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Cost-effectiveness analysis of the colorectal cancer screening program using electronic colonoscopy in Luohu, China

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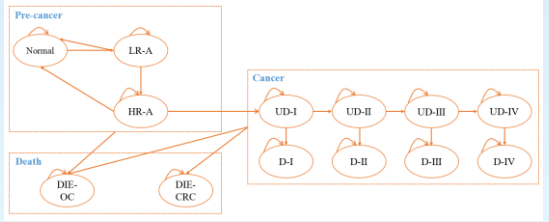
Background

- Colorectal cancer (CRC) is currently one of the most common and fatal cancers worldwide. In 2018, there were approximately **1.93 million new cases and 940,000 death cases globally, ranking third in cancer incidence and second in cancer mortality.** [1].**In China, CRC was listed fourth and fifth in incidence and mortality in 2015**, with **89,993 new cases** and **44,361 deaths**[2].
- The incidence of CRC increases substantially after the age of 50, peaking around 75 to 80 years old.
- The average costs caused by CRC in China have **increased by 6.9% to 9.2% per year**, and the personal medical expenses of patients within 1 year of a new diagnosis accounted **for ~60% of their household income**[3].
- Most CRCs originate from precancerous lesions, and the interval of this process is about 10–15 years[4].
- It was proved that **the incidence and mortality of CRC after screening could be reduced by 40% and 60%**[5], respectively, indicating the important place of screening in reducing the disease burden. There were also some studies demonstrating the cost-effectivenss of the screening in developed countries. However, the relevant evidence is insufficient in China.
- This study aimed to evaluate the effectiveness and cost-effectiveness of the CRC screening both implemented in **Luohu District**, Shenzhen of China among 2018-2021, and when scaled up to **the national level**, from the perspective of Chinese health care system.

Methods

- The target population in the base case analysis was set to enter the model **from 40 years old and exit until 75 years old or death**. When the background was set at the country level, the age that people entered the model was adjusted to 50 years old.
- The screening tools estimated in this study was **electronic colonoscopy(e-CSPY),** and the screening intervals including **10 years, 5 years, and 3 years**.
- A **12-state Markov model** was designed to simulate the disease history of a cohort of 100,000 subjects. And the model was based on the natural history of the disease. Since that most CRC developed from adenoma, the study considered the adenoma-carcinoma sequence(**normal epithelial cells, low-risk adenomas, high-risk adenomas, and cancers**[6]) only.
- Low-risk adenoma was defined as polyps with a diameter < 10 mm, and high-risk adenoma referred to polyps with a diameter >10 mm or containing more than 25% of the villous structure. The TNM classification of cancer grades was applied.
- Preclinical cancer referred to a state in which a patient is asymptomatic but has cancer. And adenomas were removed once detected, and patients returned to normal. High-risk adenomas had a certain probability of progressing to cancer each year.
- The model cycle was 1 year, and subjects in each cycle progressed according to the path or were stable when proceeding to the next cycle.
- CRC patients may be diagnosed through clinic visits when they notice symptoms or through screening. Those who participate in screening but are not diagnosed may also be diagnosed through the first route. The natural history of subjects in the screening scenario is the same as those in the scenario without screening. The main difference is that early screening may prevent disease progression at the adenoma stage, and early treatment might also suppress cancer development.



*L/HR-A:low/high risk adenoma;UD:undiagnosed;OC:other causes; I,II,III,IV represents the cancer stages

Figure 1 The structure of Markov Model

Results

- 10-year and 5-year strategy had dominance over the non-screening strategy, saving 255.78 USD and 95.06 USD per capita and increasing QALYs by 0.472 and 0.605, respectively.
- The ICER of the triennial screening strategy was 364.36 USD/QALY compared to no screening.
- Receiving screening at earlier age further decreased the ICER by 151.94–351.38 USD/QALY.
- Screening was more cost-effective when the prevalence of high-risk adenomas was higher (8.07%), or treatment were not completely successful.
- Screening reduced cancer cases by 1,939–6,219 and deaths by 974–3,118 in all situations.

Table 1 Base-case results

	Every 10 years	Every 5 years	Every 3 years
Incremental costs(USD)	-255.78	-95.06	252.88
Incremental QALYs	0.472	0.605	0.694
ICER(USD/QALY)	-541.78	-157.00	364.36

Table 2 Number of CRC cases at the end of the simulation

	Number of CRC patients			
	0	10	5	3
SZ 40-75	6851	2018 (↓4833)	1093 (↓5758)	631 (↓6219)
China 50-75	4599	1543 (↓3056)	918 (↓3681)	562 (↓4037)

Table 3 Number of deaths at the end of the simulation

	Number of deaths			
	0	10	5	3
SZ 40-75	33461	31519 (↓1942)	31148 (↓2313)	30986 (↓2475)
China 50-75	30737	29763 (↓974)	29555 (↓1208)	29449 (↓1288)

*SZ:Shenzhen

Conclusions

- It is cost-effective to implement CRC screening using colonoscopy in main-land China, as the ICER was lower than the threshold of 1 times the GDP per capita of China in 2020.
- In addition, the cost-effectiveness of CRC screening could vary in different regions, suggesting that governments need to localize the strategies based on factors such as epidemiology and economic burden of the disease.

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Conflicts of Interest

The authors declare no conflict of interest.

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