Profiling hospital utilisation in a mixed public-private system

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Abstract

While there is an extensive body of literature on the demand for hospital services, little is known about the interaction between public and private hospitals in a mixed system. In this paper, we (i) apply latent class analysis to identify distinct subgroups of patients who use the hospital market differently, (ii) characterise each patient type by their personal characteristics and (iii) link the patient type to future hospital admissions. We apply our analysis to individual-level longitudinal patient data from Australia, focusing on three popular procedures that are performed in both public and private hospitals. We find 4 to 5 patient types. The most common types use either a public or a private hospital almost exclusively and absorb a moderate level of hospital resources. The severe types represent 13 to 17% of patients. The type which uses both sectors makes up 10 to 20% and tends to have private health insurance coverage. The patient types are predictive of prospective utilisations, as we find that patients tend to be admitted to the sector they have used in the past. By revealing how patients use coexisting public and private hospitals, our results have direct implications on health resource financing and allocations.

Keywords: hospital utilisation, public and private hospital, market segmentation, latent class analysis

1. Introduction

Hospital services are the single most expensive component of health expenditures. In the United States, about 7% of the population makes a hospital visit in any given year, but hospital expenditure absorbs almost a third of the nation's total health care spending (Mirel and Carper, 2010). In England, about 68% of spending by primary care trusts, which absorbed 80% of the English National Health Service funding in 2011/12, was allocated to hospital services (Jones and Charlesworth, 2013). Across European countries, hospital expenditures account for 26 to 46% of total health expenditures (European Commission, 2014). Similarly, in Canada, nearly 30% of total healthcare spending is allocated to hospitals (Canadian Institute for Health Information, 2012) while in Australia, hospitals are used by about 12% of the population but absorb nearly 40% of the total health expenditure (Australian Institute of Health and Welfare (AIHW), 2013). Accordingly, a large body of research has been dedicated to analysing the demand for hospital services measured by the number of admissions (Cheng et al., 2014; Bago d'Uva, 2006; Hastings et al., 2010; Strunk et al., 2006; Deb and Holmes, 2000) or resources used during admission. Resources have been typically measured by length of stay (Hastings et al., 2010; Street et al., 2012; Cheng et al., 2014) and hospital costs (Baicker et al., 2013; Street et al., 2012; Johar et al., 2013; Morgan and Cunningham, 2011; Morgan et al., 2010; Cheng et al., 2014).

The literature focuses on the determinants of the overall demand for hospital services. However, in a mixed healthcare system, in which public hospitals are available to all and the private sector coexists alongside them (e.g., Canada, Australia, New Zealand, Scandinavian countries), it is also important to know how the demand is split between the public and the private sector to determine how health care should be provided and funded. Yet there is

very limited literature on sectoral hospital choice (Barros and Siciliani, 2012). The bulk of the literature on hospital choice focuses on a patient's decision to choose a particular hospital due to its attributes such as proximity to residence (Moscone et al., 2012; Tai et al., 2004; Vrangbaek et al., 2007), reputation (Akinci et al., 2005; Pope, 2009; Varkevisser et al., 2012) and quality (Beukers et al., 2013; Sivey, 2012). In this paper, we aim to fill this gap in the literature by undertaking patient-level analyses to reveal not only how the market for hospital services in a mixed system is segmented, but also how a patient's health conditions interact with his/her hospital utilisation; the correlation between health condition and health service use is unquestionable, but the two are rarely modelled as a joint outcome. We examine the case of Australia, where at the aggregate level, the ratio of public to private hospitals is about 60:40.

Our analytical approach is to employ latent class analysis (LCA) (Vermunt and Magidson, 2002) to predict distinct "types" of patients based on a series of indicators of hospital utilisation. LCA is a type of clustering techniques in Statistics which has been successfully used in the fields of medicine and psychology; it is used to group subjects with similar response patterns to the outcome variables in one cluster. In the medical literature, for example, LCA has been used to profile addictive behaviours (Lloyd et al., 2010; Agrawal et al., 2007) and to describe the disease burden of a given geographical area (Jiang et al., 2015). In the psychology literature, LCA has been used to describe people's attitudes towards a new health technology (Mok et al. 2014) and to identify various learning styles of students (Lawson and Masyn, 2015). Outside health and medicine, LCA has long been used by product developers and marketers to study consumer segmentation (Bhatnagar and Ghose, 2004; Konus et al., 2008).

In the health economics literature, studies have used latent class models to predict demand for health care (see for example Deb and Trivedi, 1997; Jimenez et al., 2002; Bago d'Uva, 2006; Conway and Deb, 2005; Deb and Holmes, 2000). The workhorse of these models is finite mixture models such as that of Deb and Trivedi (1997). These models assume that subjects come from two or more different populations with different outcomes (e.g., high- vs low-expenditure consumers, and that in each population, the outcome follows a continuous distribution (e.g., normal or poisson). Subjects belong to a certain population with some constant probability.

Our LCA approach is not quite the same as these latent class models with which econometricians are familiar. Unlike these latent class models, which have one continuous outcome variable, such as health expenditure or the number of doctor visitations, and treat the latent class as a way to accommodate a missing variable, LCA involves a series of observable outcomes and focuses directly on the latent class membership determination. In latent class models, class membership is typically just a constant parameter. In contrast, we model the latent class membership explicitly as a function of the subjects' own characteristics. The use of covariates has been shown to enhance the accuracy of the latent class membership prediction (see Wurpts and Geiser, 2014 and references within). Given that class membership is central to our objective of revealing consumer segmentation in the hospital care market, LCA supports our objective better than the latent class models that have been used in previous studies, which may be more suited for impact evaluation or predictions. After finding the latent classes of consumers that reflect distinct patient types, we describe each type in terms of its socio-demographics, economics, health and lifestyle-related conditions.

To make a clearer interpretation of utilisation pattern, we conduct separate LCAs for several health conditions that have large demand for treatment and are treatable in both public and private hospitals. We think this approach gives us sharper focus and is more informative than a general analysis in which all diseases are pooled. The health conditions we considered are problems with the nervous system, respiratory system and circulatory system.

Our findings can be summarised as follows. First, we find that there are 4 patient types for nervous and respiratory problems and 5 patient types for circulatory problems. Patient types which comprise the majority of patients use either public or private hospitals almost exclusively. Their health conditions are not so severe, as indicated by moderate use of hospital resources. The patient types that have intense use of hospital resources (severe patient types) represent between 7 and 19% of patients, depending on health problem. These types also tend to use only one sector. Dual use of public and private hospitals is observed among patients who are willing to pay for additional privileges in public hospitals such as choice of doctors and better accommodation. These patients make up between 9 and 25% of patients and use hospital resources at a level somewhere in between the moderate and severe patient types. Second, with regards to the characteristics of each patient type, we find that private health insurance membership is the strongest predictor of the patient types that use exclusively private hospitals, and, as expected, poor health predicts the patient types that use the most hospital resources. We do not find that household income predicts any patient types, which may suggest that any out-of-pocket health expenses tend to be paid through private health insurance instead of direct debit. Third, we find that the patient types can predict prospective admissions, as some types are

more likely than others to have a future admission and go to a private hospital instead of a public hospital.

2. Australian hospital sector

In 2012, there were 753 public hospitals and 592 private hospitals throughout Australia (AIHW, 2014). During an admission to a hospital, a patient can be admitted as a public (non-paying) patient or a private (paying) patient. Under the universal public healthcare system, Medicare Australia, treatment by a doctor appointed by the hospital and accommodation as a public patient in a public hospital are free to all Australian residents. Alternatively, a patient can choose to be admitted as a private patient, and Medicare will cover 75% of their in-hospital costs of medical services, excluding accommodation, theatre fees and medicines. Both public and private hospitals can admit private patients. In public hospitals, private patients incur charges in exchange for choice of doctors and accommodation.

Public hospitals are mainly funded by the Commonwealth and the state and territory governments. Non-government funding for private patients is provided by a mix of private health insurance and out-of-pocket charges. During 2011-2012, over $53.5 billion was spent on hospitals, which is about 3.6% of the gross domestic product, or $2,400 per capita; over $42 billion was spent on public hospitals, 90% of it by governments, and the remaining $11.5 billion was spent on private hospitals, a third of it by governments (AIHW, 2014). The state and territory governments manage the running of the public hospitals in their respective states and territories, while private hospitals are owned and operated by the private and charitable sector. Doctors can practise in both public and private hospitals.

In terms of overall volume (separations), the public-private hospital split is 60-40. Most health conditions are treated in both types of hospitals, although some conditions such as transplants, neonates and emergency are treated mainly in public hospitals. Both hospital sectors record a similar number of same-day separations (2.7 million in 2012-2013), but

public hospitals have more than double the number of overnight separations as private hospitals (2.7 million vs 1.2 million in 2012-2013). This may be explained by longer inpatient days in private hospitals (AIHW, 2014). In terms of quality, private hospitals seem to be doing better than public hospitals: private hospitals have a lower rate of adverse events due to drugs, medicaments, or biological substance and a lower rate of on-site falls resulting in patient harm (AIHW, 2014). However, this difference may simply reflect emergency care in public hospitals (92%). Another performance indicator is waiting time. In the absence of price as a rationing mechanism in the public sector, for non-emergency care, demand is rationed via waiting lists. In contrast, in the private sector, patients can often choose when to be treated, so waiting time is effectively zero. Long waiting time is often regarded as an indication of poor-quality public hospitals. In the past decade, the median waiting time has been stable at around 27-35 days for all non-emergency procedures in public hospitals.

Voluntary private health insurance may be used to fully or partly cover the costs of admission as a private patient in a public or private hospital. Insurance premiums are community-rated, meaning that they cannot be priced based on the insurer's health conditions. However, insurers can attract different pool of insurees by offering a wide range of insurance policies. To encourage insurance purchase, from 1997 until only recently, the cost of insurance premiums was subsidised at a flat rate of 30% (higher for those above 65); from July 2014, the subsidy rate has varied by income. About 55% of the population has private health insurance (Private Health Insurance Administration Council 2013).

3. Methodology

Our empirical strategy consists of three parts. In the first part, we use latent class analysis (LCA) to identify distinct consumer segments ("types") in the hospital care markets based on detailed information on their use of hospital services. By examining the hospital utilisation pattern of each type, we assign putative names for all types. For indicators of hospital use, we consider not only the location and frequency of admissions, but also resource use during admissions, which reflects patient health. The indicators of resource use that we considered are the number of secondary procedures, which reflect the complexity of procedures for example due to comorbidities, the length of stay and any record of emergency department (ED) presentation. In the second part, the resultant patient types are described in terms of their demographics and background characteristics, as well as variables that can be manipulated such as income and lifestyle-related factors. And in the third part of the analysis, we exploit the availability of hospital data in the post-survey period to test the relevance of the patient types in predicting future hospital utilisation.

LCA is a method of classifying individuals from a heterogeneous population into a smaller, finite number of relatively homogenous latent classes or segments on the basis of their scores on a set of indicators. Let $Y_i = (Y_{i1}, \dots, Y_{iM})$ denote patient i's response to M hospital indicator variables, where the possible values (levels) of Y_{iM} are $1, \dots, r_m$. Let $L_i = 1,2, \dots, n_c$ be the latent type of patient i, where n_c is the possible number of latent types. And let X_i denote the covariate(s) of patient i that affects the market segmentation. LCA involves an iterative process that searches for maximum likelihood parameter estimates using the expectation maximisation (EM) algorithm. Estimation is based on a routine created at the Penn State University (Lanza et al., 2014). The contribution by patient i to the likelihood is

(1) $P(Y_i = y|X_i = x) = \sum_{l=1}^{n_c} \gamma_l(x) \prod_{m=1}^{M} \prod_{k=1}^{r_m} \rho_{mk|l}^{I(y_m=k)}$,

where $I(y_m = k)$ is an indicator function that is equal to 1 if y_m is equal to k and 0 otherwise. The parameters to estimate are the probability of membership in each latent type, which is the gamma parameters, γ, and the item-response probabilities conditional on type membership, which is the rho parameter, ρ. The gamma parameter can be given by a multinomial logit (MNL) model such as

(2) $\gamma_l(x) = P(L_i = l|X_i = x) = \frac{\exp(x\beta_l)}{\sum_{j=1}^{n_c} \exp(x\beta_j)}$,

where β is the MNL coefficient.

From (1), we can see that the model will increase in size very quickly with M and r_m. For example, a model with eight binary indicators would result in 2^8 or 256 cells. In our case, we have six hospital indicator variables which are a mix of continuous and count variables at many levels. Therefore, some grouping of the levels is needed. We base ours on the inspection of the distribution of each indicator with the intention that each level represents a distinct case of hospital use.

With a large sample, we can end up with many types. Many of these types would exhibit similar characteristics, however, while others might be very small in size, making their interpretation difficult. To choose the number of types, we start with an LCA with 2 types and increasingly add more possible latent types. The model fit in terms of the number of types is assessed using the standard information criteria, namely the Akaike Information Criterion (AIC) and the Bayesian Information Criterion (BIC). In addition, to make sure that our found types are sufficiently different from each other, we calculate entropy. Entropy

measures how well a patient fits into a specific type with values ranging from 0 to 1. A value closer to 1 indicates a better fit.

Post estimation, given $(\hat{\rho}, \hat{\beta})$, $\hat{\gamma}$ is calculated to give us the distribution of patient types in the sample. The posterior probability of belonging to a given type is also estimated. We assign each individual to the type with the highest probability. After finding the patient types, the second part of our analysis is to correlate these types with patient socio-demographic, economic, and lifestyle conditions. For this, we estimate the MNL of the patient types and obtain the average partial effects (APE).

The last part of our analysis concerns the extent to which the identified patient types can predict future demand for hospital services. To answer this question, we run Heckman probit models of the private hospital admission taking into account selection into the hospitalised population. The patient types are included as covariates, and the identifying restriction is satisfied using lifestyle variables; lifestyles affect the probability of an admission but do not directly affect the choice between public or private hospital. We use hospital data from a year after the survey date. Because only a few patients in our data were hospitalised for the same health problems again in the following year, for prospective use, we consider both repeat procedures and the overall demand for any procedure.[1]

[1] For nervous system, only 3% of patients returned for nervous system problems; for respiratory system, 4% returned for respiratory problems and for circulatory system, 5% returned for circulatory problems.

4. Data and descriptive analysis

The data are derived from three data sets. The first source is the 45 and Up Study, which is a cross-section survey of non-institutionalised individuals aged 45 and over (45+) in the state of New South Wales (NSW), Australia (45 and Up Study collaborators, 2008). NSW is the most populous state in Australia, with a population of about 7.5 million (50% of the total population). The focus on the 45+ population is by no means restrictive. First, this subgroup of the population is composed of heavy users of healthcare services. In Australia, they are responsible for 62% of the total healthcare spending (AIHW, 2010). Second, in common with the rest of the world, Australia has an ageing population that is adding stress to the healthcare system. In 2013, 60% of the Australian population was over 45, with 38% aged 65 and over. By 2030, the 65+ population has been projected to grow by about 70% to 5.7 million.

The 45 and Up Study consists of over 267,000 respondents who were surveyed once between 2006 and 2010, with the largest collection taking place in 2008 (about 80%). They are randomly selected within the 45+ population in the Medicare Australia database, which covers everyone who has used Medicare. The survey collects extensive information about the respondents' demographic, socio-economic and lifestyle characteristics.

The other data sources are administrative databases. The 45 and Up Study can be linked to hospital records at the respondent level: the NSW Admitted Patient Data Collection (APDC) and the Emergency Department Data Collection (EDDC). The APDC data include all admissions by the survey respondents during 2005-2010 in NSW public and private hospitals, while the EDDC records all ED presentations during the same period.

This linkage between the survey data and administrative data means that we get detailed information about the survey respondents outside the hospital setting as well as when they are admitted to hospitals. This is a unique feature of our data. Inside hospitals, the patient-level data enables us to observe individual utilisation patterns such as multiple admissions, use of both public and private hospitals, length of stay and use of emergency care. Outside hospitals, we observe the patients' socio-demographic and economic conditions, general health and lifestyle habits.

We focus on admissions in the last two years. This is done to minimise potential noise from past health problems that are no longer relevant. In addition, although the hospital data is a five-year panel, the survey data is a cross-section. Thus, we need to make sure that the out-of-hospital characteristics are still accurate. Further, we focus on admissions for elective procedures for the nervous system, respiratory system or circulatory system. These procedures are chosen because they represent a large volume of patients in both public and private hospitals, so sectoral interaction is possible. In 2009-2010, at the aggregate level, the public-private hospital split is fairly balanced for nervous system conditions and is about 65-35 for respiratory system conditions and 75-25 for circulatory system conditions (AIHW, 2010).

For each health condition, we observe the following hospital utilisation indicators Y: (1) the number of standard admissions to public hospital; (2) the number of admissions to public hospital that involve some payment; (3) the number of admissions to private hospital; (4) the length of stay; (5) the number of secondary procedures; and (6) emergency department (ED) use. Secondary procedures are used to capture complexities or more intense use of medical resources. For example, an episode of a coronary angiography for a circulatory

patient may be supplemented with a cardioversion (normalisation of an abnormally fast heart rate), an angiography or a lung perfusion. ED use is measured by the number of times a patient has shown up in an emergency room for any health problem during the past year. As only a handful of EDs in Australia are located in private hospitals, ED presentations typically do not involve out-of-pocket cost to patients. Hence, ED presentations not only capture the frailty of an individual or his or her susceptibility to illness or injury in general, but they may also capture a group of patients who rely heavily on the universal health insurance who visit the ED instead of obtaining outpatient medical services (which may involve out-of-pocket costs).

The final sample sizes are 2,877, 857, and 5,058 for nervous system, respiratory, and circulatory procedures, respectively. Those who completed the survey in 2006 have to be dropped because we do not have a long enough hospitalisation history for them. Those who completed the survey in 2010 are also excluded because we will also analyse hospital use in the post-survey period.

Table 1 reports the summary statistics of the hospital utilisation indicators for each of the three procedures as they enter the LCA. At the patient level, the public-private hospital splits are slightly different from those obtained in aggregate: patients receiving respiratory treatment are fairly evenly split between public and private hospital admissions, while those receiving circulatory and nervous system procedures have relatively higher private hospital admissions. Another source of discrepancy between the aggregate figure and our data is that our population is older. Across all three procedures, we see that most patients exclusively go to either a public or private hospital. Respiratory patients have a lower

average number of secondary procedures compared to the other types, while the number of ED visits and average length of stay are similar for all types of procedures.

[Table 1. Hospital utilisation indicators: summary statistics and categories]

Table 2 shows the means of covariates by condition. Circulatory patients are older than other patients. For nervous system conditions, there are more female patients than male. About a quarter of the patients in each sample are foreign born, while the proportion of patients with tertiary education ranges from 17 to 21%. Private health insurance coverage is the highest for circulatory patients, whilst health cards are more prevalent for nervous system patients. In terms of health indicators, a higher percentage of patients with respiratory and circulatory conditions report fair/poor health (27%), and numerous chronic conditions. However, according to physical score, which is derived from difficulties in carrying out daily activities, nervous system patients have the worst health. For lifestyle variables, excessive drinking and smoking seem to affect respiratory system patients the most, while more obese individuals have nervous system problems.

[Table 2. Means of covariates by procedure]

5. Results

We had no strong prior expectations of how many types would be exhibited in our sample. However, it was reasonable to expect to find at least 3 types, capturing individuals who tend to use only public hospitals, those who use only private hospitals and those who use both. Table 3 reports the selection criteria for various models. AIC chooses bigger models than BIC, which is not surprising since BIC penalises additional parameters more harshly. Thus we follow BIC. Overall, entropy values are generally close to one, indicating minimal classification error. For the nervous and respiratory system groups, we identify 4 types of patients, while for the circulatory system group, the model with 5 types is the best. In the appendix, we show that the correlation between the indicator variables is substantially reduced once we take into account the latent type, which is one of the premises of LCA.

[Table 3. Selection Criteria]

5.1. Nervous system

We find 4 patient types. Table 4 shows the distribution of the 4 patient types, the hospital utilisation pattern by patient type (Panel A) and the predictors of each type (Panel B). The first type has admissions in private hospitals with a few secondary procedures and relatively short inpatient days. Hence we label this type as the “private hospital, moderate” (PVM) type. It represents 47.48% of the nervous system patients. The second type also has admissions in private hospitals but with many more secondary procedures and much longer inpatient days. Hence we label it the “private hospital, severe” (PVS) type. It represents 18.53% of the nervous system patients. The average PVS patient has an extra two or three secondary procedures and stays in hospital 5 days longer than the average PVM patient. The third type has admissions in public hospital, so we call this type the “public hospital” (PB)

type, which makes up 25% of the nervous system patients. Finally, the fourth type has admissions in public hospitals as private patients, so we label it the “public hospital, paying” (PBP) type. It represents 8.59% of the nervous system patients. We find that dual use of public and private hospitals is rare. For instance, the PVM type is almost never admitted to a public hospital. Similarly, the PB type almost exclusively uses public hospitals. The PBP type has higher private hospital utilisation than the PB type and has severity somewhere in between the PVS and the PB types.

The lower panel of Table 4 (Panel B) shows the average partial effects (APE) of covariates on the propensity of belonging to each type. Some of these covariates have strong predictive power over patient types, improving the accuracy of type prediction (Wurpts and Geiser, 2012). The PVM type tends to be older and less likely to live in a major city. They have high income, are privately insured and report fewer physical limitations. PVS type patients are also covered by private health insurance and have high income but report more physical limitations. The PB type has low income and is less likely to have private health insurance. Foreign-born patients tend to be PB. Those who do not drink alcohol for any reason, including abstinence due to health problems, also tend to be PB. For the PBP type, the strongest predictors are private health insurance and physical limitations.

[Table 4. Hospital utilisations and latent class predictors: Nervous system]

5.2. Respiratory system

The best model for respiratory patients finds 4 patient types. Table 5 Panel A shows a summary of the hospital utilisation indicators for each class. As with the above case, we find the same types as nervous system patients: PVM type, PVS type, PBP type and PB type.

The PVM and PVS types combined represent about 51% of the respiratory system patients. Patients of both types have about 1 admission during the past two years and are hardly admitted to public hospitals. However, compared to the PVM type, the PVS type stays much longer (5 days more) in hospitals and has three times the number of secondary procedures and double the number of ED visits. The PB type represents 33% of the respiratory system patients. They are hardly admitted to private hospitals. The PBP type represents 16% of the respiratory system patients.

Table 5 Panel B reports the APE of covariates for each type. The PVM type tends to be males living outside a major city with private health insurance. Obese individuals are most likely to belong to this type. We find that this result is driven by obese patients going through continuous positive airway pressure (CPAP) treatment in private hospitals to help them breathe better while sleeping. They may stay overnight in hospital, which is reflected in the relatively short length of stay for the PVM type. Meanwhile, the PVS type has physical limitations and many chronic conditions. The PB type tends to be younger and female, live in a major city, and have low income and no private health insurance. For the PBP type, as before, the private health insurance effect is very strong, followed by gender and age.

[Table 5. Hospital utilisations and latent class predictors: Respiratory systems]

5.3. Circulatory system

The sample of patients receiving treatment for circulatory system conditions is the largest of the three. The best model finds 5 patient types. This is shown in Table 6. As with the above two cases, we find the PVM type, PVS type and PBP type, but this time we also find two types that use public hospitals almost exclusively. One of them has many more secondary procedures and a longer length of stay than the other. Therefore, we name this type “public

hospital, severe" (PBS) and the other "public hospital, moderate" (PBM) type. These types combined make up 23% of circulatory patients.

The majority of circulatory system patients are found to belong to one of the private hospital types: the PVM represents 47% of patients and the PVS type represents 19%. Comparing these two types, the PVS type has twice the average number of secondary procedures than the PVM type and a 5 times longer length of stay. We find that the PVS type sometimes obtain treatment as private patients in public hospitals. PBP patients are not as severe as PBS or the PVS patients, but they are in worse health than PBM or PVM patients.

Table 6 Panel B describes the characteristics of each patient type. Again, as in previous cases, private health insurance is associated with the private patient types (PVM and PVS), whilst health cards are associated with the public patient types (PBM and PBS). The distinction between the severe and moderate types is found in age (older patients are more severe), gender (males are more severe), location, general health and physical limitations. Low-income patients are most likely to be the PBS and PBM types, whilst high-income patients are most likely to be the PVM type.

[Table 6. Hospital utilisations and latent class predictors: Circulatory systems]

5.4. Future Utilisation

In this section, we assess the extent to which the patient types obtained above may predict the future demand for hospital services. We run a Heckman-style selection model in which the selection equation concerns any elective admission a year after the survey date and the outcome equation is an admission to a private hospital. In the data, very few patients (around 11%) were admitted more than once for any procedure in the following year, so we

resort to a bivariate probit model with the patient types included as covariates. The APEs of covariates are reported in Table 7.

For nervous system patients, having more chronic conditions, having physical limitations and being obese increase the probability of a future admission. With PVS as the reference patient type, we find that the PVM and PBP types are more likely to have a future admission. The choice of a public or private hospital is determined by private health insurance status, income and whether the patient is one of the public hospital types. The public hospital types are significantly less likely to switch to a private hospital.

For respiratory system patients, the results show that patients who return to hospital in the future tend to be those who have fair and poor self-assessed health and more chronic conditions. They are more likely to be the public patient type (PB). None of the patient type indicators are significant in the choice of public or private hospital, however, as the sectoral choice is only influenced by private health insurance status.

Circulatory patients are found to be more likely to return to hospital if they are older, male with private health insurance and not in excellent or very good health and have higher physical scores. They are also less likely to be foreign born and tertiary educated. All patient types have similar probabilities of future admission. The probability of an admission to a private hospital increases with both private health insurance and possession of a health card. In our data, 25% of insurance holders also have health cards. It is possible that these patients anticipate an admission and purchase insurance to expedite treatment (Viney et al., 2006). Patient types matter for sectoral choice, with the PVS type being the most likely type to have a prospective admission at a private hospital, followed by the PBP type. The latter indicates a switching behaviour from public to private hospitals among those who used to

be a paying public patient. Meanwhile, those who used to be non-paying patients tend to remain in public hospitals.

[Table 7: Present classes as predictor for future utilisation: Heckman Probit Models]

6. Discussion

This paper examines hospital utilisation patterns at the individual patient level, focusing on the interactive use between public and private hospitals. In the setting where both providers are available to all patients and are equipped to provide the necessary treatments, the nature of the public-private hospital mix by patients has important implications for the financing and delivery of hospital services. We take the case of the Australian hospital market, where the public-private hospital share at the aggregate level is around 60-40.

Through LCA, we reveal the consumers of three popular elective inpatient procedures and their future demand. Elective treatment means that patients have the time to make a decision whether to go to a public or private hospital. We find that, at least for these procedures, despite the mixed system, most patients do not mix between sectors and use only a public or a private hospital. This is an interesting revelation, given that both sectors are quite even in size and offer competitive services. For policymakers who want to reduce fiscal burden, the low occurrence of sectoral switching is good news because it suggests that once patients enter the private sector, they are likely to remain in the private sector, thereby permanently shifting the public burden of health care to the patient. This in turn may provide incentives for individuals to increase investments in health, e.g. by eating healthily, exercising and taking more preventative care. The strongest instrument that may

initiate this move is private health insurance holding, which may justify policies to increase private health insurance rate. Dual use of public and private hospitals is observed more among patients who have private health insurance but for various reasons are admitted to public hospitals. These patients can afford health care services, either through out-of-pocket costs or insurance premiums. Across the three procedures we examine, they make up between 9 and 25% of patients. Other individual characteristics may also predict patient types. We find that older patients and male patients are more likely to belong to one of the private hospital types, as do high income patients. Lifestyle variables matter more for some conditions than others. For instance, for circulatory conditions, the private hospital types are more likely to lead an unhealthy lifestyle than the public hospital types. Meanwhile, poor general health and chronic conditions are associated with the types which use the most hospital resources.

The presence of chronic conditions or physical limitations increases the probability of an elective admission in the following year. Those with private health insurance are more likely to visit a private hospital. The private hospital types are also more likely to return to a private hospital than the public hospital types, except for patients of the public hospital paying type, who tend to switch to a private hospital.

Our study sheds light on what has largely been a black box to health policymakers: how *a patient* uses the coexistence of public and private hospitals. This information can only be obtained from individual-level longitudinal data, which reveal a patient's multiple admissions. Better still, our study uses longitudinal administrative hospital records that are not subject to patients' recall bias. We also demonstrate that the use of LCA, which has not been widely used in the health economics literature, is creative and that LCA can be used to

profile hospital demand. Patient types reveal to policymakers the demand structure of a given hospital service which in turn is a valuable input in resource allocation. Meanwhile, knowing the predictors of each patient type may inform us about patient heterogeneity in public and private hospitals and allow policymakers to shape the demand structure in the future. In this case, we find that private health insurance can lower the utilisation of public hospitals, thereby reducing the public health care burden. A reduction in health costs may also be achieved through public policies that promote a general improvement in health to reduce use of resources per admission. Finally, we are able to show that current patient types are useful for predicting patients' future hospital admissions.

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Table 1 – Hospital utilisation indicators: levels and their sample percentages (%) by procedure

Indicators	Nervous	Respiratory	Circulatory
Public hospital patients			
0	74.31	66.86	76.43
1	22.45	29.52	20.09
≥2	3.25	3.62	3.48
Private in public hospital patients			
0	91.03	82.38	88.14
1	7.86	16.22	10.66
≥2	1.11	1.40	1.21
Private hospital patients			
0	33.68	48.77	32.80
1	55.47	47.37	54.17
≥2	10.84	3.85	13.06
Average secondary procedures			
0	15.88	45.74	17.36
0-1	2.06	3.27	3.50
1-2	52.00	32.09	50.97
>2	30.07	18.90	28.11
ED visits			
0	75.22	71.41	70.36
1-2	15.82	17.62	18.37
>2	8.97	10.97	11.27
Average LOS			
1	63.84	74.80	66.90
1-4	20.02	13.89	17.54
>4	16.16	11.32	15.56
Total admissions	3564	988	6990
% Public hospital	23.85	34.51	23.82
Patients	2877	857	5058

Table 2 – Mean of covariates by procedure

	Nervous system	Respiratory system	Circulatory system
Age	65.84	65.32	68.47
Male	0.432	0.601	0.622
Major city	0.457	0.455	0.547
Foreign born	0.222	0.217	0.239
Tertiary educated	0.175	0.207	0.189
Private health insurance	0.682	0.656	0.716
Health card	0.374	0.343	0.368
Working	0.353	0.396	0.321
Income $5,000 to $19,999	0.235	0.225	0.233
Income $20,000 to 69,999 (Reference group)			
Income $70,000 or more	0.157	0.190	0.171
Health very good/excellent (Reference group)			
Health good	0.358	0.397	0.382
Health fair & poor	0.246	0.273	0.269
Physical score (0-20 worst)	6.03	5.03	5.20
Number of chronic conditions (0-9)	1.60	1.92	2.18
No alcohol	0.380	0.329	0.337
Heavy alcohol use (drinks per week >22)	0.074	0.104	0.090
Low risk drinking (Reference group)			
Obese	0.292	0.268	0.230
Ever smoked	0.453	0.564	0.496

Table 3 – Bayesian Information Criteria for different number of classes by procedure

Number of classes (k)	Nervous system			Respiratory system			Circulatory system		
	AIC	BIC	Entropy	AIC	BIC	Entropy	AIC	BIC	Entropy
2	25334.953	25609.320	0.732	7821.212	8039.8698	0.935	43240.437	43540.759	0.988
3	20953.383	21424.579	0.996	6905.819	7281.3404	0.972	40557.229	41072.998	0.942
4	20175.361	20843.386*	0.932	6377.629	6910.0144*	0.988	39816.434	40547.651	0.882
5	20064.975	20929.828	0.887	6323.503*	7012.7514	0.978	36883.145	37829.810*	0.887
6	20030.109*	21091.791	0.920	6336.109	7182.2208	0.955	36671.953*	37834.066	0.921

Notes: * indicates best class. AIC=$-2\ln L + 2\,h$; BIC=$-2\ln L + h\ln(n_c)$; entropy= $1-\left(-\sum_{i=1}^{N}\sum_{l=1}^{n_c}\hat{p}_{il}\ln(\hat{p}_{il})/N\ln(n_c)\right)$ where $\ln L$ is the log likelihood of the model, h is the number of estimated parameters, n_c is the number of class, N is sample size and p is posterior probability from the estimated model. For circulatory with 2 classes, the model is simplified and includes only demographics and health as covariates.

Table 4 - Hospital utilisation patterns & class predictors: nervous system patients

	Private hospital, moderate (PVM)		Private hospital, severe (PVS)		Public hospital (PB)		Public hospital, paying (PBP)	
A. Hospital utilisation patterns	Mean		Mean		Mean		Mean	
Public hospital	0.001		0.013		1.152		0.000	
Private in public hospital	0.002		0.009		0.007		1.158	
Private hospital	1.315		1.109		0.008		0.061	
Average secondary procedures	1.517		4.073		1.170		1.901	
ED visits	0.332		0.373		0.570		0.478	
Average LOS	1.193		6.162		2.263		3.179	
B. Class predictors	APE	(SE)	APE	(SE)	APE	(SE)	APE	(SE)
Age	0.002**	(0.001)	0.001	(0.001)	-0.002***	-0.001	-0.001	(0.001)
Male	-0.023	(0.019)	0.041***	(0.015)	-0.022*	-0.013	0.004	(0.011)
Major city	-0.039**	(0.017)	0.053***	(0.014)	-0.020*	-0.011	0.006	(0.011)
Foreign born	-0.017	(0.021)	-0.008	(0.017)	0.032**	-0.013	-0.006	(0.013)
Tertiary educated	-0.024	(0.024)	-0.002	(0.018)	0.009	-0.020	0.016	(0.013)
Private health insurance	0.199***	(0.021)	0.110***	(0.020)	-0.339***	-0.007	0.030**	(0.013)
Health card	0.012	(0.021)	-0.021	(0.018)	0.019	-0.012	-0.010	(0.013)
Working	-0.011	(0.023)	0.014	(0.019)	0.007	-0.015	-0.010	(0.013)
Income $5,000 to $19,999	-0.077***	(0.026)	0.020	(0.021)	0.078***	-0.014	-0.020	(0.017)
Income $70,000 or more	-0.035	(0.029)	0.043**	(0.022)	-0.020	-0.027	0.011	(0.016)
Health good	-0.014	(0.020)	0.001	(0.017)	0.010	-0.014	0.004	(0.013)
Health fair & poor	0.002	(0.027)	-0.034	(0.023)	0.017	-0.016	0.015	(0.017)
Physical score	-0.005**	(0.002)	0.006***	(0.002)	-0.003***	-0.001	0.002*	(0.001)
Number of chronic conditions	-0.002	(0.007)	-0.005	(0.006)	0.007	-0.005	0.000	(0.004)
No alcohol	-0.021	(0.019)	-0.021	(0.016)	0.033***	-0.012	0.008	(0.012)
Heavy alcohol use	0.034	(0.034)	-0.026	(0.027)	-0.016	-0.023	0.009	(0.020)
Obese	-0.016	(0.020)	0.011	(0.016)	0.020	-0.012	-0.016	(0.012)
Ever smoked	-0.004	(0.018)	-0.005	(0.015)	0.013	-0.012	-0.003	(0.011)
Number of patients	1366		533		731		247	
(class %)	(47.48)		(18.53)		(25.41)		(8.59)	

Notes: The total sample size is 2,877. The average partial effects (APE) are derived from a multinomial logit model with robust standard errors and PB type as the base group. APEs are corrected for multiple category variables. *, ** and *** indicate significance at the 10%, 5% and 1%, respectively.

Table 5 - Hospital utilisation patterns & class predictors: respiratory system patients

	Private hospital moderate (PVM)		Private hospital severe (PVS)		Public hospital (PB)		Public hospital, paying (PBP)	
A. Hospital utilisation patterns	Mean		Mean		Mean		Mean	
Public hospital	0.006		0.042		1.192		0.000	
Private in public hospital	0.006		0.116		0.000		1.086	
Private hospital	1.076		1.158		0.000		0.021	
Average secondary procedures	0.805		3.402		1.251		1.204	
ED visits	0.296		0.621		0.719		0.500	
Average LOS	1.003		6.003		3.160		3.867	
B. Class predictors	APE	(SE)	APE	(SE)	APE	(SE)	APE	(SE)
Age	0.001	(0.002)	-0.001	(0.002)	-0.003**	-0.001	0.004**	(0.002)
Male	0.123***	(0.032)	-0.011	(0.022)	-0.041*	-0.024	-0.071***	(0.025)
Major city	-0.083***	(0.031)	0.010	(0.023)	0.055**	-0.023	0.018	(0.026)
Foreign born	-0.025	(0.037)	-0.014	(0.028)	0.040	-0.027	0.000	(0.030)
Tertiary educated	0.022	(0.037)	-0.001	(0.028)	-0.034	-0.029	0.013	(0.029)
Private health insurance	0.139***	(0.041)	0.105***	(0.038)	-0.397***	-0.016	0.154***	(0.039)
Health card	0.043	(0.039)	-0.033	(0.028)	-0.031	-0.03	0.021	(0.033)
Working	0.040	(0.042)	-0.030	(0.030)	-0.015	-0.029	0.004	(0.034)
Income $5,000 to $19,999	-0.082*	(0.047)	-0.033	(0.035)	0.063**	-0.029	0.053	(0.035)
Income $70,000 or more	0.053	(0.045)	-0.005	(0.033)	-0.077**	-0.037	0.030	(0.037)
Health good	-0.023	(0.036)	0.017	(0.026)	0.013	-0.027	-0.008	(0.030)
Health fair & poor	-0.023	(0.051)	-0.008	(0.041)	-0.019	-0.038	0.049	(0.041)
Physical score	-0.006	(0.004)	0.006*	(0.003)	0.001	-0.003	0.000	(0.003)
Number of chronic conditions	-0.015	(0.012)	0.023***	(0.008)	-0.004	-0.008	-0.004	(0.009)
No alcohol	0.033	(0.036)	-0.035	(0.024)	0.029	-0.026	-0.027	(0.029)
Heavy alcohol use	0.045	(0.049)	-0.024	(0.038)	-0.049	-0.037	0.028	(0.038)
Obese	0.186***	(0.033)	-0.060**	(0.026)	-0.097***	-0.027	-0.029	(0.029)
Ever smoked	-0.006	(0.031)	-0.004	(0.023)	0.009	-0.024	0.000	(0.025)
Number of patients	341		95		281		140	
(class %)	(39.79)		(11.09)		(32.79)		(16.34)	

Notes: The total sample size is 857. The average partial effects (APE) are derived from a multinomial logit model with robust standard errors and PB type as the base group. APEs are corrected for multiple category variables. *, ** and *** indicate significance at the 10%, 5% and 1%, respectively.

Table 6 - Hospital utilisation patterns & class predictors: circulatory system patients

	Private hospital moderate (PVM)		Private hospital severe (PVS)		Public hospital moderate (PBM)		Public hospital severe (PBS)		Public hospital, paying (PBP)	
A. Hospital utilisation patterns	Mean		Mean		Mean		Mean		Mean	
Public hospital	0.001		0.006		1.383		1.171		0.000	
Private in public hospital	0.009		0.066		0.059		0.036		1.179	
Private hospital	1.113		1.702		0.019		0.011		0.002	
Average secondary procedures	1.576		3.811		0.422		4.156		1.734	
ED visits	0.348		0.519		0.679		1.003		0.737	
Average LOS	1.133		4.753		1.263		8.553		3.388	
B. Class predictors	APE	(SE)	APE	(SE)	APE	(SE)	APE	(SE)	APE	(SE)
Age	0.001	(0.001)	0.004***	(0.001)	-0.003***	0.000	0.000	0.000	-0.001*	(0.001)
Male	-0.102***	(0.014)	0.098***	(0.013)	0.001	-0.009	0.009	-0.007	-0.005	(0.009)
Major city	0.055***	(0.013)	-0.020*	(0.011)	-0.038***	-0.008	0.020***	-0.007	-0.017**	(0.009)
Foreign born	-0.017	(0.015)	-0.032**	(0.013)	0.030***	-0.009	0.015**	-0.007	0.003	(0.010)
Tertiary educated	-0.035**	(0.017)	0.017	(0.014)	0.019	-0.014	-0.013	-0.013	0.012	(0.011)
Private health insurance	0.171***	(0.019)	0.146***	(0.018)	-0.214***	-0.01	-0.103***	-0.009	0.000	(0.010)
Health card	0.034**	(0.015)	-0.031**	(0.013)	-0.004	-0.01	-0.001	-0.008	0.002	(0.010)
Working	0.019	(0.017)	-0.019	(0.014)	0.021*	-0.012	-0.015	-0.011	-0.007	(0.011)
Income $5,000 to $19,999	-0.025	(0.019)	-0.025	(0.016)	0.022**	-0.011	0.025***	-0.008	0.002	(0.012)
Income $70,000 or more	0.098***	(0.020)	-0.037**	(0.016)	-0.03	-0.019	-0.003	-0.019	-0.027**	(0.014)
Health good	-0.034**	(0.015)	0.018	(0.013)	0.003	-0.011	0.005	-0.009	0.008	(0.010)
Health fair & poor	-0.004	(0.020)	-0.003	(0.017)	0.010	-0.013	-0.007	-0.01	0.003	(0.014)
Physical score	-0.005***	(0.002)	0.005***	(0.001)	-0.001	-0.001	0.000	-0.001	0.001	(0.001)
Number of chronic conditions	-0.002	(0.005)	0.003	(0.004)	-0.005	-0.003	0.004	-0.003	0.000	(0.004)
No alcohol	-0.031**	(0.015)	0.002	(0.012)	0.014	-0.009	0.015**	-0.007	0.000	(0.009)
Heavy alcohol use	0.041*	(0.022)	-0.024	(0.018)	-0.017	-0.016	-0.005	-0.013	0.005	(0.015)
Obese	0.034**	(0.016)	-0.041***	(0.014)	0.015	-0.010	0.001	-0.008	-0.008	(0.011)
Ever smoked	-0.021	(0.013)	0.021*	(0.011)	-0.006	-0.009	0.013*	-0.007	-0.006	(0.009)
Number of patients	2399		980		826		362		491	
(class %)	(47.43)		(19.38)		(16.33)		(7.16)		(9.71)	

Notes: The total sample size is 5,058. The average partial effects (APE) are derived from a multinomial logit model with robust standard errors and PB type as the base group. APEs are corrected for multiple category variables. *, ** and *** indicate significance at the 10%, 5% and 1%, respectively.

Table 7 – Present classes as predictor for future utilisation: APE from Heckman Probit Models

	Nervous system				Respiratory system				Circulatory system			
	Selection equation		Outcome equation		Selection equation		Outcome equation		Selection equation		Outcome equation	
	APE	(SE)	APE	(SE)	APE	(SE)	APE	(SE)	APE	(SE)	APE	(SE)
Age	0.001	(0.001)	0.000	(0.001)	0.003	(0.002)	0.001	(0.002)	0.002***	(0.001)	0.002	(0.003)
Male	0.003	(0.019)	0.003	(0.016)	0.019	(0.034)	-0.018	(0.041)	0.035**	(0.015)	-0.011	(0.029)
Major city	-0.018	(0.018)	0.016	(0.014)	0.018	(0.033)	-0.008	(0.044)	-0.018	(0.014)	0.027	(0.021)
Foreign born	-0.016	(0.021)	-0.029	(0.019)	-0.036	(0.039)	0.075	(0.056)	-0.042***	(0.016)	-0.051	(0.048)
Tertiary educated	0.003	(0.025)	0.006	(0.021)	-0.003	(0.043)	-0.069	(0.062)	-0.042**	(0.018)	-0.009	(0.043)
Private health insurance	0.044	(0.028)	0.110***	(0.029)	0.073	(0.051)	0.301***	(0.089)	0.049**	(0.024)	0.265**	(0.120)
Health card	0.014	(0.021)	-0.008	(0.016)	0.019	(0.040)	-0.028	(0.050)	-0.016	(0.016)	0.059**	(0.026)
Working	-0.039*	(0.023)	-0.015	(0.020)	0.023	(0.043)	-0.006	(0.056)	-0.014	(0.018)	-0.015	(0.032)
Inc $5,000 to $19,999	-0.005	(0.024)	-0.063***	(0.024)	-0.041	(0.042)	0.020	(0.058)	-0.012	(0.018)	-0.049	(0.035)
Inc $70,000 or more	0.037	(0.029)	-0.001	(0.022)	0.021	(0.051)	0.013	(0.069)	0.010	(0.021)	0.052	(0.042)
Health good	0.018	(0.021)	-0.02	(0.017)	0.043	(0.038)	-0.015	(0.053)	0.060***	(0.016)	-0.032	(0.041)
Health fair & poor	0.019	(0.027)	-0.025	(0.020)	0.105**	(0.051)	-0.018	(0.069)	0.107***	(0.021)	0.000	(0.073)
Physical score	0.009***	(0.002)	-0.001	(0.002)	0.003	(0.004)	0.003	(0.005)	0.006***	(0.002)	-0.001	(0.004)
Chronic conditions	0.020***	(0.007)	-0.004	(0.006)	0.028**	(0.012)	0.005	(0.016)	0.005	(0.005)	0.002	(0.009)
No alcohol	-0.007	(0.018)			0.031	(0.034)			0.022	(0.015)		
Heavy alcohol use	0.024	(0.032)			-0.063	(0.046)			0.036	(0.024)		
Obese	0.046**	(0.018)			-0.024	(0.034)			-0.019	(0.019)		
Ever smoked	0.012	(0.017)			-0.014	(0.030)			-0.008	(0.015)		
PVM	0.049**	(0.023)	0.013	(0.015)	0.071	(0.049)	0.091	(0.084)	0.000	(0.018)	0.053	(0.036)
PBP	0.062*	(0.035)	-0.117***	(0.034)	0.003	(0.054)	-0.121	(0.097)	0.003	(0.025)	-0.289**	(0.116)
PB	0.038	(0.033)	-0.186***	(0.063)	0.167***	(0.063)	-0.096	(0.112)				
PVS	Base		Base		Base		Base		Base		Base	
PBS									0.003	(0.034)	-0.464*	(0.265)
PBM									0.046	(0.030)	-0.436*	(0.256)

Notes: sample size for nervous is 2,877, for respiratory is 857 and for circulatory is 5049. The selection equation is the probability of having any admission next year and the outcome equation is the probability of an admission into a private hospital next year. Lifestyle variables (no alcohol, heavy alcohol use, obese & ever smoked) are used as instruments for any admission and appear only in the selection equation. *, ** and *** indicate significance at the 10%, 5% and 1%, respectively.

Appendix – Correlation matrices

Nervous system

All	# admissions (public hospital public patient)	# admissions (public hospital private patient)	# admissions (private hospital private patient)	Average # secondary procedures	# ED visits	Average LOS
# admissions (public hospital public patient)	1					
# admissions (public hospital private patient)	-0.157	1				
# admissions (private hospital private patient)	-0.6687	-0.3263	1			
Average # secondary procedures	-0.4384	-0.0721	0.3746	1		
# ED visits	0.1171	0.0116	-0.0919	-0.0345	1	
Average LOS	-0.0879	0.0796	-0.003	0.5003	0.0439	1
By type						
PVS	# admissions (public hospital public patient)	# admissions (public hospital private patient)	# admissions (private hospital private patient)	Average # secondary procedures	# ED visits	Average LOS
# admissions (public hospital public patient)	1					
# admissions (public hospital private patient)	-0.0112	1				
# admissions (private hospital private patient)	-0.0399	0.0293	1			
Average # secondary procedures	-0.0819	0.0299	0.0415	1		
# ED visits	0.022	0.0784	-0.0488	-0.0065	1	
Average LOS	-0.0453	-0.0439	-0.0912	-0.2273	-0.0153	1
PVM	# admissions (public hospital public patient)	# admissions (public hospital private patient)	# admissions (private hospital private patient)	Average # secondary procedures	# ED visits	Average LOS
# admissions (public hospital public patient)	1					
# admissions (public hospital private patient)	-0.0007	1				
# admissions (private hospital private patient)	-0.0122	-0.0122	1			
Average # secondary procedures	-0.0017	-0.0017	-0.0433	1		
# ED visits	0.0802	-0.0129	0.0306	-0.0104	1	
Average LOS	-0.0098	-0.0098	0.0621	-0.0455	0.0663	1
PB	# admissions (public hospital public patient)	# admissions (public hospital private patient)	# admissions (private hospital private patient)	Average # secondary procedures	# ED visits	Average LOS
# admissions (public hospital public patient)	1					
# admissions (public hospital private patient)	-0.0317	1				
# admissions (private hospital private patient)	0.0083	0.2787	1			
Average # secondary procedures	-0.086	0.013	-0.0025	1		
# ED visits	0.0471	-0.0069	0.004	0.0528	1	
Average LOS	-0.0394	-0.0004	-0.0073	0.6115	0.1019	1
PBP	# admissions (public hospital public patient)	# admissions (public hospital private patient)	# admissions (private hospital private patient)	Average # secondary procedures	# ED visits	Average LOS
# admissions (public hospital public patient)						
# admissions (public hospital private patient)		1				
# admissions (private hospital private patient)		-0.0361	1			
Average # secondary procedures		-0.125	0.0528	1		
# ED visits		-0.0215	-0.0083	-0.0203	1	
Average LOS		-0.1824	-0.0255	0.6476	-0.0008	1

Notes: PBP type has no admissions to public hospital as public patient.

Respiratory system

All	# admissions (public hospital public patient)	# admissions (public hospital private patient)	# admissions (private hospital private patient)	Average # secondary procedures	# ED visits	Average LOS
# admissions (public hospital public patient)	1					
# admissions (public hospital private patient)	-0.2968	1				
# admissions (private hospital private patient)	-0.6215	-0.3494	1			
Average # secondary procedures	-0.0836	-0.0909	0.2276	1		
# ED visits	0.1167	0.0304	-0.1292	0.0626	1	
Average LOS	0.1154	0.0625	-0.0889	0.5638	0.194	1
By type						
PVS	# admissions (public hospital public patient)	# admissions (public hospital private patient)	# admissions (private hospital private patient)	Average # secondary procedures	# ED visits	Average LOS
# admissions (public hospital public patient)	1					
# admissions (public hospital private patient)	-0.056	1				
# admissions (private hospital private patient)	-0.0615	-0.0256	1			
Average # secondary procedures	-0.133	-0.3029	-0.0698	1		
# ED visits	0.0088	-0.0463	-0.1903	-0.0075	1	
Average LOS	-0.1186	-0.23	-0.0543	0.2031	-0.0085	1
PVM	# admissions (public hospital public patient)	# admissions (public hospital private patient)	# admissions (private hospital private patient)	Average # secondary procedures	# ED visits	Average LOS
# admissions (public hospital public patient)	1					
# admissions (public hospital private patient)	-0.0042	1				
# admissions (private hospital private patient)	-0.0202	-0.0142	1			
Average # secondary procedures	0.0235	0.0419	0.1471	1		
# ED visits	-0.0344	-0.0243	0.1155	-0.0286	1	
Average LOS	-0.0042	-0.0029	-0.0142	-0.0594	0.072	1
PB	# admissions (public hospital public patient)	# admissions (public hospital private patient)	# admissions (private hospital private patient)	Average # secondary procedures	# ED visits	Average LOS
# admissions (public hospital public patient)	1					
# admissions (public hospital private patient)						
# admissions (private hospital private patient)						
Average # secondary procedures	0.0489			1		
# ED visits	-0.0081			0.1534	1	
Average LOS	0.0911			0.6656	0.2674	1
PBP	# admissions (public hospital public patient)	# admissions (public hospital private patient)	# admissions (private hospital private patient)	Average # secondary procedures	# ED visits	Average LOS
# admissions (public hospital public patient)						
# admissions (public hospital private patient)		1				
# admissions (private hospital private patient)		-0.041	1			
Average # secondary procedures		0.203	0.0206	1		
# ED visits		0.0201	0.0465	0.0644	1	
Average LOS		0.1943	-0.0803	0.7355	0.0894	1

Notes: PB type has no admissions to public hospital as paying patients or private hospital and PBP type has no admissions to public hospital as public patient.

Circulatory system

All	# admissions (public hospital public patient)	# admissions (public hospital private patient)	# admissions (private hospital private patient)	Average # secondary procedures	# ED visits	Average LOS
# admissions (public hospital public patient)	1					
# admissions (public hospital private patient)	-0.1369	1				
# admissions (private hospital private patient)	-0.6298	-0.3475	1			
Average # secondary procedures	-0.3353	-0.0967	0.3853	1		
# ED visits	0.1189	0.0769	-0.13	-0.0368	1	
Average LOS	0.13	0.0771	-0.0418	0.3889	0.1083	1
By type						
PVS	# admissions (public hospital public patient)	# admissions (public hospital private patient)	# admissions (private hospital private patient)	Average # secondary procedures	# ED visits	Average LOS
# admissions (public hospital public patient)	1					
# admissions (public hospital private patient)	0.0293	1				
# admissions (private hospital private patient)	-0.0509	-0.0905	1			
Average # secondary procedures	-0.0033	-0.1326	-0.1884	1		
# ED visits	0.0086	0.0796	-0.1044	0.0159	1	
Average LOS	-0.018	-0.0366	-0.1953	0.298	-0.0635	1
PVM	# admissions (public hospital public patient)	# admissions (public hospital private patient)	# admissions (private hospital private patient)	Average # secondary procedures	# ED visits	Average LOS
# admissions (public hospital public patient)	1					
# admissions (public hospital private patient)	0.1178	1				
# admissions (private hospital private patient)	-0.01	-0.009	1			
Average # secondary procedures	0.0013	0.0034	-0.0754	1		
# ED visits	0.022	0.0774	0.011	-0.0279	1	
Average LOS	-0.0112	-0.0135	-0.0837	-0.0433	0.0805	1
PBS	# admissions (public hospital public patient)	# admissions (public hospital private patient)	# admissions (private hospital private patient)	Average # secondary procedures	# ED visits	Average LOS
# admissions (public hospital public patient)	1					
# admissions (public hospital private patient)	-0.0391	1				
# admissions (private hospital private patient)	-0.0443	-0.0204	1			
Average # secondary procedures	0.045	0.0678	0.0571	1		
# ED visits	-0.0327	-0.0186	-0.0258	-0.1703	1	
Average LOS	-0.0864	-0.1271	-0.008	-0.1155	-0.0273	1
PBM	# admissions (public hospital public patient)	# admissions (public hospital private patient)	# admissions (private hospital private patient)	Average # secondary procedures	# ED visits	Average LOS
# admissions (public hospital public patient)	1					
# admissions (public hospital private patient)	0.1039	1				
# admissions (private hospital private patient)	-0.006	-0.0175	1			
Average # secondary procedures	-0.0091	-0.0428	0.1039	1		
# ED visits	0.0103	-0.0554	-0.0017	-0.006	1	
Average LOS	0.1427	0.0074	0.0064	0.2126	0.0831	1
PBP	# admissions (public hospital public patient)	# admissions (public hospital private patient)	# admissions (private hospital private patient)	Average # secondary procedures	# ED visits	Average LOS
# admissions (public hospital public patient)						
# admissions (public hospital private patient)		1				
# admissions (private hospital private patient)		-0.0152	1			
Average # secondary procedures		0.0613	-0.0572	1		
# ED visits		0.0534	-0.0322	0.0019	1	
Average LOS		0.0078	-0.0347	0.5028	0.1142	1

Notes: PBP type has no admissions to public hospital as public patient.