COST EFFECTIVENESS ANALYSIS EXAMPLES

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EXAMPLE 5.2 COST EFFECTIVENESS ANALYSIS

Theoretical economic evaluation of management of anemia in hemodialysis patients

Patients with chronic renal failure who are on hemodialysis suffer from profound anemia, which is often extremely debilitating.

This is due to a reduction in their production of erythropoietin and loss of blood during hemodialysis. Historically, these patients have been managed by the use of **blood transfusion**.

EXAMPLE 5.2 COST EFFECTIVENESS ANALYSIS

Now, **synthetic erythropoietin** is available which is considered to be highly effective but very expensive.

So, the alternative are either to give erythropoietin or to give blood transfusion when the hemoglobin level of the patients is below 8gm/dl.

EXAMPLE 5.2 COST EFFECTIVENESS ANALYSIS

Effectiveness data for the two alternatives available from the literature suggest that each intervention can maintain haemoglobin levels above 8g/dl

- erythropoietin for 91% of the year
- blood transfusions for 76% of the year

EXAMPLE 5.2 COST EFFECTIVENESS ANALYSIS

The effectiveness measure used here is the percentage time spent with a hemoglobin level above 8gm/dl.

In this exercise, you will carry out an economic evaluation of the management of anemia in chronic renal failure patients.

EXAMPLE 5.2 COST EFFECTIVENESS ANALYSIS

Assume that the economic evaluation is taking the perspective of the health care provider.

You have 1000 dialysis patients who would be eligible for erythropoietin.

EXAMPLE 5.2 COST EFFECTIVENESS ANALYSIS

You have the following cost information for the two alternatives:

Cost of administration of erythropoietin

The average dose 200IU per Kg subcutaneously per week in 3 divided doses.

Using prefilled syringes, this cost **£106.65 per week per patient**.

EXAMPLE 5.2 COST EFFECTIVENESS ANALYSIS

Occasionally, patients have influence type reactions, an increase in **blood pressure** or a **hypertensive crisis**. The incidence and cost of managing these events are giving below.

	Influenza type reaction	Increased blood pressure	Hypertensive crisis
Incidence (patients per year)	1 per 10	1 per 10	1 per 500
Cost of management (£)	1.0	0	600

EXAMPLE 5.2 COST EFFECTIVENESS ANALYSIS

Cost of blood transfusion

Patients whose anemia is managed by blood transfusions have, on average, two transfusions per months. Each transfusions is typically two units of blood.

Cost per transfusions = cost of blood + cost of administration

= **£ 130**

EXAMPLE 5.2 COST EFFECTIVENESS ANALYSIS

Occasionally patients have **allergic reactions**, an **increase in blood pressure**, or **iron overload**. The incidence and cost of managing these events are giving below.

	Allergic reactions	Increased blood pressure	Iron overload
Incidence (patients per year)	1 per 100	1 per 10	1 per 100
Cost of management (£)	400	0	400

EXAMPLE 5.2 COST EFFECTIVENESS ANALYSIS

For each alternative, answer the following questions:

1. What are the direct costs to the healthcare provider?

- Cost of treating with erythropoietin: acquisition costs, administration costs, management of side effects.
- Costs of treating with transfusions: acquisition costs, administrations costs, management of side effects.

EXAMPLE 5.2 COST EFFECTIVENESS ANALYSIS

2. What are **indirect costs** and to whom **do they accrue**?

Cost to society of "knock on" consequences in terms of **lost productivity** (i.e. patients cannot work while ill or being treated): time off work while having blood transfusions.

3. What are **intangible costs** and to whom **do they accrue**?

These are costs that are hard to measure in monetary terms, e.g. the **anxiety** associated with having a blood transfusion, **fear of needles**, **social stigma**.

EXAMPLE 5.2 COST EFFECTIVENESS ANALYSIS

4. How much would it cost to manage the 1000 patients for 1 year using blood transfusions?

Transfusion costs per patient per annum:

$$(£130 \times 2) \times 12 = £3,120$$

Transfusion costs per 1000 patients per annum: £3,120,000

Side-effect costs per 1000 patients per annum:

$$(10 \times £400) + (100 \times 0) + (10 \times £400) = £8,000$$

Therefore, total costs per annum: £ 3,128,000

EXAMPLE 5.2 COST EFFECTIVENESS ANALYSIS

5. How much would it cost to manage the 1000 patients for 1 year using erythropoietin?

Erythropoietin costs per patient per annum:

£106.65 × 52 = £5,545.80

Erythropoietin costs per 1000 patients per annum: £5,545,800

Side effect costs per 1000 patients per annum:

(100 × £1) + (100 × 0) + (2 × £600) = £1,300

Therefore, total costs per annum: £5,547,100

EXAMPLE 5.2 COST EFFECTIVENESS ANALYSIS

6. What is the difference in cost of the two alternatives for the 1000 patients?

5,547,100 - £3,128,000 = £2,419,000

7. What is the difference in effectiveness of the two alternatives for the 1000 patients?

Erythropoietin keeps the Hb level over 8gm/dl for **15%** more of the year than do **blood transfusions**:

54.75 days per patient per year

=**54750 days** per **1000 patients** per year

EXAMPLE 5.2 COST EFFECTIVENESS ANALYSIS

8. What is the implicit assumption being made by the use of this outcome measure?

This is an intermediate measure of outcome.

The assumption is that this is a desirable outcome because the reversal of anemia will increase the patient's energy levels and hence their quality of life.

EXAMPLE 5.2 COST EFFECTIVENESS ANALYSIS

9. Calculate an incremental cot-effectiveness ratio for erythropoietin.

$$\text{ICER} = \frac{\text{Change in cost}}{\text{Change in outcome}}$$

$$= \frac{£2,419,100}{54\,750}$$

$$= £44.2 \text{ per extra day of Hb over } 8\text{g/dl.}$$

EXAMPLE ONE

To illustrate the differences between the simple/average and incremental C/E ratios, the following example presents two treatments as follows:

- Treatment One (a baseline comparator) **costs $500** to treat 100 patients
- Treatment Two (a new innovation) **costs $750** to treat 100 patients

EXAMPLE ONE

The effectiveness measure is a final outcome (i.e., cure rate)

95% of the patients are cured with **Treatment One**

97% of the patients are cured with **Treatment Two**

Example One

Calculating Average/Simple and Incremental Cost-Effectiveness (C/E) Ratios

Given:

Treatment One

total cost to treat 100 patients = $500

effectiveness = 95% cure rate

Treatment Two

total cost to treat 100 patients = $750

effectiveness = 97% cure rate

Computations:

1. What is the average/simple C/E ratio for each therapy?
2. What is the incremental C/E ratio comparing Treatment One versus Treatment Two?

Solution: Average/simple C/E ratio

Treatment One

500/0.95 = $526.32 average cost per cure

Treatment Two

750/0.97 = $773.20 average cost per cure

Difference = $246.88

Solution: Incremental C/E ratio

Treatment One vs Two

(750–500)/(0.97–0.95) = $12,500 per additional cure to use Treatment Two

EXAMPLE ONE

Calculating the average C/E ratio yields a relatively small difference between the average costs to treat the patient groups between the two alternatives, **$246.88**.

However, an incremental analysis finds the cost of **Treatment Two** to be substantially higher, costing $**12,500 to obtain one additional cure.**

Example Two

A Dominant Strategy

Given:

New Treatment Option

total cost of treatment	= $7,000
percent of patients with no adverse events	= 70%

Usual Medical Care

total cost of treatment	= $7,500
percent of patients with no adverse events	= 50%

Computations:

1. What is the average/simple C/E Ratio for each option?
2. What is the incremental C/E ratio comparing the new treatment versus usual medical care?
3. Where would the new treatment be placed on the cost-effective plane?

Solution: Average/simple C/E ratio

New Treatment Option

7,000/0.70 = $10,000 average cost per successfully treated patient

Usual Medical Care

7,500/0.50 = $15,000 average cost per successfully treated patient

Solution: Incremental C/E ratio

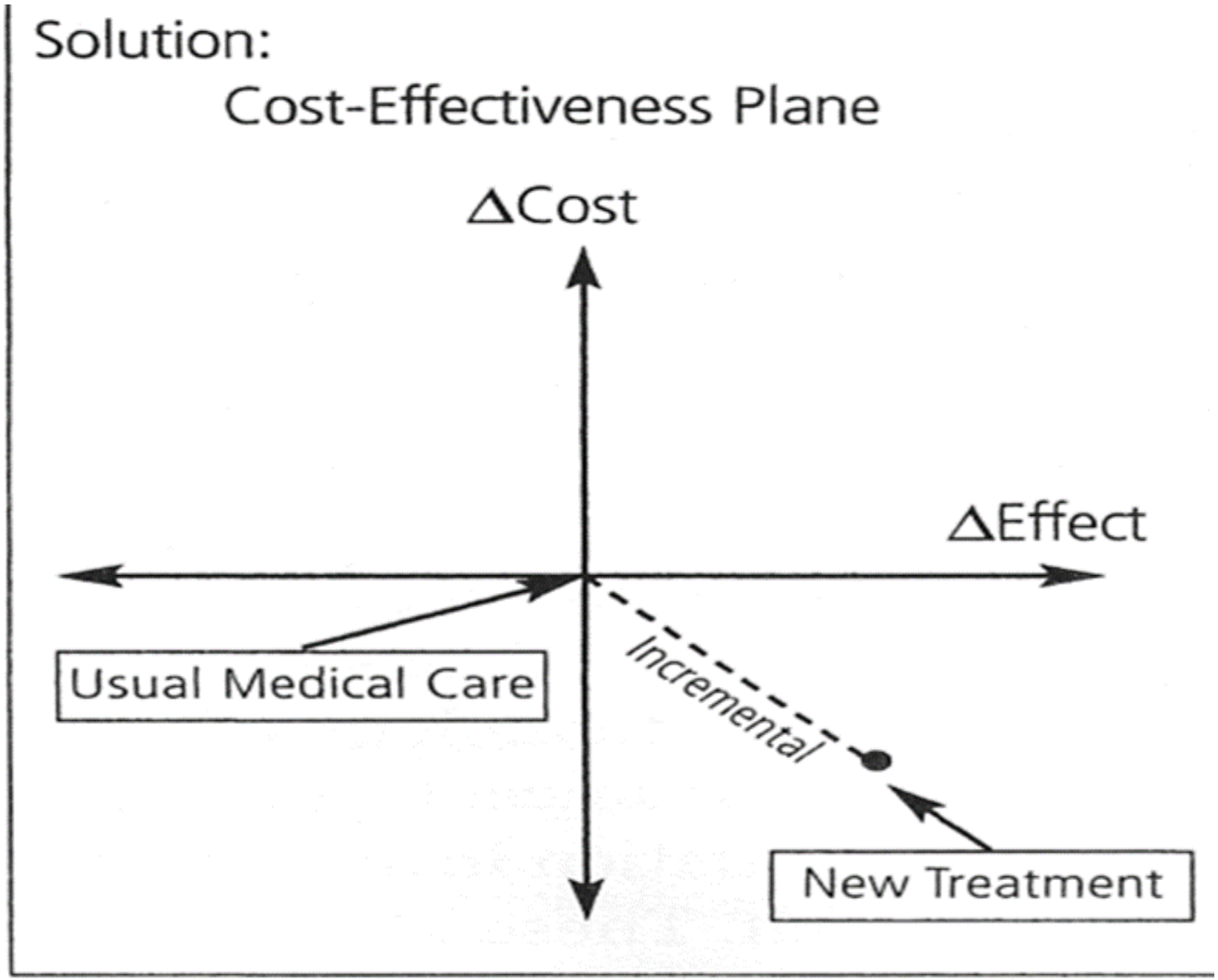
New Treatment Option vs Usual Medical Care

(7,000–7500)/(0.70–0.50) = –$2,500

{The new treatment option offers decreased cost and increased effectiveness (ie, dominant strategy), yielding a negative ICER}

Solution:

Cost-Effectiveness Plane



EXAMPLE THREE

Several treatment exist to treat **fungal toenail infections**. Four oral medicines used are drugs A, B, C, and D. the table below shows the costs (£)associated with **treating one patient** with each of these four treatments:

	Drug A	Drug B	Drug C	Drug D
Total costs (£)	1,301	1,503	1,570	1,200

EXAMPLE THREE

If you were then given the following effectiveness information about drugs C and D for a **population of 100 patients**, which of these two treatment would you choose?

Agent	Efficacy in treating fungal toenail infection
Drug C	90%*
Drug D	80%*

*Significant difference in efficacy

EXAMPLE THREE

$$\text{ICER for drug C} = \frac{\text{Cost (drug C)} - \text{Cost (drug D)}}{\text{Outcome (drug C)} - \text{Outcome (drug D)}}$$

$$= \frac{1,570 - 1,200}{10} = \frac{370}{10} = \frac{100(1,570 - 1,200)}{90 - 80} = \frac{37,000}{10}$$

= £3,700 per extra successfully treated case.

Either could be recommended, depending on the driving force for the choice. Is cost containment most important? Then choose drug D. Is improved patient outcome most important? Then choose drug C.

EXERCISE 2: Calculating an ICER

You have the following information from a trial:

	Anaesthetic A	*Anaesthetic B*
Number of patients	220	220
Drug costs per patient (£) (includes costs of anaesthetics **and** drugs used to treat nausea and vomiting)	12.0	25.0
Disposable equipment costs (needles, syringes, etc.) per patient (£)	3.0	2.0
Mean duration of operation (min)	24	30
Staff costs (£/h)	70	70
Operating theatre overheads (lighting, heating, etc.) (£/h)	80	80
Number of patients who **do not** experience nausea or vomiting	180	200

EXERCISE

Calculate the following for anesthetic A and for anesthetic B:

1. Total cost per group.
2. Incremental cost effectiveness ratio between anesthetics A and B.

Answer

Question	Anesthetic A	Anesthetic B
1.	£16,500	£22,440
2.	£297 per nausea/vomiting episode avoided	

EXERCISE

3. Draw a cost-effectiveness plane and place the ICER you have calculated on that graph. You should have a point plotted in the northeast quadrant.

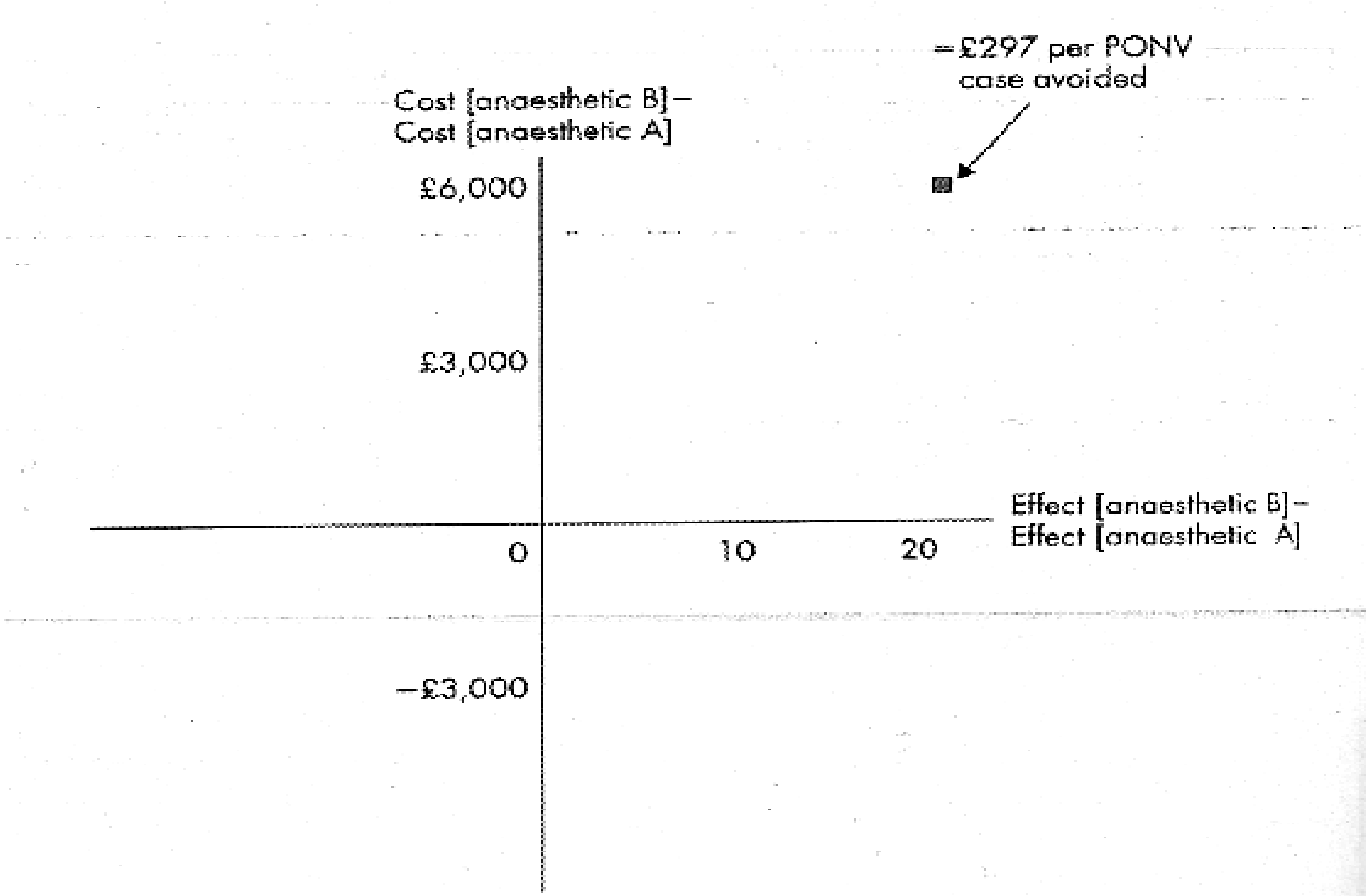


Figure 5.9 Cost-effectiveness plane for anaesthetic A *vs* anaesthetic B. PONV, postoperative nausea and vomiting.


THANKS!