

# Diagnosis-related group (DRG)-based prospective hospital payment system can be well adopted for acute care surgery: Taiwanese experience with acute cholecystitis

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## Research article

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# Abstract

## Background

Diagnostic-related groups (DRGs) are a principle type of hospital payment systems worldwide. Laparoscopic cholecystectomy (LC) is a common surgical procedure for cholelithiasis paid by DRGs. However, acute cholecystitis (AC) patients usually have heterogeneous conditions that can negatively impact the successful implementation of DRGs. We evaluated the quality and efficiency of treating AC patients under the DRG system in Taiwan.

## Methods

All AC patients who underwent LC between October 2015 and December 2016 were included. Patient demographics, comorbidities, laboratory tests, AC severity, treatment outcomes and financial results were recorded and compared. Patients were reimbursed by one of the two DRG schemes based on their comorbidities or complications (CC): DRG-1, LC without CC; and DRG-2, LC with CC. Hospitals were reimbursed with the lower threshold if costs were below the lower threshold (sector A); with the outlier threshold if costs were between the lower and outlier thresholds (sector B); and with the outlier threshold plus 80% of the exceeding cost if costs were higher than the outlier threshold (sector C). The lower and outlier thresholds for DRG-1 and DRG-2 were TWD 38,716 and TWD 64,146 and TWD 39,997 and TWD 81,843, respectively (TWD = Taiwan dollars, one US dollar is approximately 30 TWD).

## Results

Among 246 patients, 114 were paid by DRG-1, and 132 were paid by DRG-2. The sex ratio and AC severity were similar between groups, but DRG-2 patients were older and had more comorbidities. In total, 195 of 246 patients (79.3%) underwent LC within one day after admission, and patients with mild AC had shorter hospital stays than those with moderate or severe AC. The complication rate was 7.3%, and there was only one mortality. In total, 105 of 114 patients in DRG-1 and 120 of 132 patients in DRG-2 fell into sector B (the profitable sector). The average margin per patient was 11,032 TWD for DRG-1 and 24,993 TWD for DRG-2.

## Conclusions

DRGs can be well adopted for acute care surgery. Under such a system, hospitals can still provide efficient and quality medical services without losing profit.

## Trial registration:

None, the current study is not a clinical trial

# Background

Since the introduction of the first diagnosis-related group (DRG)-based payment system in the 1980s by Medicare in the United States, DRGs have spread around the world and gradually become the basis for paying hospitals in many countries [1, 2]. DRGs have categorized a large number of individual patients with a variety of confusing diagnoses into an acceptable number of clinically meaningful and economically homogenous groups. By providing a clear definition for each group, DRGs enable comparisons between healthcare systems, hospitals, or even individual practitioners [3–5]. DRGs are also thought to improve transparency, efficiency and quality in hospitals

because they provide incentives for hospitals to pursue optimal care for patients by utilizing limited resources per patient [6].

Based on the prospective payment design of DRGs, DRGs make good sense in settings where patients have relatively homogenous characteristics, take routine tests, undergo routine treatments, and have a predictable recovery and length of hospital stay. Accordingly, elective laparoscopic cholecystectomy (LC) for symptomatic cholelithiasis is one of the most frequently performed surgical procedures implemented in the DRG payment system [7]. In contrast to a noninflamed gallbladder, which is usually soft, collapsed and easy to handle and dissect, an acute inflammatory gallbladder is usually distended with a thick, edematous gallbladder wall along with a pericyclic adhesion that significantly increases surgical difficulty [8]. Furthermore, the process by which acute cholecystitis (AC) patients receive medical attention is quite distinct from that of elective patients. Typically, they are admitted via the emergency department and undergo various diagnostic studies, such as ultrasonography or computed tomography, on an urgent basis. They may be operated on at midnight, with significantly longer operation times, and consume various amounts of resources based on the severity and complexity of the disease [9]. These factors have negatively impacted the implementation of DRGs in AC patients.

In Taiwan, National Health Insurance (NHI) is the principle payer of the country's healthcare system [10, 11]. Regarding DRGs for LC, NHI reimburses hospitals with incremental payments for "complications or comorbidities" (CC) without taking the elective/emergent nature and complexity of surgery into consideration. Although a similar DRG payment design has been criticized to raise potential financial risks for medical centers where the most expensive and riskiest patients are being cared for [9, 12], in the current study, we reappraised the quality and efficiency for treating AC patients under the same DRG payment scheme in Taiwan.

## Methods

This was a retrospective study approved by the Institutional Review Board (IRB) of Chang Gung Memorial Hospital. By reviewing the medical records of all the patients with a diagnosis of AC between October 2015 and December 2016, those patients who underwent LC were identified. Patient demographics (age, sex, and body mass index), preexisting diseases, Charlson Comorbidity Index (CCI) score, American Society of Anesthesiologists (ASA) classification for physical status, body mass index (BMI), clinical profiles including routine hematological and biochemical tests as well as imaging studies, length of ICU and total hospital stays, surgical outcomes, morbidities, and in-hospital mortalities were recorded. The severity of AC was classified according to Tokyo guidelines 2018 (TG18) and was recorded as mild, moderate, and severe [13]. Patient comorbidities were defined according to the CCI score for their preexisting diseases. In addition, fees for medical services, including physician fees, ward fees, medication fees, and fees for operations and procedures, were provided by the hospital's financial system. The hospital cost was calculated as the sum of all the fees incurred during the index admission.

Since 2010, the Taiwan-version DRG (TW-DRG) payment system has been implemented by NHI. Each TW-DRG payment rate has a lower threshold and an outlier threshold. Patients who claim a fee lower than the lower threshold are reimbursed the same amount they claimed (sector A); those who claim a fee between the lower and outlier thresholds are reimbursed with the outlier threshold (sector B); and those who claim a fee more than the outlier threshold are reimbursed with the outlier threshold as in sector B plus an additional outlier payment (80% of the exceeding cost) to marginally compensate for the exceeding cost (sector C). The TW-DRG has classified several groups for LC within major diagnostic category 7 (MDC 7). All of our patients fell into one of the following two groups: DRG-1, "laparoscopic cholecystectomy without endoscopic treatment, without complications or

comorbidities”; and DRG-2, “laparoscopic cholecystectomy without endoscopic treatment, with complications or comorbidities”. The lower threshold and outlier threshold of the payment rate for DRG-1 and DRG-2 were 38,716 TWD and 64,146 TWD and 39,997 TWD and 81,843 TWD, respectively (TWD: Taiwan dollars, one US dollar is approximately 30 TWD). These DRGs reimbursed the hospital claim for the index admission during which LC was performed. According to the TW-DRG, there were add-on payment adjustments, such as for higher hospital levels, a higher case mix index (CMI), and for children or for hospitals located in remote areas. As these adjustments were derived from complicated formulas and were subject to change over time, only base rates were applied in the current study to avoid confusion.

The patients in each DRG were further divided into 3 subgroups according to the severity of AC: group 1, mild AC; group 2, moderate AC; and group 3, severe AC. AC was managed according to the well-recognized principle: early LC was the procedure of choice whenever possible. Patients who were contraindicated for early LC were managed by percutaneous gallbladder drainage followed by delayed LC 6–8 weeks later. In addition, patients who were contraindicated for surgery were not included in this study. The patient demographics, results of laboratory tests, operative details, preoperative hospital stay, postoperative hospital stay, ICU stay, total length of hospital stay (LOS), treatment outcome, and financial aspects of the DRG, including medical costs, reimbursement and margin, were calculated and compared between the groups.

Descriptive statistics were calculated for the cohort. The financial variables, including cost, revenue and margin, are shown in TWD. One US dollar equals approximately 30 TWD. Frequency tables were generated for categorical variables, and continuous variables were summarized by the means and standard deviations (SDs). Continuous data were analyzed using Student’s t test or one-way ANOVA to compare the means of two or more independent groups, respectively. Tukey’s post hoc test was used following one-way ANOVA to test for differences between the groups. All statistical analyses were performed using SPSS (version 21.0, Chicago, IL, USA). A value of  $p < 0.05$  was considered statistically significant.

## Results

In total, 246 patients (142 males and 104 females) were included in this study. Their mean age was  $56.7 \pm 15.8$  years. Most of the patients had mild or moderate AC, and only 14 patients had severe AC. Patients with severe AC were significantly older than those with mild or moderate AC ( $67.6 \pm 12.7$  vs.  $56.1 \pm 15.7$  years,  $p = 0.008$ ). According to the financial records, 114 patients were paid by DRG-1 (LC without endoscopic treatment, without comorbidities), and the remaining 132 patients were paid by DRG-2 (LC without endoscopic treatment, with comorbidities). The male/female sex distribution, BMI, white blood cell (WBC) count and percentage of neutrophils were similar between groups (DRG-1 and DRG-2); however, patients in DRG-2 were older, more likely to have multiple comorbidities (CCI  $\geq 3$ ) and had a worse physical status (ASA classification  $\geq 3$ ) compared to those in DRG-1. Moreover, the CCI and ASA scores were more likely to be higher in patients with severe AC than in patients with mild or moderate AC. Similarly, the mean plasma CRP levels were significantly higher in the patients with severe AC than in the patients with mild and moderate AC. The mean CRP level for the DRG-2 patients was also higher than that for the DRG-1 patients (Table 1).

Table 1  
Demographics of patients according to the severity of acute cholecystitis

	DRG-1 (LC, without comorbidities/complications)				DRG-2 (LC, with comorbidities/complications)				
	Mild AC	Moderate AC	Severe AC	<i>p</i>	Mild AC	Moderate AC	Severe AC	<i>p</i>	<i>p</i>
n	53	56	5		40	83	9		
Age	46.1 ± 14.2	47.1 ± 13.8	64.2 ± 18.4	0.028*	59.9 ± 11.1	66.7 ± 11.9	69.5 ± 9.0	0.005*	0.000#
Sex									
Male	30	27	2		26	50	7		
Female	23	29	3	0.590	14	33	2	0.554	
BMI (kg/m <sup>2</sup> )	25.8 ± 4.3	26.8 ± 5.0	27.3 ± 3.4	0.472	27.7 ± 3.4	25.8 ± 3.7	26.3 ± 4.2	0.061	
CCI									
% CCI ≥ 3	4/53 (7.5%)	8/56 (14.3%)	2/5 (40%)	0.087	22/40 (55%)	59/83 (71.0%)	9/9 (100%)	0.021*	0.000#
ASA class									
% of ASA ≥ 3	14/53 (26.4%)	11/56 (19.6%)	2/5 (40%)	0.482	24/40 (60%)	62/83 (74.7%)	8/9 (88.9%)	0.116	0.000#
WBCs (10 <sup>3</sup> /mm <sup>3</sup> )	11.6 ± 2.9	15.0 ± 4.9	11.8 ± 5.8	0.002*	12.4 ± 3.1	14.9 ± 6.7	12.9 ± 8.8	0.083	
Neutrophils (%)	77.4 ± 8.1	80.1 ± 9.5	76.8 ± 8.7	0.283	77.7 ± 11.4	81.3 ± 9.3	83.2 ± 7.0	0.110	
CRP (mg/L)	50.1 ± 60.2	107.5 ± 95.7	171.4 ± 131.2	0.001*	79.1 ± 90.0	142.0 ± 105.6	204.4 ± 118.6	0.001*	0.005#
LC: laparoscopic cholecystectomy; AC: acute cholecystitis; BMI: body mass index; CCI: Charlson Comorbidity Index; ASA class: American Society of Anesthesiologists classification; WBCs: white blood cells; CRP: c-reactive protein; data are shown as the mean ± standard deviation; *: <i>p</i> < 0.05 indicates statistical significance compared within each DRG; #: <i>p</i> < 0.05 indicates statistical significance compared between two DRGs									

Overall, 195 of the 246 patients (79.3%) underwent LC within one day after admission, and the average time from admission to surgery was longer for patients in DRG-2 than for those in DRG-1 ( $1.2 \pm 1.4$  vs.  $0.7 \pm 1.3$  days,  $p = 0.015$ ). The mean operation time and amount of blood loss were similar between the two groups. Eighteen of the 246 patients had a surgical complication that was classified as Clavien-Dindo grade 2 or higher. The complication rate was similar between the two groups. Among the 246 patients, the mean total LOS was significantly shorter for patients with mild AC than for patients with moderate and severe AC ( $3.2 \pm 1.4$  vs.  $5.2 \pm 7.5$  vs.  $5.3 \pm 4.2$  days, respectively,  $p = 0.025$ ). Six of the 14 patients with severe AC (42.9%) required postoperative care in the ICU, and the mean ICU stay was  $2.3 \pm 3.5$  days. For DRG-1, the mean postoperative LOS and total LOS were significantly different between patients with mild, moderate and severe AC. In contrast, such differences were not observed in DRG-2 (Table 2).

Table 2  
Patient outcome according to the severity of acute cholecystitis

	DRG-1 (LC, without comorbidities/complications)				DRG-2 (LC, with comorbidities/complications)				
	Mild AC	Moderate AC	Severe AC	<i>p</i>	Mild AC	Moderate AC	Severe AC	<i>p</i>	<i>p</i>
n	53	56	5		40	83	9		
OP time (min)	125.7 ± 36.5	144.9 ± 41.2	162.2 ± 43.3	0.014*	130.0 ± 34.7	135.9 ± 46.9	141.6 ± 34.1	0.681	0.530
Blood loss (ml)	41.4 ± 72.6	59.5 ± 128.1	92.0 ± 122.7	0.469	36.0 ± 77.5	47.6 ± 73.7	65.5 ± 55.4	0.501	0.672
Days to surgery	0.49 ± 1.2	0.96 ± 1.4	0.80 ± 0.4	0.193	0.73 ± 1.1	1.4 ± 1.5	1.1 ± 1.1	0.046*	0.015#
% OP in one day	47/53 (89%)	46/56 (82%)	5/5 (100%)		33/40 (83%)	56/83 (67.4%)	8/9 (89%)		
Post-OP LOS	2.5 ± 0.7	3.0 ± 1.3	5.8 ± 7.3	0.001*	2.6 ± 1.1	4.6 ± 9.4	3.4 ± 1.7	0.369	0.167
Days in the ICU	0	0	3.0 ± 3.3	0.000*	0	0.2 ± 1.2	1.8 ± 3.6	0.001*	0.275
Total LOS (days)	3.0 ± 1.5	4.0 ± 1.8	6.6 ± 6.9	0.001	3.3 ± 1.4	6.0 ± 9.5	4.5 ± 1.8	0.182	0.054
Complications (%)	1/53 (1.9%)	3/56 (5.3%)	1/5 (20%)	0.177	2/40 (5%)	8/83 (9.6%)	3/9 (33.3%)	0.049*	0.08
Mortality (n)	0	0	0		0	1	0		
LC: laparoscopic cholecystectomy; AC: acute cholecystitis; OP time: operation rime; post-OP LOS: length of hospital after operation (in days); ICU: Intensive Care Unit; complications: Clavien-Dindo complications classification grade II or higher were included; data are shown as the mean ± standard deviation; *: <i>p</i> < 0.05 indicates statistical significance compared within each DRG; #: <i>p</i> < 0.05 indicates statistical significance compared between two DRGs									

As shown in Table 3, the hospital cost for most of the patients fell into sector B (between the lower and outlier thresholds). Only 3 patients were in sector A (below the lower threshold), and 18 patients were in sector C (above the outlier threshold). Although those patients who fell into sector C resulted in negative margins (i.e., the hospital was reimbursed less than the actual hospital cost), the overall margin for the hospital was still positive, as it was compensated by the net income from sector B. The average margin per patient was higher in DRG-2 than in DRG-1 (24,993 TWD for DRG-2 and 11,032 TWD for DRG-1). To show the actual hospital cost of each patient relative to the DRG payment, the costs associated with each patient were regrouped in 5,000 TWD scales starting from 35,000 TWD (below the lower threshold) to 95,000 TWD and above (higher than the outlier threshold). As shown in Figs. 1 and 2, a large proportion of hospital claims fell into the lower half of sector B of DRG-1 and DRG-2; however, 10 patients in DRG-2 had extraordinarily high hospital costs that fell into in sector C (Fig. 2).

Table 3  
Financial results

	DRG-1 (LC, without comorbidities/complications)			DRG-2 (LC, with comorbidities/complications)		
	Mild AC	Moderate AC	Severe AC	Mild AC	Moderate AC	Severe AC
Sector A (below the lower threshold)						
n	1	--	--	2	--	--
Claim (\$)	38,706	--	--	30,970	--	--
Revenue (\$)	38,706	--	--	30,970	--	--
Margin (\$)	0	--	--	0	--	--
Sector B (between thresholds)						
n	51	50	4	38	75	7
Claim (\$)	48,650	50,482	48,238	51,605	54,254	50,416
Revenue (\$)	64,146	64,146	64,146	81,843	81,843	81,843
Margin (\$)	15,495	13,664	15,908	30,237	27,589	31,427
Sector C (above the outlier threshold)						
n	1	6	1	--	8	2
Claim (\$)	101,445	70,643	225,650	--	157,696	119,120
Revenue (\$)	93,985	69,344	193,349	--	142,525	111,664
Margin (\$)	-7,460	-1,299	-32,301	--	-15,170	-7,455
Average margin per patient (\$)	14,770	12,061	6,266	28,725	23,468	22,786
Sum of margins (\$)	782,792	675,401	31,330	1,149,026	1,947,825	205,078
AC: acute cholecystitis; the hospital claim, revenue and margin of each sector are shown as the average values; the sum of margins is the sum of all cases of each grade of AC; all the numbers are shown						

## Discussion

The original purposes of DRGs were to enable meaningful comparisons and facilitate hospital management by improving the effectiveness and efficiency of health care [2, 14]. It is now a principle type of hospital payment system in many developed and developing countries [2, 15]. The characteristics of a DRG-based payment system are an exhaustive patient case classification system along with its associated payment formula. Thus, patients within the same DRG scheme are expected to be clinically and economically similar, undergo a similar treatment, and be reimbursed similarly. The successful implementation of the DRG payment system across countries and disease categories has been reported elsewhere in the literature [16–18].

Over the years, LC has become the treatment of choice for AC, and it is one of the most common procedures performed by acute care surgeons [19, 20]. The diagnosis and treatment of AC have progressively been standardized [13, 21, 22]. Currently, LC for AC has proven efficacious and safe. A number of randomized trials have shown consistent results: the mean hospital stay is between 3 and 5 days, and the incidence of serious complications is approximately 6%, with almost no reports of mortality [8, 23, 24]. Such consistency provided a solid rationale to incorporate AC into the DRG payment system because the overall cost is expectable and the odds of having an unexpectedly high cost are low. In line with these studies, our results also showed that although compared to patients in DRG-1, patients in DRG-2 had more complicated comorbidities ( $CCI \geq 3$ ), higher surgical risks ( $ASA \geq 3$ ), and more severe inflammation (higher CRP levels), their postoperative outcomes were similar. There were no differences in terms of postoperative stay, ICU stay or total length of stay between the two groups. The complication rates were also similar. This supports the current concept that LC for AC is an effective and safe modality that, following adequate preparation, the surgical outcomes are generally consistent and expectable regardless of differences in preoperative physical conditions.

When each AC grade within a DRG scheme was compared, patients with severe AC in DRG-1 had a longer postoperative stay and ICU stay than those with mild and moderate AC. On the other hand, such differences were less significant in DRG-2: only ICU stay, not postoperative stay, was longer in patients with severe AC. This could in part be explained by the fact that, regardless of the severity of AC, patients with more complex comorbidities required a certain amount of time to recover from surgery. Therefore, these patients should be reimbursed by a DRG scheme different from those without major comorbidities.

Based on the above principle, the TW-DRG covered the cost for inpatient care, and the incremental payment for the LC DRG scheme was based on "comorbidities and complications". This was similar to DRGs of many other countries, in that the urgent or emergent nature of the procedure was not considered a factor for the increased costs [3, 9]. However, this policy has been under debate. Schneider et al. [25] argued that surgeons are likely to be discouraged from treating emergency patients if they cannot be compensated properly for the increased risks and challenges. In an earlier investigation, Chen et al. [9] reported that the total cost for urgent cholecystectomies was approximately 90% higher than that for elective cholecystectomies. They suggested that such increased costs and resource consumption should be recognized when the DRG authorities were establishing reimbursement rates [9]. Nonetheless, following decades of DRG implementation and revision, it appears that patient comorbidities are still the decisive factor that accounts for the costs and resource consumption within the same disease category. For example, a recent study by Boehme et al. [26] showed that patient comorbidities increased postoperative resource utilization after LC. The authors suggested that comorbidities play a major role in clinical risk stratification and should be considered in the bundled reimbursement package [26]. Similar conclusions can be found in the literature for other diseases [27]. In one study regarding the treatment of intertrochanteric femur fractures, there was a net profit for treating more comorbid patients but a net deficit for treating healthier patients [28]. Likewise, our results also showed that patients in DRG-2 (with comorbidities) had higher margins per patient than those in DRG-1 (without comorbidities). This finding is most likely due to the design of the weight-adjusted reimbursement system (e.g., weighted by the CMI of the hospital), which provide incentives for hospitals to treat patients with more comorbidities.

From the point of view of well-developed and very high-income countries, the average profit that a hospital gained per patient in this study seems to be very low (24,993 TWD, approximately USD 850, Table 3). This result is probably due to the design of Taiwan's NHI system. Taiwan's NHI is a single payer, population-based public insurance system that provides universal healthcare coverage for virtually every Taiwanese individual [29]. The

universal NHI system has been a success, and it has gained worldwide attention due to its low rates and high quality [11, 30]. The national health expenditures have been held to less than 7% of GDP, which compares very favorably to the United States' 17.8% and approximately 10% of other high-income countries as of 2016 [29, 31–34]. Even with such a constrained budget, hospitals have still managed to provide efficient and quality medical services, as demonstrated by the short period of admission to operation and a short LOS. Furthermore, as shown in Figs. 1 and 2, the claims for most of the cases managed to fall into the lower half of sector B, which is the “most profitable location”.

There are several limitations to this study. First, the current study was a retrospective review of a single-center experience, not necessarily reflecting the financial results of other hospitals operating under the same system. However, as our institution is a medical center that routinely receives difficult and complicated cases from around the country, our results showed that DRGs can be well adopted under such settings for acute care surgery. Second, it is quite natural that DRG systems across countries are very heterogeneous because of different classification variables and algorithms. The costing methodologies are also different to address the specific financial structure of each country [3, 35]. However, surgeons, hospital managers and even DRG authorities in each country may exchange experiences for new perspectives to optimize their existing DRG systems.

## Conclusions

In conclusion, by utilizing a controlled amount of resources with reasonable costs, hospitals can still manage to provide efficient medical services without compromising quality. Most importantly, hospitals have been triggered to enhance their management to maintain profit from the DRG payment system. Our experience shows that, using AC as an example, DRGs can be well adopted for acute care surgery following years of implementation and revision.

## Abbreviations

AC: acute cholecystitis; BMI: body mass index; CMI: case mix index; DRG: diagnosis-related group; LOS: length of hospital stay; TWD: Taiwan dollars

## Declarations

### *Ethics approval and consent to participate*

This retrospective study was approved by the Institutional Review Board of

Chang Gung Memorial Hospital

### *Consent for publication*

This article does not contain individual person's data in any form

### *Availability of data and materials*

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request

### *Competing interests*

The authors declare that they have no competing interests

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### ***Authors' contributions***

Study conception and design: YTW and CHH. Acquisition of the data:

CTC, YNL, CYF and CHL. Analysis and interpretation of the data: YTW, CTC, YNL, CYF, CHL and CHH. Drafting of the manuscript: YTW and CCH. Critical revision: CHH. All authors read and approved the final manuscript.

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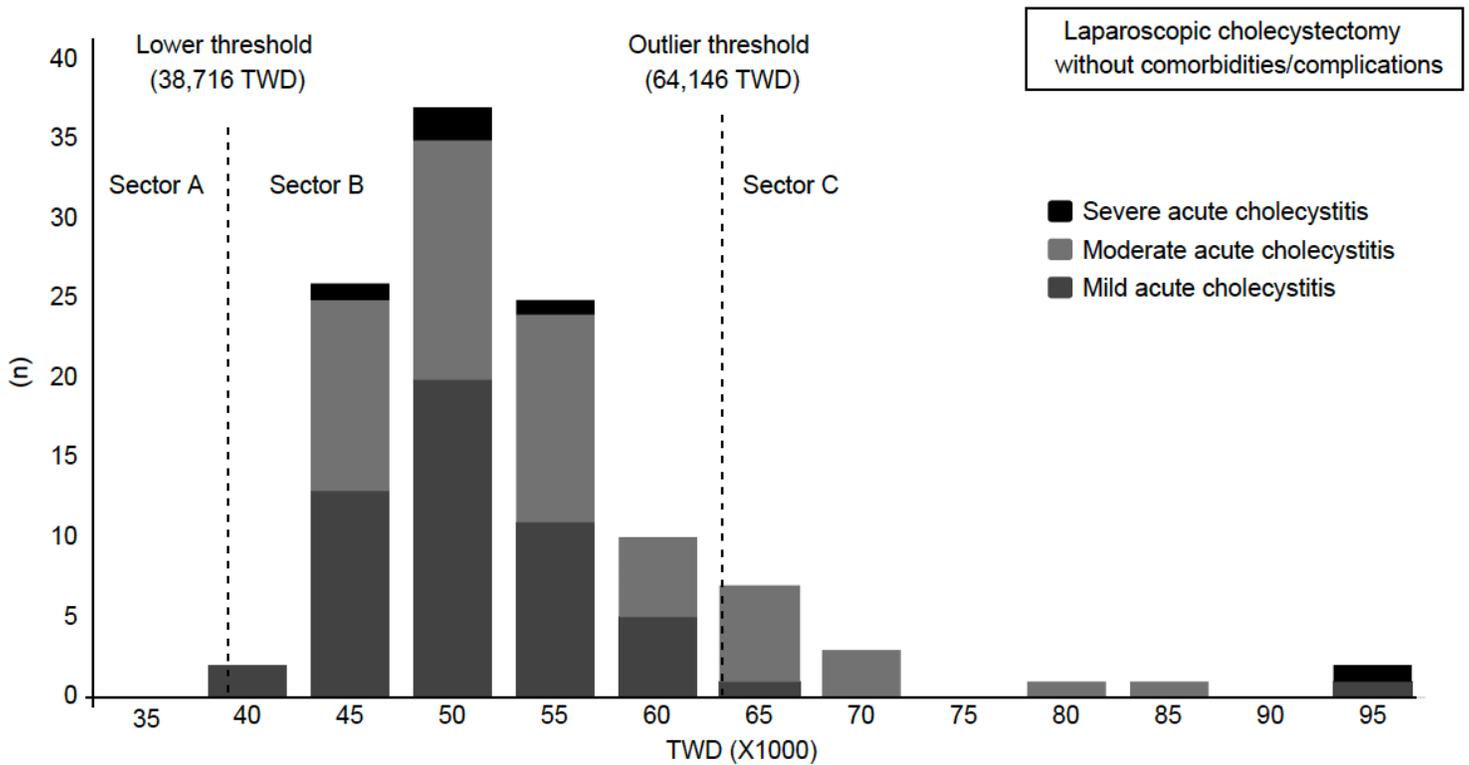
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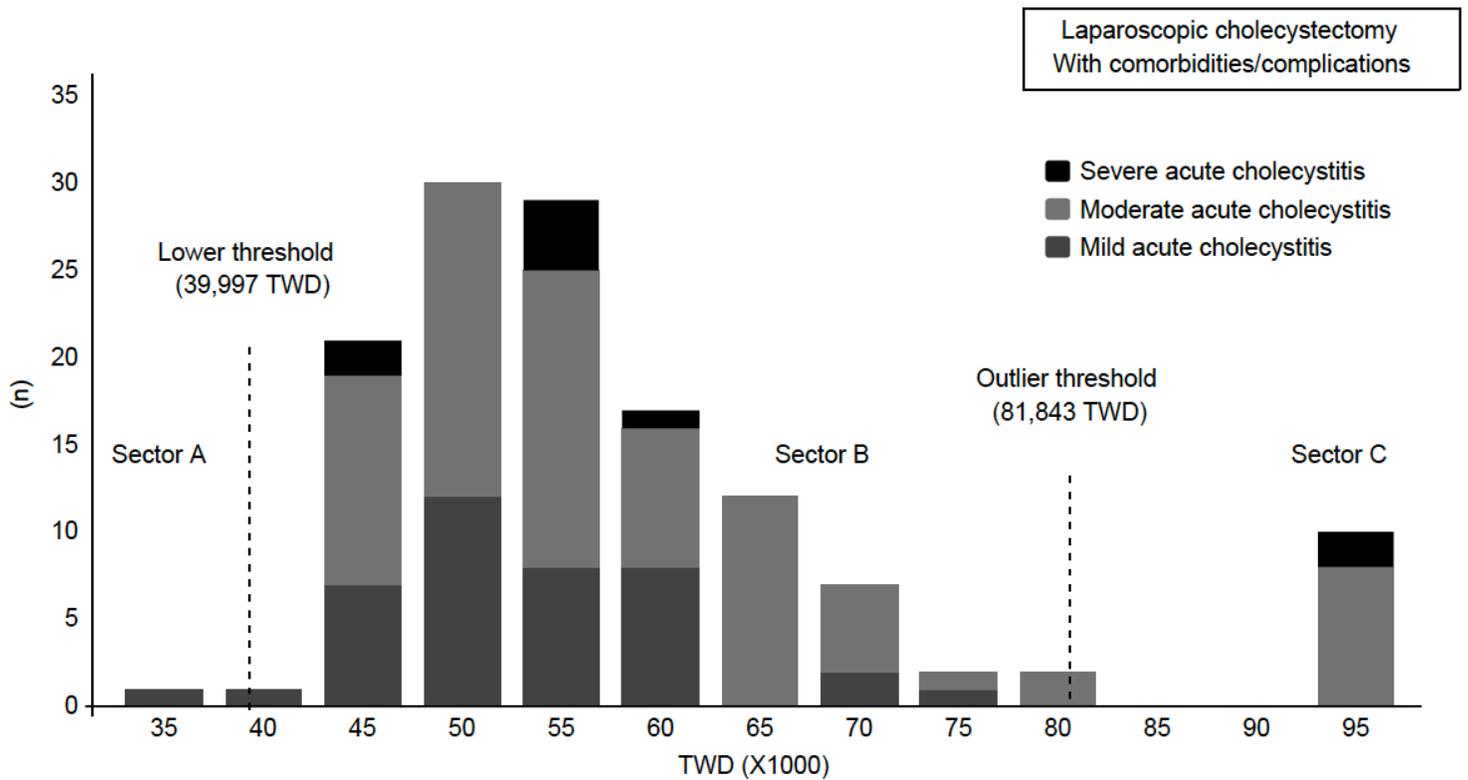
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## Figures



**Figure 1**

Distribution of hospital claims for mild, moderate and severe acute cholecystitis in DRG-1. Each DRG has a lower threshold and an outlier threshold. Hospitals were reimbursed with the lower threshold if the costs claimed were below the lower threshold (sector A); with the outlier threshold if the costs claimed were between the lower and outlier thresholds (sector B); and with the outlier threshold plus 80% of the exceeding cost if the costs were higher than the outlier threshold (sector C). The costs of each patient were regrouped in 5,000 TWD scales starting from 35,000 TWD (below the lower threshold) to 95,000 TWD and above (higher than the outlier threshold). The values are shown in Taiwan dollars (TWD). One USD = approximately 30 TWD.



**Figure 2**

Distribution of hospital claims for mild, moderate and severe acute cholecystitis in DRG-2. Each DRG has a lower threshold and an outlier threshold. Hospitals were reimbursed with the lower threshold if the costs claimed were below the lower threshold (sector A); reimbursed with the outlier threshold if the costs claimed were between the lower and outlier thresholds (sector B); and reimbursed with the outlier threshold plus 80% of the exceeding cost if the costs were higher than the outlier threshold (sector C). The costs of each patient were regrouped in 5,000 TWD scales starting from 35,000 TWD (below the lower threshold) to 95,000 TWD and above (higher than the outlier threshold). The values are shown in Taiwan dollars (TWD). One USD = approximately 30 TWD.