Examining the effect of publishing of bill sizes to reduce information asymmetry on healthcare costs

Wong CY, Wu E, Wong TY

ABSTRACT

Introduction: Information asymmetry has been offered as a reason for unnecessarily high costs in certain industries where significant information asymmetry traditionally exists between providers and consumers, such as healthcare. The purpose of this paper is to examine the impact of the introduction of publishing of bill size as a means to reduce healthcare costs. Specifically, we aim to examine if this initiative to decrease information asymmetry on healthcare prices between healthcare providers and patients, and between healthcare providers themselves, will lead to lower prices for patients.

Methods: Bill size data of 29 commonly occurring diagnosis-related groups (DRGs) for two ward classes (B2 and C) over a 16-month period were studied. Each ward class was studied separately, i.e. involving 58 DRG data sets. The mean bill size data as well as that of 50th and 90th percentile bill sizes were examined. The study involved some 46,000 inpatient episodes which occurred in the five public sector acute general hospitals of Singapore.

Results: Mean prices dropped by 4.14 percent and 9.64 percent for B2 and C classes, respectively. 50 out of 58 DRG data sets showed a drop in prices. Bill sizes at the 50th percentile dropped by 7.95 percent and 10.12 percent for B2 and C classes, respectively; while at the 90th percentile, the corresponding figures were decreases of 8.01 percent and 11.4 percent for the two ward classes.

Conclusion: The act of publishing bill sizes has led to less information asymmetry among providers, thereby facilitating more competitive behaviour among hospitals and lower bill sizes.

Keywords: diagnosis-related group, health economics information asymmetry, information costs, market failure

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Changi General Hospital, 2 Simei Street 3, Singapore 529889

Wong CY, MBBS, MMed
Chief Operating Officer

Wu E, MBBS, Dip Derm
Head, Medical Information Management

Centre for Eye Research Australia, University of Melbourne Australia, 32 Gisborne Street, Melbourne, Victoria 3002, Australia

Wong TY, MPH, PhD, FRCSE
Professor of Ophthalmology

Correspondence to:
Dr Wong Chiang Yin
Tel: (65) 6850 2829
Fax (65) 6786 5921
Email: wong.chiang.yin@singhealth.com.sg

INTRODUCTION

Health economics and healthcare cost are of concern to governments everywhere. Singapore has appeared to be one of the countries that has done reasonably well in maintaining healthcare costs. Singapore spends 3.2% of its gross domestic product (GDP) on healthcare. Government spending on healthcare amounted to 0.9% of GDP in 2004 (S$1.617 billion). With a rapidly ageing population, medical advancement and rising public expectations, healthcare spending is expected to rise in the future to nearer that of other developed countries (i.e. 6 to 8% of GDP).

Singapore has maintained a tight lid on healthcare spending by adopting the following strategies[1]:

a. Patients taking responsibility for their health – the principle of co-payment by patient for healthcare consumed.
b. A predominance of funding for healthcare by savings over insurance.
c. A social safety net to fund healthcare for the truly indigent.
d. Competition between healthcare providers to bring about greater efficiency.

Strategies (a) to (c) have been implemented with the schemes commonly known in Singapore as Medisave, Medishield and Medifund.

Healthcare has often been cited as an area of market failure. The essence of a free competitive market is that:

(a) there are many well-informed buyers and sellers and no one of whom is large enough to influence price unilaterally; (b) buyers and sellers act independently (i.e. there is no collusion); and (c) there is free entry for other buyers and sellers not currently in the market. The demand and supply forces thus interact in the market to give rise to "the unseen hand" of the free market as described by Adam Smith that in turn sets prices that vary freely according to demand and supply.

Many hospital markets depart substantially from these ideal competitive conditions, sometimes inevitably[2] and this is described as market failure which is reflected in unnecessarily high prices for services and goods produced. A major contributing factor to market failure in healthcare is imperfect information or information asymmetry. The elementary competitive model assumes that patients, physicians, and other decision makers possess all the necessary relevant information. In the real world, such information may be difficult or even impossible to obtain. High information costs are characteristic of many healthcare markets[3]. The advent of the Internet has been touted as a major tool in reducing information asymmetry in many businesses, healthcare included.

The initiative by the Ministry of Health (MOH) to publicise bill sizes over the Internet thus provides an opportunity to examine the effect of measures, aimed at reducing information asymmetry, have on healthcare costs. Information asymmetry in healthcare was first discussed by Nobel Laureate Kenneth Arrow in 1963[4]. Arrow used the term "informational asymmetry" in the following manner: "Price discrimination...also follows informational inequality, ...consequence of informational inequality between physician and patient and the lack of insurance of a suitable type, the patient must delegate to the physician much of his freedom of choice".

Arrow further states: "The logic and limitations of ideal competitive behaviour under uncertainty force us to recognize the incomplete description of reality supplied by the impersonal price system." As such, information asymmetry has been offered as a reason for unnecessarily high costs in certain industries where significant information asymmetry traditionally exists between providers and consumers. A notable example which is somewhat associated with the healthcare industry is the life insurance industry. In the late 1990s, term life insurance rates fell significantly (~8 to 15%) in the United States and this phenomenon was attributed to the term life insurance rates being published on the Internet[5]. The act of having providers' rates being freely available on the Internet decreased information asymmetry which led to decrease in insurance rates.

The purpose of this paper is to examine the impact of the introduction of publishing of bill size as a means to reduce healthcare costs. Specifically, we aim to examine if initiatives to decrease information asymmetry on healthcare prices between healthcare providers and patients, and between healthcare providers themselves, have any association with lower prices for patients.

As an attempt to reduce information asymmetry in healthcare, on September 29, 2003, MOH published on its website, statistics on hospital bills for the 28 most common illnesses in a joint initiative with the Consumers Association of Singapore. In a press release[6], the stated purpose of the exercise was to allow patients and their family doctors to know the bill size of treatment for patients of similar medical condition at different hospitals and in different ward classes. With such information, the public and general practitioners can make better informed choices on where to seek treatment. Hospitals will also be able to compare their cost with that of their counterparts and in so doing, learn to stay competitive while providing good quality care to their patients. In summary, the exercise was designed to decrease financial information asymmetry between the hospital providers and consumers and between hospitals themselves so as to attempt to create a more efficient market in the economic sense. Another 22 common conditions were added to the original list of 28 conditions on November 1, 2003[7]. Additional 20 diagnosis-related groups (DRGs) were added in December 2003, making up a total of 70 conditions, which made up about two-thirds of all admissions in acute public hospitals.

METHODS

The data were based on actual bills submitted by the hospitals over the preceding 12 months. The bill size data took into account the severity of the patient's condition and included all charges for the episode, such as doctors' professional fees, hospitalisation fees, implants, drugs, laboratory tests and diagnostic procedures. The data were updated monthly as new data were processed, based on a 12-month period of moving averages.

The data were for the 70 common illnesses or medical procedures handled in the acute public hospitals. Classification of diseases was based on the Australian National Diagnosis-Related Group (AN DRG) version 3.1 (1996) classification system. The data in each category of illness or medical procedure were also further stratified and divided according to the class of bed (i.e. class A, B1, B2 or C) that were available in these hospitals. The published statistics included (a) the average length of stay, (b) the 50th percentile bill size, i.e. the median bill size, (c) the 90th percentile bill size, and (d) the number of cases handled by the respective hospital in the preceding 12 months. Where the patient volume for a particular condition was less than 30 cases for that particular ward class, the statistics for that hospital would not be displayed.

To reduce the influence of local hospital factors, data that did not include all five public acute general hospitals (Singapore General Hospital [SGH], Tan Tock Seng Hospital [TTSH], National University Hospital [NUH], Changi General Hospital [CGH], Alexandra Hospital [AH]) were not included in the analysis, i.e. any condition which had less than 30 cases for a particular period and ward class in any of the above-mentioned five general hospitals were excluded in the analysis. Consequently, only ward classes B2 and C data were analysed, as they already comprised at least 65% of our patient workload. The data analysed comprised 29 DRGs each for B2 and C class data, i.e. a total of 58 data sets, of which five DRGs were procedural DRGs, while the remainder were classified as 'medical'. The set of DRGs in classes B2 and C were identical. Classes A and B1 data were not considered because there were too few DRGs in these two classes that fulfilled MOH's criteria for inclusion for publishing of bill sizes.

Due to the fact that the data were based on 12-month moving averages, we were not able to ascertain the exact number of episodes from which the data were derived. However, we could ascertain the average number of episodes used in deriving the moving average data that was published monthly in the 16-month study period. The DRGs that were selected for publishing of bill prices by MOH are listed in Tables I to III. For the purpose of this study, the DRGs were classified as either medical DRG or procedural DRG. The procedural DRGs are appendicectomy, haemorrhoidectomy, inguinal hernia repair, laparoscopic gallbladder removal and lumps and bumps removal (sebaceous cysts-lipoma); while rest were classified as "medical" DRGs.

Analysis was carried out based on both published and unpublished MOH data derived from January 2004 (i.e. December 2002 to November 2003) to April 2005 (i.e. March 2004 to February 2005), a period of 16 months. The published data had a one-month lag from the last month of the 12-month period, i.e. 12-month period ends in November 2003 and the data for these 12 months were published in January 2004. As the subsidy rates for B2 and C classes were different (65% and 80%, respectively), it was not meaningful to aggregate data from the two classes for analysis. As such, B2 and C class data were analysed separately in the study.

Out of the 70 DRGs published, 29 were included in the study, i.e. DRGs with at least 30 episodes in each of the five acute public hospitals at any one time of the study period (AH, CGH, NUH, SGH, TTSH). Bill size data was for amounts payable by the patient and exclude government subsidies.The mean was primarily used to examine the effect of publishing of bill sizes on gross healthcare spending, i.e. how this can help in managing national healthcare costs. The weighted mean was derived taking into consideration the number of cases in each DRG, i.e. volume of work. The median and 90th percentiles were analysed because in addition to looking into the impact of publishing of bill sizes on overall costs, it was felt that the impact on individual bill sizes at different points of the bill size distribution for each DRG should also be examined, as this reflected the actual impact on individual bill sizes, hence individual patients as well.

Data integration was achieved with data warehousing using SAGENT computer software while data analysis was performed using the software Statistical Software for Social Sciences (SPSS) version 11.0 (Chicago, IL, USA). We calculated the percentage difference and its standard deviation in mean, median and 90th percentile bill size for each DRG code between the January 2004 and April 2005 reports. The coefficient of variation (COV) was also calculated as a measure of dispersion. COV was defined as the ratio of the standard deviation to the mean bill size.

RESULTS

The analysis involved some 46,259 inpatient episodes, on which about 44% were B2 cases and the remainder were C cases. Of the 46,259 episodes, 20,270 were B2 class episodes while 25,989 were C class episodes. The majority (39,745) were medical episodes while the rest (6,514) were procedural episodes.

DRG R.170 (pneumonia in elderly [age≥55] with complications) in C class – 2,442 episodes and DRG R.252 (heart failure) in B2 class – 1,636 episodes, were the categories with the largest number of episodes for C and B2 classes, respectively. DRG R.367 (gallbladder removal surgery, laparoscopic) in C class – 83 episodes (because only two hospitals contributed in one particular month) and DRG R.260 (fainting and collapse) in B2 class – 188 episodes (because only three hospitals contributed in one particular month), were the categories with the smallest number of episodes for C and B2 classes, respectively.

Table I shows the difference in mean bill size and standard deviation for each DRG studied over the 16-month study period. Table II is a summary of difference in bill size and COV for medical and procedural DRGs by bed class, while Table III is a summary of difference in bill size and COV for all DRGs by bed class. The drop in unweighted mean prices was 4.14% and 9.64% for B2 and C classes, respectively. 50 out of 58 DRGs that were studied showed drops in weighted mean prices while only eight showed rises. COV increased collectively for both bed classes. However, 27 out of 58 DRG data sets actually showed a decrease in COV. The increase was more marked in C class DRGs (14.9%) compared to B2 class (9.47%). Notably, medical DRGs for both classes showed marked increases in COV while the converse was true for procedural DRGs. Table IV shows the difference in bill size for the 50th percentile for B2 and C classes,

Table I. Difference in bill size and standard deviation for each DRG studied over the 16-month study period.

	Class B2						Class C					
DRG description	Avg bill on Jan 2004 report	Avg bill on Apr 2005 report	% difference	SD on Jan 2004 report	SD on Apr 2005 report	% difference	Avg bill on Jan 2004 report	Avg bill on Apr 2005 report	% difference	SD on Jan 2004 report	SD on Apr 2005 report	% difference
Stroke with complications	1,656.90	1,780.64	7.47	109.98	326.57	196.94	1235.31	1297.41	5.03	120.66	258.71	114.42
Stroke	967.49	962.84	-0.48	109.81	134.04	22.06	637.57	693.73	8.81	60.54	150.43	148.48
Head injury (minor)	288.49	276.64	-4.11	127.57	110.78	-13.16	249.84	230.53	-7.73	106.21	86.22	-18.81
Dizziness and giddiness (vestibular neuritis, vertigo)	470.28	420.93	-10.49	69.80	56.58	-18.94	368.11	309.71	-15.87	35.67	61.96	73.71
Ear infection (middle ear) age≥10	403.46	380.01	-5.81	62.40	46.98	-24.71	275.24	237.21	-13.82	52.66	44.30	-15.87
Pneumonia in elderly (age≥55) with complications	1,334.25	1,304.81	-2.21	187.34	197.98	5.68	1005.70	888.87	-11.62	134.64	132.48	-1.60
Pneumonia in young (age<55) with complications	874.29	796.40	-8.91	83.73	124.54	48.75	741.19	651.66	-12.08	147.21	144.60	-1.77
Pneumonia	472.46	443.61	-6.11	86.11	84.22	-2.20	485.33	357.50	-26.34	124.49	68.78	-44.75
Chronic obstructive airways disease	683.78	679.57	-0.62	121.59	184.39	51.64	554.54	510.21	-7.99	70.27	98.59	40.30
Asthma (age<50) with complications	535.36	498.19	-6.94	111.48	150.48	34.98	430.15	370.71	-13.82	49.62	72.65	46.43
Asthma (age<50)	304.01	356.98	17.43	72.97	74.35	1.89	263.02	293.58	11.62	58.75	55.34	-5.80
Heart attack	988.14	933.53	-5.53	98.97	107.88	9.01	852.62	669.11	-21.52	146.25	57.83	-60.46
Heart failure	730.90	662.67	-9.34	97.36	87.11	-10.53	537.53	471.16	-12.35	66.24	99.49	50.19
Fainting and collapse	411.48	408.16	-0.80	78.01	86.53	10.92	310.57	255.15	-17.84	50.45	52.47	4.00
Chest pain	414.75	391.06	-5.71	57.69	84.74	46.88	295.78	276.31	-6.58	51.41	59.70	16.12
Appendix surgery (appendicectomy)	1,019.36	961.09	-5.72	60.52	67.94	12.26	740.75	665.29	-10.19	93.27	98.28	5.37
Haemorrhoid surgery (haemorrhoidectomy)	554.88	511.25	-7.86	24.92	24.56	-1.46	376.76	343.39	-8.86	63.49	23.63	-62.78
Hernia repair (inguinal)	909.95	851.51	-6.42	71.88	29.42	-59.07	597.67	596.78	-0.15	24.56	69.44	182.68
Gallbladder removal surgery (laparoscopic)	1,104.90	1,011.39	-8.46	104.82	86.56	-17.42	796.56	760.72	-4.50	117.52	26.53	-77.42
Back problems (medical)	544.34	503.55	-7.49	89.33	85.69	-4.09	404.23	399.79	-1.10	85.11	106.02	24.57
Lumps and bumps removal (sebaceous cysts, lipoma)	480.37	466.69	-2.85	60.87	74.60	22.56	322.12	325.84	1.16	75.67	65.64	-13.26
Skin infection (cellulitis) with complications	778.75	779.35	0.08	95.61	137.39	43.70	552.22	514.66	-6.80	64.89	107.55	65.73
Skin infection (cellulitis)	460.27	488.26	6.08	43.13	48.43	12.27	331.21	314.73	-4.98	29.57	56.57	91.31
Diabetes mellitus (age≥60)	546.09	516.93	-5.34	62.53	44.16	-29.38	403.25	369.24	-8.43	23.62	35.85	51.79
Diabetes mellitus (age<60)	608.11	587.90	-3.32	80.48	60.29	-25.09	472.24	444.73	-5.83	64.64	76.85	18.89
Kidney and urinary tract infections (age≥70) with complications	1,435.79	1,270.65	-11.50	191.61	237.69	24.05	1114.40	914.06	-17.98	151.54	167.69	10.65
Kidney and urinary tract infections (age<70) with complications	1,018.47	956.99	-6.04	228.12	132.95	-41.72	793.66	661.36	-16.67	72.85	114.61	57.33
Kidney and urinary tract infections (age<70)	493.81	482.42	-2.31	76.31	94.05	23.24	405.86	328.14	-19.15	73.72	47.02	-36.22
Dengue (age<60)	526.80	442.62	-15.98	63.55	46.45	-26.91	411.44	284.80	-30.78	90.78	57.60	-36.55

while Table V shows the difference in bill size for the 90th percentile for B2 and C classes.

In our analysis of the bill sizes for median and 90th percentile, bill sizes fell across the board. At the 50th (median) percentile, B2 and C class bill sizes fell by 7.95% and 10.12%, respectively (Table IV). In each class, only four out of 29 DRGs showed bill size increases. The largest decrease was for pneumonia which showed a decrease of 21.62% and 24.31% for B2 and C classes, respectively. The largest increase for B2 class bill size was for cellulitis (9.67%), while the largest increase for C class bill size was for stroke without complication (3.48%). At the 90th percentile, B2 class bill sizes fell by an average of 8.01%, with three out of 29 showing rises. For C class bill sizes at the 90th percentile, five out of 29 DRGs showed bill size increases while bill sizes fell by an average of 11.4% for the 29 DRGs studied (Table V). The largest decrease in bill size at the 90th percentile for B2 class was for chronic obstructive airways disease (17.23%) while that of for C class was for dengue which showed a change of -33.4%. The largest increases were seen for chest pain (6.24%) and stroke (11.51%) for B2 and C classes, respectively.

Figs. 1 and 2 show the trend for weighted and unweighted means of DRGs over the 16-month study period for B2 and C classes, respectively. The drops in mean prices were most marked in the first six to 12 months of the study period.

DISCUSSION

The classification of ward classes is peculiar to Singapore and it represents different levels of physical comfort and subsidy given by the government. The target subsidy rate for B2 class is 65% and C class is 80% of costs, respectively. A B2 ward has six beds per cubicle while a C ward has eight to ten beds per cubicle, and both classes do not have air-conditioning. On the other hand, A wards have one bed per room and services provided are not subsidised, while B1 wards have four beds per room and a subsidy rate of 20%. In terms of total number of beds in the country, the market share of public hospitals is about 80% while private hospitals make up the remaining 20%. Government policy dictates that at least 65% of all beds in a public hospital must be B2 and C beds. Therefore, when we examine B2 and C beds, we are examining the lion's share of the workload in each public hospital.

National healthcare expenditure (NHE) has been running at about 3% GDP, while government healthcare expenditure (GHE) has also been maintained at about 0.9% of GDP in Singapore. Actual government expenditure has increased from S$1.16 billion in 1997 to S$1.62 billion in 2004, an actual increase of 39% over the period of seven years. The maintenance of healthcare funding at 3% and 0.9%, respectively, for NHE and GHE, has been achieved mainly by a confluence of demographical factors and healthcare policy. Going forward, as the population of Singapore ages rapidly, it is hard to conceive that such

Table II. Summary of difference in bill size and COV for medical and procedural DRGs by bed class.

Class B2	Average bill on Jan 2004 report	Average bill on Apr 2005 report	% difference	Average COV on Jan 2004 report	Average COV on Apr 2005 report	% difference
Medical DRGs	706	680	-3.68	15.80	17.48	10.63
Procedural DRGs	813	780	-4.06	8.10	7.97	-1.60
Class C						
Medical DRGs	547	489	-10.60	15.98	19.43	21.59
Procedural DRGs	566	538	-4.95	14.36	11.38	-20.75

Table III. Summary of difference in bill size and COV for all DRGs by bed class.

Class B2	Average bill on Jan 2004 report	Average bill on Apr 2005 report	% difference	Average COV on Jan 2004 report	Average COV on Apr 2005 report	% difference
All DRGs (unweighted)	724.76	694.02	-4.24			
All DRGs (weighted)	769.45	715.76	-6.98	14.47	15.84	9.47
Class C						
All DRGs (unweighted)	550.51	497.81	-9.64			
All DRGS (weighted)	599.37	525.58	-12.3	15.70	18.04	14.90

low levels of healthcare expenditure could be maintained indefinitely. Indeed, healthcare inflation has always been one of the highest among the many sectors that make up the basket of prices that are used in the computation of the consumer price index (CPI) in Singapore.

Our analysis provides evidence that the act of publishing bill sizes has an association with lower bill sizes in public hospitals. The drop in unweighted mean prices was 4.14% and 9.64% for B2 and C bed classes, respectively. 50 out of 58 DRGs that were studied showed drops in weighted mean prices while only eight showed rises. Collectively, this translates into savings for patients

Table IV. Difference in bill size for the 50th percentile for B2 and C classes.

		Class B2			Class C		
DRG Code	Description	Jan 04 ($)	Apr 05 ($)	% difference	Jan 04 ($)	Apr 05 ($)	% difference
R.037	Stroke with complications	1241	1243	0.16%	903	908	0.49%
R.038	Stroke	700	657	-6.12%	466	482	3.48%
R.052	Head injury (minor)	261	252	-3.11%	195	187	-4.00%
R.130	Dizziness and giddiness (vestibular neuritis – vertigo)	371	310	-16.34%	271	235	-13.08%
R.134	Ear infection (middle ear) age≥10	351	303	-13.44%	241	205	-15.24%
R.170	Pneumonia in elderly (age≥55) with complications	990	896	-9.50%	705	625	-11.29%
R.171	Pneumonia in young (age<55) with complications	691	579	-16.16%	499	417	-16.42%
R.172	Pneumonia	474	372	-21.62%	384	291	-24.31%
R.177	Chronic obstructive airways disease	582	510	-12.37%	434	379	-12.64%
R.186	Asthma (age<50) with complications	490	425	-13.37%	386	304	-21.35%
R.187	Asthma (age<50)	342	314	-8.11%	257	237	-7.87%
R.249	Heart attack	832	842	1.18%	627	554	-11.68%
R.252	Heart failure	598	529	-11.44%	419	355	-15.10%
R.260	Fainting and collapse	367	346	-5.59%	246	212	-13.98%
R.261	Chest pain	349	320	-8.36%	253	223	-11.64%
R.314	Appendix surgery (appendicectomy)	931	903	-3.01%	605	573	-5.32%
R.318	Haemorrhoid surgery (haemorrhoidectomy)	516	484	-6.28%	328	307	-6.22%
R.320	Hernia repair (inguinal)	806	766	-4.99%	522	540	3.42%
R.367	Gallbladder removal surgery (laparoscopic)	1039	952	-8.41%	746	697	-6.47
R.455	Back problems (medical)	385	370	-3.85%	301	303	0.66%
R.484	Lumps and bumps removal (sebaceous cysts – lipoma)	402	415	3.29%	277	261	-5.62%
R.490	Skin infection (cellulitis) with complications	597	577	-3.35%	425	382	-10.21%
R.491	Skin Infection (cellulitis)	374	411	9.67%	274	267	-2.70%
R.540	Diabetes mellitus (age≥60)	501	442	-11.82%	348	318	-8.51%
R.541	Diabetes mellitus (age<60)	525	466	-11.20%	362	339	-6.36%
R.575	Kidney and urinary tract infections (age≥70) with complications	1131	945	-16.45%	796	672	-15.55%
R.576	Kidney and urinary tract infections (age<70) with complications	768	691	-10.05%	554	470	-15.23%
R.577	Kidney and urinary tract infections (age<70)	420	407	-3.25%	334	269	-19.24%
R.815	Dengue (age<60)	472	393	-16.74%	343	270	-21.37%
Average for all DRGs				-7.95%			-10.12%

as well as a decrease in healthcare expenditure on the DRGs being studied. The two data that showed significant mean bill sizes rises were for asthma. An in-house analysis in one of the hospitals included in this study (CGH), showed that this could be attributed to the introduction of disease management programme which involved use of expensive medication. However, it was also shown that the programme led to significant decrease in readmission rates for this group of patients. Unfortunately, the authors were unable to extrapolate this finding to other hospitals involved in this study.

An increased COV implies that there is more variation

Table V. Difference in bill size for the 90th percentile for B2 and C classes.

		Class B2			Class C		
DRG Code	Description	Jan 04 ($)	Apr 05 ($)	% difference	Jan 04 ($)	Apr 05 ($)	% difference
R.037	Stroke with complications	3109	3244	4.34%	2277	2370	4.09%
R.038	Stroke	1760	1646	-6.48%	1131	1261	11.51%
R.052	Head injury (minor)	768	648	-15.60%	727	500	-31.20%
R.130	Dizziness and giddiness (vestibular neuritis – vertigo)	828	799	-3.53%	679	609	-10.42%
R.134	Ear infection (middle ear) age≥10	653	617	-5.51%	412	389	-5.77%
R.170	Pneumonia in elderly (age≥55) with complications	2633	2295	-12.83%	1937	1603	-17.23%
R.171	Pneumonia in young (age<55) with complications	1529	1372	-10.28%	1313	1093	-16.81%
R.172	Pneumonia	821	815	-0.79%	859	574	-33.20%
R.177	Chronic obstructive airways disease	1321	1093	-17.23%	993	841	-15.32%
R.186	Asthma (age<50) with complications	969	804	-17.08%	695	645	-7.14%
R.187	Asthma (age<50)	616	578	-6.20%	513	497	-3.20%
R.249	Heart attack	1562	1553	-0.53%	1519	1216	-19.94%
R.252	Heart failure	1273	1062	-16.55%	905	749	-17.24%
R.260	Fainting and collapse	707	669	-5.38%	518	454	-12.35%
R.261	Chest pain	632	671	6.24%	586	453	-22.76%
R.314	Appendix surgery (appendicectomy)	1265	1221	-3.48%	900	834	-7.40%
R.318	Haemorrhoid surgery (haemorrhoidectomy)	816	720	-11.81%	555	483	-13.04%
R.320	Hernia repair (inguinal)	1204	1116	-7.37%	868	885	1.98%
R.367	Gallbladder removal surgery (laparoscopic)	1395	1258	-9.81%	1059	1007	-4.90%
R.455	Back problems (medical)	1093	1000	-8.55%	802	832	3.82%
R.484	Lumps and bumps removal (sebaceous cysts – lipoma)	788	689	-12.49%	542	561	3.38%
R.490	Skin infection (cellulitis) with complications	1250	1183	-5.36%	967	913	-5.56%
R.491	Skin Infection (cellulitis)	725	778	7.31%	527	514	-2.58%
R.540	Diabetes mellitus (age≥60)	912	808	-11.42%	625	614	-1.76%
R.541	Diabetes mellitus (age<60)	1040	959	-7.82%	830	774	-6.82%
R.575	Kidney and urinary tract infections (age≥70) with complications	2687	2173	-19.12%	2021	1688	-16.48%
R.576	Kidney and urinary tract infections (age<70) with complications	1823	1606	-11.90%	1518	1205	-20.59%
R.577	Kidney and urinary tract infections (age<70)	854	792	-7.19%	830	580	-30.11%
R.815	Dengue (age<60)	762	642	-15.75%	660	439	-33.40%
Average for all DRGs				-8.01%			-11.40%

in bill sizes. For B2 class, 16 out of 29 DRG groups showed increases in COV while for C class, 17 out of 29 DRG groups showed increases. We are unable to offer any evidence-based factors to explain why COV increased in most cases. More studies are needed to look into this phenomenon. While COV increased over the study period for most DRGs, bill sizes at the 50th and 90th percentiles generally showed significant decreases (~8 to 11%) over the same period for both B2 and C classes. This showed that the effect of publishing bill size has the similar price-depressing effect on the moderate and larger bill sizes for most DRGs.

Further analyses were not performed to attempt to look into the main factors that contributed to the drop in prices. However, it is important to note that the hospitals that contributed to the data set are all teaching hospitals and subject to scrutiny by the relevant authorities. They also have good internal clinical audit and governance structures as well as mortality and morbidity data. In addition, there was no significant change in the average length of stay for inpatients of these same hospitals. Thus at first instance, there is little reason to believe or suggest that the drop in bill sizes has come about at the expense of clinical outcome. Nonetheless, going forward, it will be important to examine clinical outcomes against the backdrop of bill size publishing to confirm the authors' empirical observations.

It is very important to note that in the data released by MOH (for 2004 and 2005) that corresponded roughly to the study period, the overall CPI for "health care" increased by 0.4% (between 2004 and 2005). In addition, the CPI for "medical treatment" (a component of CPI for "health care" which is more specific for hospitalisation fees than "health care") rose by 0.5% for the same period[8]. Hence, the most likely factor that has led to the drop in prices could well be related to decreased information asymmetry among healthcare providers, and thereby more competition, since CPI for "medical treatment" was actually positive (i.e. prices rose) in the same period.

The implications of this research show the potential impact publishing of bill sizes has on the bill size itself. We are uncertain what impact publishing has on clinical practice. Singapore is unique in that useful bill size data could be obtained because there is a national and uniform funding and subsidy framework behind the provision of B2 and C class services. In countries where this does not exist, for example in the United States, it may not be so useful to examine bill sizes across the board as has been done in this study. Also, Singapore has chosen to only publish the 70 commonest conditions. This is probably because for rarer conditions, the data set may be too small to lend itself to meaningful analyses.

This study has shown that healthcare, while different from other sectors, has also much in common. The effect

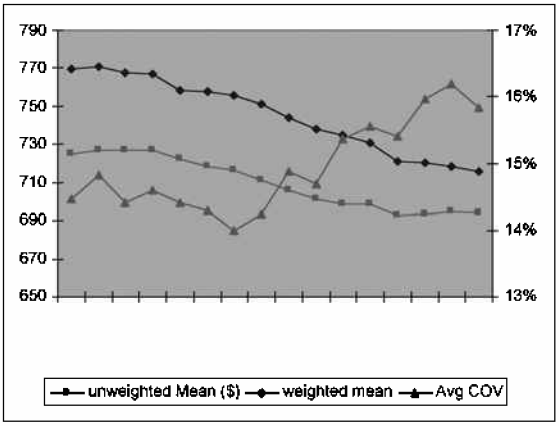

Fig. 1 Trend for weighted and unweighted means of DRGs over 16-month study period for B2 class.

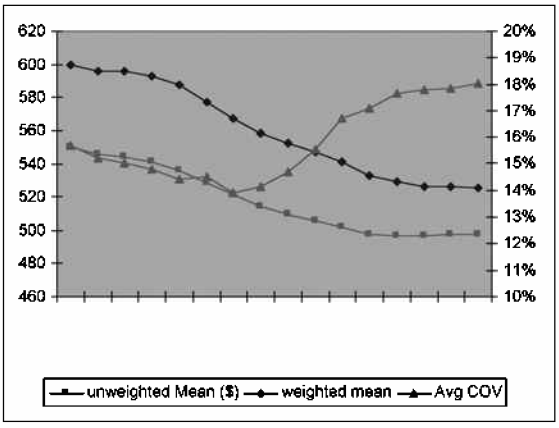

Fig. 2 Trend for weighted and unweighted means of DRGs over 16-month study period for C class.

of decreasing information asymmetry about pricing shown here has also been seen in other industries. These include the insurance industry as mentioned earlier, the hotel industry, online airline ticketing, and even book sellers, among others. In all, the internet has been a great enabler for consumers to readily avail themselves to price information that would otherwise not have been possible. However, we are unsure if patients did indeed access this information. Data on the frequency of the public and healthcare providers accessing bill size information on the Ministry of Health public website were not available. As such, we are unable to attribute changes in mean bill sizes and COV to increased public awareness to differences in bill sizes between different hospitals. Suffice it to say, the very availability of this information has made the various hospitals exhibit more competitive behaviour through less information asymmetry among providers themselves. This can be inferred from the fact that the most significant and rapid price decreases occurred shortly after the publishing of bill sizes, with further decreases becoming more muted thereafter (Figs. 1–2).

Several other possible confounding factors were

considered. These include poor economic climate and deflation as well as government healthcare funding policy change. However, the Singapore economy grew during the study period and there was no deflation. There was also no change in healthcare funding by the government. Government healthcare expenditure remained around 0.9% of GDP throughout the study period. Public hospitals' market share also remained largely unchanged during the study period.

The strengths of this study include the comprehensiveness and size of the data set as well as the quality of the data captured by the public hospitals, which contribute positively to the internal validity of the study. The weakness of the study would be that such data could only be obtained in the Singapore context. It would be very difficult for similar data to be obtained or a similar study to be conducted elsewhere, when uniform methods of data collection and a national funding framework for services are not known to exist.

One of the limitations of this study is that conditions that did not contain data from all five acute general hospitals were excluded. This was deliberately so because it was felt that the purpose of this study was to show if publishing of bill sizes has an effect on decreasing healthcare costs at the national level and not just pertaining to one or two institutions. Future studies should look into identifying and studying specific factors that contribute to the change in bill size as well as COV. An even more difficult but perhaps more important question to answer in the future would be to determine conclusively if the publishing of bill sizes has had any effect on: (a) clinical practice behaviour, (b) clinical outcome, and (c) patient satisfaction.

It is suffice to note that while we are unable to determine the volume and frequency of public access to the available bill size information, the mere act of publishing the bill sizes has an association with a decrease in patient bill sizes, thereby leading to savings for patients and a dampening effect on NHE. Further research could be undertaken to measure the differential effect of publishing of bill sizes on reducing information asymmetry between (a) providers and patients, and (b) among providers themselves. There is little research on this subject elsewhere and it would be good if this study could be compared to similar initiatives and research performed elsewhere.

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