

Cost effectiveness of implantable cardioverter defibrillator therapy (ICD) versus drug therapy in primary prevention of sudden cardiac arrest in China

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Objectives

- The mortality benefits of implantable cardioverter defibrillators (ICDs) for the primary prevention (PP) of sudden cardiac arrest (SCA) are well-established, but ICD therapy remains underutilized worldwide.
- In this study, we evaluated the cost-effectiveness of ICD versus drug therapy among patients with PP characteristics from the perspective of the Chinese health system.

Methods

Model construction

- Based on local clinical practice, extensive literature review, and expert consultations, this study developed a Markov model of ICD versus drug therapy for PP of SCA in China (Figure 1).
- The model consists of two branches at the decision node, representing the choice between two treatment strategies for PP: ICD combined with drug therapy and drug therapy alone.
- Each branch contains a Markov node. Both treatment strategy branches include the following health states: heart failure death, sudden cardiac death, other cardiac deaths, non-cardiac deaths, and living with primary disease. The treatment strategy of ICD combined with drug therapy also includes the state of operative death, ICD-related complications—continue ICD therapy, and ICD-related complications—discontinue ICD therapy. Overall, the model encompasses all possible outcomes of two treatment strategies for PP patients.

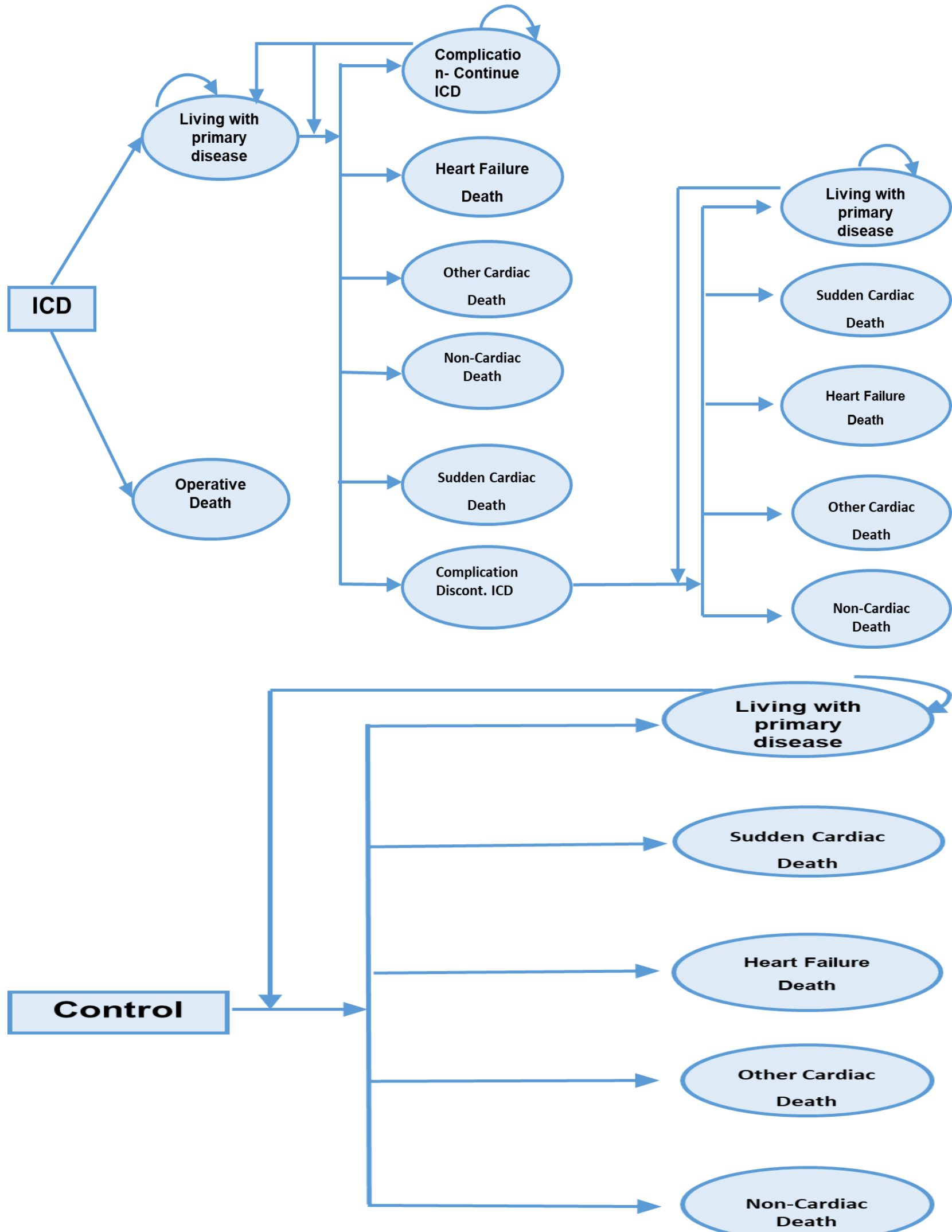


Fig 1. Markov model

Transition probability

- In this model, the transition probabilities between different states are involved. The data were obtained from literatures(Table 1).

Table1. Transition probability inputs			
Indicator Description	Initial Value	Standard Error	Source
ICD Group			
Initial operative death	0.00020	0.00004	1
ICD-Related Complications - Continued ICD	0.00339	0.00022	1
ICD-Related Complications - Discontinue ICD	0.00010	0.00007	1
Sudden Cardiac Death	0.00153	0.00010	2
Heart Failure Death	0.00290	0.00028	2
Other Cardiac Death	0.00037	0.00041	2
Non-Cardiac Death	0.00240	0.00016	2
Complications			
Infection	0.02440	0.00488	1
Lead Dislodgement	0.01800	0.01260	1
Drug Therapy Group			
Sudden Cardiac Death	0.00423	0.00041	2
Heart Failure Death	0.00017	0.00002	2
Other Cardiac Death	0.00292	0.00028	2
Non-Cardiac Death	0.00315	0.00031	2

Utility data

- As shown in Table 2, The utility data for different states after treatment were obtained from the literature.

Table2. Utility inputs			
Indicator Description	Initial Value	Standard Error	Data Source
QALY Values for Each State:			
Annual utility of heart failure patients	0.837	0.007	3
ICD Complication state	0.7408	0.0112	3
Death State	0	0	Assumption

Cost data

- The cost data were obtained from KOL surveys and tender price listed by government(Table 3).
- Fifteen experts participated in the survey in total, all of whom were cardiologists from various hospitals across different regions in China.

Table3. Cost data inputs		
Indicator Description	Initial Value (CNY)	Data Source
Total Inpatient Costs of Initial ICD Implantation	130,577	KOL surveys
Total Inpatient Costs of ICD Replacement	110,577	KOL surveys
ICD Complication Treatment Costs (Inappropriate Electric Shocks)	670	KOL surveys
ICD Follow-up Costs	133	KOL surveys
Costs of ICD Infection Treatment (total removal)	200,000	KOL surveys
Follow-up Inpatient Costs per Month (for both treatment strategies)	1917	KOL surveys
Follow-up Outpatient Costs per Month (for both treatment strategies)	644	Estimated from clinical guidelines and tender price listed by government

Results

Base case analysis

- After 340 cycles of simulation, the total cost of the ICD therapy group amounted to 383,544 CNY, while the corresponding QALYs gained were 5.89. In comparison, the total cost of the drug therapy group was 173,947 CNY, with QALYs gained amounting to 4.74. To achieve one additional QALY, the ICD therapy group incurred an extra cost of 233,002 CNY compared to the drug therapy group. The incremental cost-effectiveness ratio (ICER) of ICD compared to drug therapy was 182,618 CNY/QALY. Considering the threshold of three-folded GDP per capita in China (257,094 CNY), ICD for PP of SCA may have an advantage over purely drug therapy.(Table 4)

Table 4 Base case results			
Treatment Arm	Key Results		ICER
	Total Costs (CNY)	QALYs gained	
ICD therapy	383,544	5.89	--
Drug Therapy	173,947	4.74	Comparator
Incremental	209,597	1.15	182618 CNY/QALY

One-way sensitivity analysis

- According to the one-way sensitivity analysis, the three factors mostly influencing the outcome were discount rate, utility values, and initial implantation cost of ICD (Figure 2 Tornado Chart).

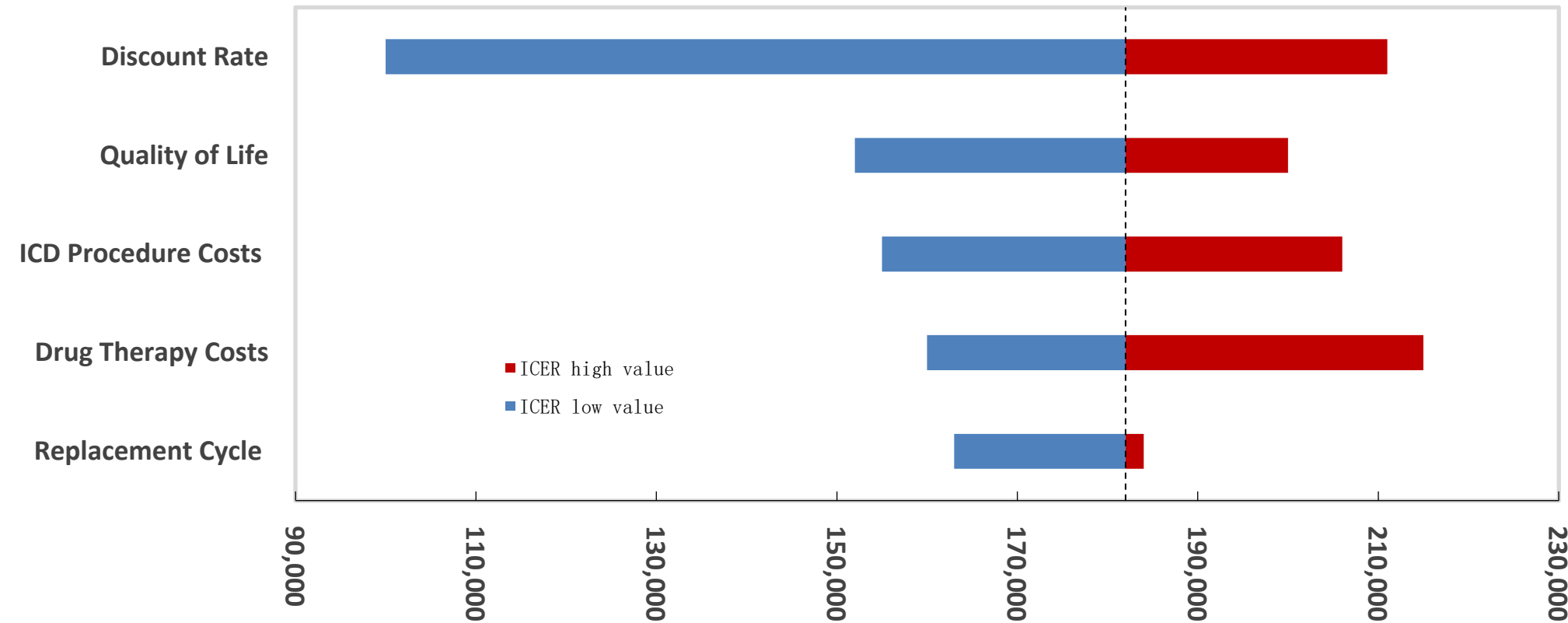


Fig 2: One-way deterministic sensitivity analysis

Probability sensitivity analysis

- When considering the threshold of three times GDP per capita, there is an 76.5% probability that ICD therapy is cost-effective compared to drug therapy for PP of SCA(Figure 3).

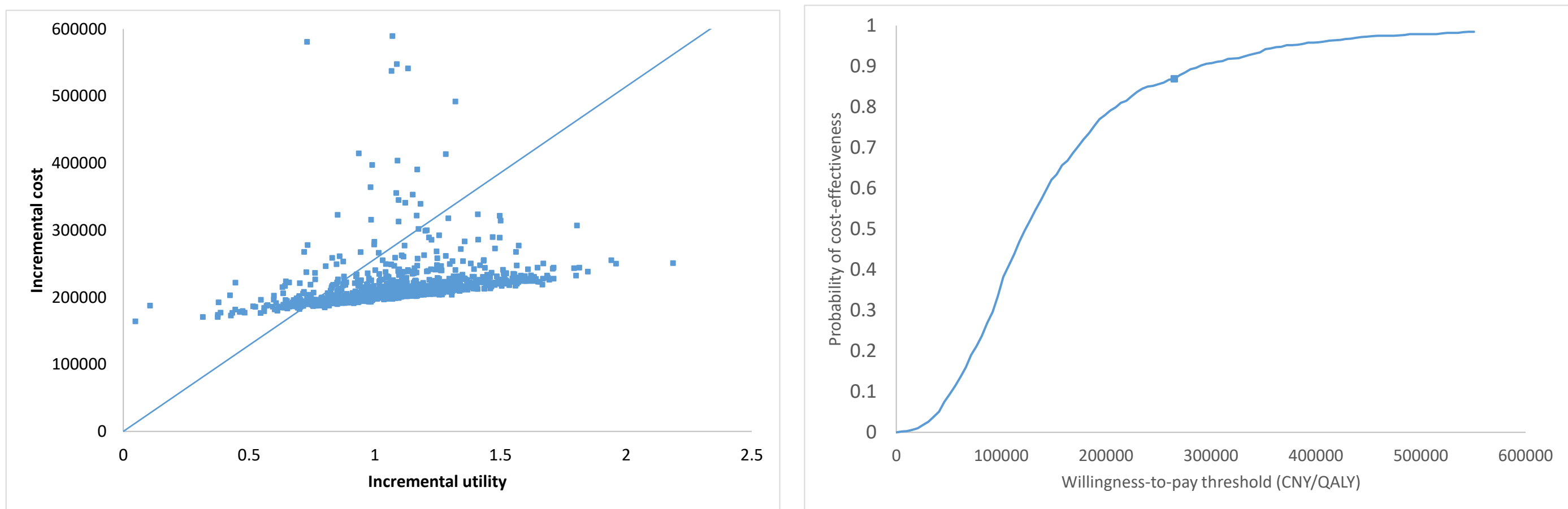


Figure 3. Probability sensitivity analysis

Conclusion

- The study revealed that, ICD therapy had a cost-effectiveness advantage over drug therapy for primary prevention of sudden cardiac arrest.
- Considering the prominent economic value of ICD, better reimbursement coverage from the perspective of China’s health system should be provided to prevent more patients from the threat of sudden cardiac arrest.

References

- Holbrook R, Higuera L, Wherry K, et al. Implantable cardioverter defibrillator therapy is cost effective for primary prevention patients in Taiwan: An analysis from the Improve SCA trial. PLoS One. 2020 Nov 19;15(11):e0241697
- Cowie MR, Marshall D, Drummond M, et al. Lifetime cost-effectiveness of prophylactic implantation of a cardioverter defibrillator in patients with reduced left ventricular systolic function: results of Markov modelling in a European population. Europace. 2009; 11(6):716–26
- Higuera L, Holbrook R, Wherry K, et al. Comparison of cost-effectiveness of implantable cardioverter defibrillator therapy in patients for primary prevention in Latin America: an analysis using the Improve SCA study. J Med Econ. 2021 Jan-Dec;24(1):173-180.