Establishing Robust and Adaptive Willingness-to-Pay Thresholds for Taiwan's National Health Insurance: A Case Study of Non-Small Cell Lung Cancer

EE415

Hsin-Hsuan Wang[1], Chen-Yi Yang[2], Huang-Tz Ou[1,2]

[1]Institute of Clinical Pharmacy and Pharmaceutical Sciences, College of Medicine, National Cheng Kung University, Tainan, Taiwan
[2]Department of Pharmacy, College of Medicine, National Cheng Kung University, Tainan, Taiwan

Introduction

The WHO-CHOICE guideline recommends setting willingness-to-pay (WTP) thresholds at one to three times a country's gross domestic product (GDP) per capita. However, empirical evidence suggests that actual thresholds are often lower. With cancer being the leading cause of death in Taiwan, and non-small cell lung cancer (NSCLC) accounting for the highest cancer-related mortality and medical expenditure, there is an urgent need to define a context-specific WTP threshold.

Objective

To establish robust WTP thresholds from the perspective of Taiwan's National Health Insurance Administration (NHIA) using advanced modelling approaches illustrated by real-world cases of NSCLC.

Method

Database

This study employed a two-step modeling approach using Taiwan's National Health Insurance Research Database (NHIRD) in 2013-2022.

Study design

- **Study Perspective**: Third-party payer
- **Study Population**: Patients with a diagnosis record of NSCLC from NHIRD
- **Two-step modeling approach**:

Step 1 Estimating the **elasticity** of **health outcomes** with respect to **health expenditures** by regression based model

Equation (1) : ln (Hi) = βi ln (Ei) + εi

Hi: total life years Ei: total healthcare costs
βi: elasticity εi: disturbance term

Step 2 Calculating **cost per life year gained** (**WTP threshold**) from the estimated elasticity

Equation (2) : Total LYs gained (attributable to a 1%-increase in total healthcare costs spent) = 1% × |βi| × total LYs gained

Equation (3) : Cost per LY gained = [(1% of total healthcare costs)/(Equation (2))]

Analysis version

- Base-case analysis
- Scenario Analysis 1: **Covariate Adjustment**
- Scenario Analysis 2: **Instrumental variable (IV) Adjustment**
  - ➢ Using the two-stage least squares (2SLS) method to address endogeneity issues.
- Scenario Analysis 3: **Covariate & IV adjustment**
- Scenario Analysis 4: Change the health outcome from "Life year" to "quality-adjusted life year (**QALY**)," and then repeat the base-case analysis and scenario analyses 1–3.
- Scenario Analysis 5: **Novel Therapy Reimbursement**
  - ➢ Study population: Patients diagnosed with ≥ stage III NSCLC between 2019-2021.
  - ➢ Include both "Life year" and "QALY" as health outcomes, and then re-run the base-case analysis and scenario analyses 1–3.

Results

Figure 1: Estimated WTP Threshold Results (Life Years as Dependent Variable; General Drug Market)

Version	β coefficient (95% CI)	Cost per LY gained	WTP threshold (USD) (95% CI)	% of GDP per capita (95% CI)
Base-case analysis	**0.7943** (0.7816–0.8069)	448,054.19	19,096.78 (18,796.55–19,406.76)	**0.5817** (0.5726–0.5912)
Scenario 1: covariate adjustment	**0.8001** (0.7844–0.8158)		18,957.73 (18,592.89–19,337.18)	**0.5775** (0.5664–0.5891)
Scenario 2: IV adjustment	**1.4351** (1.4192–1.4510)		10,568.87 (10,453.16–10,687.17)	**0.3220** (0.3184–0.3256)
Scenario 3: covariate & IV adjustment	**1.0933** (1.0740–1.1126)		13,873.19 (13,632.20–14,122.86)	**0.4226** (0.4153–0.4302)

Figure 2: Estimated WTP Threshold Results (QALYs as Dependent Variable; General Drug Market)

Version	β coefficient (95% CI)	Cost per QALY gained	WTP threshold (USD) (95% CI)	% of GDP per capita (95% CI)
Base-case analysis	**0.7991** (0.7863–0.8119)	559,941.30	23,722.24 (23,348.10–24,108.56)	**0.7226** (0.7112–0.7344)
Scenario 1: covariate adjustment	**0.8013** (0.7856–0.8170)		23,655.50 (23,202.00–24,127.07)	**0.7206** (0.7068–0.7350)
Scenario 2: IV adjustment	**1.4735** (1.4575–1.4894)		12,864.43 (12,726.65–13,005.23)	**0.3919** (0.3877–0.3962)
Scenario 3: covariate & IV adjustment	**1.0933** (1.0740–1.1126)		17,337.56 (17,037.06–17,648.85)	**0.5281** (0.5190–0.5376)

Figure 3: Estimated WTP Threshold Results (Life Years as Dependent Variable; New Drug Market)

Version	β coefficient (95% CI)	Cost per LY gained	WTP threshold (USD) (95% CI)	% of GDP per capita (95% CI)
Base-case analysis	**0.9477** (0.9318–0.9636)	927,331.84	33,124.93 (32,579.00–33,689.46)	**1.0091** (0.9924–1.0263)
Scenario 1: covariate adjustment	**0.8071** (0.7880–0.8263)		38,893.05 (37,993.83–39,835.87)	**1.1848** (1.1574–1.2135)
Scenario 2: IV adjustment	**1.7646** (1.7338–1.7954)		17,790.18 (17,484.83–18,106.38)	**0.5419** (0.5326–0.5516)
Scenario 3: covariate & IV adjustment	**1.3484** (1.3179–1.3790)		23,280.54 (22,764.64–23,820.37)	**0.7092** (0.6935–0.7256)

Figure 4: Estimated WTP Threshold Results (QALYs as Dependent Variable; New Drug Market)

Version	β coefficient (95% CI)	Cost per QALY gained	WTP threshold (USD) (95% CI)	% of GDP per capita (95% CI)
Base-case analysis	**0.9648** (0.9489–0.9807)	1,229,553.55	43,141.52 (42,442.12–43,864.35)	**1.3142** (1.2929–1.3362)
Scenario 1: covariate adjustment	**0.8080** (0.7889–0.8270)		51,515.07 (50,327.82–52,759.68)	**1.5693** (1.5331–1.6072)
Scenario 2: IV adjustment	**1.7906** (1.7597–1.8215)		23,245.30 (22,850.78–23,653.69)	**0.7081** (0.6961–0.7206)
Scenario 3: covariate & IV adjustment	**1.3470** (1.3165–1.3775)		30,900.61 (30,216.21–31,616.74)	**0.9413** (0.9205–0.9631)

Conclusions

We demonstrated a practical modeling framework to derive robust and adaptable WTP thresholds relevant to universal healthcare settings, illustrated using NSCLC populations. Incorporating various clinical and policy scenarios along with routine updates ensures broader applicability and enhances the transparency of reimbursement decision-making.

Abbreviations: CI, confidence interval.