Lung Cancer Related Spillover Effect on Family Member's Health-Related Quality of Life: A US-based Empirical Analysis

Suning Zhao, MPH[1] , Ruixi Yu, MA[1] , Boshen Jiao, MPH, PhD[1]

[1]Alfred E. Mann School of Pharmacy and Pharmaceutical Sciences, University of Southern California, Los Angeles, CA, USA

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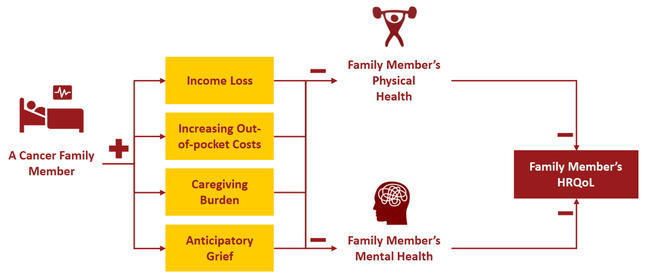
BACKGROUND

- Lung cancer affects not only patients' health but also the well-being of their family members, imposing substantial physical, emotional, and financial burden. This effect intensifies as patient health declines.
- Understanding and incorporating spillover effects into cost-effectiveness analyses (CEAs) is crucial for accurately assessing the value of lung cancer treatments.
- However, the lack of systematic data on lung cancer-related spillover effects remains a significant barrier.



*HRQoL: Health-Related Quality of Life

OBJECTIVE

- This study aims to build up an indirect measurements for family spillover effect that estimate health-related quality of life (HRQoL) loss among family members as a function of patients' HRQoL decline.
- The research question for this study is: how large is family member's HRQoL loss based on patients' HRQoL. For example, if one lung cancer patients' EQ-5D is 0.7, the family member's EQ-5D loss would be 0.1 based on indirect measurements on the population level.

METHODS

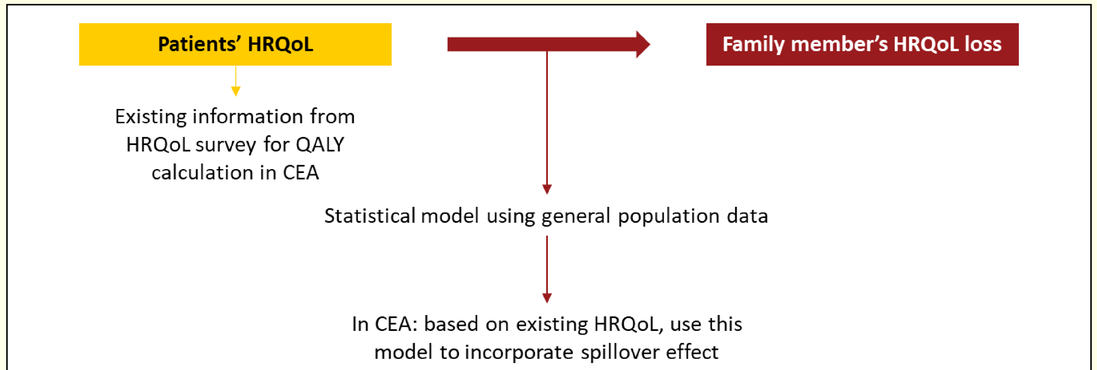
- We leveraged data from the Medical Expenditure Panel Survey from 2003 to 2023 to create a dataset of lung cancer patients and their family members.
- EQ-5D and VAS scores are transformed based on Gradient Boosting Machine (GBM) from SF-12v2 and VR-12 survey in MEPS.
- Families with lung cancer patients were included in treatment group while families without lung cancer patients served as a control group. HRQoL outcomes were measured using EQ-5D and VAS scores.
- A zero-one inflated beta regression model was employed to assess the association between family members' and patients' HRQoL scores, lung cancer status, patients' age and sex, adjusting for other demographic characteristics. The fitted regression model was then used to predict family HRQoL loss across varying levels of patient HRQoL loss and age.

$$g(u_{ij}) = \beta_0 + X_{ij}^T\beta + W_{ij}^T\gamma + Z_{ij}^T\eta$$

Main independent variables: Cancer indicator, patients' HRQoL, age and sex

Interaction terms of main independent variables

Control variables: family members' geographic characteristics, patients' other diseases indicators



RESULTS

Figure 1: EQ-5D and VAS loss trend of family members by patients' HRQoL loss, age and sex

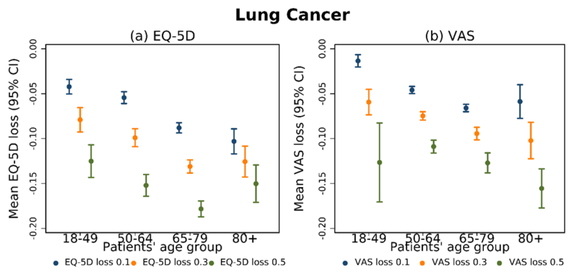
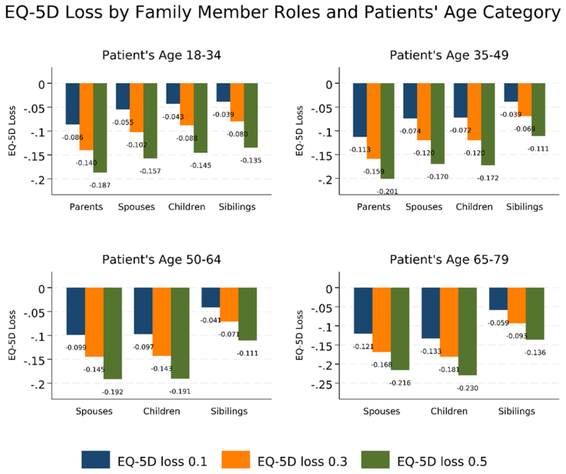


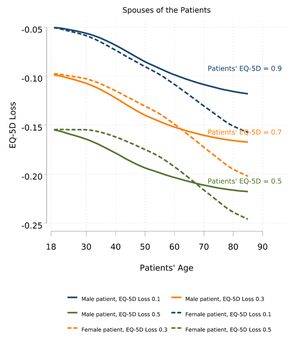
Figure 2: Family household members' EQ-5D loss heterogeneity by patients' EQ-5D loss, age categories and family members' roles.



Key Findings

- Lung cancer generated **measurable family HRQoL spillover effects** across both EQ-5D and VAS outcomes.
- Family spillover burden **increased with patient HRQoL deterioration**. Older patient age was generally associated with larger family HRQoL loss.
- Family spillover varied substantially **by family role.** Parents experienced the largest HRQoL losses when patients were younger. Children experienced larger losses when patients are older.
- **Spousal spillover showed distinct age and sex patterns**. Female spouses of male patients showed relatively greater losses at middle-to-older ages, while male spouses of female patients showed steeper increases at older ages under more severe patient HRQoL loss.

Figure 3: Family household members' EQ-5D loss for spouses of patients by patients' EQ-5D loss, age and family members' sex.



POLICY IMPACT

$$ICER = \frac{\Delta Cost}{\Delta Patient\ QALY + \Delta spillover\ effect}$$

$\Delta spillover\ effect$: *Disutility of family members' × time suffering*

- Drug A can extend both patients' life and utility, but it is the most expensive. After incorporating spillover effect, the ICER decreases $300 per QALY.
- Drug B can extend patients' life but decreases their utility. After including spillover effect, it becomes even more expensive in terms of ICER.
- Drug C cannot extend patients' life but increases their utility. It is cheapest but not as cheap as Drug A under traditional ICER calculation. However, after accounting for spillover effect, it has the lowest ICER.
- Including spillover effect in the CEA model will enhance the effect of improving patients' utility and favor drugs that not only focusing on extend patients' life.

Cancer Therapy	Length of Life (years)	Patient's Utility	Patient QALY	Cost($)	Traditional ICER (per QALY)	Family members' Disutility	Spillover Effect(QALY)	Spillover ICER (per QALY)
Control	3	0.7	2.1	10000		-0.06	-0.18	
A	5	0.9	4.0	25000	$7,900	-0.02	-0.1	$7,600
B	5	0.6	3.0	20000	$11,000	-0.08	-0.4	$15,000
C	3	0.9	2.7	15000	$8,000	-0.02	-0.06	$7,000

LIMITATION

- MEPS data incorporate cancer survivors. Those families with severe cancer patients might not be captured.
- Children (< 17) cancer patients cannot be identified due to privacy protection. Besides, children were not asked for SF-12 questionnaire.
- Updated data (instead of 2003) to bridge SF-12 and EQ-5D could elaborate this study result.

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CONTACTS

Suning Zhao, MPH
HEOR PhD Student @ USC Mann | Columbia MPH | Fudan Alumni