

TITLE: Systemwide Impacts of Provider Payment Reforms: Evidence from the Health Sectors of Central and Eastern Europe and Central Asia

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Introduction: Only a small minority of the research to date has made use of rigorous empirical methods to convincingly isolate the health sector impacts of new provider payment arrangements from those deriving from other concurrent changes in the health care system. Over the 1990s and early 2000s, several transition countries in Central and Eastern Europe and Central Asia (ECA) aimed at reforming their provider payment systems as an instrument to achieve the general objectives of protecting health care spending levels and improving the overall performance of the health sector. We use such reforms as a natural experiment to investigate empirically the systemwide impacts of introducing patient-based (casemix) and fee-for-service methods for hospital reimbursement, compared to line-item budgets, on a set of outcomes including hospital activity rates and capacity utilization, national health spending, and mortality amenable to health care.

Methods: Using panel data on 28 ECA countries from 1990 to 2004, and controlling (among other factors) for contemporaneous payment reforms in the primary care sector, our three regression-based generalizations of the difference-in-differences approach seem to account adequately for the potential endogeneity of payment method reforms.

Results: At the hospital level, our results indicate that patient-based/casemix payment reduces the average length-of-stay by around 4% and the bed-occupancy rate by 5% (with no perceptible effect on inpatient admissions), whereas fee-for-service methods increase admissions by almost 8% and the bed-occupancy rate by a similar magnitude. At the broader health sector level, both payment arrangements raise per capita health spending by a similar amount (around 20%), with equally large effects on public and private spending. Finally, we do not find evidence that using fee-for-service in preference to budgets has any effect on amenable mortality, whilst significant negative effects on the death rates for two causes—in addition to generally negative point estimates for the remaining measures—are found due to the introduction of patient-based methods.

Conclusions: On balance, our results provide evidence that patient-based/casemix and fee-for-service hospital payment methods have different effects both at the hospital level and for the health sector as a whole. Both hospital payment arrangements increase the amount of resources going into the health system (with potentially important distributional consequences), yet patient-based/casemix systems seem to do better in translating the additional resources into improved population health.

TITLE: A Comparison of Frequentist and Bayesian Approaches to the Estimation of Long-Stay Per-Diems

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Introduction: Canada's national acute-care inpatient grouping methodology is known as Case Mix Groups (CMG+). CMG+ has 588 Case Mix Groups (CMG), which are analogous to DRG. Associated with each CMG are relative cost weights known as Resource Intensity Weights (RIW). The typical RIW value represents the mean cost of patients within the CMG, excluding atypical patients (deaths, signouts, and transfers) and long-stay outlier patients. There is recognition that the typical RIW is not suitable for valuing (or weighting) cases that are atypical or that have extremely long lengths of stay.

Long-stay cases are weighted by the value of the typical RIW plus a per diem weight for each day of stay beyond the mean length of stay. The greater length of stay of these cases is considered to be due to factors largely beyond the control of the hospital. The volume of long-stay records available to estimate the long-stay per diem is low and the per diem amounts have large standard errors. Long-stay patients represent about 4.5% of all discharges overall.

Determining the likelihood-based per diem amounts is a two-step process. First, per diem amounts are estimated using a weighted least squares regression model fitted separately to each CMG using typical cases only. The dependent variable in this regression is the cost of the case and the independent variable is the length of stay. This model provides an estimate of the fixed cost and the per diem for the typical cases in the CMG. 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 to the predicted cost, where the predicted cost is based upon the typical RIW and the typical per diem. The independent effects in the model are case mix effects. This model provides adjustments to the typical per diems to improve their accuracy for long-stay cases. This adjustment results in the long-stay per diems.

In this paper we will explore the use of Bayesian methods in the estimation of the long-stay per diems and compare them with the current frequentist approach.

Methods: We propose a Bayesian alternative for several reasons; first, the long-stay per diems are susceptible to very large observed costs, are heavily affected by the assumed normal distribution, and third, we have very good information to inform prior distributions when we aggregate information across CMGs.

In the first step, a weighted least squares regression model will estimate the fixed and per-diem costs (across all CMGs). In the second step, these estimates will act as prior distributions for the weighted least squares regression models that estimate the fixed cost and per diem for each CMG.

We will compare the long-stay per diems calculated using the currently employed frequentist approach with those calculated using the Bayesian approach. We will also evaluate the difference between the frequentist and Bayesian per diems by assessing changes in weighted cases by hospital and stratum of hospitals.

Results: The results provided will include the changes in the long-stay per diems for each CMG, changes in R<sup>2</sup> and other goodness of fit measures on the long-stay cases. We will report changes in proportional weighted cases by hospital and hospital stratum.

Conclusions: Hospitals with a disproportionate share of long-stay cases have the most at stake with systematically biased per diem values. We expect that in CMGs where the distribution of patient cost is normally (or approximately normally) distributed and where there is sufficient volume of typical and long-stay cases, that there will be little difference between the per diem values. For some CMGs, the values may differ significantly. It is these CMGs that will be closely examined. We will share whether the cost of investing time into developing Bayesian methods was worth the trade-off in terms of estimation accuracy and precision.

TITLE: Quality and Payment: The U.S. Experience Typing Inpatient and Outpatient Case-Mix Payments to Quality Measures and Reporting

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Introduction: Over the past four to five years, the focus in case-mix based payment systems in the United States has begun to focus more and more on "value-based purchasing" and "pay for performance" measures. The reporting of pre-set quality indicators is now fundamentally in place for both the inpatient prospective payment system, based on Medicare-Severity Diagnosis Related Groups (MS-DRGs) and more recently, the outpatient prospective payment system based on Ambulatory Payment Classifications (APCs). For hospitals to receive their full case-mix MS-DRG or APC payment, whether for inpatient services or outpatient services, all required quality indicators must be reported. Reporting pre-determined quality indicators is important for data collection and monitoring, but the simple act of reporting data does not and should not be used as a proxy to talk about delivery of "high quality" health care 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 lack thereof.

Additional quality of care concepts have been introduced more recently. These focus on the reporting of specific diagnoses that may have an impacts on final DRG assignment and hence 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 vs. conditions, often considered preventable, that might have occurred during the stay. The concept of flagging diagnoses that are POA vs. those that are HACs is one way the U.S. Medicare program is trying to incent hospitals to provide high quality care while the patient is in their care. If certain preventable conditions, including "never events" occur during the patient's stay, then Medicare believes those secondary diagnoses should not impact grouping and the final MS-DRG payment calculation. This link between the reporting of specific data, the assumption made about quality of care rendered and the final impact on payment is quite new and to some extent controversial and 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 case-mix 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 around quality and case-mix has centered around 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 high quality health care delivery is different from implementing mechanisms that withhold payment from hospitals deemed to provide "poor quality" care. Understanding this nuance is critical in creating the "right" set of incentives for both efficiency and quality. Whether this can be done effectively by reducing or withholding case-mix payment to hospitals that fail to report quality indicators or that fail to provide quality health care as defined by the list of HACs and never events remains to be seen.

Conclusions: 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 impact hospital payments is relatively new and somewhat controversial however it is in place in the United States. Creating efficiency incentives for hospitals through the use of case-mix based payment systems must be carefully balanced with ensuring patient access and safety and the provision of high quality healthcare services. This session aims to provide attendees with information about the U.S. experience and the conclusions that can be drawn to date.

**25<sup>th</sup> PCSI**  
WORKING CONFERENCE

CASEMIX: A COMMON LANGUAGE FOR  
HEALTH SECTOR INNOVATION

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TITLE: Extraordinary disease burden: an analysis of multi-morbidity

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Introduction: The situation in Tasmania represents a unique perspective in that, 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 and the associated cost estimates.

Methods: For this analysis, a subset of this casemix dataset encompassing admitted and emergency department care was examined. An approach to identify Multimorbidity 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 4 year period; the 3,376 individuals having multi-morbidity were identified. These individuals amass nearly 48,000 episodes with 1,550 deaths.

Conclusions: The paper outlines an approach to identify these individuals and analyse 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's resources requires this analysis to be undertaken to identify the scope for improvement in the care of these individuals and better allocation of resources.



TITLE: Impact of co-morbidity on patients choice of primary health care provider.

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Introduction: In a more market oriented primary health care (PHC) system, which is under development in Sweden it is more important to be able to understand and to monitor factors that have importance for the patient's choice of PHC provider. The objective was to investigate if age, gender and co-morbidity were of importance for a population's choice of listing to either a public- or private PHC practice.

Methods: Setting. Two primary health care practices in the municipality of Ronneby in Blekinge County in southern Sweden. Subjects. The population of all patients listed to two PHC practices. A subpopulation (11223 patients) of the study population consisting of all those listed to the public PHC practice on the 1 October, 2004 and who on the 1 October 2005 were listed to the private or public PHC. Main outcome measures. The listing/re-listing behaviour of the population in this closed cohort was studied at two points in time, the 1 October 2005 and the 1 October 2006, with respect to age, gender and level of co-morbidity as measured by the Johns Hopkins Case-Mix system.

Results: Patients listed to the public practice both on the 1 October 2005 and one year later were significantly older and had a higher degree of co-morbidity than patients listed to the private practice. Patients with a higher degree of co-morbidity were more likely to re-list or to stay listed to the public practice. Patients who most often chose to re-list during the study period were male- and younger patients.

Conclusions: With this study we have shown the possibilities of using a measure of co-morbidity to investigate patient's choice of PHC provider that can help us understand more about the chronically ill patient's choice of healthcare provider.

TITLE: Comorbidity prior to diagnosis in patients with common cancer diagnoses

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Introduction: Chronic disease as diabetes, hypertonia and anemia may be associated with cancer risk as well as affect the short term survival of the malignancy.

Methods: Using population based registry data from specialist and primary care in our health care region comorbidity in the form of anemia, hypertonia, diabetes, rheumatoid arthritis, chronic obstructive pulmonary disease (KOL), and alcohol related diseases for patients with colon-, rectal-, lung-, prostate and breast cancer and survival were studied. Altogether 2047 colon cancer cases, 985 rectal cancer cases, 2017 lung cancer cases, 3578 breast cancer cases and 5106 prostate cancer cases diagnosed 2000-2005 were included. Results were age and sex adjusted and one year survival was calculated. Comorbidity was studied prior to cancer diagnosis and in order to compare with the general population all first comorbidity diagnoses within 90 days were censored.

Results: The prevalence of the chronic diseases in the general population was for all ages diabetes 3.2%, rheumatoid arthritis 0.5%, hypertonia 6.8%, anemia 1.1%, KOL 1.0% and alcohol related diagnoses 0.7%. Patients with colon and rectal cancer had a higher prevalence of anemia, and diabetes. Patients with lung cancer had a higher prevalence of anemia, KOL, diabetes, rheumatoid arthritis for both men and women and for men also a higher prevalence of alcohol related diseases. Except for alcohol related diseases in females with breast cancer comorbidity for the above diseases were not significantly elevated for breast or prostate cancer. For all diagnoses hypertonia were significantly lower than in the general population. Survival of the different cancer diagnoses was not significantly related to the comorbidity except for a tendency of worse survival for patients with alcohol related disease.

Conclusions: The prevalence of some common chronic diseases are elevated especially in colon-, rectal and lung cancer patients. The comorbidity does not seem to affect short term survival of the cancer patient except for alcohol related diagnoses. Our study also indicates the necessity to have all levels of care included in the study base of comorbidity and also emphasizes the need to censor time prior to diagnosis when comparing data with the general population.

TITLE: Casemix administrative data versus conventional data system in estimating population-based morbidity in Thailand

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Introduction: In Thailand, population morbidity report has been created with conventional reporting system. Provincial Health Office reported the number of cases admitted to hospitals by aggregating data on 75 disease groups to the Ministry of Public Health for compiling population morbidity report. After 2002, the national health insurance schemes deployed Diagnostic Related Group (DRG) as casemix payments, hospitals submit inpatient claim data to the national reimbursement clearing office. This study aims to compare quality of the two morbidity data sources with the ultimate goal of estimating Thai population morbidity status.

Methods: Two sources of data from 2005-2007 were compared: 1) the conventional reporting system, so called the 505 report, and 2) the individual inpatient data submitted for reimbursement from two major national health schemes, the National Health Security Office Scheme (NHSO) and the Civil Servant Medical Benefit Scheme (CSMBS). The analyses were done using descriptive statistics.

Results: Data on eight to nine millions morbidity conditions from five to six million hospital admissions were compiled each year from two sources. Both data sources revealed identically 10 top leading causes of hospitalizations, though the disease rankings differed. Data showed similar hospitalization rates and morbidity trends over three years. The disparities between two data sources were prominent on diseases caused by external causes and normal baby delivery condition.

Conclusions: Population based morbidity patterns from two large data sources show similar morbidity estimate. Both data sources are collected from hospitals across the country. With the availability of individual administrative data from claim process, it is possible to revoke the conventional aggregated data reporting system to mitigate the burden of data collection on healthcare providers.

TITLE: The new methodology to harmonise the development of WHO international terminologies for diseases, procedures, disability and health status

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Introduction: Sharing information across professionals, teams, legacies, countries, languages and citizens has become an important issue for health care systems. The World Health Organisation (WHO) develops and updates a family of health care terminologies (ICD, ICF, ICHI and ICPS) and has embarked on an open web based cooperation to revise ICD 11 using ontology driven tools.

Methods:

#### 1. CEN/ISO Categorial structures

The CEN/ISO Categorial structure was defined within some linguistic variations [15], as a minimal set of health care domain constraints to represent a biomedical terminology (controlled vocabularies, nomenclatures, coding systems and classifications) in a precise health care domain with a precise goal to communicate safely. The categorial structure proposes a frame for a lite ontological organisation to ensure standardisation of the knowledge representation of terminologies a way to bind terminology with ontology without description logic.

#### 2. ICD 11 revision Categorial structure role.

The ICD 11 Revision process will use a cooperative web based joint authoring platform based on a content model and on templates for clinical contributors. The contributors will be medical domains experts from the different clinical colleges related to a specific domain Topic Advisory Group (topic TAG) as internal medicine, mental health, rare diseases et. The finalized content model shall be aligned with the researches and development in ontology and description logic using the Protégé editor.

Results:

#### 1 First distinction

It is necessary to do a distinction between the pre-coordinated concepts categories or the axis of the terminology as Human Anatomy, Body Function, Morphology, Cause, Severity, Occurrence, Stage et. and the post coordinated categories which is the association of the previous categories to represent the knowledge 3.3.2 Concerning the post coordinated categories. There is enough evidence and namely with the different uses cases identified that at least 3 approaches shall be considered related between them in an architecture of Russian dolls and can be called provisionally: Disease, Diagnosis, Patient Findings and Problems Disease is the most complete view as in the mortality use case and in the clinical phenotypes use case. It is based on an abnormality in the body structure (morphology) or in the body function (patho-physiology), a Cause which can be deterministic as environmental or probabilistic as genetic plus the characteristics of the 2 other views included in it.

Diagnosis is the view of a clinical decision maker who shall take a decision in an uncertain situation as referred by the morbidity and quality and safety uses cases. It is based on a set of patient findings and problems to be defined by the domain specific TAGs but is an assumption and not as evidence based as the previous one. On the other hand it is a frequent situation where the ICD has to be used as pertinently addressed by the representative of the mental disease TAG.

Finally Patient Findings and Problems (signs, symptoms, syndromes, test results, situations et.) are very often mentioned in health record for surveillance or other without reaching the level of a diagnosis assumption. This is well addressed in the ICD revision primary care use case and in the ISO reference terminology standard for nursing.

Conclusions: We have presented the initial architecture of ICD 11 revision process based on a new organisation and on new tools available in biomedical informatics and in the Web open source community. It is an important shift from traditional paper based revisions restricted to classifications and coding references centres to an unlimited community of contributors allowing to insure the multipurpose uses of ICD 11. The utilisation of web open sources and ontology tools is the guarantee to increase semantic interoperability with other international terminologies within the WHO FIC network (ICF, ICHI and ICPS) and outside (IHTSDO and SNOMED CT). The oral presentation will show practical examples of the uses of the ICD 11 content model categorial structure and

of the templates produced by domain specific revision TAGS and the needs to coordinate with the ontologies of the other international terminologies.

TITLE: Adapting case-mix to alternative diagnostic and pharmaceutical coding systems: Going beyond ICD and NDC based case-mix systems.

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Introduction: Worldwide interest in population based case-mix is increasing as populations age and health care needs rise. Increasingly limited resources underscore the need to focus these resources on the patients who can most benefit from intervention and the providers who care for them. Likewise, integrated care systems require a common language and information base to insure continuity of care.

In addition, data systems and data collection are improving, enabling the ability to use routinely collected data to better understand the morbidity profile of patients and providers. However, most case-mix systems available today are based on ICD and/or NDC codes to measure morbidity. At the same time, in many health care systems, the lack of ICD diagnostic information or NDC pharmaceutical information makes case-mix assessments of populations difficult at best. To answer such situations, new models have been developed which rely on alternative coding systems (ICPC, Read codes) to help identify patients who could benefit from targeted interventions.

Methods: To demonstrate how adapting case mix systems to alternative diagnostic coding systems can improve efficiency in the delivery of health care in systems without ICD codes.

Results: Results will be highlighted, which demonstrate the power contained in routinely collected diagnostic and pharmacy codes to assess the morbidity burden of a population.

Conclusions: The ability to customize models to adapt to the local context, coding system, and cost structure is essential in financial, administrative as well as clinical decision making.

TITLE: Mapping of the French CCAM terminology for clinical procedures on the UMLS metathesaurus

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Introduction: A French coding system of clinical procedures, the Classification Commune Des Actes Médicaux (CCAM), has been developed between 1996 and 2001 for DRG databases. Each CCAM code comprises four letters and three numbers. The four letters give relevant information about the CCAM code on anatomy, device and access mode. The three numbers are used to differentiate between procedures with four identical letters. Such information is useful to express the meaning of CCAM codes, to build coding assistance tools or to propose mappings between CCAM and other similar terminologies.

The purpose of National Library of Medicine's Unified Medical Language System® (UMLS) is to facilitate the development of computer systems that behave as if they "understand" the meaning of the language of biomedicine and health. The main component of UMLS is the metathesaurus which contains about one hundred medical terminologies and proposes mappings between terminologies. As a first step before design of new coding tools and mappings with CCAM, our objective is to integrate the CCAM within UMLS by using appropriate lexical tools.

Methods: The first letter of the CCAM code designates the anatomic system, tract or structure which the action concerns. The second letter of this code provides additional detail combined with the letter indicating the system or tract. The third letter refers to the action. Action terms used in the CCAM have been defined by grouping them according to action type; each is identified by an action verb, and then coded. It was chosen to code this information using a single letter for simplicity. The same code is often allocated to several action verbs, grouped together because of their technical similarity.

The MeTaMap software maps biomedical text to the UMLS Metathesaurus or, equivalently, can discover Metathesaurus concepts referred to in text. Mappings to UMLS are associated to a score describing the similarity between terms to be mapped and the equivalent concepts in UMLS. In this work we considered only perfect matches with a score of 100%.

Labels of CCAM codes are in French and concepts in the UMLS metathesaurus are in English. Therefore one important step is to translate the French semantic descriptors of CCAM from French to English. We benefitted from a document that provides French English translations of the descriptors (WHO-FIC network, unpublished), and it was necessary to manually extract the required information in a database in order to allow an automatic processing by MeTaMap. The retrieval of anatomical information was straightforward using the two first letters of the CCAM code. For example the BDLA003 code "Insertion of biocolonisable keratoprosthesis" corresponds to the BD anatomical descriptor meaning "Cornée" in French and cornea in English.

The information on the action using the third letter was more difficult because a single letter was provided in the CCAM code to represent several actions. Therefore we relied on the label of the CCAM code to identify the exact action and retrieved the relevant action verb within the label rather than relying on the third letter. Then we used the same document as for anatomy in order to translate the action verb in English. This English descriptor was mapped on the UMLS metathesaurus using MeTaMap.

Results: CCAM codes are described using 194 different descriptors for anatomy and 96 descriptors (49%) were mapped to UMLS. Actions are represented in the CCAM codes using 331 descriptors and 205 (62%) were mapped to UMLS. From 7,665 CCAM codes 2,100 were mapped both with the anatomy and action descriptors; 3,414 codes had at least the anatomical mapping, and 4,585 codes had at least one mapping for action.

Conclusions: Mapping CCAM codes to the UMLS is feasible thanks to the semantic descriptors selected to represent meaning in the CCAM codes according to four different axes. We provide mappings for the anatomical and action descriptors in the UMLS and need to provide mappings for access mode also. The fourth letter in the CCAM is used to code access mode. It may identify just the approach method, particularly in invasive approaches; in other cases, it designates both approach method and technique.

As our method is based on a perfect match some descriptors had no equivalent in the metathesaurus. We plan to apply new parameters to MeTaMap in order to match UMLS concepts with similar meanings to the CCAM descriptors to improve the

mapping. Application of these mappings to UMLS for mappings from CCAM to other terminologies, allowing international case mix comparison, and implementation of novel coding tools is an important perspective.

TITLE: Setting Economic Priorities for Patient Safety Programs and Patient Safety Research Using Casemix Costing Data

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Introduction: Objective: To use patient-level cost data to estimate relative economic priorities for hospital inpatient safety efforts.

Background: 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.

Methods: Patient level costs are estimated using computerised patient costing systems that log individual utilization of inpatient services, and apply sophisticated cost estimates from the hospital's general ledger. 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 summarise data coded with ICD-10. Standard linear regression techniques were used to identify the independent contribution to inpatient costs of hospital-acquired conditions, taking into account the casemix 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 \$A21,869 to the cost of an episode, followed by MRSA (+\$A 19,892) and enterocolitis due to *Clostridium difficile* (+\$A 19,745). Aggregate additional costs to the system were highest for septicaemia (+\$A 41.5 mil), complications of cardiac and vascular implants other than septicaemia (+A28.7 mil), acute lower respiratory infections, including influenza and pneumonia (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.

Conclusions: 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.

TITLE: Evaluation of the casemix and equity of age-sex adjusted primary care capitation payment models in Ontario, Canada.

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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 that age-sex adjusted capitation rates alone do not take into account the variations in morbidity burden and health care needs that are associated with socioeconomic status.

The objective of this study is to compare capitation remuneration rates with the morbidity burden and expected primary care resource use of patients enrolled to primary care physicians in the most established capitation model -- Family Health Networks (FHN) -- by socioeconomic status (SES).

Methods: This study uses administrative data collected by the Ontario Ministry of Health and Long-Term Care. Eligible FHNs were those in existence continuously from September 1, 2005 to August 31, 2006 that had at least three physicians during the study time period. The study sample was identified as those patients who were continuously enrolled to a study FHN throughout the study period. Two measures of morbidity burden were calculated using The Johns Hopkins Adjusted Clinical Groups (ACG) Case-mix System. The number of Aggregated Diagnosis Groups (ADGs) indicates the number of types of conditions for which individuals were diagnosed. ACG weights are an indicator of the expected level of health care utilization relative to the population given the duration, severity, and aetiology of diagnosed conditions. Socioeconomic status was categorized as neighbourhood income quintile adjusted for household size relative to average income in their respective community. The average number of ADGs and ACG weights were compared across five-year age groups and among males and females. The standardized average morbidity burden was compared with the standardized average age-sex adjusted capitation rate across income quintiles.

Results: The study sample consisted of 487,131 patients enrolled to 507 physicians in 53 group practices. 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). Average ACG weights were higher in the low SES category compared to the highest (0.65 vs. 0.55). The same relationship was observed in all age and sex strata. 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. The standardized average ADG count and ACG weight of those in the lowest income group were higher than the average capitation rate, while the opposite was true for those in the highest income group.

Conclusions: Age-sex adjusted capitation rates do take into account some of the variation in morbidity burden and expected health care resource utilization that exists across the SES spectrum. However, the physician reimbursement system in FHNs do 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.

TITLE: Health care systems and funding Denmark: The Danish health care reform and the use of casemix system within the hospital Sector seen from a regional perspective.

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Introduction: In 2007 a major reform of the Danish health care sector took place with implications both for the organisation and the funding of the health care sector. The Capital Region is the largest region in Denmark with 1.7 million inhabitants (30 % of the Danish population) and an overall budget for health care 4 billion euro of which the hospitals budgets are approximately 2.5 billion euro. The Danish casemix system (Dk-DRG) is used as a budgeting and funding tool for the hospitals within the region.

Methods: The intention is to give an overview of the 'post reform' organisation of the Danish health care system and the funding of health care services particularly with the focus of use of the Danish casemix system Dk-DRG from a regional perspective. The consequences of using the casemix systems as an instrument within the budgeting process at a regional level is discussed and alternative solutions presented and discussed.

Results: The health care reform and new ways of funding – intentions and preliminary results: An overview of the new health care reform in Denmark is illustrated and the consequences of changing the ways of funding. The use of the Danish Dk-DRG-system as resource allocation system in the hospital sector illustrated by empirical examples from 2008 within the Capital Region of Denmark: Applying casemix systems as an instrument of budgeting and the use of activity based funding is shown as a complex administrative matter. It is shown that small changes within the casemixsystem have widely impacts on the budgeting process.

Conclusions: It is concluded that applying casemix system and activity based costing in the budgeting process is a new way of allocating resources within the region and give opportunities of improving budgeting at a regional level.

TITLE: Health resource reallocation by case-mix data in Japan

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Introduction: The healthcare system of 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 averages in other OECD countries. Insufficient functional differentiation of hospitals has been claimed as the cause of such inefficiency of the healthcare system. Since governments have not assigned functions for 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 hospitals in Japan, can provide advanced surgery such as cardiac interventions, as university hospitals can. In recent years, a shortage and excess work load of physicians and increased risk of medical errors have become major political issues in health 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 health; however, there have been no adequate indicators for quantitative assessment of the need and supply of regional healthcare in Japan. In this research, we examined the availability of case-mix data in Japan to estimate and visualize health resource allocation.

Methods: 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, from the micro data of the Patient Survey of Japan in 2005. Hospital performance was evaluated from the Patient Survey data and case-mix registry from acute care hospitals. Functionally undifferentiated hospitals were defined as those with fewer than 50 patients with each MDC category per year and having a less than 30 percent share of patients with each MDC in the MSA. Regional hospital undifferentiation indicators were defined as a ratio of patients treated in undifferentiated hospitals in the 47 prefectures. Regional health resources to be allocated were estimated from the disease structure and typical clinical process for each disease revealed by case-mix registry data from acute care hospitals.

Results: Travel of patients across the borders of the designated MSAs was observed, and was significant for cardiac, orthopedic and cancer surgery (odds ratio, 1.7 to 2.3), indicating that patients travel more for non-emergency, advanced surgery, and that 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, suggesting that concentration of surgical procedures may increase the utilization 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.

Conclusions: We have shown the feasibility of visualization of the regional need and supply of healthcare services and estimation of regional health resources to be allocated, using case-mix data of Japan.

TITLE: The changes and impacts of payment system for medical insurance system in China

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The payment mechanisms are important both in a health care system and insurance arrangement because of the potential for moral hazard in health care markets, including providers and demand side. Particularly to provider of health care, where reimbursement is based on a fee for service system, there is a possibility that providers will create more services than would occur in an efficient system.

Moreover, as one of key control knobs and determinants in health system performance, payment are an significant influencing factor not only to performance and outcome for the whole system, but also the health care cost and quality of care by means of efficiency of service delivery.

As we know, payment system determines the incentives for the providers and patients.

The provider behavior in medical care is directly impacted by the payment system and incentives, and influenced if the cost containing and resource utilization appropriately.

As international context, the evidence presented suggests that there is no ideal reimbursement system, each method has strengths and weaknesses, and each may be appropriate alone or in combination in different situations. China have much more pooling of basic medical insurance at present, there are different payment system among area. As the reform progress on basic medical insurance in urban area in China, there are increasingly evolution the and mix of payment system. The global budgeting adopt more and more and paid based case for given disease/diagnosis mainly for hospital care in some area increasingly, such Zhenjiang, Dalian and so on.

Zhenjiang's case in changes of the medical expenditures reveal the role of payment mechanism to impact for provider behavior. As a case of China' model in basic medical insurance system for employ, Zhenjiang have been transition of payment systems to reduce the problems of provider moral hazard and over-provision of health care. It mainly has undergone five phases: "fee-for-service unit", "global budget", "personal health account paid by fee for service, and pay for global budget", "global budget, flexibility payment and DRGs for some of disease diagnosis", a new compound system of payment mechanism "focus on capitation based global budgeting "(2003-). In the newly framework, it is important to specify either the volume of activity or the price of each of the patient included within the budget, and set up the upper limit and lower limit both outpatient care and hospital care. There are no additional compensation for over the upper limit. This is necessary as providers may otherwise have incentives to minimize the number of patients treated and the amount of care given to each patient, since the money received will be the same.

Dalian, as a another model city in basic medical insurance system in urban China, there are successfully developed various payment mechanisms recent years according to reform needs. The payment system adjusted almost each year and regulate providers and insured people effectively in Dalian. It was adopt DRGs payment for some of chronic disease after setting the payment standard for given disease. Dalian use a policy to pay the insured patients with certain chronic disease in community health centre(CHC). Meanwhile payment systems became a incentive mechanism for demands to absorb patients seeking care in community agency, that is increasing much more compensate percent for them in CHC.

The payment mechanism is important role in system arrangement and reform of medical insurance. As a lever it can lead the incentive and behavior providers/ consumers, as well as drive power for improving performance by prompting reform of medical insurance. It is indispensable learn the experiences and lessons from other countries for transforming the payment system.

TITLE: Impact of New Casemix-based National Health Insurance Tariff on Hospital Income in Mongolia

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**Introduction:** A pilot project to implement case-mix system in Mongolia was carried out over a fifteen-month period from September 2007 to December 2008 by Consultants from United Nations University with financial support from the Asian Development Bank within the framework of the Second Health Sector Development Project of Mongolia. The main aim of the project is to develop capacity of the Ministry of Health of Mongolia to implement case-mix system as a tool to improve efficiency and quality of care. It is also envisaged that the pilot project will pave a way to replace 20 major diagnostic groups, which were used in the country since 2006 for reimbursement of providers under the national health insurance system.

**Methods:** Five hospitals were selected as the pilot sites for the project; two were general tertiary hospitals and three were specialised hospitals. Two national level committees were formed to guide the implementation of the pilot project: National Case-mix Steering Committee chaired by the State Secretary for Health and National Case-mix Working Group, which is a technical committee for the project chaired by the Head of Economics and Finance Department, Ministry of Health. Minimum data set for casemix classification were collected from the participating hospitals using predefined format for a period of one year. ICD-10 and ICD-9CM were used to code the diagnoses and procedures. The participating hospitals also submitted their data on hospital performance, finance, structure and staffing. Data were grouped using International Refined DRG (IR-DRG) grouper and step-down costing was undertaken using Clinical Cost-Modelling Software (CCM Version 2.0).

**Results:** Data for a total of 42,578 cases was collected from the five pilot hospitals: 92% or 39,074 cases were grouped using IR-DRG case-mix classification. Vast majority (95.3%) of the cases were inpatients. Female patients made up 52.3% of the cases, and the average age of patients in the data set was 31.4 years. The overall average length of stay was 9.2 days. Most of the inpatient cases (86.4%) were in severity level one, 9.8% in severity level two and only 3.7% in the highest severity level, which was severity level three. The new tariff will increase the hospital income by 36.8%. The hospital income from ambulatory cases will increase nearly two fold using the new tariff. However the out-patient income is only 23.5% and 46.3% of the in-patient income for existing and new tariff respectively. Hence the overall impact on the whole hospital income for both in-patient and out-patient cases only increase by 37.1%.

**Conclusions:** The newly developed casemix based tariff will benefit the hospitals by increasing their income from inpatient and outpatient services. The 20 Major Diagnostic Group being used currently should be replaced with full casemix system to ensure fairer remuneration based on actual hospital output.

TITLE: CASE-MIX BASED PROVIDER'S PAYMENT - A NEXT CHALLENGE FOR MOLDOVA HEALTH CARE SYSTEM

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Introduction: Moldova has made major reforms in the way the health system is financed in recent years, most importantly through the introduction of a mandatory health insurance system, based on the principle of a single purchaser/payer played by the National Health Insurance Company (NHIC). This has allowed to increase the access and made health care services more affordable in terms of financial protection. Adoption of contracting between NHIC and health care providers however, has not yet resulted in improved health sector efficiency. The reimbursement of hospital in Moldova is currently a mix of input and output orientated components. Public hospitals receive reimbursement on so-called 'treated cases' but reimbursement rates reflect planned and historical input variables and norms rather than expected performance. This leaves little room for autonomous innovation to improve either the quality or efficiency of services at the local level. All inpatient cases are grouped into several case-mix groups, and this large-scale grouping is based predominantly on the hospital structural departments. This method is combined with a plafond on the annual sum fixed in a contract, based on number of case-mix groups and official approved tariffs for each of groups. Contracts are relatively simple, consisting of a general part and separate annexes for each type of care, and could be classified as cost-and-volume contracts signed between NHIC and health care providers for financing health care services included in the Basic Package of Services. In order to create the appropriate incentives for increasing efficiency in the utilization of hospital resources and reducing hospital over-capacity a new case-based financing mechanism is decided to be gradually implemented during the next 2 years. This includes a number of steps aimed at strengthening the NHIC purchasing function, improving the performance and output orientated healthcare provider payment in both in- and out-patient services, and adjusting the health service costing methodology.

Methods: The implementation methodology includes the testing and piloting of the new case-mix based financing system in 2 hospitals at each of 3 levels of hospital providers (rayon, municipal and national levels), including procedures coding, data collection (clinical and costs), reimbursement methods, contracting and payment, the new institutional arrangements design, and legal and administrative changes that are required.

Results: The most adequate performance and outputs orientated healthcare provider payment (reimbursement) mechanisms will be tested. Recommendations on the most adequate classification systems for diseases, procedures and case-mix for hospital inpatient care, including day stay and emergency will be developed. The design of the institutional arrangements, legal and administrative changes that are required and recommendations for a system wide implementation of new reimbursement mechanisms will be elaborated.

Conclusions: Improving of the purchasing mechanisms and developing the output orientated health service contracting, based on case-mix and adequate reimbursement methods, will reduce inefficiency and waste in the health service delivery system by allocating limited healthcare resources to providers in a fair, equitable, objective, and transparent manner, which is very important in the context of global financial crisis.

TITLE: A more rationale approach to funding NGOs operating in the Alcohol and Other Drug Sector in NSW

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**Introduction:** The NSW Government through NSW Health has provided funding to Alcohol and Other Drug (AOD) Non-Government Organisations (NGOs) since the early 1980s. The majority of funding is for residential rehabilitation treatment, complemented by some non-residential treatment services and non-treatment services (health promotion and prevention). In most instances, the funds are provided as a contribution to the costs of operating services. The contribution varied across services and was not related to any specific measure of capacity (such as beds) or services delivered (such as bed days). Due to concerns about the absence of transparency in, and possible inequities arising from, the current arrangements, NSW Health commissioned a review of the method of funding AOD NGOs.

**Methods:** The methodology consisted of five major processes. First, data about the current funding arrangements including the funding amount and services supported were collated into the three sub-programs, residential rehabilitation; non-residential treatment; and promotion and prevention services. Second, taking account of best practice in health services resource allocation and the available data, potential funding options were developed for each sub-program. Third, the options were canvassed through a series of consultations with representatives of NGOs and Area Health Services (that manage the NGO contracts). Fourth, the impact of using the short listed funding options was evaluated by applying the capacity and activity data to 2007/08 funding levels. Fifth, a preferred option was recommended for each sub-program along with a transition strategy.

**Results:** The investigations showed that the most information was available for residential rehabilitation services. In 2007/08, NSW Health provided a total of \$28.6m to AOD NGO services of which 52.8% was for residential rehabilitation services. Four options were considered for funding these services viz: incremental funding based on historical allocations; input based funding based on number of beds, output based funding based on bed days and blended inputs/outputs funding based on beds and bed days. The impact analysis showed considerable differential between allocated amounts under each of these options. Based on a state-of-readiness assessment, a blended inputs/outputs funding approach was recommended along with a series of refinements to data collection arrangements that would facilitate a transition to full outputs funding based on bed days over three years.

NSW Health allocated 26.8% of the \$28.6m to non-residential treatment services. Data for these services were less available than for residential services. Nonetheless, four options were also considered for funding non-residential treatment services viz: incremental funding based on historical allocations; input based funding based on staff numbers, output based funding based on client attendances; and blended inputs/outputs funding based on staff numbers and client attendances. Again, there was considerable variation in what each service would receive under each option. Given the data issues, an inputs based approach was recommended along with a proposal for refinements to data collection arrangements that would facilitate a transition to outputs funding based on client attendances over three years.

NSW Health allocated the remaining (20.4%) of the \$28.6m to promotion and prevention services. The review found that there were very little consistent data collected on these services. Only two funding options were considered viz: incremental funding based on historical allocations; and input based funding based on staff numbers. Input based funding based on staff numbers was recommended with the proviso that there be a systematic evaluation of the outcomes achieved by the funding at three-year intervals. It was also recommended that NSW Health prepare evidence-based guidelines on the promotion and prevention services that will be considered for funding.

**Conclusions:** The project demonstrated that it was very difficult to achieve rapid change to legacy funding arrangements in the NGO sector because of the wide variations between current allocations and what would be provided under a more rationale funding model. The quality and consistency of the available data on AOD NGO service activity levels was also a limiting factor. Nonetheless, for residential rehabilitation and non-residential treatment services productive change was achieved. Transparency of the funding method was improved and some casemix measures were introduced based on client characteristics (e.g. case complexity using dual diagnosis) and service characteristics (e.g. service location using rurality). Furthermore, a basis for further improvement in the funding approach towards full output based funding was developed.

**25<sup>th</sup> PCSI**  
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CASEMIX: A COMMON LANGUAGE FOR  
HEALTH SECTOR INNOVATION

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TITLE: The Adjusted Clinical Group (ACG) is adapted to predict costs of chronic disease

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

Methods: Data including diagnostic, and resource utilization were obtained for 2,121,344 patients from hospital-based computer system over a 1-year period of 2008 for retrospective analysis. Hospital and pharmacy cost data for outpatients were obtained from database system. The multiple linear regression technique was used for constructing the prediction model. Dependent variable was the natural logarithm of reimbursed money. The output of replacing ACG and Charlson Comorbidity Index variable were compared.

Results: Average annual per patient cost was THB 1,269. Pharmacy costs were THB 290, accounting for 22.89% of total outpatient costs. In the predictive model, statistically significant predictors were composed of sex, age, health insurance scheme, diseases, and ACG or Charlson Comorbidity Index. When replace the ACG with Charlson Comorbidity Index, the adjusted R<sup>2</sup> was changed from 0.28 to 0.27. However, the parameter estimated (beta coefficient) of both variable were 0.79 and 0.24 respectively.

Conclusions: The comorbidity index adapted from ACG was higher influence the predictive model than Charlson Comorbidity Index. However, the model which included of Charlson Comorbidity Index was higher R<sup>2</sup>. Both of predictive models may help to identify targets for reducing high costs, by prospectively identifying those at high risk.

TITLE: Health Promotion Target of Users with Metabolic Diseases by Adjusted Clinical Group

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Introduction: Primary care system has been an emphasis for health system development in Thailand especially after the universal coverage policy implementation. However, users of primary care facilities are allowed to make use of primary care unit nearest to their home and hospital outpatient service at district or provincial level. There are significant number of attendants with hypertension and diabetes. Yet patients with these metabolic diseases need proper health promotion plan to reduce unnecessary hospitalization episodes. This paper was to facilitate primary care system to target users with high morbidity burden to using the Johns Hopkins Adjusted Clinical Group

Methods: Ambulatory visits and admission data of users in Muang Phitsanulok district to primary care units (PCUs), regional hospital (RH) and university hospital (UH) in 2008 were compiled. The annual ambulatory visit data were run through the Johns Hopkins Adjusted Clinical Grouper version 8. Data were linked across different health facilities using unique personal identification number.

Results: Eighteen PCUs provided data of 16,320 users. Out of these users, 16% visited RH, 14% visited UH and 4% visited both RH and UH. Eleven per cent of users were flagged with metabolic diseases (10% with hypertension and 2% with diabetes). People with metabolic diseases more often visited RH and UH (for hypertension patients: 26% visited RH, 28% visited UH and 7% visited both RH; for diabetes: 81% visited RH, 40% visited UH and 21% visited both RH and UH). Patients with high morbidity burden (i.e. major Aggregated Disease Group higher than 1) were observed only when they visited hospital outpatient services. About 3 to 5% of hypertension patients at hospitals demonstrated that they had high morbidity burden while 5 to 10% of diabetes patients at hospitals were high morbid. Hypertension patients with high morbidity burden had six times higher hospitalization rate than patients with low burden. Diabetes patients with high burden had three times higher hospitalization rate than patients with low burden.

Conclusions: ACG helps identify metabolic patients with high morbidity burden once they visited hospital outpatient service. Data of patients with high morbidity burden should be referred back to PCUs to help provide targeted health promotion care to reduce unnecessary hospitalizations.

TITLE: Facilitating equity & efficiency in Malaysian primary health care through the application of the ACG ® Case Mix System

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Introduction: Malaysian health care is a dual parallel system with public and private sectors. The MOH 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, looking at past performances with additional increment 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 the morbidity profiles of these populations. With the development of the Tele-Primary Care (TPC) electronic system, considerable data is now collected with vast potential for data mining purposes. One potential area of study is the need to account for differences in the health status of populations and their anticipated need for health care 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-groupings. This was the first step in a multi-stage process to demonstrate the benefits of integrating case-mix into the Malaysian health care system. As a result of the first project, we gained an increased understanding of the TPC database 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 resource 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 Tele-primary Care System (TPC) & an alternative electronic system, a small group practice of private primary care clinics using a separate electronic system and a network of a private medical insurance group with nationwide enrollees.

The project had the objective of taking the analyses a step further by incorporating new data input streams from private providers, validating that the newly developed micro-costing information is meaningful, assessing the ability to link patient information across different providers, re-analyzing the results from Phase 1 using the new resource measure, developing a program targeted at improving data quality and comparing differences in service delivery patterns between TPC facilities and providers in assessing the efficiency of resource use.

Results:

a) The demonstration of the success of the coding quality training programs to ensure continued improved data quality in TPC over time. 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 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 ability to link data to better capture the services being provided from multiple providers show that existing challenges are surmountable. Better understanding of the differences in service delivery in public vs. private sectors is imperative before a national capitation scheme is possible.

d) That 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 proven to work with Malaysian data and works very well for Total Visits where they can now be used to predict Total Visits with very high certainty. Where the data quality has improved, the predictive modelling 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.

TITLE: Using The ACG® Case-Mix System in Population Health Management Programs at Johns Hopkins

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Introduction: Johns Hopkins HealthCare contracts with the US Department of Defense (DOD) to provide fully capitated health care 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® Case-Mix System to perform a population health analysis and target 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 process for identifying and stratifying appropriate patients for interventions; 3) Describe the management programs employed at Johns Hopkins HealthCare; and 4) Review 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 the patients with the lowest ACG risk scores. Patients with moderate risk scores or single chronic disease were offered health coaching resources for lifestyle management to improve health behaviors. Members with multiple chronic conditions and high ACG risk scores participated in Guided Care, a nurse-led, patient-centered, comprehensive chronic care program delivered in the primary care setting and in 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 (GC) 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 multi-morbid population with high risk scores on the outcomes of care for patients, families, primary care practices, physicians, nurses, and health care 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 lead secondarily 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 indicate that Guided Care (GC):

- 1) Improves the quality of patients' care. After six months, GC patients were twice as likely as usual care patients to rate the quality of their care highly. After 20 months, GC patients were more than twice as likely as usual 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 health care episodes, as well as 9% more specialist visits (not statistically significant). Based on current Medicare payment rates and GC costs, these differences in utilization produce net savings for health care payors.
- 3) Reduces family caregiver strain. After six months, the GC caregivers' "strain" and "depression" scores were lower than the comparison (usual 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.

Conclusions: The ACG® Case-Mix 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. 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 as led to desirable outcomes for other stakeholders in chronic care.

TITLE: SOCIOECONOMIC STATUS AND HEALTHCARE UTILIZATION IN ISRAEL'S LARGEST HEALTH PLAN

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Introduction: Objective: To examine differences in healthcare utilization between persons in low and high socioeconomic groups controlling for their morbidity level using a diagnoses-based case-mix measure.

Methods: : A cross sectional study of a randomly selected representative sample of 77,000 adult enrollees of Clalit Health Services (CHS), the largest Health Maintenance Organization in Israel. Socioeconomic status (SES) was determined according to the area level characteristics of the primary care clinic the person belongs to. Morbidity level was measured using the Johns Hopkins Adjusted Clinical Groups Case-Mix System that assigns each person into a morbidity group according to diagnostic information. Diagnoses from all medical encounters each person had during the calendar year of 2006 were used in this study. Utilization of the following services was examined: primary care and specialist visits, and performance of diagnostic tests (all types of imaging except pregnancy tests). Multiple logistic regression models, accounting for the clustering of patients within clinics, were used to examine the association between each type of resource use and SES, controlling for age, gender and morbidity level.

Results: Persons from low socioeconomic areas were significantly more likely to have an above average number of visits to primary care physicians (Odds Ratio [OR]:1.42, confidence interval [CI]: 1.28-1.56) and significantly less likely to have an above average number of visits to specialists (OR: 0.65, CI: 0.59-0.72), or an above average number of diagnostic tests performed (OR: 0.69, CI: 0.65-0.76), controlling for morbidity level, age and gender. We examined the above associations using both regional and individual level proxy measures for SES (i.e., holding a social security waiver or having supplementary insurance), and showed that the associations remained significant.

Conclusions: This is the first Israeli study to examine differences in healthcare utilization by persons from low and high socioeconomic areas taking into account individual morbidity level based on a diagnoses measure, rather than self-reports. Although Israel has a universal healthcare system, differences in the distribution of services as well as copayment requirements can pose significant access barriers to persons from low socioeconomic areas. Policy implications from these findings, currently being examined in CHS, include exploring ways for reducing barriers to specialty and diagnostic services in different population groups and assessing ways to enhance the ability of primary care physicians of underprivileged populations to provide comprehensive care.

TITLE: The Role of DRGs in Healthcare System Convergence

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**Introduction:** The golden age of the welfare state of the early 1970s was characterized by distinct healthcare system types: the Private Insurance System, the Social Insurance System and the National Health Service (NHS). During the past decades, healthcare systems have grown more similar and become more 'hybrid'. This can be interpreted as a form of healthcare system convergence. At the same time regulatory instruments, such as DRGs have spread broadly from the US to other countries. One possible explanation for convergence is that systems have learned from each other, as in the case of DRGs. In our contribution, we show that DRGs (1) provide a convincing example for the diffusion of ideas in healthcare systems and (2) corroborate our argument of system convergence. Taking the U.S., England and Germany as examples, we show that these most distant cases of healthcare systems have implemented DRGs, yet with very different objectives. Thereby, DRGs contribute to the hybridization of healthcare systems and convergence.

**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 distant case'-design. The U.S. represents a Private Insurance System, while the English NHS is a state-led healthcare system of the Beveridge type. Germany, finally, as the oldest Social Insurance System in the world, stands for the Bismarckian type of healthcare system. We examine these three cases by collecting qualitative data through case studies.

**Results:** DRGs were first developed in the private insurance system of the U.S. at a time when healthcare cost was continuously rising. In order to cut cost, DRGs were implemented through hierarchical state regulation in 1983 in the Medicare program. For the first control over hospital service providers was exerted while at the same time seriously endangering their clinical autonomy. In the private market-based healthcare system of the U.S., therefore, DRGs 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 DRGs changed from a pure accounting mechanism and a tool to monitor clinical performance to a far more expansive usage to solve institutional deficiencies such as waiting lists, as well as to contain costs and to bring a performance component into the provider remuneration method. HRGs finally served as a vehicle for the introduction of competition through the purchaser/provider split and internal markets. Thus, we see that while the private, competition-based healthcare system implements DRGs to bringing more hierarchy into the healthcare system, the state-led NHS system in Britain introduces DRGs to introducing market principles. The German social insurance system was the last in our sample to introduce DRGs. Although observations for Germany can only be tentative since they are fully phased in only by 2009, it must be seen against the backdrop of a more general trend of introducing competition as a coordination mechanism in its own right. At the same time, more state regulation is linked to the enforcement of the process. The German healthcare systems, therefore, the social insurance elements decrease in favour of the market and hierarchical state regulation. Thus in Germany too, DRGs contribute to the hybridization of the healthcare system.

**Conclusions:** 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 how that DRGs are a flexible instrument to be implemented against the backdrop of specific healthcare policy objectives. We find that these systems employ DRGs in a very different way, 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.

TITLE: 7 modes of healthcare operations – a tool for casemix analysis?

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Introduction: Over the last decades some healthcare organizations have attempted to transform themselves from functional to process organizations. During the transition many have observed that some of its services are ill-suited for 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 unsuitable for this approach and require some modifications. We suggest 7 alternative modes of operation, each distinguished by its different core management issues, particularly the control points and management levers, which should be used as basis for measurement and monitoring. The modes and their respective managerial focal points can be described in the following.

Methods: Case studies of the operational modes.

Results:

1. In the visit-based mode the unit of service production amounts to a single visit. It is typical for primary care providers, such as community health centres, which often constitute a patient's first encounter with the health care system. The patient is either treated during the visit or referred to a secondary-care provider for future care or examinations.

Distinctive for this kind of visit is that it largely composes of information exchange and interaction between the service provider and the patient. Clinical interventions are relatively simple to their nature whenever they occur.

2. The cure mode is related to the treatment of curable diseases or ailments. In this mode the unit of analysis is a chain of events. A process is a sequence of producer events describing the activities of a producer. An episode is a sequence of relevant patient activities. A service event is the combination of producer and patient activities, which is expected to result in changes in the patient's medical condition, which can be assessed by comparing the health condition before and after the cure.

A 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 a process mode are sequencing, process flow, handovers, patient inventory management and time management.

3. The care mode is related to the treatment of chronic or incurable diseases, where the outcome is not a separable "product", but the maintenance of a state. In other words, the outcome of the process is the care itself, and there is no meaningful before-after comparison.

4. The elective mode focuses on the production of scheduled service events in which some medical procedure is performed (e.g. surgery). Although the core unit of analysis is a single event it differs from other events in three respects; 1) the patient's healthcare condition undergoes a sudden step-like change as a result of the clinical intervention, leading to a clear 2) 'before-and-after' situation, 3) the intervention requires specific preparations, i.e. it can't be performed during a visit, 4) the type and amount of resources needed can be estimated and scheduled in advance. From this follows that the managerial focus is on the scheduling of resources and the preparation of the event.

5. The emergency mode deals with health problems on a critical time line, where speed, rapid decision making, and prioritization are of essence. The case flow is unpredictable, and can't be scheduled on a detail level. acute need for care. Thus, the managerial focus of this mode is on time. The output of this mode is primarily an effort to prevent death and to stabilize the patient's condition for further treatment.

6. The project mode is appropriate when managing specialized service production, where patients suffering from several diseases require very complex or highly variable courses of care.

The managerial focus of the project-based approach 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 on to quickly mobilizing any required resources when needed.

7. The preventive mode is concerned with prevention of a decrease in the patient's health status by addressing a health issue before it has turned into a health problem demanding medical attention. The preventive mode resembles financial services where the focus is on the return of the investment. The payoff of investment in preventive interventions today lower cost of care in the future.

Conclusions: The suggested operational modes may have a significant impact on how we think about casemix. Within each mode the casemix 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.

TITLE: Visualisation of the Flow Model - the patients pathway through healthcare - a powerful management tool

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Introduction: This article describes how Blekingesjukhuset (Hospital of county Blekinge) in Sweden implemented and use the Flow Model - a tool for managing and monitoring the key healthcare process. We decided to create a graphical visualisation of the most important parameters and the result is that we today have a powerful and supporting tool that help us to plan and govern our daily work, accessible from the very top to the bottom of our organisation.

Methods: The Flow Model has been developed by a number of Swedish county councils and regions where the region of Blekinge was one of them. The work with the model started in 1996 and has subsequently developed into a cohesive, national basic model and method for the systematic collection of information on the flows of healthcare. The implementation started in 2003 and took about 1½ year at the Blekinge hospital where every department had to invent the working process resulting in major or minor changes in their routines. All this to gain time and quality at the end. It was a new way of thinking - process thinking! One example: before the use of the Flow Model the same healthcare-problem could have three or four different ways of registration that made it impossible to compare data.

Results: After about six months our data warehouse contained a significant amount of data giving us the possibility to evaluate the data down to transactional level. We use our intranet system for presentation of the results - all in graphics, tables and numbers. The software we use is the most user-friendly tool we ever had, helped us initially in the phase of validating data and finally presenting results ad hoc. You just click and view! We can for the whole organisation measure and visualise the inflow of referrals, follow events during the process, reasons why people seek care, dates for decisions on undertakings and activities, lead times and waiting times in the flow of care, identifying bottlenecks and also gives us the possibility to see whether the healthcare guarantee has been fulfilled. All parameters that are registered are also shown transparently - no more hiding of data. We have also added DRG to the application. This makes it possible to follow for example the variation of DRG for a certain healthcare problem, or if any specific doctor has referred especially expensive patient groups to the hospital. To visualise casemix also makes it possible to look at the weight of work during a period of time, follow a diagnosis through different medical specialities, see enclosed table.

Conclusions: The Flow Model is, with our graphical presentation, a very powerful management-tool from the top till the bottom. It also makes it easy to follow a healthcare process from the start till the end. You can follow a single patient, a specific group of patients or the whole stock of patients at the hospital. Every single employee have the possibility too use the Flow Model from their own aspect. The hiding-data-time is over, we can see each other processes, number of referrals, reasons of interruptions and learn from each other. Our data is now possible to compare and are continuously validated. We can also follow DRG (Nord-DRG) at any level.

The biggest profits we have done by implementing the Flow Model is: 1. Validated data from the same source; 2. Gain of time; 3. Possibility to follow the healthcare process; 4. See if the healthcare guarantee has been fulfilled and a lot of other things.

TITLE: Applying Machine Learning for Supporting Clinical Decision Making and Documentation

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Introduction: The patient care and production of clinical documentation are collaborative processes. As patients travel through complex care processes, different pieces of digital documentation are recorded into numerous information systems by many healthcare professionals. One information system holds "Patient X was performed surgical operation ACYZ01", another system contains "Laboratory experiment D932 was performed on the Patient X", another system knows "Patient X stayed a week at this department", and another system knows "Patient X has chronic disease E023", etc. One hospital can have from dozens to even hundreds of information systems that have been implemented for different purposes.

These heterogeneous healthcare information systems are integrated in different ways. In most cases the integration is loose, which means there is no transparent access to the information as a whole, at least in real time fashion. For viewing the complete patient documentation, the healthcare professional must access several different information systems and collect the information from multiple sources. For the purposes of clinical decision making and accurate documentation, it would be convenient to have a transparent access all information that is available for the particular patient.

Methods: This study applies software agent and data mining methods to healthcare information systems environment. The goal of the study is to evaluate a decision support system based on heterogeneous data sources. The software agents operate within the hospital information system infrastructure and collect information from heterogeneous data sources.

The software agent is able to provide aggregations and recommendations for the healthcare professional to view. The agent fetches information concerning one patient in real-time fashion from multiple sources and provides the information for the healthcare professional.

The agents model the patient documentation in vector spaces and utilize information retrieval (IR) and data mining (DM) methods to provide recommendation based on statistical similarities between the current patient and the complete database of existing patient cases. The material used in the experimental study was collected from Finnish hospitals.

Results: The software agent is able to provide for instance the following answers:

- "Patients that had laboratory experiment D932, have often chronic disease E023. However the documentation of this patient does not have this information." Is this information missing?
- "Patients that had surgical operation ACYZ01, the primary diagnose was usually J189. However for this patient the primary diagnose is E099. Is the information correct?"
- "Patients that had primary diagnose N039 and have been performed operation AC024 have commonly secondary diagnose B069." Did this patient also have that diagnose?

This study reports recommending accuracy measures for different clinical use case scenarios based on real material from Finnish hospitals. The system is flexible and not restricted to any particular use case. Therefore different sorts of clinical decision support needs can be satisfied using a flexible description language.

Conclusions: This study proposed applying software agent and machine learning techniques for building a healthcare decision support system based on heterogeneous data sources. The prototype system was implemented and tested with real healthcare data. The system is able to provide recommendations based on multidimensional heterogeneous data. The experimental results also show that the system scales to large data sets.

TITLE: Thai Inpatient Casemix version 5 better fits all hospitalizations

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Introduction: Diagnosis related group is the first casemix system used to pay for inpatient care in Thailand. Criticisms on four versions of DRG range from imperfect groupers, inappropriate calibration to invalid classification for paying chronic inpatient care. This paper was to propose the new version of casemix classification for paying acute, psychiatric and sub-acute and non-acute inpatients in the Thai health care system.

Methods: Literature review of research on casemix systems in Thailand.

Results: Out of 6 million annual hospitalizations in Thailand, 3% are the psychiatric patients and 6% are the subacute and nonacute cases. Though Thai DRG version 4 has been developed to recognize procedures on bilateral organs and multiple repeated procedures on the same organ, new groupers for psychiatric casemix and subacute and nonacute casemix outperform the Thai DRG version 4 on the reduction in variance of costs. The submission of datasets required for handling the Thai Inpatient Casemix version 5 must broaden to cover mental health measurement and functional status.

Conclusions: Inpatient casemix systems in Thailand have been developed to better explain cost and care variations among acute and chronic hospitalizations.

TITLE: Assessment of prophylactic use of antibiotics in general surgery from case-mix data in Japan

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Introduction: The proper use of antibiotics is required to prevent antimicrobial-resistant bacterial infections and to decrease healthcare costs. Over the past decades, many papers have described optimal prophylaxis, and guidelines for surgical prophylaxis have been developed. However, the use of antibiotics has not been precisely investigated in Japan. In this study, we examined differences in antibiotic use among hospitals and the causes of the differences in patients undergoing general surgery, using case-mix data obtained for the diagnosis procedure combination (DPC)-based payment system that has been introduced in acute care hospitals of Japan since 2003. We studied adherence to the guidelines for antibiotic prophylaxis in general surgery.

Methods: Case-mix data were collected from 42 national hospitals and 20 private hospitals from July to October in 2004 and 2005. The selection and duration of antibiotic administration for patients undergoing inguinal hernia repair, appendectomy and laparoscopic cholecystectomy were extracted from precise process records and compared with the guidelines. Clinical information including sex, age, length of stay (LOS), risk of surgical site infection (SSI), day of operation and hospital information including number of beds and ownership were extracted from the database.

Results: A total of 2390 patients were recorded. The criteria for exclusion from the study were more than one operation recorded, death during 24 hours after hospitalization, and hospitals with fewer than 5 patients. A total of 2373 patients were studied, including 1015 inguinal hernia repairs, 370 appendectomies, and 988 cholecystectomies. There were 1522 men. The mean age of the population was  $56.1 \pm 17.9$  years (mean  $\pm$  SD) and the age range was 15 to 92 years old. Non-compliant antibiotic selection was observed in 30.8% of patients (732/2373) and non-compliant antibiotic duration was observed in 46.3% of patients (1101/2373). Antibiotic prophylaxis was inappropriately administered in 59.5% of the population studied. LOS was significantly longer and antibiotic cost was significantly higher in patients with non-compliant use of antibiotics in comparison with those with compliant use of antibiotics. The duration of antibiotic administration was longer in low surgical volume hospitals than in high volume hospitals (Odds ratio, 0.10; 95%CI, 0.07-0.16;  $P < 0.05$ ). Regarding antibiotic compliance, the influence of non-compliant duration was stronger than that of non-compliant selection ( $R^2 = 11.8\%$  vs  $2.7\%$ ).

Conclusions: Although the principles of antibiotic prophylaxis in surgery are clearly established and several guidelines have been published, a substantial number of antibiotics were inappropriately used. The guidelines fail to support prolonged administration of prophylactic antibiotics. This study showed that antibiotic prophylaxis was appropriately administered in nonpublic hospitals and high surgical volume hospitals, suggesting that these hospitals used standardized procedures according to the guidelines for duration. However, our study has a limitation, as we did not evaluate the local guidelines for each hospital. Therefore, non-compliant antibiotic selection was observed in high surgical volume hospitals. Our results suggested that antibiotic use in acute care hospitals in Japan needs to be more efficient and standardized according to the guidelines.

TITLE: Evaluation of expensive drug and medical devices under the casemix based payment in Japan

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Introduction: The Japanese government has introduced the casemix system for the acute-care hospitals since 2003. The applied casemix system is DPC (Diagnostic Procedures Combination) that was newly developed in Japan. It has been criticized by clinicians that DPC scheme tends to underfinance the treatments using expensive drugs and materials. In order to solve this problem, we have conducted a situation analysis of expensive drug and medical devices based on the DPC database.

Methods: The DPC study gathers very detailed electronic data as E-file and F-file. The E-file has information of the bundled charge of procedure, i.e., injection of Solita T3. The F-file indicates the detail of bundled procedures, i.e., Solita T3 500ml 2 bottle, Chienam IV 500mg 2kits and Vitamejin IV 1 bottle. E-file and F-file are connected by ID number, discharge date, admission date and data category. In addition to these electronic data, a clinical data, so called Form 1 Minimum Data Set (Form 1) is also gathered. Form 1 contains the following patient information; data ID number, age, sex, major diagnosis (ICD-10), co-morbidity and complication (ICD-10), surgical intervention (Japanese payment code), other major procedures (Japanese payment code), emergency case or not, and outcome. The registration of above mentioned information is obligatory. Furthermore, there are facultative information such as ADL score (Barthel index), severity score such as NYHA and Killips score, cancer staging, AIS score and other clinical indicators. The MHLW published a standard manual for data registration to which the participant hospital must follow. We have analyzed the 2008 DPC data from 869 hospitals in order to evaluate appropriateness of procedures using expensive drugs and medical devices.

Results: The present analysis clarified that there was a wide variation in use of expensive drug and medical devices among the Japanese casemix based hospitals. For example, some hospital uses DES for more than 90% of angina patients and another hospital is less than 5%. It seems that non-clinical factors might be more important for the choice of medical devices.

Conclusions: Our study has clarified usefulness of DPC database for evaluation of clinical processes. According to the results of these studies, MHLW plans to modify the classification and to develop a series of clinical indicators in order to evaluate hospital function from 2010.

TITLE: Who is using DRGs for prospective payment?

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Introduction: International comparisons of healthcare costs are growing in importance for a number of different applications. National health care systems faced dramatic increases in health care costs without corresponding increases in available resources. The main cost drivers are an ageing population, highly specialized human resources and innovation development. Hospitals are multiproduct organizations with very complex products, making it difficult to measure outputs and corresponding costs. At the same time the relations between countries are increasingly closer, there are more and more temporary migrants what is also due to the free mobility of individuals within the EU meaning that the same country will end up making different payments for the same type of care provided to its citizens. To standardize hospital payments would allow a better understanding of the payments to hospitals and health care delivered in different countries. The main policies of several industrialized countries are; to create a knowledge-based economy and society, accelerating the process of structural reform for competitiveness and innovation; to modernise the social model, by investing in people and combating social exclusion; and to sustain favourable growth prospects by means of an appropriate macroeconomic policy mix. The Diagnosis Related Groups (DRG) is a patient classification system widely used around the world that can be used as an information tool to characterize the products of an hospital inpatient setting and a funding tool, both for prospective or reimbursement payment systems. The main objective in most countries concerns a hospital financing new methodology, based on similar groups of patients, by applying a global budget. DRGs were created to finance Medicare patients treated in American hospitals, in other words, a way to set prices according to the resources consumed by similar patients in different hospitals.. Once set up in USA, have been migrated to Europe, Australia and many other countries with different types of adaptations. Today we can find countries using DRGs only as an information tool and others where the system used to group patients as well as a funding tool.

Methods: A questionnaire will be developed to help on a survey on the use of patient classification systems in the 27 EU countries plus Australia, Canada, and USA. The questionnaire will be filled in through information collected in a literature review and, when not possible, national experts will be contacted by e-mail.

Results: The results will enable to have a better perspective about tailored and out of the shelf adoption regarding patient classification systems around the world. At the same time, information about the system in place as well as about diagnosis and procedure codes classifications in use will be available.

Conclusions: As an outcome, the present research will be advantageous in a global decision-making about future uses and developments of DRG's type systems for prospective payment, particularly in Europe. It will also be important to analyse cross border care in different contexts, in any kind of stakeholders point view.

TITLE: The structure of hospitals in Japanese paying system with DPC classification.

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Introduction: A Japanese paying system based on DPC classification was revised every two years and the number of hospitals entry to DPC system increases as shown in Table 1. About fifteen percentages of hospitals, corresponding to fifty percent of beds, entry into this DPC system. This system was considered to adopt on the acute hospitals at starting time. In the present, however, the hospitals having recuperative wards entry into DPC system.

Methods: About 430,000 cases during three times revises (I:200407-200603, II:200604-200803, III:200804-) are used for 43 hospitals. The rate of the patients adopted paying system of DPC to all patient in the hospital was calculated in these three durations I, II, III. ALOS (Averaged length of stay) was also estimated in each hospital at three durations. A scattered plot was depicted for the rate of DPC patient vs. ALOS. The rate of DPC fee to fee-for-service was also calculated and compared to the rate of DPC patient in each hospital during three terms.

Results: A scattered plot between the rate of DPC patient vs. ALOS for whole patients was shown in Table 2. In the hospitals with higher rate of DPC patients, ALOS decreased. These scattered plots was separated into three clusters. On the other hand, a scattered plots between the rate of DPC patient vs. ALOS for DPC patient was revealed almost uniform ALOS around 10 days as shown in Table 2.

Conclusions: The structure of hospitals in Japanese paying system with DPC classification was investigated from the rate of DPC patients to whole patients in each hospital. A length of stay for the patients except DPC classification in term III (after 2008) found to became longer than those in term I (at the start of DPC system).

TITLE: Classification and Alternative Tool for Budget Allocation of Oral Healthcare Service in Thailand

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**Introduction:** After the implementation of Universal Coverage policy, currently the Thai healthcare system virtually achieved universal health insurance coverage for its population through the existing three health insurance schemes, those are, the Civil Servant Medical Benefit Schemes (CSMBS), the Social Security Scheme (SSS) and the Universal Coverage Scheme (UCS). These three insurance schemes differ somewhat in financial arrangements. Diagnosis Related Groups (DRGs) has been developed for resource allocation particularly for inpatient care. So all health insurance systems have been improved continuously on basis of global budget and (DRGs) as a general budgeting system management tool for payment. In the current Thai health care financing system, DRGs has implemented only for inpatient-related oral healthcare services, not for all oral health care services yet. This study aimed to develop a new casemix classification system as an alternative tool for resource allocation of oral healthcare services in the Thai health care system.

**Methods:** The electronic data of individual patients from three selected tertiary hospitals were accessed to perform the analyses. These databases contained information of outpatient and inpatient care utilization, i.e. demographic (age, sex), clinical (diagnoses and procedure) and resource consumption (hospital charge and length of stay). To develop casemix that are clinically homogenous with respect to resource use, this study employed the system analyses consisted of development of the new classification, calibration of relative weight (RW), and evaluation of the newly developed casemix classification. Coefficient of variance (CV) and reduction in variance (RIV) are the statistics used to compare statistical properties of the new casemix with the Thai DRGs version 4.

**Results:** The first step of the development of the new casemix for oral healthcare services was to review International Refined DRGs (IR-DRGs), Thai DRGs version 4, International Classification of Disease, ninth edition, Clinical Modification (ICD-9-CM), International Classification of Disease, tenth edition (ICD-10), International Statistical Classification of Diseases and Related-health problems, tenth revision, Thai Modification (ICD-10-TM) and Current Dental Terminology (CDT). The ICD-10-TM codes related to oral healthcare services were retrieved by the researcher and approved by four experts; thereby the subgroup classification was developed based on the concept of 'the Case Mix Group' (CMG). These codes were then mapped to ICD-10 and ICD-9-CM. The disease groups were further classified into two main groups consisting of oral-maxillofacial (OMF) related-disease, and tooth-periodontium related-disease. For the latter, it was dichotomized into healthy and disease groups. Each of these groups was then categorized by procedures together with complications, i.e. with and without complication and comorbidity. There were 810 diagnoses relative to oral healthcare services. The new casemix system consisted of 2 Major Diagnostic Categories (MDCs) and 65 Diagnosis Clusters (DCs) and 1,084 Casemix Subclass according to treatment procedures. The appropriate RW will be later calculated as well as its CV and RIV, and compared with those in the Thai DRGs version 4.

**Conclusions:** The concept of the new casemix classification employed in this study provided more detailed classification for oral healthcare services which would require further calibration and proof for appropriate financing arrangements for oral healthcare services in Thailand.

TITLE: Physician Staffing Patterns and Costs of Septic Patients in Intensive Care Units

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Introduction: Sepsis is a serious disease, from both clinical and economical perspectives. From 2002, the Surviving Sepsis Campaign attempted to achieve better clinical outcomes. Nevertheless, high mortality in patients with sepsis remains an issue. For instance, approximately 9,300 patients per 100,000 population in Japan died of sepsis in 2007. In addition to the challenge of further improving clinical outcomes in patients with sepsis, the cost of sepsis is a serious burden for the healthcare system. Costs of intensive care unit (ICU) stays are associated with both the underlying disease and the high incidence of severe sepsis in critical care patients. As healthcare costs vary between hospitals, the difference in hospital or ICU costs at various institutions is unknown. In the present study, we utilized patient classification systems data to evaluate the relationship between physician staffing patterns and health care costs for patients with sepsis in ICUs in Japan.

Methods: An observational cross-sectional study was performed between January 1, 2007, and December 31, 2008. The Institutional Review Board of the Faculty of Medicine at the Graduate School of Medicine of Kyoto University, Kyoto, Japan approved this study. Setting: 49 ICUs in 49 acute-care hospitals in Japan. Patients: All cases identified as sepsis were obtained from administrative data in Japan. For the identification of patients with sepsis, we used the International Classification of Diseases, 10th version. Sepsis was defined as the coding series related to bacterial, fungal, viral, and obstetric sepsis. Patients less than 20 years of age were excluded from our analysis. For the present study, 786 cases with a diagnosis of sepsis were analyzed. Interventions: None.

Results: To assess health care costs and daily costs in the ICU, administrative data from the Quality Indicator/Improvement Project database enabled us to collect data from a large population in a short period of time. The data, which was based on Diagnosis Procedure Combination data with detailed claims data, included information on medical care, daily resource use, and health care costs. Based on ICU staffing patterns, the 49 ICUs were classified into either high-intensity ICUs, in which critical care physicians (CCPs) had primary responsibility or mandatory consult, or low-intensity ICUs, in which CCPs had optional consult or were not involved. Of the 18 high-intensity ICUs, 303 cases were analyzed; of the 31 low-intensity ICUs, 483 cases were analyzed. Age, gender, and reason for admission were not significantly different between the two ICU models. Healthcare costs during ICU stays (termed total ICU costs) were calculated from ICU admission to ICU discharge. Daily ICU costs were calculated by dividing the total ICU cost by the ICU length of stay (in days). All costs were converted to US dollars at the 2008 exchange rate (102=US \$1). For overall cases, correlation of total or daily ICU costs and predicted mortality rate calculated using the Critical Care Outcome Prediction Equation (COPE) model without physiological data was not presented. In the low-intensity and high-intensity ICU models, no significant differences in the total ICU costs (\$ 9,937 vs. \$ 10,264;  $p = 0.987$ ) or the daily ICU costs (\$ 1,761 vs. \$ 1,688;  $p = 0.461$ ) were observed. Subgroup analysis in the low-intensity ICU model, however, showed that the total ICU costs and daily ICU costs of the no-CCPs group, which included only 19 cases from 3 ICUs, were significantly more expensive than those of the optional consult group (total ICU costs, \$ 35,730 vs. \$ 9,853,  $p < 0.05$ ) (daily ICU costs, \$ 3,970 vs. \$ 1,750,  $p < 0.01$ ).

Conclusions: In the current study, the severity of sepsis did not correlate with ICU costs. Moreover, ICU staffing patterns were not associated with total ICU costs and daily ICU costs for patients with sepsis in critical care. Compared to lack of CCPs, allocation of a CCP might reduce these costs in patients with sepsis, irrespective of the level of intensivist care. Therefore, further research is necessary to determine the effect of CCPs on ICU costs for patients with sepsis.

TITLE: Impact of 2004 DES introduction on the share of PCI and CABG in Japan.

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Introduction: The purposes of this survey are to describe the number of patients undergoing conventional POBA, PCI with BMS or DES, and on-pump or off-pump CABG between 2004 and 2007, and to clarify how DES impacted the share of PCI and CABG, and whether the share pattern is different across hospital characteristics and regions. For this study, we used the Diagnosis Procedure Combination (DPC) Database of hospital discharges in Japan.

Methods: For a time series comparison of the share of PCI and CABG, we selected data of all patients who were diagnosed as angina pectoris (AP) (DPC code 050050) or acute myocardial infarction (AMI) (DPC code 050030) and discharged in July 2004, 2005, 2006, and 2007 from 145 hospitals (60 academic hospitals and 86 non-academic hospitals). Patients who admitted only for examinations were excluded. We collected in-hospital patients' data including age; sex; ICD10-coded principal and secondary diagnoses, comorbidities and complications; procedures coded with Japanese original coding system (K codes); length of stay (LOS); and in-hospital mortality. With regard to disease severity, diagnosis of congestive heart failure (ICD codes I50), New York Heart Association (NYHA) classification, Canadian Cardiovascular Society (CCS) classification for angina and Killip classification for AMI were used. With regard to procedures, the number of stents (BMS and/or DES) used for PCI were obtained from the Database. K codes were labeled as follows: PCI without stents as K546, K547 or K548; PCI with stents as K549; 1-vessel, on-pump CABG as K552\$1; 2 or more vessels, on-pump CABG as K552\$2; 1-vessel, off-pump CABG as K552-2\$1; and 2 or more vessels, off-pump CABG as K552-2\$2. The numbers of patients treated with (1) conservative therapies, (2) PCI without stents, (3) PCI with BMS alone, (4) PCI with DES alone, (5) PCI with both BMS and DES, (6) off-pump CABG and (7) on-pump CABG during 2004-2007 in 145 hospitals were calculated.

Results: Table 1 shows result of this study.

Conclusions: In Japan, using DES have been widely embraced by the cardiology community. Using DPC data, we can describe this condition.

TITLE: Relationship Between Hospital Volume and Outcomes Following Percutaneous Coronary Interventions in Japan

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Introduction: Percutaneous coronary interventions (PCIs) are important treatment options for patients with acute coronary disease in Japan where coronary artery bypass graft (CABG) surgery is less common. In recent years, PCI with stents have been more performed than angioplasty alone as the improvement of coronary stent such as drug-eluting stent has been progressed. Previous studies in western countries suggest that there is an inverse association between hospital procedure volume of PCIs and patient outcomes. However, such relationship has not been investigated in Japan, especially under the wide availability of coronary stents.

Methods: The data source for the study was a Diagnostic Procedure Combination (DPC) database that consisted of discharge claims data from June 2006 through December 2006. Data were extracted from the database based on the DPC code 050030 so that 8,962 patients undergoing PCIs in 363 hospitals were included in the analyses. Hospitals were divided into three categories, low, medium, and high volumes based on the number of PCIs performed. Outcome variables were hospital length of stay (LOS) and in-hospital mortality. Chi-square statistics was applied to see the difference in patient characteristics. LOS was transformed with a natural logarithm and then t-test was used for comparing categories. In-hospital mortality and adjusted odds ratio (OR) of death were analyzed by Chi-square statistics and logistic regression, respectively.

Results: Patient characteristics in three categories are presented in Table 1. The means and standard deviations of LOS were 22.3±18.7 days in the low category, 21.5±18.6 days in the medium category, and 18.9±16.6 days in the high category. LOS in the high category was significantly shorter than those of other categories. With respect to in-hospital mortality, mortalities in the low and medium categories were higher than that of the high categories, but they were not statistically different as presented in Table 2. After adjustment with patient characteristics, adjusted ORs of death following PCIs were 1.48 in the low category and 1.20 in the medium category compared to the high category.

Conclusions: Patient characteristics were different in three categories, which suggested that hospitals have different role in the community. It was considered that higher volume hospitals treated patients more effectively than lower volume hospitals in terms of LOS. An inverse relationship between hospital PCI volume and in-hospital mortality was observed, but it was not statistically significant. The reason of this result may be because the sample size of the present study was relatively small. Therefore, the further research would be needed with a large sample to have better understanding of the association between hospital volume and outcomes because it is important to improve quality of patient care.

TITLE: Factors associated with protracted hospital stay after hip fracture surgery in Japan

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Introduction: The purpose of this study was to examine factors related to protracted hospital stay of patients with hip fracture surgery in Japan.

Methods: Discharge summary and claim data were collected from acute care hospitals in Japan from July to December 2006. Patients with a primary diagnosis of ICD10 (S720,S721,S722), age greater than 65 years, hip fracture surgery and rehabilitation were extracted. Cases with other surgery, bilateral hip fractures, other fractures, and fatal outcome were excluded. The effects of age, sex, comorbidity, complications (cardiopulmonary, infections, hemorrhage, thromboembolism, others), transfer to another hospital, hospital ownership, hospital volume, number of days from surgery to rehabilitation, surgical procedures, and use of opioids on the length of post-operative hospital stay and the period between the start of rehabilitation and discharge were studied. Day parameters were converted to categorical entities according to the distribution of the variable. Multivariate logistic regression analysis was used to identify factors associated with protracted stay.

Results: About 67% of the patients were older than 80 years old, and over 80% were female. The average of the length of post-operative hospital stay was 32.7 days. Complications including cardiopulmonary, infection and thromboembolism and private hospital ownership were associated with a significantly longer length of post-operative hospital stay ( $p<0.05$ ). The length of post-operative hospital stay was significantly shorter in high volume hospitals ( $p<0.05$ ).

Conclusions: We found that complications including cardiopulmonary, infections and thromboembolism, private hospital ownership and low hospital volume were associated with an increase in the length of post-operative hospital stay. Our results suggest that low hospital volume may be associated with a high risk of prolonged hospital stay.

TITLE: Switching from one DRG classification to another – The Romanian Experience

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Introduction: Romania is one of the countries which started the DRG hospital financing using a classification system and moved in 5 years towards a new one in order to have a better clinical accuracy and an increased objectivity in financing. After 5 years of utilization of the older system and 2 years after the introduction of the new one, the obtained results will give an answer: does Romania gained experience in changing the DRG classification system or is just an experiment?

Methods: The project team provided an analysis of the events and results prior and after DRG classification switch, working on three main directions: (1) the area of clinical consequences of introduction of the new system, (2) the area of cost-weights and case-mix index and (3) the area of financial aspects (hospital rates and budgets). The project analysis was based for the clinical analysis, mainly, on the data collection of Minimum Basic Data Set for hospital discharges for years 2006 and 2008. Year 2006 was the last one completely with the utilization of the "old" DRG system (HCFA DRG v.18) and 2008 is the second one after the introduction of AR DRG v.5 (from July 1st 2007). The financial data used are from the period 2005-2008, the years with complete DRG financing for almost all Romanian acute hospitals (276 hospitals).

Results: The analysis is in progress, because the final data for analysis for year 2008 is just validated. On the clinical side, the introduction of the new classification brought more accuracy, but also some new issues unsolved at this moment. In terms of the financing, the lack of local cost-weights and a clear transition policy towards a national rate produced a lot of dissatisfaction and gave an incentive to hospital to increase their up-coding.

Conclusions: The authors preliminary conclusions are that the Romanian switching form one DRG classification to another is not just an experiment in Romania (because of some weak decisions taken), but also a good experience in terms of lessons learned and the aspects to be repeated or avoided by other countries that plan to do such a change in their case-mix system

TITLE: Outpatient Classification & Costing Ireland: From Pilot Project to Implementation

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Introduction: The 2008 Outpatient study introduced three new hospitals to the study group. The study also introduced a new method for the allocation of costs to the Treatment Related Groups (Final Products) the procedure was introduced at the Irish Casemix conference in April 2008. Essentially it was based on the same collection process as the speciality costing process used in the inpatient collection. Costs were assigned to specialities and non direct costs were distributed to specialities based on the hospitals knowledge of services provided in the Outpatient (OPD) areas.

The 2008 OPD study saw the final products (TRG) file increase from 42 to 60 clinics and there were several clinics in the OPD study that had activity but no cost assigned hence those clinics are not included at this stage in the final products file. Conversely we also observed that in many of the hospitals there were costs that could not be assigned to the patient data as there was no patient activity in those specialities.

Purpose: The intention is to fund casemix hospitals for their OPD services, in this study hospitals were costed for their services and then a casemix blend rate was applied at 1% of the total funding for OPD services. This blend rate is being applied to realign the budget in casemix hospitals so that there is a fair and reasonable allocation funds for services provided.

Methods: A cost modelling approach was adopted to analyse the data. This involved a number of staged functions to the data sets.

Each cost area was then assigned a cost centre number which was used to identify those cost areas which were direct or indirect expenses for a clinic. Overhead costs were redistributed to the direct care cost centres through the speciality costing module assigned to each hospital.

The patient files from each hospital contained information which included observing the clinic name; the consultants' clinic descriptions in the final products file that identifies the clinic type. A series of SQL statements and a basic algorithm were used to allocate direct cost centres and apply those costs by patient volumes and service weights to each clinic.

Results: The results are demonstrated in sections: 1. The cost per attendance at each clinic by hospital; 2. Derived cost weights for each clinic by hospital with comparison to NSW Cost weight; 3. Derived cost weights for each clinic by hospital with comparison to derived Irish Group 1 Cost weight; 4. Total cost associated with each clinic; 5. Cases by clinic; 6. 2007 Group 1 Hospitals Cost Weight; 7. Proposed Product TRG Clinics for next years OPD Cost File.

Conclusions: Discussion: The results gave a good indication of how much additional work would be required to effectively adopt the Irish generated cost weights for future use. The casemix blend rate results for the 2007 data, ranged between of average cost per case at hospital from €112 to €213 with a relative cost weight of 0.96 to 1.35. This information was applied to the blend rate of 1% and funds were redistributed.

A number of Specialities/Clinics (TRG) were identified that produced a cost weights well below that of the comparative NSW cost weights (Australia) in many of the hospitals, these TRGs have been highlighted and on further investigation in the patient and cost file these area are either under resourced through the OPD costing process or have had patients assigned to the TRG which should have been allocated to other TRGs.

The study produced Irish cost weights for group 1 teaching hospitals for the first time, and identified the casemix blend rate for prospective funding for OPD. This information provided the Casemix Unit with useful guide as to the additional work required to improve on this excellent start in classification and costing of OPD. It is anticipated that the 2008 collection will show an ever increasing improvement in all areas of outpatient classification and costing as hospital staff become more familiar with the data elements associated OPD.

TITLE: Case Mix in the Austrian outpatient sector

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Introduction: The project aims at establishing a classification of the ambulant (outpatient) patient spectrum according to Case Mix criteria similar to diagnosis from the inpatient sector (hospitals) as well as other administrative health data available for the population. The lack of standardized, reliable and systematic coding of diagnoses in the outpatient sector renders the availability of valid epidemiological data impossible. However, they are necessary for describing the case mix in primary health care in order to establish a new reimbursement system for physicians and for the outpatient sector of hospitals. Currently, such a system only exists in the Austrian inpatient sector with the LDF/LKF (Austrian procedure and diagnosis orientated hospital financing system), the Austrian version of a DRG system. This project grows in relevance due to the ongoing discussion within the latest financial equalization between the Federal State and the Provinces that lead to the current treaty for the development of the healthcare system. In order to achieve the aims of the treaty basic research that is necessary for a possible change of the reimbursement system in the outpatient sector has to be done.

Methods: The project "ATC -> ICD – evaluating the reliability of prognoses for ICD-10 diagnoses derived from the ATC-Code of prescriptions" forms the basis for this project. A classification system for the Case Mix in the outpatient sector with relevant information using the results from the aforementioned project will be developed. The calculation of groupers (classification/clustering of patients according to their treatment, their use of resources and their sicknesses) is relevant in order to establish a DRG system and further a reimbursement system for the outpatient sector in Austria.

Results: The results of this project, namely obtained Case Mix components and their simulated financial impacts can be used as a model in the on-going political discussion about financial flows. The modelled clusters can be evaluated under different aspects in respect of homogeneity. These aspects can be medical, epidemiological or economical. Also quality aspects (variability of care) and outcome aspects can be taken into consideration. The economical point of view is very important and suitable for the development of a reimbursement system in the outpatient sector.

Conclusions: The above-mentioned questions concerning the outpatient sector are discussed internationally. Therefore, other than being prepared for these upcoming questions for a political discussion, this project must be seen as a basic research implicating national and international consequences.

TITLE: Severity of symptom and level of functioning of Thai psychiatric inpatient through the Health of the Nation Outcome Scales (HoNOS)

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Introduction: The purpose of this paper was to explore changes of the Thai HoNOS scores of inpatients during in the hospitals including admission and discharge by comparing the scores among disease clusters.

Methods: This is a retrospective analysis of the Thai HoNOS scores of psychiatric inpatients from the two psychiatric hospitals. Data were collected from the Thai HoNOS form and patients' service files in 2005. Statistical analysis was performed by comparing the HoNOS scores at different times in hospitals and among disease clusters.

Results: There were 2,383 subjects with 16,039 Thai HoNOS rating times. The mean score of total HoNOS scores (item 1-10) was 15.3 at admission and 3.8 at discharge. Total scores and each item score reduced significantly from admission to discharge in schizophrenia disorders, mood disorders, and organic disorders while subjects with anxiety disorders and mental retardation had insignificantly reduced of the scores. The highest average total HoNOS score was found in relationship problems (item 9), followed by hallucinations/delusions (item 6), cognitive problem (item 4), aggression, disruptive behavior (item 1), other psychological problems (item 8), activities daily living (item 10), alcohol/drug problems (item 3), physical problems (item 5), depressed mood (item 7), and deliberate self-harm (item 2).

Conclusions: The findings provide level of severity of symptom and functioning of psychiatric inpatients among disease clusters during in hospitals. Thus, treatment plan and clinical guideline for patients should be prepared in different ways to match their severities.

TITLE: Efficiency of the psychiatric hospitals in Thailand with Data Envelopment Analysis

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Introduction: Efficiency of 13 psychiatric hospitals under the Thai Mental Health Department (MHD) can be measured by Data Envelopment Analysis techniques (DEA). The objective of this research is to study costs and efficiency of 13 psychiatric hospitals under MDH by DEA model.

Methods: By DEA model, five variable inputs (personnel-related costs from government budget, operating expenses from government budget, operating expenses from hospital charges, number of beds, and number of staffs) were employed to compare with four outputs (number of outpatients, number of inpatients, length of stay, mean of relative weight) to find out relative efficiency of the hospitals.

Results: Constant returns to scale assumption (CCR) for overall efficiency was 0.915 (S.D. = 0.128) with only 7 hospitals on cost-frontier line. Variable returns to scale (VAS) for technical efficiency was 0.957 with 10 hospitals on cost-frontier line.

Conclusions: The results will be useful to the executives in such ways to promote high efficiency-score hospitals and to alarm low efficiency-score hospitals.

TITLE: Visualization model for medical care processes by utilizing Japanese case-mix classification and its application to the variance analysis of clinical pathway

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Introduction: In the research relevant to the Japanese case-mix classification (DPC; Diagnosis Procedure Combination) utilized as the per diem prospective payment system, information regarding medical care quality, such as information on clinical practice, medical treatment, and treatment date, is stored in a standardized format. Under the DPC system, patient information is coded using 14-digit code which combines a disease name and associated medical care treatment. The system is promising as a tool for visualizing medical care with hidden potential to promote verification of medical care quality and standardization of medical care. Meanwhile, clinical pathway is known as another tool to improve medical care quality. In this study, we create information on medical care processes in chronological order per patient with the use of the DPC system, for the comparative verification with clinical pathway. Our aim is to experimentally verify medical care quality in a precise way through visualization of the actual medical care situation and factor analysis in order to see any significant divergence from clinical pathway.

Methods: Subjects are 54 patients who had undergone laparoscopic cholecystectomy at Saiseikai kumamoto hospital, during a period between July and December 2006. We have coded information of concern regarding medical care treatments as DPC medical care processes 20-digit codes (i.e. DPC extended codes) following the 14-digit code. Specifically, the 15th digit indicates fluid administration, 16th digit antibiotic, 17th digit blood sampling, 18th digit other examinations, 19th digit image, and 20th digit meal. We have coded DPC extended codes including the 14-digit code day by day, based on daily medical care treatments delivered. We have presented information on medical care treatments from the date of admission to the date of discharge in chronological order by using these DPC extended codes. We have also created DPC extended codes for clinical pathway and defined a discrepancy with each patient's DPC extended codes as variance to analyze factors. Furthermore, we have calculated the chronological occurrence proportion per medical care treatment included in the DPC extended codes.

Results: The results are as follows: Male 25 cases (46.3%), Emergency hospital admission 13 cases (24.7%), Gallbladder inflammation 20 cases (37.3%). The comparison between DPC extended codes of clinical pathway and that per patient revealed the following significant factors affecting variances: age (divergence; over 65 years old 69.2%, under 65 years old 43.9%,  $P=0.024$ ), urgency of the admission (divergence; urgent admission 76.9%, scheduled admission 41.5%,  $P=0.024$ ), inflammation (divergence; inflammation 65.0%, non-inflammation 41.2%,  $P=0.046$ ). When calculating the occurrence proportion of medical care treatments for inflammation disease vs. non-inflammation disease, which is one of variability factors, the occurrence proportion depending on postoperative days were varied in antibiotic, blood sampling, and image.

Conclusions: Coding of medical care processes enabled us to compare each patient's individuality with standard medical care processes set in clinical pathway and see the actual medical care situation. In the case of laparoscopic cholecystectomy, divergences from the standard medical care processes were examined in age, gallbladder inflammation, and urgency of the admission. Accordingly, the use of DPC extended codes allowed us to confirm adequacy of clinical pathway for each patient and disease, and provided possible evidence for required revision of clinical pathway. The study suggests that creators of clinical pathway and surgeons should reaffirm details of preoperative and postoperative medical care treatments.

TITLE: DEVELOPMENT OF CLINICAL PATHWAYS: UNIVERSITI KEBANGSAAN MALAYSIA MEDICAL CENTRE EXPERIENCED

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Introduction: The focus of healthcare services in recent years has shifted towards better clinical management strategies to make healthcare organization more efficient, high quality of care delivered and reasonable medical cost. Clinical pathways have been implemented in many healthcare systems and have been demonstrated beneficial tool to improve the quality care and cost controlled. Clinical pathway is multidisciplinary plan of care based on best clinical practice for specified groups of patients with particular diagnosis designed to minimize delays, optimum resource utilization and to maximize the quality of care.

Methods: Our institution, UKMMC has carried out few sessions of meetings and workshops involving the expert teams to develop the pathways. The expert teams consist of cardiologists, respiratory physicians, orthopedic surgeons, obstetric & gynecologists, public health medicine specialist, nurses, pharmacists and physiotherapists. The content of the clinical pathway is based on clinical practice guideline (CPG), best practices and consensus agreement. The steps used to develop the pathway were divided into 5 phases. Phase 1 the introduction and team development, Phase II determining the cases and information gathering, Phase III establishing the draft of CP, Phase IV is implementing and monitoring the effectiveness of CP and Phase V to evaluating, improving and redesigning of the CP. Universiti Kebangsaan Malaysia Medical Centre (UKMMC) has developed the clinical pathways for total knee replacement (TKR), uncomplicated acute myocardial infarction (AMI), chronic obstructive airways diseases (COAD) and elective lower segment caesarean section (LSCE).

Results: The clinical pathways have been launched and implemented in February 2009 at UKMMC. Further analysis will be carried out to evaluate the effectiveness of them.

Conclusions: As a conclusion the overall purpose of the development and implementation of the pathways in our institution was to assess the benefit of CP in improving the quality of care and controlling the cost by improving patient outcomes, promoting patient safety, increasing patient satisfaction and optimizing the use of resources.

TITLE: Using Health GIS to evaluation of the regional diversity of the quality and efficiency of health care systems in Japan.

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Introduction: The Agency for Healthcare Research and Quality (AHRQ) developed Prevention Quality Indicators (PQIs), which make use of readily available hospital inpatient administrative data to measure health care quality. Nevertheless, indicators similar to PQIs have not been developed in Japan. The AHRQ PQIs include the ICD9CM procedure codes to identify each condition. The ICD10 is applicable to the national health insurance system in Japan. A great difference is apparent between PQIs of the United States and Japan.

Therefore; A need exists to translate procedure codes from ICD10 to ICD9CM. No studies of PQIs exist in Japan. To compare the PQIs of United States and Japan directly is difficult. This study is intended to clarify evaluation of the regional diversity of the quality and efficiency of health care systems in Japan using PQIs.

Methods: PQIs for COPD, hypertension, CHF, asthma, uncontrolled diabetes, as defined by the AHRQ, were examined as indicative proxies for the quality of ambulatory care. Factors that affect PQIs were determined through descriptive analyses and multivariate regression analyses. PQIs were mapped using ArcGIS 9.3.

Results: We found that the factors that influence PQIs differed among disease groups in Japan.

Conclusions: Although PQIs were adjusted for age and sex, results suggested that adjustment for other disease-specific factors is necessary to evaluate regional diversity of health care systems' quality and efficiency.

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TITLE: Applying Software Change Management Tools for Clinical Classification Development

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Introduction: When you develop healthcare classification systems, such as diagnosis, procedures, casemix systems, you have various expert groups working on different parts of the classification. Probably you need a couple of people that prioritize the change requests and make the actual modifications to the classification. The testing phase might afterwards include large number of people and organizations that begin to send change proposals that concern the system. Healthcare classifications are under constant flow of change requests. To satisfy the needs new codes have to be created, previous ones must be moved to another part in the classification, existing groups have to be split into several subgroups, etc.

In software industry, the crucial outcome is the source code. The source code implements the business requirements of a particular software application. The software products are under a constant pressure of different types of modifications. The source code modification process might employ tens of thousands of people in large software companies. The most complex software products are the most complex and time-consuming constructions that human has ever built.

Software engineering is the science of organizing the development processes in a way the business requirements can be effectively transferred into the final product. This process includes change and configuration management that prioritizes and schedules: new feature requests, bug fixes, new business ideas, etc. In the software industry, thousands of people might take part in modifying the source code. Large software products contain millions of lines of code and excessive tools have been developed for maintaining such source code.

Methods: This is a discussion paper that applies a multidisciplinary literature study. We list different approaches developed within the software industry for helping source code version control and change management. We discuss how these methods could be applied for developing healthcare classification systems.

Results: We identify three main branches of software engineering science that could be applied for developing healthcare classifications:

- Development processes
- Version control
- Change management

We note there is a wide range of sophisticated version control tools that are available even for free as open source. Some of the systems have inbuilt capabilities for two level version control development that would be beneficial for developing classifications on international and national level.

Conclusions: Developing healthcare classifications is becoming more and more complex and concerning large number of people in different expert groups on national and international levels. Currently there is a lack of sophisticated methods and tools for organizing the development process and corresponding version control of clinical classifications. The outcome of this is that the development cycles are long and the traceability of the development of clinical classification systems would benefit of more sophisticated tools.

We argue that instead of reinventing the wheel for solving problems in clinical classification version development we could apply methods and tools that are created for software source code configuration management. We argue software engineering has solved and developed sophisticated tools to address the problems that are faced in the development of the clinical classifications.

TITLE: Impact of postgraduate training on medical care process in teaching hospitals in Japan

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Introduction: It has been shown that the density of clinical procedures in teaching hospitals is higher than in other hospitals; however, the validity of the differences in clinical processes in teaching hospitals has been difficult to prove and the measures to compensate the education cost of teaching hospitals have been unclear. While some countries estimate the cost of medical education using the ratio of interns and residents to beds (IRB) as an indicator, the association between IRB and teaching cost in teaching hospitals in Japan has not been examined. The purpose of the present study was to elucidate the effects of teaching intensity on clinical processes and the density of medical procedures in teaching hospitals in Japan.

Methods: Discharge summary and medical claim data from July -October 2004 were obtained from 40 major teaching hospitals and 12 teaching hospitals in Japan. Records of patients who were assigned to those residents with diseases that they are required to experience during the postgraduate training period were extracted and examined. A total of 52,098 hospitalizations were used in the analyses. Hospitals were classified into three groups by IRB; low IRB group ( $IRB < 0.02$ ), medium IRB group ( $0.02 \leq IRB \leq 0.05$ ) and high IRB group ( $IRB > 0.05$ ). Reference costs were estimated from fee-for-service charge, and relative reference costs were calculated as the value relative to the average cost of patients with the same Diagnosis Procedure Combination, DPC, the Japanese case-mix classification. Differences in the relative reference costs for clinical laboratory tests, radiological imaging, investigative procedures and surgical procedures and length of stay (LOS) by IRB were examined by t-test. Multiple logistic regression analysis was employed with adjustment for age, sex and Charlson comorbidity index.

Results: The total reference cost was 6.3% greater in the medium IRB group and 5.8% greater in the high IRB group compared to the low IRB group. There were no significant differences in age, sex and Charlson comorbidity index among the three groups. An increase in IRB was associated with increases in clinical laboratory examinations, radiological imaging and LOS.

Conclusions: The reference cost for laboratory examinations was significantly greater for the higher IRB groups after adjustment for age, sex and comorbidity.

TITLE: Work Limitations and Their Relationship with Morbidity Burden

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Introduction: Work limitations are functional limitations within the work context resulting from chronic illness that produce a restricted ability to perform in one's work role. Work limitations can result in a loss of work and its economic benefits, psychological deterioration, and permanent disability for employees; escalating healthcare costs and lost productivity for employers; and economic loss to society. Little is known about the prevalence of work limitations in employed persons with diabetes; how morbidity burden affects work limitations in employed persons with diabetes; how clinical programs can best design their interventions in order to alleviate work limitations; and how clinical programs can best target those employees who are most likely to benefit from these programs.

The purpose of this study is to explore work limitations and the extent to which they are related to morbidity burden. Specific aims are: 1) To determine the prevalence and level of work limitations, time limitations, mental interpersonal limitations, physical limitations, and output limitations in employees with diabetes; 2) Examine the relationship between morbidity burden and work limitations, time limitations, mental/interpersonal limitations, physical limitations, and output limitations in health system employees with diabetes; and 3) To determine if a morbidity-based patient classification system which is typically used to predict high healthcare resource utilization can predict work limitations in health system employees with diabetes.

Methods: This study uses a cross-sectional design. Employees of an academic health center were identified as having diabetes using patient classification output from the Johns Hopkins University Adjusted Clinical Groups Case-Mix System (ACGs), and surveyed via internet and mail regarding their experience with work limitations over the most current 4-week period using the Work Limitations Questionnaire. The ACG output, which qualifies morbidity burden using diagnosis and medication information from administrative healthcare claims data, was used to examine the relationship between morbidity burden and work limitations. Approval was received from the Johns Hopkins University School of Medicine Institutional Review Board.

Results: The survey achieved a 26% response rate (n=504 completers out of n=1904 eligible), with n=405 completing online and n=99 completing via postal mail.

Conclusions: Data analysis is currently underway. This presentation will highlight the results from this study.

TITLE: How to improve hospital management to face PPS in France: A case study

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Introduction: France has adopted a Prospective Payment System (PPS) based on GHM (French DRGs) in 2004 for hospitals. The last step was a 100% PPS based payment from 2008. Since, most of the University hospitals are facing an important deficit. This has created an incentive to change hospital management. This change needs the support of a new information system (IS) based on expenditure and income in relation with activity. Unfortunately, as any newcomer hospital in the DRG world, the existing IS is related to clinical department and not to the patient or case. Faced with this situation, the Saint Etienne University hospital must set up the indicators allowing on one hand to weight the expenses and the incomes by clinical departments adjusted by DRG and on the other hand to assess the hospitalisation performance with regard to a national reference DRG cost database.

Methods: The present available data are restricting the use of DRG cost to a top down methodology allowing only a crude comparison between DRG adjusted actual cost of the hospital and a reference national DRG cost data.

Expenditure indicators: The Reference cost by DRG is the expected direct cost per stay (staff; drugs and other consumable, laboratory, radiology, surgical unit, anesthesia) measured by the national cost study (French acronym ENC) that includes only 100 public or private non for profit hospitals out of 1000. This expected cost is applied on the hospital case mix and divided between the different units accommodating the patient during the stay according to the length of stay in each unit. For the actual cost by clinical department, the direct cost are also used: staff expenditure, intermediate products consumption (laboratory, radiology, surgical unit, anesthesia) enhanced with the ENC mean cost of value unit. Income indicators: National tariff per GHM is applied on hospital casemix then divided between the different clinical units with the same distribution rules than previously for cost. Performance indicators: the LOS performance is the difference between the number of observed days and the expected days calculated from the ALOS by DRG in the reference DRG database. These income and cost indicators are described for the whole hospital and for each clinical department Data used are 2008 case mix database from St Etienne university hospital (67315 datasets).

Results: The results for direct cost for the hospital (year 2008) are:

Total expected costs= 125 642 112 € (55 015 982 € for staff, 34 744 055 € for consumables, 35 882 075 € for Intermediate products)

Total observed costs= 190 980 308 € (104 814 353 € for staff, 36 993 363 € for consumables, 46 264 470 € for Intermediate products)

The total incomes are 132 781 049 €

Global performance of Saint Etienne hospital is an excess of length of stay of 28638 days (+9,7%)

These results are declined for each clinical department showing important variation.

Conclusions: 1 The IS limits of the hospital are not preventing an analysis of the cause of the important deficit of Saint Etienne hospital under PPS payment.

2 The main causes are:- too long LOS and lack of cases not compensated by extra DRG funding (outliers, ICU, costly drugs) - overcost of staff not compensated by extra DRG funding (emergency, pain management, health education and researches) overcost of lab tests and imaging.

3 The variability of results by clinical departments provides a tool to change the healthcare delivery to allow to come back in 3 years to a balanced financial situation by: - Reducing LOS and increasing the number of cases treated in the clinical departments if there are waiting patients; - Redistributing beds and staff from clinical departments underused and without waiting patients to departments having waiting patients; - Deleting beds and staff if the two previous points are not possible

The new French PPS system is a strong incentive to increase efficiency. Time will allow us to assess its practicability and namely if the equity outcomes are acceptable by the French socio economic context.

TITLE: Inpatient vs Outpatient care and incentives for efficiency and quality in Cardiology

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Introduction: In the past years, the financing model adopted by the Portuguese Health Authorities to finance Hospitals has been based, for inpatient care, in DRG's grouping. Furthermore, increased weight of outpatient care, financed by Ambulatory DRG, has deepened the complexity of the overall system. The effects of such a model, in its diverse aspects, from efficiency to quality have been increasingly studied, and efforts are continuously being directed to increase those studies. We will try to analyse its impact in a particular setting: Cardiovascular procedures. This area has witnessed a huge increase in outpatient care, thereby dramatically changing the rules that ruled this activity.

Methods: This study will be conducted by analyzing the evolution of the activity of a Cardiology Unit of an Acute Care University Hospital. It will present the evolution of the mix between inpatient and outpatient care, as well as the results in terms of efficiency and quality. We will also start a comparison, to be refined and developed in subsequent work, of real costs and the DRG price, in order to determine the specific effect of increased outpatient care in this specific area.

Results: As the study is still in its final revisions, results cannot be yet publicized as final

Conclusions: Although it is still under final revisions, it is already possible to present some preliminary conclusions:

1. There has been a significant increase in the number of patients being treated. This increase has not implied a shift from other hospitals but rather a reduction of waiting lists, in the case of elective procedures, and better service to patients of the current geographic area.
2. There has been an increase in efficiency, as measured by cost per patient or cost by procedure
3. Although the Hospital has registered an increase in its income, it has been less than proportional to the increase in activity, because of the rules of the financing contract defined by the Health Authorities. This implies that there have not been enough incentives for Hospitals to adopt a more aggressive strategy in terms of increasing outpatient activity.

TITLE: Divergence between case-mix based operational parameters and financial ratios

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Introduction: Credit rating agencies use a range of liquidity, profitability, coverage and leverage ratios or a mix of them to judge the financial status of an organization. Impact of case-mix differ on these financial measures. Given the increasing importance of such a credit rating for hospital set-up, both private and public, this paper explores the relationship between credit rating ratios and case-mix. The arguments in the paper have direct impact on hospital audits, be it public or private sector, and should be considered carefully while looking into the case-mix based operational parameters and financial efficiencies at the hospital.

Methods: Standard & Poor's formulas for key ratios are considered. These include EBIT interest coverage, EBITDA interest coverage, Funds from operations/Total debt, Free operating cash flow/Total debt, Pretax return on capital, Operating profit margin, Long-term debt/Capitalization and Total debt/Capitalization. The methodology emphasizes the varying ability of case-mix to influence balance sheet, earning statement and cash flows.

Multiples Discriminant Analysis is most suitable methodology to summarize case-mix effects on various factors; however, the eigenvectors are hard to define given their overlapping nature. At the same time, equating case-mix with net income and especially with cash flows, as attempted in the past, has led to discrepancies due to over-simplification when the care-based operational models and the financial model are considered to be one and the same thing. Regressing financial parameters which form the inputs for the credit rating ratios with different case-mix subgroups provides impact localization on a particular healthcare institute.

Results: The influence of case-mix on the ratios differ across the healthcare institutions depending on a host of factors; some of the most important ones being: the corporate structure of the institution, the debt structure, usage of asset-backed papers, special purpose vehicles, corporate governance, geographical location, macroeconomic factors, reimbursement methodologies, accounting techniques, methodologies used for cash flow projections (whether absolute or relative) and for the enterprise evaluation, depreciation and amortization methodologies, taxation, currency adjustments, and so on.

The relationship between case-mix and gross income is the strongest as long as the coding is done correctly because gross income is based on accrual, both within US GAAP and IFRS used internationally, allowing the billed services to be considered directly within the income statement. The various aspects of healthcare delivery efficiency plus macroeconomic factors defining costs of services in the region together influence the cost of sales which implies that there is a slight divergence already in place between what is case-mix efficiency on the one hand and the financial indicator with core operating income. Further divergence ensues when the other Sales, general and administrative factors are considered defining the operating income. Thus, a perceived simple indicator of operating income, although is still close to the case-mix performance, it already has components influenced from the healthcare organization and regional and international factors which makes the case-mix based argument tricky to use without modifications. Deduction of R&D costs while deriving the operating income adds another layer of complication effectively meaning that despite having high case-mix efficiencies, some healthcare institutes with large R&D expenses might seem to underperform financially compared to a non-R&D for-profit organization.

Further divergence between operational efficiency and financial performance occur when the cash flow is calculated. S&P defines net income plus non cash charges (depreciation, amortization etc.) as Funds from operations; deducting working expenditures (current asset and liability changes) as operating cash flow; deducting capital expenditure as free operating cash flow, and so on. Each of these layers include complexities arising from both internal and external factors which shape hospital policies in different ways. Thus cash flow ratios have a much larger divergence from case-mix efficiencies than the earning parameters.

Conclusions: Healthcare finance and economics community in general and case-mix community in particular should define work-plans to create standards and protocols which provide ways and methodologies to align case-mix based operational efficiency parameters with financial parameters (credit rating parameters used as one of the many benchmarks available). The current financial crisis and increasingly complex financial environment would mean that the divergence between these parameters is large and a collaborative work between hospital organizations and specific communities to address these issues has become essential.

TITLE: Development of a method for assessing operating room management based on Diagnosis Procedure Combination E and F-file data

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Introduction: Due to rising health costs, hospitals are making efforts to assess and improve management efficiency. However, at present Japanese hospitals rely on their own individual assessment methods. Due to the lack of a common method of assessment based on standardized data available from all hospitals, meaningful comparisons cannot be conducted. The objectives of this study were to development 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: Diagnosis Procedure Combination (DPC) is a patient classification system in Japan. DPC data E and F files contained detailed information such as general anesthesia duration and dosages for all medication prescribed. 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 for 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, and 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 in which 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 in which the dependent variable was the Number of operations per OR per Month, and the independent variables used 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: Table 1 shows the results of descriptive statistics for 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 and the procedural fee per OR per hour. There were large inter-hospital variations seen in all 5 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 (Table 2), we found that the number of surgeons per OR and the total number of beds in each hospital were 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.

Conclusions: The OR management assessment method based on the 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 greater insight into the target of the fee and the number of surgical operations of each hospital after taking into account inter-hospital variations, and therefore may be used as a tool in target management.

TITLE: How to make a simple classification system for geriatric and rehabilitation care

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**Introduction:** Case-mix systems for rehabilitation and geriatric care require information about patients' functioning. Patients' functioning and limitations are measured by assessment tools. The numbers of items or questions within these assessment tools are usually large. For example, in Japan, one of the major geriatric assessment tool used for the case-mix classification system contains 80 questions and it requires 1.8 hours per person to complete the questionnaire overloading the surveyors. Therefore it is mandatory to develop a method to reduce the number of items of the questionnaire. In this study, the authors discuss a method to efficiently decrease the number of items by constructing Gutman scale in combination with Rasch analysis. International Classification of Functioning(ICF) is employed for this assessment tool.

**Methods:** As shown in former studies, health service resource utilization in geriatric facility was mostly explained by mobility, toileting, eating, cognitive functioning and type of medical needs. Therefore the authors selected relevant 88 ICF codes covering mobility, toileting, eating, and cognitive functioning. Because ICF codes do not cover the problem related to dementia care, we also selected the scales with dementia care, such as dementia behavior disturbance scale, revised Hasegawa dementia scale and brief version of geriatric depression scale. To construct a questionnaire for the purpose of this study, we also developed a simple dichotomous qualifier for each code adding adequate explanation suitable for geriatric care setting. For medical need, authors selected top 20 diagnosis.

**Participants:** 1166 Japanese elders aged 65 and elders in geriatric health facilities were recruited as participants and written informed consent were obtained. Of these participants, 300 elders were measured independently by two surveyors to examine test-retest reliability.

**Analysis:** Using data obtained from the participants, the authors selected items that fit to Rasch model for each domain of measurement (mobility, toileting, eating, and cognitive function). Several code sets such as mobility, toileting, eating, orientation, and behavioral disorders are constructed. Using item difficulty location parameters, simple Gutman type scales are constructed.

**Results:** Nine Gutman scales were constructed. These were named basic behavior, mobility, orientation, communication, cognitive activities, eating function, eating behavior, toileting, and bathing. Each Gutman type scale was composed of four ICF items used as thresholds. The levels between the thresholds were labeled and illustrations were added to characterize each level. For example, mobility item is composed of four ICF codes. These codes are d4702 (Using public motorized transportation), d4551 (Climbing staircase), d465 (walking with equipment), d450 (walking short distance within institution). Out of these, d4702 was the most difficult item and d450 was the easiest item. Then the items are ordered from top to bottom according to the difficulty of the items, and each item was used as threshold to demarcate patient characteristics.

**Discussion:** Most of current system to measure resource utilization employes functional assessment of the patients. However, these systems tend to include many assessment items and making these systems inefficient. To decrease the number of items we employed Rasch method to construct Gutman type scales. Rasch method enables us to test whether each code were adequately used as an item of a measurement scale. If an item meets the Rasch model, then these item can be used as a measurement scales. Then we developed Gutman scale using the location parameter of the Rasch analysis and hierarchically rearranged original items. This is because a Gutman type scale could contains multiple items. In addition, recent discussion on the application of the ICF was mostly focused around the concept of the ICF. Only a few studies addressed the question, whether the ICF codes could be used to describe functioning of the patients. Therefore, this study gives an example to adopt ICF codes in reality.

**Conclusions:** In this study the author constructed simple Gutman type scales using ICF codes by adopting Rasch method. The new scales have following characteristics: 1. Items included in an assessment scale are unidimensional, and independent of measurement setting, because these items were selected using Rasch method; 2. By hierarchically rearranging the items in a Gutman scale, each scale includes four ICF items, making the measurement more effective, less time consuming.

TITLE: Implementation of a complexity classification system for Inpatient Rehabilitation Facilities for financing proposes – Comparing scales

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Introduction: In Portugal there is no formal casemix inpatient rehabilitation classification system. Budget for Inpatient Rehabilitation Facilities within the Portuguese NHS is calculated on a per diem basis with no relation to the diagnosis and complexity of patients treated.

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 a more adequate care management and resource utilization. Furthermore, the aim of this pilot project is to create a specific rehabilitation grouper where each group will have a different price indexed to the complexity.

In what rehabilitation care is concerned, it is clear that most of the disability measure instruments do not reflect accurately the overall patients' clinical conditions. Measuring complexity, especially for financing proposes, is a controversial issue where the use of an 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 measure instruments, applying them to a randomly sample and also study the results, identifying if there is concordance between different ways of measure disability. On the ongoing classification project, inpatient episodes throughout some NHS Rehabilitation Facilities have been classified retrospectively and a data base of about 1000 episodes has been created. Also retrospectively, and for the present study, the ICF qualifiers and the Barthel Index were applied to a random sample of this database. In order to compare final classifications, Kappa's and Kendall's quotient were used to observe the concordance between the instruments.

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

Conclusions: The level of disability in rehabilitation and the burden of care it implies have to be integrated on any financing system for inpatient rehabilitation facilities. Each instrument measures complexity differently according to the evaluated dimensions. However, one may or not may 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 doesn't have to integrate all possible dimensions (as it must do for clinical proposes) but it has to give a complexity and functional dependence accurate measurement. Deciding for what kind of measure instrument to apply depends on what is our goal in terms of budgeting.

TITLE: Funding mental health care services: is casemix a suitable tool? A tale of three countries

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Introduction: Among mental health care services' patients different treatment needs, patterns of care, and levels of resources used are present. However, mental health services have been funded without taking into consideration those differences and not reflecting levels of complexity. In Portugal, a prospective payment system based on Diagnosis Related Groups (DRGs) has been in place since 1997 for acute care hospitals meaning that psychiatric patients admitted to those facilities have been funded according to the case-mix they present. Nevertheless, DRGs are not suited to group and finance patients admitted into psychiatric hospitals providing long term care. However, three of those psychiatric hospitals have been using DRGs to group their inpatients since 2003 with poor results, as expected. It was observed that close to 84% of all their inpatient episodes were grouped into DRG 426 Depression Neurosis and DRG 430 – Psychosis (AP-DRGs v 21.0) (ACSS, Base Nacional de Dados GDH, 2009). Non-acute mental health services of psychiatric hospitals are paid through a per diem based solely on the inpatient's length of stay. The goals of the current work were several folds: should the case-mix system in place for acute care hospitals be adapted to finance mental health care in Portugal? Should one of the reviewed patient classification systems for mental health care be adopted in Portugal? What are the similarities in the Minimum Basic Data Set (MBDS) within the systems analyzed?

Methods: A review of the literature was done for the development and use for funding purposes of mental health care patient classification systems in Australia, Canada and the USA. Mental health care in Portugal was described according to its inpatient and outpatient volume and also to its geographical distribution. Bearing this information in mind, it was sought to evaluate the feasibility of implementing a case-mix system to fund mental health care facilities in Portugal.

Results: The analysis makes clear the importance of tailored patient classification systems as a basis for the description and financing of mental health care. Its adoption enables a better and more accurate understanding of the several factors driving the costs of mental health care while at the same time provides some leads regarding cost-saving strategies.

Conclusions: In one's opinion the selected classification system should favor a rapid implementation and not involve burdensome investments but at the same time promote a fair resource allocation. The MBDS should include data covering patient's socio-demographic characteristics, principal diagnoses and severity of illness. As in the MBDS designed for use in Australia and Canada information concerning the level of functionality should also be collected because it is an important predictor of resources and costs consumed. Surgical procedures are included in the American grouper but not in the other two.

TITLE: Classification and alternative payment for Sub-Acute and Non-Acute inpatient care in Thailand

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Introduction: The objectives for the study were two folds: 1) to develop and test on validity and reliability of the new classification for sub-acute and non-acute inpatient with iso-resource and clinically sensible characteristics and 2) to develop an appropriate mechanism to pay for sub-acute and non-acute inpatient services.

Methods: A prospective study was undertaken on 2,479 inpatients from Ratchaburi Hospital and Udonthani Hospital with retrospective data collection on 586 inpatients from Sirindhorn National Medical Rehabilitation Center. Other data sources in this study were: functional measurements, questionnaires, hospital annual financial reports, and electronic databases. The study was conducted from May 2008 to February 2009. The steps for the study included: 1) Developing a classification system for sub-acute and non-acute inpatient services, 2) Analyzing cost and assigning payment weights, 3) Testing capability of the new classification system in predicting hospital resource use. Independent variables for classification were principal diagnosis, functional status (measured as Barthel Index for motor function and Mini – Mental State Examination: Thai version; MMSE Thai 2002 for cognitive function), patient age, and secondary diagnosis. Dependent variable was cost. 4) Developing appropriate methods to pay for sub-acute and non-acute inpatient services. Statistics used were such as frequency, mean, percentage, ratio, coefficient of variation (CV), reduction in variance (RIV), linear regression, split-half cross-validation, and Pearson's product-moment correlation.

Results: The casemix classification for sub-acute and non-acute patient (SNAP) contained 99 groups. Average cost of sub-acute phase was 37,311 baht. Cost of SNAP 66110 Neurological condition, low BI score was the highest (155,767 Baht, RW 4.1748), followed by SNAP 61110 Stroke, low BI score, age<60, low cognitive (121,300 Baht, RW 3.2510), and SNAP 79110 Burns, low BI score (118,715 Baht, RW 3.1818). Cost of each score improvement of the Barthel Index was 4,529 Baht. CV of cost lower than 150% was 98% of all SNAP. RIV on cost was 33%. RIV on LOS was 35%. Average predictive ratio was 1. Regression analysis revealed that the Barthel Index score at admission, the rehabilitation impairment categories (RIC), and LOS were key determinants of cost at sub-acute and non-acute phase (adjusted R<sup>2</sup>=0.749. P=.001). The validity result of split-half cross-validation of SNAP was high (Shrinkage 0.0267). Five payment methods were proposed. The per diem payment based on SNAP and the per diem (not included rehabilitation cost) payment plus rehabilitation cost and reward for functional gain were significantly related to cost (r 0.960, P 0.001). The payment based on SNAP relative weight (RW) was moderately correlated with cost (r 0.538) whereas the payment based on Diagnosis related group RW showed lower correlation (r 0.382).

Conclusions: The result indicated that SNAP closely predicted the hospital resource use during sub-acute and non-acute phase. SNAP should be further developed for the prospective payment system in Thai health insurance system.

TITLE: Regional Variation in Selected Patient Care Services in Ontario

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Introduction: Ontario's Institute for Clinical Evaluative Sciences (ICES) has shown that the treatment for the same disease is not uniform across Ontario. Further, little is understood regarding the relative importance of neighborhood characteristics, environmental factors and other local factors associated with variations in the trajectories of care. As Local Health Integration Networks (LHINs) increasingly manage responsibility for planning, measuring, funding and integrating health services in their regions, characterizing regional variation of care for disease management is important for improving integration of health services.

Methods: This study provides a population-based descriptive analysis of the patterns of integration of utilization of health care for 3 patient types. Specifically, we propose to create 3 anonymous cohorts of Ontario residents; one for each of knee replacement, chronic liver disease and kidney disease patients. These conditions are selected based on their diagnostic accuracy and likelihood of accessing services in multiple settings. Cohorts will be defined from identifying incident cases amongst acute inpatient hospital discharge records from Ontario's discharge abstract database (DAD) of over 1 million acute hospital discharges per year. Hospitalizations will be linked (anonymously) to sub-acute care episodes and physician billing data. The analysis and results propose to be a first step in developing methods for measuring aspects of integration of care across different settings and to explore different methods for case mix measurement across multiple settings. The analysis will serve as a prototype to achieve two objectives; first, acute, sub-acute and other clinical and administrative datasets will be linked to measure regional variation in integration of care across settings. Simultaneously, the analysis will investigate whether acute episodes can be successfully linked to sub-acute episodes to propose a 'comprehensive', or 'bundled' case mix episode. Proposed integration of care measures and 'bundled' case mix measures will be evaluated for clinical relevance, consistency and reliability.

Results: Variation in patterns of treatment between regions across care settings will be described. For example, are some region's hospitals more closely aligned with rehabilitation and chronic care hospitals, easing transitions from acute care to sub-acute settings? Differences in patterns of treatment will facilitate the conversation regarding the appropriate level of care between regions. Where data is available in clinical and physician billing datasets, process of care measures will be evaluated. Importantly, gaps in the data will articulate opportunities to include population based data and other clinical and administrative datasets. Regional level results will also be provided.

Conclusions: The research project is in working progress. The conclusions will be provided with the submission of the article.

TITLE: Breast cancer acute care hospitalizations – equity for patients' reimbursement in 2 similar regions of France and Romania

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Introduction: This paper is part of a larger study aiming at identifying similarities and differences between geographical and economical aspects of access, utilization and resources allocation for breast cancer patients in 2 similar regions of Romania and France. The present paper presents the resources allocation models used, draws some conclusions (including limitations) and makes recommendations on A. further details to be included in the analysis and B. relationship between patients' classification tools and equitable resources allocation for breast cancer patients.

Methods: The 2 selected regions are Rhones Alpes, France and Transylvania, Romania (as defined by 16 specific counties identified by the authors). The selection of the data sets used respected for both regions some common criteria: female patients discharged from hospitals during 2005 (Jan 1st to Dec 31st) in the selected regions that had an ICD10 code of C50 (breast cancer) as principal diagnosis and had been reimbursed to the respective hospital on a case mix based tariff. Different other filters had been applied, based on the classification system used for grouping of the clinical data. Romanian data has been grouped with HCFA 18.0 and AR DRG v.5.0 groupers; before submission of the full paper, Ro patients will be also grouped using GHM v.10 grouper. French data has been grouped with GHM v.10. Tariffs for each hospitalization episode had been applied as follows: real tariff reimbursed during 2005 for each patient in the respective region and full case mix payment at a national rate for a weighted patient.

Results: Based on the data sets available and grouping (classification) methodology used, preliminary results were obtained for equity comparisons in financial resources allocation. France: After estimations of a national casemix adjusted tariff and application of official 2005 reimbursement rates, preliminary results indicate actual reimbursement below the national complexity adjusted rates of about 5%. Romania: Our analysis shows (similar with France) that the level of financing paid to the respective hospitals for breast cancer patients were lowest when using the HCFA classification model, but are also influenced by the financial allocation policy in place at the time.

Conclusions: Using classifications systems that have similar clinical and resources consumption aggregation principles and collecting standardized clinical and demographic data sets allows for comparisons between different types of populations, health care systems or health policies implementation – useful when we want to import good patterns or drive policy changes.

TITLE: Analysis on geographic distribution of acute care hospitals and accessibility to care, based on Japanese DPC database

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Introduction: Geographic accessibility to care not only depends on distribution of hospitals, but also on what service is provided in each hospital. This study illustrates methods to utilize nationally collected hospital case mix information in accessibility to care analysis.

Methods: Hospital case mix data published by the Ministry of Health Labor and Welfare (DPC survey data) is used to construct an acute care hospitals database. Hospitals are then geo-coded using their addresses to calculate drive times to geographic mesh. Resulting hospital-to-mesh drive time table is used to analyze accessibility to services in each region or prefecture.

Results: 2007 DPC survey data consisted of 1,428 hospitals (16% of all hospitals), 457,000 beds, (50% of all hospital beds) and four million discharges for the latter half of year 2007. Coverage rates of population within 90 minutes to these hospitals were over 88.9% for all prefectures, with 33 out of 47 prefectures having rates over 99%. However, when volumes of services provided by each hospital were considered, population coverage showed a large disparity between prefectures and hospital services. The results also suggest existence of monopolistic provision of specific services in few prefectures.

Conclusions: Analysis on geographic accessibility to care relies deeply on description of hospital services. Nationally collected information, such as the Japanese DPC survey data, is crucial in pursuit of closing care gap that exist in real world settings.

TITLE: Using randomized control as a tool for assessing the coding quality

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**Introduction:** In 2001 Estonian Health Insurance Fund (EHIF, the main purchaser agency responsible for purchasing the health benefits) decided to introduce DRG based payment system and began work on adapting the NordDRG system by providing hospitals with feedback on their activity by DRGs and calculating prices for reimbursement. The use of a DRG system has been facilitated by the high level of detailed data (reimbursement claims) available to the EHIF through the billing system in place. Since 2004 the NordDRG system was implemented as a payment method. NordDRG system uses two primary classifications: ICD-10 (used in Estonia since 1996) and NOMESCO Classification of Surgical Procedures – NCSP (implemented in Estonia in 2003). In assignment process the principal diagnosis (in some cases complication or co-morbidity, age, discharge information) and most significant procedure is used to allocate the patient into the DRG. Hence, DRG is a secondary classification and in order to assign the case to the proper DRG a correct use of primary classifications is required. As there exist differences in describing the clinical diagnosis in medical record and statistical diagnosis in reimbursement claim (mainly in terms of sequence of the codes) compliance with the ICD-10 instructions has of high importance in using the DRG system. From purchaser point of view is essential to pay attention and detect attempts to game the system by upcoding or using complicated DRGs in order to boost earnings. This leads to the unfair reimbursement of health care providers, inadequate statistics etc. In addition, it disguises the data used for DRG pricing.

**Methods:** In order to verify whether the claims presented to EHIF reflected the true severity of the cases and the correct sequence of codes the (according the ICD-10) the randomised control was conducted. The sample (N=778) was derived from the database of EHIF comprising from the cases of patients with stroke. The basic principle of the control was: 1) to compare the codes described in medical records with those in reimbursement claims; 2) to detect inappropriate use of ICD-10 which led to the change in assignment of the cases into DRGs.

**Results:** The randomised control showed that in 553 cases (71%) out of 778 the codes in medical record and on reimbursement claim were identical.

The reasons of different coding were as follows: a) the amount of codes in medical record was bigger than in claim (31% of the non-identical cases); b) the sequence of codes in medical record and claim was different (31%); c) the amount of codes in medical record was less than in claim (24%); d) the other reasons (14%).

As for the differences in assigning the cases to DRGs, 5% of the cases were reassigned due to an inappropriate use of ICD-10. One third of reassigned cases were allocated to the DRGs with lower cost weight compared to the initial assignment.

**Conclusions:** The coding and use the primary classifications are the key factors in DRG system. Despite the fact that both classifications have been used during a long period, there still exist the lack of skills and knowledge among the coders (medical doctors or accordingly trained health care workers) of how to use the primary classifications correctly. For improving the coding quality and avoid gaming the coding rules have to be clearly defined and applied; the coders have to be continuously educated and have professional ethical standards; regular audits and/or randomised controls have to be performed; the feedback for detecting the coding problems and differences in coding among health care providers have to be used and developed.

TITLE: The discharge letter as source document for a pathology-based health care financing system. An exploratory study about quality-measurement of discharge letters.

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Introduction: In the future the finance of the health care system will evolve from a structure-based system to a pathology-based system. The pathology will be evaluated on a coding system, in Belgium at this moment ICD-9-CM. The codes associated with a specific pathology are extracted from the discharge letter about the hospital admission. Coders classify the relevant information from the discharge letter into a pre-defined, hierarchical classification system (top-down approach) using the correct coding rules. On 1 January 2008 a Belgian coding manual was published in order to support coding people to associate a lessambiguous code with the information in the discharge letter. During this process, it is forbidden to make certain assumptions or interpretations by combining different semantic concepts into a new semantic concept. We expect that the correctness and the specificity of coding is very much dependent on the quantity and the quality of the information off the discharge letter. (Brian Hazlehurst, PhD, H. Robert Frost, MS, Dean F. Sittig, PhD, Victor J. Stevens, PhD / Journal of the American Medical Informatics Association Vol. 12 number 5 page 517-529).

Methods: In Belgium, almost all discharge letters are sent to the general practitioners by a secured electronic communication system (MediBridge®). In this way almost all discharge letters are electronically available. These digital documents are processed by the iKnow® software to extract all the relevant semantic concepts. Where the classical NLP systems (natural language processing) use a top-down approach to identify terms on a pre-defined base of thesauri, ontologies or statistical models, iKnow® uses a bottom-up approach. The 'Smart Indexing Engine' automatically identifies all complex terms in data, regardless of their length or semantic complexity. The output of this process is in the first place the amount of relevant semantic concepts for each discharge letter. We were also able to produce for each physician a frequency list of all used concepts in their written documents. Finally we made a distribution diagram of the concepts and the n-grams used. N-grams (the amount of words for each concept) exist of a central concept, completed with one or more modifiers. These modifiers add an additional dimension to the central concept which consists of a positive/negative status finding or an adjective to describe the degree of severity of a symptom or a clarification of the primary concept.

Results: As a general descriptive indicator, we used the average amount of used concepts for each letter and each physician. There was a great variation between the different physicians, where the variation between non-surgical physicians was more explicit than between surgeons. Also the distribution diagrams of the concepts into the n-grams showed a great variability between physicians, what could be an indication of the specificity of the available information. Bi- and trigrams (n>1) will have lessambiguous information than monograms (n=1). In these distribution diagrams, we also noticed a great difference in the reuse of the same concept in different letters. The frequency list of the concepts can be used to inform the physicians on an individual, objective and measurable manner concerning the use of concepts in their discharge letters.

Conclusions: When the quality of the discharge letter is inferior, it is almost impossible for a coder to use the correct and specific ICD-9 code. To solve this challenge, physicians should receive feedback about the quality of their discharge letters. Our approach to measure the quality with the used variables creates a possibility to monitor this evaluation. When the patient file is more digitalized, software tools could be developed for physicians to support them "on the fly" to produce a qualitatively superior discharge letter, according to the desired specificity of the coding system (ICD9Code Assistant: A prototype/Selnur Erdal DDS MS, Jing Ding PhD, Carol Osborn PhD RHIA, Hagop Mekhjian MD, Jyoti Kamal PhD/AMIA 2007 Symposium Proceedings p. 950). In attendance of a better quality of the discharge letter, the coding manual should instruct the coder to use the exact code in case of a vague description of the pathology. Taking into consideration that in the near future, there will be a change from ICD-9-CM coding system to the more specific ICD-10 coding system, more specific rules for coding in the daily practice will result in a more correct and accurate pathology based finance system.

TITLE: PREDICTING THE COST OF ACUTE CARE NURSING A Nursing Workload Demonstration Project

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**Introduction:** Nursing workload data has not consistently been used 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 it accurately reflects the practice environment. Several studies have shown that workload measurement systems may not reflect true workload. In 2006, the Ontario Ministry of Health and Long Term Care (MOHLTC) completed a study on nursing workload data collection. The study evaluated the quality and value of the data, and the cost-benefit of collecting the data. Results of the study lead to the MOHLTC recommendation that nursing workload data collection would only be mandatory for Case Costing hospitals, since at the time, there was no alternative in place to predict the cost of nursing. This 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 and investigate the feasibility of a model to predict the use of nursing resources.

**Methods:** A Time and Motion Study was conducted on 3 medical / surgical units in an academic hospital and a large community hospital. Each staff nurse (RN, RPN, CA) on each unit was shadowed by a nursing student using custom-designed software on a tablet computer to capture all the time spent by the nurses on the 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.

Using administrative patient level cost data 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 explored to explain the variation in nursing costs. Various dependent cost variables were identified in the case costing dataset, including 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 accounts for the highest percentage (approximately 26 %) of nursing time while the 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 costs of intervention, emergency department, clinics and operating room were significant but increased the r-squared very little.

**Conclusions:** This study confirmed that the nursing workload data, from 3 wards in 2 hospitals, correlates highly with a time and motion study data. A simple model was developed using several factors explained over 70% of nursing resource utilization. Future research will include investigating additional patient-level variables, as well as outcome variables (e.g., operating room times, discharge disposition, admission source, HOBIC scores, etc.) to enhance the model.

TITLE: The Audit Process in Patient Classification System Based on Dependency of Nursing Care (PCS/N)

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Introduction: The authors present the Internal and External Audit processes, associated to the utilization of the Patient Classification System/Nursing (PCS/N).

In the context of the current crisis it is imposed the necessity of costs control. In the health area, a critical one in any society, the increase of expenses becomes, many times, inexplicable and it is demanded to the managers severity and containment. For this, they need to use methodologies that provide the necessary information and also need tools to control the produced information.

The PCS/N application allows the measurement and control of nursing productivity in hospitals, serves of support to decisions, elaboration of plans and budgets and allows establishing balanced financing criteria's. To promote the reliability of the produced data had been created the Internal and External Audit processes. The Internal Audit verifies the accomplishment of the patients' classification rules and contributes to assure the consistency of the correct choice of dependency levels. The External Audit controls the information produced by the system utilization.

Methods: The PCS/N model has been developed from the GRASP methodology and consists in classifying inpatients by critical activity indicators, according to their needs of nursing care. Through the daily evaluation of inpatients needs, nurses can plan their interventions in a prospective mode. The classification allows the determination of the necessary care hours per patient, which, related with the number of inpatient per day, allows getting the management indicator-Hours of Nursing Care required per Patient per Day (HCR/ID). This daily produced information allows planning and managing nursing resources and contributes for the guarantee of quality care, in accordance with the instituted standard of care.

Associated with the application of the PCS/N are the Internal Audits aiming at ensuring the reliability of the data generated in each hospital and verifying the accomplishment of the patients' classification rules. The suitability of the recorded care levels is evaluated through the analysis of patients' records and planned estimated care. Through a monthly verification, based on a randomised analysis of clinical processes, the internal auditors validate the results of patient classifications, in all unit care, using the PCS/N.

Simultaneously, an External Audit process was set up, aiming at implementing a control system to ensure the reliability of the information generated. External audits take place once a year, in each hospital; a random set of internal audits is thoroughly analyzed, not only to ascertain the fulfillment of the rules but also to monitor the presupposition of the PCS/N, which contribute directly to ensure the quality of the system itself and, indirectly, to the quality of the healthcare provided. External auditors are selected and trained by the project manager, in the central department of the Ministry of Health where the PCS/N is based.

Results: The internal audit process is inherent to the application of the SCD/E and results, nowadays, in a data repository of about 20 years. Between 1987 and 2004, the internal audit rules in vigor allowed a margin of error. This was annulled with the adoption of measures of quality emanated by ISO 9000. With this process it is possible to know the number and percentage of correct classifications. In 2008 the internal audit process was developed in 363 services where have been effectuated 31.768 audits. This audits revealed 19.179 correct classifications that corresponds to 60,37%.

The external audit process has a shorter time of life. In his 12 years we have assist a more and more accurate utilization of PCS/N, at national level, guaranteeing benchmarking of the produced data. In last year the results was 66,54% of correct audits, slightly raised in relation to the internal audit.

Conclusions: The internal and external audit processes of PCS/N had been innovative for nursing, in Portugal, and had provoked an enormous change with particular influence in care management and human resources management.

The evolution of these two processes has been supported by the Guidelines for quality and/or environmental management systems auditing (ISO 19011:2002).

Although the audit process has been considered as a more-value, the data collected with his application shows that it was not achieved the quality platform, because of the crescent requirements placed on for global quality systems and the difficulty of maintenance of safe endowments in hospitals. These values will raise upper levels, in the future, when hospitals gain more stability in these new projects of quality management.

TITLE: An evaluation of the relative merits of using generalised linear models compared to case mix based on diagnostic related groupings (DRGs) to measure relative provider performance

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Introduction: Measuring provider performance relative to peers for admission rate, cost or utilization of high cost ward settings has considerable benefit in terms of selecting efficient providers for network plans and reimbursement negotiations. It is therefore imperative that the technique used to risk adjust the underlying data is robust if the results will be used to inform business decisions. We aim to investigate in this paper if fitting a generalized linear model (GLM) based on demographic data will result in different conclusions to risk adjusting the data based on DRGs. In addition the relative merits in interpreting the results will be discussed.

Methods: Using Discovery Health's DRG grouper for risk adjustment and applying generalised linear models as another form of risk adjustment

Results: The authors are in the process of collating results.

Conclusions: The paper will conclude with a discussion of the relative merits of each form of risk adjustment.

TITLE: Predictive Models to Identify High-Risk Older Patients

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Introduction: To target interventions to patients with complex care needs that can benefit from them the most, effective high-risk case identification tools are required.

Objectives: To assess the ability of the Johns-Hopkins Adjusted Clinical Groups Predictive Modeling (ACG-PM) system to identify high-risk elderly patients who are best suited for inclusion in care management programs in Israel's largest health plan.

Methods: We assessed the ability of the ACG-PM system, compared to prior cost, to identify older adults at high-risk for deterioration in their health status. Diagnostic and / or healthcare utilization characteristics of a representative sample of 15,000 elderly patients were used to identify those at highest risk. The predictive accuracy of each model was assessed using Positive Predictive Value (PPV) and ROC curve area.

Results: The two approaches identified older patients at risk for future deterioration and high resource use. ACGPM performed significantly better than prior cost only. Predictive accuracy was high: PPV ~40% and area under the ROC ~0.7. Clinical characteristics of patients identified by the two systems indicated that they are well-suited for care management interventions.

Conclusions: PM systems that are based on clinical characteristics as well as resource use are superior to those based on prior cost only. Model performance of the JH-ACG-PM system, which was not yet enhanced to take into account Clalit's patients' characteristics, demonstrates the robustness of the system in identifying high-risk patients.

Health Policy Implications: Identification of high-risk patients is a crucial healthcare resource optimization tool that can assist in the delivery of effective and efficient care. Further testing of the JH-ACG system is underway to allow for incorporation of pharmacy and other data into the predictive model, for even better accuracy in high-risk case identification.

TITLE: Using administrative data for research: the importance of appropriate statistical techniques

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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 of 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 some patients' characteristics. Let us suppose that we seek to evaluate the impact of a given treatment on 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 outcome. 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, we however postulate that appropriate statistical techniques can help reducing 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 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 (diagnosis 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, 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 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 in 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 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 under-estimated 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.

Conclusions: 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.

TITLE: Risk-adjusted assessment of blood product use in acute-care hospitals in Japan: an analysis using administrative data

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Introduction: Continuous monitoring of blood use and feedback on transfusions effectively decreases inappropriate blood use. However, traditional monitoring methods (e.g., auditing) pose practical challenges, such as limited availability of experts and funding. As some studies showed that blood usage was similar within various diagnostic groups, a patient classification system may be employed for risk-adjusted assessment of hospital-wide blood use. In 2003, Japan introduced a new medical payment system based on its unique patient classification system, called the "Diagnostic Procedure Combination (DPC)." Hospitals that utilize DPC for medical payment use a uniform format to produce discharge summary data (i.e., DPC data). DPC data are created for each patient per hospitalization, and include clinical data such as diagnosis, comorbidities, and surgery information. By linking medical claim data to clinical data, it is possible to know the specific conditions for transfusions and details on the type, amount, and timing of blood products use.

Methods: We conducted a retrospective audit of blood use at two hospitals (Hospitals A and B) to examine underlying conditions for blood use and appropriateness of blood transfusion in each hospital. Audit targets were consecutive patients who received albumin or fresh frozen plasma (FFP) transfusions during hospitalization and were discharged from the hospitals between July 2006 and September 2006. Appropriateness of transfusions was judged according to "Guidelines for blood transfusions" developed by the ad-hoc group of the Japanese Ministry of Health, Labor, and Welfare. Next, by using DPC data from 587,045 cases provided by 73 acute-care hospitals, we developed case-mix adjustment models to predict hospital-wide use of albumin and FFP, and compared them with the observed values in order to assess hospital-wide use of blood products. We utilized the distribution of diagnostic groups to predict the total amount of albumin or FFP transfused at each hospital. We calculated the mean blood products use per case for each diagnostic group (defined by the first 10 digits, representing disease code + surgical code), and used these values as expected values for the use of each blood product in that diagnostic group.

The expected total amount of blood product used in a given hospital can be described by the following formula:

$$\text{SUM}\{Q(i) \times N(i)\} \quad (i=1 \text{ to } W),$$

where Q(i) represented mean units used per case in the ith group, N(i) represented the number of cases belonging to that group, and W represented the total number of diagnostic groups. In order to assess case-mix adjusted blood products use, the expected total use of albumin or FFP at the hospital was compared with the observed values, by calculating observed to expected ratios (O/E ratios) for each hospital.

Results: Of the 587,045 cases targeted, 3.5% received albumin transfusions, and 1.3% patients received FFP transfusions. Table 1 summarizes the audit results at the two hospitals. Appropriate use of albumin and FFP was quite infrequent. Case-mix adjusted models showed good predictive abilities. Model goodness-of-fit assessed using R<sup>2</sup> for linear regression was 0.77 for albumin use, and 0.78 for FFP use. O/E ratios calculated using the case-mix adjustment models were relevant to proportions of appropriate transfusions (Table 2). Higher proportions of inappropriate blood product use were associated with the higher O/E ratios.

Conclusions: Risk-adjusted assessments of blood product use based on administrative data allow hospital-wide evaluation of transfusion use. Blood use comparisons between different hospitals contribute toward establishing appropriate transfusion practices.

TITLE: USING CASEMIX DATA IN UNDERSTANDING THE BURDEN OF CANCER

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Introduction: Cancer incidence is increasing worldwide and there are many reasons for this. In Europe mortality is falling (due to screening progress and better treatments) but is still high, the health care expenditure for cancer is significantly lower (4-7 percent), than the share of the burden of cancer, accounting for 16.7 percent of all 'healthy' years lost in the European Union. Indirect costs account for two-thirds of the economic burden of cancer and direct health care cost and drugs account for approximately 7 percent and 13 percent respectively of all health care costs for cancer.

Methods: An analysis of cancer indicators and health expenditure indicators is made for Europe region, as well as for different countries. A comparison per types of cancer is also performed. Data used is from Karolinska Institute Comparator Report on Patient Access to Cancer Drugs in Europe (2009) as well as from two studies (Globocan 2002 and Ferlay 2006). Data for Romania is from National Hospital database (SNSPMS, 2008).

Results: Overall, in 2005 in Europe the expenditure per capita for cancer was 148 € (Eurostat 2007) comparing to 124€ in 2004, which represents 6.3% of total healthcare expenditure. Country comparisons are difficult, due to different percentages of GDP allocated to healthcare in general, as well as to the different share allocated to cancer treatment. Lower expenditures can be observed in the countries with lower % of GDP allocated to healthcare. Romania, with 22€ per capita is among the lowest in EU, although cancer incidence is high. One of the causes for growing mortality from cancer in Romania is the relatively low absorption of new innovative drugs compared to other Central-Est European countries (Poland, Hungary, Estonia, Slovakia, Lituania).

Conclusions: Casemix data can be used to show the real burden of cancer, in terms of evolution of volume of cases per types of cancers, and for various diagnosis, as well as in terms of the economic burden associated with the disease.

TITLE: Impact of hospital volume on surgical mortality and morbidity following nephrectomy: data from the Japanese Diagnosis Procedure Combination database

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Introduction: This study aimed to analyze the impact of hospital nephrectomy volume on in-hospital mortality and postoperative complications, using the Diagnosis Procedure Combination (DPC) Database in Japan.

Methods: A total of 7,988 cases who underwent nephrectomy were identified between July and December in 2006 and 2007. Cases were almost equally divided into three groups based on hospital nephrectomy volume: low ( $\leq 26$  nephrectomies per year), medium (27 - 64), or high (more than 65) volume groups. In logistic regression analyses, the occurrence of postoperative complications and in-hospital death independently regressed against hospital volume and patient-based factors.

Results: In-hospital mortality was 0.84%. Overall postoperative complication rate was 7.4%. The patient factors that increased mortality were age and chronic renal failure. Those that increased postoperative complication were hypertension, chronic lung diseases, cardiac diseases, and chronic renal failure. The high volume group showed significantly lower postoperative complication rate (Odd Ratio, 0.72;  $p=0.014$ ) in comparison with the low volume group. Video-assisted nephrectomy showed a significantly lower rate of in-hospital death (OR, 0.28;  $p<0.01$ ) and postoperative complications (OR, 0.47;  $p<0.01$ ) than open nephrectomy.

Conclusions: Higher hospital volume, less comorbidity, less invasive surgery, and shorter anesthesia were associated with a significantly lower postoperative complications following nephrectomy.

TITLE: Determinants of return on resource input based on the cost database of a patient classification system: cases of percutaneous coronary intervention and gastrectomy

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Introduction: The aim of this study was to elucidate any possible association of return on resource input (RORI, given by individual charge divided by individual cost) with patient factors and hospital factors among patients who underwent percutaneous coronary intervention (PCI) or gastrectomy.

Methods: The charge and cost data of 411,706 patients discharged from 189 hospitals in Japan between July 2006 and December 2006 used in the national DPC research project. The hospitals included 9 national or private university hospitals, 102 governmental or insurance association hospitals and 78 others. Charge data were calculated based on the diagnosis procedure combination (DPC) payment system. Patient-level costs were obtained through a standardized methodology. We selected 4,896 operable angina pectoris patients (mean age: 68 years) and 2,616 operable gastric cancer patients (mean age: 66 years) from the above database. Multiple regression analyses were performed to identify factors associated with RORI. The independent variables consisted of patient-level and hospital-level factors. Patient-level variables included gender, age, total length of stay (LOS), surgical procedure type, and Canadian Cardiovascular Society (CCS) classification for angina pectoris patients or chemotherapy for gastric cancer patients. Hospital-level variables consisted of the proportion of PCI or gastrectomy patient volume to total inpatient volume and the ratio of total inpatient charge to total inpatient cost (RTCC).

Results: The mean RORI for PCI and gastrectomy were found to be 0.99 and 1.09, respectively. The mean LOS for PCI was 6.8 days and the LOS for gastrectomy was 25.1 days. Results from both the PCI and gastrectomy multiple linear regression models revealed that a shorter LOS, a higher RTCC and female patients were significantly associated with higher RORI ( $P < 0.01$ ). Furthermore, in both regression models, LOS was found to have the strongest association among all the independent variables. With regard to procedure-specific features, the proportion of PCI patient volume to total inpatient volume was found to have a significant association with RORI, while there was no significant association between the proportion of gastrectomy patient volume to total inpatient volume and RORI.

Conclusions: Our results show that a shorter LOS results in a higher RORI, and reflects that the design of the current Japanese healthcare reimbursement system results in an economic incentive for reducing LOS in individual patients. On the other hand, from the viewpoint of hospital management, a simple reduction of LOS with the same volume of patients would result in the reduction of RTCC, thus diminishing any economic incentive for hospitals to reduce hospital stay durations. Therefore there may be a necessity for interventions that seek to decrease LOS of each individual patient while increasing the hospital-level RTCC by increase patient volume. Furthermore, our results show that there may be an economic incentive for hospitals to specialize to a certain degree in PCI patients, as increasing the proportion of PCI patient volume to total inpatient volume would result in a higher RORI. However, as this association was not observed in gastrectomy, this type of advantage in specialization may be procedure-specific.

TITLE: Cost of Simple Pneumonia ( IR 44616) by severity level and the weight of medication - Sanatorio Americano, FEMI. Uruguay

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Introduction: The Sanatorio Americano, Sistema FEMI de Uruguay, has implemented a Patient Classification System of the type of Diagnosis Related Groups, IR-DRG 2.1 version.

Additionally, the Hospital applies a cost-per-patient system to determine the total direct cost for each patient that receives care at the institution and to discriminate the incidence of the various items (room-and-board, drugs, professional fees, etc ). The primary objective herein is to compare the three levels of severity of IR DRG 04416, relating to the discharges of patients admitted with simple pneumonia and whooping cough and the actual consumption of resources, specifically medication-derived costs. The study analyzed discharges for IR DRG 04416 that occurred from April 1, 2007 to March 31, 2008, breaking them down by three levels of severity.

Methods: The statistical analysis used means to summarize quantitative variables, proportions for qualitative variables and the Kruskal Wallis's Test to test cost medians between groups.

Results: The average length of stay (LOS) for level 1 was 3.8 ; 5.4 for level 2 and 7.7 for level 3. Mean costs reached USD 615 for level 1, USD 1,044 for level 2 and USD 2,403 for level 3. The incidence of accommodation in the overall consumption of resources was 60% at levels 1 and 2 and 50% for level 3. The incidences of medicines in the overall consumption of resources were 11%, 9% and 13%, respectively, with a higher incidence of non antibiotic medication at level 3.

Conclusions: The most relevant conclusions are listed below: The greater the severity, the higher the consumption of resources. Accommodation accounts for over 50% of resource consumption Antibiotics account for 5% of the expenses at each level. The higher cost seen in level 3 is due to the increased cost of non antibiotic medication (medication related to the therapy of complicating events)

TITLE: Institutional Structures and Processes of Care Associated with The Length of Hospital Stay in Elderly Patients with Hip Fractures.

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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 length of hospital stay (LOS) in elderly patients with hip fractures is generally long. While many studies have revealed that patient characteristics are strongly 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, and explanatory variables included surgical procedure (hip replacement or internal fixation), timing of operation (within 48 hours or later), timing of rehabilitation (within 2 days after operation or later), frequency of rehabilitation (rehabilitation was provided for more than 80% of total LOS or less than 80%), number of acute care beds ( $>400$  or  $\leq 400$ ), inpatient volume per physician per year ( $>150$  or  $\leq 150$ ), annual case volume of physical therapist (PT;  $>2000$  or  $\leq 2000$ ), number of medical social workers (MSW) per bed ( $> 1$  or  $\leq 1$ ), hospital ownership (a local government hospital, private hospital, or public hospital), and presence of sub-acute care beds in the hospital.

Results: In patient-level analysis, we found that age, complication, and previous hospitalization were significantly associated with LOS. The results of hospital-level regression analysis are shown in Table 1. 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. 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 discharge to other facilities.

Conclusions: 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, LOS in elderly patients with hip fractures was significantly affected by institutional structures and processes of care, in addition to patient characteristics.

TITLE: Factors influencing new medical device dissemination in Japan: Case of drug-eluting stent

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Introduction: There are number of reports on medical device utilization in Japan, but these are mainly on diagnostic devices. Using case-mix data, this study examined the factors influencing new medical device dissemination in Japan, taking the case of the first drug-eluting stent (DES).

Methods: Japanese case-mix data of 2004 and 2005 were used to extract patients with angina pectoris or chronic ischemic heart disease who underwent coronary stent implantation with either a bare metal stent (BMS) or a drug-eluting stent. Only index hospitalization and those patients from sites that had performed more than 10 stent implantations during the study period were analyzed. Chi-squared test was used for patient background analysis, and multiple logistic regression analysis was used to examine factors influencing dissemination of DES. Age, sex, Charlson index score, Canadian Cardiac score (CCS), New York Heart Association (NYHA) score, number of stents implanted, other cardiovascular related surgery performed along with stent implantation and LOS were used as patient background factors. For multiple logistic regression analysis, in addition to patient background, the number of physicians per unit of beds by prefecture, and type of hospital (national university hospital or private hospital) were considered as geographic covariates. Analysis was performed by comparing the data for 2004 and 2005.

Results: From the case-mix database, 1179 patients from 30 sites were extracted. Length of stay ranged from 2 days to 110 days; therefore, the upper 5 percentiles of LOS were excluded. As a result, there were 455 and 581 patients for 2004 and 2005, respectively. The backgrounds of BMS- and DES-implanted patients were compared by univariate analysis, and there was no significant difference in age, sex, Charlson index and LOS distribution. However, DES implantation was more likely to be performed for lower CCS score patients, was associated with a larger number of implanted stents, at least one concomitant cardiovascular related surgery, treatment at a private hospital. From multiple logistic regression analysis, factors associated with DES in 2004 were Private hospitals (odds ratio (OR) 5.07, 95% confidence interval (CI) 2.16-11.91), associated with a larger number of implanted stents (OR 3.05, CI 1.59-5.85), younger age, under 64 (OR 2.63, CI 1.11-6.24) and was CCS1 (OR 0.43, CI 0.20-0.89). In 2005, factors associated with DES were greater number of physicians per unit of beds (OR 5.32, CI 3.22-8.78), and was associated with a larger number of implanted stents (OR 1.65, CI 1.08-2.54).

Conclusions: Our analysis showed that factors influencing new device dissemination in the first year were patient-related factors. In the second year, the dissemination factors were mainly geographic factors. These differences may derive from the device being much awaited by physicians, because of the known significant reduction of restenosis and revascularization from clinical trials. It has been said that there was distribution issues in the year that the device was approved by the Ministry of Health, Labor and Welfare. This may mean that those surgeons who were able to use the DES in that year had to make a decision on which patient to use the new device, and thus the selection factors were patient background. On the other hand, in 2005, the distribution issue may have been resolved and selection factors were no longer patient related, but more geographic. The greatest influencing selection factor in 2005 was the number of physicians per unit of hospital beds. This may be because that DES manufacturer could distribute the device more efficiently and the hospital may have had more time and a larger budget to try the new device and technology. The number of DES implanted was greater than the number of BMS in both years, which may derive from the expectation of reduced restenosis and revascularization.

TITLE: Organisational and individual characteristics that can predict the adoption of technology by a private for-profit hospital.

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Introduction: The study examines the relationship between decision to adopt new technology by a private for-profit hospital and its determinants. It also tries to identify the organizational characteristics that can predict the adoption of technology by a hospital. The study further analyses the importance of the individual characteristic of the person who heads the hospital in influencing the decision to adopt. Also as to how the adopter and non-adopter hospitals differ for these variables.

Methods: The study is based on both primary and secondary data though, much depended on the primary data. From the review conducted on existing literature on adoption and diffusion of technology major variables influencing the adoption of technology in health care sector were identified. The study focused on the factors influencing the adoption of technology by the private for-profit based on a sample of 103 hospitals from both urban and rural areas. Data was collected by interviewing the owner hospital or the Chief Medical Officer or the Chief Administrative Officer of the hospital. Technology adoption was assessed based on hospital's responses on the presence or absence of 14 equipments used for the treatment of respiratory disease. Thus hospitals with five or more equipments out of the 14 were categorized as adopters and those with less than five as non-adopters. The equipments were chosen from a group of 84 equipments used for the treatment of respiratory disease..

Results: The study could find many significant variation between adopters and non- adopters on some of the organizational characteristics studied such as the size of the hospital (measured based on the bed size), specialisation (measured based on the number of departments) and the average bed occupancy rate. These three variables were found to be good predictors of medical technology adoption by the hospital. Characteristic like age of the hospital does not show much difference between adopter and non-adopters and shows negative correlation with the rate of adoption and hence is a poor predictor of the adoption of technology by private for-profit -hospital. The "dynamism" of the individual who heads the hospital was found to be a significant variable influencing the adoption decision. The individual dynamism is a weighted average of the five individual characteristics of the person who heads the hospital considered for the study. These includes the level of education of the person who actually heads the hospital, his/her length of service (years of experience), his cosmopolitanism ( measured by the individual's participation in various organizations both medical and non-medical), his involvement in the day-today functioning (measured by his frequency of visit to the hospital) and his/her's frequency of information updation (measured by the individual's frequency of attending scientific conferences). The correlation between the dynamism and the number of medical equipments shows a strong positive relationship (Cov=0.8290) Among the factors that influence the decision to adopt medical equipment by the private hospital it was found that the three factors namely the demand from the doctors, existence of obsolete equipment and the evidence of the capability of the available technology actually drives the decision to adopt a medical technology. On analyzing as to whether there existed some differences based on the size of the hospital and the importance given to the demand from the doctors it was found that as size of the hospital increases, the importance given to the demand from doctors for new equipments increased (91.6% of the large hospitals rated the demand from doctors as important in influencing the decision to adopt while only 50% of small hospitals and 86.36 of medium hospitals rated similarly). Also contrary to the general belief that the rural hospitals depend more on the doctors, our study revealed that that the urban hospitals gave more importance to the demand from doctors. Interestingly, private hospital's decision to adopt equipments are not driven by the demand from patients or the availability of technology in the market or adoption of medical equipment by neighboring hospitals.

Conclusions: Size, average occupancy rate and specialization are the organizational variables identified by the study that can predict the adoption of technology by private-for-profit hospitals. Hospitals which are headed by individuals having high value in 'dynamism' (the weighted average of five individual characteristics) tend to be adopters than others. Doctors plays a key role in influencing the decision to adopt a technology by private-for-profit hospitals. The reasons like the obsolescence of existing equipment and the evidence regarding the technology's capability also influences the decision to adopt technology.

TITLE: Impact of Implementation of Casemix System on Efficiency of A Teaching Hospital in Malaysia

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Introduction: University Kebangsaan Malaysia Medical Center (UKMMC) is the first government hospital in Malaysia which has taken the initiative to implement the casemix system since July 2002. Established in 1997, this 873 bed teaching hospital provides tertiary level services to around 600,000 people in two southern districts of Federal Territory Kuala Lumpur. Casemix Centre of UKMMC is responsible to coordinate the implementation of case-mix system in the hospital. The Centre is run by five trained coders and two full-time clinicians. UKMMC implement casemix system with the long term goal of improving the efficiency and enhance quality of care. The objective of this study is to assess the impact of case-mix system on efficiency of clinical services provided by UKMMC using Stochastic Frontier Analysis (SFA). The hypothesis for the study is implementation of case-mix system would improve the level of efficiency of UKMMC.

Methods: Six Clinical Departments of UKMMC were selected for this study: Obstetrics & Gynaecology, Orthopedic, Ophthalmology, Pediatric, Surgery and Psychiatry. Data from the year 1998 to 2006 from these departments was collected for the study. Four inputs were used for the SFA model: number of beds as representative of capital, number of doctors, number of nurses and numbers of non-medical staff as representative of labor. Outputs were measured by total inpatient discharges and total outpatient visits in each department. . The SFA model can be expressed as:

$$y_i = f(x_i, \beta) + v_i - u_i \quad (1)$$

The technically inefficiency effect is specified as

$$u_i = z_i \delta + w_i \quad (2)$$

The maximum likelihood estimation procedure is proposed for estimation of the parameters of stochastic frontier in first model and ordinary least square in second model. The explanatory variable in the inefficiency model is a dummy variable: value of 0 and 1 for before and after the introduction of case-mix system.

Results: The mean value of single output to single input ratio was higher after the introduction of case-mix system in most clinical departments in the study. The ratio of number of outpatient visits to number of doctors increased in all six departments ranging from 2.8% in the O&G Department to 46.8% in the Paediatric Department. Except for Department of Psychiatry and Surgery, the four other department has increased ratio of outpatient visits to number of nurses between 8.9% to 166.2%. Four Departments (O&G, Orthopaedic, Paediatric and Surgery) had increased in inpatient discharges to number of beds from 0.5% to 21.3%. The ratio of number inpatient discharges to number of nurses increased from 10.5% to 134.9% for all departments except Surgery and Psychiatry. The SFA models comprising of production function and efficiency model showed that the number of beds, number of doctors and number of non-medical staff were significantly related to the output variables. Casemix variable was significantly related to increase in efficiency of the hospital (coefficient = 1.931 SE= 0.328 p=0.021).

Conclusions: Both results of descriptive analyses using single output to single input ratios and the SFA models proved that introduction of casemix system for the past six years has enhanced efficiency of clinical services provided by UKMMC.

TITLE: Redevelopment of the CACS Ambulatory Care Grouper: An Overview

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Introduction: The Canadian Institute for Health Information (CIHI) is currently redeveloping its Comprehensive Ambulatory Classification System (CACS) grouping methodology for release in 2011. The CACS methodology was first released in 2001 and currently groups almost ten million records (largely from the province of Ontario) from the National Ambulatory Care Reporting System (NACRS) annually. In Ontario data submission to NACRS is mandated currently for emergency departments, day surgeries, and dialysis, cardiac catheterization and oncology clinics. Some facilities in the provinces of British Columbia, the Yukon, Prince Edward Island and Nova Scotia also submit data.

Two main factors are motivating the redevelopment of the CACS grouping methodology. The first is that recent analysis of cost data has revealed a significant difference in costs between day surgery patients and emergency department patients, even when the same intervention is performed. The current CACS methodology does not differentiate between these two patient types and so does not reflect these cost differences. The CACS redevelopment project will seek to better understand the drivers of these differences and to incorporate them into the methodology, providing greater cost and clinical homogeneity.

The second motivating factor is that the current CACS methodology does not provide much differentiation for both the ambulatory rehabilitation and mental health populations. Beginning in April 2010 Alberta will begin submission to NACRS of ambulatory records, of which the rehabilitation and mental health populations constitute a significant proportion. The CACS redevelopment project will aim to improve cost and clinical homogeneity of the CACS methodology for the ambulatory rehabilitation and mental health populations.

Methods: This paper will provide an overview of the CACS redevelopment project, progress to date, and a discussion of some of the decisions made thus far in the choice of grouping rules. One example of grouping rule choices is the consideration of whether the system should be setting independent or instead should emergency department cases be split off from day surgery cases.

The evaluation of alternatives in the choice of grouping rules takes into account various design criteria including that the resulting case mix system be logical, manageable, transparent to users, relevant to clinicians and administrators and that the case mix groups are both cost and clinically homogeneous.

Assessment of cost homogeneity is based upon patient-level cost data from the provinces of Alberta and Ontario. Analysis of this cost data using decision tree software is used to detect groups of patients that have similar costs. Clinical homogeneity is determined by case mix members with classification and utilization management backgrounds, along with advice from clinicians. Guidance on system logic, transparency, and relevancy to users is provided through an advisory committee of external stakeholders.

Results: Redevelopment is ongoing. Progress will be discussed in the paper and in the presentation.

Conclusions: Redevelopment is ongoing. Progress will be discussed in the paper and in the presentation.

TITLE: Redevelopment of the CACS Ambulatory Care Grouper: A Discussion of the Data

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Introduction: The Canadian Institute for Health Information (CIHI) is currently redeveloping its Comprehensive Ambulatory Classification System (CACS) grouping methodology for release in 2011. The CACS methodology was first released in 2001 and currently groups almost ten million records (largely from the province of Ontario) from the National Ambulatory Care Reporting System (NACRS) annually. In Ontario data submission to NACRS is mandated currently for emergency departments, day surgeries, and dialysis, cardiac catheterization and oncology clinics. Some facilities in the provinces of British Columbia, the Yukon, Prince Edward Island and Nova Scotia also submit data.

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Methods: The process of redeveloping the CACS grouping methodology involves the use of an analytical dataset containing patient-level cost and clinical information available from the provinces of Ontario and Alberta.

The creation of this dataset includes an assessment of variations in clinical coding and case costing among facilities in general, adjustment of patient-level costs due to factors other than case mix (e.g. facility size, location, etc.), and the consideration that the Alberta data comes from Alberta's own ambulatory reporting system, which has different abstracting rules than NACRS. As an example, in Alberta's system when a patient receives diverse types of care (e.g. emergency care and respiratory therapy) during the same visit, multiple abstracts or records will be generated. Multiple abstracts are not expected to occur according to current NACRS abstracting standards.

This paper will discuss the creation of the analytical dataset, the evaluation of the data, and the adjustments to the data so as to be more appropriate for use in the development of the new CACS methodology.

Results: Analysis is ongoing. Results will be discussed in the paper and in the presentation.

Conclusions: Analysis is ongoing. Results will be discussed in the paper and in the presentation.

TITLE: Rapid implementation of activity based funding for outpatient services in NSW

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Introduction: The NSW Government through NSW Health planned to exercise stronger, more centralised control over the budget performance (costs and outputs) of individual hospitals by negotiating annual performance agreements with each Area Health Service (AHS) Chief Executive. As part of this process, the strengths of the existing NSW Episode Funding Policy were reinforced, and the Policy was further enhanced by adopting some aspects from the Victorian public hospital funding policy. Specifically, NSW Health set out to adopt and adapt the Victorian Ambulatory Classification System (VACS) and associated funding model as part of the revised Policy. Accordingly, NSW Health commissioned a project, in late May 2009, to modify the VACS system for use in funding outpatient services in NSW from 1st July 2009.

Methods: The methodology consisted of four major processes. First, reviewing and comparing the existing NSW and Victorian approaches to funding outpatient services. Second, by using the available Department of Health Reporting System (DoHRS) data on outpatient services in NSW, the key components (scope, clinic categories, cost weights, activity targets, and constituent grants) of the adapted VACS system were defined and developed. Third, the decisions made about the adapted VACS system were reflected in an EXCEL model that was used to assess its impact on the outpatient service funding allocated to in-scope hospitals. Fourth, based on the impact analysis, a refined adapted VACS system for use in 2009/10 was recommended, along with supporting funding guidelines and governance processes.

Results: Review of the DoHRS data showed that about 75% of the outpatient services provided in NSW would be captured by including the largest 19 hospitals in the scope of activity based funding (about 13% of hospitals). Given the limited timeframe, it was decided to focus on these 19 hospitals for 2009/10 (the Victorian system only covers the 19 largest hospitals). The next challenge was to address the fact that the VACS system bundles pathology, imaging and pharmacy services provided within 30 days of the outpatient encounter into the funded episode. There was not the data to take the same approach within the DOHRS system; hence pathology, imaging and diagnostic services were excluded from the initial funding model scope.

This decision meant that the VACS cost weights had to be adjusted to remove diagnostic and pharmacy services. Component costs data for outpatient services in Victoria were used for this purpose (equivalent NSW data were not available). These adjustments resulted in services that had a high diagnostic or pharmaceutical cost component decreasing their relative weights by as much as 55% whereas services that were highly consultative increased their relative weights by as much as 38%. Similarly, the historical data on funds provided for outpatient services (DoHRS Program 3) had to be adjusted to exclude the amounts provided for diagnostic and pharmacy services.

For classification purposes, NSW Tier 2 Clinic categories as reported in DoHRS were chosen as the base unit for funding. There was no mapping available of these categories to the 35 general and 12 allied health VACS categories. To develop a mapping, the Tier 2 clinic categories were fitted to the VACS classification using the clinic label. This approach proved problematic given the considerable variation in labels used. This mapping was supplemented by using the high level categories used for national reporting and ensuring that at this level the NSW Tier 2 clinics were in the same category as the VACS classification to which they were mapped.

After making all these adjustments, the activity targets and national funding levels were set. Analysis of historical outpatient activity levels revealed considerable annual variation so for some hospitals rolling three year averages were used. Where historical activity levels were more stable last years outpatient service numbers were used as the base for the activity target. This information was then consolidated into the funding guidelines that were used to roll-out the system for 2009/10. Finally, a series of recommendations were made for further refinements to the NSW activity based funding model for outpatient services.

Conclusions: The project demonstrated that it was possible to modify rapidly the VACS system for application to funding outpatient services in NSW. Many compromises needed to be made, due to limitations in the available data and the restricted timeframe. Nonetheless, the project has established a basis for activity based funding of outpatient services. Through further development of the DoHRS data set and refinement of the initial model it should be possible to move towards the better practice of basing funding on patient characteristics rather than relying exclusively on service characteristics.

TITLE: Using pharmacy information in a decision support system to improve efficient delivery of primary health care. A study on the Swedish National Drug Register

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Introduction: The aim of the project was to apply the John Hopkins ACG Case-Mix system, Rx-PM model on the Swedish National Drug Register (period 2006-2008). Analyse and compare results between different county councils and analyse if the drug use in the population can be used as an approximation for the need of care and as a tool to adjust the capitation payment system in the county councils. This paper has focus on the comparisons between the different county councils. Practical examples and usage of data is 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 has not been available previously. The tool can be used for Disease/Case Management, Profiling (Population and Provider) and to forecast pharmacy and total costs for large groups.

In the analysis included Sweden's entire population (9 Million unique persons) and their usage of drugs (6,2 Million patients annually) with 29 Million combinations of patients and used ATC-codes for each year been grouped for the periods 2006, 2007 and 2008. The analysis represents an annual cost of 24-25 Billion SEK (appr. 2,5 Mill Euro). The grouping went well in practice without any coding issues.

Results: The analysis model involves five steps, looking at: 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. Detailed comparison on practices and costs.

Conclusions: The Rx-model works well for Swedish data. The analysis showed significant differences between county councils and on municipality level. Measures generated from the system could i.e. 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 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 to use. Pharmacy data alone has a higher explanatory value than age and gender but still low in comparison with combined models

TITLE: Using Short-Stay Trim Points to Identify Potential CMG Design Improvements

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Introduction: Canada's national acute-care inpatient grouping methodology is known as Case Mix Groups (CMG+). CMG+ has 588 Case Mix Groups (CMG), which are analogous to DRG. Associated with each CMG are relative cost weights, known as Resource Intensity Weights (RIW).

Atypical patients (deaths, signouts, and transfers) and long-stay outlier patients receive special consideration in the RIW methodology. However, no such consideration is given to short-stay outlier cases. Short-stay cases receive the standard (or typical) RIW, representing the mean cost within the CMG. This paper explores the potential use and impact of short-stay trim points in CMG+. At the same time, analysis of length-of-stay patterns and cost profiles of short-stay cases will identify whether select CMGs are candidates for redesign. Redesign may be indicated if the distribution of length of stay or cost is multimodal.

Methods: This paper will explore the setting of short-stay trim points. Setting of these trim points will be done based on the empirical distribution using the interquartile range of the length-of-stay distribution of each CMG.

Use of the empirical distribution often trims out cases that should be included amongst the typical cases. The cost distribution of short-stay cases and the extent to which it differs from that of typical cases will be reviewed.

The clinical and demographic profiles of cases identified as short stay will be reviewed. Correlation of short stay with specific clinical attributes may indicate that the CMG is a candidate for redesign (e.g. a split or redefinition). Correlation of short stay with certain hospitals may suggest variations in practice patterns. The incidence of short-stay cases by different strata of hospitals will be assessed to determine whether they differentially affect some hospitals.

The overall impact of short-stay cases will be assessed by recalculation of the typical RIW values, with the short-stay cases removed.

Results: CMGs in which the profiling of the short-stay cases points to redesign will be presented in detail. The effect of the removal of short-stay cases on the typical RIW estimates will be provided.

Conclusions: Discussion will include the value of short-stay trim points in the evaluation and refinement of CMGs, the appropriateness of the exclusion of short-stay cases from the calculation of the typical RIW, and consideration of whether these short-stay cases should receive special consideration in the RIW methodology.

TITLE: Evaluating various trimming methodologies to set cost weights based on diagnostic related groupings(DRG) for South African in hospital events

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Introduction: Discovery Health administers South Africa's largest medical scheme which consists of 2 million assured lives. Cost Weights that are set for Hospital networks that enter into a DRG based method of reimbursement with Discovery need to be fair and indicate a 'true' average cost of treating a patient.

Methods: The project has the following challenges:

- Many DRGs have difference distribution shapes. A consistent trimming methodology may be inappropriate for certain DRGs.
- DRGs that have scanty data need certain adjustments to add credibility to the estimated cost weight.
- Determining if trimming data in production is appropriate
- What measures can be used to evaluate different trimming methodologies

The following trimming methodologies will be evaluated in detail:

- Inter-quartile range of trimming
- Geometric method of trimming
- Inter-quartile method of trimming adjusting for the skewness of each DRG
- Truncation

In addition the method of application of these cost weights is of considerable interest. Whether or not these cost weights are applied to inlier events only are all events has considerable impact on the quantum of reimbursement. We also aim to investigate in this paper the appropriate application of these cost weights to hospital events from a purely academic perspective.

Results: The authors are still in the process of collating and testing results.

Conclusions: We believe that the findings will add considerable value to the academic debate of measuring case mix based on cost data.

TITLE: Developing a New Casemix System for Orthopaedic Surgery

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Introduction: A new casemix system for orthopaedic surgery has been developed in a corporation between The Danish Association of Orthopaedics and The National Board of Health in Denmark. Currently the Danish casemix groups for orthopaedic surgery are lacking clinical homogeneity as well as cost homogeneity. Instead of performing a partial analysis of some of the orthopaedic DRG's, the National Board of Health decided to complete a full scale study, including all sub-specialities within orthopaedic surgery.

Methods: The study was carried out in three phases:

1. Preliminary casemix categories. All relevant diagnosis and procedure codes was classified into categories, the categories being clinical homogenous as well as cost homogenous. Typical low-cost and high-cost patient cases from each sub-speciality was identified, as well as how these cases could be identified through the present coding praxis or by a suggested future coding praxis.
2. Examination of cost homogeneity. The Danish Patient Cost Database maintained by The National Board of Health contains cost data for virtually all outpatient visits and inpatient discharges in Denmark since 2004. About 120.000 orthopaedic visits and discharges from 2007 were used for this study. These cases were grouped to the categories, which were examined for cost homogeneity. If heterogeneity was found, emphasis was put to identify the combinations of diagnoses and procedures identifying the low-cost and high-cost cases – resulting in even more categories.
3. Merging categories to DRG's. All categories were merged into DRG's preserving – as far as possible – the clinical homogeneity as well as cost homogeneity.

Results: The number of DRG's for orthopaedic surgery has been raised from 41 to 67. The number of discharges grouped to orthopaedic residual groups has been reduced from 30% to 3% – including a reduction from 65% to 7% for knee and shoulder procedures. Focus in the casemix has changed from emphasize “where on the body” to “what was done”. The number of groups relevant for each sub-speciality has risen from 2-5 to 10-12 groups making the casemix far more differentiated. More results will be presented at the conference.

Conclusions: The paper will outline the methodologies, the challenges and more results from the study based on data from 2008 from the Danish Patient Cost Database.