

To estimate the **Potential Peak Sales** for pembrolizumab (KEYTRUDA) in the indication of locally recurrent unresectable or metastatic triple-negative breast cancer (TNBC) with PD-L1 expression (CPS  $\geq 10$ ) in the US, EU5 (Germany, France, Italy, Spain, UK), China, and Japan, as well as the **\$ value of a 1% share of treated patients** in these geographies, we need to follow a structured approach. This involves estimating the eligible patient population, treatment rates, market share, pricing, and other relevant factors. Since specific data (e.g., exact patient numbers, pricing in each region) may not be fully available, I will use reasonable assumptions based on publicly available information, epidemiology data, and industry standards as of my last update in October 2023. If you have specific data or updates, I can refine the calculations accordingly.

## **Step 1: Indication and Patient Population**

- **Indication:** Pembrolizumab is approved for locally recurrent unresectable or metastatic TNBC with PD-L1 expression (CPS  $\geq 10$ ).

- **Epidemiology of TNBC:**

- TNBC accounts for ~10-15% of all breast cancer cases.

- Of TNBC cases, ~40-50% are estimated to be PD-L1 positive (CPS  $\geq 10$ ), based on clinical trial data (e.g., KEYNOTE-355 trial).

- Focus on advanced/metastatic TNBC (Stage IV or recurrent unresectable), which is a smaller subset of total TNBC cases.

- **Geographical Incidence of Breast Cancer** (based on GLOBOCAN 2020 and other sources, adjusted for TNBC and metastatic cases):

- **US:** ~280,000 new breast cancer cases/year; ~15% TNBC (~42,000); ~10% metastatic at diagnosis or recurrence (~4,200); ~40% PD-L1+ (~1,680 eligible patients/year).

- **EU5:** ~250,000 new cases/year; ~15% TNBC (~37,500); ~10% metastatic (~3,750); ~40% PD-L1+ (~1,500 eligible patients/year).

- **China:** ~420,000 new cases/year; ~15% TNBC (~63,000); ~10% metastatic (~6,300); ~40% PD-L1+ (~2,520 eligible patients/year).

- **Japan:** ~90,000 new cases/year; ~15% TNBC (~13,500); ~10% metastatic (~1,350); ~40% PD-L1+ (~540 eligible patients/year).

- **Total Eligible Patients (Incident Cases/Year):**

- US: ~1,680

- EU5: ~1,500

- China: ~2,520

- Japan: ~540

- **Total:** ~6,240 patients/year (incident cases). Note that prevalence (existing patients) could be higher due to survival duration, but for peak sales, we often focus on annual treatment-eligible patients.

## **Step 2: Treatment Rate and Market Share**

- **Treatment Rate:** Not all eligible patients receive treatment due to access, cost, or clinical decisions. Assuming a treatment rate of 70-80% in developed markets (US, EU5, Japan) and 50-60% in China

due to access barriers:

- US: 75% (~1,260 treated patients/year)
- EU5: 75% (~1,125 treated patients/year)
- China: 55% (~1,386 treated patients/year)
- Japan: 75% (~405 treated patients/year)
- **Total Treated Patients:** ~4,176/year
- **Market Share for Pembrolizumab:** Given the query assumes a 20-30% share of treated patients:
  - At 20% share: ~835 patients treated with pembrolizumab/year
  - At 30% share: ~1,253 patients treated with pembrolizumab/year

### **Step 3: Pricing and Annual Cost of Therapy**

- Pembrolizumab is typically dosed at 200 mg every 3 weeks or 400 mg every 6 weeks. Annual cost varies by region due to pricing differences and healthcare systems.
- **Estimated Annual Cost per Patient** (based on list prices and industry reports as of 2023):
  - US: ~\$150,000/year (list price, though discounts/rebates may apply)
  - EU5: ~\$100,000/year (lower due to negotiations and health systems)
  - Japan: ~\$100,000/year (similar to EU5)
  - China: ~\$50,000/year (lower pricing due to market access agreements and generics/biosimilars competition)
- **Duration of Therapy:** For metastatic TNBC, median progression-free survival (PFS) in trials like KEYNOTE-355 is ~9-12 months with pembrolizumab + chemo. Assuming an average treatment duration of 1 year for simplicity.

### **Step 4: Potential Peak Sales Calculation**

Peak sales are calculated as: **Number of Treated Patients with Pembrolizumab × Annual Cost per Patient.**

#### At 20% Market Share:

- **US:** 1,260 treated patients × 20% = 252 patients × \$150,000 = **\$37.8 million**
- **EU5:** 1,125 treated patients × 20% = 225 patients × \$100,000 = **\$22.5 million**
- **China:** 1,386 treated patients × 20% = 277 patients × \$50,000 = **\$13.9 million**
- **Japan:** 405 treated patients × 20% = 81 patients × \$100,000 = **\$8.1 million**
- **Total Peak Sales at 20% Share:** **\$82.3 million/year**

#### At 30% Market Share:

- **US:** 1,260 treated patients × 30% = 378 patients × \$150,000 = **\$56.7 million**

- **EU5:**  $1,125 \text{ treated patients} \times 30\% = 338 \text{ patients} \times \$100,000 = \text{\$33.8 million}$
- **China:**  $1,386 \text{ treated patients} \times 30\% = 416 \text{ patients} \times \$50,000 = \text{\$20.8 million}$
- **Japan:**  $405 \text{ treated patients} \times 30\% = 122 \text{ patients} \times \$100,000 = \text{\$12.2 million}$
- **Total Peak Sales at 30% Share:** **\\$123.5 million/year**

## **Step 5: \$ Value of 1% Share of Treated Patients**

A 1% share of treated patients corresponds to 1% of the total treated patient population in each geography, multiplied by the annual cost per patient.

- **US:**  $1,260 \text{ treated patients} \times 1\% = 12.6 \text{ patients} \times \$150,000 = \text{\$1.89 million}$
- **EU5:**  $1,125 \text{ treated patients} \times 1\% = 11.25 \text{ patients} \times \$100,000 = \text{\$1.13 million}$
- **China:**  $1,386 \text{ treated patients} \times 1\% = 13.86 \text{ patients} \times \$50,000 = \text{\$0.69 million}$
- **Japan:**  $405 \text{ treated patients} \times 1\% = 4.05 \text{ patients} \times \$100,000 = \text{\$0.41 million}$
- **Total \$ Value of 1% Share Across All Geographies:** **\\$4.12 million**

## **Final Answer**

- **Potential Peak Sales for Pembrolizumab in TNBC (PD-L1 CPS  $\geq 10$ ) Indication:**
- At 20% market share: **\\$82.3 million/year**
- At 30% market share: **\\$123.5 million/year**
- **\$ Value of 1% Share of Treated Patients:**
- US: **\\$1.89 million**
- EU5: **\\$1.13 million**
- China: **\\$0.69 million**
- Japan: **\\$0.41 million**
- Total: **\\$4.12 million**

## **Notes and Caveats**

1. These estimates are based on assumptions for patient numbers, treatment rates, market share, and pricing. Real-world data may vary due to competition (e.g., other immunotherapies), access barriers, or changes in pricing.
2. Peak sales could be higher if prevalence (existing patients) is considered or if treatment duration exceeds 1 year for some patients.
3. Pembrolizumab is used in combination with chemotherapy, but the sales estimate here reflects only pembrolizumab's contribution (not chemo costs).
4. Market dynamics (e.g., biosimilars, payer negotiations) could impact pricing and share over time.
5. If you have specific data on patient numbers, pricing, or market share, I can refine the calculations.

Let me know if you'd like a deeper dive into any specific region or aspect!