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Casemix Differences Within Cancer Diagnosis Related Groups

Terri Jackson and Andrew Street

Report of a Study Undertaken with the
Peter McCallum Cancer Institute

National Health and Medical Research Council
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Abstract

The fairness of casemix-based payment rests on the assumption that within DRG variability in patient complexity is randomly distributed across all hospitals. Specialisation and hierarchical referral patterns call this assumption into question. This study analyses patient record abstract data for 33,297 inpatient episodes of cancer care to test whether cases treated in a tertiary referral cancer hospital (the Peter McCallum Cancer Institute) showed greater within-DRG complexity than those treated elsewhere in Victoria. For the eighteen DRGs examined, the specialist cancer hospital cases were found to be significantly more complex on more than half of the complexity markers identified (137/234), while other Victorian hospitals showed greater complexity on only five. The study discusses sources and patterns of this greater case complexity for each of the 18 DRGs considered.

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Context

The treatment of cancer patients is a highly specialised and rapidly evolving field. The interface between medical research and clinical practice is particularly close, as the development of better therapies for cancer has literally life and death consequences for many patients.

Many of these therapies are very expensive, and thus attract the attention of payers and policy makers. In order to ensure that the benefits of the close linkage between research and clinical practice are available to patients in a timely way, payment policy for cancer treatments must be appropriately sensitive to differences within groups of patients, and responsive to changes in treatment protocols over time.

In July 1993, the Victorian Department of Health and Community Services (DHCS) began funding hospitals on the basis of their casemix as measured by Australian National diagnosis related groups (ANDRGs, hereinafter `DRGs'). From that date, general hospitals have been reimbursed for cancer patients on the basis of benchmark fixed and variable costs for those DRGs assigned to cancer care.

The DHCS delayed implementation of this funding system for the Peter MacCallum Cancer Institute (PMCI) until July 1994, in recognition of the specialised nature of the hospital's casemix and its role as a tertiary referral centre for the state. PMCI has historically reported higher costs per patients than other tertiary referral hospitals. In 1992-93, its cost per DRG-weighted inpatient

separation was 68% higher than the DRG-weighted cost per separation in other Group A (metropolitan teaching) hospitals (*Rainbow Hospital Indicators*, 1994).

In preparation for the transition to casemix funding in 1994, the Peter MacCallum Cancer Institute (PMCI) initiated a study with researchers from the NHMRC National Centre for Health Program Evaluation of the within-DRG casemix of cancer patients treated in Victorian hospitals.

The question investigated is fundamental to the successful use of casemix payment to increase technical efficiency in hospitals: are higher costs at PMCI attributable to endogenous or exogenous cost drivers? The terms are used to distinguish those sources of increased hospital costs which are within the control of the hospital from those which are beyond its control.

Endogenous cost drivers are those within the control of the hospital. Inefficiency in providing services is the principal cost driver which casemix funding attempts to modify. Other endogenous cost drivers are such factors as unmeasured differences in quality or outcomes of care and other functions of the hospital, such as clinical research.

Exogenous cost drivers are those which casemix systems are designed to neutralise, namely differences in the cost of care attributable to differences in the requirements of groups of patients, case complexity, and comorbidities. Demographic characteristics, in particular age, are sometimes used as surrogates for otherwise unmeasured differences in patient complexity or ill-defined comorbidity.

While it is theoretically possible to identify all exogenous cost drivers, in practice it is more difficult, for two reasons. First, the search for valid and reliable predictors of higher cost care (Iezzoni, 1994) is a continuing one, with the DRG system still amongst the best of the casemix adjustment approaches. Second, more severely-ill patients (defined as risk of death or stage of cancer) may not always be high cost. It is likely, for example, that the most severely ill cancer patients in some DRGs require only relatively low cost palliative care at a particular stage of their disease. Thus, some caution is required in inferring high treatment costs from severity of illness measures.

Casemix classifications can never eliminate all of the variation in the costs of caring for patients which exogenous factors introduce. In casemix funding, the assumption is made that exogenous factors not captured in the casemix classification itself are randomly distributed across all hospitals. Thus, every hospital is assumed to get a `fair' share of more complex, high cost patients within each DRG that it treats.

In hospital `systems,' that is, groups of hospitals subject to some degree of planning of service developments, efforts to rationalise high cost equipment or the care of high risk patients will work counter to the assumption that costly patients are randomly distributed across hospitals. This is particularly true for cancer treatment in Victoria.

Delineation of hospital roles serves two related purposes. The first is to facilitate development of clinical specialisation in institutions which are equipped to support the particular specialty. The second is to discourage proliferation of technologies and procedures to hospitals without appropriate supporting services, or to those which are unlikely to generate sufficient volume to maintain quality of care or justify the cost of development (Duckett, 1991).

The 1985 Report of the Ministerial Committee to Review Cancer Services (Lovell, 1985) recommended creation of a hierarchy of cancer treatment centres in Victoria, with designation of `principal' radiotherapy centres such as PMCI, alongside `associated' radiotherapy centres, which were envisaged as working closely with the principal centres (Lovell, pp 36-37). For chemotherapy, a less hierarchical approach was adopted, which nonetheless recommended that `designated medical oncology units' and peripheral `affiliated' units having a `formal association' with designated units, provide medical oncology services across the state (Lovell, pp 92-97). Both recommendations were based on minimum patient caseloads, and reflected a longstanding hierarchical pattern of hospital organisation which included community hospitals, district or base hospitals, and major teaching hospitals.

Even in countries with more market-determined patterns of service development, such as the United States, there is a considerable degree of specialisation in cancer care. The literature review, below, demonstrates recognition in that country of the ways in which specialisation may bias against fair payment under a casemix-based funding system.

Brief Overview of Findings

The challenge for this study was to examine existing data to find markers or indicators of the extent to which the caseload of PMCI might be affected by systematic referral of more seriously-ill or more costly patients to the hospital. Data was collected on all separations for the 30 top volume cancer-related DRGs at PMCI over a five-month period (July to November 1993). These are compared with separations in these DRGs from all other Victorian hospitals over the same period, extracted by DHCS from the Victorian minimum data set.

In total, 34,855 inpatient separations were analysed in these 30 cancer DRGs. However, in 12 of these, PMCI had fewer than ten separations during the five month study period. Comparative data for these DRGs was presented in an Interim Report to the hospital, and the analysis reported here is restricted to the remaining 18 DRGs in which more than ten separations were recorded at PMCI. This reduced the total number of separations analysed to 33,297, of which 3,167 (9.5%) were treated at PMCI.

Analysis was undertaken of demographic and clinical characteristics of patients treated at PMCI and elsewhere. While most demographic complexity indicators did not show PMCI patients to be significantly different from other Victorian cancer patients, clinical characteristics available from the VIMD revealed a clear pattern of higher complexity at PMCI in a subset of DRGs.

Patients at PMCI were significantly older than those treated elsewhere in a number of DRGs, and spent longer in hospital, on average. Length of stay and age, however, were rarely correlated. In general, PMCI saw a higher proportion of currently married patients than did other hospitals, casting doubt on the hypothesis that length of stay differences are attributable to absence of family support for PMCI patients. These findings were against expectations.

PMCI had a consistently lower number of deaths in hospital than other hospitals, and makes greater than average use of domiciliary support for patients discharged home. It was not evident that PMCI attracted a significantly higher proportion of non-metropolitan patients, although data limitations made measurement of referral from non-metropolitan areas somewhat unreliable.

In contrast to demographic and service markers, patients at PMCI were found to show a consistent pattern of greater numbers of recorded diagnosis and procedure codes than for patients elsewhere, with the differences significant for most DRGs. More importantly, in addition to the primary cancer diagnosis, PMCI patients have more other cancers, both primary and secondary sites, than cancer patients in other Victorian hospitals. For some DRGs, PMCI patients also had a higher number of other complicating conditions. Overall, the number of diagnoses under active treatment in the episode, and the number of complications (both cancers and other conditions) was significantly higher for most of the DRGs studied.

Table 1 summarises these measures at PMCI, and Table 2 provides a contrast with the same complexity markers at other Victorian hospitals.

No direct comparisons of cost per DRG were undertaken. In part, this was because comparable data was not available for the hospitals under examination, but it is also the case that cost data

conflates endogenous and exogenous factors. Future research might focus on examining costs of care for subgroups of patients identified in this study (those with multiple cancers, for example) which distinguished PMCI's caseload from that of other hospitals. Cost differences associated with this subgroup of patients within particular DRGs would lend support to the hypotheses explored here solely with the use of medical record coding.

Literature Review

Relatively little research has been undertaken on the suitability of DRG classifications as a basis for funding specialist cancer hospitals. In the United States, which has employed casemix funding for Medicare patients since 1983, `comprehensive cancer centres and clinical cancer research centres' have been excluded from the `prospective payment system' (PPS) used to fund other hospitals. Those hospitals which are recognised by the National Cancer Institute, and which have at least 80% of total discharges in DRGs with cancer as a principal diagnosis, are reimbursed the `reasonable costs' of patient care. Reimbursement does not extend to research costs, clinical trials or experimental treatments.

In explaining the rationale for this exemption, a recent Congressional report noted:

`Cancer hospitals are excluded from PPS because they specialize in treating relatively costly cancer patients. This prevents them from offsetting the costs of more expensive cases within a DRG with lower-cost cases. Nor can they use revenue from some DRGs to offset losses in others. Designated cancer subunits within PPS hospitals are not exempt from PPS because the hospital can offset higher costs within the cancer subunit with revenues from its other clinical services' (ProPAC, 1993, p 85).

This highlights two sources of potential distortion in payment for inpatient cancer care. The first is the systematic referral of more serious (and more costly) cases to specialist centres; the second is the `mixed' DRG.

In 1989, Langenbrunner, *et al.* reviewed payment refinements for excluded units under U.S. prospective payment. Although specialist cancer hospitals were not considered, the review identified patterns of patient referral as a key problem for excluded hospitals. This has particular relevance for cancer hospitals, where referral of patients may result in systematic variation in patient severity and/or cost.

`Excluded hospitals and units cannot be viewed in isolation, but rather as part of highly differentiated care systems. Patients with greater-than-average treatment needs are more often than not systematically transferred or referred to a few specialized facilities' (p 97).

Such `systematic risk' of higher cost cases is distinguished from the more general unsystematic risk of variations of patient costs around the average payment amount, which all hospitals face. Langenbrunner and his colleagues argue that using an average cost payment where systematic risk is known to exist is likely to result in the `...[destruction] of an efficient differentiated care system' (p 98).

Franklin (1993), dealing specifically with radiation oncology services, argues persuasively for regionalisation of such specialist services in the Australian context, that is, maintaining a highly differentiated system through concentrating specialist resources at a few sites rather than spread across all hospitals.

Schoenman, *et al* (1991), in reviewing research relating to excluded units, identified another source of systematic variation or risk in patient costs related to cancer care. This is the fact that many DRGs, while not specific to the treatment of cancer, include cancer patients (*e.g.,* AN-DRG 646, *D&C, conization, vagina, cervix & vulva procedures*). These are referred to as `mixed' DRGs.

Hilsenbeck and colleagues (1987) studied the resource use in a single hospital of both cancer and non-cancer patients in 35 mixed DRGs. Using estimated cost per case, they found that cancer patients consumed more resources than non-cancer patients within the same DRG for all but 3 of the DRGs studied. Tumour registry data on the stage of disease allowed these investigators to test resource use related to disease stage, and they found that increased costs were associated with more advanced disease stages.

Recent analysis undertaken by the Australian Clinical Casemix Committee (ACCC) has confirmed Hilsenbeck's finding on resource-use in mixed DRGs using Australian data on average length of stay. Twelve mixed DRGs were identified with sub-samples of at least 200 cases in a 1990-91 national data base. Each of the 12 showed at least a 2 day longer ALOS in cancer patients compared with non-cancer patients. This work has led to an ACCC recommendation that complication and comorbidity lists for 15 surgical DRGs be amended to include a principal diagnosis of malignant neoplasm. It was also recommended that malignancy be added to the `complicating clinical factors' lists for a number of other DRGs (p B-2).

In an attempt to develop more accurate classification variables for cancer patients, Iezzoni *et al.* (1991) devised a purpose of admission typology (POA), using a 20% sample of U.S. Medicare data for lung, colon and breast cancer. The study used information standardly available for Medicare patients (specifically, 5 diagnosis and 5 procedure fields) to differentiate patients into six broad POA groups. The groups were 1) major surgery with diagnostic evaluation, 2) major surgery alone, 3) active medical treatment with diagnostic evaluation, 4) active medical treatment alone, 5) diagnostic evaluation alone, and a residual category 6) palliation, assigned when none of the other treatment patterns was identified in the case.

While average hospital charges varied significantly across the six groups, they were not found to be better at predicting charges than DRGs used alone. The authors conclude that `POA categories should not replace DRGs as a method for paying hospitals for inpatient cancer care' (p 37), but are potentially useful adjusters for explaining in-hospital mortality, and other hospital outcome measures.

The authors stress that systematic referral patterns would distort payment incentives in an averaged DRG payment system. In particular, they found high proportions of relatively low cost palliation undertaken in smaller hospitals, but a high proportion of the more costly major surgery and diagnostic evaluation concentrated in more specialised hospitals.

Finally, Lion and colleagues (1987) examined cost differences for chemotherapy in inpatient and outpatient settings, finding inpatient costs four to five times higher than outpatient treatment for the three high patient-volume cancers treated in both settings. While the cost difference was not surprising, they also found that cancer sites treated in the two settings were very different. Clinical reasons why particular cancers are most often treated in one or the other setting are discussed, and the authors conclude that `there is little substitution between inpatient and outpatient chemotherapy treatments for common cancers.'

Lion *et al.* also tested whether the recorded presence of metastases could serve as a discriminator of more costly patients, allowing the splitting of cancer DRGs on this basis. While first-recorded cancer site was such a discriminator, the presence of metastases was found to add less than 1 percent of explained variance once diagnosis was taken into account. The authors cautioned, however, that metastases might have more explanatory power in less heterogeneous DRGs.

In summary, the research evidence, though limited, has highlighted a number of problems related to prospective payment of specialist cancer facilities and within-DRG casemix differences. These hospitals are likely to treat a more limited range of patient types (*i.e.* DRGs) than general hospitals,

and thus to have fewer opportunities for cross subsidy by other product lines. To the extent that patient referral patterns result in more costly cases being concentrated in specialist hospitals, an averaged payment based on the mix of patients ordinarily found in non-specialist facilities may underfund cases treated in a specialist facility.

Cancer patients within mixed DRGs (those grouping both cancer and non-cancer patients) have been found to require more resources for their care. Hospitals which attract more *cancer* patients in mixed DRGs (such as specialist cancer hospitals) are more likely to suffer financial losses on these DRGs.

Finally, chemotherapy patients requiring inpatient care have been found to differ from those who can be treated on an day patient basis. The mix of cancers treated by chemotherapy in a specialist Cancer Hospital is more likely to be weighted toward `inpatient' cancers, with attendant higher costs. Systems which have attempted to identify more resource-intensive patients within DRGs (cancer staging, POA or presence of metastases), either impose large data collection burdens or have not been more successful than DRGs themselves in explaining cost variation.

Secondary Analysis of Data

This study relies on secondary analysis of data (reanalysis of data originally collected for another purpose). Information on cancer patients for this study derives from data required by and routinely filed with DHCS for administrative and financial accountability. Use of such data has many advantages including its availability on a timely basis, its much lower cost than direct collection, and its use of standardised definitions and coding protocols. As a way of targeting further research in areas which will repay the cost of direct collection, secondary analysis is particularly powerful.

The use of such data to understand case complexity, however, is subject to a number of limitations. In brief, these are that coding completeness may vary between hospitals, that some apparent differences may simply reflect different coding conventions from one hospital to another, and that aggregation up to ICD-9-CM codes may obscure greater clinical variability which might be apparent from direct review of case notes.

The present study was conducted to ascertain whether patients within DRGs were more resource intensive at PMCI than elsewhere. On the face of it, the more coded diagnoses found on a medical record abstract, the more seriously ill the patient is likely to have been. Similarly, the

presence or absence of particular procedure codes for complex or expensive procedures should also be indicative of medical complexity and resource use. However, the degree of thoroughness in coding varies between hospitals, and thus, conclusions which rely on the presence or absence of particular codes must assume equivalent levels of coding completeness between hospitals being compared. Reid (1991), in a study of NSW medical record abstraction, found considerable difference between coding practice (at the level of the individual coder) and coding policy, as embodied in official guidelines.

A simple count of diagnoses is also inadequate because diagnosis fields on the medical record abstract are used for a number of recording tasks. With cancer diagnoses, for example, each neoplasm is accorded an additional field for recording of the morphology of that neoplasm, thus generating two `diagnoses' for each condition. For chemotherapy and radiation therapy a third (`V') code is added to this pair to indicate when these particular therapeutic interventions have been used.

Isolation of morphology codes, and separate analysis of cancer and non-cancer-related secondary diagnoses have been employed in this report to take account of these coding conventions.

In this study, the presence or absence of particular codes can only be suggestive of greater case complexity within DRGs for a number of reasons. PMCI has a high rate of coding, with 4.95 diagnosis fields used per separation, in contrast to only 2.88 per record in other hospitals. A major threat to the validity of this data is the degree to which PMCI's level of recording reflects genuine patient complexity, or simply more thorough coding.

Three factors persuade us that PMCI's coding reflects real differences in case complexity. The first is that there are no obvious incentives on PMCI to over-code: for the period of the study, its funding did not rely on medical record coding in any way. The second is that only a few sets of cancer DRGs (*e.g.* 566/7, 770/1/2, 776/7/8, and 783/84) are assigned on the basis of coded secondary diagnoses. That is, the presence of particular complication codes would assign the case to a higher-weighted DRG; in other DRGs additional codes would have no effect on DRG assignment.

Finally, to the extent that there are funding-related incentives to code more thoroughly, such incentives would affect coding in the other Victorian acute care hospitals, which since July 1993 have had their funding determined on the basis of medical record coding and DRG assignment. Over the time period represented by this data, other Victorian hospitals had a financial incentive to ensure complete and accurate coding which PMCI did not have. In time, these incentives will work

toward a uniform standard of accuracy and completeness of record abstracts across all hospitals, but for the data used in this study, there are good grounds for believing that coding levels are equivalent between the two groups, and any differences are attributable to genuine differences in patient complexity.

Study Design

In the 18 DRGs selected for the final analysis, there were 33,297 separations, 3,167 (9.5%) of them treated at PMCI in the four month period 1 July to 30 November 1993. A separation is defined as a single patient admission and discharge. Therefore, patients admitted but not discharged during the study period are not included. On the other hand, patients admitted before the study period are included if they were discharged between the relevant dates. A patient may have more than one separation within and across DRGs during the period under consideration.

Each of the eighteen DRGs have been examined to ascertain whether separations at PMCI are more complex, and inferentially, more resource-intensive, than those treated elsewhere. No single indicator of case complexity is available, but a consistent pattern of proxy measures is taken to indicate greater complexity. The following discussion describes the casemix at PMCI and other Victorian hospitals in relation to a variety of patient characteristics which have been hypothesised to be related to case complexity. Tables accompanying each section of the discussion present information for each of the DRGs considered.

Patient separations are assigned a variety of types of ICD-9-CM codes, with up to 12 diagnostic codes recorded for each case. The complex matrix formed by diagnosis fields and their different uses (recording of diagnoses, descriptive morphology codes and prefixes which distinguish primary conditions from complications, *sequelae*, etc.) was approached in a number of stages.

First, morphology codes in each field (DIAG1 through DIAG12) were identified and grouped for later internal analysis by PMCI (Appendix 4). Next, diagnoses were analysed in two ways: first on the basis of prefix and second on the basis of the ICD-9-CM diagnosis code itself.

While descriptive prefixes were uniformly coded for separations at both PMCI and the other hospitals, information in these prefixes is understood to be unreliable, and DH&CS coding guidelines (1992) caution that `prefixes should be interpreted with caution, if used at all' (p 79).

The original intent of the prefix system was to distinguish primary conditions (which required active treatment in the episode), from diagnoses associated with a primary condition, and these from other diagnoses which arose as complications during treatment of primary conditions. There is little consistency in how coders make the distinction between primary and associated conditions, and this distinction in particular is known to be unreliable. Identifying complications, however, requires somewhat less judgment, and thus, may shed some additional light on secondary diagnoses in a treatment episode.

The strategy employed for this study was to group together primary and associated diagnoses, on the assumption that together they reflect exogenous factors which affect clinical practice. Codes with a prefix denoting treatment complications are separately analysed. For most DRGs, it is the combined effect of all three of these code-types (net of morphology codes) which is taken as an indicator of case complexity. For a few DRGs, however, (especially 129, 650 and 774), where PMCI did not have a significantly greater number of diagnosis codes in total, a higher proportion of cases with complications and/or a significantly greater number of complication codes, provide additional evidence of complexity.
Finally, the principal diagnosis (DIAG1) on which DRG assignment is determined was separately identified, and diagnosis fields 2 through 12 analysed for more specific diagnostic content of conditions not directly related to the DRG. ICD-9-CM codes in these fields were summarised to quite specific cancer groups (see Appendix 2), or where the diagnosis was not in the neoplasm range of ICD-9, to broader body system groups (see Appendix 1). Thus, secondary diagnoses can be separated into cancer/non-cancer, and to one further level of detail within each of these groups. Throughout the Report, `secondary diagnoses' should not be confused with diagnoses of `secondary' cancers; a secondary diagnosis is simply any diagnosis code other than the principal diagnosis, and may refer to cancer or to any other disorder.

Demographic Indicators

Tables 3 through 7 present data on demographic case complexity factors and Tables 8 through 12 summarise coded clinical indicators. Data on separations are presented for each DRG showing the numbers treated at PMCI and other Victorian hospitals, as well as the proportion treated at PMCI. The numbers and proportions treated at PMCI vary considerably by DRG. Across the State 10,470 cases of chemotherapy (DRG 780) were recorded, PMCI accounting for 1,690 (16%) of the total, making it the cancer DRG with the greatest number of separations at PMCI and in Victoria. PMCI dominates in the provision of radiotherapy (DRG 779), with 92% of the 585 Victorian separations undertaken at PMCI.

Age

Although patient age is an important determinant of the costs of inpatient care for many DRGs, the current version of ANDRGs does not use age as a splitting variable to identify higher cost/higher intensity admissions. These costs are partially accounted for by the identification of complications and comorbidities, more frequent in older patients. For ANDRG Version 3, which is currently under development, it is proposed that patient age be included in a cluster of `complicating clinical factors' any one of which will assign cases to a more complex DRG.

Payment policy rests on the fact that these cases are proportionally represented in the calculation of cost weights, and on the assumption that more costly cases are randomly scattered across hospitals, with each hospital bearing an average share of such separations.

Table 3 presents data comparing PMCI and other Victorian public hospitals in terms of patient age, testing whether the PMCI caseload is older than that in other Victorian hospitals. Means, standard deviations, significance levels for t-tests, and medians are reported. Mean and median ages are similar for each DRG and hospital group, suggesting a relatively normal distribution of the data.

PMCI patients were *significantly older* than those seen at other hospitals in seven of the DRGs (DRGs 481, 483, 484, 499, 646, 753 and 778). There was *no significant difference* in the mean age between PMCI and other patients for ten DRGs, including chemotherapy and radiotherapy. PMCI treated a significantly younger group of patients in DRG 320 with a mean difference in age of six years.

Length of Stay

It was hypothesised that patients with more serious illness will require a longer period in hospital than those less ill. If PMCI treats more seriously ill patients than other Victorian hospitals this should be reflected in differences in length of stay. This relationship is confounded, however, by variations between hospitals, and even between individual clinicians in judgments about the appropriate length of stay for particular patients and conditions. For this reason, average length of stay (ALOS) can only be considered a marker of case complexity; better measures of complexity would be needed to distinguish the *clinical* from the *clinical practice* determinants of ALOS.

Table 4 provides information on the length of stay at PMCI and other Victorian hospitals for the 18 DRGs analysed. The mean length of stay was longer than the median length of stay for all DRGs, reflecting the positive skew of the distribution. The highest mean length of stay at PMCI was for radiotherapy (12.2 days, ± 10.2). The mean length of stay was 7.9 days (± 9) for this DRG in other Victorian hospitals, the difference being significant. On average, patients also spent significantly longer at PMCI than at other hospitals in DRG 483 (mean difference = 1.4 days), DRG 484 (0.9 days), DRG 646 (2.7 days), DRG 778 (5.6 days) and DRG 780 (0.5 days).

These findings are consistent with the fact that overall casemix adjusted ALOS for PMCI patients is 13% greater than adjusted ALOS in other Group A hospitals (Rainbow Hospital Indicators, 1994).

Correlations Between Age and Length of Stay

One important way in which patient age increases the cost of hospital care is in the longer stay which older people may require. Increased co-morbidity, longer recovery times and more complex arrangements for discharge are all considered to contribute to increased length of stay and increased costs of care for older patients.

Table 5 presents correlation coefficients and significance levels for age and length of stay, after exclusion of day-case patients (which are analysed in the following section). Only significant findings are reported ($p<0.01$). The hypothesis tested is that a linear relationship exists between the two variables on the basis that older people in general require more care. The strength of any observed association is measured using the Pearson correlation coefficient (r), with values close to +1 and -1 indicating a strong positive and negative relationship respectively, and values of zero indicating no linear relationship. Thus, if older people are in hospital for longer than younger people, r will be positive.

Age and length of stay were positively correlated in other Victorian public hospitals for DRGs 320, 373, 481, 484, 487, 499, 646 and 753. Only for DRG 779 (Radiotherapy) were age and length of stay correlated for PMCI separations.

Day Case Admissions

It was hypothesised that one indicator of a more complex patient mix would be a lower proportion of one day admissions, as more seriously-ill patients would require treatments not possible on a day-only basis. For all but one DRG, the proportion of day-only cases at PMCI was equivalent to or less than that for other hospitals. In DRGs 170, 481, 483, 484, 499, 646, 774, 778, 779 and 780, PMCI was found to have a significantly smaller proportion of day-only patients using Pearson's $?^2$ to test for statistical significance. Fisher's exact test was computed when tables contain cells with an expected frequency of less than five cases, and significance levels for this test are reported for DRGs 487 and 650.

In a number of DRGs the difference in the proportion of day-only cases between PMCI and other Victorian hospitals was marked. In particular, 93.8% of separations in DRG 646 in other Victorian hospitals were treated on a day cases basis, compared to only 5.9% of those at PMCI. Large differences were also apparent for DRGs 481, 483 and 778, in which under 10% of PMCI separations were day case patients, compared to approximately 50% for other Victorian hospitals.

As was the case for length of stay comparisons, however, it is difficult to distinguish clinical from clinical practice reasons for these differences with the data available to this study.

Leave Days

Patients requireing extended inpatient care can be temporarily discharged home (or to their normal accommodation) and then readmitted to continue treatment. In Victoria, if this interval does not exceed seven days, the patient is considered a continuing patient of the hospital, and length of stay (and DRG assignment) calculated on the basis of the entire episode, minus any `leave days' which may have intervened.

Twelve of the eighteen DRGs studied were found to have significantly more leave days recorded at PMCI than for other hospitals treating cancer patients. No DRG showed a higher count of leave days in the other hospitals. This difference could be interpreted in a number of ways, and further research on questions of measurement and resource use is required.

In five of the DRGs for which PMCI has more leave days (DRGs 483, 646, 778-780), patients' average length of stay is also longer than that for patients treated elsewhere, and there are also fewer day-only admissions. This combination of factors may indicate that as a group, patients are

more seriously ill (and cannot be treated as day cases), but can be returned home for brief periods in otherwise longer inpatient stays. Interpreted in this way, PMCI patients are `sicker' and thus, probably more resource intensive than other patients.

A second interpretation, however, is that different treatment protocols have been developed in different hospitals. On this explanation, it may be that PMCI patients stay longer in a single episode with more frequent short breaks, while patients treated elsewhere (of presumed equal complexity) have inpatient episodes planned around longer `breaks' from hospital (>7 days), with these cases then recorded as discrete admissions and discharges for each hospitalisation.

Finally, the finding that PMCI patients are discharged to leave more often than other patients may relate to differences in recording practice between PMCI and other hospitals. Particularly with the introduction of casemix funding in July, 1993, the incentive for other hospitals would be to abandon the convention of recording leave days in a continuing admission. This would result in two distinct separations (and two DRG-based payments) for these patients. Changes to care protocols (above) in addition to different recording practice may have developed in response to casemix funding in other hospitals.

Data on planned readmission of patients within 30 days of discharge is now routinely collected by DH&CS, but was not sought for this study. Examination of this data would clarify whether extended care episodes in other hospitals (*i.e.,* a series of planned readmissions) are similar to PMCI episodes, with only differences in recording of leave days, or whether underlying differences in patient complexity result in fundamentally different patterns of care.

Martial Status

Patients with fewer home supports may be hypothesised to require longer hospital stays. This would reflect both those patients for whom complex discharge arrangements (*e.g.,* hospice or nursing home care) are required, as well as those patients who are nursed to the point of self-care when earlier discharge home would have been possible with better family support. No good measure of home support is available, but as a proxy, the marital status of patients was analysed on the assumption that patients who are married or in a de facto relationship have greater home support than single or previously-married patients. A finding that PMCI had a lower proportion of currently married patients would lend support to the hypothesis that PMCI patients have above-average care requirements.

Table 6 shows the marital status of patients at PMCI and other Victorian hospitals. Only DRG 320 (Digestive malignancies) had a higher proportion of single or previously-married patients at PMCI than at other hospitals. In this DRG, 57.9% of PMCI patients were previously married compared to 27.5% elsewhere, a difference of 30.4%. For many DRGs, contrary to the hypothesis, PMCI had a greater proportion of married patients, with the difference in proportions exceeding 15% in seven DRGs (DRGs 373, 429, 481, 483, 499, 753 and 778).

Although the probability levels following $?^2$ tests are reported, these should be interpreted with caution because for many DRGs there were fewer than five expected cases in cells. This was mainly because only a small number of patients were recorded with marital status as `unknown'.

Residence

Patients travelling from country and regional centres to Melbourne for treatment at PMCI would be an indicator of two aspects of a more complex caseload at PMCI. The first relates to PMCI's status as a tertiary referral centre: a higher proportion of non-metropolitan patients would document the hierarchical referral pattern from other Victorian hospitals for specialised cancer care. The second relates to patient-stay characteristics. Longer ALOS and smaller proportion of same day treatments at PMCI may be attributable to the longer distances which patients are required to travel for treatment or between treatments.

Table 7 presents data on patient residence and discharge status. Patients were classified as resident in metropolitan Melbourne on the basis of postcode information and the analysis was conducted to establish whether PMCI had a wider catchment area than other Victorian hospitals. To conduct meaningful comparison it is necessary to exclude non-metropolitan hospitals from the analysis, because such hospitals are likely to attract fewer metropolitan patients solely on the basis of their location.

Unfortunately, individual hospital identifiers were unavailable for reasons of confidentiality of patient data. As an alternative, the proportion of metropolitan patients are presented for hospitals classified in Group A by the Victorian Department of Health and Community Services. This classification comprises major teaching or specialist hospitals, all with the exception of Geelong, in the Melbourne metropolitan area. Geelong is likely to attract a greater proportion of non-metropolitan patients because of its location but, in the absence of hospital markers, could not be removed from the analysis. This will tend to underestimate differences between PMCI and

comparable hospitals, as the `Group A' proportions of non-metropolitan patients are inflated by Geelong cases.

Compared to Group A hospitals, PMCI had a higher proportion of cases from outside Melbourne for three DRGs (DRGs 487, 646 and 650), supporting the hypothesis that PMCI has a wider than average catchment area for these DRGs, with 50% of PMCI caseload coming from non-metropolitan Melbourne postcodes. PMCI had a higher proportion of referred cases for these DRGs even when compared to all other Victorian hospitals. However, it does not appear from this analysis that PMCI has a significantly larger catchment area for the other DRGs.

The proportion of *metropolitan* patients treated at PMCI is higher than it is for Group A hospitals for seven DRGs (DRGs 30, 320, 373, 483, 774, 778 and 779). Notably, 67.4% of PMCI patients having radiotherapy (DRG 779) are from the metropolitan area, compared to 32.4% for Group A hospitals. This reflects the fact that the state's only other radiotherapy facility is based at Geelong Hospital, which is outside the Melbourne metropolitan area, thus confounding measurement of travel outside the metro area.

Discharge Status

Data on patient discharge status provides information on two additional aspects of patient care requirements. Death in hospital is one of the discharge codes, and while potentially confounded by discharge policy, availability of hospice or palliative care services and clinical practice factors, may provide an indicator of the seriousness of patient illness. Additional information is available from discharge status records about care requirements post-discharge, with patients requireing nursing home admission or home nursing presumed to be more seriously ill than those discharged home with no professional supports.

Table 7 summarises by DRG the discharge status of PMCI patients and those in other Victorian hospitals. The Victorian Department of Health and Community Services has ten codes for discharge status, but only the most common are presented here. The table reports discharges home, home with domiciliary care, to nursing homes, to major specialist or teaching hospitals, to other hospitals, those who died, and other discharges.

PMCI has a consistently lower number of deaths in hospital as a proportion of total separations than do other hospitals, except for DRGs 751 and 779. The difference is marked for DRG 170, where 5% of separations ended in death at PMCI compared to 25% at other hospitals, and DRG

320 with figures of 5% and 17% respectively. However, all figures on deaths should be interpreted with caution. It is possible that the reason for the differences lies in the discharge policies of the various hospitals. PMCI is more likely to organise domiciliary care for patients discharged home than are other hospitals (only for DRG 650 is the proportion of patients discharged home with domiciliary care lower at PMCI).

The greater use of domiciliary care may reflect PMCI policy to discharge patients who are dying to more appropriate settings. Correspondingly, a patient is less likely to be discharged home without domiciliary support at PMCI than at other hospitals, particularly for DRGs 30, 429, 481, 487, 646, 753, 774 and 779. Whilst PMCI patients within these DRGs may be more seriously ill than those at other hospitals, it may also be the case that the existence of the PMCI home nursing service, as well as greater attention to development of networks of care providers outside hospital, may increase use of home nursing. Discharges to nursing homes, teaching hospitals, and other hospitals are not common, and rates at PMCI are similar to those at other Victorian hospitals.

These differences are not as striking when comparing the discharge status of patients from PMCI with that for Group A hospitals. The proportion of deaths at Group A hospitals is generally comparable with PMCI. Discharges home with domiciliary care tend to account for a higher proportion of total discharges at Group A hospitals than at all Victorian hospitals (in which Group A hospitals are included), but are not as high a proportion as at PMCI, except for DRGs 129 and 650. The difference in the proportion of discharges with domiciliary care is reflected in the generally higher proportion of patients discharged home without domiciliary support from Group A hospitals than at PMCI. In general, discharges home without support are also a higher proportion of discharges at Group A hospitals than at all Victorian hospitals.

In conclusion hypotheses about demographic complexity were largely not supported. Indicators of home support (marital status and discharge status) showed no significant disadvantage for PMCI patients. A wider catchment at PMCI (patient referred from more distant locations) was not apparent, although data limitations do not allow firm conclusions to be drawn. However, PMCI patients were significantly older for 7 of the 18 DRGs examined, and a significant lower proportion of PMCI separations were treated as day-cases (11 of 18 DRGs) than in other hospitals.

Case Complexity Indicators

Counts of Diagnosis and Procedure Codes

Table 8 presents data on the average number of diagnosis and procedure codes recorded per separation. Up to twelve diagnosis and procedure codes may be entered per record. The information contained in Table 8 is based on a count of the number of fields filled per record once morphology codes were removed from analysis. Thus, for example, patients with nervous system neoplasms (DRG 30) at PMCI had an average of 6.4 coded diagnoses and 2 coded procedures, not including morphology codes.

In all eighteen DRGs, more diagnoses were coded at PMCI than elsewhere, and in 17 of the 18, the difference was significant (DRGs 30, 320, 373, 429, 481, 483, 484, 487, 499, 646, 753, 778, 779, 780 and 170).

A similar picture emerges from the comparison of procedure codes, with greater numbers coded for PMCI in general. There were three exceptions to this, with more procedures coded in other Victorian hospitals than at PMCI for DRGs 373, 646 and 780. Of these, only for DRG 780 was the difference significant ($p<0.001$). In contrast, PMCI patients had significantly more procedure codes in eleven DRGs (DRGs 30, 170, 320, 429, 481, 483, 484, 650, 774, 778 and 779).

For both diagnosis and procedure codes the standard deviations were less than mean values for most DRGs, suggesting that the distribution of the number of codes per record was not widely spread. Median values were generally similar or slightly less than mean values, respectively reflecting either a normal or a slight positive skew to the distributions.

As noted in the discussion of secondary analysis of data, diagnosis fields are used for a range of purposes including recording the morphology of cancers, visit codes, injury codes, *etc*., and thus simple counts are a weak indicator of increased case complexity. Stronger evidence of increased complexity is found in Tables 9 to 12 which provide more detailed analysis of the diagnosis codes recorded at PMCI and elsewhere. Table 9 presents data on those diagnoses recorded as either `primary' or `associated' conditions, Table 10 reports diagnoses coded as `complications', Table 11 shows the recording of additional primary and secondary cancers, and Table 12 presents information on other, non-cancer complicating diagnoses.

Diagnoses Coded as Primary and Associated Conditions

Primary and associated diagnoses are defined as conditions which either require active treatment during the inpatient episode or affected treatment decisions. Because incidental clinical observations are excluded from these fields, a difference in the average number of these diagnoses per patient at PMCI would be a fairly strong indicator that patients were more seriously ill. Although coded separately, `primary' and `associated' code prefixes have been combined here because the distinction between them is considered to be unreliable and designation as one or the other varies from hospital to hospital. The distinction between these and complications is relatively more clearcut. Table 9 presents counts of the number of primary and associated conditions recorded per separation at PMCI and at other Victorian hospitals for each of the DRGs analysed.

The hypothesis of increased PMCI complexity is supported for ten of the eighteen DRGs examined: 30, 373, 429, 484, 487, 499, 753, 778, 779 and 780. In these there were significantly more primary and associated codes recorded at PMCI than elsewhere. The reverse is the case for DRG 646. In the remaining seven DRGs there were no significant differences in the use of such codes.

Diagnoses Coded as Complications

Table 10 presents data on the diagnoses coded as complications at PMCI and other Victorian hospitals. It is to be expected that patients suffering complications during their admission will be more resource intensive than are patients without, and it is hypothesised that PMCI treats a higher proportion of patients with complications than do other hospitals.

In general, this hypothesis is supported by the data provided in Table 10. The information is presented in two ways. First, details of the number and proportion of separations suffering complications are reported, together with *p* values for $?^2$ or Fisher's Exact test. PMCI treats a greater proportion of separations with complications in all DRGs considered. For example, 99.4% of those in DRG 779 (Radiotherapy) were coded as having at least one complication at PMCI compared to 64.4% of those treated elsewhere. In fifteen of the eighteen DRGs, the differences in the proportion of separations with complications treated at PMCI and other Victorian hospitals were significant.

Second, the mean number of complications recorded per separation is reported for each DRG, together with significance levels for t-tests comparing PMCI and other hospitals. The mean number of complications per separation was significantly greater at PMCI than elsewhere in 12 of the 18 DRGs. For example, for patients in DRG 646 (D&C, conization, vagina, cervix and vulva procedures), an average of 0.66 complication codes were recorded per separation at PMCI compared to only 0.02 recorded elsewhere, reflecting in part, the proportion of PMCI patients with any complication reported.

Other Primary and Secondary Cancers

Table 11 presents data on the diagnoses coded as other primary and secondary cancers. The information was aggregated from specific ICD-9-CM codes as detailed in Appendix 2.

One indicator of severity or complexity of illness in cancer patients is the extent of the cancer, that is, additional primary tumours, or secondary cancers which have arisen from a primary site. Patients with multiple cancer sites are likely to be more resource-intensive to treat because of the more advanced state of their disease.

It is hypothesised that, as a specialist cancer hospital, PMCI will treat a greater proportion of patients with primary and secondary cancers recorded in addition to their principal diagnosis than do other hospitals. In 16 of the 18 DRGs analysed, PMCI treated a significantly greater proportion of separations with multiple neoplasms than did other Victorian hospitals. This finding is mirrored by the data showing that PMCI separations had more cancer diagnoses per record than did separations elsewhere.

Other Non-Cancer Comorbidities

Table 12 presents data on other complicating diagnoses recorded after the principal diagnosis. The ICD-9-CM codes which have been grouped to form these diagnoses are presented in Appendix 1. As with the previous tables, data are presented first showing the number and the proportion of separations with these codes, and second as the mean number of codes recorded per separation.

Comorbidity diagnoses in the neoplasm range of ICD-9-CM are summarised in Table 11; Table 12 presents information on those comorbid conditions involving other body systems. By summarising

to chapters or body systems, a better overview of the sorts of primary, associated and complicating conditions in the episode is possible than analysis of individual codes. Patterns of cancer and non-cancer secondary diagnoses are noted in the discussion of each DRG in the section which follows. Counts of these additional non-cancer diagnoses, and the proportion of patients with any complicating diagnosis are better indicators of general health prior to the cancer diagnosis, although in many cases these will be related.

For some DRGs, case complexity is apparent from a larger number of cancer diagnoses alone; for some, complexity is marked by a larger number of other body system diagnoses, and for many DRGs, both sorts of secondary diagnoses combine.

DRG by DRG Analysis

30 Nervous System Neoplasms

PMCI treated nearly 10% of the state's patients in this DRG (35 of 401 in the study period). These patients had significantly more primary and associated conditions, and more complications than those treated in other Victorian hospitals.

Nearly all of the patients at PMCI (97%) were recorded as having multiple diagnoses of neoplastic disease (primary and secondary), in contrast to only 41% of separations in other hospitals. PMCI patients were recorded with a mean of 2.1 additional cancers, while patients in other hospitals had a mean of 0.6 ($p<0.001$). In both treatment settings, neurological secondaries were the most frequent principal diagnosis, with bone and lung secondaries the most frequent complicating conditions.

Patients at PMCI averaged two procedures per separation, while patients at the other hospitals averaged a little over one procedure for every second separation.

There were no significant differences in average length of stay or percent of sameday cases, but PMCI patients were recorded as having significantly more leave days, indicating either different recording or treatment patterns.

DRG 129 Ear, Nose, Mouth & Throat Malignancy

Cases admitted to PMCI in this DRG were not found to be different from those in other hospitals, except for the number of coded complications. The treatment of nearly a third of PMCI patients was complicated by a coexisting condition. The coefficient of variation (CV), which compares the mean number of complications for this group with the standard deviation, is quite large (2.15), suggesting considerable variation in the group as a whole. Examination of diagnosis fields reveals that the result reflects a subset of patients in the DRG with multiple and varied complications, rather than a consistent pattern across all patients.

PMCI treated 16% of the state's caseload in this DRG over the study period.

DRG 170 Respiratory Neoplasms

Victorian hospitals recorded 1,216 separations in this DRG in the five month study period, with PMCI cases representing 7.8% of these separations.

PMCI had a significantly higher rate of diagnosis coding, with an average of 4.6 diagnosis codes per record (compared with 4.2 in other hospitals). All PMCI records had at least two diagnostic codes (reflecting high rates of morphology coding), and over 50% of cases had at least 5 codes recorded. The number of codes per record drops off quickly in other Victorian hospitals, with only 35.8% having five or more codes recorded.

The within-DRG casemix at PMCI was concentrated in three ICD-9-CM diagnosis codes, which represented nearly three-quarters of its caseload. These were *Malignant neoplasm of the upper lobe, bronchus or lung (162.3)* at 35.8%, *Malignant neoplasm of other parts of the bronchus or lung (162.8)* at 16.8%, and *Secondary malignant neoplasm of the pleura (197.2)* at 22.1%.

In other Victorian hospitals, coding was less precise, with 34.2% of cases assigned a principal diagnosis of *Malignant neoplasm of the bronchus or lung, unspecified (162.9)*. Some 15.5% of cases were coded to *162.3 (Malignant neoplasm of the upper lobe, bronchus or lung)*, and 17.2% and 10.2% were coded to secondary neoplasms of the lung *(197.0)* and pleura *(197.2)* respectively.

Only 12.6% of PMCI separations in this DRG entailed no operative procedure, compared with 40.8% of patients in the other hospitals. There was a significant difference in the number of procedures performed, with 1.6 per separation at PMCI, and .9 at other hospitals. The most commonly recorded procedures for these cancer patients were bronchoscopies. The rate of diagnostic bronchoscopies (*33.22 and 33.23)* at PMCI was 2.4% of cases in this DRG, contrasted to 0.2% for patients in other Victorian hospitals. When bronchoscopic biopsies *(33.24)* are included, however, rates between the two groups (PMCI *vs* other hospitals) are very similar, with 2.5% of PMCI separations recording one of these three procedures, compared with 2.2% of separations at the other hospitals.

While mean length of stay was not significantly different between PMCI and other hospitals, a significantly smaller proportion of PMCI separations were one day (sameday or overnight only) admissions. Nearly 40% (38.4) of other hospital admissions were one day, compared with less than 20% (18.9) of PMCI admissions.

DRG 320 Digestive Malignancy

DRG 320 is the single classification for medical (*i.e.,* non-surgical) admissions for digestive tract malignancies. In the 35 PMCI separations, nearly one third of patients were hospitalised with a principal diagnosis of primary digestive system cancer, and two-thirds with secondary cancers of the digestive system.

While two thirds of PMCI admissions in this DRG were for secondary malignancies, in the other Victorian hospitals, the relationship between primary and secondary malignancies was reversed. Some 79.5% of cases outside PMCI were primaries, with only 14.9% of admissions for secondary digestive system malignancies, and the remainder miscellaneous digestive system neoplasms (carcinoma in situ, uncertain behaviour, *etc*).

A total of 79 secondary diagnosis codes were recorded in addition to 70 morphology codes for PMCI cases. Over half of the PMCI secondary diagnosis codes (52%) were for *other cancers* with non-cancer conditions, complications and comorbidities making up 48% of these codes. A significantly higher proportion of PMCI cases had other primary and secondary cancers recorded (54.7%) compared with cases in the other hospitals (39.6%). 28.9% of PMCI separations were recorded as having any complications, with complications recorded for only 7.6% of separations from other hospitals.

At PMCI, the most common secondary codes were gynaecological malignancies, and other gastro-intestinal primary and secondary malignancies. In other Victorian hospitals, secondary cancers of the gastro-intestinal tract and other non-malignant digestive disorders were most frequently recorded. With the larger sample in other hospitals (*n*=995), both cancer and non-cancer subsidiary diagnoses were more diverse. Gastro-intestinal primary and secondary cancers (in addition to the principal diagnosis) were the most common cancers recorded, followed by haematological and lung cancers. Other non-cancer digestive system diagnoses and circulatory conditions were the most frequently recorded non-cancer secondary diagnoses.

Fifty percent of patients in both hospital groups (PMCI/Other) were treated as day patients, and there was no significant difference in average length of stay. Patients in other hospitals were significantly older than PMCI patients for this DRG, with a mean age of 66 years for other hospitals, and a mean of 60 at PMCI. This is one of the few complexity markers which would suggest more resource-intensive treatment outside PMCI.

However, a larger proportion of PMCI patients in this DRG had multiple malignancies and complications, and those with complications recorded a significantly greater number of complications per case at PMCI than cases treated elsewhere in Victoria.

DRG 373 Malignancy of the Hepatobiliary System or Pancreas

DRG 373 is assigned for medical treatment of liver and pancreatic cancers. PMCI treated 17 cases in the DRG in the study period (3.2%), and 519 cases were treated in other Victorian hospitals.

Patients of PMCI were recorded as having significantly more diagnoses per separation, with the difference being made up of primary and associated diagnoses rather than complications, and significantly more cases of other primary and secondary cancers. PMCI recorded 4.1 primary and associated conditions per separation in the DRG, while other hospitals recorded only 2.7. PMCI cases had an average of 2.4 other cancers, compared with 0.6 per case in other hospitals. 94.1% of PMCI separations entailed multiple cancers, but only 46.2% of cases in other hospitals were complicated by other cancer diagnoses.

In both groups (PMCI/Other) the principal diagnosis was a secondary cancer of the liver or pancreas in the majority of cases, and complicating cancers were largely secondaries in a range of sites.

Patients at PMCI were recorded as having significantly more leave days. Although average length of stay was shorter in PMCI than in other hospitals (4.6 versus 7.4) the difference was not significant, presumably because of the relatively small PMCI sample and the greater variability in ALOS in other hospitals (CV = 1.3).

DRG 429 Pathological Fractures & Musculoskeletal & Connective Tissue Malignancies

All of the coding markers of complexity suggest that for this DRG PMCI cases are more complex than those treated elsewhere. An average of 6.6 diagnoses are recorded for PMCI separations, compared with only 4.5 at other hospitals. Significantly more procedures are also performed at PMCI, with an average of 1.6 per separation, compared to 0.6 elsewhere.

When additional diagnoses are analysed in more detail, PMCI separations in this DRG show a higher mean count of primary and associated diagnoses (3.7 *vs* 3.2), and complications (0.8 per separation *vs* 0.3). 45.8% of patients at the Cancer Institute were recorded as having complications, compared with only 15.2% of those in the other hospitals.

Secondary cancers of the bone were the most frequent principal diagnoses in all hospitals. Nearly all PMCI patients (96.4%) had other cancers recorded, while only 41.2% of patients treated elsewhere were recorded as having other primary or secondary cancers.

Primary gastrointestinal, lung, urological and breast cancers were the most frequently recorded at PMCI, a pattern also apparent in the cases treated in other hospitals.

Again, the larger number of cases treated in hospitals other than PMCI yielded a wider range of other-body-system secondary codes. In part this is an artefact of the lower rate of morphology coding in other hospitals, and the smaller proportion of other cancers recorded, leaving more fields available for other complications. Non-cancer musculoskeletal diagnoses were the most frequently recorded for these cases.

DRG 481 Skin Graft &/or Debridement Except for Skin Ulcer, Cellulitis

Perhaps the best complexity marker for this minor surgical DRG is the proportion of patients admitted for a single day of care. On this criterion, PMCI (with only 8.2% of patients so admitted) sees patients at the more complex end of the distribution of patients in this DRG, while hospitals across Victoria (which average 53.8% same- and one-day stays) treat patients at the less complex end of the spectrum.

One possible factor is the significantly older age of PMCI patients in this DRG, who are on average 20 years older than patients seen in the other hospitals (72.1 *vs* 52.1 years).

The two groups are also different in the sorts of procedures performed. 84.5% of PMCI patients in the DRG are assigned there on the basis of a skin graft procedure, while the most common procedures assigning patients to this DRG in other hospitals are excisions of skin lesions (64.0%). PMCI patients have significantly more procedures performed in the episode, and only 9.3% of cases have a single procedure performed. This contrasts with patients in other hospitals, where nearly 40% have only one procedure performed.

This is a `mixed' DRG, where patients without a cancer diagnosis are also assigned for a variety of conditions which may require skin excisions or grafting. For both groups (PMCI/Other), the most common principal diagnosis is skin cancer. But whereas 99% of PMCI separations are recorded with a principal diagnosis of cancer, only 51.1% of separations in the other hospitals have cancer as the principal diagnosis. The finding that other hospitals have a higher proportion of cases with non-cancer complicating diagnoses merely reflects the wider range of indications for admission in other Victorian hospitals.

Significantly more PMCI separations are coded as having complications, and these are primarily multiple cancers. Nearly 40% (37.1%) of PMCI patients have additional cancer diagnoses beyond the principal diagnosis, but less than 10% (9.8) of patients in other hospitals are recorded as having multiple cancers. The count of additional cancers per case is also significantly different between the two sites of care.

DRG 483 Skin, Subcutaneous Tissue & Breast Plastic Procedures

DRG 483 is also a `mixed' DRG, taking in a wide range of plastic surgery procedures undertaken in other Victorian hospitals, and a much narrower range of procedures on cancer patients at PMCI. Less than a quarter of patients in other hospitals have a principal diagnosis of cancer (24.9%). The most common principal procedures for these hospitals was reduction of the abdomen, thighs or buttocks (*86.83*--16.2%) and various forms of rhinoplasty (*21.84-21.87*--11.2%).

For PMCI, the most common principal diagnosis is malignant neoplasm of the skin, and the most common operations are repairs to the nose (*21.89*--52.1%), to the ear (*18.79*--29.2%) and eyelid (*87.4*--8.3%). Patients at PMCI require significantly more operations in the episode, averaging 2.4 compared with 1.8 in the other sites. Only 2.1% of patients had only a single operation in their PMCI separation, whereas 45.3% of patients in other hospitals had a single procedure.

The difference in the proportion of day-patients is even more evident in this DRG, with 64.1% of other patients admitted for short stays, compared with only 2.1% of PMCI patients. Age, as well as multiple procedures, may both be factors in PMCI's significantly longer average length of stay. The average PMCI patient is 72 years (median=73), and the average patient in other hospitals is 42 years (median=39).

Because of the mixed nature of the DRG, most patients in the other hospitals are not admitted for cancer, and thus it is not surprising that PMCI patients are recorded with significantly higher rates of additional cancers.

DRG 484 Other Skin, Subcutaneous Tissue & Breast Procedures

The pattern of case complexity for DRG 484 follows closely that for 481 and 483. It is a mixed DRG, with 85.4% of PMCI patients having a malignancy as principal diagnosis, but only 46.8% of patients in other hospitals having a diagnosis of malignancy.

Procedures performed in both settings are more varied than in the previous skin DRGs, although the most frequently performed procedure in both settings (PMCI/Other) is *Other local excision or destruction of lesion or tissue of skin or subcutaneous tissue (86.3)*. Almost half of PMCI patients (47.6%), and three-quarters of other patients (74.2%) were recorded with this principal procedure. An additional 102 procedure codes are recorded as principal procedure in other hospitals, and an additional 9 procedure types are recorded for PMCI patients in this DRG. Most patients in both

sites had a single procedure in the episode, but this represented 83.2% of other hospital patients and only 54.9% of PMCI patients.

PMCI patients in this DRG are significantly older (66 years compared with 43), have a longer average length of stay (2.5 days *vs* 1.6), and significantly fewer are hospitalised for a single day (32.9% *vs* 87.1%). Cancer hospital patients have significantly more recorded diagnoses (primary and associated), more cases with complications recorded (6.1% *vs* 1.2%), and a higher proportion of cases with complicating (non-cancer) diagnoses (42.7% *vs* 27.6%).

Again, the proportion of cases with multiple cancer diagnoses, and the count of such diagnoses is higher at PMCI because of the mixed nature of the DRG, and the wider range of indications for admission at other Victorian hospitals.

DRG 487 Malignant Breast Disorders

Cases of malignant breast disease which require medical (non-surgical) management, and which are not admissions principally for administration of chemotherapy (DRG 779) fall into DRG 487. PMCI treated just 3% of the state's cases (16 of 542 separations) in this DRG in the study period.

While average length of stay was not different in the two settings (PMCI/Other), the proportion of cases treated on a same- or one-day basis was significantly different. 83.8% of patients treated elsewhere were short-stay, compared with only 50% of PMCI patients. This could be attributable to the fact that PMCI patients in this DRG were significantly more likely to be from non-metropolitan areas, an indicator of the hospital's role as a tertiary referral centre. The distribution of ALOS was quite skewed for both settings, with large standard deviations indicating a number of very long-stay outliers.

Most coding indicators suggest that PMCI patients are more complex. They had more total diagnoses recorded (5.4 *vs* 3), more primary and associated diagnoses (requireing active treatment in addition to the principal diagnosis) (3.4 *vs* 1.8), more cancers amongst those secondary diagnoses (1.6 *vs* 0.3), and also more non-cancer complicating diagnoses (1.1 *vs* 0.6). All of these were significant differences.

The most common principal diagnosis in both settings was breast malignancy. Complicating cancer diagnoses were largely secondary cancers of the skin, bone, lung and lymphatic system.

Nearly half (44.7%) of the separations at other hospitals recorded only a single diagnosis; none of the PMCI separations did so.

DRG 499 Minor Skin Disorders

DRG 499 is another example of a mixed DRG: one in which a principal diagnosis of cancer does not result in assignment to a cancer-specific DRG. PMCI saw only 2% of the 1115 patients treated in the five-month study period in Victoria. The proportion of cancer patients was reversed between the two sites (PMCI/Other), with 18.5% of PMCI separations related to *non-cancer* principal diagnoses, and 18.7% of other hospitals' separations related to *cancer* diagnoses.

A smaller proportion of these patients was admitted for same- or one-day care at PMCI: only a third of patients at PMCI *vs* three quarters (76.2%) in other hospitals. Patients of PMCI were significantly older, at 72.3 years (median=73), than other patients at 37.8 years (median=35).

Total recorded diagnoses were significantly different between the two sites of care: 3.7 per separation at PMCI and 1.9 at other hospitals. When morphology coding is removed, and primary/associated and complication codes are considered, PMCI patients are found to have significantly more of each type of diagnosis per separation (2.3 *vs* 1.6 primary/associated; 0.19 *vs* 0.04 complications). The latter is related to the significantly higher proportion of cases with any complications recorded: 14.8% at PMCI *vs* 2.2 at other hospitals.

As expected, primary and secondary cancers are more frequent at PMCI because of the hospital's higher proportion of cancer patients within the DRG.

Without more analysis of costing data, it is not possible to say whether treating cancer patients in this DRG is more costly than treating the non-cancer patients assigned to the DRG in most other hospitals. Even without this information, however, the indicators point to a more complex patient load at PMCI.

DRG 646 D&C, Conization, Vagina, Cervix & Vulva Procedures

This DRG encompasses minor gynaecological surgery, predominantly not for indications of cancer. Common procedures assigned to the DRG include dilatation and curettage, laparoscopy, and occlusion of the Fallopian tubes. In other Victorian hospitals, only 10.9% of principal diagnoses in this DRG were in the neoplasm range of the ICD-9-CM classification.

Although PMCI treated only 1.3% of cases assigned to this DRG during the study period, 85% of cases were in two principal diagnosis categories: *Malignant neoplasm of the corpus uteri* (182.0) (52.0%) and *Malignant neoplasm of the cervix uteri (other specified sites--180.0)* (33.3%). PMCI was the only hospital recording the use of intracavity caesium, a procedure involving the insertion of this radioactive element into the uterus for treatment of uterine cancer. 88.2% of PMCI patients (90 of 102) received this form of treatment, emphasising the high degree of specialisation in the PMCI casemix for this DRG.
Nearly half the cases treated in other hospitals had only a single diagnosis (46.7%), while PMCI patients averaged 3.2 per case. A higher proportion of PMCI patients were recorded as having complicating conditions (35.1% compared with 1% elsewhere). PMCI recorded a significantly higher proportion of cases with multiple cancers (15.7% compared with 3.6%), in part because other hospitals had a much lower proportion of principal diagnoses of cancer.

PMCI patients were significantly older ($\bar{X}$ 62.9, Median 66, *vs* $\bar{X}$ 38.4, Median 37, in other hospitals). Perhaps related to this age difference, PMCI patients had significantly more non-cancer diagnoses recorded per separation (0.9 *vs* 0.7). Treatment at PMCI resulted in a significantly longer ALOS (3.8 *vs* 1.1), and a much lower proportion of patients treated on a same- or one-day basis (5.9% *vs* 93.8%). A significantly higher proportion of patients at PMCI were resident in non-metropolitan Melbourne areas than was the case for other Group A (largely metropolitan teaching) hospitals.

DRG 650 Malignancy, Female Reproductive System

With only 14 separations, PMCI sees 10% of the state's cases in this DRG which is assigned when patients with gynaecological cancers are admitted for neither surgical treatment, nor specifically for chemo- or radiotherapy.
A significantly higher proportion of PMCI patients are recorded as having complications, and per case, more complications are recorded. Patients treated in both sites frequently have secondary gynaecological cancers and secondaries of the gastrointestinal, respiratory and lymphatic systems, but PMCI patients do not have more of these additional cancer diagnoses than patients treated elsewhere, and the higher rate of complications is largely explained by significantly more non-cancer diagnoses per case.

Treatment at PMCI entails a higher rate of `minor' procedures performed per case, such as CT scans, bone scans and injection of chemotherapeutic agents. It is not clear whether this reflects a

higher rate of coding of these procedures, patient-related complexity factors or differences in practice patterns of clinicians providing care.

The fact that PMCI separations include significantly more leave days may also reflect some combination of these three factors, or the fact that patients are more likely to come from non-metropolitan areas than was the case for patients in other Group A hospitals. Patients with long travel times may be admitted rather than treated on a day-only basis, but discharged to leave in the course of a prolonged treatment regimen.

DRG 753 Red Blood Cell Disorders Age >9

Two principal diagnoses characterise 97% of PMCI patients assigned to this non-surgical DRG: *Anaemia, unspecified (285.9)* and *Other unspecified aplastic anaemias (284.8)*. These are linked with second diagnoses of cancers of the bone and bone marrow, acute leukaemia and lymphatic cancers. Haematological malignancies are reported for 42% of records with a second diagnosis code, secondary bone cancers for an additional 13%, and malignancies of the lung and gastrointestinal system together representing an additional 10% of coded cases.

Principal diagnoses of anaemia also characterise patients admitted in this DRG in other Victorian hospitals, but here the second diagnosis is more likely to be non-cancer related, with 20% of patients recorded with digestive system disorders, 11% with circulatory disorders, etc. Of patients with second diagnoses recorded in these other hospitals, only 34.7% in these other hospitals relate to neoplastic conditions.

Patients at PMCI have more recorded diagnoses (4.5 *vs* 2.2), including more active treatment (primary/associated) diagnoses per case (3 *vs* 1), more complications per case (0.18 *vs* 0.05), and a higher proportion of separations with recorded complications (11% compared with 3% in other hospitals). In part this may reflect the significantly older population treated at PMCI, on average, some 10 years older than in the other hospitals.

In this mixed DRG, it is not surprising that a higher proportion of PMCI cases are reported with additional cancers, nor that there is a significantly higher count of cancers per case.

DRG 774 Lymphoma & Non-Acute Leukaemia

DRG 774 is one of a set of 6 DRGs classifying patients with a principal diagnosis of lymphoma or leukaemia. This classification is specifically for episodes of inpatient care of adult patients whose care does not entail surgery; as such, it is a `medical' as opposed to a `surgical' DRG, and is not split on the basis of complications or comorbidities.

DRG 774 is the lymphoma/leukaemia DRG with the largest number of separations in the state, and PMCI's 86 patients in the study period represented 6% of the total state caseload. Most patients in the state are treated on a same- or one-day basis, but PMCI has a significantly smaller percentage of patients treated on this basis (51% compared with 68% in other hospitals). While the group of patients discharged on leave is very small in both PMCI and other hospitals, per separation PMCI recorded a significantly larger number of leave days.

PMCI had a significantly higher proportion of cases with recorded complications (30.2% *vs* 7.8%), and a higher count of complications per record (0.5 *vs* 0.2). These complications were primarily other cancers, with 15% of PMCI separations having multiple cancers recorded, in contrast to only 9% of other-hospital separations. On average, PMCI records contained 0.2 additional cancer diagnoses, compared with 0.1 in other hospitals.

PMCI patients were also recorded as having significantly more `minor' procedures, that is, procedures not performed in an operating theatre. For a third of PMCI patients, the principal procedure was *Therapeutic plasmapheresis (99.71)*, a procedure performed in less than one percent of separations in this DRG in other hospitals. *Bone marrow biopsy* accounted for an additional 8.1% at PMCI.

Principal procedures most commonly recorded in other hospitals were transfusions of various blood products (packed cells, platelets, whole blood--21.0%) and injections of a variety of therapeutic substances (chemotherapy, steroids, antibiotics--19.6%). While the average number of procedures performed was greater at PMCI, a higher proportion of PMCI patients had no procedure performed during the separation (22.1% *vs* 17.1%).

DRG 778 Myeloproliferative Disorders or Poorly Differentiated Neoplasms With Other O.R. Procedures

This DRG is one of a set of three which are assigned to inpatient episodes with principal diagnoses of myeloproliferative disorders or poorly differentiated neoplasms, and which may have required surgery, but not one of the 272 `major' surgical procedures which would otherwise have assigned the episode to DRGs 776 or 777.

During the study period, most Victorian patients with these diagnoses were assigned to DRG 778, and PMCI treated nearly a third (29%) of the state's cases.

At PMCI, `minor' procedures included *Teleradiotherapy using photons (92.24)* or *Implantation or insertion of radioactive elements (92.27)* for over half (55.6%) of the episodes. In other hospitals, the most frequent principal procedures were *Injection or infusion of cancer chemotherapeutic substance (99.25)* and a range of skin excisions and biopsy procedures. At PMCI only 5.6% of separations entailed a single procedure, while 44.6% of separations in other hospitals were single-procedure.

A range of complexity indicators also suggest that PMCI patients are unlike those admitted to other hospitals in the state. Patients of the cancer hospital were significantly older than patients admitted to other hospitals, by an average of 15 years (PMCI median age=64; elsewhere median age=49). Their average stay was significantly longer ($\bar{X}$ 9.9 days *vs* $\bar{X}$ 4.3), and a significantly smaller proportion were treated as day patients (5.6% *vs* 49.2%). The longer average stay is consistent with the larger number of leave days per separation at PMCI (1.28 *vs* 0.03).

Significantly more diagnoses and procedures were recorded per separation for PMCI patients. This was reflected in every category coding: PMCI patients had significantly more active treatment diagnoses (primary/associated--3.6 compared with 2.1); more complications (1.2 compared with 0.4); a higher proportion of complicated separations (38.9% compared with 12.3%) and separations with multiple cancers (88.9% compared with 27.7%); and a higher count of both cancer and non-cancer diagnoses (1.6 per case compared with 0.4 for cancer; 2.1 *vs* 1.1 for non-cancer).

DRG 779 Radiotherapy

PMCI is the largest provider of radiotherapy services in the state. For the five months of this study, PMCI had 540 of the 585 Victorian separations in DRG 779 (92.3%). Significantly more diagnoses and procedures were recorded for PMCI patients than for patients of other Victorian hospitals, with an average of 6.6 diagnoses (3.9 in the rest of the state) and 1.7 procedures (compared with 1.1).

Principal diagnosis for these cases is quite different between the two hospital groups, with a third of cases in other Victorian hospitals recorded as follow-up visits subsequent to radiotherapy (V67.1); only 0.5% of PMCI cases were so coded. The largest group of radiotherapy patients (26.3%) recorded *secondary malignant neoplasms of the bone and bone marrow (198.5)* as the second diagnosis. Admission for concomitant *Chemotherapy (V58.1)* represented an additional 25.0%, and a *History of bladder cancer (V10.51),* another 24.4%.

The inclusion of *Followup examination following radiotherapy* in the DRG (representing a third of separations in the DRG in other hospitals) is likely to create a bimodal distribution of costs within the DRG; the largest group being very expensive, capital-intensive treatments with radiotherapy, and the smaller and much less expensive group being followup visits. Hospitals which provided only the followup care could expect to receive a considerable profit on these cases, whose reimbursement is largely based on the costs of the radiotherapy itself.

Of the 45 radiotherapy separations in other Victorian hospitals, the largest group had a second diagnosis of admission for *Chemotherapy (V58.1)*, representing 26.6% of these radiotherapy patients. The proportion of patients having both chemotherapy and radiotherapy was similar in all hospitals.

PMCI patients averaged 3.8 primary and associated diagnoses per separation, while patients at other hospitals averaged 2.8. At PMCI, these were primarily other cancers, with 2.0 additional cancer diagnoses per separation; patients in other hospitals averaged less than 1 additional cancer (0.9) per separation. Roughly the same proportion of patients in both groups were recorded as suffering from other complicating conditions, but the count of these per separation was significantly higher at PMCI (1.9 per case) than in other hospitals (1.1).

Only 10% of PMCI patients were treated on a one-day basis, compared with 31.1% of separations from other hospitals. Average length of stay was very skewed in both treatment settings, but significantly longer (12.2 days) at PMCI than in other hospitals (7.9 days).

DRG 780 Chemotherapy

PMCI provided 1690 of the 10,470 chemotherapy separation in Victoria in the study period (16.1%). Principal diagnosis in both settings was *Admission for chemotherapy (V58.1)*, with a small proportion of cases coded to *Followup examination following chemotherapy (V67.2)*. These followup visits represented only 0.1% of the PMCI caseload, and 0.3% of that in the other hospitals.

The second diagnosis field for cases in this DRG yields more specific information, but reflects the wide range of indications for chemotherapy, and the wide range of ICD-9-CM codes applicable. Very small numbers of cases fall in any single ICD-9 code.

The largest group of chemotherapy patients at PMCI (12.1%) were those with *Secondary malignant neoplasm of the bone and bone marrow (198.5)*; this compared with only 1.6% of the caseload of other Victorian hospitals for this indication. The second largest group at PMCI fell into *174.8 (Malignant neoplasm of other specified sites in the female breast)*, with 8.5% of cases. Only 0.9% of separation in the other hospitals were coded to this site. In both of these groups, PMCI had more cases than all other hospitals combined.

Malignant neoplasms of the ovary (183.0), rectum (154.1) and secondary malignant neoplasms of the liver (197.7) all contained more than 5% of PMCI cases.

In other Victorian hospitals, the largest single code was for *Malignant neoplasms of the female breast, unspecified (174.9)*, with 8.5% of the caseload; this was followed by *Malignant neoplasm of the rectum (154.1), of the colon (unspecified)(153.9), and Secondary malignant neoplasm of the liver (197.7)*, each with more than 5% of those hospitals' caseload.
The dominant procedure in both sites was not surprisingly: *99.25 Injection or infusion of cancer chemotherapeutic substance*. The second most frequently coded procedure in other Victorian hospitals was *Other puncture of vein (38.99)*, a code not used at PMCI. Few other procedures were performed, with only a few codes representing more than 0.1% of separations.

Specifically, few chemotherapy patients received radiotherapy treatment in the same admission. Only ten of PMCI's 1690 episodes (0.6%) were so coded, and 0.01 percent of the 8780 chemotherapy episodes in other hospitals.

Analysis of coded diagnoses showed a consistent pattern of more complex conditions at PMCI: more conditions were recorded (4.8 *vs* 3.7); more primary/associated diagnoses (3.0 *vs* 2.5); more complications per case (0.12 *vs* 0.02); more cancer diagnoses (1.9 *vs* 1.3); and higher proportions of separations with any complication (6.7% *vs* 0.9).

While chemotherapy is most often administered as a sameday procedure in all hospitals, the proportion of patients requireing only a single day was significantly lower for PMCI (88.3%) compared with those treated elsewhere (94.6%).

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Appendix 1