POSB44

Drivers of Value-Based Pricing (VBP) for a Multi-Cancer Early Detection (MCED) Test

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INTRODUCTION

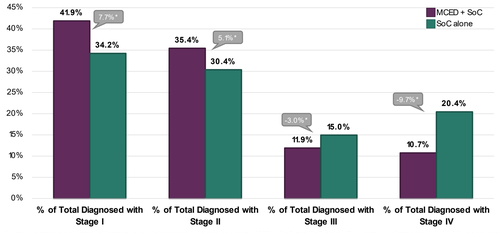
- Cancer is the leading cause of global mortality in 2020, accounting for 10 million deaths.[1,2]
- Cancer screening is associated with a reduction in mortality in populations where screening programs have been implemented.[3,4]
- Recently, new blood tests that can simultaneously screen for multiple types of cancer have been developed, including the multi-cancer early detection (MCED) test.[5-7]
- MCED testing could increase detection of cancers that are clinically significant (i.e., those cancers diagnosed during a patient's lifetime)[8] at early stages when survival outcomes are better and treatment costs are lower, but it is expected to increase the screening costs.

OBJECTIVE

- To explore key drivers of the potential range of value-based pricing (VBP) for a multi-cancer test in a US population.

KEY RESULTS

Figure 1. Percent of Total Cancers Diagnosed by Stage



*Number represents percent difference in total diagnosed by stage between MCED + SoC and SoC alone. Total number of cancers was 34,718 in each arm and 35,019 when overdiagnosis was considered.
The percent of total cancers diagnosed by stage is the same for both base cases due to the low number of cancers identified when overdiagnosis was considered.
MCED= Multi-cancer early detection; SOC= Standard of care

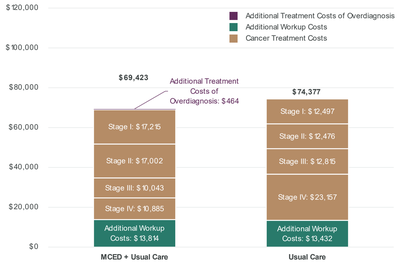
Base case results (without overdiagnosis)

- MCED screening plus SoC resulted in 0.18 more LYs and 0.17 more QALYs than SoC alone.
- MCED reduced the proportion of cancers detected at stage IV to 10.7% from 20.4% (lowering stage IV treatment costs by $12,272) and increased those detected at stage I from 34.2% to 41.9% (Figure 1 and Figure 2).
- There was $5,397 less cancer-related treatment and diagnosis costs associated with MCED plus SoC as compared with SoC alone, excluding cost of the MCED screening test.
- At a WTP of $50,000/QALY, the VBP for the MCED test is $938/test, while at a WTP of $150,000/QALY, the VBP reached $2,089/QALY.

Base case results (with overdiagnosis)

- A total of 301 additional cancers were detected with MCED plus SoC, of which 87.1% were diagnosed in stages I and II.
- The LYs and QALYs gain and proportion of cancers detected by stage were similar to the without overdiagnosis base case.
- The cancer-related treatment and diagnosis costs associated with MCED plus SoC increased by $465 compared to the without overdiagnosis base case.
- The VBP for the MCED test decreased to $904/test and $2,049/test, respectively.
- Results were not affected in a meaningful way between the two base case scenarios.

Figure 2. Base Case Cost Outcomes (Cost Per Person Over Lifetime)

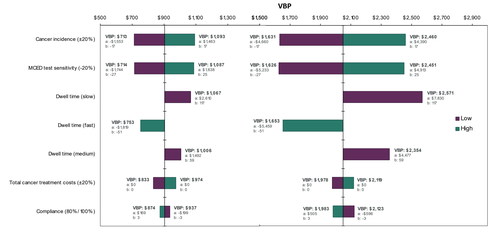


ICER= Institute for Clinical and Economic Review; MCED= Multi-cancer early detection

Sensitivity analysis results

- Changes in cancer incidence and dwell time and MCED test sensitivity had the highest impact on the VBP (Figure 3).

Figure 3. Tornado Diagram of Sensitivity Analyses



a = The difference in incremental total costs between the base case with overdiagnosis and the specified scenario; b = the difference in the number of cancers detected per round of screening between the base case with overdiagnosis and the specified scenario.

- VBP was almost exactly proportional to the number of detected cancers per round of testing and changed linearly with total number of clinically significant cancers detected.
- Changes in cancer treatment cost and compliance parameters and the impact of false positives due to high specificity had small impacts on VBP.

LIMITATION

- The model does not account for the additional post-diagnosis risk of developing cancer later in life; cancer recurrence or patients who have multiple types of cancers are not explicitly considered.

CONCLUSIONS

- Maximizing clinically significant cancer cases detected is the most significant driver of impact of MCED testing, and correspondingly, the VBP.
- Benefits associated with the use of MCED testing are proportional to the number of clinically significant cancers detected.

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Disclosures

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METHODS

Model Overview and Structure

- A Markov model with a yearly cycle was developed to compare annual MCED plus standard of care (SoC) screening with SoC alone in a cohort of asymptomatic adults beginning at age 50 with annual screening until age 79 (90% compliance) from a US third party payer perspective.
- Patient survival, cost, and quality of life (QoL) measures were calculated pre- and post-diagnosis over a lifetime time horizon.
- SoC is defined as current screening practices for lung, colon, breast, cervical, and prostate cancers as recommended by National Comprehensive Cancer Network (NCCN) and US Preventive Services Task Force (USPSTF).[9-14]
- The model included 19 solid cancer groupings representing over 80% of total cancer incidence in this population (see Table 1 for list of cancers).
- VBP was estimated for willingness-to-pay (WTP) thresholds of $50,000/quality-adjusted life years (QALY) and $150,000/QALY. All costs and outcomes were discounted at 3% annually.
- A hybrid structure (Figure 4) was developed with two key components:
  - Cohort Markov: estimates the fraction of patients diagnosed with cancer during each cycle based on age- and stage-specific cancer incidence rates. Under the MCED test scenario, cancer in patients could be detected earlier in time and stage than under SoC alone.
  - Decision-tree: estimate the long-term consequences of incident cancer (survival, utility, treatment costs).

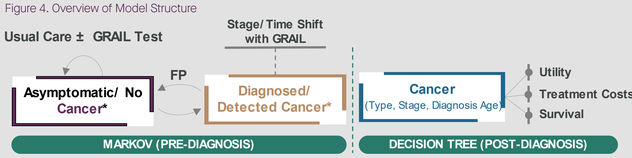
Overdiagnosis

- To understand the potential impact of overdiagnosis due to the MCED test detecting cancer in patients who would have died with undetected cancer, the potential for overdiagnosis with MCED was considered in a second base case.
  - 5% of patients who died of non-cancer mortality were assumed to have undiagnosed cancer at death.[15]
  - While the identification of these cancers do not affect patient survival, overdiagnosis does result in cost and utility penalties in the model.

Stage and Time Shift

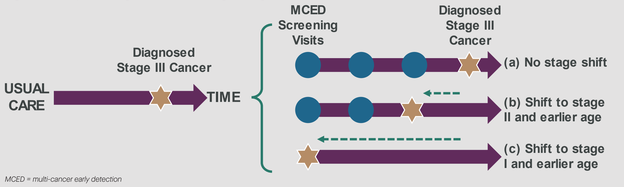
- To handle an earlier diagnosis with MCED screening than with SoC screening alone, the model stage- and time-shifted the cancer diagnosis to an earlier time and age (example shown in Figure 5).[16]
- The distribution of stage shift is cancer-specific and not age-dependent, and is derived using inputs on frequency of MCED screening, estimated cancer dwell times by stage, and the sensitivity of the MCED test for different cancer types and stages.[16]
- Patients are shifted back in time to an earlier age, which is based on cancer dwell time by stage as shown in the interception model.[16]

Figure 4. Overview of Model Structure



*False positive (FP) patients (in asymptomatic/no cancer group) and those misdiagnosed due to wrong TOO (in detected cancer group) accrued additional work-up costs and disutilities before being accurately assigned to having cancer or not.

Figure 5.Example of Stage and Time Shifting of Diagnosed Cancers due to MCED Test



MCED = multi-cancer early detection

Model Inputs

- Surveillance Epidemiology and End Results (SEER) data informed incidence by age and stage at detection.[17,18]
- MCED test sensitivity (Table 1) differs by cancer and stage, while specificity is 99.5% across cancers.[19] SoC screening included breast, lung, colon and rectum, prostate, and cervical cancer with an associated specificity of 89%, 87%, 87%, 91%, and 85%, respectively.[20-23]
- Baseline background mortality (derived from US life tables from the National Vital Statistics Report[23]) was assigned pre-cancer diagnosis.
- Post-diagnosis mean survival based on SEER was assigned based on stage and age at clinical diagnosis and cancer type, considering stage shift if diagnosed with MCED.[17,18]
- SEER-Medicare linked data informed resource use with a 2.34x multiplier for commercial costs.[24]
- Screening costs, treatment costs over five years, and costs related to additional workups were considered.
- Cancer- and stage-specific utility multipliers adjusted baseline age-specific utility over five years.
- False positives resulted in additional diagnostic workups and reduced QoL.

Table 1. MCED Test Sensitivity[19]

Cancer	Stage I	Stage II	Stage III	Stage IV
Anus	25%	75%	100%	100%
Bladder*	18%	18%	75%	100%
Breast	3%	48%	85%	91%
Breast: hormone receptor-positive	3%	48%	85%	91%
Cervix	58%	100%	100%	100%
Colon and rectum	43%	85%	88%	95%
Esophagus	13%	65%	94%	100%
Head and neck	63%	82%	84%	96%
Kidney and renal pelvis*	5%	19%	19%	55%
Liver and intrahepatic bile duct*	81%	81%	100%	100%
Lung and bronchus	22%	80%	91%	95%
Lymphoma*	27%	58%	66%	66%
Other	0%	0%	0%	0%
Ovarian	50%	80%	87%	95%
Pancreas*	61%	61%	86%	96%
Prostate	3%	5%	14%	83%
Stomach	17%	50%	80%	100%
Urothelial	0%	0%	0%	100%
Uterus	17%	30%	74%	100%

*Note: MCED test sensitivity was adjusted for the indicated cancer; a weighted mean across two stages was used to calculate sensitivity by stage when sensitivity was not in ascending order.