A1
A comparison of frequentist and Bayesian approaches to the estimation of long-stay per-diems
Jeff Hatcher1 and Jason M Sutherland2
1Canadian Institute for Health Information, Ottawa, Ontario, Canada
2The Dartmouth Institute for Health Policy and Clinical Practice, Dartmouth College, Hanover, NH, USA

Introduction: Within many diagnosis related group (DRG) systems, there is recognition that a single cost weight per DRG is not suitable, and that cost weights should take into account extremely lengthy hospital stays. Long lengths of stay are considered to be due to factors largely beyond the control of the hospital, and a single weight per DRG would potentially place hospitals under financial risk.

Within Canada’s acute-care, inpatient grouping methodology - Case Mix Groups (CMG+) - long-stay episodes represent approximately 4.5% of all discharges. Within a CMG (analogous to DRG), the cost weight assigned to long-stay cases consists of the typical cost weight, plus a per diem for each day the case stays beyond the CMG mean. Within a CMG, the volume of long-stay records may be low, and the episode cost data highly variable. This results in per diem estimates of low precision. In this paper, we compare two methods for calculating long-stay per diems. We employ Bayesian methods for sparse data, and compare the results to those of the current frequentist approach.

Methods: CMG+ uses a two-step, likelihood-based approach to estimate long-stay per diems. In the first step, per diems are estimated using a weighted, least-squares regression model fitted separately to each CMG. Only typical cases are used (i.e., deaths, signouts, transfers - and long-stay cases are excluded). The dependent variable in this regression is the cost of the case, while the independent variable is the length of stay. This model provides an estimate of the fixed cost as well as an estimate of the per diem for typical cases. In the second step, a weighted, least-squares regression model is fitted to the long-stay cases. The dependent variable in this regression is the ratio of the actual cost of the case to the predicted cost, where the predicted cost incorporates the typical per diems from the first step. The independent variables are case mix effects. This model provides adjustments to the typical per diem, resulting in per diems for long-stay cases.

There is a strong motivation for proposing a Bayesian alternative. First, the current long-stay per diem estimates are susceptible to cost outliers. Second, we have very good information to inform prior distributions based on aggregating information for long-stay episodes across CMG. In our Bayesian alternative, a weighted, least-squares regression model will first estimate the fixed and per diem values across all CMG. In the second step, these estimates will act as prior distributions for the weighted, least-squares regression models that estimate the typical per diem for each CMG. We will evaluate whether the Bayesian models are sensitive to the values of the prior probability distributions.

Results: We will compare the long-stay per diems, calculated using the current frequentist approach, with those calculated using our Bayesian approach. We will evaluate the magnitude and direction of changes in the per diems, changes in explanatory power of the resulting cost weights, and changes in weighted cases by hospital and stratum of hospitals.

Conclusion: Hospitals with a disproportionate share of long-stay cases have the most at stake when per diem values are inaccurate. For CMG with large differences, underlying causes will be pursued. We will discuss whether the computing effort associated with implementing Bayesian methods is worthwhile in terms of improvement in the accuracy and precision of per diem estimates.

A2
System-wide impacts of provider-payment reforms: evidence from the health sectors of Central and Eastern Europe and Central Asia
R Moreno-Serra1, R Moreno-Serra2 and A Wagstaff3
1Centre for Health Economics, University of York, York, UK
2Department of Economics, University of York, York, UK
3Development Research Group, The World Bank, Washington, DC, USA

Introduction: Only a small portion of today’s existing research has made use of rigorous empirical methods to convincingly isolate the impact on the health sector of the new provider-payment arrangements from those which resulted from other changes occurring at the same time. Throughout the 1990s and early 2000s, several transitional countries in Central and Eastern Europe and Central Asia (ECA) aimed at reforming their provider-payment systems in order to achieve the general
Introduction: In Portugal, there is no formal casemix inpatient rehabilitation classification system. The budget for inpatient rehabilitation facilities within the Portuguese NHS is calculated on a per diem basis, with no relation to the diagnosis and the complexity of the patients treated. However, there is an ongoing pilot project where inpatient episodes are classified according to pathology (using ICD 9 CM), functional limitation group, and motor and cognitive functional independency (using the Functional Independence Measure). In a country where there is no systemized information on the complexity of treated rehabilitation inpatients, such a classification may give important information about the treated patients, enabling more adequate care management and resource utilization.

In addition, the aim of this pilot project is to create a specific rehabilitation grouper, where each group has a different price indexed to its complexity. And, as far as rehabilitation care is concerned, it is clear that most of the instruments measuring disability do not accurately reflect the patients’ overall clinical conditions. Measuring complexity, especially for financing proposes, is a controversial issue where the use of one instrument instead of another depends on the goal of the financing system. Therefore, the authors compared three different instruments concerning patient classification in rehabilitation inpatient facilities.

Methods: The aims of this study are to review disability measuring instruments, apply them to a stroke-rehabilitation inpatient sample, and then study the results. The objective is to identify if there is a concordance between the different ways of measuring disability. In the ongoing classification project, inpatient episodes throughout some NHS rehabilitation facilities have been classified retrospectively, and a database of about 1000 episodes, with nearly 400 stroke inpatient episodes, has been created. Also retrospectively, and for the present study, the ICF qualifiers and the Barthel Index were applied to the stroke-rehabilitation inpatients sample of this database. In order to compare final classifications, statistical analysis was carried out to observe the concordance between the instruments.

Results: In its final results, the study suggests that differences between scales reside mainly in what dimensions they measure. However, if we establish cut points between the disability severity levels in each instrument, and compare them as global or partial single measures, there is a significant concordance between the scales used.

Conclusion: Both the level of disability in rehabilitation, and the burden of care it implies, have to be integrated into any financing system for inpatient rehabilitation facilities. Each instrument measures complexity differently according to the evaluated dimensions. However, one may or may not come across diverse results about the level of patient functional dependence when using different ways of measurement. A patient classification system that will sustain a rehabilitation financing system does not have to integrate all possible dimensions (as it must do for clinical purposes), but it must give an accurate measurement based on complexity and functional dependence. Deciding on what kind of measuring instrument to apply depends on our goal in terms of budgeting.

A4 Setting economic priorities for patient safety programs and patient safety research using case mix costing data

T Jackson1, HS Nghiem1, D Rowell1, C Jorm2 and J Wakefield3

1Australian Centre for Economic Research on Health, University of Queensland, Herston QLD, Queensland, Australia
2Australian Commission on Safety and Quality in Health Care, Department of Health & Ageing, Sydney, New South Wales, Australia
3Queensland Health Patient Safety Centre, Queensland Health, Brisbane, Queensland, Australia

BMC Health Services Research 2009, 9(Suppl 1):A4

Introduction: Patient safety efforts are often recommended solely on judgments about the relative importance of particular
adverse events in hospital care, without considering the frequency and costs of all hospital-acquired illness and injury. The objective of the study was to use patient-level cost data to estimate relative economic priorities for hospital inpatient safety efforts.

**Methods:** Patient level costs are estimated using computerized patient costing systems that initially log individual utilization of inpatient services, and then apply sophisticated cost estimates from the hospital’s general ledger. The occurrence of a hospital-acquired diagnosis is identified using a new Australian ‘condition-onset’ flag for all diagnoses not present on admission. These diagnoses are grouped to yield a comprehensive set of 144 categories of hospital-acquired conditions, using a recently-developed algorithm to summarize data coded with ICD-10-AM. Standard linear regression techniques are used to identify the independent contribution to inpatient costs of hospital-acquired conditions, taking into account the case mix of a sample of acute inpatients (n = 1,699,997) treated in Australian public hospitals in Victoria (2005/06) and Queensland (2006/07).

**Results:** The most costly types of adverse events were post-procedure endocrine and metabolic disorders, adding $A 21,869 to the cost of an episode, followed by (methicillin-resistant staphylococcus aureus) MRSA (+$A 19,745) and enterocolitis due to Clostridium difficile (+$A 17,475). Aggregate additional costs to the system were highest for sepsicaemia (+$A 41.5 mil), complications of cardiac and vascular implants other than sepsicaemia (+$A 28.7 mil), acute lower respiratory infections – including influenza and pneumonia ($A 28.0 mil) – and UTI (+$A 24.7 mil). Hospital acquired complications are estimated to add 17.1% to the costs of treatment in this sample.

**Conclusion:** Patient safety efforts frequently focus on dramatic but rare complications with very serious patient harms. Adding an economic dimension to priority-setting could result in changes to the priorities of patient safety programs. It could also provide guidance as to other areas where research into causes and prevention strategies may prove a productive investment. Financial information should be combined with information on patient harms to allow for cost-utility evaluation of future programs.

**A5**

The role of diagnosis related groups (DRGs) in healthcare system convergence

Mirella Cacace and Achim Schmid

Collaborative Research Center 597, “Transformations of the State”, University of Bremen, Linzer Strasse 9 A, 28359 Bremen, Germany

E-mail: mirella.cacace@sfb597.uni-bremen.de

**BMC Health Services Research 2009, 9(Suppl 1):A5**

**Introduction:** Healthcare systems in the early 1970s, the so-called ‘golden age’ of the welfare state, came much closer to what we characterize as distinct ideal types: the Private Insurance System, the Social Insurance System and the National Health Service (NHS). During the past decades, as a consequence of problem pressure caused, for example, by globalization and demographic change, healthcare systems have grown more alike and become ‘hybrid’ over time. This can be interpreted as a form of healthcare system convergence.

One possible explanation for this convergence is that systems have learned from one another. In our contribution, we show that DRGs (1) provide a convincing example for policy learning and the diffusion of ideas in healthcare systems and (2) corroborate our argument regarding system convergence and hybridization. Taking the United States, England, and Germany as examples, we show that these most distinct cases of healthcare systems have implemented DRGs, yet with very different objectives and consequences.

**Methods:** The proposed contribution is placed in the field of comparative research on healthcare systems. In our case selection, we follow the typology of healthcare systems by selecting a ‘most distinct case’-design. The US represents a Private Insurance System, while the English NHS is a state-led healthcare system of the Beveridge type. Germany, finally, with the oldest Social Insurance System in the world, stands for the Bismarckian type of healthcare system. We examine these cases by collecting qualitative data from three in-depth case studies.

**Results:** DRGs were first developed in the US private insurance system at a time when healthcare cost was continuously rising. The public Medicare program implemented DRGs in 1983 to stop price inflation in medical care. Hierarchical control was thereby exerted over formerly autonomously acting service providers. In the private, market-based healthcare system of the US, DRGs therefore brought more hierarchical control over service providers.

In 1992, the British NHS adopted an analogous version of DRGs, referred to as Health Resource Groups (HRGs). Here we witness how HRGs changed from a pure accounting mechanism, and a tool to monitor clinical performance, to a far more expansive instrument for solving institutional deficiencies such as waiting lists. Finally, HRGs brought a performance component into the provider remuneration method, thereby serving as a vehicle for competition. Thus, we see that while the private, competition-based healthcare system implements DRGs to bring more hierarchy into the healthcare system, the state-led NHS system in Britain introduces HRGs to pave the way for market principles.

The German social insurance system was the last in our sample to introduce DRGs. Although observations for Germany can only be tentative, we observe that, initially, DRGs were implemented here for promoting competition between hospitals. We expect that competitive forces will have a major effect in shaping the hospital-provider landscape, thereby undermining the planning capacities of the regional state authorities. Potentially, these developments will provoke more hierarchical state regulation in the form of (minimum) quality standards, and the definition of a minimum set of services that hospitals will be obliged to offer.

DRGs in Germany, therefore, must be seen against the backdrop of a more general trend of decreasing the social insurance elements of corporatist self-regulation in favour of competition as a coordination mechanism ‘in its own right’, and of more hierarchical state regulation.

**Conclusion:** In our examination of the implementation of DRGs in the U.S. Private Insurance System, the English NHS, and the German Social Health Insurance system, we show that DRGs are a flexible instrument to be implemented against the backdrop of specific healthcare policy objectives. We find that these three systems employ DRGs in very different ways, i.e., according to their functional requirements and in line with their policy objectives. The integration of non-system specific components through DRGs contributes to the hybridization of healthcare systems and therefore to convergence.
A6

Using pharmacy information in a decision support system to improve efficient delivery of primary health care. A study focusing on the Swedish national drug register

A Johansson1, M Heurgren2 and K Kinder Siemens3
1Ensolution, Stockholm, Sweden
2The National Board of Health and Welfare in Sweden, Stockholm, Sweden
3Bloomberg School of Public Health, Johns Hopkins University, Baltimore, MD, USA

BMC Health Services Research 2009, 9(Suppl 1):A6

Introduction: The aim of the project was to apply the John Hopkins ACG case-mix system, Rx-PM model, to the Swedish National Drug Register (period 2006-2008). Its intention was to analyze and compare results between different county councils, and analyze if drug use in the population can be employed to approximate the need for care, and as a tool to adjust the capitation payment system in the county councils. This paper focuses on the comparisons between the different county councils. Practical examples and usage of data are presented.

Methods: The ACG-Rx system, based on the unique Rx-MG categories, is an Rx-based risk adjustment tool (NDC, ATC, Read code) that can be used as a predictive model and to understand patterns of medication use. Pharmaceutical utilization is a proxy for underlying morbidity. The John Hopkins ACG case mix system, Rx-PM model, is a grouping logic that uses drug utilization to measure the severity of the underlying morbidity, the therapeutic goal of medication use, and the duration of treatment to present pharmacy data in a new perspective that had not been available previously. The tool can be used for disease/case management, profiling (population and provider) and forecasting pharmacy and total costs for large groups. The analysis included Sweden’s entire population (9 million persons) and their usage of drugs (6.2 million patients annually). This resulted in 29 million combinations of patients and used ATC-codes for each year. Results have been grouped for the periods 2006, 2007 and 2008. The analysis represents an annual cost of 24-25 Billion SEK (approx. 25 Mill Euro). The grouping went well in practice without any coding issues.

Results: The analysis model involves five steps: 1) Actual pharmacy cost and predicted pharmacy cost per county council. The purpose of this analysis is to determine the cost level. 2) Actual costs per inhabitant and predicted cost per inhabitant per county council/municipality. The purpose of this analysis is to determine the differences in consumption. 3) Proportion of high-risk patients per municipality. The purpose of this analysis is to determine how specific outliers influence the results. 4) Standard Morbidity Rates (SMRs) for major Rx-MGs per county council. The purpose of this analysis is to determine if specific groups and practices influence the results. 5) Comparisons of specific Rx-MGs per county council. The purpose of this analysis is to provide a detailed comparison on practices and costs.

Conclusion: The Rx-model works well for Swedish data. The analysis showed significant differences between county councils as well as on the municipal level. Measures generated from the system could, therefore, be used in the Swedish benchmarking model Open Comparisons.

The model also provides functionality for predicting change in total cost. Comparison between predicted costs from the Rx-model and the actual costs showed a low variation (1%). The model provides a large amount of data for analysis and usage in practice, i.e., specific analysis for measuring costs for high-risk patients. More analysis with diagnosis and cost data on the county council level is still needed to prove if Rx-MG can be a useful tool for resource allocation in a capitation model. The combined models (Rx-PM + Dx-PM) with diagnoses and pharmacy data are recommended for use. Pharmacy data alone has a higher explanatory value than age and gender, but it is still low in comparison with combined models.

A7

Facilitating equity and efficiency in Malaysian primary health care through the application of the ACG® case mix system

MN Kamaliah1, S Jaafar1, FZ Ehsan1, I Safiee1, F Ismail1, NM Saleh1, FZM Rathi1, AM Bulgiba2, RH Hussein2, ZF Zakaria3, SUHishahii4, KK Siemens5, C Abrams6 and O Wario7
1Family Health Development Division, Ministry of Health, Putrajaya, Malaysia
2Social and Preventive Medicine, University Malaya, Kuala Lumpur, Malaysia
3Planning and Development Division, Ministry of Health, Putrajaya, Malaysia
4Putrajaya Health Clinic, Ministry of Health, Putrajaya, Malaysia
5Community Medicine and Public Health, University Malaysia Sarawak, Kuching, Malaysia
6Bloomberg School of Public Health, Johns Hopkins University, Baltimore, MD, USA
7Putrajaya Health Office, Ministry of Health, Putrajaya, MALAYSIA

BMC Health Services Research 2009, 9(Suppl 1):A7

Introduction: Malaysian health care is a parallel system with both public and private sectors. The MOH (Ministry of Health) is the main provider of health services in the country, delivering comprehensive medical, health, dental and pharmaceutical services at primary, secondary and tertiary levels of care. The public health services are heavily subsidized by the government. The practice of financial distribution within the Ministry of Health of Malaysia has traditionally been dependent on historical information, i.e., looking at past performance. Any additional increment has been based on arbitrary predictions of the consumer index or inflation. A more appropriate distribution would be based not only on the volume of patients, but also on the morbidity profiles of these populations. Because of the development of the TPC (Tele-Primary Care) electronic system, considerable data is now collected, and there exists a vast potential for data-mining. One potential area of study is to account for the differences in the health status of populations and their anticipated need for healthcare services. An earlier project demonstrated that the TPC dataset provides viable data that can be used for understanding differences in case mix and resource need by various population sub-groups. This was the first step in a multi-stage process to demonstrate the benefits of integrating case mix into the Malaysian healthcare system.
As a result of the first project, an increased understanding of the TPC database was gained, which is providing usable data. However, to make full and effective use of TPC, a resource-use measure based on micro-costing information needed to be developed and validated. This project evaluated the plausibility of recently developed cost measures. This new resource-use measure would enable a clearer understanding of the consumption based on the morbidity profile of populations across regions, as well as individual clinics.

**Methods:** The primary sources of data for this project came from public, primary care clinics using the TPC system; an alternative electronic system; a small group practice of private primary care clinics using a separate electronic system; and the network of a private medical insurance group with nationwide enrollees. The objective of the project was, first, to take the analyses a step further by incorporating new data input streams from private providers, and then to validate that the newly developed micro-costing information was meaningful.

In addition, the project sought to assess the ability to link patient information across different providers, re-analyze the results from Phase I using the new resource measure, and then develop a program targeted at improving data quality. Lastly, the aim was to compare differences in service delivery patterns between TPC facilities and providers to assess the efficiency of resource use.

**Results:**

a) The success of the coding-quality training programs to ensure continually improved data quality in TPC over time was demonstrated. The data quality is sufficiently high to create more sophisticated models. Models to identify “high risk” patients or “high cost” patients are already possible.

b) The ACG system has been proven to work with Malaysian TPC data, and the micro-costing data works for the TPC population and allows us to better understand differences in resource allocation/need. The 2008 Total Visits model is extremely predictive. However, the cost data for health clinics needs to be improved before the Total Cost can be used to predict costs with the same predictive ability as the Total Visit models.

c) The analyses of the UPIN’s (Unique Patient Identification Number) ability to link data to better capture the services being provided from multiple providers show that existing challenges are surmountable. A better understanding of the differences in service delivery in public vs. private sectors is imperative before a national capitation scheme is possible.

d) The profiling of providers on a regional basis as the initial step to determining the viability of a morbidity-based capitation formula was successful.

**Conclusions:**

The initial project successfully demonstrated the ability of Malaysia to apply readily available diagnostic and other clinical information to develop state-of-the-art case-mix measures relevant to medical and fiscal management activities using the TPC database. It also offered an example of how risk adjustment tools can be used to monitor the TPC data collection process.

The ACG system has been proven to work with Malaysian data, and it works very well for Total Visits where they can now be used to predict Total Visits with a very high certainty. Where the data quality has improved, the predictive modeling has improved in tandem. The data quality is sufficiently high to create more sophisticated models. Models to identify “high risk” patients or “high cost” patients are already possible.

**Development of a method for assessing operating room management based on diagnosis procedure combination E- and F-file data**

M Tanaka, M Sekimoto and Y Imanaka

**Department of Healthcare Economics and Quality Management, School of Public Health, Graduate School of Medicine, Kyoto University, Kyoto, Japan**

**BMC Health Services Research 2009, 9(Suppl 1):A8**

**Introduction:** Due to rising health costs, hospitals are making efforts to assess and improve management efficiency. However, patient costs for health clinics are based on standardized data available from all hospitals - meaningful comparisons cannot be conducted. The objectives of this study were to develop a method of assessing OR management based on standardized administrative data, and to apply this method in assessing and comparing OR efficiencies in a multi-institutional setting.

**Methods:** DPC (Diagnosis Procedure Combination) is a patient classification system in Japan. DPC data E and F files contain detailed information such as general anesthesia duration, and dosages for all medications. We obtained patient data from 133 hospitals, between April 2006 and March 2008, from the specific components of the DPC database known as the E and F files.

As possible indicators of assessing operation management, we offer the following variables. Using data from the E and F files of the DPC database, we calculated:

- x) Procedural fee per OR per month
- a) Number of operations per OR per month
- b) Procedural fee per operation
- c) Total utilization times of each OR per month
- d) Procedural fee per OR per hour

In order to take into account hospital variations while analyzing reimbursement, we carried out a multiple linear regression analysis at the hospital level. The dependent variable was the procedural fee per OR per month, and the independent variables were the number of surgeons per OR and the total number of beds.

Next, for surgery volume, another multiple linear regression analysis was conducted. The dependent variable was the number of operations per OR per month, and the independent variables were the number of surgeons per OR, and the total number of beds.

Finally, we conducted a multi-institutional comparison of expected and observed values for the dependent variables from both regression models in 133 hospitals.

**Results:** We show the results of descriptive statistics for the following:

- Procedural fee per OR per month
- Number of operations per OR per month
- Procedural fee per operation
- Total utilization time of each OR per month
- Procedural fee per OR per hour

There were large inter-hospital variations seen in all five of these indicators. The mean procedural fee per OR per month was found to be US $76,516 (SD: US $31,145; Range: US $11,857-US $195,546). There was an observed mean of 46 operations per OR per month (SD: 16 operations; Range: 10-107 operations).

According to the results of our regression analyses, we found that the number of surgeons per OR, as well as the total number of beds in each hospital, was significantly and positively associated.
with our operation management assessment indicators of procedural fee per OR per month, and the number of operations per OR per month. Using the expected values of the dependent variables from the regression models, we conducted a comparison of the observed/expected (O/E) ratios of each hospital, as well as their respective residual values relative to an O/E ratio of 1. This allowed for the assessment of the relative performance of each hospital.

**Conclusion:** The OR management assessment method, which is based on standardized DPC data, allows for meaningful multi-institutional comparisons. Comparisons of the expected and observed values of the indicators, based on these data, may provide a greater insight into the target of the fee, as well as the number of surgical operations occurring at each hospital (after taking into account inter-hospital variations). Therefore these comparisons may be useful as a tool in target management.

**A9**  
Institutional structures and processes of care associated with the length of hospital stay in elderly patients with hip fractures  
T Motohashi, M Sekimoto and Y Imanaka  
Kyoto University, Kyoto, Japan

**BMC Health Services Research 2009, 9(Suppl 1):A9**

**Introduction:** Some of the most feared complications of falls are hip fractures. Of those who sustain hip fractures, up to 20% become non-ambulatory, and only 14-21% recover their ability to carry out instrumental activities of daily living. In Japan, the incidence of hip fracture is estimated as 120,000 persons per year, and the number of elderly patients with hip fractures is increasing. The LOS (length of hospital stay) in elderly patients with hip fractures is generally long. While many studies have revealed that patient characteristics are closely associated with longer hospitalization, little is known about hospital structures and processes of care associated with LOS. The objective of this study is to identify institutional factors and processes of care associated with LOS in elderly patients with hip fractures.

**Methods:** We analyzed administrative data provided by 67 hospitals participating in the Quality Indicator/Improvement Project (QIP). The study included 2,134 patients with hip fractures who were 60 years of age or older, underwent surgical treatment, and were discharged from the hospitals between April 2007 and March 2008. We excluded patients whose lengths of stay were longer than 150 days.

First, we conducted a patient-level multiple linear regression analysis to identify patient-risk factors associated with LOS. Using this model, we calculated the risk-adjusted mean LOS for each hospital. Secondly, we categorized patients into two groups according to discharge destination: home or other facilities. We conducted a multiple linear regression analysis to identify institutional factors and processes of care associated with risk-adjusted mean LOS in each subgroup (discharge to home or discharge to other facilities).

In this analysis, the dependent variable was the risk-adjusted mean LOS of hip fracture in each hospital. Explanatory variables included the following:

- Frequency of rehabilitation (rehabilitation was provided for more than 80% of total LOS or less than 80%)
- Number of acute care beds >400 or ≤400)
- Inpatient volume per physician per year (>150 or ≤150)
- Case volume of physical therapist (PT) per year (>2000 or ≤2000)
- Number of medical social workers (MSW) per bed (>1 or ≤1)
- Hospital ownership (a local government hospital, private hospital, or public hospital)
- Presence of sub-acute care beds in the hospital

**Results:** In the patient-level analysis, we found that age, complication, and previous hospitalization were significantly associated with LOS. We also took into account the results of a hospital-level regression analysis. In both groups (discharge to home and discharge to other facilities), timing of rehabilitation was significantly associated with LOS. However, timing of operation, and frequency of rehabilitation, were significant predictors of longer LOS only among patients discharged to home.

The number of beds, case volume per physician and PT, hospital ownership, and the presence of sub-acute care beds in the hospital were significantly associated with LOS in both groups. The number of MSW per bed was a significant predictor of shorter LOS only among patients discharged to other facilities.

**Conclusion:** In this study, we examined institutional structures and processes of care associated with LOS in elderly patients with hip fractures. Our results suggest that early and intensive rehabilitation can decrease LOS of patients who were discharged to their homes through a rapid recovery of activity of daily life (ADL). Institutional structures such as hospital bed size, case volume per physician and PT, and number of MSW were strong predictors of shorter LOS. In conclusion, in addition to patient characteristics, LOS in elderly patients with hip fractures was significantly affected by institutional structures and processes of care.

**A10**  
Health resource reallocation by casemix data in Japan  
K Fushimi and S Matsuda

1 Health Care Informatics, Tokyo Medical and Dental University, Tokyo, Japan  
2 Department of Preventive Medicine and Community, University of Occupational and Environmental Health, Kita Kyushu, Fukuoka, Japan

**BMC Health Services Research 2009, 9(Suppl 1):A10**

**Introduction:** The healthcare system in Japan is characterized by long hospital stay and a large excess of hospital beds. The average length of hospital stay, and the number of beds per population for acute-care hospitals, are both about twice the average of those in other OECD countries. Insufficient functional differentiation of Japan’s hospitals has been claimed as the cause of such inefficiency in the healthcare system. Since governments have not assigned functions to hospitals, and have imposed very few restrictions on hospital performance (other than the number of hospital beds), even small private hospitals - which are the dominant type of hospital in Japan - can provide advanced surgery, such as cardiac interventions, just as university hospitals do. In recent years, a shortage of physicians, the excess workload placed on them, and the increased risk...
of medical errors have all become major political issues in healthcare. This is due to the introduction of a new postgraduate training system for doctors, a decrease in the length of hospital stay, and advances in medical technology. Health resource reallocation needs to be considered in order to overcome these political difficulties in healthcare. However, there have been no adequate indicators for a quantitative assessment of the need and supply of regional healthcare in Japan. In our research, we examined the availability of casemix data in Japan to estimate and visualize health-resource allocation.

**Methods:** Using the micro data of the Patient Survey of Japan in 2005, regional disease structures were estimated for MDC (Major Diagnostic Category) groups, surgery, acute, and chronic care in 360 medical service areas (MSA) and 47 prefectures. Hospital performance was evaluated using Patient Survey data and the casemix registry from acute-care hospitals. Functionally undifferentiated hospitals were defined as those with fewer than 50 patients within each MDC category per year, and having less than a 30% share of patients within each MDC in the MSA. Regional hospital undifferentiation indicators were defined as the ratio of patients treated in undifferentiated hospitals in the 47 prefectures. Regional health resources to be allocated were estimated from the disease structure, and the typical clinical process for each disease was revealed by casemix registry data from the acute-care hospitals.

**Results:** Travel of patients across the borders of the designated MSAs was observed. It was found to be significant for cardiac, orthopedic and cancer surgery (odds ratio: 1.7 to 2.3). This indicates that patients travel more for non-emergency, advanced surgery. Therefore, such health-service specific factors need to be taken into account for health resource reallocation and functional differentiation of hospitals. Regional hospital undifferentiation indicators differed from 9% to 40% among the 47 prefectures, and were inversely associated with the utilization rate for cardiac interventions. This suggests that a concentration of surgical procedures may increase the use of the procedures. The estimated need for acute-care beds was about 40% of the current number of beds, indicating a large excess of acute-care beds in most regions in Japan. Simulated reallocation of health resources from chronic care to acute care predicted an improvement in the shortage of physicians in acute-care hospitals.

**Conclusion:** Using the casemix data of Japan, we show the feasibility of visualizing the regional need and supply of healthcare services, and estimating the regional health resources to be allocated.

A11 Using short-stay trim points to identify potential CMG design improvements
Jeff Hatcher
Canadian Institute for Health Information, Ottawa, Ontario, Canada

**BMC Health Services Research 2009, 9(Suppl 1):A11**

**Introduction:** Within diagnosis related group (DRG) systems, long-stay trim points are commonly used to identify patient episodes with extraordinarily long lengths-of-stay, and exclude them from the calculation of the standard (or typical) cost weights. Long-stay cases would potentially distort the typical cost weights if they were included in their calculation. In addition, long-stay cases often receive special treatment in the cost weights assigned to them. However, identification and exclusion of short-stay, outlier cases in the calculation of typical cost weights is not as common.

This article explores the impact of short-stay outliers on the calculation of cost weights, and the potential use of short-stay trim points in the Case Mix Groups (CMG+) system. Canada’s national, acute-care inpatient grouping methodology. Analysis of length-of-stay patterns, and cost profiles of short-stay cases, will identify whether select CMGs (analogous to DRGs) are candidates for redesign.

**Methods:** This article explores the setting of short-stay trim points. Setting of these trim points is done based on empirical distribution using the interquartile range of the length-of-stay distribution of each CMG. The cost distribution of short-stay cases, and the extent to which this cost distribution differs from that of typical cases, will be reviewed. The clinical and demographic profiles of cases identified as short stay will, as well, be appraised. Correlation of short-stay cases with specific clinical attributes may indicate that the CMG is a candidate for redesign (e.g., a split or redefinition). The incidence of short-stay cases by hospital, and stratum of hospitals, will be assessed to determine whether short-stay cases affect some hospitals differently. A correlation of short-stay cases with certain hospitals may suggest variations in practice patterns.

The overall impact of short-stay cases will ultimately be assessed by a recalculation of the typical cost weights - with the short-stay cases removed.

**Results:** CMGs for which the profiling of the short-stay cases suggests potential for redesign will be presented in detail. The effect of the removal of short-stay cases on typical cost-weight estimates will be provided.

**Conclusion:** Discussion will include an examination of the value of short-stay trim points in the evaluation and refinement of CMGs, and consideration of whether or not short-stay cases should be excluded from the estimation of typical cost weights.

A12 Evaluation of the case mix and equity of age-sex adjusted primary care capitation payment models in Ontario, Canada
Lyn M Sibley1 and Richard H Glazier2
1Health System Performance Research Network, Department of Health Policy, Management, and Evaluation, University of Toronto, Canada
2Centre for Research on Inner City Health and Department of Family and Community Medicine, St. Michael’s Hospital, Institute for Clinical Evaluative Sciences (ICES), Departments of Family and Community Medicine and Dalla Lana School of Public Health, University of Toronto, Canada

**BMC Health Services Research 2009, 9(Suppl 1):A12**

**Introduction:** Several innovative models for primary care delivery have recently been introduced in Ontario, Canada. These group-practice models share common characteristics of patient rostering, age-sex based capitation rates, and performance-based incentives. These models have been adopted because of their potential strengths to reduce the overall cost of care, improve effective medical care management, and increase the use of appropriate preventative-care measures. There is
concern, however, that age-sex adjusted capitation rates alone do not take into account variations in the morbidity burden and the healthcare needs that are associated with socioeconomic status. The objective of this study is to compare capitation remuneration rates, by socioeconomic status (SES), with the morbidity burden and the expected primary care resource use of patients enrolled to primary care physicians in the most established capitation model – Family Health Networks (FHN).

**Results:** The study sample consisted of 487,131 patients enrolled to 507 physicians in 53 group practices continuously from September 1, 2005 to August 31, 2006. The number of ADGs (types of diagnosed conditions) and ACG weights (relative expected resource use) was higher among women, and increased incrementally with increasing age. This finding was consistent across income quintiles. Low SES was associated with a higher average number of ADGs compared to the highest SES (2.7 vs 2.9; p < 0.001). Average ACG weights were higher in the low SES category compared to the highest (0.65 vs. 0.55; p < 0.001). The average capitation rate increased incrementally with decreasing SES; however, it did not increase at the same rate as the measures of expected resource use. Both the standardized average ADG count, and ACG weight of those in the lowest income group, were higher than the average capitation rate. The opposite was true for those in the highest income group.

**Conclusion:** Age-sex adjusted capitation rates do take into account some of the variation in the morbidity burden and the expected healthcare resource utilization that exists across the SES spectrum. However, the physician reimbursement system in FHNs does not take into account all of the variation in morbidity burden that is associated with socioeconomic status. There is a risk that adjusting capitation rates for age and sex alone introduces an incentive to preferentially enrol patients with higher socioeconomic status, or to practice in geographic areas where residents have higher incomes.

**A13**
Extraordinary disease burden: an analysis of multi-morbidity
KM Ratcliffe and J Smith
Clinical Performance and Planning, Health Services Tasmania, Hobart, Tasmania, Australia

**BMC Health Services Research 2009, 9(Suppl 1):A13**

**Introduction:** The situation in Tasmania represents a unique perspective. Within the public system, the entire patient population is available for examination in a linked and costed dataset covering the past 10 years. This dataset provides the opportunity to examine the effect of high levels of co-morbidity on patient-care pathways, as well as the associated cost estimates.

**Methods:** For the present analysis, a subset of the existing casemix dataset - encompassing admitted and emergency department care - was examined. An approach to identifying multi-morbidity cases was created based on the occurrence of distinct conditions in the coded dataset. A further analysis of PCCL scores was made by using a modified version of the AR_DRG-V5.1 grouper.

**Results:** The primary dataset comprised 191,000 individuals with 433,000 episodes of admitted data over a four-year period. The 3,376 individuals having multi-morbidity were identified. These individuals encompass nearly 48,000 episodes with 1,550 deaths.

**Conclusion:** The paper outlines an approach to identifying these individuals, and analyzing some aspects in terms of occurrence, cost, and outcome. It builds on work already undertaken in identifying the impact of tertiary care using Australian and European data. The high level of disease burden, and disproportionate use of hospital resources, requires that this analysis be undertaken to identify the scope for improvement in the care of these individuals, as well as creating a model for a better allocation of resources.

**A14**
The adjusted clinical group (ACG) is adapted to predict costs of chronic disease
N Upakdee
Department of Pharmacy Practice, Faculty of Pharmaceutical Sciences, Naresuan University, Phitsanulok, Thailand

**BMC Health Services Research 2009, 9(Suppl 1):A14**

**Objective:** (1) To determine chronic illness costs for outpatients at the provincial hospital, (2) to develop a prospective model predicting total costs using demographic and clinical information including the Adjusted Clinical Group (ACG) and Charlson Comorbidity Index (CCI).

**Methods:** A retrospective study included 2,433,027 patients attending 22 large general and provincial hospitals. Data, including diagnostic and resource utilization, were obtained over the one-year period of 2008. Hospital and pharmacy costs data for outpatients were obtained from a hospital-based computer system. The multiple linear regression technique was used for constructing the prediction model. The dependent variable was the natural logarithm of reimbursed money. The output that would result from replacing the ACG with the CCI variable was considered, and the two possible outputs were compared.

**Results:** Average annual per patient cost was THB 1,489. Pharmacy costs were THB 343, accounting for 23% of the total outpatient costs. In the predictive model, statistically significant predictors were composed of sex, age, health insurance scheme, chronic diseases (such as diabetes, hypertension, asthma, chronic renal failure, etc.), and the ACG or CCI. When the CCI was replaced by the ACG, using the number of aggregated diagnostic groups (ADG) and major ADG, the adjusted R² changed from 0.249 to 0.301.

**Conclusion:** The comorbidity index adapted from ACG had a higher influence on the predictive model than the CCI. In an outpatient setting, a simple count of diagnoses may be the most efficient comorbidity measure for predicting utilization and healthcare costs over the year.

**A15**
Seven modes of healthcare operations - a tool for casemix analysis?
J Groop, T Malmstrom, P Lillrank, M Sarkka and H Hietala
Helsinki University of Technology, BIT Research Centre, Institute of Healthcare Engineering, Management and Architecture, Espoo, Uusimaa, Finland

**BMC Health Services Research 2009, 9(Suppl 1):A15**

Over the last few decades, some healthcare organizations have attempted to transform themselves from functional organizations to process-based ones. During the transition, many people have
observed that certain organizational services are ill-suited to such a change in managerial approach. Process management is a way to describe and organize activities as a sequence, or flow, in order to realize benefits from focus and specialization. Some service operations are unsuited to this approach and require modifications.

We suggest seven alternative modes of operation, each distinguished by different core-management issues, particularly control points and management levers, which should be used as the basis for measuring and monitoring. The operational-modes perspective attempts to solve the demand/supply mismatch by segmenting patients according to need types, and devising corresponding supply organizations that focus on one type of medical problem. The model applies only to a demand that can be segmented. Unspecified demand must be met by other means. Segmentation is based on the distinction of need types such as:

- Discrete/Continuous
- Urgent/Not Urgent
- Severe/Not Severe
- One Cause/Several Causes
- Actual Illness/Risk Of Illness

The modes and their respective managerial focal points are described below.

1. **Visit-Based Mode:** In the visit-based mode, the unit of service amounts to a single visit. This mode is typical of primary-care providers, such as community health centres, which often constitute a patient's first encounter with the healthcare system. The patient is treated during one visit. If that is not possible, the patient is referred elsewhere, or the mode changes into a process. This kind of visit is distinctive in that it largely consists of an information exchange and a personal interaction between the service provider and the patient. When clinical interventions occur, they are of a relatively simple nature, and the patient's medical history is not highly relevant. The core management issues in the visit-based mode are access, scheduling, and keeping the amount of visits per health problem optimal.

2. **Cure Mode:** The cure mode is related to the treatment of curable diseases, or ailments, with an assumed end. The unit of analysis is a process sequence, combined with a patient episode consisting of a string of health events. A cure is a combination of both producer and patient activities, which is expected to result in changes in the patient's medical condition. These changes can be assessed by comparing the health of the patient before and after the cure. A cure process/episode may consist of a multitude of events, and span the organizational borders of several service providers. Thus, from a managerial point of view, the core issues of the cure mode are throughput time and the amount of patient-in-process inventory, supported by sequencing, process flow, and handovers.

3. **Care Mode:** The care mode is related to the treatment of chronic or incurable diseases, where the outcome is not a permanent improvement of the medical condition, but the maintenance of a state. The outcome of the process is the care itself, and there is no meaningful before/after comparison. Thus, the focus of coordination should be on patient status per time period.

4. **Elective Mode:** The elective mode focuses on the production of scheduled service events in which some medical procedure is performed (e.g., surgery). The elective mode differs from the others in four respects: a) The patient's healthcare condition undergoes a sudden step-like change as a result of the clinical intervention. This leads to b) A before-and-after situation. c) The intervention requires specific preparations; i.e., it cannot be performed during a visit. Lastly, d) The type and amount of resources needed can be estimated and scheduled in advance. From these, it follows that the managerial focus is on the scheduling of resources and the preparation of the procedure to ensure efficient, high-quality services.

5. **Emergency Mode:** The emergency mode deals with severe health problems on a critical timeline where speed, rapid decision-making, and prioritization are of the essence. The case flow is unpredictable, and cannot be scheduled on a detail level. Thus, the managerial focus of this mode is on time, or response time, relative to the urgency of the case. The objective of this mode is to prevent death and to stabilize the patient's condition for further treatment. Once this is accomplished, the patient's future care can be handled through one of the other suggested modes.

6. **Project Mode:** The project mode is appropriate when managing specialized service production; that is, where patients suffering from several diseases require very complex or highly variable courses of care, plus the coordination of several tests and treatments. The project mode is especially warranted in very expensive cases. The managerial focus of the project mode is on the mobilization of resources from different units, and the logic of each individual case. As deviations from the normal service process may be hard to anticipate, the resources and their preparation are difficult to manage in advance. The focus, therefore, shifts to quickly mobilizing any required resources when needed.

7. **Preventive Mode:** The preventive mode is concerned with preventing a decrease in the patient's health status by addressing health issues before they turn into health problems. Prevention can apply to risk groups (obese, smokers), and take the form of risk management. Or, it can apply to patients with an existing diagnosis to prevent worsening of the case (disease management). The preventive mode resembles a financial service where the focus is on future events and return on investment. The payoff is lower cost of care in the future. The managerial focus should be on managing risks to avoid unpredictable problems. The suggested operational modes may have a significant impact on how we think about case mix. Within each mode, the case mix is thought to behave in a similar way. This approach offers a new way to analyze the relevance and suitability of various casemix tools in different healthcare settings. We illuminate this with case studies of the operational modes.

**A16 Using the ACG® casemix system in population health management programs at Johns Hopkins**

L Dunbar and M Sylvia

*Care Management, Johns Hopkins HealthCare, Glen Burnie, MD, USA*

**BMC Health Services Research 2009, 9(Suppl 1):A16**

**Introduction:** Johns Hopkins HealthCare contracts with the US Department of Defense (DOD) to provide fully capitated healthcare services to 28,000 DOD beneficiaries. The health plan
is known as the US Family Health Plan (USFHP). In order to understand and meet the healthcare needs of the USFHP population, Johns Hopkins HealthCare uses the ACG® (Adjusted Clinical Group) Casemix System to perform a population health analysis. It then targets patients for a variety of population health-management interventions. Programs such as Health Coaching, Disease Management and Case Management have been developed and implemented to help this population improve health, and reduce healthcare expenditures. The purpose of this presentation is to:

1) Present the results of the population analyses
2) Review the process for identifying and stratifying appropriate patients for interventions
3) Describe the management programs employed at Johns Hopkins HealthCare
4) Review the results of an intensive case-management program, Guided Care (GC), for patients with multi-morbidity

**Methods:** Population analyses were performed annually to assess changes in population morbidity over time, and to create a population-management plan. Additionally, the ACG diagnostic and pharmacy predictive models were run monthly to identify and stratify individuals for a variety of population health-management programs. Health education and promotion, via books and web-based access to materials, were offered to patients with the lowest ACG risk scores. Patients with moderate risk scores, or a single chronic disease, were offered health-coaching resources for lifestyle management to improve their health behaviors. Members with multiple chronic conditions, and high ACG risk scores, participated in GC, a nurse-led, patient-centered, comprehensive chronic-care program delivered in both the primary-care setting and the patient's home.

**Results:** Annual population analyses showed demographic and morbidity characteristics of the 28,000 patients. Mean ACG risk scores by primary care site, number of chronic conditions, and prevalence of chronic disease compared to national US benchmarks showed that morbidity is high in the US Family Health Plan population. In 2006, we began a cluster-randomized, controlled trial of Guided Care in the mid-Atlantic region of the United States. This study was designed to measure the effects of GC on the quality of care for a multi-morbid population with high-risk scores on the outcomes of care for patients, families, primary-care practices, physicians, nurses, and healthcare insurers. We hypothesized that 1) GC would improve patients' quality of care and physicians' satisfaction with care within 6 months, and 2) better quality of care would secondarily lead to improvements in patients' quality of life and efficiency of resource use - as well as to desirable outcomes for other stakeholders in chronic care. Preliminary data indicated that Guided Care:

1) Improves the quality of patients' care. (After six months, GC patients were twice as likely as regular-care patients to rate the quality of their care highly. After 20 months, GC patients were more than twice as likely as regular-care patients to rate the quality of their care highly.)
2) Reduces the use and cost of expensive services. (After the first eight months of the study, GC patients experienced, on average, 24% fewer hospital days, 37% fewer skilled nursing facility days, 15% fewer emergency department visits, and 29% fewer home healthcare episodes. GC patients also experienced 9% more specialist visits; however, this is not considered statistically significant. Based on current Medicare payment rates, and GC costs, these differences in utilization produce net savings for healthcare payors.)
3) Reduces family caregiver strain. (After six months, the GC caregivers' "strain" and "depression" scores were lower than the comparison (regular care) caregivers' scores, especially among caregivers who provided more than 14 hours of weekly assistance.
4) Improves physicians' satisfaction with chronic care. (Compared to the physicians in the control group, the physicians who practiced GC for a year rated their satisfaction with patient/family communication, and their knowledge of their chronically-ill patients' clinical conditions, significantly higher.

**Conclusion:** The ACG® Casemix System was used effectively to perform population health analyses for the US Family Health Plan, a fully capitated 28,000 member health plan managed by Johns Hopkins HealthCare. The ACG Predictive Model identified and stratified the members into appropriate levels of population health-management intervention programs. As a program for members with multi-morbidity and the highest-risk scores, Guided Care improved patients' quality of care, physicians' satisfaction with care, patients' quality of life and efficiency of resource use. As well, it led to desirable outcomes for other stakeholders in chronic care.

### A17
**Using administrative data for research: the importance of appropriate statistical techniques**

J Perelman and C Mateus
Escola Nacional de Saude Publica, Universidade Nova de Lisboa, Lisbon, Portugal

**BMC Health Services Research 2009, 9(Suppl 1):A17**

**Introduction:** Administrative data routinely collected at hospitals are attractive for researchers: they are large, often exhaustive, and of relatively easy access. However, they are not intended for research, and they lack the clinical details of observational studies or clinical trials. Researchers thus face a trade-off between using large but incomplete databases versus using detailed but often poorly representative ones. One of the major limitations of missing information in administrative data is that endogeneity cannot be corrected due to the non-observability of the characteristics of some patients.

Let us suppose that we seek to evaluate the impact of a given treatment on a patient's health. The decision to treat a patient is not random in real practice, contrary to what occurs in clinical trials. In the "real world", patients are selected into treatment arms based on their expected outcomes. Hence, the explanatory variable (treatment) is endogenous, as it is explained by the dependent variable (outcome). This problem would be solved if one could control for a large array of patients' characteristics, in order to estimate the differences between the treated and the untreated. Unfortunately, this is not the case with administrative data.

In the present study, however, we postulate that appropriate statistical techniques can help reduce this problem. To do so, we examine the impact of invasive treatments for cardio-vascular disease - percutaneous coronary intervention (PCI) - and
coronary artery bypass grafting (CABG) on in-patient mortality, using administrative data from Portuguese NHS hospitals. We examine how outcomes vary whether we account for endogeneity or not. Then, we examine how the selection bias spreads to other indicators, namely, the differences between men’s mortality and women’s mortality following invasive treatments.

**Methods:** We study patients admitted for cardio-vascular disease at NHS hospitals in Portugal for the 2000-2006 period (diagnoses were selected using ICD-9-CM codes). Since cardio-vascular diseases are mostly treated at NHS hospitals, this offers us an exhaustive data set representative of national patterns of treatment. Patients are selected according to their principal diagnosis and grouped according to the HCFA-DRG classification. Our final sample includes 259,519 discharges from 57 hospitals.

First, we consider a simple probit model to measure the impact of invasive treatment on in-patient mortality, with in-patient mortality as a dependent binary variable (0/1), controlling for the patient’s age and comorbidities. Indeed, our data do not provide further details on the severity of disease (in particular, the ejection fraction and number and type of affected vessels). Then, we estimate the impact of treatment, controlling for endogeneity through the use of a recursive bivariate model, which consists in assuming that allocation to treatment is non-random and endogenous to mortality.

The basic idea of the model is that mortality and treatment can be thought of as two latent variables from a bivariate normal distribution. Hence, we assume from the start that there is a correlation between the error terms of both variables, i.e., that there are unobservable variables that affect both mortality and treatment. Then, we compare the findings between the simplest model and the recursive bivariate model.

**Results:** Without accounting for endogeneity, we observe that patients treated by PCI have a 51% likelihood of dying during hospitalization. When controlling for endogeneity, the reduction in in-patient mortality increases to 87%. As regards CABG, treated patients have a 12% lower mortality ratio on average with the simple binomial model, and a 76% lower mortality ratio using the recursive bivariate model. In both cases, the discrepancy in results indicates that the endogeneity bias is large, and that treated patients have some characteristics which make them more likely to die. Hence, the impact of treatment is underestimated using the simple model.

As regards the differences between men and women, we observe a similar pattern. Women have a 3% higher likelihood of dying during hospitalization after PCI according to the simplest model, for a 6% lower mortality ratio when controlling for endogeneity. In this case, the discrepancy in results is even more dramatic, since the sign of the inequality is reversed. Similar variations are observed for CABG.

**Conclusion:** Our study indicates the relevance of using appropriate statistical techniques when relying on administrative data for clinical research. However, our outcomes also show that, when using more sophisticated techniques, we obtain results with administrative data that are comparable in sign and magnitude to those obtained from observational studies. This should encourage us to pursue investigation using administrative data, but with a proper adjustment for the lack of detailed patients’ characteristics.
monitoring, but the simple act of reporting data does not, and should not, be used as a proxy to talk about the delivery of "high-quality" healthcare services. In fact, critics in the U.S. consider the current "pay-for-performance" system simply a "pay-for-reporting" system which does little to measure true quality, or the lack of it.

Additional quality-of-care concepts have been introduced more recently. These focus on the reporting of specific diagnoses that may influence final DRG assignment and, thus, final payment in the inpatient setting. These concepts focus on whether reported diagnoses were "Present on Admission" (POA), or whether they were "Hospital Acquired Conditions" (HACs) that surfaced during the patient's hospitalization.

Examining such data begins to tell a different story about the patient's disease state upon arrival to the hospital versus conditions, often considered preventable, that might have occurred during the stay. The practice of flagging diagnoses that are POA, versus those that are HACs, is one method the U.S. Medicare program uses to provide an incentive to hospitals to offer high-quality treatment while a patient is in their care.

If certain preventable conditions, including Never Events, occur during the patient's stay, then Medicare believes that these secondary diagnoses should not influence grouping, nor the final MS-DRG payment calculation. This link between the reporting of specific data, the assumption made about the quality-of-care rendered, and the final impact on payment is quite new, and to some extent controversial. It will be reviewed during this session.

Methods: This session will provide a review of the required inpatient and outpatient quality indicators that hospitals, under the Medicare program, must report in order to receive their full casemix payment. In addition, it will cover current requirements related to flagging certain diagnoses as POA, versus those that are considered HACs, and Never Events, as defined by Medicare.

Finally, this session will provide a preview of Medicare's future plans related to measuring quality and typing it to payment.

Results: Much of the discussion focusing on quality and casemix has centered on reducing payments, rather than offering incentives, or extra payment, for hospitals that are truly innovative in their approach to offering high levels of patient safety, quality and access. Creating incentives that promote the delivery of high-quality healthcare is different from implementing mechanisms that withhold payment from hospitals deemed to provide "poor-quality" care.

Understanding this nuance is critical to creating the "right" set of incentives for both efficiency and quality. Whether this can be done effectively by reducing, or withholding, casemix payment to hospitals that fail to report quality indicators, or that fail to provide quality healthcare (as defined by the list of HACs and Never Events), remains to be seen.

Conclusion: Measuring quality-of-care has always been difficult, and the fact that there is no one "right" answer complicates the discussion. Many studies have shown that neither higher costs, nor greater spending, nor higher utilization is a guarantee for high-quality-of-care. In many cases, quite the opposite has been found. Therefore, a discussion about quality-of-care can begin with the reporting of certain data elements, and through the creation of certain incentives and disincentives related to payment.

But this is only the beginning of the quality, cost and payment debate, and we still have a long way to go. The use of quality concepts, insofar as they influence hospital payments, is still relatively new and somewhat controversial. However, it is in place in the United States.

Creating efficiency incentives for hospitals through the use of casemix-based payment systems must be carefully balanced along with ensuring patient access and safety, and providing high-quality healthcare services. This session aims to provide attendees with information about the U.S. experience, and the conclusions that can be drawn from it at present.

A20 Predicting the cost of acute-care nursing: a nursing workload demonstration project
I Daniel1, A Bandurchin1 and N Brooks1
1Health Policy Management and Evaluation, University of Toronto, Toronto, Ontario, Canada
2Nursing Research Unit, University Health Network, Toronto, Ontario, Canada

BMC Health Services Research 2009, 9(Suppl 1):A20

Introduction: Nursing workload data has not been used consistently for its original purpose: predicting staffing requirements and making staffing decisions. Too often, little time was paid to monitoring a workload measurement system to ensure that it accurately reflected the practice environment. Several studies have shown that workload measurement systems may not indicate true workload.

In 2006, the Ontario Ministry of Health and Long Term Care (MOHLTC) completed a study on the collection of nursing workload data. The study evaluated the quality and value of the data, and the cost-benefit of collecting the data. Results of the study led to the MOHLTC’s recommending that the collection of nursing workload data be mandatory only for case-costing hospitals. The reason was that, at the time, there was no alternative in place to predict the cost of nursing.

The present nursing demonstration study, commissioned by the Nursing Secretariat of Ontario, Ministry of Health and Long Term Care, will explore the factors that affect nursing resources. It will also investigate the feasibility of a model to predict the use of nursing resources.

Methods: A time-and-motion study was conducted on three medical/surgical units in both an academic hospital and a large community hospital. Each staff nurse (RN, RPN, CA) on each unit was shadowed by a nursing student using a tablet computer, with custom-designed software, to capture the time spent by the nurses on 12 activities. Analyses were performed to investigate the amount of variation explained by the total nursing time spent on the nursing costs.

Using the hospital's administrative datasets, the costs of the resources consumed by patients, including nursing, supplies and medicine, were linked to the patients’ nursing times recorded in the study. Regression analyses were done with the total nursing time as the independent variable, and the various patient costs as the dependent variables. Cost data included all resources consumed by the patient during his or her stay including nursing (estimated from workload data), supplies, diagnostics, therapies and overhead costs.

Administrative patient-level cost data was used from the case-costing dataset for 2006/07 for patients in the medical, surgical and combined medical/surgical units in the two hospitals. Regression models were then explored to explain the variation in nursing costs. Various dependent cost variables were...
identified in the case-costing dataset. These included the following:
- Pharmacy costs
- Therapy costs
- Diagnostic imaging costs
- Clinical laboratory costs
- Electrodiagnostic laboratory costs (e.g., EEG, EMG)
- Interventions (e.g., dialysis, endoscopy, DI intervention, cardiac catheterization lab)
- Intensive care unit costs
- Operating room costs
- Emergency department costs
- Clinic costs.

Age and acute-care length-of-stay were also included.

**Results:** Patient care accounted for the highest percentage (approximately 26%) of nursing time, while average non-clinical time accounted for 20% of nursing time. The average amount of time spent on nursing activities varied by day of stay and by unit. 78.9% of the observed variance in direct nursing costs was explained by total nursing time spent \( p < 0.0001 \), as recorded in the time-and-motion study.

Using direct nursing cost data for medical, surgical and combined inpatient units for 2006/07, in the two hospitals, the costs of other services explained over 70% of the nursing cost variation. The variables selected were significant \( p < 0.001 \) and included length of stay, therapy costs, laboratory costs, diagnostic costs, ICU/CCU costs and pharmacy costs. Other variables, such as the costs of intervention, the emergency department, clinics and the operating room were significant. However, they increased the r-squared value very little.

**Conclusion:** This study confirmed that the nursing workload data from three wards in two hospitals correlated highly with time-and-motion study data. The simple model which was developed, using several factors, explained over 70% of nursing resource utilization. To enhance the model, future research will include the investigation of additional patient-level variables, as well as outcome variables (e.g., operating room times, discharge disposition, admission source, HOBIC scores, etc.).