

Casemix Reimbursement: A Singapore Children's Hospital Perspective

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Abstract

Introduction: Casemix reimbursement was introduced to Singapore in October 1999 using the Australian National Diagnosis Related Groups Version 3.1 (AN-DRGs 3.1). The possible impact of this classification system on a Singapore Children's Hospital is discussed. **Materials and Methods:** Data on paediatric patients in KK Women's and Children's Hospital (KKH) were drawn from the inhouse Datamart warehouse system, and reviewed with regards to volume of patients, length of stay and charges. Several high cost categories were selected for a more in-depth review and discussed. **Results:** The classification system and reimbursement method did not take into account the higher cost of treating children, thus penalising the Children's Hospital. The wide variety of cases treated also gave rise to difficulty in obtaining appropriate reimbursement. The lack of severity of illness measures was a drawback in the Diagnosis Related Group (DRG) for ventilated patients. The lack of outcome measures gave rise to potentially inequitable reimbursement in some high cost neonatal DRGs. **Conclusion:** While Casemix is an improvement over previous methods of providing Government funding in Singapore, particular aspects need to be reviewed, and reimbursement criteria refined to ensure equitable funding to Children's Hospitals.

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Introduction

Evidence from studies conducted in the United States and in Australia indicate paediatric care costs more than adult care.¹⁻³ While this has not been studied in Singapore, it is probably also true here due to similarities in the level and intensity of care provided.

Even though children and babies are physically smaller and hence consume smaller quantities of everything (space, food, medication), the reduction in costs is outweighed by the additional demand in time and attention required to care for and nurse sick children.⁴

Not only do young children and infants need additional care for day-to-day activities such as feeding and bathing, procedures undertaken on small children also utilise greater staff intensity and time. Compare the drip-setting procedure in an adult with that of an infant. The process of getting a chest film requires additional time, skill and persuasion. Certain procedures, such as magnetic resonance imaging (MRI) and dental extraction may need anaesthesia, unlike in adults. Special child-sized equipment such as incubators and ventilators, and consumables such as tubings and blood culture bottles, can cost more than the adult equivalent.

A Bit of History and Historical Costing Information

The majority of public hospitals in Singapore were

corporatised around 1990. Itemised charging was introduced and an effort was made to ensure appropriate charging according to costs. Bills are itemised and state charges before and after the provision of the Government subsidy which is shown as a discount (Government Grant). The total charges prior to the application of the subsidy is also referred to as Total Charges Before Government Grant (TCBGG), and this figure is often taken as a proxy of treatment costs, since public hospitals were non-profit entities.

The Children's Hospital of KK Women's and Children's Hospital (KKH) was formed in May 1997. Prior to that, public paediatric services were provided by Paediatric Departments in General Hospitals. These were the Paediatric Departments of Singapore General Hospital (SGH), Tan Tock Seng Hospital and Alexandra Hospital and the Paediatric Surgery Department of SGH. Other surgical services, such as Neurosurgery or Orthopaedics, were drawn from departments providing care to both adult and children. As costs were generally determined on an aggregate hospital level and not at the departmental level, children's costs were not separately identified.

The Singapore Casemix pilot run began in May 1998 and Casemix as a basis for government funding of inpatients was implemented in October 1999. The quantum of

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Government funding for subsidised patients for every Diagnosis-Related Group (DRG) was determined largely by the data collected during the pilot run phase, particularly the TCBGG, and was fixed at a common rate across all public hospitals in Singapore.⁵ Because charges for children were the result of aggregate costing studies involving both adults and children, they were likely to be underestimated (in view of the fact that children cost more). Likewise, reimbursements based on charging data were probably inadequate.

In addition to the above consideration, there are issues within the classification system which affect paediatric hospitals. Three of these will be discussed here with regards to its effects on KKH. Firstly, the DRG age splits and the distribution of paediatric cases within the DRGs.

TABLE I: THE DRGs WHICH ARE RESTRICTED TO CHILDREN AGE 16 YEARS OR LESS (AN-DRGs 3.1)

DRG	Description
R.002	Mouth, larynx or pharynx disorder with tracheostomy (Age <16)
R.004	Tracheostomy except for mouth, larynx or pharynx disorder (Age <16)
R.049	Febrile Convulsions (Age <5)
R.136	Laryngotracheitis
R.058	Cerebral Palsy (Age <4)
R.188	Whooping Cough & Acute Bronchiolitis
R.135	Otitis media & uri (Age <10)
R.321	Hernia procedures (Age <10)
R.350	Gastroenteritis (Age <10)
R.351	Oesophagitis & miscellaneous digestive system disorders (Age <10)
R.354	Other digestive system diagnoses (Age <10)
R.510	Major skin disorders (Age <10)
R.565	Urethral procedures (Age <10)
R.611	Testes procedures except for malignancy (Age <10)
R.613	Circumcision (Age <10)
R.813	Fever of Unknown Origin (Age <10)
R.871	Tracheostomy for multiple significant trauma (Age <16)

AN-DRGs 3.1: Australian National Diagnosis Related Groups Version 3.1

Secondly, some of the problems associated with the classification of patients who are intubated and ventilated during their stay. Thirdly, the neonatal DRGs and the special problems these surface with regards survival rates of extremely-low-birth-weight infants.

Volume and Distribution of Cases and its Implications

The Australian National Diagnosis Related Groups Version 3.1 (AN-DRGs 3.1) classification system adopted by Singapore uses complications and co-morbidities (CCs) to split DRGs far more frequently than it uses age within its 667 DRGs. There are over 149 splits according to CCs and just 15 DRGs which differentiate children from adults by age group (Table I). A few DRGs without age split also refer to children and two of the most obvious ones have also been included in this table, i.e. whooping cough and bronchiolitis, and laryngotracheitis.

Of the children (excluding neonates) admitted to KKH, 39.8% fall within the 17 DRGs shown in Table I with the remaining falling into 358 other DRGs. This huge number of DRGs is not surprising considering the range of medical services and the nature of the Children's Hospital which is a full-fledged General Hospital for children.

Meaningful statistical analysis on the impact of paediatric costs is a difficult task given the large spread of DRGs. In 295 of these DRGs, KKH patients make up less than 12.5% of the volume of all public hospitals (Table II). In fact, KKH has 10 or fewer patients in 219 of these DRGs and just 1 patient in 53 DRGs. In these 53 DRGs, the length of stay (LOS) between our patient and the public hospital average (unpublished data) was compared. Although the average ratio of the difference was just 1.03, the standard deviation is huge at 0.95. Figure 1 compares the difference in LOS by DRG and shows the variability involved.

Another point to note is that high outliers may consume many times the average resource requirement leading to high potential losses. On the downside, as reimbursement is pegged upon average resource consumption, the potential

TABLE II: DRGS IN WHICH KKH PAEDIATRIC PATIENTS OCCUR (OCTOBER 1999 TO SEPTEMBER 2000)

Proportion of KKH cases as % of all public hospital cases	DRGs without paediatric age split		DRGs with paediatric age split*	
	No. of DRGs	% of total KKH paediatric cases	No. of DRGs	% of total KKH paediatric cases
>75%	2	0.1	12	38.1
50% to 75%	8	1.3	4	1.7
25% to 50%	19	20.5		
12.5% to 25%	34	15.6		
0% to 12.5%	295	22.6	1	0.0
Total	358	60.1	17	39.8

DRG: Diagnosis Related Group

*as in Table I

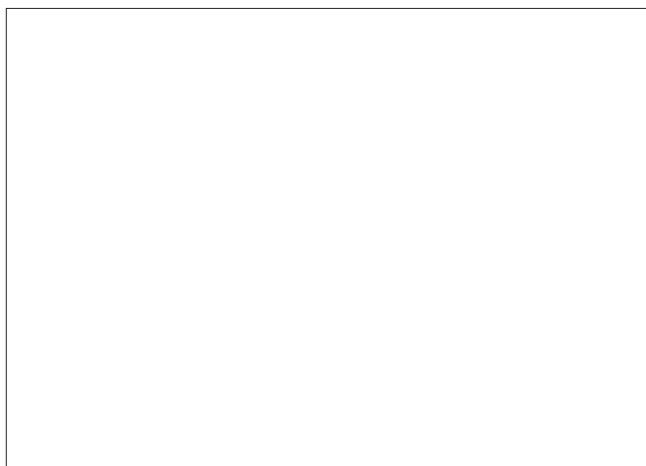


Fig. 1. Comparing public hospital ALOS with KKH patient LOS for DRGs in which KKH has a single patient (October 1999 to September 2000).

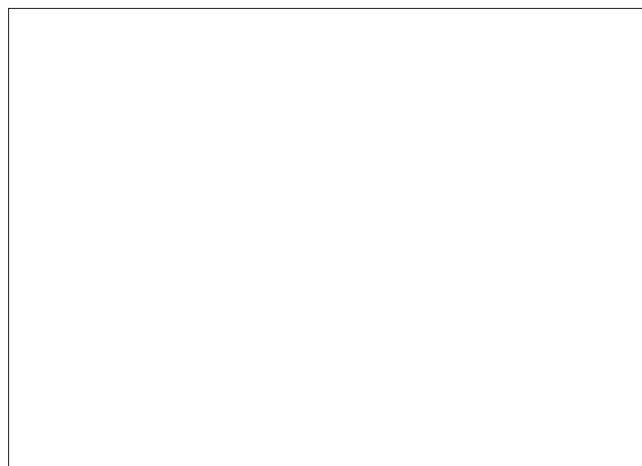


Fig. 2. Relationship between LOS and TCBGG for DRG 004 in KKH (October 1998 to June 1999).

revenue gain from a low outlier is limited. It is of interest that high outlier funding by and large only kicks in after the LOS has exceeded the average by a factor of about 2.4 or more (unpublished data), particularly in the DRGs with longer LOS. Again, this means the potential loss from high outliers outweighs potential revenue gains from low outliers.

Casemix reimbursement is based on the principal of an average payment for the average case. Having very few patients in many DRGs means that ‘averaging out’ phenomena within the DRG which modifies risk cannot take place.

DRG 004 and Intubations

Occasionally, even when a moderate number of patients are involved, the range of severity of illness and charges may be so wide such that the standard reimbursement may seem out of proportion to the actual costs incurred, being either too high or too low. DRG 004 is one such DRG. It is also known by its short descriptive title “Tracheostomy Except for Mouth, Larynx or Pharynx Disorder Age<16”.⁶ In practice, tracheostomies are rare, and most of our cases fall into this DRG because they received non-operative intubation and ventilation.

The relationship between the LOS and TCBGG of KKH cases is shown in the scatter diagram in Figure 2. There is obviously a large variation in the LOS which ranges between 1 and 112 days. The TCBGG also varies widely from approximately \$1,700 to \$115,000. The Pearson correlation between LOS and TCBGG is highly significant at 0.86; thus indicating that for this DRG, the LOS is a good proxy for the total cost of treatment, and a fitted linear equation can be calculated.

This DRG attracts a funding of \$16,876 per case (inlier) at 80% subsidy rate (different subsidy classes will attract

the corresponding subsidy amount). Additional funding in the form of marginal quantum occurs when the patient stays beyond the high trim point of 63 days. At an LOS of 63 days, the approximate treatment cost of a KKH patient according to the calculated fitted linear equation is \$53,948. It can be seen that a few extremely high-cost cases can wipe out the gains made by several low-cost cases.

Hence, the high variability within this DRG and the high costs involved present great financial risk to KKH. This high variability occurs in this DRG because it uses intubation as the principal procedure, and is unable to differentiate between the patient who requires short-term ventilation but recovers quickly and the severely ill patient with multiple problems requiring long-term care.

In order to ensure more equitable funding, the severity of illness needs to be factored into funding. One suggestion is to use the number of days spent in the intensive care unit (ICU) as a measure of severity of illness. The ICU stay can then be separately funded from the basic DRG reimbursement rate.

Neonatal Charges and DRGs

Neonatal DRGs are largely classified according to the birth or admission weight, with some consideration for the severity of illness.⁷ For infants below 1000 g, no splits are provided for severity of illness. All infants below 750 g go into DRG 705, while all those between 750 g and 1000 g go into DRG 706 (Table III). Infants 1000 g and above are split into DRGs according to the presence of ‘problems’ or performance of surgery.

The costs of treatment of extremely premature infants below 1000 g can be highly variable, depending on the development of complications such as intracranial haemorrhage, persistent ductus arteriosus, jaundice, sepsis

TABLE III: RESOURCE WEIGHTS AND HIGH TRIM POINTS FOR DRGs 704, 705 AND 706

DRG	Description	Resource weight*	High trim point* (days)
R.704	Cardiothoracic/Vascular Procedures for Neonates	19.30	151
R.705	Neonate, admission weight <750 g	33.08	184
R.706	Neonate, admission weight 750 to 999 g	29.84	151

DRG: Diagnosis Related Group

*As at 1 April 2000, MOH data (unpublished)

and others. It is well recognised that successful care of such infants can only be carried out at high cost at the most sophisticated centres, and is dependant on the quality of neonatal and obstetric care provided.

The outcomes of these extremely-low-birth-weight infants can be categorised as follows: good outcome with minimal complications and discharge within 60 to 120 days; intermediate outcome with more complications and longer period of hospitalisation; and poor outcome with early demise.

While in most DRGs, poorer outcomes tend to be associated with longer hospitalisation and hence higher costs, the reverse is true for these 2 neonatal DRGs. The poorest outcome, which is early demise, actually consumes far less resources than a good or intermediate outcome.

Hence, good centres with good outcomes and high survival rates would utilise far more resources per case treated than centres with poorer survival rates. The fixed reimbursement sum per case within the DRG would thus penalise centres with better outcomes. In fact, this could be true for all high cost DRGs which include severely ill

patients on the brink of death.

Another interesting feature of the classification system is that any cardiovascular procedure in a neonate would take precedence and throw it into DRG 704 "Cardiovascular/Vascular Procedures for Neonates",⁷ attracting a different resource weight (Table III). Some of our neonates which would otherwise have gone into DRG 705 or 706 required surgical ligation for patent ductus arteriosus and hence, were coded into DRG 704 which has a lower resource weight and attracts a correspondingly lower reimbursement rate.

Table IV gives an estimate of the losses sustained by KKH in these three high cost Neonatal DRGs over a 12-month period. Although not every patient is admitted to C class, this was chosen to provide a conservative estimate of losses as these patients receive the highest quantum of government subvention.

Conclusion

The Children's Hospital in KKH faces an increased burden due to the higher cost of care for children which has not been taken into account by the fixed reimbursement rate across all public hospitals. The AN-DRG 3.1 classification also gives rise to several difficulties as it cannot sufficiently take into account severity of illness and clinical outcomes in some instances. It is suggested that reimbursement criteria and quantum be reviewed based on the ideas surfaced here.

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TABLE IV: ESTIMATED LOSSES IN DRGS 704, 705 AND 706 FOR KKH, OCTOBER 1999 TO SEPTEMBER 2000

KKH data Oct 99-Sep 00				Maximal Government subvention per case (highest for C class patients)				Payment due from patient**	Average losses per KKH case		Average losses per case for period Oct 99-Sep 00***	Estimated total losses Oct 99-Sep 00
DRG	Vol	Average TCBGG	ALOS	Subvention for C class	HTP (days)	Subvention for C class	HTP (days)		Oct 99-Mar 00	Apr 00-Sep 00		
704	33	\$60,897	59.0	\$38,902	229	\$31,440	151	\$12,179	\$9,816	\$17,278	\$13,547	\$447,051
705	23	\$114,651	119.5	\$50,675	201	\$53,887	184	\$22,930	\$41,045	\$37,834	\$39,440	\$907,109
706	46	\$70,285	87.2	\$44,034	165	\$48,609	151	\$14,057	\$12,194	\$7,619	\$9,906	\$455,686
												\$1,809,845

ALOS: average length of stay; DRG: Diagnosis Related Group; HTP: high trim point—beyond this length of stay, additional per diem funding is provided; TCBGG: Total Charges Before Government Grant

* Refer to Table III for a brief description of these DRG codes.

** For C class patients, the co-payment required of the patient approximates 20% of TCBGG.

*** This is the mathematical average of the preceding two columns.

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