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Dynamic Budget Impact of Artificial Intelligence Assisted Imaging Interpretation for Brain Metastases in Advanced Lung Cancer

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Background

Demand for AI-based software as a medical device is increasing as health systems seek to improve diagnostic accuracy and efficiency. This study evaluates the budgetary and workforce impact of DeepBT® for brain metastasis detection in advanced non–small cell lung cancer (NSCLC) from the Taiwan National Health Insurance perspective.

Method

A dynamic target population approach estimated annual eligible patients with stage III and IV NSCLC in Taiwan from 2027 to 2031, incorporating both incident and prevalent populations based on 2023 projections. Annual cohorts then entered a Markov model to simulate health-state transitions and brain magnetic resonance imaging (MRI) utilization. Health states were defined by cancer stage, brain metastasis status, treatment, and death. State-specific annual MRI utilization rates from the National Health Insurance Research Database were applied to estimate SaMD use and radiologist workload under standard and AI-assisted interpretation.

The model assumed a per-scan SaMD cost of NTD 2,500 and improved radiologist efficiency, with reporting time reduced from 4.8 to 3.6 minutes per MRI. SaMD adoption was evaluated over a five-year budget impact horizon under two uptake scenarios. First- and fifth-year penetration rates were 9.4% and 53.8% for the conservative scenario, and 20.8% and 83.0% for the optimistic scenario, respectively.

Result

Over the five-year horizon, the conservative diffusion scenario was associated with an annual net budget impact increasing from NTD 2.59 million in 2027 to NTD 15.77 million in 2031, alongside annual physician working time savings of 1,248–8,014 minutes. In the aggressive diffusion scenario, the annual net budget impact increased from NTD 5.73 million to NTD 24.33 million, with corresponding time savings of 2,764–11,739 minutes, suggesting that broader DeepBT adoption would generate higher budgetary impact but greater efficiency gains.

Table 1. Budget and Physician Time Impact of DeepBT Adoption, 2027–2031

	2027	2028	2029	2030	2031
Current scenario					
Without DeepBT					
MRI examination costs	157910054.8	160418253.6	162906504.6	165414466.7	167902557.5
Total expenditure	157910054.8	160418253.6	162906504.6	165414466.7	167902557.5
Physician time impact (minutes)	54352.16	55217.5	56073.98	56937.25	57793.67
Conservative diffusion estimate					
Without DeepBT					
MRI examination costs	142871623.1	132790032	117687046.3	99056976.88	76396920.81
With DeepBT					
MRI examination costs	15038431.67	27628221.6	45219458.36	66357489.84	91505636.72
DeepBT costs	2591617.18	4761252.73	7792802.32	11435581.48	15769435.64
Total expenditure (NTD)	160501672	165179506.3	170699306.9	176850048.2	183671993.2
Physician working time(minutes)	53104.29	52920.96	52313.99	51419.9	49779.87
Financial and physician time impact					
Financial impact	2591617.18	4761252.73	7792802.32	11435581.48	15769435.64
Physician time impact (minutes)	-1247.9	-2296.5	-3760	-5517.4	-8013.8
Aggressive diffusion estimate					
Without DeepBT					
MRI examination costs	124633525.2	105161810.4	77253588.97	51634831.36	26732151.44
With DeepBT					
MRI examination costs	33276529.65	55256443.19	85652915.66	113779635.4	141170406.1
DeepBT costs	5734642.27	9522505.45	14760818.99	19607979.36	24328311.48
Total expenditure	163644697.1	169940759	177667323.6	185022446.1	192230869
Physician working time, minutes	51588.49	50624.41	50627.19	47476.95	46054.5
Financial and physician time impact					
Financial impact	5734642.27	9522505.45	14760818.99	19607979.36	24328311.48
Physician time impact (minutes)	-2763.7	-4593.1	-5446.8	-9460.3	-11739.2

Costs are reported in in New Taiwan dollars (NTD). Financial and physician time impacts represent differences from the current scenario; negative physician time values indicate time savings.

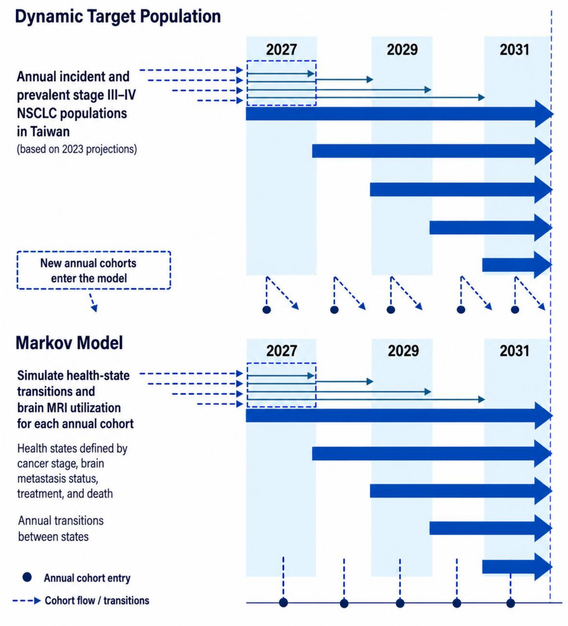

Figure 1. Dynamic target population for budget impact analysis from 2027 to 2031

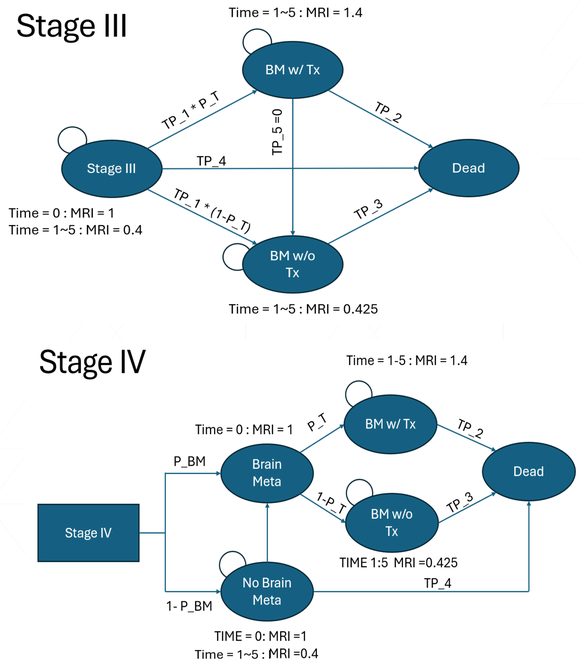

Figure 2. Markov Model for Stage III& IV NSCLC

Figure1 : The dynamic target population was estimated annually from 2027 to 2031. Thin dashed arrows indicate prevalent cases carried into the analysis period; thin solid arrows indicate their follow-up within the analysis; and thick solid arrows indicate newly eligible patients entering the model each year and contributing to subsequent budget impact estimates.
Figure2: BM = brain metastasis; NSCLC = non-small cell lung cancer; TP = transition probability. **P_BM:** Probability of having BM at the time of stage IV NSCLC diagnosis; ;**TIME:** model year; **MRI:** number of MRI scans used in that model year; Tx: Treatment **TP_1:** TP from stage IV NSCLC without BM to BM; **P_T**: Probability of receiving treatment after developing BM; TP_1 x **P_T:** TP from NSCLC to BM with treatment; **TP_1 x (1 – P_T):** TP from NSCLC to BM without treatment; **TP_2:** TP from BM with treatment to death; **TP_3:** TP from BM without treatment to death; **TP_4:** TP from NSCLC without BM directly to death, without experiencing BM. TIME = N indicates the Nth cycle; MRI = N indicates the annual MRI utilization frequency in that cycle.

Conclusion

Adoption of SaMD for MRI interpretation was associated with increased budget impact and reduced radiologist working time, with potential amplification under wider adoption across diverse clinical settings and health system.

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