Morbidity Profiles at three Primary Care Clinics in Perlis, Malaysia

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INTRODUCTION

Allocation of funding within the Ministry of Health of Malaysia has traditionally been dependent on previous utilisation with some consideration of population coverage through burden of workload. A more appropriate distribution would be based not only on the volume of patients, but also on the morbidity profiles of these populations through case-mix [1]. Johns Hopkins Adjusted Clinical Groups® System (ACG), developed by Johns Hopkins University was selected to study case-mix in the Malaysian primary care setting, in view of its wide use and its applicability within primary care [2].

ACG is used to determine the morbidity profile of patient populations in order to assess provider performance fairly, to reimburse providers based on the health needs of their patients, and to allow for more equitable comparisons of utilisation or outcomes across two or more patient groups [3,4]. Perlis is one of the states in Malaysia, located in the north of Peninsular Malaysia. It has a population of 240,000. Health care is provided by both public and private facilities. The public sector is delivered through the Ministry of Health's facilities, comprising of a hospital, 9 primary care clinics with doctors and 29 community clinics without doctors. These are complemented by 34 private general practice clinics, the majority of them organised as solo practices.

As part of the Government's initiative on telehealth, three public clinics in Perlis were equipped with Teleprimarycare® System (TPC), an electronic clinic management and clinical information system. TPC in Perlis was initiated in 2006 at Kangar Health Clinic (HC), the biggest clinic with the full complement of supporting services and located in the state's capital city. This was followed by Beseri HC and Simpang Empat HC in 2008. The population coverage of these clinics was 54,248 for Kangar HC, 27,546 for Beseri HC and 27,714 for Simpang Empat HC. The availability of a rich electronic database, which was easily accessible from TPC, presented an opportunity to study the possibility of applying ACG for the development of a morbidity-based resource allocation for primary care providers in Malaysia.

The aim of this report is to describe the morbidity profiling of patients in three public primary care clinics in Perlis and its variation in morbidity patterns. This exercise also had the beneficial effect of determining the quality of TPC data pertaining to diagnostic coding.

MATERIALS AND METHODS

Data extracted from TPC database using Microsoft SQL query analyzer were unique patient ID by clinic, sex, age, ethnicity, ICD-10 diagnosis code, WHO Anatomical Therapeutic Chemical (ATC) drug code, pharmacy cost and total cost consumption. All data were based on individual patient's visit records for the year 2010 according to clinic. To minimize the non- matched diagnoses, several ICD-10 codes were collapsed to their parent codes. The TPC data were later downloaded to ACG software version 8.2 for further analysis. Three different markers of morbidity profiling which are embedded into the system are presented [3,4]. Firstly, Aggregated Diagnosis Groups (ADG), the building blocks of ACG, is a grouping of diagnosis codes that are similar in terms of severity and likelihood of persistence of the health condition over time as well as similar in expected resource use. Five clinical criteria guide the assignment of each diagnosis code into an ADG: duration, severity, diagnosis certainty, type of aetiology and expected need for specialty care. All ICD-10 codes generated by clinicians over a period of one year are assigned to one of 32 ADGs. Because it is diagnosis centric, an individual with multiple diagnoses can be assigned more than one ADG. Expanded Diagnosis Cluster (EDC) is another type of morbidity marker through clustering of people into specific diseases or symptoms. EDC can be used to measure prevalence of disease or clinical conditions, but cannot describe resource utilisation. There are 264 EDC categories derived from all ICD diagnoses. The last morbidity marker is Pharmacy Defined Morbidity Groups (RxMG) which is a grouping incorporated into the model where medications prescribed are assigned to morbidity groups using WHO ATC drug codes. Pharmacy data can capture more morbidity information as compared to diagnoses-dependent information as it can fill in missing information and capture non concordance of clinical information, where there are patients who are prescribed drugs with no supporting diagnoses as well as those with diagnoses but not given expected prescribed medication.

Age-sex observed-to-expected standardised morbidity ratio (SMR) is an epidemiological adjustment process that provides a framework for comparing EDC or RxMG prevalence across subpopulations of interest and is automatically calculated by the software. An SMR above 1.0 indicates that the subgroup has a higher rate of disease than the total population, even after controlling for age and sex, while SMR below 1.0 suggests a lower than expected rate. The ratio is considered significantly higher or lower than the referent population,

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even after adjusting for age and sex, if the confidence interval does not include 1.0 (at the 0.05 level).

RESULTS

Demographic Distribution

There were 73,236 distinct patients attending the three clinics in 2010. Kangar HC had contributed 64.04% of the total patients registered followed by Beseri HC (21.20%) and Simpang Empat HC (15.76%). The Malays formed the largest ethnic group at 90.38%, followed by Chinese (5.13%), others (3.11%) and Indians (1.38%). Females formed a larger proportion of the patients at 53.29% as compared to males at 47.71% (Table I).

The three clinics showed a relatively higher proportion of patients aged from 0 to 4 years followed by the 15 to 19 years age group. Those below 20 years old comprised 38.29% of the patients, while those 30 years and above contributed 42.98% of the total patients. Simpang Empat HC had a slightly bigger proportion of the elderly as compared to the other clinics.

Distribution of Aggregated Diagnosis Groups (ADG)

A total of 107,016 ICD-10 diagnoses were recorded with an average of 1.46 diagnoses per patient. In total, 91,514 ADGs were assigned from all 32 unique ADG available. Top 10 ADG formed 86.10% of all the ADGs. Table II shows that ADG 2 (Time Limited: Minor Primary Infections) formed the highest proportion in all the clinics, except Simpang Empat HC, where ADG 26 (Signs/Symptoms: Minor) formed the biggest proportion. Kangar HC had relatively more patients with ADG 10 (Chronic Medical: Stable), ADG 31 (Prevention/Administrative), ADG 7 (Likely to Recur: Discrete) and ADG 28 (Signs/Symptoms: Major) as compared to the other clinics. Beseri HC had the highest proportion of ADG 1 (Time Limited: Minor), and ADG 33 (Pregnancy).

Distribution of Expanded Diagnosis Cluster (EDC)

A total of 100,195 EDCs were assigned with 236 unique EDC encountered. Top 10 EDC formed 56.09% of all the EDCs. Table III showed that EDC EAR11 (Acute Upper Respiratory Infections) was the commonest presentation for all clinics, particularly Beseri HC with 33.33%. EDC CAR14 (Hypertension, without major complications) was the second most common with a prevalence of 12.70% for all clinics. Total prevalence of Type 2 diabetes was 8.13%, Type 2 diabetes without complication (EDC END06) was 7.04% and with complication (EDC END07), not shown in Table 3, was 1.09%. For those aged 20 years and above, the total prevalence of Type 2 diabetes was 13.18%.

As shown in Table IV below, it was observed that Beseri HC had an 11% higher of age-sex adjusted prevalence of EDC END06 (Type 2 diabetes, without complication), Kangar HC had a 32% higher prevalence of ADM05 (Administrative concern and non-specific laboratory abnormalities) and Simpang Empat HC had a 196% higher prevalence of EDC GSI03 (Fever), even after controlling for age and sex. Among the chronic diseases, the prevalence of asthma was less variable with only Simpang Empat HC showing a significantly higher SMR at 1.14.

Pharmacy Defined Morbidity Groups (RxMG)

There were 148,501 RxMGs assigned to 49 out of 60 RxMGs available. Top 10 RxMG contributed to 88.41% of the total frequency. Similar to EDC, RxMG is an alternative to measure prevalence of morbidity category based on drug use. It was noted that most of the prescriptions given in Perlis were related to General Signs and Symptoms/Pain and Inflammation followed by Respiratory/Acute Minor and Allergy/Immunology/Acute Minor (Table V).

As shown in Table VI, Simpang Empat HC had significantly higher prevalence of the top four RxMG, as well as for chronic diseases such as Endocrine/Diabetes without Insulin, after adjusting for age and sex. Kangar HC had a 4% higher prevalence of Cardiovascular/Hyperlipidaemia and an 8% lower prevalence of Infections/Acute Minor.

Table I: Percentage of age, sex and ethnic distribution across clinics

Category		Beseri HC	Kangar HC	Simpang Empat HC	Grand Total
Sex	Female	53.74	52.64	55.36	53.29
	Male	46.26	47.36	44.64	46.71
Ethnic	Malay	93.53	88.27	94.90	90.38
	Chinese	1.06	6.66	4.10	5.13
	Indian	0.39	1.95	0.37	1.38
	Others	5.02	3.12	0.63	3.11
Age group	0-4	13.54	12.77	13.41	13.04
	5-9	7.33	4.95	8.20	5.95
	10-14	10.15	6.23	8.92	7.45
	15-19	11.17	12.96	8.26	11.85
	20-24	7.96	11.26	8.49	10.16
	25-29	8.03	9.08	7.14	8.57
	30-34	5.39	5.75	5.10	5.58
	35-39	4.57	4.35	4.17	4.37
	40-44	5.10	4.51	4.35	4.61
	45-49	4.69	5.09	5.21	5.03
	50-54	4.55	5.77	5.27	5.45
	55-59	4.55	5.20	5.92	5.19
	60-64	4.23	4.19	4.78	4.30
	65-69	3.24	2.97	4.00	3.19
	70-74	2.60	2.38	3.60	2.61
	75-79	1.69	1.49	1.72	1.50
	≥80	1.21	1.05	1.46	1.15

Table II: Top 10 ADG distribution across clinics

ADG Name	Beseri HC	Kangar HC	Simpang Empat HC	Total
Time Limited: Minor-Primary Infections(ADG2)	36.80	24.47	26.92	27.35
Chronic Medical: Stable (ADG10)	19.81	21.35	21.20	21.02
Signs/Symptoms: Minor (ADG26)	11.83	9.79	28.27	13.11
Prevention/Administrative (ADG31)	8.67	14.37	8.61	12.31
Time Limited: Minor (ADG1)	9.31	6.97	6.57	7.38
Likely to Recur: Discrete (ADG7)	5.95	7.38	5.49	6.79
Signs/Symptoms: Uncertain (ADG27)	5.97	4.00	6.85	4.85
Signs/Symptoms: Major (ADG28)	3.82	5.32	2.69	4.60
Asthma (ADG6)	3.44	3.20	4.08	3.39
Pregnancy (ADG33)	4.90	2.64	4.06	3.32

Table III: Top 10 EDC distribution across clinics

EDC Name	Beseri HC	Kangar HC	Simpang Empat HC	Total
Acute upper respiratory tract infection (EAR11)	33.33	19.75	24.09	23.18
Hypertension, w/o major complications (CAR14)	11.58	12.94	13.12	12.70
Preventive care (ADM06)	5.00	8.18	5.96	7.19
Type 2 diabetes, w/o complication (END06)	7.45	6.62	8.24	7.04
Disorders of lipoid metabolism (CAR11)	1.76	5.96	2.30	4.53
Dermatitis and eczema (SKN02)	3.72	4.45	3.80	4.20
Fever (GSI03)	3.26	1.99	11.77	3.79
Pregnancy and delivery, uncomplicated (FRE01)	5.25	3.14	4.41	3.77
Administrative concerns and non-specific laboratory abnormalities (ADM05)	1.11	4.95	0.92	3.54
Asthma, w/o status asthmaticus (ALL04)	3.44	3.20	4.08	3.39

Table IV: SMR by top 10 EDC across clinics

EDC Name	Clinic	Patient Count	Observed /1000	Age/Sex Expected /1000	SMR	95% Confidence Interval
Acute upper respiratory tract infection (EAR11)	Beseri HC	4932	333.29	242.72	1.37	1.33,1.41*
	Kangar HC	9264	197.54	227.36	0.87	0.85,0.89*
	Simpang Empat HC	2780	240.90	235.85	1.02	0.98,1.06
Hypertension, w/o major complications (CAR14)	Beseri HC	1714	115.83	122.78	0.94	0.90,0.99*
	Kangar HC	6070	129.43	124.30	1.04	1.02,1.07*
	Simpang Empat HC	1514	131.20	143.13	0.92	0.87,0.96*
Preventive care (ADM06)	Beseri HC	740	50.01	70.22	0.71	0.66,0.76*
	Kangar HC	3836	81.79	72.65	1.13	1.09,1.16*
	Simpang Empat HC	688	59.62	70.85	0.84	0.78,0.90*
Type 2 diabetes, w/o complication (END06)	Beseri HC	1102	74.47	67.38	1.11	1.04,1.17*
	Kangar HC	3105	66.21	69.55	0.95	0.92,0.99*
	SimpangEmpat HC	951	82.41	77.90	1.06	0.99,1.13
Disorders of lipoid metabolism (CAR11)	Beseri HC	260	17.57	42.99	0.41	0.36,0.46*
	Kangar HC	2795	59.60	45.09	1.32	1.27,1.37*
	Simpang Empat HC	265	22.96	49.32	0.47	0.41,0.52*
Dermatitis and eczema (SKN02)	Beseri HC	550	37.17	43.52	0.85	0.78,0.93*
	Kangar HC	2087	44.50	41.38	1.08	1.03,1.12*
	Simpang Empat HC	439	38.04	42.56	0.89	0.81,0.98*
Fever (GSI03)	Beseri HC	483	32.64	40.34	0.81	0.74,0.88*
	Kangar HC	931	19.85	36.58	0.54	0.51,0.58*
	Simpang Empat HC	1358	117.68	39.82	2.96	2.80,3.11*
Pregnancy and delivery, uncomplicated (FRE01)	Beseri HC	777	52.51	34.43	1.52	1.42,1.63*
	Kangar HC	1474	31.43	39.44	0.80	0.76,0.84*
	Simpang Empat HC	509	44.11	34.75	1.27	1.16,1.38*
Administrative concerns and non-specific laboratory abnormalities (ADM05)	Beseri HC	164	11.08	32.34	0.34	0.29,0.40*
	Kangar HC	2321	49.49	37.36	1.32	1.27,1.38*
	Simpang Empat HC	106	9.19	31.24	0.29	0.24,0.35*
Asthma, w/o status asthmaticus (ALL04)	Beseri HC	509	34.40	33.96	1.01	0.92,1.10
	Kangar HC	1500	31.98	33.33	0.96	0.91,1.01
	Simpang Empat HC	471	40.81	35.92	1.14	1.03,1.24*

*significant

Table V: Top 10RxMG distribution across clinics

RxMG Name	Beseri HC	Kangar HC	Simpang Empat HC	Total
General Signs and Symptoms/Pain and Inflammation (GSIx020)	51.68	40.75	56.39	49.61
Respiratory/Acute Minor (RESx010)	23.89	18.12	33.41	25.14
Allergy/Immunology/Acute Minor (ALLx010)	22.32	18.39	30.36	23.69
Gastrointestinal/Hepatic/Acute Minor (GASx010)	19.04	16.29	22.46	19.26
Infections/Acute Minor (INFx020)	20.61	15.14	18.76	18.17
Skin/Acute and Recurrent (SKNx020)	17.5	11.77	20.98	16.75
Other and Non-Specific Medications (ZZZx000)	10.68	14.93	15.26	13.62
Cardiovascular/High Blood Pressure (CARx030)	12.45	11.55	14.77	12.92
Cardiovascular/Hyperlipidaemia (CARx040)	8.81	9.35	9.04	9.07
Endocrine/Diabetes without Insulin (ENDx040)	6.74	6.08	8.01	6.94

Table VI: SMRby top 10 Rx-MG across clinics

RxMG Name	Clinic	Patient Count	Observed /1000	Age/Sex Expected /1000	SMR	95% Confidence Interval
General Signs and Symptoms/ Pain and Inflammation (GSIx020)	Beseri HC	7648	516.83	464.44	1.11	1.09,1.14*
	Kangar HC	19113	407.54	448.09	0.91	0.90,0.92*
	Simpang Empat HC	6507	563.86	466.25	1.21	1.18,1.24*
Respiratory/Acute Minor (RESx010)	Beseri HC	3535	238.88	223.15	1.07	1.04,1.11*
	Kangar HC	8499	181.22	214.02	0.85	0.83,0.86*
	Simpang Empat HC	3856	334.14	221.03	1.51	1.46,1.56*
Allergy/Immunology/Acute Minor (ALLx010)	Beseri HC	3303	223.21	219.12	1.02	0.98,1.05
	Kangar HC	8626	183.93	206.59	0.89	0.87,0.91*
	Simpang Empat HC	3503	303.55	216.70	1.40	1.35,1.45*
Gastrointestinal/ Hepatic/Acute Minor(GASx010)	Beseri HC	2818	190.43	176.85	1.08	1.04,1.12*
	Kangar HC	7638	162.86	177.88	0.92	0.90,0.94*
	Simpang Empat HC	2592	224.61	181.00	1.24	1.19,1.29*
Infections/ Acute Minor (INFx020)	Beseri HC	3050	206.11	175.66	1.17	1.13,1.22*
	Kangar HC	7099	151.37	164.79	0.92	0.90,0.94*
	Simpang Empat HC	2165	187.61	172.14	1.09	1.04,1.14*
Skin/Acute and Recurrent (SKNx020)	Beseri HC	2590	175.02	148.55	1.18	1.13,1.22*
	Kangar HC	5519	117.68	141.11	0.83	0.81,0.86*
	Simpang Empat HC	2421	209.79	148.53	1.41	1.36,1.47*
Cardiovascular/ High Blood Pressure (CARx030)	Beseri HC	1843	124.54	118.36	1.05	1.00,1.10
	Kangar HC	5417	115.51	119.64	0.97	0.94,0.99*
	Simpang Empat HC	1704	147.66	138.79	1.06	1.01,1.11*
Other and Non-Specific Medications (ZZZx000)	Beseri HC	1580	106.77	140.47	0.76	0.72,0.80*
	Kangar HC	7000	149.26	139.83	1.07	1.04,1.09*
	Simpang Empat HC	1761	152.60	147.69	1.03	0.98,1.08
Cardiovascular/ Hyperlipidaemia (CARx040)	Beseri HC	1304	88.12	88.17	1.00	0.95,1.05
	Kangar HC	4385	93.50	90.26	1.04	1.01,1.07*
	Simpang Empat HC	1043	90.38	103.47	0.87	0.82,0.93*
Endocrine/Diabetes Without Insulin (ENDx040)	Beseri HC	998	67.44	62.33	1.08	1.01,1.15*
	Kangar HC	2850	60.77	64.25	0.95	0.91,0.98*
	Simpang Empat HC	924	80.07	72.50	1.10	1.03,1.18*

**significant*

DISCUSSION

Completeness of TPC Data on Demographic Profiles

There were 73,236 unique patients registered at the three clinics in the year 2010. Kangar HC saw the majority of the patients, as among the clinics, it had the biggest population in its operational area, being the State's capital town. The patients in the three clinics had almost similar patterns of age distribution, with the toddlers forming the biggest proportion because of the policy of providing preventive child health services, like immunization and growth monitoring, for children in the Ministry of Health clinics.

The ethnic distribution of the patients in all the three clinics, whereby Malays formed 90%, was consistent with the population distribution of the State.5 The gender distribution of slightly more females was also congruent with findings from previous National Health & Morbidity Surveys, as more females use services at public primary care facilities in Malaysia due to the policy of implementing comprehensive maternal care, family planning and well-women's services in these clinics. In general, recording of demographic data in the TPC system was highly reliable due to the convenience of using this module as well as compulsory data entry into the system for selected variables.

Completeness of TPC Data for Coding Diagnosis and Drugs Prescription

An average of 1.46 diagnoses was generated per patient. In general, diagnosis coding through TPC was good for common chronic diseases. The prevalence of EDC Type 2 diabetes at 8.13% for all ages and 13.18% for age group 20 years and above is consistent with the reported prevalence of 13.5% for known cases and newly diagnosed diabetes, aged 18 years and above, from the NHMS 3 (Perlis) survey in 2006 [5]. The data from RxMG based on drugs prescription also showed similar prevalence of 8.13% (EDC Endocrine/Diabetes without Insulin (ENDx040) of 6.94% and Endocrine/Diabetes with Insulin (ENDx030) at 1.16%). Similarly, the prevalence of EDC Hypertension, w/o major complications was 12.70% and RxMG Cardiovascular/High Blood Pressure was 12.92%. However, diagnosis coding for acute illnesses with a wide variety of codes in ICD-10 may lead to diverse coding practices among the health care providers. Simpang Empat HC with SMR for EDC Fever of 2.96 revealed this clinic had 196% higher prevalence of fever as compared to the total population of the three clinics. This is likely to be a coding issue rather than true disease prevalence and require further evaluation and training. SMR for EDC Disorder of Lipoid Metabolism (CAR11) was also variable with a 59% lower prevalence at Beseri HC to a 32% higher prevalence at Kangar HC. This is probably due to the subjective case definition for hyperlipidaemia and its management, based on risk profiles and very often it is concurrently presented with other chronic diseases. Only 4.53% of all patients were identified by diagnosis coding as EDC Disorder of Lipoid Metabolism but a much higher proportion, at 9.07%, were identified through drug prescription as RxMG Cardiovascular/Hyperlipidaemia.

From the few studies that have been published on the validation of general practice computerised databases, it is clear that recording of acute illness captures only a quarter of the total prevalence but that doctors are capable of recording high-quality data for some chronic diseases [6,7]. As a general principle, those diagnoses with recognised objective diagnostic criteria were recorded with a more consistent prevalence than those without [8]. Although quality of morbidity coding in general practice computerised medical records is a challenge, it can be improved over time with some encouragement [9].

Making a diagnosis in primary care using ICD-10 is also new among primary care providers in Malaysia. The appropriateness of using ICD coding in primary care has also been questioned as many of the conditions seen in the primary care setting are vague and ill-defined and can only be classified as symptoms, and only 55% can be classified based on aetiology, pathology and morphology [10]. The International Classification of Primary Care (ICPC) has received increasing global recognition as an appropriate classification for general practice and primary care and its use in TPC will have to be studied further to improve the diagnosis coding.

Morbidity Profiles and Its Variation among Clinics

Morbidity pattern is variable among the clinics and this is especially obvious when comparing public and private general practices. Using medical insurance claim data, private general practice in Malaysia sees less of ADG Chronic Medical: Stable of 3.1% and more of Time Limited: Minor of 13.6% [11]. In this study of public primary care clinics, ADG Chronic Medical: Stable formed 21.02% while Time Limited: Minor formed 7.38%. Another study by Teng et al. found chronic diseases (hypertension, diabetes or asthma) were recorded only in 7.4% of all encounters at three major cities among private general practice in Peninsular Malaysia [12]. It is postulated that due to higher resources required in managing chronic diseases, many patients prefer to get treatment from public clinics which are highly subsidized by the government. The data from other countries also showed wide variations of morbidity. A study by Carlsson et al. using computerised data from publicly managed primary care centres found Time Limited: Minor at 19.7% and Chronic Medical: Stable at 9.0%[13]. However, data from Taiwan where the volume of ambulatory visits was exceptionally high, with a mean of 14.4 visits per person annually, showed Time Limited: Minor of 39.8% and Chronic Medical: Stable of 32.3% [14]. Kangar HC had 2321 patient with ADM05 (Administrative concern and non-specific laboratory abnormalities) or 32% more from other clinics, as it is the only centre in Perlis to perform routine and specific medical examination, a requirement for pre-employment or pre-institutionalisation.

EDC provides a useful report on disease prevalence and together with SMR, pattern of diseases can be determined beyond statistical chance [15]. There was significant difference in EDC pattern across clinics. As mentioned before, some of these variations may be due to coding practice and some are genuine differences in prevalence of morbidity.

Pharmacy Defined Morbidity Groups (RxMG) is another method to determine morbidity profiles as prescription data are sometimes more reliable as it does not depend on coding diagnosis but is affected by prescribing habits. Nearly half the

patients were categorised as RxMG General Signs and Symptoms/Pain and Inflammationand this may be due to the request by patients to stock up on drugs like paracetamol or other analgesics, as over-the-counter (OTC) drugs in Malaysia is provided at public clinics almost-free, as the outpatient charge of RM1 covers consultation, investigation and drugs. Due to this, patients will come to public clinics for minor complaints which can be managed with OTC drugs. A large proportion of patients in public primary care clinics in Malaysia are managed by paramedics and this can also explain the higher proportion of simple and low resource diagnoses category.

CONCLUSION

Electronic data from TPC system is proven a valuable source to perform a case-mix evaluation which otherwise will require a massive effort in data collection, if done manually. Through ACG case-mix system, patients' morbidity profiles by individual clinic can be determined so that resources required can be further assess and justified. This study revealed there are variations in the morbidity profiles of the different public primary care clinics in Perlis.

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REFERENCES

1. Verhulst L, Reid RJ, Forest CB. Hold It – My patients are sicker! The importance of case-mix adjustment to practitioner profiles in British Columbia. BC Med Journal 2001; 43(6): 328-33.
2. Majeed A, Bindman AB, Weiner JP. Use of risk adjustment in setting budgets and measuring performance in primary care I: how it works. BMJ 2001; 23: 604–7.
3. Weiner JP, Starfield BH, Steinwachs DM, and Mumford LM. Development and application of a population-oriented measure of ambulatory care case-mix. Medical Care 1991; 29(5): 452-72.
4. The Johns Hopkins ACG® System Reference Manual Version 8.2. Baltimore 2008.
5. The Third National Health and Morbidity Survey (NHMISIII), State Report: Perlis. Institute for Public Health, National Institutes of Health, Ministry of Health, Malaysia 2006.
6. Pringle M, Ward P, Chilvers C. Assessment of the completeness and accuracy of computer medical records in four practices committed to recording data on computer. British Journal of General Practice 1995; 45: 537-41.
7. Johnson N, Mant D, Jones L, Randall T. Use of computerised general practice data for population surveillance: comparative study of influenza data. BMJ 1991; 302: 763-5.
8. Yeoh C, Davies H. Clinical coding: completeness and accuracy when doctors take it on [editorial]. BMJ 1993; 306: 972.
9. Jordan K, Porcheret M, Croft P. Quality of morbidity coding in general practice computerized medical records: a systematic review. Fam Pract 2004; 21: 396-412.
10. The International Classification of Primary Care (ICPC); date accessed: 20 June 2010. http://www.globalfamilydoctor.com/wicc/icpcstory.html
11. Using Teleprimarycare® (TPC) to improve the delivery of Primary Health Care in Malaysia: application of the Johns Hopkins Adjusted Clinical Group® (ACG) System to improve data quality, financing and efficiency. Final report on project II. Ministry of Health, Malaysia, 2008. (unpublished)
12. Teng CL, Aljunid SM, Cheah M, Leong KC, Kwa SK. Morbidity and process of care in urban Malaysian general practice: the impact of payment system. Med J Malaysia 2003; 58(3): 365-74.
13. Carlsson L, Strender LE, Fridh G, Nilsson G. Types of morbidity and categories of patients in a Swedish county. Applying the Johns Hopkins Adjusted Clinical Groups System to encounter data in primary health care. Scand J Prim Health Care 2004; 22(3): 174-9.
14. Lee WC. Quantifying morbidities by Adjusted Clinical Group System for a Taiwan population: a nationwide analysis. BMC Health Serv Res 2008; 8: 153.
15. Schneeweiss R, Rosenblatt RA, Cherkin DC, Kirkwood R, Hart G. Diagnosis clusters: tool for analysing the content of ambulatory medical care. Med Care 1983; 21: 105-22.