

COST-EFFECTIVENESS ANALYSIS OF OPEN CHOLECYSTECTOMY  
VERSUS LAPAROSCOPIC CHOLECYSTECTOMY IN CHOLELITHIASIS  
AT THE AFFILIATED HOSPITAL OF INNER MONGOLIA, CHINA

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การวิเคราะห์ต้นทุน-ประสิทธิผล ของการบำบัดรักษาด้วยการผ่าตัดโรคนิ่วในถุงน้ำดีแบบเปิดหน้าท้อง  
และการผ่าตัดแบบส่องกล้องในโรงพยาบาล เขตอินเนอร์มองโกเลียของสาธารณรัฐประชาชนจีน



วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาวิทยาศาสตรมหาบัณฑิต

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# # 5885576329 : MAJOR HEALTH ECONOMICS AND HEALTH CARE MANAGEMENT

KEYWORDS: COST-EFFECTIVENESS ANALYSIS,LAPAROSCOPIC CHOLECYSTECTOMY,OPEN CHOLECYSTECTOMY,CHOLELITHIASIS AND GALLSTONE DISEASE

BAO CHAOLUMEN: COST-EFFECTIVENESS ANALYSIS OF OPEN CHOLECYSTECTOMYVERSUS LAPAROSCOPIC CHOLECYSTECTOMY IN CHOLELITHIASIS AT THE AFFILIATED HOSPITAL OF INNER MONGOLIA, CHINA.

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This study used the cost-effectiveness analysis method to compare the 40 patients of laparoscopic cholecystectomy with the 40 patients of open cholecystectomy in Affiliated Hospital in Inner Mongolia, China, during January 2013 to December 2013, The sources of data are the medical records and patient care bills from hospital information system (HIS).

The objectives of this study are to calculate the cost from the perspective of provider, to estimate immediate outcome (no complications rate) and medium outcome (surgical sequelae rate), to calculate the cost - effectiveness ratio of the surgical treatments for cholelithiasis and gallstone disease between laparoscopic cholecystectomy and open cholecystectomy.

The results show that the cost of laparoscopic cholecystectomy is \$1586 per patient, 37 out of 40 patients are no complications ,and the CEA ratio is \$685.95.The cost of open cholecystectomy is \$1425 per patient, the number of no complications patients are 39 out of 40. CEA ratio is \$584.46. In conclusion, from the provider perspective, the effectiveness of open cholecystectomy is better than the effectiveness of laparoscopic cholecystectomy. However, the interpretation of this study results should be with caution, since this study used only data of one hospital with only 80 patients and a short period of time that is only two years after surgery.

Field of Study: Health Economics and      Student's Signature .....

Health Care Management Advisor's Signature .....

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## ABBREVIATION

LC Laparoscopic cholecystectomy

OC Open cholecystectomy

CEA Cost-effectiveness analysis

HR Human resource

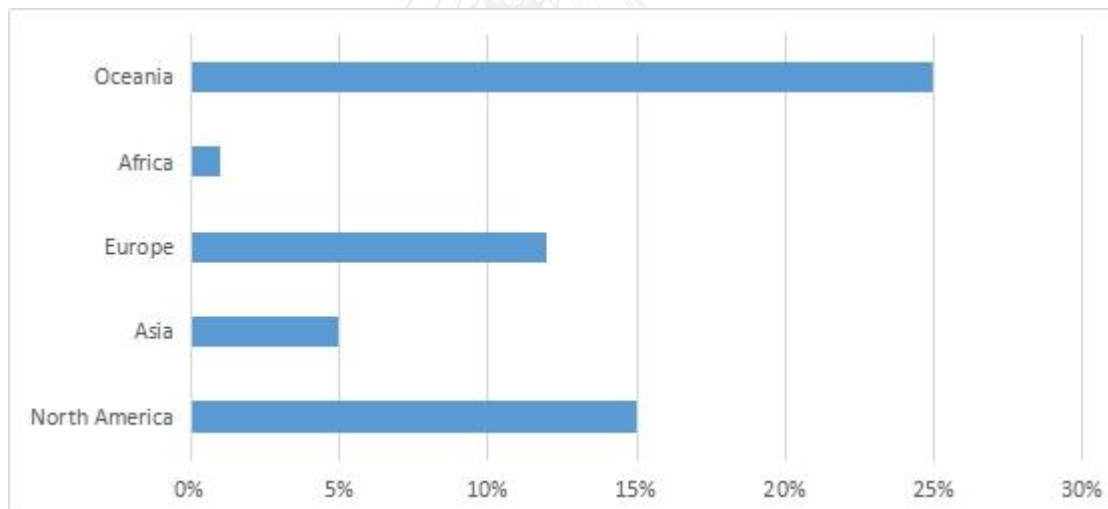


# CHAPTER I

## INTRODUCTION

### 1.1 Problems and Significance

Cholelithiasis and gallstone disease is one kind of urinary system disease which is stones formed within the gallbladder out of bile components. Stone in the gallbladder is called cholelithiasis. Gallstones are form in the gallbladder, and they may pass distally into other parts of the biliary tract. It is threatens human health in recent year. There are different incidence rate all over the world in different countries and areas. From figure 1, we can see that the Oceania and North America have the high incidence rate, and Asia is ranking fourth.



*Figure 1 The incidence rate of over 50 in different continents*

(Source: Epidemiology of Gallbladder Disease: Cholelithiasis and Cancer)

As people life rhythm accelerate, the change of diet and living environment, chronic disease has become a main factor to influence the residents healthy .in the global, cholelithiasis has become one of the main public health problem to many countries. Incidence rates of the gallstone are increasing speedy year by year, especially in China and the United States, and the incidence rate

of female is higher than male. In Europe, Germany have the highest incidence rate. China also has a high incidence in Asia area.

*Table 1 Age-standardized necropsy prevalence of gallstone*

Country	Gallstone prevalence %	
	Female	Male
Australia	13	6
Chile	42	16.7
China	12	7
England	20.5	12.2
Germany	33.7	13.1
Greece	8.4	3.5
Ireland	12.4	3.4
Japan	13	5.3
Mexico	16.1	5.2
New Zealand	14.2	9
Norway	12.4	5.3
Romania	10.4	5
Singapore	6.6	4.3
Sweden	22.4	9.1
Thailand	4.2	2.3

Source: Hepatobiliary diseases: cholelithiasis and gallstones

In China, according to the statistics data from the Chinese Disease Control and Prevention Center and the Ministry of Health, in some pilot cities and countries which are information of incidence that an upward trend in gallstone disease. Statistics show that in 2010, the incidence of gallstones is 10%, two times higher than 2000, and also higher than the average prevalence rate of Asia.

In clinic, there are usually two kinds of treatment methods for gallstone disease. One is the traditional open cholecystectomy. With the developing of modern medical technology in the

whole world, the application of the medical machine gradually applied in clinical operation as well. The minimally invasive treatment of laparoscopic cholecystectomy is become another main treatment method of some disease. The new medical technology and traditional open surgery are applying in the lots of clinical fields. For example: the treatment of uterine cancer, kidney cancer general surgery as well as urology system cholelithiasis treatment.

Laparoscopic operation is widely used in the clinical field for many years in some western developed countries, but China introduced this technology in general hospitals since 1991. And the first time, this treatment were introduced in the department of obstetrics and gynecology disease surgery. However, comparing with laparoscope, cost of the open surgery remains lower.

In China, the traditional treatment method is open surgery, which has been widely used for many years. In recently years, using laparoscope to do the minimally invasive surgery gradually promoting the usage, the two treatment methods become the mainly treatment to cure the cholelithiasis and gallstone disease. But it has different cost and effectiveness of the two treatments. And according to many related literature, there are lots of studies do the comparison between the two treatments methods only focus on the cost of patients, in views about length of the hospital days, operation time and so on. There is less researches analysis of LC and OC from the provider perspective.

This study aim to analyze the cost effectiveness of two different treatment methods. The results of this study can be used for patient and hospital. It can provide the evidence for making decision for patient and provide more reasonable policy suggestions for hospital.

The study also wants to provide basis of decision-making to establish the rational treating cost, payment methods and medical standards. These research results are not only for costing, but



also for estimating the effectiveness of the different treatment method. The theoretical basis for the development of DRG will be provided in the future at Inner Mongolia as well.

## 1.2 Research Questions

### 1.2.1 General question

What is the cost-effectiveness treatment method of cholelithiasis and gallstones disease in the Affiliated Hospital of Inner Mongolia, China?

### 1.2.2 Specific question

1. What are the costs of the laparoscopic cholecystectomy and open cholecystectomy?
2. What are the effectiveness of the laparoscopic cholecystectomy and open cholecystectomy ?

## 1.3 Research Objectives

### 1.3.1 General objective

To compare the cost-effectiveness ratio between the two treatments which are laparoscopic cholecystectomy and open cholecystectomy of the cholelithiasis and gallstone disease.

### 1.3.2 Specific objectives

1. Explore the review of effectiveness in term of after different treatment for cholelithiasis and gallstones disease
2. To estimate the total cost of laparoscopic cholecystectomy and open cholecystectomy from provider perspective.
3. To calculate the effectiveness of laparoscopic cholecystectomy and open cholecystectomy.

4. To calculate the cost-effectiveness ratio of laparoscopic cholecystectomy and open cholecystectomy and compare the cost-effectiveness ratio between the two treatments of cholelithiasis and gallstone disease.

5. To perform the sensitivity analysis in order to check the stability of the results of this study.

#### **1.4 Scope of the Study**

The data used in this study are the history of patient's records from the surgical department and the medical bills from the financial department, at the Affiliated Hospital of Inner Mongolia, China. This study extracts patients' documents during January 2013 - December 2013. The LC group of patients with the same period of OC group, and all of the patients had the cholecystectomy at age between 20—90 years.

#### **1.5 Expected Benefits**

1. We can access the more effective, safe and economic of the introduction of treatment through the analysis.

2. For hospital, it can provide policy recommendations and decision-making basis. According to the results of the study hospital can to do some technical improvement, provide reasonable evidences on establishing payment criteria of disease, and even how to save cost for each treatment.

In conclusion cost-effectiveness of two treatment methods not only takes the contributed benefit expanded in the clinical effectiveness into account, but also consider about costs. Thus, the results of this study would provide evidences and suggestions for decision makers of the

hospital. It can attain our goals which are to achieve rational allocation and to improve the utilization of health care resources.



## CHAPTER II

### BACKGROUND

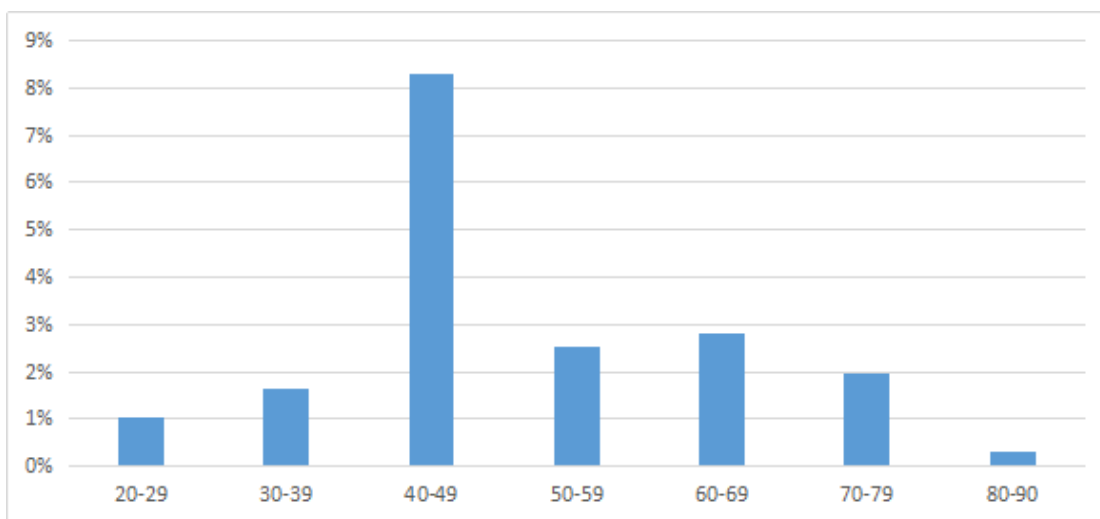
#### 2.1 Cholelithiasis and gallstone disease

The gallbladder is a tiny, pear-shaped organ which is located in the upper right abdomen, the area is below the liver, between the chest and hips. Cholelithiasis and gallstone disease is hard particles that develop in the gallbladder. The gallstones can range in size from a grain of sand to a ping-pong ball. The gallstone in the gallbladder can develop a single large stone, or hundreds of small stones, or both of large and small stones. Many people with gallstones do not have any symptoms. When the gallstones that do not cause any symptoms, we are call it asymptomatic or silent gallstones. It does not affect the function of the gallbladder, liver, or other organs.

Gallstones can cause sudden pain, the location is in the upper right of the abdomen, when gallstones block the ducts of the biliary tract, it will occurs, and we call the pain is gallbladder attack or biliary colic. If gallstones block the bile ducts, the pressures will increase in the gallbladder, and causing gallbladder attack. Gallbladder attacks usually follow heavy pains, and they often occur in the evening or night time. Sometimes the pain usually lasts about one to several hours. Gallbladder attacks can stop when gallstones is moved and no longer block the bile ducts after some treatments. However, if any the bile ducts remain blocked for more than several hours, complications will occur. It has much kind of complications, including the inflammation, swelling of the gallbladder and serious damage and infection of the gallbladder, or bile ducts, or liver. Presence of gallstones also can lead to acute cholelithiasis.

Inner Mongolia, located in the plateau region of northern China, and because the climate is cold and dry, people willing to eat salt heavy and oil heavy food. Due to the geographical location and the diet habit, these areas have a high incidence of the gallstone disease. The incidence rate of

urban higher than rural. Female patients are two times as much as male patients. There are big differences in incidence rate among different age groups, and the 40-49 age groups has the highest incidence rate of this disease .



*Figure 2 The age distribution of the incidence rate of gallstones in Inner Mongolia*

(Source: Disease Control and Prevention Center of Inner Mongolia Published data in 2010)

## 2.2 Treatments rationale

When the gallstone is not cause symptoms, the patient usually not need to cure. However, if the patients have a gallbladder attack and other symptoms, the clinical doctor will usually provide health care treatment. First they need to take some medicines, but a person had gallbladder attack one time, it is usually more episodes will be follow. So after the patients have more pains of disease, the normal treatment for gallstones is to do the operation to remove the gallbladder. We call the surgery to remove the gallbladder is cholecystectomy, it is one of the most common surgery performed on patient all over the world.

According to the theory of evidence-based medicine, to combine with the patients level of physical condition and disease stages, there are two types of cholecystectomy: Open cholecystectomy (OC) and Laparoscopic cholecystectomy (LC).

The gallbladder is an essential organ, but people can live who normally without a gallbladder. In recent years, some doctors put forward retention of gallbladder, so according to the different stages of the disease, there are two different laparoscopic surgery methods have been used in the clinical field: cholecystectomy and retention of gallbladder. It is depending on the stone size and disease stage to use the two methods. But if the operation is to keep the gallbladder, it has the possible to recurrence of the patient's disease.

Although how to use the two types of surgeries remains controversial at present, cholecystectomy is the classical operation method, it has good effect on low relapse rate. So in this study, we only discuss the case of total gallbladder excision, do not take a few cases of gallbladder retention into account.

### **2.3 Laparoscopic cholecystectomy**

Laparoscopic is similar to the electronic gastroscopy, it is one kind of instrument with a miniature camera. LC is one kind of surgery that used the laparoscopic and associated to the medical equipment. It uses cold light to provide illumination and put the laparoscopic into the abdominal cavity of patients, use the functions of the digital camera to take photos and transform to signal handle system by optical fiber, and display in the special monitor on time. While watching the monitor, the surgical doctor uses instruments to carefully separate the gallbladder from the liver, bile ducts, and other structures. Then the surgical doctor removes the gallbladder.

Before the surgery the patients need to accept general anesthesia. The advantages of the laparoscopic are small wound, rapid recovery, short postoperative diet time, less pain, short hospitalization days. But it is also have some disadvantages: the high cost of operation, and some technical limitations, because it is a new medical technology, as some security reasons, some patients do not want to choose it. And in China, the laparoscopic surgeons need to accept technical training for six months before they apply this operation.

#### **2.4 Open cholecystectomy**

The open cholecystectomy is a common surgical procedure for biliary tract surgery, and it had for long time used in clinical. Open cholecystectomy is planned in the beginning in most of these cases when the gallbladder is in the serious infected, severely inflamed, or infection of other organs. To perform an open cholecystectomy, the surgical doctor usually opens an incision about 4-6 inches long in the abdomen to remove the gallbladder. Before the operation patients need to accept general anesthesia. After the open cholecystectomy, it is depend on the recovery situation to require the hospital days of patients. In usual, it is need to stay about 7 days in the hospital and longer time than the laparoscopic. But OC is a very safety treatment method.

#### **2.5 About the Affiliated hospital of Inner Mongolia, China**

In this study, data collect from only the Affiliated Hospital of Inner Mongolia, China. It was founded in 1958, is a set of medical treatment, teaching, training, research of study, prevention and protect as one of the modern comprehensive tertiary hospitals. The hospital currently has 2632 beds and 3436 employees.

The proposal of this study is focus on one hospital, because this hospital is the second largest general hospital in Inner Mongolia, It is also a public hospital undertakes the task of teaching

of the Inner Mongolia Medical University. The hospital introduced the laparoscopic technology since the year 2006, it is the earliest hospital introduced the laparoscopic equipment in Inner Mongolia Autonomous Region. There are 5000-7000 outpatients per day, and general surgical department is a excellent department compared to other hospitals in Inner Mongolia. Now there are 22 surgeons and 28 anesthetists who can implement the laparoscopic and open surgery. The hospital has joined the national health insurance system, and fee-for-service is used in health care payment system.





## CHAPTER III

### LITERATURE REVIEW

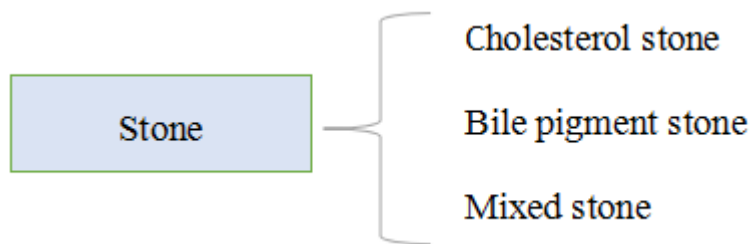
According to some related studies of the two treatments which are LC and OC, There are 5 types of researches include to the literature review of this fields.

1. The cholelithiasis and gallstones disease.
2. The economics evaluation in health care system and clinical fields.
3. The cost-effectiveness analysis in clinic.
4. The decision-tree analysis in health field.
5. The comparison of the LC and OC in some previous researches.

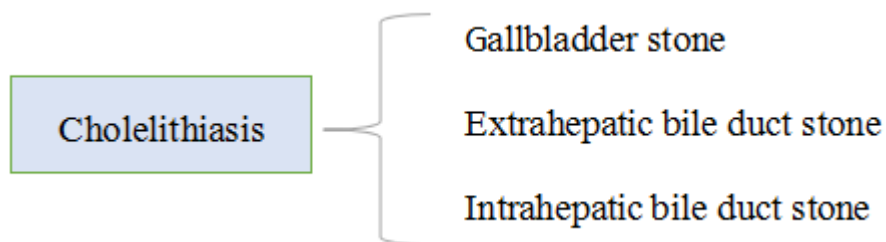
Many people use the cost-effectiveness analysis which is one of the methods of economic evaluation tools to estimate one or more intervention or treatment of disease. Some researches only study the cost analysis. Some analyze the patients outcomes, some studies also use the decision tree to analysis the different clinical outcomes after the operation.

#### **3.1 Cholelithiasis and gallstones disease**

Cholelithiasis and gallstones disease is the most common bile duct disease in China. In recent year starting from year 2000 there is an increasing trend year by year. According to the composition of the stone, they are divided into three categories: cholesterol stone, bile pigment stone, and mixed stone. The cholesterol stone is the most common among the true. According to the lesion location, they can be divided into gallbladder stone, extrahepatic bile duct stone and intrahepatic bile duct stone, and the gallbladder stone accounted for about 50% of all stones in clinic.



*Figure 3 Classification of the stone composition*



*Figure 4 Classification of the lesion location*

Patients with gallstones who have recently experienced biliary tract pain are likely to develop recurrent symptoms in the future. In the clinical, according to the relation of gastrointestinal complaints and medical machine findings results, we divided into three stages of cholelithiasis and gallstones. As a consequence, most symptomatic patients are accepted a reasonable treatment to cure.

1. The first stage is the formation of stones from the gallbladder in the beginning. Stones can be divided into single or multiple, can be a new formation, or has existed for a long time. Patients had no obvious symptoms, or only mild symptoms of the digestive tract.

This period characterized is the gallbladder can still maintain normal absorption and concentration function, so it can be shown by inspect show stone. The gallbladder has mild chronic inflammation, and the wall of capsule is slightly thickened. At this time, if there are obvious symptoms for the patient, people just need to carry out drug treatment.

2. The second stage is internal complications of gallbladder. The complications were caused by the obstruction of stones. When the gallbladder outlet obstruction, gallbladder pressure increased, the gallbladder contents cannot be discharged, the high concentration of bile salts can be caused by the damage of gallbladder mucosa, and gallbladder mucosa inflammation, hyperemia, edema, exudation, they will make the pressure increasing further in the gallbladder, therefore, lead to the acute cholecystitis. With lifting of the stone obstruction, acute inflammation of the gallbladder has improved rapidly; part of the destroyed mucosal repair and ulcer healed the formation of fibrous scar tissue, Inter organizational hemorrhage is absorbed, resolution of acute inflammation, chronic inflammatory cell infiltration and gallbladder wall of fiber fabric hyperplasia and thickening, then turn to chronic cholecystitis stage.

3. The third stage is external complications of gallbladder. A serious complication occurred at this stage. The most common symptoms are gallbladder effusion, empyema, cholecystoenteric fistula; a few patients will happen canceration. Common complication disease is gallbladder and biliary tract infection, obstructive jaundice, cholangitis, liver damage and so on.

So there are three aspects of the pathogenesis of gallstone. The surgery can be done only in the second and third stages.

### **3.2 Economics evaluation in clinical fields and health care fields**

As a tool, economics evaluation plays an important role in clinical economics. Economic evaluation is the course of systematic identification, estimate and measurement of the inputs and outcomes of two or more alternative activities, finally we will do analysis between them. it is aim to choose the best course of activity, combined the evidences available. It is most widely applied in the health economics and health technology assessment. There are three analysis methods

consist of the economics evaluation which are cost-utility analysis (CUA), cost-effectiveness analysis (CEA), cost-benefit analysis (CBA), they are all used in the health care system and clinical fields.

With the development of new medical equipment, and new technology of the disease treatments and interventions constantly innovation, symptoms of the disease is complicated, it is a difficult question to the decision maker that how to choose the reasonable treatments and interventions are good for the patients, so the economic evaluation can evaluate the different treatments or interventions, and can provide the reasonable results to the decision makers as well. This study use the economics evaluation method to analysis the treatment of the cholelithiasis and gallstones disease, to compare the new technology which is the laparoscopic cholecystectomy to open cholecystectomy in the clinical fields, and to provide more comparison information to the decision makers.

### **3.3 Cost-effectiveness analysis in health care field**

Cost-effectiveness analysis is one kind of health economics and clinical economics evaluation method, used to compares the relative inputs and outcomes of two or more alternative activities. Cost-effectiveness analysis is a common economic method which is often used in health care services system and assesses the interventions or treatment results in health care activities. Based on the limited health care resources and the increasing demand of human beings, this evaluation method can provide some evidences of decision-making to manager.

Cost-effectiveness analysis is assigns a monetary value to the measure of outcomes. It has two steps. The first step is to use the monetary measure the inputs, which is also called costs. Generally speaking, there are three perspectives sides of the cot, the one is provider, like public and private hospitals. Second is receiver, like patients and customer. And the third is third-party,

like insurance company. After collect the costs, the second step is measuring the outcomes. We often use some index to evaluate the outcomes of one treatment, such as survival rate and no complication rate. The cost-effectiveness ratio will be calculated, and we can analysis the results between different treatments and identify which one is the more cost-effectiveness. This study will use the CEA, because this study will collect the immediate outcomes and medium outcomes, using effectiveness index that can be more directly and obviously reflecting the results in the clinical research, the effectiveness index can reflect more completely results.

### **3.4 Laparoscopic cholecystectomy and Open cholecystectomy**

Laparoscopic operation and open operation have already used in lots of clinical fields. In general, no matter which kind of surgical disease, they have same advantages after laparoscopic surgery, which are recovery quickly, short hospital days, speedy wounds healing, less pain and so on. The clinical outcome of LC is better OC. But in economics evaluation analysis, according the some debates, although the LC has lots of advantages, but the cost of medical equipment is expensive, and it needs the high medical technology for doctor and nurse, so it is hard to say which one is better.

*Table 2 Laparoscopic cholecystectomy VS Open cholecystectomy*

	LC	OC
<b>ADVANTAGE</b>	1.Small wound 2.Rapid recovery 3.Less pain 4.Short hospitalization days 5.Short postoperative diet time	1.Low expenditure for patient 2.Clinical experiences for many years 3.Technical risk is low 4.Wider application
<b>DISADVANTAGE</b>	1.High expenditure for patient 2.Demand High-Technology for health service provider 3.Security requirements for hospital 4.Limit conditions of applying	1.Long wound 2.Slowly recovery 3.More pain 4.Long hospitalization days 5.Long postoperative time

Source: The Clinical analysis of LC and OC (Zhouyonggui ,2012)

In 1882, German doctors Langenbuch completed first case of open cholecystectomy (OC) in the world, and published gallbladder stone treatment theory: "cholecystectomy not only because of the gallbladder with stones, but also prevent the stone growth again", it is also called the "hotbed theory", It used in the clinical to treatment the gallstone has been more than 100 years. Since the last century, the development of laparoscopic technology, LC has become another good method to treatment of gallbladder stone.

In 1996, Mochill did the analysis of laparoscopic versus open appendectomy of clinical inputs and outcomes. He analyzed all patients who did the surgery for suspected acute appendicitis at the University of Washington Medical Center during January 1991-January 1995. He used hospital length of stay, operative time and the postoperative complications rate as the effectiveness index. The charges of operation room and total charges of the hospital are the cost. The conclusions is laparoscopic appendectomy had higher cost and did not had better clinical outcomes compared

with patients who did the open appendectomy. This study analyzed two different perspectives which are patients and hospital, and associated with the cost and effectiveness. So this study used a good point and finally found more comprehensive results than other literature.

In 1995, William used the basic data of operation room from hospital and did the prospective cost analysis of LC, and this study used the hospital perspective to estimate which department spent higher cost during LC. This study put some recommendations of promoting the surgical value such as decrease cost but maintaining quality of treatment. But he just analyzed the cost, and only gave some suggestions to hospital, and ignored the patients and did not give the good guideline to them.

In 2011, Zengshu Xing (CHINA) did a comparison analysis of the clinical outcomes for treatment of the renal tumor. He compared the clinical effect between open partial nephrectomy and laparoscopic partial nephrectomy. He used the effectiveness indexes which are blood loss, postoperative intestinal function, the incidence of postoperative complications rate, hospitalization days and recovery time and so on. The conclusion is to compare with the open partial nephrectomy, the laparoscopic partial nephrectomy has lots of advantages for treatment of the renal tumor, which are small wound, quickly recovery, and good effect. But this study just paid attention to the effectiveness, exclude the analysis of the patients' cost.

### **3.5 Review of the outcomes of LC and OC**

#### **3.5.1 Review purpose**

A purpose of research has many different analysis aspects which are related to some specific problems. In this study, the size of samples is small. Therefore, the scope of the research has limited which makes the study difficult to collect an accurate and precise conclusion. However, in

order to make this study can collect a comprehensive results and conclusions; we review some reference literature so that the result is convincing than before.

This study used only data of one hospital with only 80 patients. Hence, the scope of the research was limited. It is difficult to attain conclusions from a single result, so it indispensable to make a review and Meta-analysis. In clinical research, the effectiveness has many indexes to measure such as the no complications rate and surgical sequelae rate. This study collects information of effectiveness (outcomes). We do review to compare LC and OC for cholelithiasis with regard to immediately outcome which are intraoperative complication and postoperative complications, and medium outcomes which is surgical sequelae. In addition, this study also performs other clinical outcomes from some literature.

### **3.5.2 Review strategy**

#### **Analysis question**

What were clinical outcomes that cholelithiasis and gallstone patients undergoing LC and OC?  
What kind of complications they were occurred after surgery?

#### **Retrieval strategy**

The literature review uses the Science Direct and PUBMED databases. The search keywords are “cholelithiasis and gallstone” AND “laparoscopic cholecystectomy” AND “open cholecystectomy”. The literature review includes journals from various countries, books, online sources, and others. The literature is limited to the years from 1995 to 2014, because of the development of the clinical technology.

#### **Inclusion criteria**



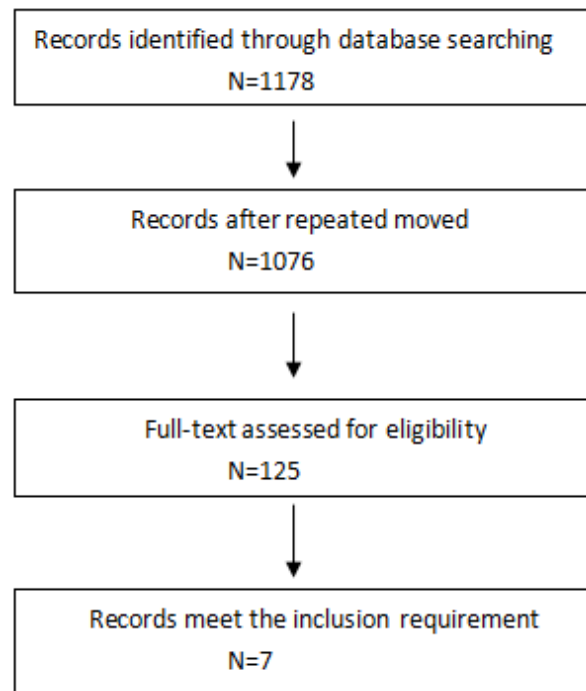
To make sure the selected data is in the same level of analysis, this study (1)Did comparative research from cholelithiasis and gallstone underwent LC and OC;(2) Put forward at least one of the outcome measures or other outcomes;(3)Use only documents that defines the treatment as “cholecystectomy” . (4)Did literature review of retrospective researches. This study also links the clinical trials to the clinical outcomes.

#### **Exclusion criteria**

The basic information of patients must match with database of this study, it means that the data are in keep with the eligible criteria which include age, complications, and stage of disease. If the patient's report does not match the criteria, it will be excluded in this analysis. In this study, we uses the Stata12 to do the statistical analysis to show the forest figure and funnel plots in table 3, to identify the heterogeneous and to test the overall effect of the total selected literature, and to get the range of the highest and lowest number of the no complications rate.

#### **3.5.3 Review results**

There are a total of 1,178 publications found with the given search keywords. After excluding some for complications, there are 7 papers left to use for in this study.



*Figure 5 Literature information*

Figure 6 show that only 7 studies match the treatment method, age, retrospective. Some studies did not match the target population or disease stage, so they were excluded.

*Table 3 Systematic review of the effectiveness (rate of no complications)*

Author	Year	LC	OC
M. Johansson	2005	100.00%	97.14%
Boo	2007	93.33%	94.44%
F. Catena	2013	95.83%	93.06%
P. Pessaux	2001	94.00%	93.26%
C.H. Chau	2002	96.77%	85.71%
S. Eldar	1997	93.15%	92.78%
Z. Glavic	2001	97.87%	91.30%

This study uses the Review Manager 5.3 to calculate the results. Statistical analysis for effectiveness is performing by use the odds ratio (OR) as the statistical index. This ratio is related to the odds of some influence factors occurring in the LC compared with the OC. Moreover, heterogenous test result is done and shows the Chi-square value.

*Table 4 Statistical analysis for review of literature*

Study or Subgroup	LC		OC		Weight	Odds Ratio M-H, Fixed, 95% CI	Odds Ratio M-H, Fixed, 95% CI
	Events	Total	Events	Total			
Boo 2007 (1)	14	15	17	18	5.6%	0.82 [0.05, 14.39]	
S. Eldar 1997	136	146	90	97	40.5%	1.06 [0.39, 2.88]	
P. Pessaux 2001	47	50	83	89	19.6%	1.13 [0.27, 4.74]	
F. Catena 2013	69	72	67	72	15.3%	1.72 [0.39, 7.47]	
M. Johansson 2005	35	35	34	35	2.6%	3.09 [0.12, 78.41]	
Z. Glavic 2001	92	94	105	115	11.0%	4.38 [0.94, 20.51]	
C.H. Chau 2002	30	31	36	42	5.4%	5.00 [0.57, 43.87]	
<b>Total (95% CI)</b>		<b>443</b>	<b>468</b>	<b>100.0%</b>		<b>1.79 [1.01, 3.17]</b>	
Total events	423		432				
Heterogeneity: Chi <sup>2</sup> = 4.00, df = 6 (P = 0.68); I <sup>2</sup> = 0%							
Test for overall effect: Z = 2.00 (P = 0.05)							

H0: Two groups of studies do not have heterogeneity.

H1: Two groups of studies have heterogeneity.

The Chi-square and I-square test results are Chi-square=4, df=6(p=0.68); and I-square=0%, respectively. The I-square value is not larger than 50%, and with a p-value of 0.05, we reject H1 for H0, it means the two groups of studies of treatment method do not have heterogeneity; so the 7 literature do not have the heterogeneity.

Consolidation effect value test.

This study uses the OR value to calculate the effect value of the consolidation, and uses the fixed effect model and M-H method to collect value of the effect. There are several effect lines through the inefficient lines on the forest plot. Some clinical outcomes are in keep with the inefficient line, the consolidation effect value is on the right side of the inefficient line. This statistical test uses the z-value, it is 2.0 (p=0.05), which means the combined value has significant.

### 3.6 Decision tree diagram

Decision tree diagram is designed in order to follow up for different outcomes after the two surgeries and estimate the costs of the treatments.

Based on the available data and the actual effect of the treatment, the diagram is built. Following the screening process and literature review, combining to the eligible criteria from the medical knowledge, the diagram of the decision tree shows what types of the complications would be occur after operation. The complications can be divided into 2 types among the different treatments, inoperative complications and postoperative complication.

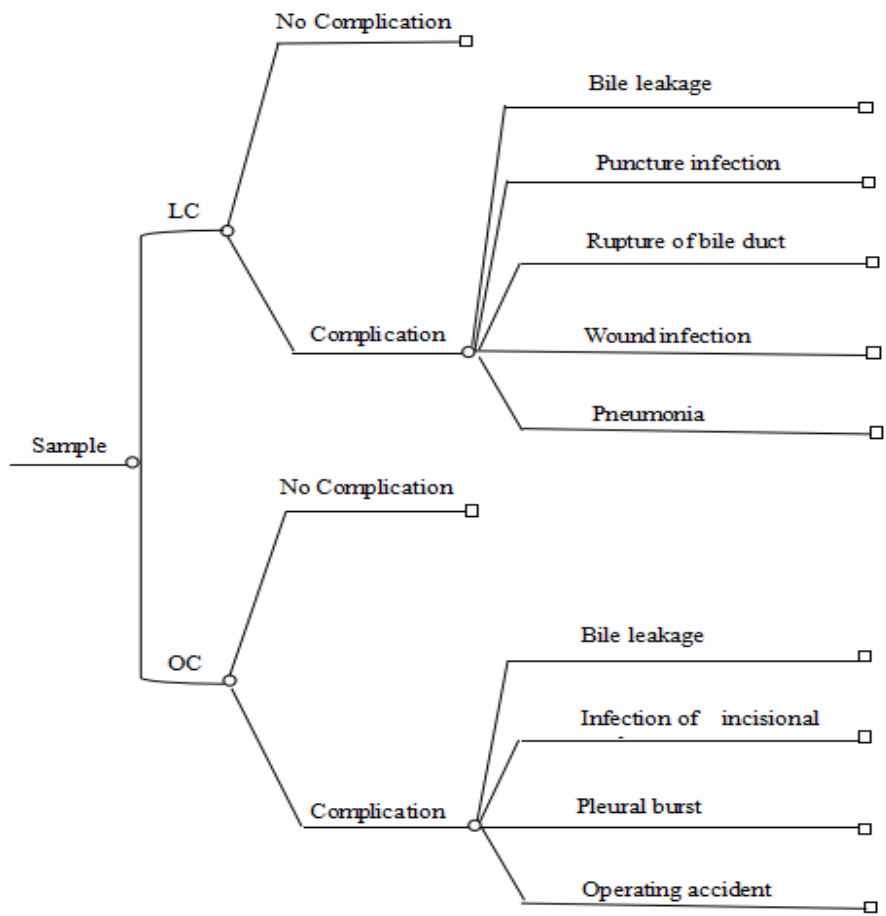


Figure 6 The common complication disease from the literature review

Table 5 Proportion of each complication from literature review

	Rupture of bile duct	Wound infection	Infection of incisional
LC	2%(Pessaux 2001 ) 3%(Eldar 1997)	1%(Pessaux 2001 ) 4%(Eldar 1997)	
OC			7%(Pessaux 2001 ) 7%(Eldar 1997)

## CHAPTER IV

### METHODOLOGY

#### 4.1 Study design

This study will compare the laparoscopic cholecystectomy and open cholecystectomy in treatment of cholelithiasis and gallstone disease, and using economic evaluation method which is cost-effectiveness analysis. This study is to collect the patients' medical records and the medical bills (January 2013-December 2013) from the hospital.

In order to complete the different stages of the patients after the two treatments, according to the purpose of this study, it will be the no complications rate as immediate outcomes and the surgical sequelae (postcholecystectomy syndrome(PCS)) as medium outcomes.

#### 4.2 Data resource

The data used in this study are the history of patient's records from the department of surgical and the medical bills from the financial department, at the Affiliated Hospital of Inner Mongolia, China. This study collects the patient documents during January 2013 - December 2013. Basic information including the patient name, age, contact information, admitted time, discharged time, the history of surgery, the medical screening results and complication history. Clinical patient information including hospital days, recovery times, the blood loss, wound healing situation, the cure rate and so on.

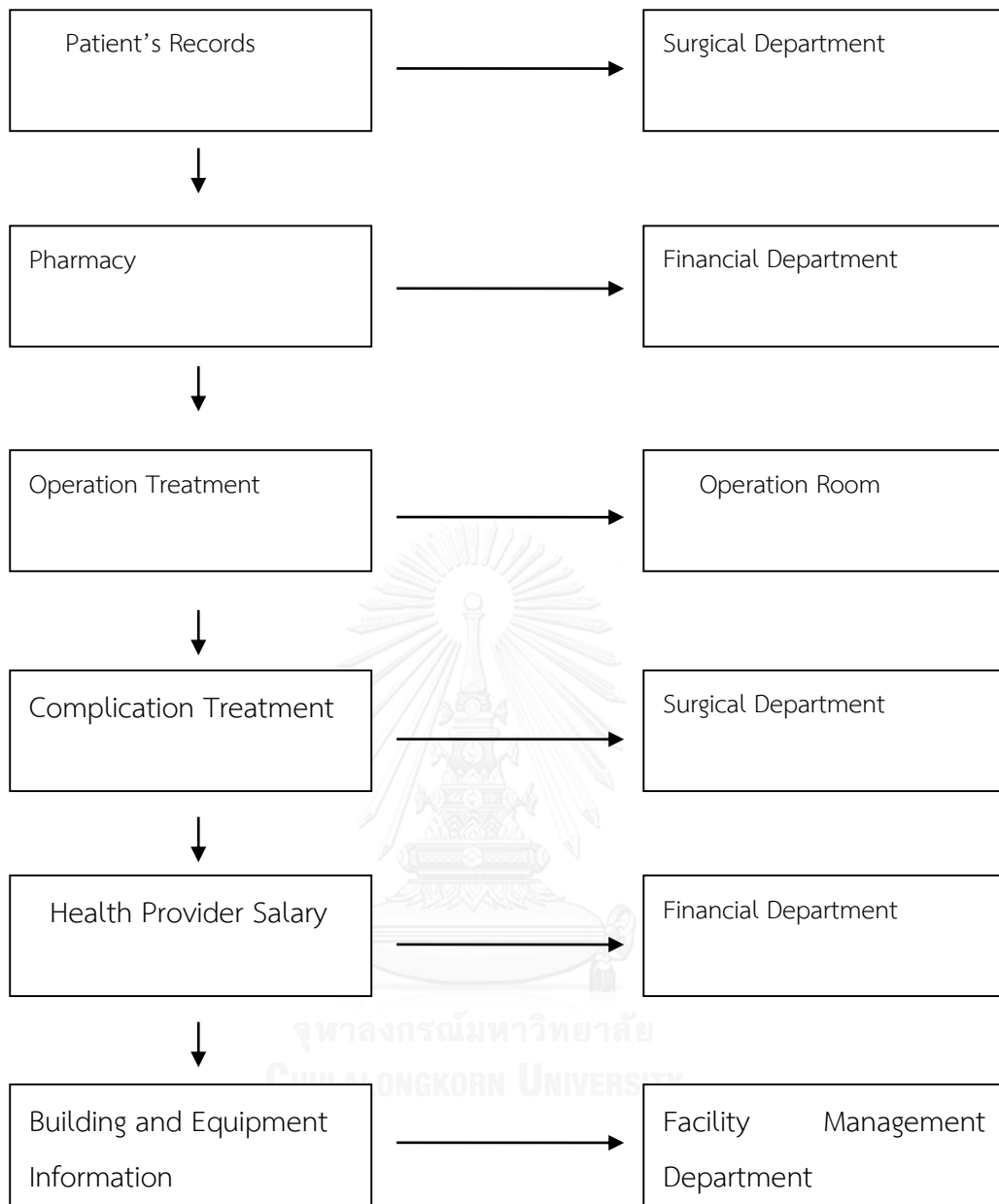


Figure 7 Data sources departments

#### 4.3 Conceptual framework

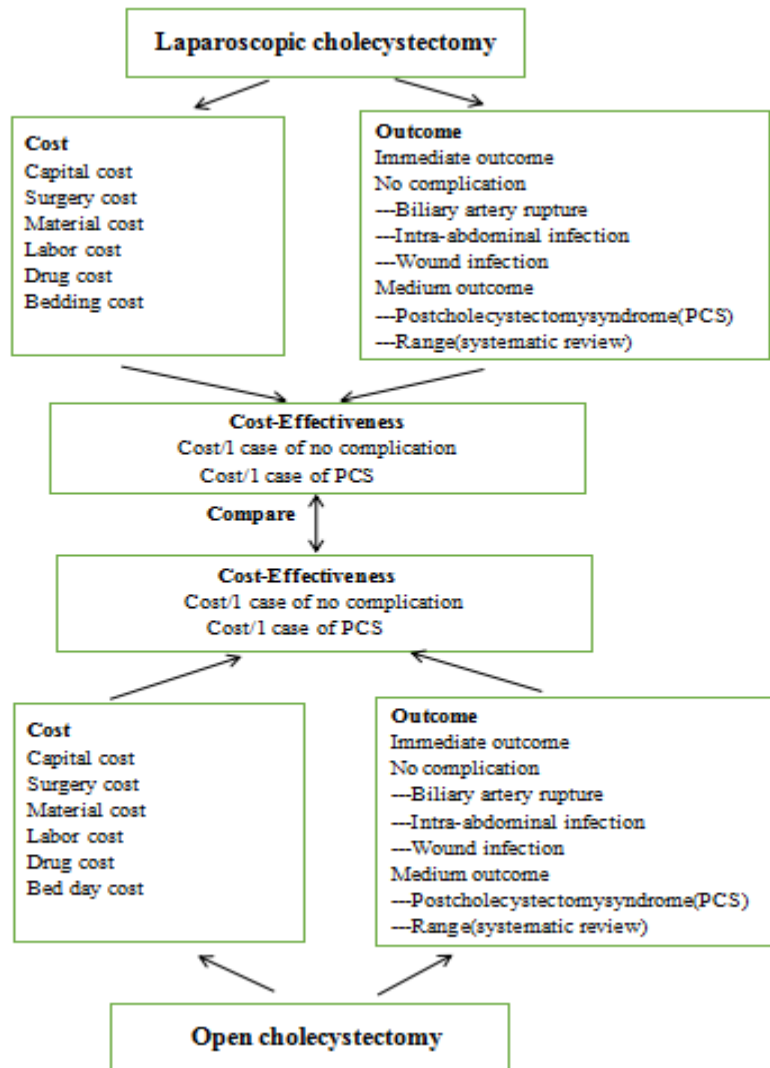


Figure 8 Comparison of costs and outcomes of the two treatments

#### 4.4 Target Population

Target populations were the cholelithiasis and gallstone disease patients who used the LC or OC to cure the disease during January 2013 - December 2013. This study will use the samples that



moved the gallbladder in the surgery. We would not use the cases that do the surgery but already retain gallbladder.

#### 4.5 Inclusion criteria and exclusion criteria

##### 4.5.1 Inclusion criteria

1. The patients do not have other abdominal complicated diseases.
2. There are three stages in the pathogenesis of gallstones. Based on the different stages, therefore the patients have different cost and effectiveness. This study will select cases from the second stage and third stage.

##### 4.5.2 Exclusion criteria

1. The patients have other abdominal complicated diseases.
2. Patients who was included in the first stage of gallstone.

After operation, the patients do not have complications, wound healing is in good condition, and the diet is normal, after 5 days they can discharge from hospital. But if the patients occur the complications after operation, the hospital will do the corresponding treatment for the patients. The hospital will do the postoperative follow-up after they discharge from hospital.

**Table 6 Summary of the inclusion criteria and exclusion criteria**

<b>INCLUSION</b>	<b>EXCLUSION</b>
1. Not have other abdominal complicated diseases. 2. Second and third stage of the cholelithiasis and gallstone disease.	1. Have other abdominal complicated diseases. 2. First stage of the cholelithiasis and gallstone disease.

#### 4.6 Sample selection

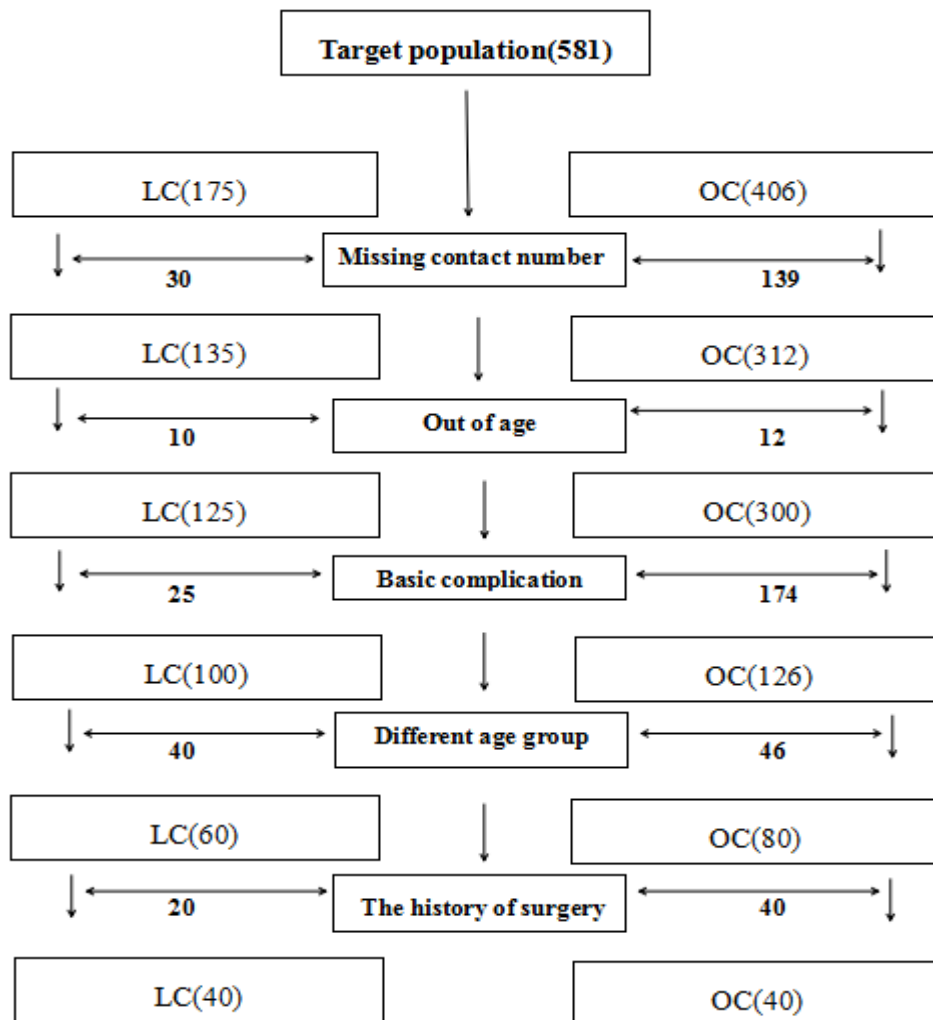


Figure 9 Sample data selection process

#### 4.7 Data analysis

##### 4.7.1 Costs analysis

According to the retrospective analysis, costs of operation are from the provider perspective. This study calculates the cost from the day of admission until they are discharged from the hospital.

Table 7 Costing steps during different treatments

Steps	Costing category	laparoscope	open operation
1	inpatient treatment	✓	✓
2	pharmacy	✓	✓
3	operation treatment	✓	✓
4	complication treatment	✓	✓
5	total cost		sum of 1, 2, 3, 4

### 1. Inpatients treatment cost

Inpatients treatment cost is the total cost about the patient' hospital days until discharge the hospital. According to the patient's medical care bills, inpatients treatment cost is including the ward cost and operation cost.

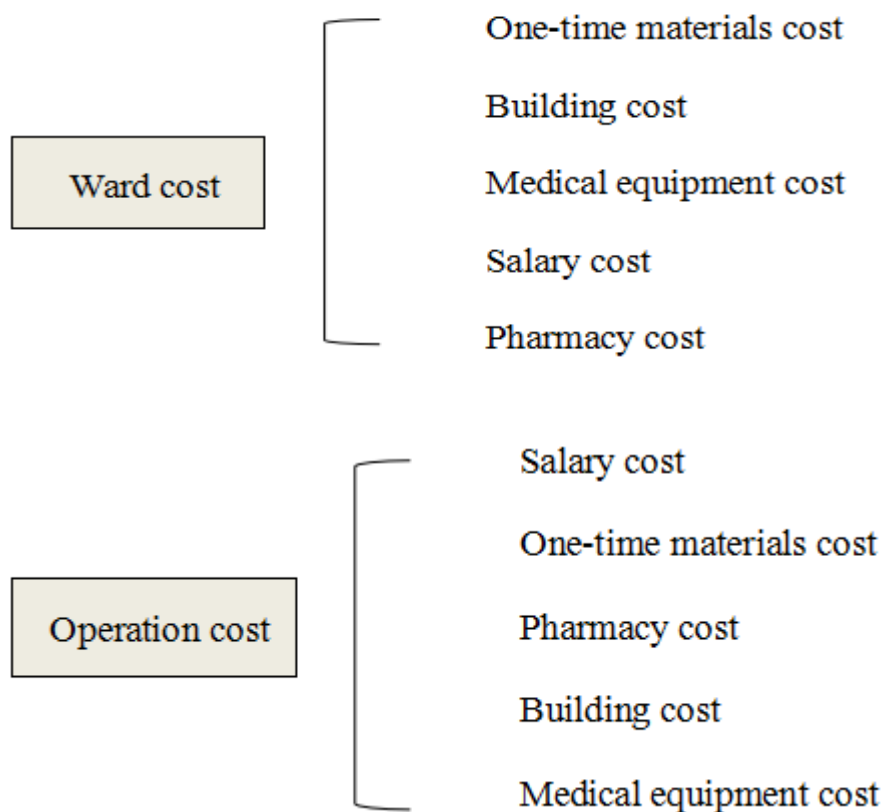


Figure 10 Fix cost and variable cost

## 2. Pharmacy cost

It means the cost of drugs who used in ward and the operation room. The price of drugs can be increased by fifteen percent on the basis of the input price in general hospital, according to the National System for Basic Drugs Rule in China, So the cost of drugs can be identified as follow:

$$\text{Amount of pharmacy} = \text{Retail pricing of pharmacy} * (1 - 15\%)$$

## 3. Treatment cost for complication

Cost of the complication treatment means the total cost of curing the intraoperative complication and postoperative complication for the patients after surgery. Different patients have different complications, the doctors and nurses will take some measures to treat, so the part of cost including equipment depreciation cost, drug cost and the labor cost.

### 4.7.2 Effectiveness analysis

This study defines immediate outcomes and surgical medium outcomes.

To estimate the effectiveness in short term of the operation, this study will calculate the number of complication rate, the standard is the patient did not have the complication until they discharged from the hospital. And to estimate the effectiveness in medium term meaning the number of patients who do not have the surgical sequelae.

According to the medical knowledge, the complication divided into two kinds of situations. One of them, the complication of patient was caused by another disease, for example, diabetes cause liver cancer. Another one is the complications occurs after the operation, but both of two types of complications are not caused by the reason of the medical malpractice. In China, according to the rules of the operation, before the operation, the patient's families must sign the Operative

Informed Consents. If in case of the complications, it is not the doctor's mistakes, so we do not consider about this situation.

#### 4.7.3 Cost-effectiveness

CEA ratio=Cost/Effectiveness ratio

After calculating the cost and effectiveness of the two treatment method which are LC and OC, the cost-effectiveness analysis will be estimated, and compare the two ratios.

#### 4.7.4 Sensitivity analysis

Sensitivity analysis is a primary analysis when dealing with data collection, which is a key to do quantitative assumptions and computations (a decision or activity), it changes some uncertainty of the variables in the data within a reasonable range, to systematically assess their effect on the final outcomes. It can reduce the instability of results.

Because of the limited samples in this study, we just analysis the immediate outcomes and medium outcomes, and do not have final outcomes (5-year surgical sequelae, 10-year surgical sequelae). The cost just include the directly cost of two treatment, therefore, this study has some limitation, so we will do the sensitivity analysis.

The study will change some parameters for sensitivity and refer to the other related factors to find new total cost, and use the no complication rate to calculate the highest effectiveness and lowest effectiveness. At last compare the three different result, test the stability of them.

## CHAPTER V

### RESULTS AND DISCUSSION

#### 5.1 Basic patients' information

This study performs a statistical data analysis using SPSS Statistics 17, and calculates the basic information on sampled patients. The content includes age, gender, stage of disease, hospitalization days, recovery days after operation, and a therapeutic effect.

The null hypothesis is that the data of LC and OC are not statistically significant, while the alternative hypothesis is that the data is statistically significant.

1. Age of Patients: this is the age when the patients admitted in the hospital for treatments based on the patients' medical records. At statistical significance level 95%, the  $p\text{-value} \geq 0.05$ , hence we do not reject the null hypothesis that the means of the age is different for the two groups. Table 9 shows the test results.

*Table 8 Age information of the LC group and OC group (unit : year)*

	LC (40)	OC (40)	P
<b>MEAN</b>	<b>46.125</b>	<b>48.125</b>	<b>0.586</b>
<b>SD</b>	<b>16.184</b>	<b>16.561</b>	

2. Patients gender : Based on the patients' medical records, to test statistical difference mean of ages of the two groups. At significance level 95%.the  $p\text{-value} \geq 0.05$ , hence we do not reject the null hypothesis that means the age is different for the two groups. Table 9 shows the results.

*Table 9 Gender information of the LC group and OC group*

	LC (40)	OC (40)	X <sup>2</sup>	P
<b>MALE</b>	<b>17</b>	<b>23</b>	<b>0.452</b>	<b>0.5</b>
<b>FEMALE</b>	<b>20</b>	<b>20</b>		

3. Hospitalization days: means the number of days that the patients who admitted to the hospital for the treatment until they discharged from the hospital. Based on the patients' medical records, the table 10 shows the test results, at significance level 95% the  $P \geq 0.05$ , we do not reject the null hypothesis, The difference between two groups of hospitalization days, are statistical significant.

*Table 10 Hospital days of the LC group and OC group (unit : day)*

	LC (40)	OC (40)	P
<b>MEAN</b>	<b>6.775</b>	<b>9.675</b>	<b>0.179</b>
<b>SD</b>	<b>2.537</b>	<b>3.347</b>	

4. Recovery time : It means the number of days from the operation until the patients discharged from the hospital. Regarding the review found that the laparoscopic cholecystectomy recovery time is shorter than the open cholecystectomy, because the patients of open surgery need more time to exhaust. According to the patients' medical records, comparing two groups' recovery time, it found that the recovery time among the two groups is statistical significant at 95%. The table 11 shows the test result, the  $P \leq 0.05$ , the null hypothesis was rejected.

*Table 11 Recovery time of the LC group and OC group (unit : day)*

	LC (40)	OC (40)	P
MEAN	3.325	6.65	0.001
SD	0.971	1.63	

5. Episode situation: It means when the patient was admitted to the hospital for clinical diagnosis is acute or chronic disease. The disease episode situation is also affecting the treatment method. Based on the patients' medical records, test statistical difference mean of episode situation of the two groups, at significance level 95%. The  $P \geq 0.05$ , significance level is 95%, we do not reject the null hypothesis. The statistical difference of episode situation of the two groups not has the statistical significant. The table 12 shows the test results.

*Table 12 Episode situation of the LC group and OC group (unit: case)*

	LC (40)	OC (40)	$X^2$	P
ACUTE	15	25	2.74	0.098
CHRONIC	30	10		

6. Therapeutic effect: it means the results of surgery. Based on the patients records information for comparing LC and OC group' therapeutic effect statistical difference. At significance level is 95%, the  $P \geq 0.05$ , do not reject the null hypothesis. The table 15 shows the test result.

*Table 13 Therapeutic effect information of the LC group and OC group*

	LC (40)	OC (40)	$X^2$	P
SUCCESS	29	30	1.74	1.0
FAIL	1	0		



Table 14 Summary of statistics

Classification	Average value (SD)		P Value
	LC (40)	OC (40)	
<b>1. Sex</b>			
Male	17	23	0.5
Female	20	20	
<b>2. Age (year)</b>			
	46.12(16.2)	48.12(16.6)	0.58
<b>3. Hospital days(day)</b>			
	6.78(2.53)	9.68(3.35)	
<b>4. Recovery time(day)</b>			
	3.36(0.97)	6.65(1.63)	0.001
<b>5. Episode situation(Number of case)</b>			
Acute	15	25	0.098
Chronic	30	10	
<b>6. Operation results(Number of case)</b>			
Success	39	1	1.0
Fail	40	0	

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## 5.2 Costs

There are two types of cost, the ward cost and the operation cost. This study is divided accordingly, using the provider's perspective. The data is at the patient-level, which includes the disposable materials costs, pharmacy costs in terms of patients in the ward and in the operation room, as well as general building costs and the equipment costs is in operation room and in the ward of the hospital. Furthermore, the labor cost is also calculated.

According to the objective of this study, this study analyze the treatment costs of all LC and OC groups' patients, so there are the cost of the operation room and ward room.

According to the cost analysis for all patients, disposable materials and drugs were estimated based on the hospital designated standard price. And we calculated the capital cost, including building costs and medical equipment costs, which were purchased in 2010. All capital costs will be converted to the year 2013 using an inflation-adjusting method.

### 5.2.1 Ward cost

#### 1. Materials cost and pharmacy cost

The one-time materials costs and pharmacy costs calculation are displayed in the table below, this part of the cost calculation is used for the price charge ratio according to the patients' payment records.

*Table 15 Disposable materials cost of the two treatments (unit: RMB)*

	LC	OC	Data source
<b>Total cost</b>	47323	34544	Financial department
<b>Unit cost</b>	1183	863	

*Table 16 Pharmacy cost of the two treatments (unit: RMB)*

	LC	OC	Data source
<b>Total cost</b>	130608	102017	Financial department
<b>Unit cost</b>	3265.2	2550.4	

#### 2. Salary cost calculation

The costs of the human resource in the ward are divided into nurse salary and doctor salary. Every level of medical providers can provide health care services to patients. This study takes into account the cost of per patient per day.

Concerning the labor management of hospital, the nurses who work in the ward are managed by the inpatient department, while the ward nurses just provide the medical services to the inpatient needs. The doctors are working in the ward, the outpatient room and the operation room. The nurses' salaries are related to the inpatient department and operation department, which are two independent departments. But the salaries of the doctor include inpatients, outpatients and operation department.

#### 2.1 Salaries of ward nurses

The ward of the surgical department has 20 nurses, there are 20 working days per month, and there is an average of 40 inpatients in the ward per day. So we can take the formulas.

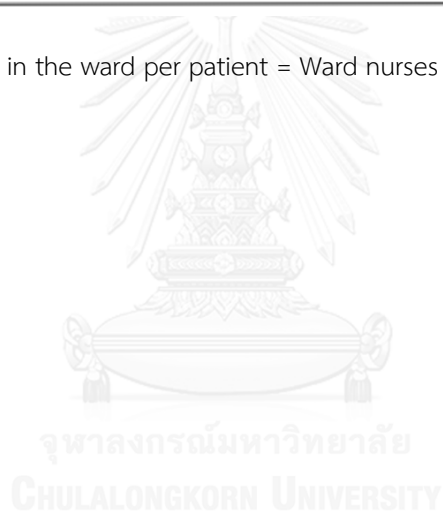
- (1) Total salary of the ward nurses = sum of the average salary per month of 20 nurses in 2013
- (2) Average salary per day of ward nurses = Total salary of the ward nurses / 20
- (3) Average salary per patients per day of ward nurses = Average salary per day of ward nurses / 40

According to the wage in this hospital, the total salary of a nurse is RMB108000, because the ward nurse working days are 20 days per month, so average salary per day is RMB5,400, and there are 40 beds in the ward, so average salary per patient per day of ward nurses is RMB135, According to the hospital days, this study collect salary cost the ward nurses for every patients. More details in the table 19.

Table 17 Salary cost of nurses in ward (unit: RMB)

Steps	Formulas	Results
1. Total salary per month	sum of the 20 nurses salary	108000RMB
2. Average salary per day	$108000/20$	5400RMB
3. Average per patient per day	$5400/40$	135RMB

(4) Salary costs of nurses in the ward per patient = Ward nurses average salary per patients per day \* inpatient days



*Table 18 Total salary costs for nurses in the ward (unit: RMB)*

Patients code	Inpatient days (day)		Salary cost	
	LC	OC	LC	OC
01	5	8	675	1080
02	5	9	675	1215
03	5	4	675	540
04	8	6	1080	810
05	7	9	945	1215
06	6	11	810	1485
07	6	8	810	1080
08	5	3	675	405
09	5	9	675	1215
10	12	5	1620	675
11	4	6	540	810
12	5	7	675	945
13	4	10	540	1350
14	14	13	1890	1755
15	5	7	675	945
16	6	7	810	945
17	7	6	945	810
18	7	6	945	810
19	5	15	675	2025
20	5	4	675	540
21	7	7	945	945
22	7	4	945	540
23	5	6	675	810
24	6	6	810	810
25	14	14	1890	1890
26	4	4	540	540
27	11	7	1485	945

28	5	8	675	1080
29	7	5	945	675
30	7	6	945	810
31	7	7	945	945
32	6	8	810	1080
33	6	7	810	945
34	6	8	810	1080
35	7	9	945	1215
36	6	5	810	675
37	8	20	1080	2700
38	5	7	675	945
39	9	11	1215	1485
40	12	5	1620	675
<hr/>				
Total cost	271	307	36585	48445

## 2.2 Salaries of ward doctors

According to the human resource management system of hospital, the surgical doctors provide medical service 12 days per month in the ward department, 6 days in outpatient department, and 6 days in the operation room. The next paragraph allocates the salary of a physician. There are 22 doctors in this department.

*Table 19 Allocation of total salary of doctors (unit: RMB)*

	Percentage of working day allocation		
	Inpatient	Outpatient	Operation
Total salary of doctors'			
Per month	50%	25%	25%
Working day	12	6	6
132000	66000	33000	33000

Because this study just needs the costs of the operation room and ward room, the salary of doctors in the inpatient department is 66000RMB. The calculation method is same as before with the salaries of nurses in ward room. Hence we have the same formulas and steps as introduced before.

*Table 20 Salary cost of doctors in the ward (unit: RMB)*

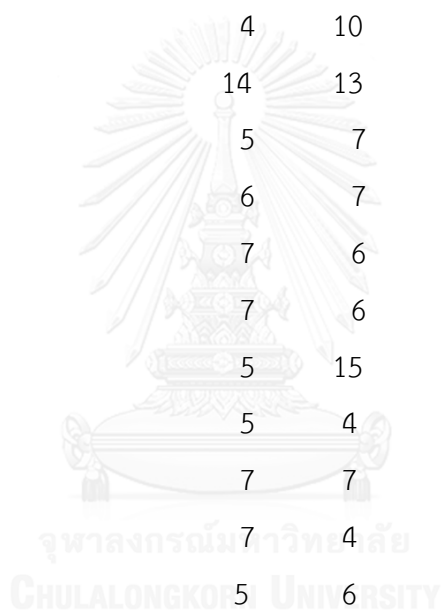
Steps	Formulas	Results
1. Total salary per month	sum of the 22 doctors salary	66000RMB
2. Average salary per day	66000/12	5500RMB
3. Average salary per patients per day	5500/40	138RMB

Salary costs of nurses in the ward per patient = Ward doctors average salary per patients per day\*Inpatient days

*Table 21 Salary cost for doctors in the ward (unit: RMB)*

Patients code	Inpatient days		Salary cost	
	LC	OC	LC	OC
01	5	8	690	1104
02	5	9	690	1242
03	5	4	690	552

04	8	6	1104	828
05	7	9	966	1242
06	6	11	828	1518
07	6	8	828	1104
08	5	3	690	414
09	5	9	690	1242
10	12	5	1656	690
11	4	6	552	828
12	5	7	690	966
13	4	10	552	1380
14	14	13	1932	1794
15	5	7	690	966
16	6	7	828	966
17	7	6	966	828
18	7	6	966	828
19	5	15	690	2070
20	5	4	690	552
21	7	7	966	966
22	7	4	966	552
23	5	6	690	828
24	6	6	828	828
25	14	14	1932	1932
26	4	4	552	552
27	11	7	1518	966
28	5	8	690	1104
29	7	5	966	690
30	7	6	966	828
31	7	7	966	966
32	6	8	828	1104
33	6	7	828	966





34	6	8	828	1104
35	7	9	966	1242
36	6	5	828	690
37	8	20	1104	2760
38	5	7	690	966
39	9	11	1242	1518
40	12	5	1656	690
<hr/>				
Total cost	271	308	37398	42366

*Table 22 Summary of the total salary cost in the ward (unit: RMB)*

<b>Cost</b>	<b>LC</b>	<b>OC</b>
<b>Nurses</b>	<b>36585</b>	<b>48445</b>
<b>Doctors</b>	<b>37398</b>	<b>42366</b>
<b>Total cost</b>	<b>73983</b>	<b>90811</b>

### 3. Medical equipment cost and building costs.

The equipment and building costs in the ward are the capital costs. There are several allocation methods in economic evaluation. In this study, we use the annuity of the equipment and building over their lifetime. This method has many advantages and widely used in health care filed. Concerning the capital costs, the main costs are opportunity costs and depreciation. The annuity method accounts for both costs. According to the data the equipment was purchased in 2010, and the building was constructed in the year 2005. This study calculates the capital costs for the year 2013. The discount rate used was 3.6%, the annual interest rate by the Central Bank of China.

Medical equipment cost

$$C_{2013} = C_t * (1-r)^{2013}$$

Where  $C_{2013}$  = presents the cost of capital in year 2013

$C_t$  = purchase cost of capital in year t (2010)

r = discount rate

t = the year the capital was purchased (2010)

After the conversion from the original value (2010) to the year 2013, this study used the expected lifetime of the medical equipment. According to the hospital's assets book, the lifetime for the hospital equipment is 6 years, while the building has a lifetime of 20 years. The annuity formula and depreciation and capital costs formula is below:

$$A = [1 - (1+r)^{-n}] / r$$

Where A = annuity

r = discount rate (0.036)

n = lifetime of capital for depreciation

$$E = C_{2013} / A$$

Where A = annuity

E = equivalent annual cost

From the financial department of the hospital reported that the cost of the equipment for the depreciation is 628116RMB

Equipment annuity in the ward = 628116RMB

(1) Average capital cost per day = total cost / 365 = 1720RMB

(2) Average capital cost per day per patient = average capital cost per day / average numbers of patients = 1720RMB / 40 = 43RMB

(3) Capital cost of LC=Average capital cost per day per patient\*hospital stays=43\*271=11653RMB

(4) Capital cost of OC=Average capital cost per day per patient\*hospital stays=43\*307=13201RMB

From the financial department of the hospital reported that the cost of the building for the depreciation is 182256RMB.

Building annuity in the ward=182256RMB

(1) Average building cost per day=total cost/ 365 =500RMB

(2) Average building cost per day per patient=average building cost per day/average numbers of patients=500RMB/40 beds=12.5RMB

(3) Building cost in LC=Average capital cost per day per patient\*Inpatient days=12.5\*271=3387RMB

(4) Building cost in OC=Average capital cost per day per patient\* Inpatient days =12.5\*307=3800RMB

*Table 23 Summary of the cost in the ward (unit: RMB)*

Step	Cost type	LC	OC
1	One-time materials cost	47323	34544
2	Pharmacy cost	130608	102017
3	Salary cost	73983	90811
4	Equipment cost	3387	3800
5	Building cost	11653	13201
6	Total ward cost	266954	244373

## 2.2.2 Operation cost

### 1. Materials and pharmacy costs

According to the payment records of patients, we can know one-time materials and pharmacy costs in the operation room.

*Table 24 Disposable materials cost in the operation room (unit: RMB)*

	LC	OC	Data source
<b>Total cost</b>	<b>47323</b>	<b>50962</b>	<b>Financial department</b>
<b>Unit cost</b>	<b>1183</b>	<b>1274</b>	

*Table 25 Pharmacy cost in the operation room (unit: RMB)*

	LC	OC	Data source
<b>Total cost</b>	<b>41863</b>	<b>21769</b>	<b>Financial department</b>
<b>Unit cost</b>	<b>1046.57</b>	<b>544</b>	

### 2. Salary cost

In operation room, salary cost is divided into three types: the operation room nurse, surgery doctors and anesthetists. The nurses and the anesthetists are managed by the operation department, the doctors are managed by inpatient department. This study takes the total salary of one year for the nurses, physicians and anesthetists. When calculate the salary cost of the nurses, physicians and anesthetists in operation room, we assume that they did not differentiate with patients, no matter gallstone or other diseases patients. In others word, the salary is allocated to each patient, the difference is only the operation hour.

*Table 26 HR requirement and operation hours in LC and OC (unit: hour)*

Type	Nurse	Doctor	Anesthetist	hours
LC	1	2	1	2
OC	2	2	1	2

### 2.1 Nurses salary in operation room

The operation room has 45 nurses, the working days are 30 days, according to the operation procedure of the two kinds of operation, the LC only need one nurse and OC use two nurses can operate one case of surgery, so this study calculate the average salary per hour of a nurse, and use the operation time to estimate the nurses salary of two treatments. The working hours are 8 hours per day. So this study takes the formulas as follow.

*Table 27 Salary cost of operation nurses (unit: RMB)*

Steps	Formulas	Results
1. Total salary per month	sum of the 45 nurses salary	157500RMB
2. Average salary per day	$157500/45/20$	175RMB
3. Average salary per patients per hour	$175/8$	21.9RMB
4. Salary input in two treatments	$21.9*1*2(\text{LC})$ $21.9*2*2(\text{OC})$	43.7RMB 87.6RMB

## 2.2 The doctors' salary in operation room.

This study already calculated the doctor's salary in table 12. According to the doctors working time, which are in the inpatients, outpatients and operation department, and allocated salary for doctors in operation time is 21780RMB, the allocation method is the same formula as before (table 9). We need to calculate the average doctors' salary by numbers, and according to the operation procedure, LC need two doctors, OC need two doctors, and the average operation hours are 2 hours, the formulas shown in table 30.



*Table 28 Salary cost of doctors in the operation room (unit: RMB)*

<b>Steps</b>	<b>Formulas</b>	<b>Results</b>
<b>1. Average salary per month</b>	<b>sum salary of 20 doctors</b>	<b>33000RMB</b>
<b>2. Average salary per day</b>	<b>33000/20/6</b>	<b>275RMB</b>
<b>3. Average salary per patients per hour</b>	<b>275/8</b>	<b>34.4RMB</b>
<b>4. Salary input Input in two treatments</b>	<b>34.4*2*2(LC)</b> <b>34.4*2*2(OC)</b>	<b>137.6RMB</b> <b>137.6RMB</b>

## 2.3 The anesthetists' salary in operation room

This cost is also based on input of operation room. The operation room has 28 anesthetists, the work days are 20 days, according to the operation procedure of the two kind of treatments,

they both need one anesthetist for one operation, so this study calculate the average salary per hour of the anesthetist. The working hours are also 8 hours.

*Table 29 Salary cost of anesthetist (unit: RMB)*

Steps	Formulas	Results
1. Average salary per month	sum salary of the 28 anesthetist	126000RMB
2. Average salary per day	$5400/28/20$	225RMB
3. Average salary per patients per hour	$225/8$	28RMB
4. Salary input in two treatments	$28*2*1(LC)$ $28*2*1(OC)$	56RMB 56RMB

*Table 30 Summary of the total salary cost per patient in operation room (unit: RMB)*

Cost	LC	OC
Nurses	43.7	87.5
Doctors	137.6	137.6
Anesthetist	56	56
Total cost	237.3	281.1

(1) Total salary cost in LC= $237.3*40=9492$ RMB

(2) Total salary cost in OC= $281.1*40=11244$ RMB

### 3. The cost of the equipment and building in operation room.

This study used the annuity formula to calculate the depreciation of capital in the operation. There are 20 operation rooms in this hospital. One operation uses one room; one room has same medical equipment which were bought in 2010. So this study assumes that every patient uses two hours of the depreciation. It is the same for every treatment except for the laparoscopic surgery. In laparoscopic surgery we need to calculate the depreciation of machine per month and calculate the average cost of machine per patient per hours.

(1) Average capital cost per hour=total capital cost per month/(30\*8)

(2) Average capital cost for per patient=Average capital cost per hour\*2 hours

*Table 31 Operation room capital cost per patient in LC (unit: RMB)*

Steps	Formulas	Results
1.1 Average equipment cost per hour	$34075 / (30 * 8)$	141RMB
1.2 Average equipment cost per patients	$141 * 2$	282RMB
2.1 Average building Cost per hour	$41130 / (30 * 8)$	171RMB
2.2 Average building Cost per patients	$171 * 2$	342RMB
3.1 Average laparoscopic Machine cost per hour	$8400 / (30 * 8)$	35RMB
3.2 Average laparoscopic Cost per patient	$35 * 2$	70RMB



Table 32 Operation room capital cost per patient in LC (unit: RMB)

Steps	Formulas	Results
1.1 Average equipment	$34075 / (30 * 8)$	141RMB
Cost per hour		
1.2 Average equipment cost	$141 * 2$	282RMB
Per patients		
2.1 Average building	$41130 / (30 * 8)$	171RMB
Cost per hour		
2.2 Average building	$171 * 2$	342RMB
Cost per patients		
<b>Total cost</b>		<b>624RMB</b>

(1) Total capital cost of LC =  $694 * 40 = 27760$ RMB

(2) Total capital cost of OC =  $624 * 40 = 24960$ RMB

Table 33 Summary of the cost in operation room (unit: RMB)

Step	Cost type	LC	OC
1	One-time materials cost	47323	50962
2	Pharmacy cost	41863	21769
3	Salary cost	9492	11244
4	Building and equipment cost	27760	24960
5	Total ward cost	126438	108935

*Table 34 Summary of the cost in two treatments (unit: RMB)*

Step	Cost types	LC	OC
1	Ward room	266954	244373
2	Operation room	126438	108935
3	Total cost	393392	353308

### 5.3 Complication cost

The total costs include the no-complication cost and the complication cost. This study does not perform the calculation process of the complication cost. However, the capital cost, drugs cost and salary cost can be estimated from the total cost, the result shown in the table 37.

*Table 35 The total cost of complication treatment (unit: RMB)*

	Total cost
LC	3784
OC	1098

### 5.4 Effectiveness

This study uses the immediate and medium-term outcome to calculate effectiveness. The numbers of patients that do not have any complications in the two treatments over the total number of operations is the short-term effectiveness, and the surgical sequelae rate is the medium-term effectiveness.

According to the collected data, the effectiveness of patients of LC is 37 with the rate of no complications being  $37/40=92.5\%$  and the effectiveness of patients of OC is 39, so the rate of no complications is  $39/40=97.5\%$ .

**Table 36 Summary of the types of complications (immediate outcomes) in two groups**

	Name	Type	LC	OC
No complication			37	39
Complication	Puncture infection	postoperative	1	
	Rupture of bile duct	intraoperative	2	
	Infection of incisional	postoperative		1
Total number			40	40

About the medium-term effectiveness, according to the patients' history record and feedback over telephone, there are 6 patients that had surgical sequelae after the laparoscopic surgery and 4 patients that had surgical sequelae after the open surgery. So the surgical sequelae rate in laparoscopic is 15%, and the open surgery is 10%. However, this result is only for two years after the surgery, and it is necessary to follow up on all the patients after at least five years. Some of the patients are young now, after several years they may be experiencing surgical sequelae. However, because of the limitation of the database, there is just data of the 2-year follow up. So this study adds the sensitivity analysis to find more effectiveness in the medium-term, and get the more convincing results.

### 5.5 Cost-Effectiveness analysis

On the basis of this study definition of cost-effectiveness analysis, this evaluation aims to calculate the average cost of each treatment result no complication and average cost of each surgical sequelae rate.

1 dollar  $\approx$  6.2 RMB (2013)

This study gets the results:

1. Unit cost

LC=393392 /40=9834.8RMB $\approx$ \$1586

OC=353308 /40=8832RMB $\approx$ \$1425

2. Unit cost of no complication

LC=389608/40=9740RMB $\approx$ \$1571

OC=352210/40=8805RMB $\approx$ \$1420

3. Unit cost of complication

LC= 3784/3=1261 $\approx$ \$203

OC =1098/1=1098 $\approx$ \$177

4. Cost-effectiveness analysis (CEA)

LC=393392/92.5%=4252.88RMB $\approx$ \$685.95

OC=353308/97.5%=3623.67RMB $\approx$ \$584.46

Therefore, in laparoscopic cholecystectomy, the CEA ratio=\$685.95. In open cholecystectomy, the CEA ratio=\$584.46.

According to the results, the OC has the fewer ratios, so the open cholecystectomy is the more cost effectiveness than laparoscopic cholecystectomy.

## 5.6 Sensitivity analysis

This study uses the discount rate to perform sensitivity analysis, because the samples of this study is only 80 patients, not a large sample, so using the discount rate for sensitivity analysis

can achieve more information and the changes of the results. When we calculate the capital cost we use the annual interest rate as the discount rate that is 3.6%, so when we do sensitivity analysis we increase or decrease the rate for 10%,and recalculate the total cost and test the stability of the result.

(1)The total cost when discount rate decreasing 10% ( unit: RMB)

$$LC= 389112\text{RMB}\approx\$62760$$

$$OC=349166\text{RMB}\approx\$56317$$

(2)The total cost with discount rate increasing 10 %( unit: RMB)

$$LC=397672\text{RMB}\approx\$64140$$

$$OC=357558\text{RMB}\approx\$57670$$

CEA result with the range of the lower discount rate and higher discount rate. The result are converted to US dollar.

(3)Lower value

$$CEA_{LC}=62760/92.5%=\$678.5$$

$$CEA_{OC}=56317/97.5%=\$577.6$$

(4)Higher value:

$$CEA_{LC}=64140/92.5%=\$693.4$$

$$CEA_{OC}=57670/97.5%=\$591.5$$

According to the sensitivity analysis of the two range of the discount rate, there are no differences from the results of the original database. The open cholecystectomy is the more cost effective method to treat the cholelithiasis and gallstone disease.

## 5.7 Discussion

1. There were many papers regarding the study of the laparoscopic cholecystectomy versus open cholecystectomy in clinical field. The differences are on method of these studies that some outcomes used the view of clinical outcomes while others used the view of patient expense, however based on these previously studies, the results of outcomes were similar to some extents. The similar aspects are the costs; most of the researches hold the views that the laparoscopic is more expensive than the open surgery in short term. This study analysis reveals that whether short term or medium term outcomes, the cost of LC is higher than cost of OC, and the samples of the hospitals showing that there is not much difference outcomes between these two treatment methods.

Moreover, from the review, the different aspect is the effectiveness, the results of more than 80% references shown that the laparoscopic cholecystectomy is more effectiveness than open cholecystectomy, the results reflect from the aspects of hospital days, complication situation, and recovery time. With the development of the national economics and the increasing income of people, the demand of high quality treatment from the patients is increasing in accordance, many reasons also affect the decision of the doctors how to provide treatment methods. Therefore, there are a lot of other factors needing consideration.

In this study, we use the number of no complication and the surgical sequelae rate. The hospital days, age of patients, episode situation, gender, and recovery time are not the applicable index. The results of this study have some limitations. The surgical sequelae rate is not complied with the request of the follow up time; 2-years surgical sequelae rate is not stable as well.

2. Cost of salary in the ward, in terms of the salary cost calculation, this study not only use the number of patients as the index but also use the hospital days and operation hours as

calculation approach. There is one assumption that is the doctors and nurses have the same conscious for each patient, in other word, the hospital spends the same human resources and health care services on each patient respectively. In fact, they cannot provide the same services for each patient totally.

3. Comparing with the other effectiveness, this study take one aspect of effectiveness into account, according to medical knowledge, the operation results are affected by some other aspects as well. Because of the advantages of LC, which would recovery in short time and the miniature wound, with the development of the medical technology in recently years, patients prefer to enjoy more comfortable treatment, therefore, lots of uncontrolled reasons will affect the effectiveness.

#### **5.8 Limitation of the study**

1. This study only includes 80 patients from one hospital; it is the limitation of the database, so the sample size is small. This study includes the labor costs and capital costs, because they have the directly relation with the two treatment methods. However, it does not include other indirect costs, such as overhead costs and laboratory costs. So the cost analysis of the study has some limitations.

2. This study analyzes the medium outcome of a 2-years surgical sequelae rate, but if we use the standard 5-years or 10-years, the surgical sequelae rate may change. Hence, this study's research may have a larger significance if a longer following period of 5 or 10 years would be selected.

3. The CEA ratio of medium-term could not be collected; only the medium-term outcomes were estimated. The costs of the surgical sequelae is difficult to collect, this is another limitation of this study.

## CHAPTER VI

### CONCLUSION AND SUGGESTION

#### 6.1 Conclusion

Cholelithiasis and gallstone disease is a common disease of the human being. At present, the population of adults suffering from cholelithiasis accounted for 10%-15% in some areas of China, and the incidence rate is increasing year by year with the changing of lifestyle and diet. Although the cholelithiasis and gallstone disease has a low mortality rate, but it is also a heavy burden to the patient and society.

In the clinic, there are mainly two treatment methods to cure this disease: LC and OC. Each method has their own advantages and disadvantages. So in this study we used the economic evaluation method to compare the effect of the two treatments. The CEA is a method of the economic evaluation in health care system, it can estimate a more comprehensive and accurate results of the effect of two treatment methods. In this study we calculate the CEA ratio, and the result can guide the doctor and patients make the treatment decisions.

According to the comparison of the two cost-effectiveness results, which are short-term (complication rate) and medium-term (surgical sequelae), this study concludes that open surgery is the more cost-effective for the treatment for gallstone.



*Table 37 Conclusion of the comparison between the two treatments*

	LC	OC	Outcomes
No. of patients	40	40	
Total cost	\$63450	\$56985	
Unit cost	\$1586	\$1425	
Immediate outcome	27	29	no complication rate
CEA ratio	\$686	\$584	
Medium outcome	34	36	surgical sequelae
Effectiveness ratio	85%	90%	

## 6.2 Policy suggestion

1. For hospital, the result of this study can show which treatment method is more cost-effectiveness. This study results showed that the open cholecystectomy for hospital is the more cost effectiveness treatment for the gallstone patients.

2. Policy recommendations for hospital. The two treatments could be technically improved and the patients could be more rationally allocated which would improve the utilization of the health care resources.

In conclusion, the cost-effectiveness analysis of this study not only pays attention to the contribution of the benefits of the clinical effectiveness, but also considers the monetary perspective. Thus, this study results are benefit to both of hospitals and patients. The hospital can provide some rational suggestions to patients how to choose the better treatment.

### 6.3 Suggestion for further study

1. In the cost-effectiveness analysis, we should have more samples to ensure the validity of the result. This study has limitation in collecting the samples, therefore only 80 samples were selected, and so some types of complication did not occur after surgery, we need to collect more samples in the surgical period of time.

2. This paper based on one hospital data. However many hospitals have carried out laparoscopic surgery in Inner Mongolia now. So we can choose a number of hospitals to perform the cost-effectiveness analysis and comparing the different influence factors among them.

3. The study did not calculate the long-term effectiveness. Because it was not able to calculate the treatment cost of the surgical sequelae. So it is necessary to follow up the patients and collect the treatment cost of surgical sequelae after five years or ten years.

4. This study used the provider perspective and collects the cost from hospital. But if we choose the patient perspective maybe the CEA ratio would change, and in fact if the patient can choose the treatment method by themselves, most of person prefers to choose the LC, because it has less pain and small wound compare to OC even though it costs more for the patients.

## REFERENCES



Fitzgerald JEF, Fitzgerald LA, Maxwell-Armstrong CA, Brooks AJ

(2009). "Recurrent gallstone ileus: time to change our surgery?".

Journal of Digestive Diseases 10 (2): 149–151. doi:10.1111/j.1751-

2980.2009.00378.x. PMID

Laura M. Stinton and Eldon A. Shaffer“ Epidemiology of Gallbladder

Disease: Cholelithiasis and Cancer”Gut Liver. 2012 Apr; 6(2): 172– 187.2012 Apr 17

Center for Disease Control and Prevention of China Published data in2010

Panliuyong,Research progress in the treatment of gallstone.China

Medicine and Pharmacy, NO:17th,2011

Wangfurong .An analysis of the effect of laparoscopic cholecystectomy in the treatment of gallstones.Contemporary medicine,March 2013

Csendes A, Burdiles P, Maluenda F, Diaz JC, Csendes P, Mitru N, Arch

Surg. 1996;131(4):389Simultaneous bacteriologic assessment of bile from gallbladder and common bile duct in control subjects and patients with gallstones and common duct stones.

Disease Control and Prevention Center of Inner Mongolia Published data

in 2010

Luowenyong,Lizhenya,Linyongping,Wuhua,Clinical effect analysis of

laparoscopic minimally invasive treatment of gallstones,NO:7,2014

DOI10.14164/j.cnki.cn11-5581/r.2014.07.119

Zhangchenguang, Liyueping, NO:13 Medical Recapitulate.Application

of traditional Chinese medicine in the prevention and treatment of

gallstones.Cuixiaopeng,Fanyong,Clinical analysis of laparoscopy

combined with bile duct endoscopy in the treatment of patients with gallstones,Chongqing Medicine, NO:24,2013

Zhangjieying,Wangyong,Clinical effect of laparoscopic operation in the

treatment of elderly patients with gallstones, NO:2,2014,China Modern Doctor, **【DOI】**

R657.42

Zouyonggui,Clinical effect of laparoscopic cholecystectomy and open

surgery in the treatment of gallstones,NO:12,2012,Seek Medical and Ask the Medicine

**【DOI】** R657.4

Sunying,Yangzhanlan,Research Progress on the composition and

formation. 2001.Science in China,Ser.B,mechanism of gallstones,

**【DOI】** R575.6

Qiaotie,Maruihong,Research Progress on classification of

gallstones,NO:16,2014, Science & Technology . **【DOI】** R657.4

Drummond, Michael; Sculpher, Mark; Torrance, George; O'Brien, Bernie;

Stoddart,Greg (2005). Methods for the Economic Evaluation of

Health Care Programmes (3 ed.). New York: Oxford University

Press. ISBN 9780198529453.

National Institute for Health and Care Excellence. Guide to the methods of technology appraisal

2013

Bleichrodt H, Quiggin J (December 1999). "Life-cycle preferences over

consumption and health: when is cost-effectiveness analysis equivalent to cost-benefit

analysis?". J Health Econ 18 (6): 681–708. doi:10.1016/S0167-6296(99)00014-4. PMID

10847930.

- Quinlan, J. R. (1987). "Simplifying decision trees". International Journal of Man-Machine Studies 27 (3): 221. doi:10.1016/S0020-7373(87)80053-6. C\_Oh, MC Schweitzer. Skeletal Radiology, 1999, 28(12):670-678.
- Tanxiaoming, Xiangqian, Clinical analysis of laparoscopic cholecystectomy and open cholecystectomy, 2014, Chinese general practice.
- Wangyuehua, Vol.20 No.8 Aug 2011. How to choose laparoscopic cholecystectomy or gallbladder stone removal for patients who with gallstone. Chinese Journal of General Surgery.
- Laurence E. MoCahill, M.D., Carlos A. Pellegrini, M.D. et al. (1996) Clinical outcome and cost analysis of laparoscopic versus open appendectomy [J]. The American Journal of Surgery, 171(5):503-506
- L. William Traverso, M.D., Kent Hargrave, B.A. (1995) A prospective cost analysis of laparoscopic cholecystectomy. [J]. The American Journal of Surgery, 169 (5) : 533-537
- Zengshu XING, Yajun XIAO et al. (2011) A comparison of the clinical effects between retroperitoneal laparoscopic and open partial nephrectomy for the treatment of renal tumor. Journal of Clinical Urology, 26(12):890-891
- M. Johansson, A. Thune, L. Nelvin (2005) Randomized clinical trial of open versus laparoscopic cholecystectomy for acute cholecystitis British Journal of Surgery 6 DEC 2004 DOI: 10.1002/bjs.4836

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