



The second national hospital costing study: Background, results and implications

BRETT OATES, JO MURRAY AND DON HINDLE

Brett Oates is Director, Private Sector Casemix Unit. Jo Murray is Acting Assistant Secretary of the Classification and Payments Branch, Commonwealth Department of Health and Family Services. Don Hindle is National Director, Australian Healthcare Association.

Abstract

The costing of hospital outputs, and especially of acute admitted patients categorised by DRG, has been the focus of considerable attention in the last decade. Many individual hospitals now routinely estimate the costs of their main products, several State and Territory health authorities undertake periodic multi-site studies, and there have been a few one-off national studies.

This paper summarises the methods and results of the most recent national study, which measured costs at a sample of public and private hospitals around Australia for the 1996–97 financial year. We briefly describe the main results and note some implications.

The context

Product costing is an analytical process whereby the costs of manufacture of each type of product are determined. It involves identifying the costs of inputs and tracing them through to the products. The methodology is well established, and it has become a routine activity in many parts of the Australian health care

system. Particularly useful reports of costs by Australian national diagnosis related group (AN-DRG) are now being generated in several States.

There are several types of uses. One is for the purpose of improving the product classifications themselves. At the level of the individual hospital, a more important application is to *production management*. Differences in costs per product relative to other hospitals or over time suggest potential problems in efficiency. A related use concerns *internal contracting*. It is becoming common in large hospitals to base (say) the obstetrics department budget on agreed prices per product, and to require it to purchase services from ancillary areas such as pathology and physiotherapy.

The fourth type of use has attracted the most interest until recently: that of *external pricing*. Results from studies like that reported here have been important in the context of casemix funding of public hospitals, and are similarly assisting refinement of contracts between private insurers and private hospitals.

The first serious Australian study of hospital costs for products defined by DRG took place in 1987, and involved major public hospitals in South Australia. Many other studies were conducted over the next five years which used similar methods but refined the details and made use of better data. Since then many individual hospitals, hospital groups, and State health authorities have established routine costing cycles.

The first major national study was conducted in 1992–93 (CDHFS 1994). A stratified random sample of 97 hospitals with over 50 beds was used to estimate the mean total and component service costs of acute admitted patients classified by both AN-DRG versions 1 and 2. The costs of all other products were excluded. Each hospital provided its own cost data by cost centre, overhead cost allocation statistics, and product volumes. Almost all the final costs were allocated among DRGs by use of service weights derived from Maryland charges data. The only significant exception was use of nursing service weights derived from a sample of public hospitals in New South Wales and South Australia.

In 1995, the Commonwealth re-processed the 1992–93 data to create version 3 cost weights (CDHFS 1995). One weakness was that the production data were out of date. However, there were some counterbalancing improvements. In particular, the 97 hospitals were given the opportunity to correct some of their original data, and the Maryland service weights were largely replaced by the results of Australian studies. Completely new service weights were developed for operating rooms (Deloitte Touche Tohmatsu 1995), diagnostic imaging (KPMG 1995a), pathology (KPMG 1995b) and critical care (KPMG 1995c). The nursing service weights were refined through addition of data from more public hospitals in NSW.

In 1996, the decision was taken to replicate the survey for the 1996–97 financial year, but with significant differences. Inter alia, there was no *a priori* sampling. Rather, every site which wished to participate would be supported, if it met standards for data systems. Second, the opportunity would be taken to broaden the scope of included products and costs. Third, improvements in methodology would be implemented. Finally, there would be a deliberate aim of establishing a routine process, rather than a one-off study. This has had important ramifications, including greater emphasis on local skills development and the establishment of methods having long-term validity, as opposed to precision of the first set of results.

Hospitals around Australia were invited to indicate their interest during early 1997, and 146 were selected as summarised in Table 1. They were provided with detailed documentation (and costing software if they wished). Most hospitals chose to use a new variant of the Yale Cost Model called COMBO, and some used a similar product, COSMOS. National DRG service weights data were provided on disk for use as required.

Table 1: Distribution of participating hospitals by location, function and size

Public hospitals	
Distribution by State	
NSW	41
Victoria	25
Queensland	27
South Australia	15
Western Australia	7
Tasmania	6
Northern Territory	3
ACT	2
Distribution by function	
Teaching	34
Non-teaching	92
Distribution by size	
Under 50	27
50 to 149	38
150 and over	61
<i>Public hospital total</i>	126
Private hospitals	22
Total in study	148

Training sessions for hospital staff were conducted in late 1997. During this and subsequent stages, they had ready access to expert advice from State and Territory coordinators, and to a private hospitals advisory team.

Method

The standard method of cost allocation was applied for the most part. First, all costs were identified for the entire operation of each participating hospital for the complete 1996–97 financial year, and amended as necessary to match the products in scope. As noted above, the emphasis was on validity. Sites were therefore encouraged to make best estimates of relevant costs which were missing from the accounting data (such as those relating to services provided by an offsite corporate or 'group' office), and similarly to exclude costs in the accounts relating to products out of scope (such as services to admitted patients at other hospitals).

Particular attention was given to the treatment of capital-related costs. Sites were asked to conform to a set of standards regarding such matters as depreciation, leases and rentals, licence and royalty fees, taxes, and return on investment. For example, they were asked to insert missing costs relating to any asset which continued to be used during the study period, even if it had been fully depreciated in the accounts.

Where revenue was generated by selling products outside the hospital, sites were asked not to offset revenues against costs but, rather, to remove the estimated costs. They were asked to impute costs of donated capital items even if this was not the accounting practice. It was decided, however, that there should be no imputation of 'notional' costs related to the provision of personal services free of charge (as in the case of volunteers who assist with hospital activities).

Some rules related for the most part to private hospitals. For example, it was common practice for prostheses costs to be missing from the hospital's accounts where they had been acquired by patients or their doctors. In these cases, the hospital was asked to estimate the missing costs by type of prosthesis.

Once the starting costs had been adjusted in these and other ways, they were distributed in the *second stage* to cost centres defined to be either overhead or final product. Costs of the latter are able to be associated with final products (patient care episodes), whereas the former provide their services to other cost centres. Participating sites were encouraged to refine their cost centre structures to approximate a standard list.

As a minimum, they were required to indicate two attributes of each cost centre: the type of input (such as equipment or nursing), and the type of product (acute

admitted patient, rehabilitation, and so on). This was an improvement on the previous national study, where analytical teams often had to guess the cost types from cost centre names.

Third, the overhead costs were fully distributed among the final product cost centres using the standard matrix multiplication technique. An improved set of minimum standard cost allocation statistics was incorporated.

Fourth, costs were tracked from the final product cost centres to final products, which constituted a refined set relative to the first national study. Eight major product types were defined. The most important, acute admitted patients, were to be sub-categorised by the most recent AN-DRG version (3.1). In a few private hospitals, the separations were also sub-categorised by the CMBS procedure classification.

The remaining major product types (rehabilitation admitted patient, palliation admitted patient, non-acute admitted patient, non-admitted patient, research, and teaching) were required to be reported only in terms of total and component costs without sub-categorisation. No details about volumes were required, excepting total admissions. It was recognised that the cost data might not be accurate. However, it was considered to be worthwhile to make best estimates, if only to minimise the extent to which the DRG costing results were polluted by the retention of other episodes or costs.

Products were defined according to national standards where they existed. For example, the definitions of patient care types contained in the National Health Data Dictionary were applied. In accordance with the dictionary, psychiatric admitted patient episodes were distributed among the four categories in the same way as all other types of health problems.

Statistical separation rules were applied. Many participating hospitals had not, in fact, been fully applying these rules during 1996–97. We asked hospitals to make the best possible estimates, and to adjust the discharge data accordingly. All hospitals were required to provide a computer file containing all separations during 1996–97 in which all records were to be coded to indicate whether they were acute, rehabilitation, palliation or non-acute.

Many hospitals relied almost exclusively on the improved national service weights. However, increased use was made of locally developed allocation statistics. They ranged from service weights to patient-level statistics derived from the use of both local relative value unit scales for intermediate products and consumption data.

Some sites used a mix of patient consumption data and service weights. A few made extensive use of locally developed allocation statistics at the level of individual patient care episodes, and therefore submitted their results in the form of a patient-level file. They tended to be hospitals using commercial software packages like Trendstar and Transition, because they had chosen to establish a routine process of costing of individual episodes.

Participating sites were required to provide their results in a standard format. They also provided various sets of key source data files so that their results could be checked and additional analyses undertaken by the Commonwealth team (including the development of cost weights for AN-DRG version 4 when it becomes available).

Overview of the results

The results are fully reported elsewhere, and are available on disk (CDHFS 1998). Here, we will merely illustrate the data structure and discuss a few aspects of precision.

The main kind of report is illustrated in Tables 2 to 5. Table 2 shows mean costs per separation for the top 20 AN-DRGs by volume in the public hospital sector. The standard error of the estimated cost weight is reported in the same way as in previous national studies (CDHFS 1993) for the purpose of comparison. The number of cases is the estimated national total, by inflation of the sample. Component costs for public hospitals are shown in Table 3 for the top 7 AN-DRGs. Unlike the 1992–93 study, overheads are reported separately for each component. Tables 4 and 5 show the same data for private hospitals.

As shown in Table 2, the mean cost per acute admitted patient was \$2275 for public hospitals in 1996–97, compared with \$2454 in 1994–95. Table 4 shows the mean was \$2060 for private hospitals in 1996–97 (compared with \$1671 in 1994–95).

The reported fall in mean costs in public hospitals probably reflects two main factors. First, they have become more efficient. Second, they have also changed their methods of cost measurement and attribution. *Inter alia*, they have improved with respect to statistical separation (thus splitting more episodes into two), and they have more completely removed the non-DRG costs such as teaching and research.

The reported increase in private hospitals is probably a consequence of two quite different factors. First, they continue to increase the range and complexity of patients treated. Second, they appear to have tended to include a greater range

of costs than in 1992–93. In particular, they have more precisely handled capital-related, prosthesis, and diagnostic services costs. There was significant under-reporting in the 1992–93 survey.

Table 2: Cost weights and mean total costs per case, top 20 AN-DRGs, public hospitals

AN-DRG	Cost weight	Std error	Number of cases	Mean LOS	Cost per case (\$)		
					Direct	O'head	Total
572 Admit for renal dialysis	0.22	0.01	309 049	1.00	356	140	496
780 Chemotherapy	0.22	0.01	149 508	1.00	368	140	508
674 Vaginal delivery, no complctng dx	0.79	0.02	132 911	3.29	1 152	642	1 793
727 Neo,ad wt >2499g -sg op -prb	0.54	0.02	124 223	3.33	797	439	1 237
332 Other gastroscopy+n-m dig dis-cc	0.37	0.03	90 434	1.17	568	268	836
335 Other colonoscopy -cc	0.36	0.03	62 685	1.22	554	274	828
187 Bronchitis & asthma a<50 -cc	0.45	0.01	48 779	2.02	654	371	1 025
683 Abortion+d&c,asprtn crtg/hystrtmy	0.41	0.03	43 708	1.09	605	338	944
484 Other skin, subc tis & brst pr	0.55	0.02	41 828	1.34	833	421	1 254
659 Conistn,vagina,cervix&vulva pr	0.45	0.01	41 731	1.16	680	346	1 026
686 Other antntl ad +mod/no cmlpg dx	0.45	0.01	40 862	1.88	650	382	1 032
177 Chronic obstructv airways dis	1.39	0.03	39 543	7.27	2 101	1 068	3 169
252 Heart failure & shock	1.47	0.05	35 776	7.18	2 269	1 085	3 354
261 Chest pain	0.53	0.02	35 735	2.05	818	389	1 207
347 Abdmnl pn, mesentrc adents -cc	0.42	0.01	35 039	1.78	625	325	950
843 Major affective disorders	1.80	0.14	34 213	10.67	2 797	1 300	4 097
099 Lens proc -vitrectomy & -cc	0.77	0.04	33 114	1.18	1 276	484	1 760
943 Other factors infl hlth st a<80 -cc	0.40	0.03	32 644	3.28	566	342	908
349 Oesphs,gast&mdd a10-74 -cc	0.46	0.02	31 305	2.01	682	368	1 050
660 Endoscopic procs, fem rep sys	0.58	0.02	30 666	1.11	857	458	1 314
All DRGs	1.00		4 051 443	3.68	1 568	708	2 275

Table 3: Mean component costs per case, top 7 AN-DRGs, public hospitals

Cost element		Cost per case by AN-DRG (\$)						
		572	780	674	727	332	335	187
Ward Medical	Direct	72	52	189	157	125	144	124
	Overhead	18	12	30	11	18	18	24
Ward Nursing	Direct	115	75	691	440	100	110	260
	Overhead	28	27	194	102	30	35	75
Pathology	Direct	14	23	17	20	28	35	20
	Overhead	3	6	6	7	8	9	7
Imaging	Direct	2	4	2	4	10	10	15
	Overhead	1	1	1	1	3	3	5
Allied Health	Direct	7	5	5	37	4	4	5
	Overhead	2	1	4	12	2	2	3
Pharmacy	Direct	44	143	23	16	33	18	39
	Overhead	6	22	6	5	6	4	8
Critical Care	Direct	4	1	1	22	2	1	21
	Overhead	2	0	1	11	1	0	8
Oper Rooms	Direct	20	12	43	21	164	134	14
	Overhead	6	5	19	10	68	58	6
Emerg Dept	Direct	1	0	3	3	7	6	61
	Overhead	0	0	3	3	3	2	26
Supplies	Direct	50	30	83	42	41	40	46
	Overhead	41	37	226	109	73	82	142
Prostheses	All	2	2	1	2	9	8	0
Depreciation	All	14	12	50	35	38	37	30
Oncosts	All	18	16	82	44	27	27	41
Other	All	28	20	113	124	38	41	46
Total	Direct	356	368	1 152	797	568	554	654
	Overhead	140	140	642	439	268	274	371
	All	496	508	1 794	1 236	836	828	1 025

Table 4: Cost weights and mean total costs per case, top 20 AN-DRGs, private hospitals

AN-DRG		Cost weight	Std error	Number of cases	Mean LOS	Cost per case (\$)		
						Direct	O'head	Total
128	Dental extract and restorations	0.35	0.02	55 461	1.02	405	311	716
335	Other colonoscopy -cc	0.39	0.03	54 938	1.21	481	317	797
332	Other gastroscopy+n-m dig dis-cc	0.41	0.04	53 993	1.20	520	329	849
99	Lens proc -vitrectomy & -cc	0.80	0.04	49 183	1.24	926	728	1 654
421	Knee procedures	0.65	0.05	46 777	1.45	768	580	1 348
674	Vaginal delivery, no complctng dx	1.00	0.09	36 707	5.34	1,257	800	2 057
572	Admit for renal dialysis	0.27	0.04	35 852	1.00	290	265	555
656	Utn,adx pr-mal a>39-cc/a<40+cc	1.32	0.08	27 192	4.64	1 555	1 157	2 713
484	Other skin, subc tis & breast pr	0.53	0.04	26 695	1.33	613	474	1 087
320	Inguinal & femoral hernia a>9	0.78	0.04	25 536	2.48	920	696	1 616
274	Circ d-ami+inv c in pr-cmpdx&-mcc	0.66	0.11	24 974	1.67	918	443	1 361
122	Tonsillectomy &/or adenoidectomy	0.38	0.05	24 429	1.32	433	354	788
367	Cholecystectomy - cde	1.31	0.07	23 643	3.37	1 503	1 193	2 695
659	Conistn, vagina, cervix & vulva pr	0.42	0.03	21 753	1.19	515	358	873
424	Lcl excs & rmvl int fx dv -hp &fmr	0.63	0.07	20 727	1.55	722	568	1 290
727	Neo, ad wt >2499g -sg op -prb	1.16	0.13	19 952	5.54	1 503	882	2 385
780	Chemotherapy	0.31	0.03	19 268	1.02	367	269	635
661	Diag curett &/or diag hysterscopy	0.39	0.03	18 891	1.03	476	335	811
124	Myringotomy + tube insertion	0.49	0.03	18 344	1.00	563	452	1 015
455	Medical back problems a<75 -cc	0.59	0.07	18 180	3.72	649	561	1 210
All DRGs		1.00		1 651 467	3.60	1 212	848	2 060

Most of the results appear to be plausible. For example, the cost relativities between related AN-DRGs were much as expected, as illustrated by the subset of obstetrics classes shown in Figure 6. There are increases in proportion to

complexity, in both the private and the public hospitals. The same pattern is present for mean length of stay (LOS) excepting that, for private hospitals, AN-DRG 677 has a shorter LOS but higher cost than AN-DRG 676. This is presumably because of the higher fixed costs in operating rooms. The statistics are reversed for the public hospitals, but the cost weights (1.04 compared with 1.54) are further apart.

Table 5: Mean component costs per case, top 7 AN-DRGs, private hospitals

Cost element		Cost per case by AN-DRG (\$)						
		128	335	332	99	421	674	572
Ward Medical	Direct	1	2	1	2	2	4	2
	Overhead	0	0	0	0	0	0	0
Ward Nursing	Direct	97	147	141	132	188	648	128
	Overhead	55	56	53	79	101	387	55
Allied Health	Direct	3	1	1	10	11	5	6
	Overhead	1	1	1	7	5	0	5
Pharmacy	Direct	7	10	14	8	16	12	10
	Overhead	2	3	6	2	3	9	4
Critical Care	Direct	1	10	9	4	5	14	42
	Overhead	1	5	5	2	2	9	28
Oper Rooms	Direct	176	155	203	421	298	20	11
	Overhead	116	92	110	262	180	12	7
Emerg Dept	Direct	7	26	22	5	20	12	0
	Overhead	3	11	10	2	7	5	0
Supplies	Direct	52	51	49	44	106	179	57
	Overhead	106	123	119	289	242	312	160
Prostheses	All	5	17	12	283	36	0	0
Depreciation	All	46	47	50	64	66	143	16
Oncosts	All	25	22	25	28	39	94	15
Other	All	11	19	19	8	19	194	8
Total	Direct	716	797	849	1 654	1 348	2 057	555
	Overhead	405	481	520	926	768	1 257	290
	All	311	317	329	728	580	800	265

Table 6: Cost weights and mean length of stay, selected obstetric AN-DRGs

AN-DRG		Private hospitals		Public hospitals	
		Cost weight	Mean LOS	Cost weight	Mean LOS
674	Vaginal delivery, no complicating diagnosis	1.00	5.34	0.79	3.29
675	Vaginal delivery, moderate complicating diagnosis	1.14	6.14	0.98	4.14
676	Vaginal delivery, severe complicating diagnosis	1.29	6.73	1.04	4.45
677	Vaginal delivery, complicating OR procedures	1.47	5.68	1.54	5.21

The opportunity was taken to check the results against those of other studies where possible. An example is presented in Figure 7, with respect to the recently released results of the National Pharmacy Bridging Project (SHPA 1998).

Table 7: Pharmacy cost per case, this study and the Bridging Project, three high-cost AN-DRGs

AN-DRG		Mean cost per case (\$)					
		Bridging Project Nov 95 – Mar 96		NHCDC, public Jul 96 – Jun 97		NHCDC, private Jul 96 – Jun 97	
		Direct	Overhead	Direct	Overhead	Direct	Overhead
780	Chemotherapy	121	7	143	22	85	11
003	Tracheostomy ... age >15	1687	216	2391	336	250	114
572	Admit for renal dialysis	20	47	44	6	10	4
Weighted mean, all AN-DRGs				92	15	27	10

There were differences of scope and definition, and there is a satisfactory degree of correlation between the Bridging Project and the public hospital results in the circumstances. However, private hospital costs are understated. The main reason is that many pharmacy costs are not recorded in the private hospital's accounts because they are financed in other ways (for example, through direct payment by a private insurer to a pharmacy service provider not part of the hospital accounting entity).

There are several areas in which data problems appear to have affected the precision of the results. In some cases, there is simply no solution at present. Most obvious, the allocation of medical costs is largely a matter of imputation

through the use of crude correlates because no data systems exist which record what doctors do.

In other cases, there is reason to believe better use could have been made of available data. The costs of critical care services seem to be of doubtful precision overall. An example is AN-DRG 674 (vaginal delivery without complications) which has a nonzero critical care cost although it is difficult to imagine cases where critical care was needed but there were no significant complications.

The prosthesis cost data are presumably inaccurate. For example, public hospitals have probably under-reported these costs and failed to attribute them correctly across AN-DRGs. Private hospital data are even more implausible. Examples are the AN-DRGs involving AICD implant, where the reported mean costs are probably underestimated by at least a factor of 2. In spite of instructions, many hospitals obviously failed to estimate costs of prostheses where they were acquired by the doctor (and consequently not recorded in the hospital's accounts).

In other areas, apparently inaccurate results are probably a consequence of underlying weaknesses in the casemix model itself. For example, operating room costs appear to be relatively precise overall, but there are problems with respect to medical AN-DRGs (such as 453, 454, and 455) where a subset (of varying size across hospitals) would appropriately receive OR services.

Another category of problems derives from variations in care settings. For example, allied health professional costs are affected by differences between hospitals in terms of the extent to which care is provided during the admission rather than on an ambulatory basis after discharge. There may also be avoidable weaknesses in the case of allied health. It is evident that the less precise unconditional service weights have been used, when there were presumably some data on actual patient contacts which would have supported the use of conditional service weights.

Discussion

For the reasons outlined above, the results need to be used with caution. However, initial checks suggest they are of greater precision overall than those from the 1992-93 study. They have the additional advantage of reflecting more recent clinical practice.

An important improvement is the more useful disaggregation of costs. For example, separate reporting of salary oncosts (which include expenses as workers' compensation, payroll tax and superannuation) allows account to be taken of

State and sector (public, private for profit, private nonprofit) differences which are significant and largely outside the control of the individual hospital.

Some methodological issues have been clarified. One is the long-time debate about the merits of cost modelling (typified by the use of service weights and low-cost software) and patient costing (typified by the use of more expensive software and local consumption data). The debate has often involved confusion over three largely unrelated issues: the software's capabilities, the use of service weights or locally generated RVU and consumption data, and the data requirements of managers.

We have demonstrated that, although the various software packages vary in many respects, they allocate costs in much the same way and their outputs are compatible. Similarly, we have shown that a mix of patient costing and service weight data can be combined. We intend to explore the extent to which differences in cost allocation methods have affected the precision of the results.

The last issue is the most difficult to address: at what level of precision should products be costed? We believe there is no single answer, and it will depend on local circumstances and intended uses. Routine costing at the individual patient level has some obvious advantages, but involves large initial and maintenance costs. We suspect that some hospitals may have overestimated the advantages if the main objective is simply to manage a hospital. For most kinds of management purposes, estimation of the average cost for a class of patients is the most sensible goal. Managers do not have the time to worry about the costs of individual patients.

We believe it is important to calculate national averages on a routine basis. One consideration is that national statistics help us to move towards equity of access to quality services, which is a key community goal. Another factor is recognition of the practical benefits: Australia is too small to allow good estimates to be made of the costs of many low-volume case types at the State level or below.

A related conclusion is that it is essential to measure costs using a national standard methodology. We need to establish a routine annual cycle of updated costs, which reflects the continual changes in hospital input prices and clinical practice. This can only be done well if a valid standard methodology is applied as soon as possible. Some of the current differences between States are justified by variations in local needs and data collection capabilities. However, it should be possible to establish national standards without prejudice to other needs.

The national cost data collection should not be an expensive task. The key is reliance on by-product data. At the level of the individual hospital, the data for

costing should largely be the by-products of care provision and routine accounting. The national collection should in turn depend on aggregating those data captured by individual hospitals. There are significant savings if the process is ongoing, in that many one-off costs are avoided. Moreover, errors will be more easily found and rectified if there is a series of annual results based on a stable (albeit progressively refined) methodology.

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