

# 10-Year Impact on Productivity Costs Associated With Mortality in Stage III or IV Classical Hodgkin Lymphoma Based on the Overall Survival Update of the ECHELON-1 Trial: Application of an Oncology Simulation Model in the United States

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## Background

- Classical Hodgkin lymphoma (cHL) has a bimodal age distribution affecting younger individuals of working age as well as older adults<sup>1</sup>
- Consequently, Hodgkin lymphoma (HL) was predicted to have the second highest productivity costs lost per death as measured by present value lifetime earnings (PVLE) across site-specific cancers in the United States in 2010<sup>2</sup>
  - An estimated \$828,691,758 in productivity costs annually were lost due to mortality among adults with HL aged ≥20 years<sup>2</sup>
  - An estimated \$544,118 in productivity costs were lost per HL death<sup>2</sup>
- Approximately 30% of patients with newly diagnosed stage III or IV cHL are refractory to or relapse following treatment with ABVD (doxorubicin, bleomycin, vinblastine, dacarbazine)<sup>3</sup>
  - PET/CT imaging is important with frontline (1L) ABVD at initial staging and during follow-up, including after 2 cycles to adapt treatment based on response (RATHL 2016)<sup>4</sup>
- Based on the ECHELON-1 trial, 1L A+AVD (brentuximab vedotin in combination with doxorubicin, vinblastine, dacarbazine) is the first regimen to show an overall survival (OS) advantage compared with ABVD in patients with stage III or IV cHL in several decades and continues to show durable improvement in progression-free survival since FDA approval in 2018<sup>5</sup>
  - After approximately 6-years of follow-up, A+AVD demonstrated a 41% reduction in the risk of death (hazard ratio [HR]: 0.59; 95% CI: 0.40-0.88; *P*=0.009) and a 32% reduction in the risk of progression or death (HR: 0.68; 95% CI: 0.53-0.86) compared with ABVD
- The impact of the OS improvement with A+AVD versus ABVD on productivity costs in patients with stage III or IV cHL from a societal perspective has not been assessed

## Objective

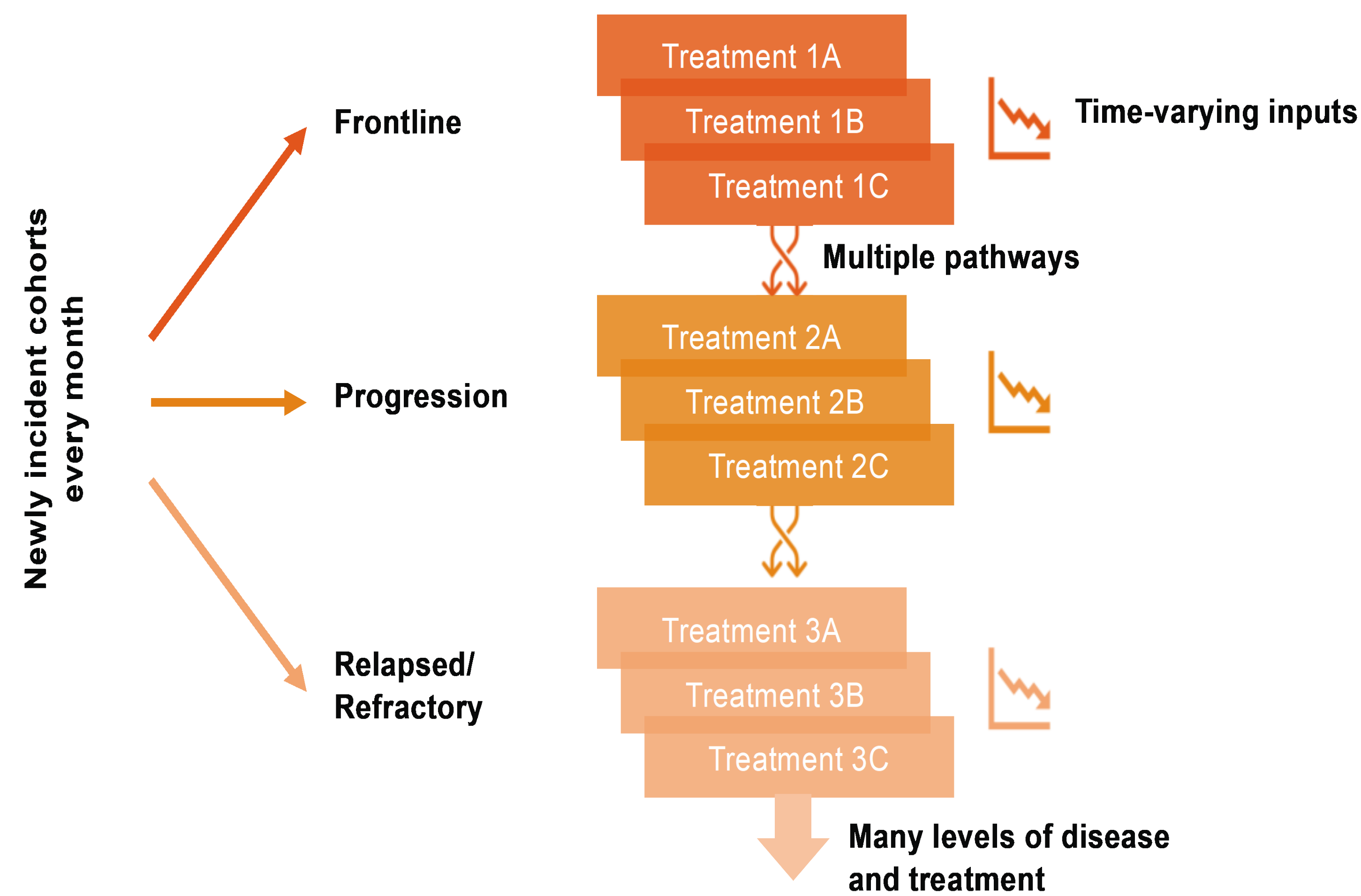
- To estimate the lifetime productivity impact due to mortality in patients newly diagnosed with stage III or IV cHL over 10 years in scenarios *without* and *with* 1L A+AVD, based on the OS results from ECHELON-1

## Methods

### Oncology Simulation Model

- An oncology simulation model (OSM) utilizing a dynamic cohort Markov model approach was leveraged to estimate long-term survival (ie, mortality) over 10 years based on the annual prevalence of patients newly diagnosed with stage III or IV cHL<sup>6</sup> (Figure 1)
  - The OSM simulates the entire disease landscape from early- to late-stage cHL over time, accounting for continuous incidence of the disease at each stage, as well as progression from early to later stages
  - By allowing population characteristics, incidence rates, treatment efficacy, treatment patterns, and treatment availability to vary with time, the model can simulate real-world population dynamics<sup>7</sup>

Figure 1. Example Model Framework



### Population Inputs

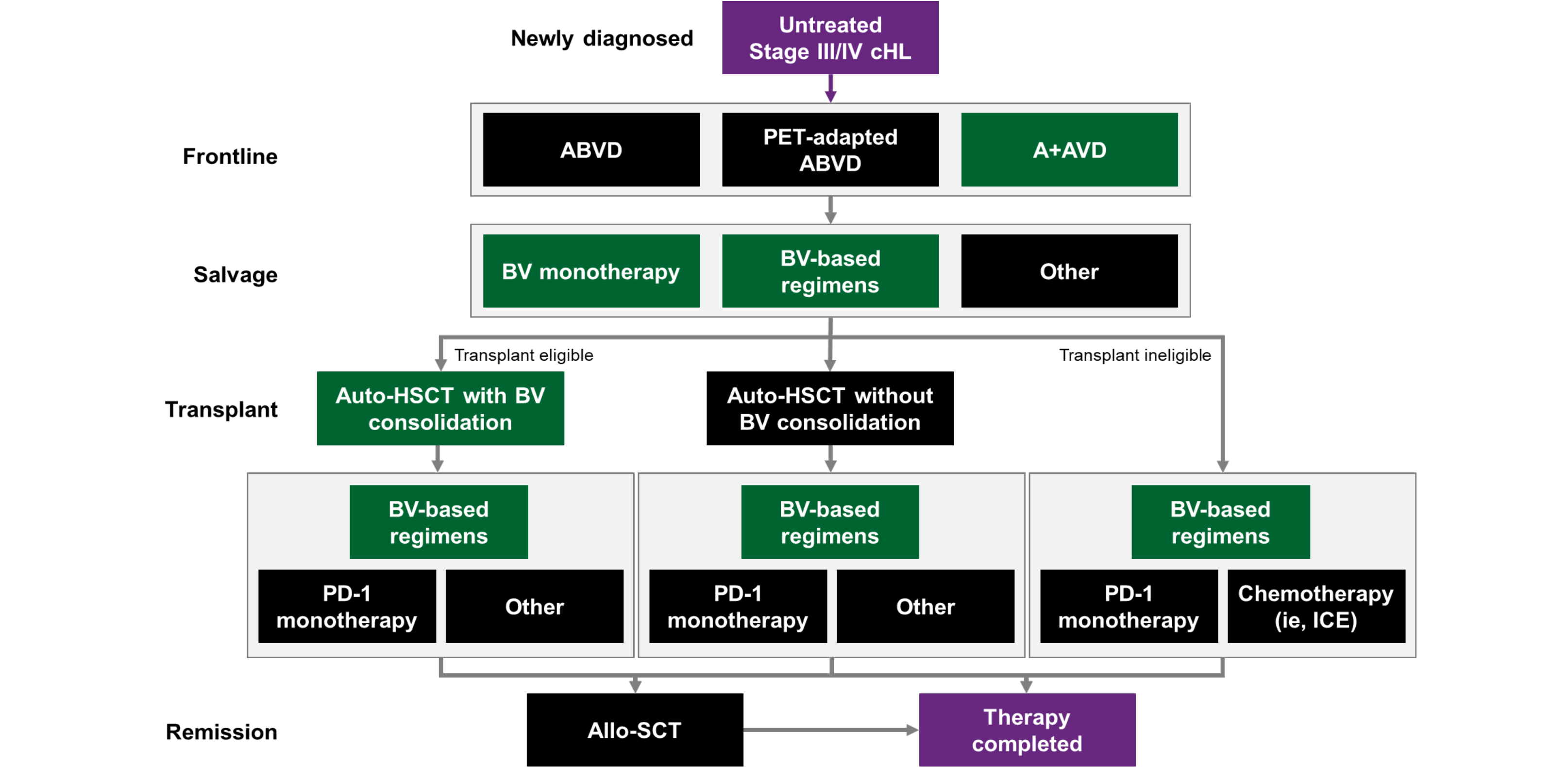
- Incidence of cHL was derived from the 2019 Surveillance, Epidemiology, and End Results (SEER) Program, assuming that 95% of HL cases are cHL and 41% of cHL cases are stage III or IV<sup>8,9</sup>

## Methods (cont'd)

### Treatment Patterns and Utilization

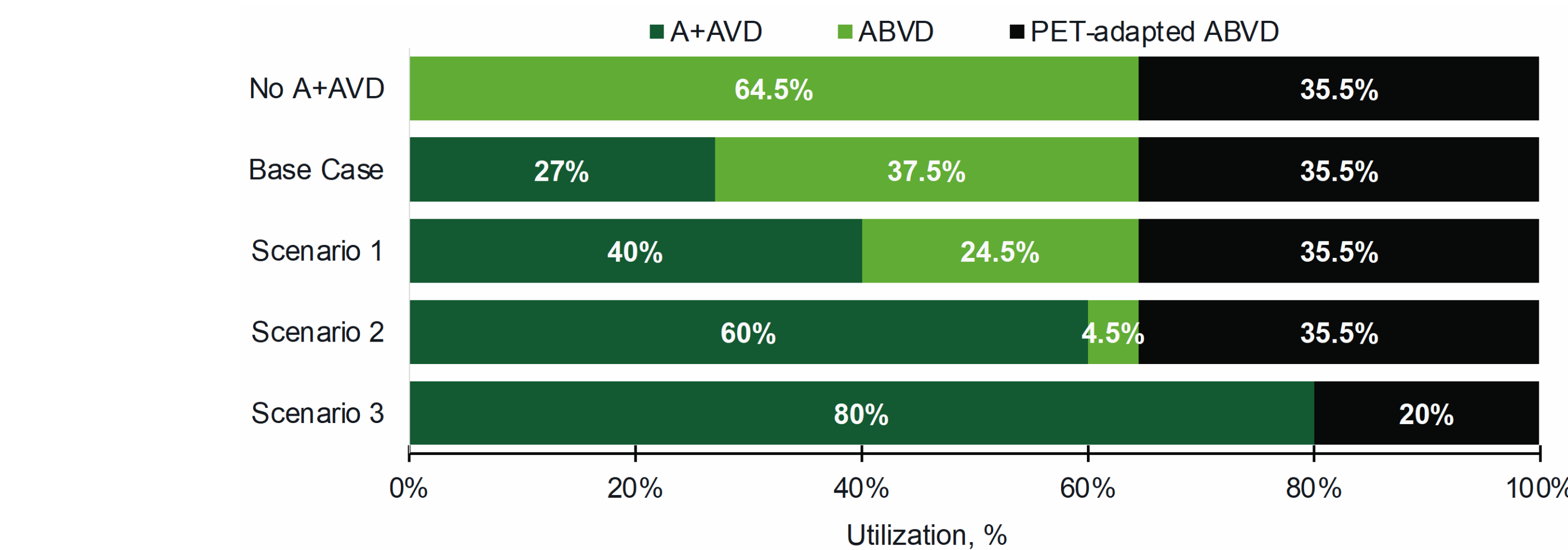
- The modeled treatment pathway was informed by NCCN guidelines (v2.2020)<sup>3</sup> and expert clinicians' consensus opinion on commonly used regimens for stage III or IV cHL; stem cell transplantation was assumed available at a single time point, after salvage therapy (Figure 2). For each 1-month cycle, patients with progressive disease moved to second-line/salvage therapy
- In the base case, a scenario *without* A+AVD (ABVD: 64.5%; PET-adapted therapy: 35.5%) was compared to a scenario *with* A+AVD (ABVD: 37.5%, PET-adapted therapy: 35.5%, A+AVD: 27%) as informed by real-world data sources (Figure 3)
- Scenario analyses varied 1L A+AVD utilization from 40% to 80% as recommended by expert clinicians' consensus opinion

Figure 2. Modeled Pathway



Abbreviations: ABVD, doxorubicin, bleomycin, vinblastine, dacarbazine; Allo-SCT, allogeneic stem cell transplantation; Auto-HSCT, autologous hematopoietic stem cell transplantation; A+AVD, doxorubicin, vinblastine, dacarbazine; BV, brentuximab vedotin; cHL, classical Hodgkin lymphoma; ICE, ifosfamide, carboplatin, etoposide; PD-1, programmed cell death protein 1; PET, positron emission tomography

Figure 3. Base Case and Scenario Analyses: Utilization Assumptions<sup>a</sup>



<sup>a</sup>Treatment utilization was informed by real-world data sources

Abbreviations: A+AVD, brentuximab vedotin, doxorubicin, vinblastine, and dacarbazine; ABVD, doxorubicin, bleomycin, vinblastine, dacarbazine; PET, positron emission tomography

### Productivity Costs

- Lost productivity costs due to mortality among patients newly diagnosed with stage III or IV cHL were estimated using the human capital approach<sup>10</sup>
  - Productivity costs are expressed in terms of PVLE, a measure of an individual's productivity expressed in terms of potential lifetime earnings
  - The model calculates earnings on a yearly cycle with each cycle reflecting the specific age and sex of the cohort in the future year to account for changing earning potential over time
  - The model assumes that individuals will be working and earning an income according to the pattern of earnings based on their age and sex in the US<sup>11</sup>
  - The lifetime earnings of patients across their life expectancy, accounting for cHL survival, provide the model outputs

### US Employment Rates and Earnings

- Employment rates (full- and part-time) and earnings by age and sex were informed by the Bureau of Labor Statistics (Table 1)<sup>11</sup>
  - Average wages were applied to the proportion of individuals employed to arrive at the projected lifetime earnings *without* and *with* A+AVD
  - Annual earnings were adjusted using the Consumer Price Index to reflect 2022 US dollars<sup>12,13</sup>
  - To account for fringe benefits (ie, vacation pay, leave and retirement benefits), full-time and part-time wages were increased by 29.8% and 19.3%<sup>14</sup>

## Methods (cont'd)

Table 1. US Employment Rates and Adjusted Earnings for 2022

| Age, y | Employed (full/part time), % |         | Earnings (full/part time), \$ <sup>a</sup> |               |
|--------|------------------------------|---------|--|---------------|
|        | Males                        | Females | Males                                      | Females       |
| 0-15   | 0/0                          | 0/0     | -  | -             |
| 16-19  | 12/20                        | 86/24   | 29,736/11,404                              | 26,485/11,351 |
| 20-24  | 49/17                        | 40/23   | 35,704/16,094                              | 33,040/15,188 |
| 25-34  |                              |         | 51,745/19,398                              | 47,055/19,771 |
| 35-44  | 79/50                        | 60/12   | 66,080/21,263                              | 52,917/20,890 |
| 45-54  |                              |         | 69,102/22,648                              | 54,036/21,050 |
| 55-64  |                              |         | 67,092/19,984                              | 52,011/20,090 |
| 65-69  |                              |         |  |               |
| 70-74  | 36/6                         | 24/8    | 59,632/18,492                              | 46,309/15,987 |
| ≥75    |                              |         |  |               |

<sup>a</sup>Note: The model assumes that individuals will be working and earning an income (therefore productive) according to the same pattern of earnings based on their age and sex throughout their lifetime. The oldest age category was reported as ≥75 years for percentage employed and ≥55 years for full- and part-time employment. The model assumed that the breakdown of full- and part-time employees ≥55 years remained constant at the rate reported for individuals aged ≥55 years.  
<sup>b</sup>2022 adjusted US dollars

## Results

- The annual number of newly diagnosed patients with stage III or IV cHL in 2031 was estimated at 3,654

### Base Case Analysis (27% A+AVD Utilization)

- Over 10 years:
  - The estimated total number of deaths was 2,650 *without* and 2,290 *with* 1L A+AVD (360 fewer deaths, 14% decrease)
  - The total PVLE loss was estimated at \$1.664 billion *without* 1L A+AVD vs \$1.438 billion *with* 1L A+AVD (\$226 million saved, 14% decrease)
- The overall estimated PVLE loss per death was \$628,000
- The model predicted that annually, for every 100 patients treated *with* A+AVD, 3.7 deaths would be avoided, equating to \$2.3 million in PVLE saved

### Scenario Analyses

- Varying 1L A+AVD utilization from 40% to 80% avoided 530-840 deaths (20%-32% decrease), equating to an estimated \$333 million to \$527 million in PVLE saved (20%-32% decrease) over 10 years compared to the scenario *without* 1L A+AVD (Table 2)

Table 2. Deaths Avoided and PVLE Saved Over 10 Years

| Frontline A+AVD Utilization | Total deaths over 10 yrs | Deaths avoided over 10 yrs <sup>a</sup> | PVLE loss over 10 yrs, USD | PVLE saved over 10 yrs, USD <sup>a</sup> |
|-----------------------------|--------------------------|---|----------------------------|--|
| None                        | 2,650                    | -                                       | \$1.664 billion            | -  |
| 27% (base case)             | 2,290                    | 360                                     | \$1.438 billion            | \$226 million                            |
| 40%                         | 2,120                    | 530                                     | \$1.331 billion            | \$333 million                            |
| 60%                         | 1,850                    | 800                                     | \$1.162 billion            | \$502 million                            |
| 80%                         | 1,810                    | 840                                     | \$1.137 billion            | \$527 million                            |

<sup>a</sup>Compared with a scenario without frontline A+AVD  
Abbreviations: A+AVD, brentuximab vedotin, doxorubicin, vinblastine, and dacarbazine; PVLE, present value lifetime earnings; USD, United States dollars

## Limitations

- Estimates are limited to projecting the incident diagnosis of cHL over the decade January 1, 2022, through December 31, 2031, and the estimated PVLE loss is calculated based on the deaths occurring within this period
- OS was extrapolated from the 6-year ECHELON-1 data and bounded by the general US population mortality
- The full impact on productivity is assumed to be determined by survival only; differences in productivity between patients who are progression free versus progressed or patients on versus off treatment were not accounted for due to a lack of published data

## Conclusions

- Estimated loss of productivity costs due to mortality in patients newly diagnosed with stage III or IV cHL are high and are comparable to previous estimates
- Our model quantifies how increasing 1L utilization of A+AVD compared with 1L ABVD in patients newly diagnosed with stage III or IV cHL leads to an estimated reduction in loss of productivity costs due to deaths avoided, based on the OS results from ECHELON-1
- Overall, long-term 6-year OS results of 1L A+AVD from ECHELON-1, the first study to show an improvement in OS compared with ABVD in stage III or IV cHL in several decades, may translate to a societal benefit through savings in productivity costs

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## Disclosures

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