Original Article

Rational Classification of Simple Disease Cases in Bangkok Dusit Medical Services Hospitals using Relative Weight and Case Mixed Index

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Abstract

OBJECTIVES: This study proposes using relative weights (RW) of specific health conditions or diagnoses as a simple tool to differentiate simple from not-simple disease cases.

MATERIAL AND METHODS: Using data from 1,558 records of closed chart review, conducted by Utilization Management and Third-party-payer Services (UM) of Bangkok Dusit Medical Services (BDMS) and a list of simple diseases advised by five health insurance partners, we compared discriminating power of various RW levels. Scenario assessment was conducted to quantify number of cases that could be missed out and turn into risk management (RM) cases.

RESULT: RW of 0.3 could categorize 22 (71%) of 31 conditions as simple diseases while RW of 0.4 had the power to categorize 27 (87%) and RW of 0.8 could categorize 31 (100%) of the whole list. Scenario assessment showed increasing risk management (RM) cases from 8 cases using RW = 0.3 to 42 cases (5.3 folds) using RW = 0.4 and to 141 cases (17.6 folds) when RW = 0.8 was used. Although greater RW threshold could capture greater proportion of simple diseases, it could result exponentially increase of RM cases. As a result, RW = 0.4 would be the optimum and practical cut-off point to differentiate simple from not-simple diseases. To monitor hospital performance, different levels of "Percentage of simple disease" should be applied due to different complexity (indicated by case mixed index-CMI) of hospitals in BDMS network. We propose "Yellow zones" of 10%-20% for super tertiary care (CMI > 2.0), 40% - 50% for hub tertiary care (CMI 1.00 – 1.99), 60% - 70% for basic tertiary care (CMI 0.50 – 0.99) and 70% - 80% for secondary care (CMI < 0.5) hospitals. Only continuous monitoring is required when performance stays below these yellow zones. However, when the proportion of simple disease is in the yellow zones, hospital management should pay specific attention. If the situation progressed and the proportion is higher than the upper limit of the yellow zone, special interventions of hospital management and insurance partners would be urgently required.

CONCLUSION: Our data showed that RW of 0.4 was the optimum threshold to differentiate simple from not-simple diseases as it could cover 87% of the current list of simple diseases with minimum number of possible RM cases. Different ranges of proportions of simple diseases are proposed for different complexity of BDMS hospitals according to their case complexity, reflected by case mixed index (CMI). More studies using data from other networks are recommended for broader application of this concept.

Keywords: case-mixed index (CMI), relative weight (RW), simple disease, Bangkok Dusit medical services (BDMS), private hospital, Thailand

The concern for appropriateness of healthcare resources utilization and cost containment have been raised worldwide. Various measures and tools, such as AEP (Appropriateness Evaluation Protocol), ISD criteria (Intensity of service, Severity of illness, Discharge screens), and application of other defined criteria or expert opinion, have been used to determine admission appropriateness in order to ensure an effective utilization of hospital beds.[1-6] Utilization management (UM) employing those tools together with regular informational feedback to hospital management and physicians are effective in reducing inappropriate admission.[7-10] However, those direct measures significantly add administrative burdens to third-party-payers, particularly in performing concurrent management of all inpatient hospitalizations.[11-12] Thus, some indirect measures such as admission rates,

length-of-stay, and costs benchmarking among hospitals have been widely used to induce hospitals and physicians to utilize resources efficiently.[13]

The term "simple disease" has been used in health insurance industry in Thailand to indicate a group of illnesses that are diagnosed and treated at out-patient departments (OPD) and mostly do not require admission to in-patient departments (IPD). The reason "simple disease" is particularly important is because both health care providers and insurance partners want to avoid misuse of resources. However, this is not always achieved due to complexity of situations where diagnosis requires some laboratory results or duration of observation. Sometimes, cases that look simple at the beginning turn out not to be so simple after thorough clinical assessments. With fast processing of paper work, final diagnoses sometimes were not appropriately determined. In these cases, disagreement between health care providers and payers happens and thus complicating approval for reimbursement. With limited amount of human resources to perform thorough audits, medical experts of third party (insurance) partners thus formulate lists of simple diseases to screen out reimbursement of in-patient department expenses. These lists usually contain common medical conditions such as upper respiratory tract infection, pharyngitis, gastritis, gastroenteritis, headache and vertigo. However, once a complication is detected, physicians in charge may often decide to keep patients in for more investigation and care.

Despite the fact that medical necessity and appropriateness of care can be evaluated using existing evidence-based criteria or clinical guidelines, inappropriate admission may be influenced by many other potential factors, including patient preferences, convenient access to hospital, cautiousness of doctors, geographical environment, and the design of reimbursement and payment policies etc. [14-16]

There has been increasing trends of cases with disagreement, and solving this would result in a healthier relationship between health care providers and third party payers.

A microeconomic theory of moral hazard effect has been well described to explain both patient and physician behavior change in response to insurance.[17-20] Decreasing self-protection and demanding more healthcare, ex ante- and ex post-, are two types of demand-side moral hazard. Supplier-induced demand arising from informational asymmetry between physicians and patients is also influential in overutilization of resources, especially in the fee-for-service system.[20] The impact of moral hazard in private health insurance industry in Thailand is intensified through some insurance products providing daily compensation for each hospitalization day, which is currently one of the strongest financial incentives in patient-induced inappropriate admission.

Strategic planning for the loss-of-interest (Loss) ratio has been implemented by insurance companies to reduce both demand side- and supply- side moral hazard, including: (a) concurrent review and retrospective review which is time- and resource-intensive; (b) statistical report review - set targets/ thresholds for hospitals which is easier; and (c) cheaper insurance agents controlled by government or regulatory bodies.

Previous studies have shown patient characteristics and conditions frequently have a high rate of inappropriate admission.[21-23] However, the definition of "simple diseases" has not been well described in any text books or literatures. Most insurance companies in Thailand currently monitor the percentage of "simple diseases" admission as a key hospital performance. Our work here began with the list of existing cases advised by our insurance partners (Table 1). It is clear that there is a need to develop an objective method to categorize simple disease from the others primarily to avoid confusion or disagreement. We, therefore, conducted this study to identify an objective method to guide differentiating complicated simple disease cases from non-complicated cases using Thai Diagnosis Related Groups (DRGs) based on International Classification of Disease (ICD) codes.

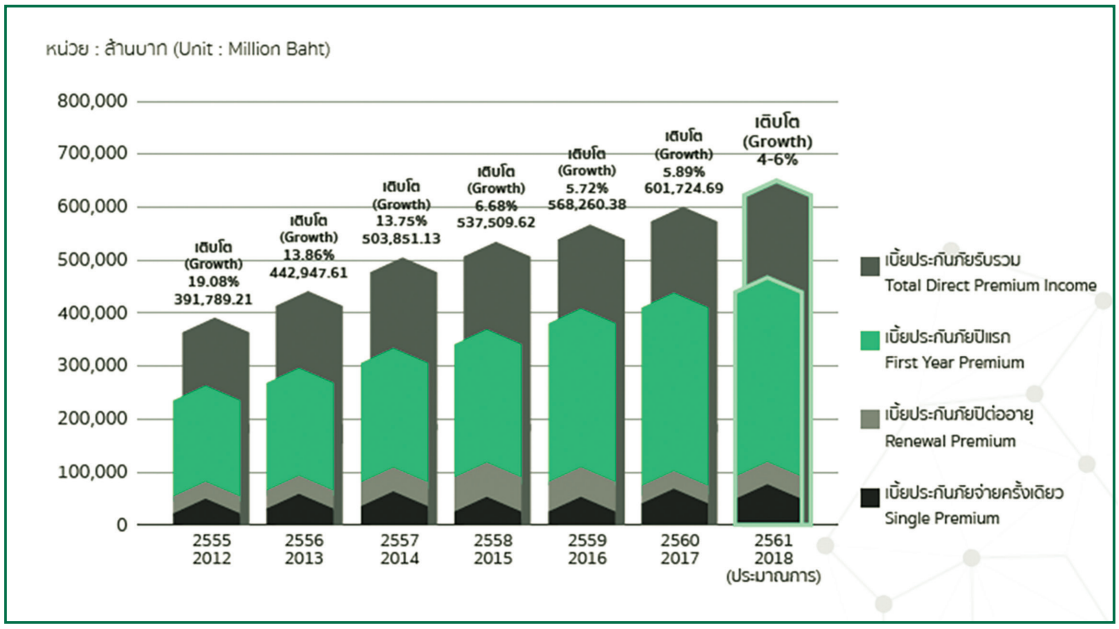
In addition to individual case management, another issue that requires attention is on monitoring of hospital performance. With an increasing demand of Thai people to take out insurance coverage to use private instead of public hospitals (Figure 1), competition among insurance salespersons has resulted in persuasion statements that created expectations among enrollees that hospital admissions would be easier with some insurance plans. The situation creates tensions between patients and physicians with subsequent tensions between hospitals and insurance partners. Hospitals with 40 to 50 percentages of simple disease admission rates (varied by insurance partners) were on the spot for being including on the watch-list. A measure based on comparative analysis is not worthwhile without determining the impacts of different case mix compositions.[24] Using one threshold judgment does not provide any solution to the abuse of resources because insurance enrollees that are able to shop around and tensions would be even more prevalent. Without an effective solution, this could result in an unhealthy relationship between hospitals and insurance partners as well. As a result, this study proposes a more rational method to monitor hospital performance using CMI according to level of hospital care.

CMI is an adjusted RW of diagnosis-related groups (DRG) of patients in a health service delivery system (hospital). CMI has been commonly used as a disease severity index that reflects mixture of severity among admitted cases. Higher CMI indicates greater proportion of severe cases in a given setting and duration, and requires more resources and costs for patient care.[26-27] Therefore, CMI can be used to monitor performance of a health care setting over time. It can also be used to benchmark performance among similar health care settings. Generally speaking, if a hospital has a high CMI, it is likely that there are more complex than simple cases, and vice versa.

Table 1: List of simple diseases advised by five key insurance partners

AIA[1,2]	MTL[1]	AZAY[1]	BLA[1]	AXA[1]
Pharyngitis, Laryngitis and Tracheitis	Acute Pharyngitis		Pharyngitis	Acute pharyngitis unspecified
Influenza	Influenza	Influenza	Flu, unspecified	Influenza virus not identified
URI, URTI, Common Cold	URI Common cold	Upper Respiratory Infection Common Cold	URI Common cold	Acute upper respiratory infection unspecified Acute nasopharyngitis [common cold]
Gastritis	Gastritis	Gastritis	Gastritis	Gastritis unspecified Other acute gastritis
Gastroenteritis, Diarrhea	AGE/Acute Diarrhea	Acute Gastroenteritis	AGE/Diarrhea	Diarrhoea and gastroenteritis of presumed infectious origin
Migraine Headache	Headache	Headache	Headache	Headache
Vertigo	Vertigo		Vertigo	Other peripheral vertigo
	Dizziness	Dizziness	Dizziness	Dizziness and giddiness
Acute Bronchitis		Acute Bronchitis		Acute bronchitis unspecified
	Low back pain	Low Back Pain		
	Acute Sinusitis			Acute sinusitis unspecified
	Acute Tonsillitis	Tonsillitis		Acute tonsillitis unspecified
		Viral Infection	Viral infection	Viral infection unspecified
		Muscle Strain		Myalgia
		Urticaria	Urticaria	
		Syncope		
			Allergic rhinitis	Allergic rhinitis unspecified
			Dyspepsia	Dyspepsia
			Abdominal pain	Other and unspecified abdominal pain
			Fever	Fever unspecified
				Other physical therapy
				Gingivitis and periodontal diseases
				Dermatitis unspecified

Note: 1. AIA: American Insurance Association, MTL: Muang Thai Life Assurance; AZAY: Allianz Ayudha Assurance, BLA: Bangkok Life Assurance, AXA: AXA Insurance Public Company Limited
2. In 2019, AIA uses RW to determine simple diseases instead of this list.



Source: Office of Insurance Commission.
Note: Average growth rates of 9 percent exceed population growth by more than ten times

Figure 1: Increasing trend of insurance coverage in Thailand from 2012 - 2018

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A previous study in Thai public hospitals revealed that one particular DRG has a different adjusted RW in different levels of hospitals. For example, adjusted RW for DRG 06570 increased from 0.4511 to 0.4607, 0.4620, and 0.5405 in primary care, secondary care, tertiary care, and teaching hospitals respectively. The result showed that the higher hospital tier, the higher disease severity, even if it is the same diagnosis and same DRG.[25]

In 2019, BDMS governs 46 hospitals providing healthcare from secondary to basic tertiary, hub tertiary and super-tertiary care levels. Threshold proportion of simple disease admission of every hospital in the network has been assessed using the range of 40% - 50%. The current level would not allow a secondary care hospital to achieve this target thus having a higher likelihood of being on the watch-list and this may complicate improvement of services. Different thresholds for various levels of hospital care (CMI) would, on the contrary, encourage a fine tuning of admissions thus facilitating development towards preferred direction of optimum use of hospital and insurance resources.

This study aims to identify an objective way to label simple diseases in order to guide medical practitioners and insurance partners to utilize resources rationally. Specific objectives are as follows:

1. To assess relationship between proportion of simple disease cases and hospital specific CMI in BDMS hospitals.
2. To identify cut off points of RW that would rationally differentiate simple from not simple disease cases.
3. To demonstrate different scenarios of cases differentiated by various levels of RW cut off points.

Materials and Methods

This cross sectional study used three sources of data, i.e. (i) anonymized data from hospital information system, (ii) list of simple diseases recommended by insurance partners, and (iii) selected de-identified claimed records from closed chart reviews supplied by the BDMS Utilization Management and Third Party Payers Services team.

Anonymized data from the hospital information system (HIS) of 34 Hospitals in BDMS in 2017 were used to demonstrate the relationship between CMI and the proportion of Simple Disease admissions. A total of 387,311 cases were included for the calculation of hospital specific CMIs. Hospital specific proportion of simple disease cases in 2017 were calculated based on the list of 31 diseases provided by insurance partners. These numbers of simple disease cases served as nominators while the numbers of total admissions of respective hospitals in 2017 served as denominators. The process resulted in 34 pairs of hospital specific CMIs and the proportion of (theoretical) Simple Disease admissions.

The List of Simple Diseases has been introduced in the Background section. We first received a list of diagnoses labeled as "Simple Disease Admission" from one partner. Trying to generalize, we obtained four more lists from key insurance partners and summarized them into a list of 31 diseases/diagnoses by keeping the same list while adding the difference. With the concept of RW in mind, we labeled each disease/diagnosis with a respective RW and sorted them out to look for the meaningful cut off points to differentiate the majority and mostly agreed upon Simple Diseases. Two cut off points were identified using interpolation technique. These are shown in Table 2 and Figure 3. A total of 1,558 de-identified claimed records in 2017 were then used to represent BDMS UM team viewpoints on Simple Disease perspective. They were randomly selected from all claimed records of 33 hospitals for internal discussions towards improvement of resource utilization and accurate medical documentation. Our study used this dataset to "test" the proposed RW cut off points by showing different scenarios that would happen, given using various RW cut of points.

Data extraction was in full compliance with Health Insurance Portability and Accountability Act (HIPAA) standards. Data were analyzed using Statistical Package for Social Science Personal Computer (SPSS-PC) version 22 after processing with online, free access modules of R-Code. Statistical significant difference level was set at 0.05. Data used for this study will be kept for five years after the date of publication.

Results

Relationship between CMI and proportion of simple disease admissions

To assess the nature of health performance of the BDMS hospital network, we constructed a scattergram of 34 pairs of hospital specific CMIs and proportion of (theoretical) Simple Disease admissions and found an overall negative relationship between the two variables, with correlation coefficient (R) – 0.76, 95% Confidence Interval from -0.59 to -0.89, $p < 0.01$ (Figure 1). To assess whether the relationship occurs only among specific groups i.e. claimed admissions, data were stratified and four scatter plots were generated. In addition to Figure 2, the relationship between CMI and proportion of simple disease cases was found to be consistent, among claimed (165,667 cases) and both claimed and unclaimed (total 366,576 cases). Please see Figure 3a, 3b, 3c and 3d.

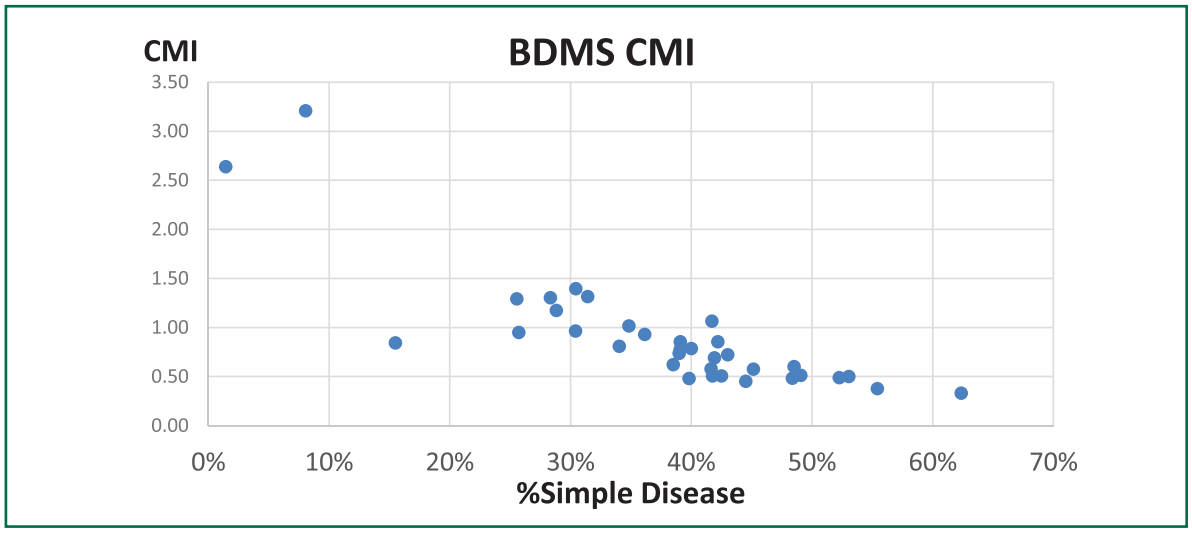
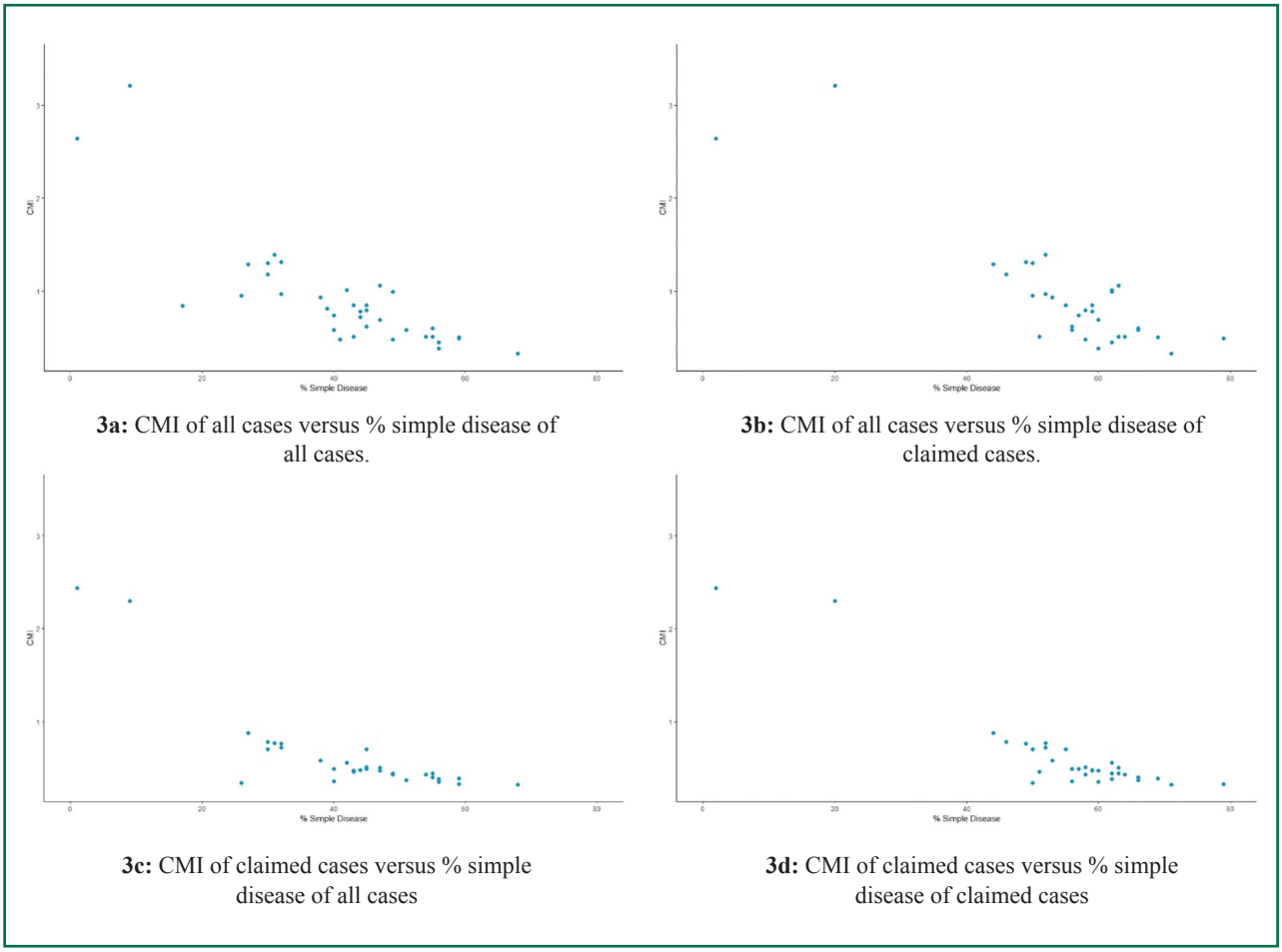


Figure 2: Scatter plot between Case Mixed Index (CMI) and proportion of simple diseases among network hospital of Bangkok Dusit Medical Services (BDMS) PLC network hospitals, 2017.



3a: CMI of all cases versus % simple disease of all cases.

3b: CMI of all cases versus % simple disease of claimed cases.

3c: CMI of claimed cases versus % simple disease of all cases

3d: CMI of claimed cases versus % simple disease of claimed cases

Figure 3: Correlation between CMI levels and proportion of simple disease cases admitted in four scenarios.

Identifying RW cut off points

We mapped the 31 Simple Diseases with their respective RWs. With this, we found three clusters of diseases/diagnosis of:

- Number 1 (vertigo) to number 22 (syncope)
- Number 23 (myalgia) to number 27 (fever of unspecified origin, adults)
- Number 28 (gingivitis and periodontitis) to number 31 (other physical therapy).

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As a result, two cut off points were proposed by interpolating the RW of number 22 and 23 (resulting RW equals to 0.3), and interpolating the RW of number 27 and 28 (resulting RW equals to 0.4), see Figure 4. The first cut off point of 0.3 would have the power to categorize 22 (71%) of the whole list of 31 diseases / outcomes as simple diseases while the other cut off point of 0.4 would have the power to categorize 27 (87%) of the whole list (Table 2).

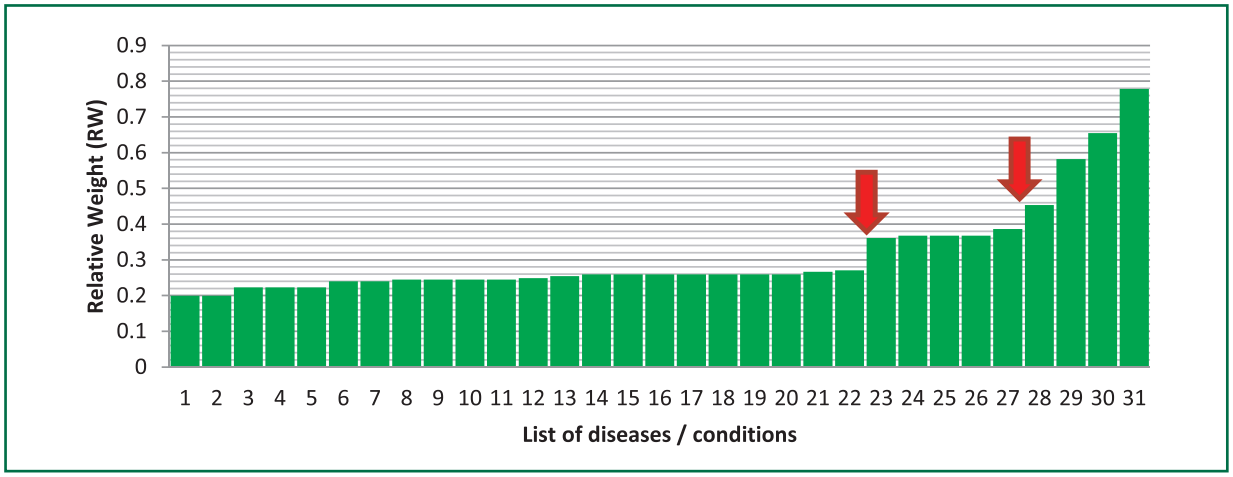

Figure 4: List of the 31 simple diseases by relative weights (RWs)

Table 2: List of condition and respective RW

Variables	RW
Vertigo	0.1998
Dizziness	0.1998
Gastroenteritis	0.2225
Diarrhea	0.2225
Acute Gastro-enteritis	0.2225
Gastritis	0.2395
Dyspepsia	0.2395
Dermatitis unspecified	0.2444
Migrane	0.2444
Headache	0.2444
Urticaria	0.2444
Abdominal pain	0.2486
Viral Infection	0.2541
Pharyngitis	0.2591
Influenza	0.2591
URI/URTI	0.2591
Common Cold	0.2591
Acute Sinusitis	0.2591
Acute Tonsillitis	0.2591
Allergic rhinitis unspecified	0.2591
Fever unspecified (child)	0.2667
Syncope	0.2705
Cut-off point 1	0.3
Myalgia	0.3610
Laryngitis	0.3678
Tracheitis	0.3678
Acute Bronchitis	0.3678
Fever unspecified (adult)	0.3864
Cut-off point 2	0.4
Gingivitis and periodontal diseases	0.4533
Muscle Strain	0.5820
Low back pain	0.6544
Other physical therapy	0.7781

Different scenarios resulting from using various levels of RW cut-off points

A critical question here is what would happen when we use different RW cut-off points. The direct effect is that using a higher RW cut-off point would result in categorizing more cases as "Simple Disease". We then simulated three scenarios of using 0.3, 0.4 and 0.8 as the cut-off points to the 1,558 records of de-identified cases.

Each time a cut-off point was applied to this dataset, it segregated 1,558 cases into two groups of "more than" and "less than or equal to" the cut-off point. With specific diagnosis from this dataset, we brought in data to determine whether each case was with "complication" or not and labeled them accordingly. The final step was to label them whether they were categorized as "Simple Disease" or not. The results of three scenarios appear in Figures 5, 6 and 7.

A group of cases requiring attention would be those which are categorized as simple diseases with complications. Service delivery settings and insurance partners share responsibilities on these potentially complicated cases. In this dataset of 1,558 cases, there are 202 cases with complications, of which 151 cases were categorized as Simple Disease.

In the first scenario of using 0.3 cut-off point, 895 cases would be categorized as Simple Disease and only 8 among them would fall into this potential RM category (Figure 4). For the second scenario of using 0.4 cut-off point, 1,143 cases would be categorized as Simple Disease and 44 cases would be in this potential RM category (Figure 5). Once the threshold of 0.8 cut-off point is used, 1,402 cases would be labeled as Simple Disease and number of potential RM cases would increase to 165 (Figure 6). Increasing cut-off point thresholds

from 0.3 to 0.4 would increase the number of potential RM cases from 8 to 44 cases (5.5 times) and from 0.4 to 0.8 from 44 to 169 cases (3.8 times). It is obvious that while increasing threshold brings some benefit of detecting more Simple Disease cases, it also brings along more risks.

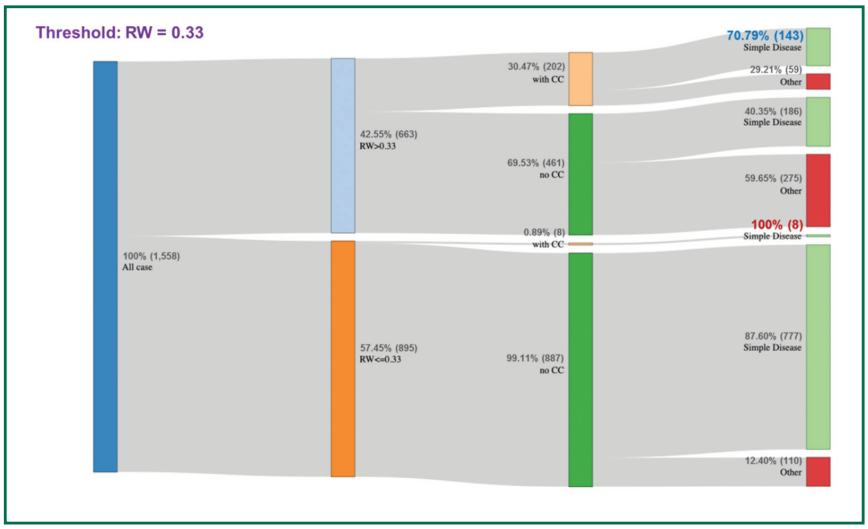

Figure 5: Number of cases categorized into simple or not simple diseases using 0.3 RW cut-off point

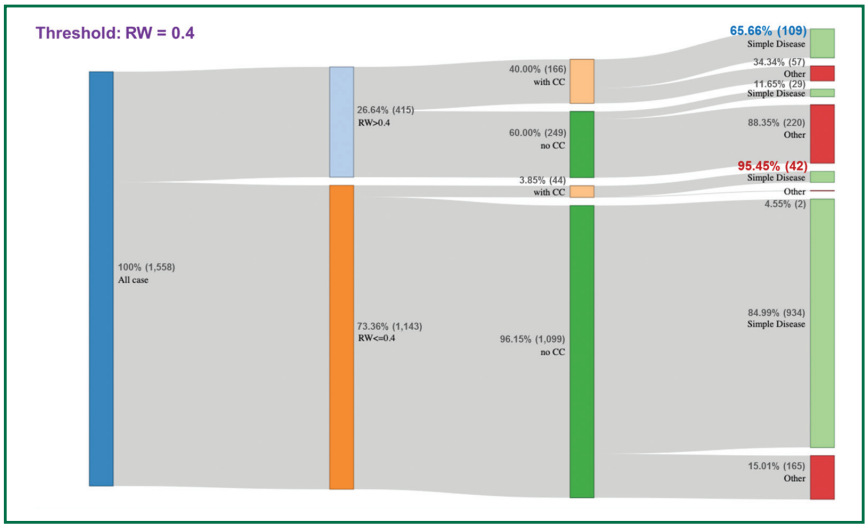

Figure 6: Number of cases categorized into simple or not simple diseases using 0.4 RW cut-off point.

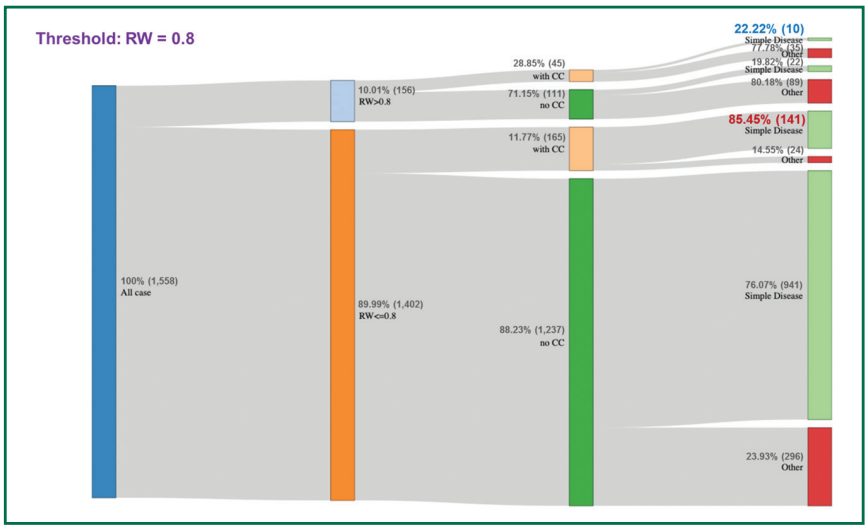

Figure 7: Number of cases categorized into simple or not simple diseases using 0.8 RW cut-off point.

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Monitoring hospital performance

Percentages of simple diseases admitted: With different complexity of cases (broad range of CMI among BDMS network hospitals, different levels of percentages of simple diseases should be assigned for the monitoring of hospital performance. From 2017, using the total discharged cases with RW data (n = 366,576), we calculated group specific median proportion of simple disease and compared these with median proportion of cases below RW = 0.4 and found them to be consistent (Table 3). As a result, an idea of group specific "yellow zones" are proposed. The idea follows traffic lights of red, yellow and green that we should have two cut-off points of percentages of simple disease cases (identified using RW – 0.4) admitted. If the average percentage of a hospital is greater than the upper cut-off point, hospital performance is in the red zone. If the percentage is less than the lower cut-off point, the performance is in the green zone. This would give a list of hospitals whose performance is in between two cut-off points, i.e. in the yellow zone.

Once hospital performance (reflected by average percentages of admission of simple disease identified using RW = 0.4) stays below these yellow zones, only continuous monitoring is required. However, when the proportion falls into the yellow zones, specific attention should be paid by hospital management. If the situation progresses and the proportion moves to higher than the upper limit of the relevant yellow zone, special interventions of hospital management and insurance partners will be urgently required.

Although there is no sufficient data currently to determine the two cut-off points for the construction of the "yellow zones", we believe it would not be totally incorrect to round up what we found as group specific median percentages of cases with RW below 0.4 (Table 3) to define the lower cut-off points. The upper ones are more difficult. For the interim, we just added an absolute amount of 10% to each of the lower ones.

Table 3: Recommended levels of %Simple Disease to be used for various hospital complexity

Classification	CMI	Group specific median %Simple Disease	Group specific median % below RW=0.4	Proposed group specific "Yellow zone"
Super tertiary care	CMI > 2.00	5%	8%	10% - 20%
Hub tertiary care	CMI 1.00 – 1.99	31%	39%	40% - 50%
Basic tertiary care	CMI 0.50 – 0.99	44%	58%	60% - 70%
Secondary care	CMI < 0.49	56%	64%	70% - 80%

Discussion

At the individual-case level, RW 0.4 may be used as a screening tool for first-level review. However, RW derived from DRG coding based on discharge abstract data does not reflect patient's severity of illness accurately.[32-34] Regardless of severity of illness consideration, both hospitals and insurance companies may be at risk of medical negligence and liability. Moreover, one factor that has not been widely used at the stage of insurance claim is whether admitted cases encounter a complication. Although both practitioners and payers know that a complication could be identified later during admission either with clinical signs or with laboratory tests, different viewpoints are often from different data received. In this study we found 210 out of 1,558 (13.5%, 95%CI from 12.9% to 14.1%). Interestingly, 151 (72%) of these 210 cases were labeled as simple disease cases. The issue of severity of illness and complications should be attended to more carefully by both practitioners and payers.

In addition, preauthorization for non-emergency hospitalization should be taken into account to help to reduce inappropriate resource utilization from unnecessary admission. As it imposes documentation requirements and administrative burden and may delayed necessary treatment, an effective health management information system and interoperability between hospitals and payers, such as an automated utilization review process and electronic claim processing should be seriously taken into consideration by both parties.[28] A set of structural data and clinical guidelines should be formulated and agreed upon by both parties. This would standardize routine practice for smoother operations so resources could be allocated to improve efficiency of the whole system. The current insurance policies and provider payment methods should also be redesigned to create effective incentives for patients to utilize healthcare appropriately and for hospitals to provide medically necessary and high-quality healthcare. [29-31] Insurance policy holders should be well educated regarding their insurance coverage and exclusion.

This study suffers from some degree of incomplete information on severity in particular complications among simple disease cases. This could lead to a lowering of the estimates of RW among simple disease cases, thus compromising the RW. As a result, the cut-off point of 0.4 could serve as the lower possible value to differentiate simple from non-simple disease cases. We therefore suggest setting up a registry system to prospectively collect data from a portion of admitted cases (10% - 30%) that are classified as simple and not simple diseases and use these data to adjust the cut-off point if required.

Conclusions

Using 2017 anonymized data of both claimed and unclaimed cases admitted to a number of BDMS network hospitals, we found that the RW of 0.4 could well differentiate simple disease from not simple disease cases defined by insurance partners. This level of RW was associated with a low proportion of complications (44/1143, i.e. 3.9%, Figure 5). As a result, the RW of 0.4 could serve well to classify simple from not simple disease cases.

Scenario analysis among 1,558 closed chart review cases showed that increasing the RW cut-off point thresholds from 0.3 to 0.4 would increase number of potential RM cases from 8 to 44 cases (5.5 times) and from 0.4 to 0.8 from 44 to 165 cases (3.8 times). It is obvious that while increasing threshold brings some benefit of detecting more Simple Disease cases, it also brings along more risks.

Different levels of percentages of simple diseases should be assigned for the monitoring of hospital performance, at least in the BDMS network. We found consistency between groups of specific median proportion of simple diseases and median proportion of cases below RW = 0.4, which reflects the value of using this RW to identify simple diseases. With this tool, hospital performance could be better monitored on their percentage of simple diseases admitted, whether they are performing well (in the green zone) or not (in the red zone). Those in between are in yellow zones. From our data, we propose "Yellow zones" of 10%-20% for super tertiary care (CMI > 2.0), 40% - 50% for hub tertiary care (CMI 1.00 – 1.99), 60% - 70% for basic tertiary care (CMI 0.50 – 0.99) and 70% - 80% for secondary care (CMI < 0.5) hospitals. Once the proportion of simple disease (identified using RW = 0.4) stays below these yellow zones, only continuous monitoring is required. However, when the proportion falls into the yellow zones, specific attention should be paid by hospital management. If the situation progresses and the proportion moves to higher than the upper limit of the relevant yellow zone, special interventions of hospital management and insurance partners will be urgently needed.

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