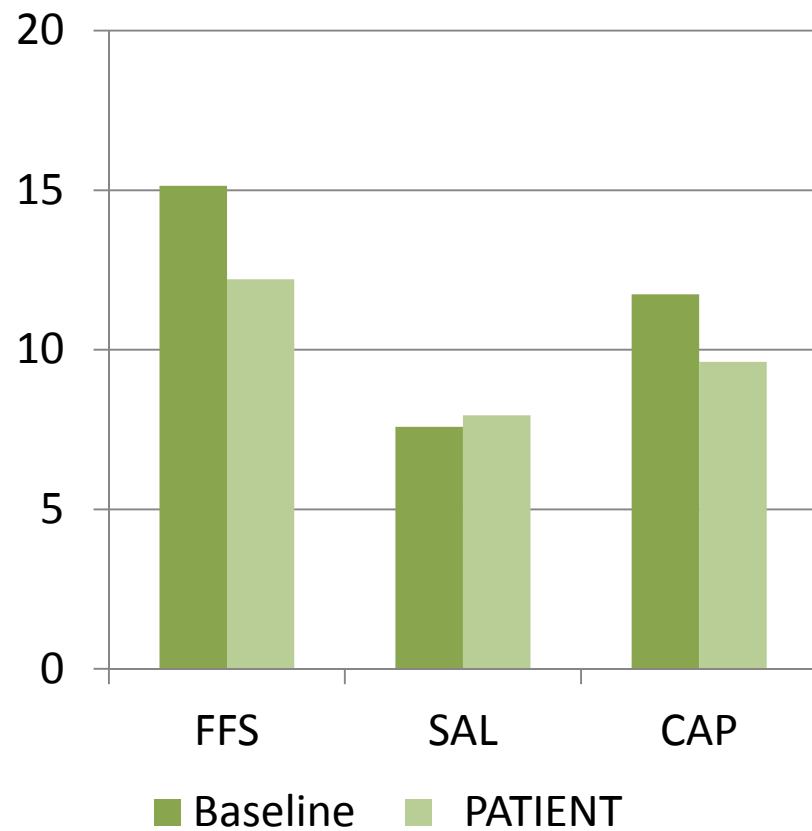
B – PATIENT treatment



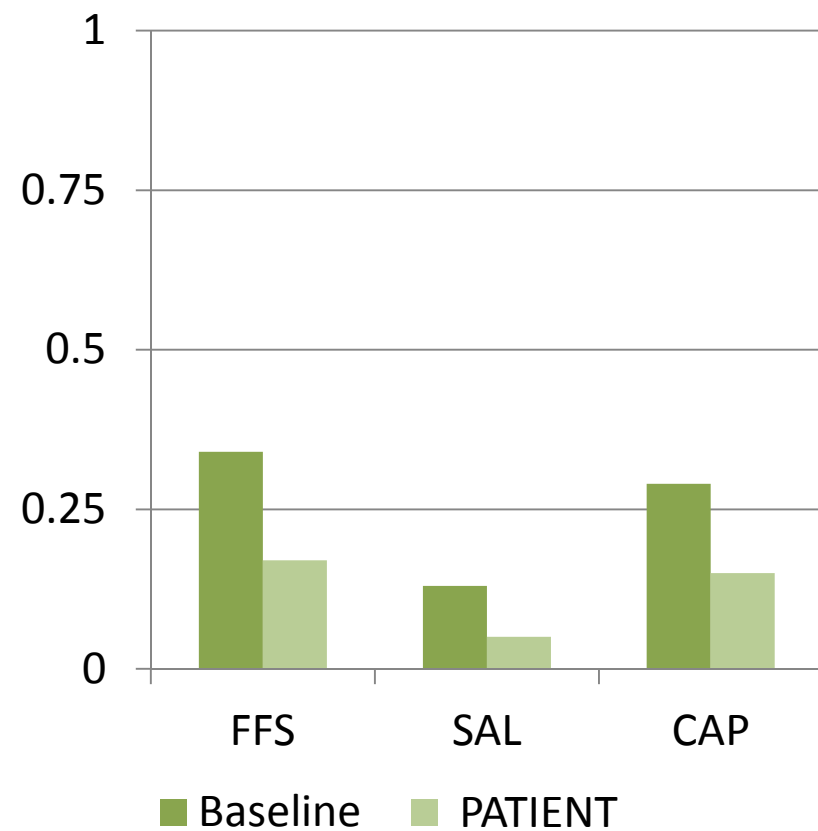
Undesirable behaviours



Over-servicing



Gaming



Impact on undesirable behaviours



	Over-servicing		Gaming rate		Cream-skimming	
	(1)	(2)	(3)	(4)	(5)	(6)
SAL	-2.163** (0.763)	-2.213** (0.846)	-0.084*** (0.018)	-0.077*** (0.021)	-0.186 (0.969)	-0.243 (0.989)
CAP	-2.216*** (0.551)	-2.226*** (0.537)	-0.033 (0.024)	-0.032 (0.025)	0.828 (0.892)	0.782 (0.908)
Period 2		0.159 (0.856)		-0.013 (0.018)		-0.465 (0.856)
Period 3		0.400 (1.105)		-0.058* (0.029)		-0.754 (0.916)
Entries made	0.105*** (0.006)	0.104*** (0.008)			-0.013* (0.008)	-0.012 (0.008)
Completed reports			0.066*** (0.009)	0.069*** (0.008)		
Constant	-5.702*** (1.313)	-5.698*** (1.293)	-0.356*** (0.094)	-0.368*** (0.083)	-2.402 (1.665)	-2.221 (1.697)
Observations	198	198	198	198	198	198
R ²	0.698	0.698	0.563	0.578	-41.59	-41.21

Impact on undesirable behaviours



	Over-servicing			Gaming rate		
	(1)	(2)	(3)	(4)	(5)	(6)
SAL	-1.967*** (0.375)	-2.860*** (0.825)	-2.832*** (0.834)	-0.058*** (0.012)	-0.087*** (0.025)	-0.082*** (0.027)
CAP	-2.107*** (0.412)	-2.368*** (0.581)	-2.362*** (0.558)	-0.019 (0.017)	-0.033 (0.025)	-0.033 (0.026)
PATIENT	-0.330 (0.820)			-0.063** (0.027)		
PATIENT * FFS		-1.084 (1.041)	-1.073 (1.061)		-0.092** (0.046)	-0.090** (0.045)
PATIENT * SAL		0.642 (0.849)	0.644 (0.848)		-0.035 (0.023)	-0.033 (0.024)
PATIENT * CAP		-0.576 (1.194)	-0.567 (1.199)		-0.064* (0.037)	-0.062* (0.037)
Period 2			-0.508 (0.405)			-0.028*** (0.010)
Period 3			0.186 (0.750)			-0.065*** (0.009)
Entries made	0.092*** (0.005)	0.091*** (0.005)	0.092*** (0.005)			
Completed reports				0.064*** (0.005)	0.064*** (0.004)	0.066*** (0.005)
Constant	-3.520*** (0.736)	-3.011*** (0.968)	-3.012*** (0.880)	-0.353*** (0.042)	-0.337*** (0.045)	-0.334*** (0.046)
Observations	396	396	396	396	396	396
R ²	0.574	0.578	0.581	0.560	0.565	0.586

Benefit-cost ratios



	Salary	CAP	FFS
PANEL A: Baseline treatment			
Total cost (in ZAR)	125.00	190.75	199.36
Total number of items entered	147.73	188.09	199.36
Benefit cost ratio	1.18	0.99	1.00
Total number of items correctly entered	101.11	77.95	64.95
Benefit cost ratio	0.81	0.41	0.33
PANEL B: Social benefit treatment			
Total cost (in ZAR)	125.00	176.52	179.15
Total number of items entered	144.67	171.12	179.15
Benefit cost ratio	1.16	0.97	1.00
Total number of items correctly entered	118.36	104.71	93.65
Benefit cost ratio	0.95	0.59	0.52

Summary of results



- Confirm some theoretical predictions
 - FFS leads to highest quantity of effort
 - Low-powered incentives (salary) leads to higher quality (non-incentivised)
 - Quantity-quality trade-off
 - Over-servicing when high powered incentives linked to quantity
- Support models of altruistic physicians
- Results less clear for Incentives of CAP because instructions not clear enough?

Future work



- Finish analysis of rest of the data!
 - Impact of quality-enhancing mechanisms (public reporting, bonus)
 - Determinants of self-selection into remuneration schemes
- Future research
 - More analysis of quantity-quality trade-offs in health care context (seeing more patients vs. spending more time with them)?
 - Efficiency frontier of individual physicians



Thank you

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