

Supplementary Table S1. The distributions and parameters of overall survival and progression-free survival curves obtained by survival analysis

| Indication | Treatment | Overall survival | | | Progression-free Survival | | |
|--|--------------|------------------|-----------|----------|---------------------------|-----------|---------|
| | | Distribution | Parameter | | Distribution | Parameter | |
| Atezolizumab | | | | | | | |
| 2nd-line NSCLC (reimbursed indication) | Intervention | Log-logistic | Shape | 1.3617 | Gen.gamma | Mu | 0.9926 |
| | | | Scale | 13.1451 | | Sigma | 1.1601 |
| | Comparator | Log-logistic | Shape | 1.3617 | Log-normal | Q | -0.4318 |
| | | | Scale | 13.1451 | | Meanlog | 1.2961 |
| 1st-line metastatic NSCLC | Intervention | Gompertz | Shape | 0.02282 | Log-logistic | Shape | 1.6283 |
| | | | Rate | 0.028441 | | Scale | 8.9497 |
| | Comparator | Weibull | Shape | 1.2436 | Log-logistic | Shape | 1.6283 |
| | | | Scale | 20.8296 | | Scale | 8.9497 |
| 1st-line locally advanced or metastatic TNBC | Intervention | Log-logistic | Shape | 1.613 | Log-normal | Meanlog | 2.0136 |
| | | | Scale | 7.477 | | Sdlog | 1.0541 |
| | Comparator | Weibull | Shape | 1.092 | Log-normal | Meanlog | 2.0136 |
| | | | Scale | 7.8449 | | Sdlog | 1.0541 |
| Nivolumab | | | | | | | |
| 2nd-line NSCLC (reimbursed indication) | Intervention | Log-normal | Meanlog | 2.3978 | Gen.gamma | Mu | 0.9081 |
| | | | Sdlog | 1.3665 | | Sigma | 1.2775 |
| | Comparator | Log-logistic | Shape | 1.61 | Log-normal | Q | -0.7629 |
| | | | Scale | 8.1392 | | Meanlog | 1.245 |
| 2nd-line advanced RCC | Intervention | Log-normal | Meanlog | 3.3352 | Gen.gamma | Mu | 1.1203 |
| | | | Sdlog | 1.2084 | | Sigma | 0.7785 |
| | Comparator | Log-normal | Meanlog | 3.3352 | Gen.gamma | Q | -1.5512 |
| | | | Sdlog | 1.2084 | | Mu | 1.3078 |
| 2nd-line recurrent or metastatic HNSCC | Intervention | Log-normal | Meanlog | 2.0056 | Log-logistic | Sigma | 0.7913 |
| | | | Sdlog | 1.3701 | | Q | -0.9403 |
| | Comparator | Log-logistic | Shape | 1.804 | Log-logistic | Shape | 2.022 |
| | | | Scale | 5.104 | | Scale | 2.465 |
| Pembrolizumab | | | | | | | |
| 2nd-line NSCLC (reimbursed indication) | Intervention | Log-normal | Meanlog | 2.8782 | Gen.gamma | Mu | 1.0281 |
| | | | Sdlog | 1.5718 | | Sigma | 1.262 |
| | Comparator | Log-normal | Meanlog | 2.8782 | Log-normal | Q | -1.508 |
| | | | Sdlog | 1.5718 | | Meanlog | 1.3965 |
| 1st-line treatment of metastatic non- squamous NSCLC | Intervention | Exponential | Rate | 0.03135 | Log-logistic | Sdlog | 1.0339 |
| | | | Scale | 9.2301 | | Shape | 1.4816 |
| | Comparator | Log-normal | Meanlog | 2.5031 | Log-logistic | Scale | 9.2301 |
| | | | Sdlog | 1.2887 | | Shape | 1.4816 |
| | | | Scale | 9.2301 | | | |

| | | | | | | | |
|---|--------------|--------------|---------|----------|--------------|---------|---------|
| 1st-line treatment of metastatic squamous NSCLC | Intervention | Weibull | Shape | 1.1752 | Log-logistic | Shape | 1.4915 |
| | | | Scale | 24.2974 | | Scale | 8.3228 |
| | Comparator | Weibull | Shape | 1.1752 | Log-logistic | Shape | 1.4915 |
| | | | Scale | 24.2974 | | Scale | 8.3228 |
| 1st-line metastatic NSCLC ($\geq 50\%$ TPS) | Intervention | Gompertz | Shape | -0.03856 | Gompertz | Shape | -0.1052 |
| | | | Rate | 0.03986 | | Rate | 0.1124 |
| | Comparator | Gompertz | Shape | -0.03856 | Log-normal | Meanlog | 1.5225 |
| | | | Rate | 0.03986 | | Sdlog | 0.9494 |
| 1st-line treatment of metastatic or unresectable recurrent HNSCC as monotherapy | Intervention | Log-normal | Meanlog | 2.5166 | Gen.gamma | Mu | 0.9879 |
| | | | Sdlog | 1.3798 | | Sigma | 1.1172 |
| | Comparator | Weibull | Shape | 1.2255 | Log-logistic | Shape | 1.956 |
| | | | Scale | 15.2282 | | Scale | 4.889 |
| 1st-line treatment of metastatic or unresectable recurrent HNSCC as combination therapy | Intervention | Exponential | Rate | 0.0507 | Log-logistic | Shape | 1.5703 |
| | | | | | | Scale | 4.9135 |
| | Comparator | Weibull | Shape | 1.2512 | Log-logistic | Shape | 2.002 |
| | | | Scale | 15.1327 | | Scale | 4.906 |
| 2nd-line recurrent or metastatic HNSCC ($\geq 50\%$ TPS) | Intervention | Exponential | Rate | 0.05777 | Log-logistic | Shape | 1.369 |
| | | | | | | Scale | 4.015 |
| | Comparator | Exponential | Rate | 0.05777 | Log-logistic | Shape | 2.139 |
| | | | | | | Scale | 2.351 |
| 1st-line treatment of advanced renal cell carcinoma | Intervention | Log-logistic | Shape | 1.382 | Log-normal | Meanlog | 2.7714 |
| | | | Scale | 50.964 | | Sdlog | 1.2993 |
| | Comparator | Log-normal | Meanlog | 3.7437 | Log-normal | Meanlog | 2.7714 |
| | | | Sdlog | 1.5704 | | Sdlog | 1.2993 |

Abbreviations: NSCLC, non-small cell lung-cancer; TNBC, triple-negative breast cancer; RCC, renal cell carcinoma; HNSCC, head and neck squamous cell carcinoma; TPS, tumor proportion score

Supplementary Table S2. Key input data for the cost-effectiveness model

| Indication | Health states | Category | Cost, \$US | | Utility | |
|--|------------------|--|------------------|------------|--------------|------------|
| | | | Intervention | Comparator | Intervention | Comparator |
| Atezolizumab | | | | | | |
| 2nd-line NSCLC (reimbursed indication) | PF | Treatment cost | 2,970 | 820 | | |
| | | Dispensing cost | 35 | 35 | | |
| | | Monitoring and outpatient visit cost | 233 | 233 | 0.74 | 0.74 |
| | | Adverse event cost | 23 | 441 | | |
| | PD | Subsequent treatment and monitoring cost | 1,232 | 2,037 | 0.59 | 0.59 |
| | Death | End-of-life cost | 2,894 | 2,894 | - | - |
| 1st-line metastatic NSCLC | PF | Treatment cost (1~6 cycle) | 7,279 | 4,310 | | |
| | | Treatment cost (after 7 cycle) | 6,588 | 3,619 | | |
| | | Dispensing cost (1~6 cycle) | 57 | 57 | 0.71 | 0.71 |
| | | Dispensing cost (after 7 cycle) | 55 | 55 | | |
| | PD | Monitoring and outpatient visit cost | 239 | 239 | | |
| | | Adverse event cost | 717 | 534 | | |
| | | Subsequent treatment and monitoring cost | 959 | 2,192 | 0.67 | 0.67 |
| | | Death | End-of-life cost | 2,847 | 2,847 | - |
| 1st-line locally advanced or metastatic TNBC | PF | Treatment cost | 4,658 | 1,540 | | |
| | | Dispensing cost | 83 | 55 | | |
| | | Monitoring and outpatient visit cost | 418 | 557 | 0.715 | 0.715 |
| | | Adverse event cost | 175 | 150 | | |
| | PD | Subsequent treatment and monitoring cost | 1,453 | 1,783 | 0.443 | 0.443 |
| | Death | End-of-life cost | 2,907 | 2,907 | - | - |
| Nivolumab | | | | | | |
| 2nd-line NSCLC (reimbursed indication) | PF | Treatment cost | 4,845 | 933 | | |
| | | Dispensing cost | 50 | 34 | | |
| | | Monitoring and outpatient visit cost | 266 | 214 | 0.74 | 0.74 |
| | | Adverse event cost | 125 | 843 | | |
| | PD | Subsequent treatment and monitoring cost | 1,129 | 1,548 | 0.59 | 0.59 |
| Death | End-of-life cost | 2,978 | 2,978 | - | - | |
| 2nd-line advanced RCC | PF | Treatment cost | 4,819 | 1,325 | | |
| | | Dispensing cost | 83 | 8 | 0.895 | 0.895 |
| | | Monitoring and outpatient visit cost | 311 | 260 | | |

| | | | | | | |
|---|---|--|----------------|-------|-------|-------|
| | | Adverse event cost | 9 | 45 | | |
| | PD | Subsequent treatment and monitoring cost | 2,293 | 3,340 | 0.817 | 0.817 |
| | Death | End-of-life cost | 2,941 | 2,941 | - | - |
| 2nd-line recurrent or metastatic HNSCC | | Treatment cost | 4,819 | 3,707 | | |
| | | Dispensing cost | 83 | 57 | | |
| | PF | Monitoring and outpatient visit cost | 185 | 189 | 0.805 | 0.77 |
| | | Adverse event cost | 6 | 27 | | |
| | PD | Subsequent treatment and monitoring cost | 911 | 905 | 0.746 | 0.676 |
| | Death | End-of-life cost | 2,506 | 2,506 | - | - |
| | Pembrolizumab | | | | | |
| 2nd-line NSCLC (reimbursed indication) | | Treatment cost | 7,364 | 933 | | |
| | | Dispensing cost | 34 | 34 | | |
| | PF | Monitoring and outpatient visit cost | 214 | 214 | 0.74 | 0.74 |
| | | Adverse event cost | 0 | 157 | | |
| | PD | Subsequent treatment and monitoring cost | 686 | 1,279 | 0.59 | 0.59 |
| | Death | End-of-life cost | 2,978 | 2,978 | - | - |
| | 1st-line treatment of metastatic non-squamous NSCLC | | Treatment cost | 8,278 | 953 | |
| | | Dispensing cost | 57 | 57 | | |
| PF | | Monitoring and outpatient visit cost | 239 | 239 | 0.74 | 0.74 |
| | | Adverse event cost | 552 | 455 | | |
| PD | | Subsequent treatment and monitoring cost | 939 | 2,766 | 0.67 | 0.67 |
| Death | | End-of-life cost | 2,847 | 2,847 | - | - |
| 1st-line treatment of metastatic squamous NSCLC | | | Treatment cost | 8,016 | 691 | |
| | | Dispensing cost | 57 | 57 | | |
| | PF | Monitoring and outpatient visit cost | 239 | 239 | 0.74 | 0.74 |
| | | Adverse event cost | 531 | 571 | | |
| | PD | Subsequent treatment and monitoring cost | 618 | 948 | 0.67 | 0.67 |
| | Death | End-of-life cost | 2,847 | 2,847 | - | - |
| | 1st-line metastatic NSCLC (≥50% TPS) | | Treatment cost | 7,325 | 871 | |
| | | Dispensing cost | 57 | 57 | | |
| PF | | Monitoring and outpatient visit cost | 239 | 239 | 0.778 | 0.778 |
| | | Adverse event cost | 7 | 423 | | |
| PD | | Subsequent treatment and monitoring cost | 231 | 353 | 0.641 | 0.641 |
| Death | | End-of-life cost | 2,847 | 2,847 | - | - |
| 1st-line treatment of | | PF | Treatment cost | 7,325 | 3,723 | 0.805 |

| | | | | | | | |
|---|--|--|--|-------|-------|-------|-------|
| metastatic or unresectable recurrent HNSCC as monotherapy | (1~6 cycle) | | | | | | |
| | | Treatment cost (after 7 cycle) | 7,325 | 3,661 | | | |
| | | Dispensing cost | 55 | 55 | | | |
| | | Monitoring and outpatient visit cost | 188 | 188 | | | |
| | | Adverse event cost | 242 | 931 | | | |
| | PD | Subsequent treatment and monitoring cost | 1,481 | 1,778 | 0.746 | 0.676 | |
| Death | End-of-life cost | 2,506 | 2,506 | - | - | | |
| 1st-line treatment of metastatic or unresectable recurrent HNSCC as combination therapy | Treatment cost (1~6 cycle) | | 7,440 | 3,723 | | | |
| | PF | Treatment cost (after 7 cycle) | 7,325 | 3,661 | | | |
| | | Dispensing cost | 55 | 57 | 0.805 | 0.77 | |
| | | Monitoring and outpatient visit cost | 188 | 188 | | | |
| | | Adverse event cost | 1,074 | 981 | | | |
| | PD | Subsequent treatment and monitoring cost | 1,234 | 1,779 | 0.746 | 0.676 | |
| | Death | End-of-life cost | 2,506 | 2,506 | - | - | |
| | 2nd-line recurrent or metastatic HNSCC (\geq 50% TPS) | Treatment cost | | 6,790 | 3,707 | | |
| | | PF | Dispensing cost | 55 | 57 | | |
| | | | Monitoring and outpatient visit cost | 185 | 188 | 0.805 | 0.77 |
| Adverse event cost | | | 8 | 101 | | | |
| PD | | | Subsequent treatment and monitoring cost | 774 | 1,169 | 0.746 | 0.676 |
| Death | | End-of-life cost | 2,506 | 2,506 | - | - | |
| 1st-line treatment of advanced renal cell carcinoma | | Treatment cost | | 9,275 | 2,815 | | |
| | PF | Dispensing cost | 61 | 8 | | | |
| | | Monitoring and outpatient visit cost | 253 | 231 | 0.75 | 0.75 | |
| | | Adverse event cost | 160 | 111 | | | |
| | | PD | Subsequent treatment and monitoring cost | 1,630 | 3,860 | 0.66 | 0.66 |
| | Death | End-of-life cost | 2,941 | 2,941 | - | - | |

Abbreviations: PF, progression-free; PD, progressive disease; NSCLC, non-small cell lung-cancer; TNBC, triple-negative breast cancer; RCC, renal cell carcinoma; HNSCC, head and neck squamous cell carcinoma; TPS, tumor proportion score

Supplementary Table S3. Key input data for budget impact analysis

| Non-reimbursed indication | The expected number of treated patients (the expected market share) | | | Annual cost, \$US | | | |
|---|---|---------------------------------|--------------------------------|---------------------|-----------------------------|-----------------|-----------------------|
| | The first year after expansion | The second year after expansion | The third year after expansion | Value-based pricing | | | 4.75% price reduction |
| | | | | Scenario 1: IBP | Scenario 2: IBP with refund | Scenario 3: WAP | |
| Atezolizumab | | | | | | | |
| 1st-line metastatic NSCLC | 1,977 (30%) | 2,727 (40%) | 3,526 (50%) | 46,509,548 | 46,509,548 | 57,785,952 | 65,460,619 |
| 1st-line locally advanced or metastatic TNBC | 181 (30%) | 257 (40%) | 341 (50%) | 24,612,402 | 24,612,402 | 31,673,598 | 38,783,951 |
| Nivolumab | | | | | | | |
| 2nd-line advanced RCC | 82 (30%) | 114 (40%) | 150 (50%) | 34,661,572 | 24,837,802 | 30,639,859 | 23,678,067 |
| 2nd-line recurrent or metastatic HNSCC | 297 (30%) | 409 (40%) | 527 (50%) | 44,835,494 | 13,798,779 | 17,022,144 | 13,154,482 |
| Pembrolizumab | | | | | | | |
| 1st-line treatment of metastatic non-squamous NSCLC | 1,384 (30%) | 1,909 (40%) | 2,468 (50%) | 68,497,185 | 68,497,185 | 86,506,186 | 85,440,250 |
| 1st-line treatment of metastatic squamous NSCLC | 824 (30%) | 1,136 (40%) | 1,469 (50%) | 59,759,917 | 59,759,917 | 74,890,183 | 73,936,452 |
| 1st-line metastatic NSCLC ($\geq 50\%$ TPS) | 655 (30%) | 904 (40%) | 1,169 (50%) | 64,324,818 | 64,324,818 | 76,313,099 | 75,247,163 |
| 1st-line treatment of metastatic or unresectable recurrent HNSCC as monotherapy | 506 (30%) | 695 (40%) | 896 (50%) | 49,136,322 | 29,087,851 | 28,109,265 | 27,716,552 |
| 1st-line treatment of metastatic or unresectable recurrent HNSCC as combination therapy | 506 (30%) | 695 (40%) | 896 (50%) | 58,814,184 | 47,481,924 | 46,223,742 | 45,718,825 |
| 2nd-line recurrent or metastatic HNSCC ($\geq 50\%$ TPS) | 155 (30%) | 213 (40%) | 274 (50%) | 59,439,937 | 37,398,665 | 36,140,483 | 35,635,566 |
| 1st-line treatment of advanced renal cell carcinoma | 248 (30%) | 347 (40%) | 455 (50%) | 111,220,275 | 111,220,275 | 158,607,287 | 156,868,130 |

Abbreviations: IBP, indication value-based pricing; WAP, weighted average pricing; NSCLC, non-small cell lung-cancer; TNBC, triple-negative breast cancer; RCC, renal cell carcinoma; HNSCC, head and neck squamous cell carcinoma; TPS, tumor proportion score

Supplementary Table S4. Comparator and randomized clinical trial for each indication of immunotherapy

| Indication | Intervention | Comparator | Randomized clinical trial |
|---|--|---|------------------------------|
| Atezolizumab | | | |
| 2nd-line NSCLC (reimbursed indication) | Atezolizumab | Docetaxel | OAK study |
| 1st-line metastatic NSCLC | Atezolizumab +bevacizumab +paclitaxel +carboplatin | Placebo +bevacizumab +paclitaxel +carboplatin | IMpower150 |
| 1st-line locally advanced or metastatic TNBC | Atezolizumab +nab-paclitaxel | Placebo +nab-paclitaxel | IMpassion130 |
| Nivolumab | | | |
| 2nd-line NSCLC (reimbursed indication) | Nivolumab | Docetaxel | CheckMate 017 +CheckMate 057 |
| 2nd-line advanced RCC | Nivolumab | Everolimus | CheckMate 025 |
| 2nd-line recurrent or metastatic HNSCC | Nivolumab | Docetaxel or Methotrexate or Cetuximab | CheckMate 141 |
| Pembrolizumab | | | |
| 2nd-line NSCLC (reimbursed indication) | Pembrolizumab | Docetaxel | KEYNOTE-010 |
| 1st-line treatment of metastatic non-squamous NSCLC | Pembrolizumab +platinum +pemetrexed | Placebo +platinum +pemetrexed | KEYNOTE-189 |
| 1st-line treatment of metastatic squamous NSCLC | Pembrolizumab +carboplatin +(nab)paclitaxel | Placebo +carboplatin +(nab)paclitaxel | KEYNOTE-407 |
| 1st-line metastatic NSCLC ($\geq 50\%$ TPS) | Pembrolizumab | Platinum based chemotherapy | KEYNOTE-024 |
| 1st-line treatment of metastatic or unresectable recurrent HNSCC as monotherapy | Pembrolizumab | Cetuximab +platinum +5-fluorouracil | KEYNOTE-048 |
| 1st-line treatment of metastatic or unresectable recurrent HNSCC as combination therapy | Pembrolizumab +platinum +5-fluorouracil | Cetuximab +platinum +5-fluorouracil | KEYNOTE-048 |
| 2nd-line recurrent or metastatic HNSCC ($\geq 50\%$ TPS) | Pembrolizumab | Docetaxel or Methotrexate or Cetuximab | KEYNOTE-040 |
| 1st-line treatment of advanced renal cell carcinoma | Pembrolizumab +axitinib | Sunitinib | KEYNOTE-426 |

Abbreviations: NSCLC, non-small cell lung-cancer; TNBC, triple-negative breast cancer; RCC, renal cell carcinoma; HNSCC, head and neck squamous cell carcinoma; TPS, tumor proportion score