

## HIGHLIGHTS OF PRESCRIBING INFORMATION

These highlights do not include all the information needed to use Pemetrexed for Injection safely and effectively. See full prescribing information for Pemetrexed for Injection.

**Pemetrexed for injection, for intravenous use**  
Initial U.S. Approval: 2004

### INDICATIONS AND USAGE

Pemetrexed for Injection is a folate analog metabolic inhibitor indicated:

- in combination with cisplatin for the initial treatment of patients with locally advanced or metastatic, non-squamous NSCLC. (1.1)
- as a single agent for the maintenance treatment of patients with locally advanced or metastatic, non-squamous NSCLC whose disease has not progressed after four cycles of platinum-based first-line chemotherapy. (1.1)
- as a single agent for the treatment of patients with recurrent, metastatic non-squamous, NSCLC after prior chemotherapy. (1.1)

**Limitations of Use:** Pemetrexed for Injection is not indicated for the treatment of patients with squamous cell, non-small cell lung cancer. (1.1)

- initial treatment, in combination with cisplatin, of patients with malignant pleural mesothelioma whose disease is unresectable or who are otherwise not candidates for curative surgery. (1.2)

### DOSAGE AND ADMINISTRATION

- The recommended dose of Pemetrexed for Injection, administered as a single agent or with cisplatin, in patients with creatinine clearance of 45 mL/minute or greater is 500 mg/m<sup>2</sup> as an intravenous infusion over 10 minutes on Day 1 of each 21-day cycle. (2.1, 2.2.)
- Initiate folic acid 400 mcg to 1000 mcg orally, once daily, beginning 7 days prior to the first dose of Pemetrexed for Injection and continue until 21 days after the last dose of Pemetrexed for Injection. (2.4)
- Administer vitamin B<sub>12</sub>, 1 mg intramuscularly, 1 week prior to the first dose of Pemetrexed for Injection and every 3 cycles. (2.4)
- Administer dexamethasone 4 mg orally, twice daily the day before, the day of, and the day after Pemetrexed for Injection administration. (2.4)

### DOSAGE FORMS AND STRENGTHS

For Injection: 100 mg or 500 mg pemetrexed equivalent to 118.3 mg or 591.5 mg pemetrexed dipotassium as lyophilized powder in single-dose vial (3)

### CONTRAINDICATIONS

History of severe hypersensitivity reaction to pemetrexed. (4)

### WARNINGS AND PRECAUTIONS

- Myelosuppression: Can cause severe bone marrow suppression resulting in cytopenia and an increased risk of infection. Do not administer Pemetrexed for Injection when the absolute neutrophil count is less than 1500 cells/mm<sup>3</sup> and platelets are less than 100,000 cells/mm<sup>3</sup>. Initiate supplementation with oral folic acid and intramuscular vitamin B<sub>12</sub> to reduce the severity of hematologic and gastrointestinal toxicity of Pemetrexed for Injection. (2.4, 5.1)
- Renal Failure: Can cause severe, and sometimes fatal, renal failure. Do not administer when creatinine clearance is less than 45 mL/min. (2.3, 5.2)
- Bullous and Exfoliative Skin Toxicity: Permanently discontinue for severe and life-threatening bullous, blistering or exfoliating skin toxicity. (5.3)
- Interstitial Pneumonitis: Withhold for acute onset of new or progressive unexplained pulmonary symptoms. Permanently discontinue if pneumonitis is confirmed. (5.4)
- Radiation Recall: Can occur in patients who received radiation weeks to years previously; permanently discontinue for signs of radiation recall. (5.5)
- Embryo-Fetal Toxicity: Can cause fetal harm. Advise patients of the potential risk to a fetus and to use effective contraception. (5.7, 8.1, 8.3)

### ADVERSE REACTIONS

- The most common adverse reactions (incidence ≥20%) of pemetrexed, when administered as a single agent are fatigue, nausea, and anorexia. (6.1)
- The most common adverse reactions (incidence ≥20%) of pemetrexed when administered with cisplatin are vomiting, neutropenia, anemia, stomatitis/pharyngitis, thrombocytopenia, and constipation. (6.1)

To report SUSPECTED ADVERSE REACTIONS, contact Avyxa Pharma, LLC at 1-888-520-0954 or FDA at 1-800-FDA-1088 or [www.fda.gov/medwatch](http://www.fda.gov/medwatch).

### DRUG INTERACTIONS

Ibuprofen increased risk of pemetrexed toxicity in patients with mild to moderate renal impairment. Modify the ibuprofen dosage as recommended for patients with a creatinine clearance between 45 mL/min and 79 mL/min. (2.5, 5.6, 7)

### USE IN SPECIFIC POPULATIONS

Lactation: Advise not to breastfeed. (8.2)

See 17 for PATIENT COUNSELING INFORMATION and FDA-approved patient labeling.

Revised: 06/2024

**FULL PRESCRIBING INFORMATION: CONTENTS\***

**1 INDICATIONS AND USAGE**

- 1.1 Non-Squamous Non-Small Cell Lung Cancer (NSCLC)
- 1.2 Mesothelioma

**2 DOSAGE AND ADMINISTRATION**

- 2.1 Recommended Dosage for Non-Squamous NSCLC
- 2.2 Recommended Dosage for Mesothelioma
- 2.3 Renal Impairment
- 2.4 Premedication and Concomitant Medications to Mitigate Toxicity
- 2.5 Dosage Modification of Ibuprofen in Patients with Mild to Moderate Renal Impairment Receiving Pemetrexed for Injection
- 2.6 Dosage Modifications for Adverse Reactions
- 2.7 Preparation for Administration

**3 DOSAGE FORMS AND STRENGTHS**

**4 CONTRAINDICATIONS**

**5 WARNINGS AND PRECAUTIONS**

- 5.1 Myelosuppression and Increased Risk of Myelosuppression without Vitamin Supplementation
- 5.2 Renal Failure
- 5.3 Bullous and Exfoliative Skin Toxicity
- 5.4 Interstitial Pneumonitis
- 5.5 Radiation Recall
- 5.6 Increased Risk of Toxicity with Ibuprofen in Patients with Renal Impairment
- 5.7 Embryo-Fetal Toxicity

**6 ADVERSE REACTIONS**

- 6.1 Clinical Trials Experience
- 6.2 Postmarketing Experience

**7 DRUG INTERACTIONS**

**8 USE IN SPECIFIC POPULATIONS**

- 8.1 Pregnancy
- 8.2 Lactation
- 8.3 Females and Males of Reproductive Potential
- 8.4 Pediatric Use
- 8.5 Geriatric Use
- 8.6 Patients with Renal Impairment

**10 OVERDOSAGE**

**11 DESCRIPTION**

**12 CLINICAL PHARMACOLOGY**

- 12.1 Mechanism of Action
- 12.2 Pharmacodynamics
- 12.3 Pharmacokinetics

**13 NONCLINICAL TOXICOLOGY**

- 13.1 Carcinogenesis, Mutagenesis, Impairment of Fertility

**14 CLINICAL STUDIES**

- 14.1 Non-squamous NSCLC
- 14.2 Mesothelioma

**15 REFERENCES**

**16 HOW SUPPLIED/STORAGE AND HANDLING**

**17 PATIENT COUNSELING INFORMATION**

\*Sections or subsections omitted from the full prescribing information are not listed.

## FULL PRESCRIBING INFORMATION

### 1 INDICATIONS AND USAGE

#### 1.1 Non-Squamous Non-Small Cell Lung Cancer (NSCLC)

Pemetrexed for Injection is indicated for:

- in combination with cisplatin for the initial treatment of patients with locally advanced or metastatic, non-squamous NSCLC.
- as a single agent for the maintenance treatment of patients with locally advanced or metastatic, non-squamous NSCLC whose disease has not progressed after four cycles of platinum-based first-line chemotherapy.
- as a single agent for the treatment of patients with recurrent, metastatic non-squamous, NSCLC after prior chemotherapy.

Limitations of Use: Pemetrexed for Injection is not indicated for the treatment of patients with squamous cell, non-small cell lung cancer [see *Clinical Studies (14.1)*].

#### 1.2 Mesothelioma

Pemetrexed for Injection is indicated, in combination with cisplatin, for the initial treatment of patients with malignant pleural mesothelioma whose disease is unresectable or who are otherwise not candidates for curative surgery.

### 2 DOSAGE AND ADMINISTRATION

#### 2.1 Recommended Dosage for Non-Squamous NSCLC

- The recommended dose of Pemetrexed for Injection when administered with cisplatin for initial treatment of locally advanced or metastatic non-squamous NSCLC in patients with a creatinine clearance (calculated by Cockcroft-Gault equation) of 45 mL/min or greater is 500 mg/m<sup>2</sup> as an intravenous infusion over 10 minutes administered prior to cisplatin on Day 1 of each 21-day cycle for up to six cycles in the absence of disease progression or unacceptable toxicity.
- The recommended dose of Pemetrexed for Injection for maintenance treatment of non-squamous NSCLC in patients with a creatinine clearance (calculated by Cockcroft-Gault equation) of 45 mL/min or greater is 500 mg/m<sup>2</sup> as an intravenous infusion over 10 minutes on Day 1 of each 21-day cycle until disease progression or unacceptable toxicity after four cycles of platinum-based first-line chemotherapy.
- The recommended dose of Pemetrexed for Injection for treatment of recurrent non-squamous NSCLC in patients with a creatinine clearance (calculated by Cockcroft-Gault equation) of 45 mL/min or greater is 500 mg/m<sup>2</sup> as an intravenous infusion over 10 minutes on Day 1 of each 21-day cycle until disease progression or unacceptable toxicity.

#### 2.2 Recommended Dosage for Mesothelioma

- The recommended dose of Pemetrexed for Injection, when administered with cisplatin, in patients with a creatinine clearance (calculated by Cockcroft-Gault equation) of 45 mL/min or greater is 500 mg/m<sup>2</sup> as an intravenous infusion over 10 minutes on Day 1 of each 21-day cycle until disease progression or unacceptable toxicity.

#### 2.3 Renal Impairment

- Pemetrexed for Injection dosing recommendations are provided for patients with a creatinine clearance (calculated by Cockcroft-Gault equation) of 45 mL/min or greater [see *Dosage*

and Administration (2.1, 2.2)]. There is no recommended dose for patients whose creatinine clearance is less than 45 mL/min [see Use in Specific Populations (8.6)].

## 2.4 Premedication and Concomitant Medications to Mitigate Toxicity

### Vitamin Supplementation

- Initiate folic acid 400 mcg to 1000 mcg orally once daily, beginning 7 days before the first dose of Pemetrexed for Injection and continuing until 21 days after the last dose of Pemetrexed for Injection [see Warnings and Precautions (5.1)].
  - Administer vitamin B<sub>12</sub>, 1 mg intramuscularly, 1 week prior to the first dose of Pemetrexed for Injection and every 3 cycles thereafter. Subsequent vitamin B<sub>12</sub> injections may be given the same day as treatment with Pemetrexed for Injection [see Warnings and Precautions (5.1)].
- Do not substitute oral vitamin B<sub>12</sub> for intramuscular vitamin B<sub>12</sub>.**

### Corticosteroids

- Administer dexamethasone 4 mg orally twice daily for three consecutive days, beginning the day before each Pemetrexed for Injection administration.

## 2.5 Dosage Modification of Ibuprofen in Patients with Mild to Moderate Renal Impairment Receiving Pemetrexed for Injection

In patients with creatinine clearances between 45 mL/min and 79 mL/min, modify administration of ibuprofen as follows [see Warnings and Precautions (5.6), Drug Interactions (7) and Clinical Pharmacology (12.3)]:

- Avoid administration of ibuprofen for 2 days before, the day of, and 2 days following administration of Pemetrexed for Injection.
- Monitor patients more frequently for myelosuppression, renal, and gastrointestinal toxicity, if concomitant administration of ibuprofen cannot be avoided.

## 2.6 Dosage Modifications for Adverse Reactions

Obtain complete blood count on Days 1, 8, and 15 of each cycle. Assess creatinine clearance prior to each cycle. Do not administer Pemetrexed for Injection if the creatinine clearance is less than 45 mL/min.

Delay initiation of the next cycle of Pemetrexed for Injection until:

- recovery of non-hematologic toxicity to Grade 0-2,
- absolute neutrophil count (ANC) is 1500 cells/mm<sup>3</sup> or higher, and
- platelet count is 100,000 cells/mm<sup>3</sup> or higher.

Upon recovery, modify the dosage of Pemetrexed for Injection in the next cycle as specified in Table 1.

For dosing modifications for cisplatin, refer to the prescribing information.

**Table 1: Recommended Dosage Modifications for Adverse Reactions<sup>a</sup>**

Toxicity in Most Recent Treatment Cycle	Pemetrexed for Injection Dose Modification for Next Cycle
<b>Myelosuppressive toxicity [see Warnings and Precautions (5.1)]</b>	
ANC less than 500/mm <sup>3</sup> <u>and</u> platelets greater than or equal to 50,000/mm <sup>3</sup> <u>OR</u> Platelet count less than 50,000/mm <sup>3</sup> without bleeding.	75% of previous dose

Platelet count less than 50,000/mm <sup>3</sup> with bleeding	50% of previous dose
Recurrent Grade 3 or 4 myelosuppression after 2 dose reductions	Discontinue
<b>Non-hematologic toxicity</b>	
Any Grade 3 or 4 toxicities EXCEPT mucositis or neurologic toxicity OR Diarrhea requiring hospitalization	75% of previous dose
Grade 3 or 4 mucositis	50% of previous dose
Renal toxicity [see <i>Warnings and Precautions (5.2)</i> ]	Withhold until creatinine clearance is 45 mL/min or greater
Grade 3 or 4 neurologic toxicity	Permanently discontinue
Recurrent Grade 3 or 4 non-hematologic toxicity after 2 dose reductions	Permanently discontinue
Severe and life-threatening Skin Toxicity [see <i>Warnings and Precautions (5.3)</i> ]	Permanently discontinue
Interstitial Pneumonitis [see <i>Warnings and Precautions (5.4)</i> ]	Permanently discontinue

<sup>a</sup> National Cancer Institute Common Toxicity Criteria for Adverse Events version 2 (NCI CTCAE v2)

## 2.7 Preparation for Administration

- Pemetrexed for Injection is a hazardous drug. Follow applicable special handling and disposal procedures.<sup>1</sup>
- Calculate the dose of Pemetrexed for Injection and determine the number of vials needed.
- Reconstitute Pemetrexed for Injection to achieve a concentration of 25 mg/mL as follows:
  - Reconstitute each 100-mg vial with 4.2 mL of 5% Dextrose Injection, USP (preservative-free)
  - Reconstitute each 500-mg vial with 20 mL of 5% Dextrose Injection, USP (preservative-free)
  - Do not use calcium-containing solutions for reconstitution.
- Gently swirl each vial until the powder is completely dissolved. The resulting solution is clear and ranges in color from colorless to yellow or green-yellow. FURTHER DILUTION IS REQUIRED prior to administration.
- Store reconstituted, preservative-free product under refrigerated conditions [2-8°C (36-46°F)] for no longer than 24 hours from the time of reconstitution. Discard vial after 24 hours.
- Inspect reconstituted product visually for particulate matter and discoloration prior to further dilution. If particulate matter is observed, discard vial.
- Withdraw the calculated dose of Pemetrexed for Injection from the vial(s) and discard vial with any unused portion.
- Further dilute Pemetrexed for Injection with 5% Dextrose Injection, USP to achieve a total volume of 100 mL for intravenous infusion.
- Store diluted, reconstituted product under refrigerated conditions [2-8°C (36-46°F)] for no more than 24 hours from the time of reconstitution. Discard after 24 hours.

### 3 DOSAGE FORMS AND STRENGTHS

For injection: 100 mg or 500 mg pemetrexed equivalent to 118.3 mg or 591.5 mg pemetrexed dipotassium as a sterile preservative free white to light-yellow or green-yellow lyophilized powder in single-dose vials for reconstitution.

### 4 CONTRAINDICATIONS

Pemetrexed for Injection is contraindicated in patients with a history of severe hypersensitivity reaction to pemetrexed [see *Adverse Reactions (6.1)*].

### 5 WARNINGS AND PRECAUTIONS

#### 5.1 Myelosuppression and Increased Risk of Myelosuppression without Vitamin Supplementation

Pemetrexed for Injection can cause severe myelosuppression resulting in a requirement for transfusions and which may lead to neutropenic infection. The risk of myelosuppression is increased in patients who do not receive vitamin supplementation. In Study JMCH, incidences of Grade 3-4 neutropenia (38% versus 23%), thrombocytopenia (9% versus 5%), febrile neutropenia (9% versus 0.6%), and neutropenic infection (6% versus 0) were higher in patients who received pemetrexed plus cisplatin without vitamin supplementation as compared to patients who were fully supplemented with folic acid and vitamin B<sub>12</sub> prior to and throughout pemetrexed plus cisplatin treatment.

Initiate supplementation with oral folic acid and intramuscular vitamin B<sub>12</sub> prior to the first dose of Pemetrexed for Injection; continue vitamin supplementation during treatment and for 21 days after the last dose of Pemetrexed for Injection to reduce the severity of hematologic and gastrointestinal toxicity of Pemetrexed for Injection [see *Dosage and Administration (2.4)*]. Obtain a complete blood count at the beginning of each cycle. Do not administer Pemetrexed for Injection until the ANC is at least 1500 cells/mm<sup>3</sup> and platelet count is at least 100,000 cells/mm<sup>3</sup>. Permanently reduce Pemetrexed for Injection in patients with an ANC of less than 500 cells/mm<sup>3</sup> or platelet count of less than 50,000 cells/mm<sup>3</sup> in previous cycles [see *Dosage and Administration (2.6)*].

In Studies JMDB and JMCH, among patients who received vitamin supplementation, incidence of Grade 3-4 neutropenia was 15% and 23%, the incidence of Grade 3-4 anemia was 6% and 4%, and incidence of Grade 3-4 thrombocytopenia was 4% and 5%, respectively. In Study JMCH, 18% of patients in the pemetrexed arm required red blood cell transfusions compared to 7% of patients in the cisplatin arm [see *Adverse Reactions (6.1)*]. In Studies JMEN, PARAMOUNT, and JMEI, where all patients received vitamin supplementation, incidence of Grade 3-4 neutropenia ranged from 3% to 5%, and incidence of Grade 3-4 anemia ranged from 3% to 5%.

#### 5.2 Renal Failure

Pemetrexed for Injection can cause severe, and sometimes fatal, renal toxicity. The incidences of renal failure in clinical studies in which patients received pemetrexed with cisplatin were: 2.1% in Study JMDB and 2.2% in Study JMCH. The incidence of renal failure in clinical studies in which patients received pemetrexed as a single agent ranged from 0.4% to 0.6% (Studies JMEN, PARAMOUNT, and JMEI [see *Adverse Reactions (6.1)*]. Determine creatinine clearance before each dose and periodically monitor renal function during treatment with Pemetrexed for

Injection. Withhold Pemetrexed for Injection in patients with a creatinine clearance of less than 45 mL/minute [see *Dosage and Administration (2.3)*].

### **5.3 Bullous and Exfoliative Skin Toxicity**

Serious and sometimes fatal, bullous, blistering and exfoliative skin toxicity, including cases suggestive of Stevens-Johnson Syndrome/Toxic epidermal necrolysis can occur with Pemetrexed for Injection. Permanently discontinue Pemetrexed for Injection for severe and life-threatening bullous, blistering or exfoliating skin toxicity.

### **5.4 Interstitial Pneumonitis**

Serious interstitial pneumonitis, including fatal cases, can occur with Pemetrexed for Injection treatment. Withhold Pemetrexed for Injection for acute onset of new or progressive unexplained pulmonary symptoms such as dyspnea, cough, or fever pending diagnostic evaluation. If pneumonitis is confirmed, permanently discontinue Pemetrexed for Injection.

### **5.5 Radiation Recall**

Radiation recall can occur with Pemetrexed for Injection in patients who have received radiation weeks to years previously. Monitor patients for inflammation or blistering in areas of previous radiation treatment. Permanently discontinue Pemetrexed for Injection for signs of radiation recall.

### **5.6 Increased Risk of Toxicity with Ibuprofen in Patients with Renal Impairment**

Exposure to pemetrexed is increased in patients with mild to moderate renal impairment who take concomitant ibuprofen, increasing the risks of adverse reactions of Pemetrexed for Injection. In patients with creatinine clearances between 45 mL/min and 79 mL/min, avoid administration of ibuprofen for 2 days before, the day of, and 2 days following administration of Pemetrexed for Injection. If concomitant ibuprofen use cannot be avoided, monitor patients more frequently for pemetrexed adverse reactions, including myelosuppression, renal, and gastrointestinal toxicity [see *Dosage and Administration (2.5)*, *Drug Interactions (7)*, and *Clinical Pharmacology (12.3)*].

### **5.7 Embryo-Fetal Toxicity**

Based on findings from animal studies and its mechanism of action, Pemetrexed for Injection can cause fetal harm when administered to a pregnant woman. In animal reproduction studies, intravenous administration of pemetrexed to pregnant mice during the period of organogenesis was teratogenic, resulting in developmental delays and increased malformations at doses lower than the recommended human dose of 500 mg/m<sup>2</sup>. Advise pregnant women of the potential risk to a fetus. Advise females of reproductive potential to use effective contraception during treatment with Pemetrexed for Injection and for 6 months after the last dose. Advise males with female partners of reproductive potential to use effective contraception during treatment with Pemetrexed for Injection and for 3 months after the last dose [see *Use in Specific Populations (8.1, 8.3)* and *Clinical Pharmacology (12.1)*].

## **6 ADVERSE REACTIONS**

The following adverse reactions are discussed in greater detail in other sections of the labeling:

- Myelosuppression [see *Warnings and Precautions (5.1)*]
- Renal failure [see *Warnings and Precautions (5.2)*]
- Bullous and exfoliative skin toxicity [see *Warning and Precautions (5.3)*]
- Interstitial pneumonitis [see *Warnings and Precautions (5.4)*]

- Radiation recall [see Warnings and Precautions (5.5)]

### 6.1 Clinical Trials Experience

Because clinical trials are conducted under widely varying conditions, adverse reactions rates cannot be directly compared to rates in other clinical trials and may not reflect the rates observed in clinical practice.

In clinical trials, the most common adverse reactions (incidence  $\geq 20\%$ ) of pemetrexed, when administered as a single agent, are fatigue, nausea, and anorexia. The most common adverse reactions (incidence  $\geq 20\%$ ) of pemetrexed, when administered in combination with cisplatin are vomiting, neutropenia, anemia, stomatitis/pharyngitis, thrombocytopenia, and constipation.

#### Non-Squamous NSCLC

##### *Initial Treatment in Combination with Cisplatin*

The safety of pemetrexed was evaluated in Study JMDB, a randomized (1:1), open-label, multicenter trial conducted in chemotherapy-naive patients with locally advanced or metastatic NSCLC. Patients received either pemetrexed 500 mg/m<sup>2</sup> intravenously and cisplatin 75 mg/m<sup>2</sup> intravenously on Day 1 of each 21-day cycle (n=839) or gemcitabine 1250 mg/m<sup>2</sup> intravenously on Days 1 and 8 and cisplatin 75 mg/m<sup>2</sup> intravenously on Day 1 of each 21-day cycle (n=830). All patients were fully supplemented with folic acid and vitamin B<sub>12</sub>.

Study JMDB excluded patients with an Eastern Cooperative Oncology Group Performance Status (ECOG PS of 2 or greater), uncontrolled third-space fluid retention, inadequate bone marrow reserve and organ function, or a calculated creatinine clearance less than 45 mL/min. Patients unable to stop using aspirin or other non-steroidal anti-inflammatory drugs or unable to take folic acid, vitamin B<sub>12</sub> or corticosteroids were also excluded from the study.

The data described below reflect exposure to pemetrexed plus cisplatin in 839 patients in Study JMDB. Median age was 61 years (range 26-83 years); 70% of patients were men; 78% were White, 16% were Asian, 2.9% were Hispanic or Latino, 2.1% were Black or African American, and <1% were other ethnicities; 36% had an ECOG PS 0. Patients received a median of 5 cycles of pemetrexed.

Table 2 provides the frequency and severity of adverse reactions that occurred in  $\geq 5\%$  of 839 patients receiving pemetrexed in combination with cisplatin in Study JMDB. Study JMDB was not designed to demonstrate a statistically significant reduction in adverse reaction rates for pemetrexed, as compared to the control arm, for any specified adverse reaction listed in Table 2.

**Table 2: Adverse Reactions Occurring in  $\geq 5\%$  of Fully Vitamin-Supplemented Patients Receiving Pemetrexed in Combination with Cisplatin Chemotherapy in Study JMDB**

Adverse Reaction <sup>a</sup>	Pemetrexed/Cisplatin (N=839)		Gemcitabine/Cisplatin (N=830)	
	All Grades (%)	Grade 3-4 (%)	All Grades (%)	Grade 3-4 (%)
<b>All adverse reactions</b>	90	37	91	53
<b>Laboratory</b>				
<b>Hematologic</b>				
Anemia	33	6	46	10
Neutropenia	29	15	38	27

Adverse Reaction <sup>a</sup>	Pemetrexed/Cisplatin (N=839)		Gemcitabine/Cisplatin (N=830)	
	All Grades (%)	Grade 3-4 (%)	All Grades (%)	Grade 3-4 (%)
Thrombocytopenia	10	4	27	13
<b>Renal</b>				
Elevated creatinine	10	1	7	1
<b>Clinical</b>				
<b>Constitutional symptoms</b>				
Fatigue	43	7	45	5
<b>Gastrointestinal</b>				
Nausea	56	7	53	4
Vomiting	40	6	36	6
Anorexia	27	2	24	1
Constipation	21	1	20	0
Stomatitis/pharyngitis	14	1	12	0
Diarrhea	12	1	13	2
Dyspepsia/heartburn	5	0	6	0
<b>Neurology</b>				
Sensory neuropathy	9	0	12	1
Taste disturbance	8	0	9	0
<b>Dermatology/Skin</b>				
Alopecia	12	0	21	1
Rash/Desquamation	7	0	8	1

<sup>a</sup> NCI CTCAE version 2.0.

The following additional adverse reactions of pemetrexed were observed.

**Incidence 1% to <5%**

*Body as a Whole* — febrile neutropenia, infection, pyrexia

*General Disorders* — dehydration

*Metabolism and Nutrition* — increased AST, increased ALT

*Renal* — renal failure

*Eye Disorder* — conjunctivitis

**Incidence <1%**

*Cardiovascular* — arrhythmia

*General Disorders* — chest pain

*Metabolism and Nutrition* — increased GGT

*Neurology* — motor neuropathy

**Maintenance Treatment Following First-line Non-Pemetrexed Containing Platinum-Based Chemotherapy**

In Study JMEN, the safety of pemetrexed was evaluated in a randomized (2:1), placebo-controlled, multicenter trial conducted in patients with non-progressive locally advanced or metastatic NSCLC following four cycles of a first-line, platinum-based chemotherapy regimen. Patients received either pemetrexed 500 mg/m<sup>2</sup> or matching placebo intravenously every 21 days until disease progression or unacceptable toxicity. Patients in both study arms were fully supplemented with folic acid and vitamin B<sub>12</sub>.

Study JMEN excluded patients with an ECOG PS of 2 or greater, uncontrolled third-space fluid retention, inadequate bone marrow reserve and organ function, or a calculated creatinine clearance less than 45 mL/min. Patients unable to stop using aspirin or other non-steroidal anti-inflammatory drugs or unable to take folic acid, vitamin B<sub>12</sub> or corticosteroids were also excluded from the study.

The data described below reflect exposure to pemetrexed in 438 patients in Study JMEN. Median age was 61 years (range 26-83 years), 73% of patients were men; 65% were White, 31% were Asian, 2.9% were Hispanic or Latino, and <2% were other ethnicities; 39% had an ECOG PS 0. Patients received a median of 5 cycles of pemetrexed and a relative dose intensity of pemetrexed of 96%. Approximately half the patients (48%) completed at least six, 21-day cycles and 23% completed ten or more 21-day cycles of pemetrexed.

Table 3 provides the frequency and severity of adverse reactions reported in ≥5% of the 438 pemetrexed-treated patients in Study JMEN.

**Table 3: Adverse Reactions Occurring in ≥5% Patients Receiving Pemetrexed in Study JMEN**

Adverse Reaction <sup>a</sup>	Pemetrexed (N=438)		Placebo (N=218)	
	All Grades (%)	Grade 3-4 (%)	All Grades (%)	Grade 3-4 (%)
<b>All adverse reactions</b>	66	16	37	4
<b>Laboratory</b>				
<b>Hematologic</b>				
Anemia	15	3	6	1
Neutropenia	6	3	0	0
<b>Hepatic</b>				
Increased ALT	10	0	4	0
Increased AST	8	0	4	0
<b>Clinical</b>				
<b>Constitutional symptoms</b>				
Fatigue	25	5	11	1
<b>Gastrointestinal</b>				
Nausea	19	1	6	1
Anorexia	19	2	5	0
Vomiting	9	0	1	0
Mucositis/stomatitis	7	1	2	0
Diarrhea	5	1	3	0
<b>Infection</b>	5	2	2	0
<b>Neurology</b>				
Sensory neuropathy	9	1	4	0
<b>Dermatology/Skin</b>				
Rash/desquamation	10	0	3	0

<sup>a</sup> NCI CTCAE version 3.0

The requirement for transfusions (9.5% versus 3.2%), primarily red blood cell transfusions, and for erythropoiesis stimulating agents (5.9% versus 1.8%) were higher in the pemetrexed arm compared to the placebo arm.

The following additional adverse reactions were observed in patients who received pemetrexed.

**Incidence 1% to <5%**

*Dermatology/Skin* — alopecia, pruritis/itching

*Gastrointestinal* — constipation

*General Disorders* — edema, fever

*Hematologic* — thrombocytopenia

*Eye Disorder* — ocular surface disease (including conjunctivitis), increased lacrimation

**Incidence <1%**

*Cardiovascular* — supraventricular arrhythmia

*Dermatology/Skin* — erythema multiforme

*General Disorders* — febrile neutropenia, allergic reaction/hypersensitivity

*Neurology* — motor neuropathy

*Renal* — renal failure

**Maintenance Treatment Following First-line Pemetrexed Plus Platinum Chemotherapy**

The safety of pemetrexed was evaluated in PARAMOUNT, a randomized (2:1), placebo-controlled study conducted in patients with non-squamous NSCLC with non-progressive (stable or responding disease) locally advanced or metastatic NSCLC following four cycles of pemetrexed in combination with cisplatin as first-line therapy for NSCLC. Patients were randomized to receive pemetrexed 500 mg/m<sup>2</sup> or matching placebo intravenously on Day 1 of each 21-day cycle until disease progression or unacceptable toxicity. Patients in both study arms received folic acid and vitamin B<sub>12</sub> supplementation.

PARAMOUNT excluded patients with an ECOG PS of 2 or greater, uncontrolled third-space fluid retention, inadequate bone marrow reserve and organ function, or a calculated creatinine clearance less than 45 mL/min. Patients unable to stop using aspirin or other non-steroidal anti-inflammatory drugs or unable to take folic acid, vitamin B<sub>12</sub> or corticosteroids were also excluded from the study.

The data described below reflect exposure to pemetrexed in 333 patients in PARAMOUNT. Median age was 61 years (range 32 to 83 years); 58% of patients were men; 94% were White, 4.8% were Asian, and <1% were Black or African American; 36% had an ECOG PS 0. The median number of maintenance cycles was 4 for pemetrexed and placebo arms. Dose reductions for adverse reactions occurred in 3.3% of patients in the pemetrexed arm and 0.6% in the placebo arm. Dose delays for adverse reactions occurred in 22% of patients in the pemetrexed arm and 16% in the placebo arm.

Table 4 provides the frequency and severity of adverse reactions reported in ≥5% of the 333 pemetrexed-treated patients in PARAMOUNT.

**Table 4: Adverse Reactions Occurring in ≥5% of Patients Receiving Pemetrexed in PARAMOUNT**

Adverse Reaction <sup>a</sup>	Pemetrexed (N=333)		Placebo (N=167)	
	All Grades (%)	Grade 3-4 (%)	All Grades (%)	Grades 3-4 (%)
<b>All adverse reactions</b>	53	17	34	4.8
<b>Laboratory</b>				

<b>Hematologic</b>				
Anemia	15	4.8	4.8	0.6
Neutropenia	9	3.9	0.6	0
<b>Clinical</b>				
<b>Constitutional symptoms</b>				
Fatigue	18	4.5	11	0.6
<b>Gastrointestinal</b>				
Nausea	12	0.3	2.4	0
Vomiting	6	0	1.8	0
Mucositis/stomatitis	5	0.3	2.4	0
<b>General disorders</b>				
Edema	5	0	3.6	0

<sup>a</sup> NCI CTCAE version 3.0

The requirement for red blood cell (13% versus 4.8%) and platelet (1.5% versus 0.6%) transfusions, erythropoiesis stimulating agents (12% versus 7%), and granulocyte colony stimulating factors (6% versus 0%) were higher in the pemetrexed arm compared to the placebo arm.

The following additional Grade 3 or 4 adverse reactions were observed more frequently in the pemetrexed arm.

**Incidence 1% to <5%**

*Blood/Bone Marrow* — thrombocytopenia

*General Disorders* — febrile neutropenia

**Incidence <1%**

*Cardiovascular* — ventricular tachycardia, syncope

*General Disorders* — pain

*Gastrointestinal* — gastrointestinal obstruction

*Neurologic* — depression

*Renal* — renal failure

*Vascular* — pulmonary embolism

*Treatment of Recurrent Disease After Prior Chemotherapy*

The safety of pemetrexed was evaluated in Study JME1, a randomized (1:1), open-label, active-controlled trial conducted in patients who had progressed following platinum-based chemotherapy. Patients received pemetrexed 500 mg/m<sup>2</sup> intravenously or docetaxel 75 mg/m<sup>2</sup> intravenously on Day 1 of each 21-day cycle. All patients on the pemetrexed arm received folic acid and vitamin B<sub>12</sub> supplementation.

Study JME1 excluded patients with an ECOG PS of 3 or greater, uncontrolled third-space fluid retention, inadequate bone marrow reserve and organ function, or a calculated creatinine clearance less than 45 mL/min. Patients unable to discontinue aspirin or other non-steroidal anti-inflammatory drugs or unable to take folic acid, vitamin B<sub>12</sub> or corticosteroids were also excluded from the study.

The data described below reflect exposure to pemetrexed in 265 patients in Study JME1. Median age was 58 years (range 22 to 87 years); 73% of patients were men; 70% were White,

24% were Asian, 2.6% were Black or African American, 1.8% were Hispanic or Latino, and <2% were other ethnicities; 19% had an ECOG PS 0.

Table 5 provides the frequency and severity of adverse reactions reported in ≥5% of the 265 pemetrexed-treated patients in Study JMEI. Study JMEI is not designed to demonstrate a statistically significant reduction in adverse reaction rates for pemetrexed, as compared to the control arm, for any specified adverse reaction listed in the Table 5 below.

**Table 5: Adverse Reactions Occurring in ≥5% of Fully Supplemented Patients Receiving Pemetrexed in Study JMEI**

Adverse Reaction <sup>a</sup>	Pemetrexed (N=265)		Docetaxel (N=276)	
	All Grades (%)	Grades 3-4 (%)	All Grades (%)	Grades 3-4 (%)
<b>Laboratory</b>				
<b>Hematologic</b>				
Anemia	19	4	22	4
Neutropenia	11	5	45	40
Thrombocytopenia	8	2	1	0
<b>Hepatic</b>				
Increased ALT	8	2	1	0
Increased AST	7	1	1	0
<b>Clinical</b>				
<b>Gastrointestinal</b>				
Nausea	31	3	17	2
Anorexia	22	2	24	3
Vomiting	16	2	12	1
Stomatitis/pharyngitis	15	1	17	1
Diarrhea	13	0	24	3
Constipation	6	0	4	0
<b>Constitutional symptoms</b>				
Fatigue	34	5	36	5
Fever	8	0	8	0
<b>Dermatology/Skin</b>				
Rash/desquamation	14	0	6	0
Pruritus	7	0	2	0
Alopecia	6	1	38	2

<sup>a</sup> NCI CTCAE version 2.0.

The following additional adverse reactions were observed in patients assigned to receive pemetrexed.

**Incidence 1% to <5%**

*Body as a Whole* — abdominal pain, allergic reaction/hypersensitivity, febrile neutropenia, infection

*Dermatology/Skin* — erythema multiforme

*Neurology* — motor neuropathy, sensory neuropathy

**Incidence <1%**

*Cardiovascular* — supraventricular arrhythmias

## Renal — renal failure

### Mesothelioma

The safety of pemetrexed was evaluated in Study JMCH, a randomized (1:1), single-blind study conducted in patients with MPM who had received no prior chemotherapy for MPM. Patients received pemetrexed 500 mg/m<sup>2</sup> intravenously in combination with cisplatin 75 mg/m<sup>2</sup> intravenously on Day 1 of each 21-day cycle or cisplatin 75 mg/m<sup>2</sup> intravenously on Day 1 of each 21-day cycle administered until disease progression or unacceptable toxicity. Safety was assessed in 226 patients who received at least one dose of pemetrexed in combination with cisplatin and 222 patients who received at least one dose of cisplatin alone. Among 226 patients who received pemetrexed in combination with cisplatin, 74% (n=168) received full supplementation with folic acid and vitamin B<sub>12</sub> during study therapy, 14% (n=32) were never supplemented, and 12% (n=26) were partially supplemented.

Study JMCH excluded patients with Karnofsky Performance Scale (KPS) of less than 70, inadequate bone marrow reserve and organ function, or a calculated creatinine clearance less than 45 mL/min. Patients unable to stop using aspirin or other non-steroidal anti-inflammatory drugs were also excluded from the study.

The data described below reflect exposure to pemetrexed in 168 patients that were fully supplemented with folic acid and vitamin B<sub>12</sub>. Median age was 60 years (range 19 to 85 years); 82% were men; 92% were White, 5% were Hispanic or Latino, 3.0% were Asian, and <1% were other ethnicities; 54% had KPS of 90-100. The median number of treatment cycles administered was 6 in the pemetrexed/cisplatin fully supplemented group and 2 in the pemetrexed/cisplatin never supplemented group. Patients receiving pemetrexed in the fully supplemented group had a relative dose intensity of 93% of the protocol-specified pemetrexed dose intensity. The most common adverse reaction resulting in dose delay was neutropenia.

Table 6 provides the frequency and severity of adverse reactions ≥5% in the subgroup of pemetrexed-treated patients who were fully vitamin supplemented in Study JMCH. Study JMCH was not designed to demonstrate a statistically significant reduction in adverse reaction rates for pemetrexed, as compared to the control arm, for any specified adverse reaction listed in the table below.

**Table 6: Adverse Reactions Occurring in ≥5% of Fully Supplemented Subgroup of Patients Receiving Pemetrexed/Cisplatin in Study JMCH<sup>a</sup>**

Adverse Reaction <sup>b</sup>	Pemetrexed /cisplatin (N=168)		Cisplatin (N=163)	
	All Grades (%)	Grade 3-4 (%)	All Grades (%)	Grade 3-4 (%)
<b>Laboratory</b>				
<b>Hematologic</b>				
Neutropenia	56	23	13	3
Anemia	26	4	10	0
Thrombocytopenia	23	5	9	0
<b>Renal</b>				
Elevated creatinine	11	1	10	1
Decreased creatinine clearance	16	1	18	2

Adverse Reaction <sup>b</sup>	Pemetrexed /cisplatin (N=168)		Cisplatin (N=163)	
	All Grades (%)	Grade 3-4 (%)	All Grades (%)	Grade 3-4 (%)
<b>Clinical</b>				
<b>Eye Disorder</b>				
Conjunctivitis	5	0	1	0
<b>Gastrointestinal</b>				
Nausea	82	12	77	6
Vomiting	57	11	50	4
Stomatitis/pharyngitis	23	3	6	0
Anorexia	20	1	14	1
Diarrhea	17	4	8	0
Constipation	12	1	7	1
Dyspepsia	5	1	1	0
<b>Constitutional Symptoms</b>				
Fatigue	48	10	42	9
<b>Metabolism and Nutrition</b>				
Dehydration	7	4	1	1
<b>Neurology</b>				
Sensory neuropathy	10	0	10	1
Taste disturbance	8	0	6	0
<b>Dermatology/Skin</b>				
Rash	16	1	5	0
Alopecia	11	0	6	0

<sup>a</sup> In Study JMCH, 226 patients received at least one dose of pemetrexed in combination with cisplatin and 222 patients received at least one dose of cisplatin. Table 6 provides the ADRs for subgroup of patients treated with pemetrexed in combination with cisplatin (168 patients) or cisplatin alone (163 patients) who received full supplementation with folic acid and vitamin B<sub>12</sub> during study therapy.

<sup>b</sup> NCI CTCAE version 2.0

The following additional adverse reactions were observed in patients receiving pemetrexed plus cisplatin:

**Incidence 1% to <5%**

*Body as a Whole* — febrile neutropenia, infection, pyrexia

*Dermatology/Skin* — urticaria

*General Disorders* — chest pain

*Metabolism and Nutrition* — increased AST, increased ALT, increased GGT

*Renal* — renal failure

**Incidence <1%**

*Cardiovascular* — arrhythmia

*Neurology* — motor neuropathy

*Exploratory Subgroup Analyses based on Vitamin Supplementation*

Table 7 provides the results of exploratory analyses of the frequency and severity of NCI CTCAE Grade 3 or 4 adverse reactions reported in more pemetrexed-treated patients who did not receive vitamin supplementation (never supplemented) as compared with those who

received vitamin supplementation with daily folic acid and vitamin B<sub>12</sub> from the time of enrollment in Study JMCH (fully-supplemented).

**Table 7: Exploratory Subgroup Analysis of Selected Grade 3/4 Adverse Reactions Occurring in Patients Receiving Pemetrexed in Combination with Cisplatin with or without Full Vitamin Supplementation in Study JMCH<sup>a</sup>**

Grade 3-4 Adverse Reactions	Fully Supplemented Patients N=168 (%)	Never Supplemented Patients N=32 (%)
Neutropenia	23	38
Thrombocytopenia	5	9
Vomiting	11	31
Febrile neutropenia	1	9
Infection with Grade 3/4 neutropenia	0	6
Diarrhea	4	9

<sup>a</sup> NCI CTCAE version 2.0

The following adverse reactions occurred more frequently in patients who were fully vitamin supplemented than in patients who were never supplemented:

- hypertension (11% versus 3%),
- chest pain (8% versus 6%),
- thrombosis/embolism (6% versus 3%).

#### Additional Experience Across Clinical Trials

*Sepsis, with or without neutropenia, including fatal cases: 1%*

*Severe esophagitis, resulting in hospitalization: <1%*

## 6.2 Postmarketing Experience

The following adverse reactions have been identified during post-approval use of pemetrexed. Because these reactions are reported voluntarily from a population of uncertain size, it is not always possible to reliably estimate their frequency or establish a causal relationship to drug exposure.

*Blood and Lymphatic System* — immune-mediated hemolytic anemia

*Gastrointestinal* — colitis, pancreatitis

*General Disorders and Administration Site Conditions* — edema

*Injury, poisoning, and procedural complications* — radiation recall

*Respiratory* — interstitial pneumonitis

*Skin* — Serious and fatal bullous skin conditions, Stevens-Johnson syndrome, and toxic epidermal necrolysis

## 7 DRUG INTERACTIONS

### Effects of Ibuprofen on Pemetrexed

Ibuprofen increases exposure (AUC) of pemetrexed [see *Clinical Pharmacology* (12.3)]. In patients with creatinine clearance between 45 mL/min and 79 mL/min:

- Avoid administration of ibuprofen for 2 days before, the day of, and 2 days following administration of Pemetrexed for Injection [see *Dosage and Administration* (2.5)].

- Monitor patients more frequently for myelosuppression, renal, and gastrointestinal toxicity, if concomitant administration of ibuprofen cannot be avoided.

## 8 USE IN SPECIFIC POPULATIONS

### 8.1 Pregnancy

#### Risk Summary

Based on findings from animal studies and its mechanism of action, Pemetrexed for Injection can cause fetal harm when administered to a pregnant woman [see *Clinical Pharmacology (12.1)*]. There are no available data on pemetrexed use in pregnant women. In animal reproduction studies, intravenous administration of pemetrexed to pregnant mice during the period of organogenesis was teratogenic, resulting in developmental delays and malformations at doses lower than the recommended human dose of 500 mg/m<sup>2</sup> [see *Data*]. Advise pregnant women of the potential risk to a fetus [see *Use in Special Populations (8.3)*].

In the U.S. general population, the estimated background risk of major birth defects and miscarriage in clinically recognized pregnancies is 2 to 4% and 15 to 20%, respectively.

#### Data

##### *Animal Data*

Pemetrexed was teratogenic in mice. Daily dosing of pemetrexed by intravenous injection to pregnant mice during the period of organogenesis increased the incidence of fetal malformations (cleft palate; protruding tongue; enlarged or misshaped kidney; and fused lumbar vertebra) at doses (based on BSA) 0.03 times the human dose of 500 mg/m<sup>2</sup>. At doses, based on BSA, greater than or equal to 0.0012 times the 500 mg/m<sup>2</sup> human dose, pemetrexed administration resulted in dose-dependent increases in developmental delays (incomplete ossification of talus and skull bone; and decreased fetal weight).

### 8.2 Lactation

#### Risk Summary

There is no information regarding the presence of pemetrexed or its metabolites in human milk, the effects on the breastfed infant, or the effects on milk production. Because of the potential for serious adverse reactions in breastfed infants from pemetrexed, advise women not to breastfeed during treatment with Pemetrexed for Injection and for one week after last dose.

### 8.3 Females and Males of Reproductive Potential

Based on animal data, pemetrexed can cause malformations and developmental delays when administered to a pregnant woman [see *Use in Specific Populations (8.1)*].

#### Pregnancy Testing

Verify pregnancy status of females of reproductive potential prior to initiating Pemetrexed for Injection [see *Use in Specific Populations (8.1)*].

#### Contraception

##### *Females*

Because of the potential for genotoxicity, advise females of reproductive potential to use effective contraception during treatment with Pemetrexed for Injection and for 6 months after the last dose.

### *Males*

Because of the potential for genotoxicity, advise males with female partners of reproductive potential to use effective contraception during treatment with Pemetrexed for Injection and for 3 months after the last dose [see *Nonclinical Toxicology (13.1)*].

### Infertility

#### *Males*

Pemetrexed for Injection may impair fertility in males of reproductive potential. It is not known whether these effects on fertility are reversible [see *Nonclinical Toxicology (13.1)*].

## **8.4 Pediatric Use**

The safety and effectiveness of Pemetrexed for Injection in pediatric patients have not been established.

The safety and pharmacokinetics of pemetrexed were evaluated in two clinical studies conducted in pediatric patients with recurrent solid tumors (NCT00070473 N=32 and NCT00520936 N=72).

Patients in both studies received concomitant vitamin B<sub>12</sub> and folic acid supplementation and dexamethasone.

No tumor responses were observed. Adverse reactions observed in pediatric patients were similar to those observed in adults.

Single-dose pharmacokinetics of pemetrexed were evaluated in 22 patients age 4 to 18 years enrolled in NCT00070473 were within range of values in adults.

## **8.5 Geriatric Use**

Of the 3,946 patients enrolled in clinical studies of pemetrexed, 34% were 65 and over and 4% were 75 and over. No overall differences in effectiveness were observed between these patients and younger patients. The incidences of Grade 3-4 anemia, fatigue, thrombocytopenia, hypertension, and neutropenia were higher in patients 65 years of age and older as compared to younger patients: in at least one of five randomized clinical trials. [see *Adverse Reactions (6.1)* and *Clinical Studies (14.1, 14.2)*].

## **8.6 Patients with Renal Impairment**

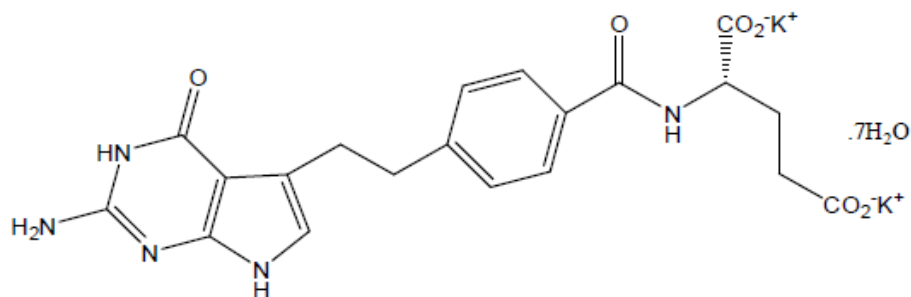
Pemetrexed is primarily excreted by the kidneys. Decreased renal function results in reduced clearance and greater exposure (AUC) to pemetrexed compared with patients with normal renal function [see *Warnings and Precautions (5.2, 5.6)* and *Clinical Pharmacology (12.3)*]. No dose is recommended for patients with creatinine clearance less than 45 mL/min [see *Dosage and Administration (2.3)*].

## **10 OVERDOSAGE**

No drugs are approved for the treatment of pemetrexed overdose. Based on animal studies, administration of leucovorin may mitigate the toxicities of pemetrexed overdose. It is not known whether pemetrexed is dialyzable.

## 11 DESCRIPTION

Pemetrexed is a folate analog metabolic inhibitor. The drug substance is pemetrexed dipotassium heptahydrate, has the chemical name L-glutamic acid, N-[4-[2-(2-amino-4,7-dihydro-4-oxo-1H-pyrrolo[2,3-d]pyrimidin-5-yl)ethyl]benzoyl]-, dipotassium salt, heptahydrate. It is a white to off-white powder having blue or green tinge with a molecular formula of  $C_{20}H_{19}K_2N_5O_6 \cdot 7 H_2O$  and a molecular weight of 629.49. Pemetrexed dipotassium is freely soluble in water. The reported pKaS are 3.6 and 4.5. The structural formula of pemetrexed dipotassium heptahydrate is as follows:



Pemetrexed for Injection is supplied as a sterile white to light-yellow or green-yellow lyophilized powder or cake for intravenous infusion available in single-dose vials. Each 100-mg or 500-mg vial of Pemetrexed for Injection contains 100 mg pemetrexed equivalent to 118.3 mg pemetrexed dipotassium and 106 mg mannitol or 500 mg pemetrexed equivalent to 591.5 mg pemetrexed dipotassium and 500 mg mannitol, respectively. Hydrochloric acid may have been added to adjust the pH.

## 12 CLINICAL PHARMACOLOGY

### 12.1 Mechanism of Action

Pemetrexed is a folate analog metabolic inhibitor that disrupts folate-dependent metabolic processes essential for cell replication. In vitro studies show that pemetrexed inhibits thymidylate synthase (TS), dihydrofolate reductase, and glycinamide ribonucleotide formyltransferase (GARFT), which are folate-dependent enzymes involved in the de novo biosynthesis of thymidine and purine nucleotides. Pemetrexed is taken into cells by membrane carriers such as the reduced folate carrier and membrane folate binding protein transport systems. Once in the cell, pemetrexed is converted to polyglutamate forms by the enzyme folylpolyglutamate synthetase. The polyglutamate forms are retained in cells and are inhibitors of TS and GARFT.

### 12.2 Pharmacodynamics

Pemetrexed inhibited the in vitro growth of mesothelioma cell lines (MSTO-211H, NCI-H2052) and showed synergistic effects when combined with cisplatin.

Based on population pharmacodynamic analyses, the depth of the absolute neutrophil counts (ANC) nadir correlates with the systemic exposure to pemetrexed and supplementation with folic acid and vitamin B<sub>12</sub>. There is no cumulative effect of pemetrexed exposure on ANC nadir over multiple treatment cycles.

## 12.3 Pharmacokinetics

### Absorption

The pharmacokinetics of pemetrexed when pemetrexed was administered as a single agent in doses ranging from 0.2 to 838 mg/m<sup>2</sup> infused over a 10-minute period have been evaluated in 426 cancer patients with a variety of solid tumors. Pemetrexed total systemic exposure (AUC) and maximum plasma concentration (C<sub>max</sub>) increased proportionally with increase of dose. The pharmacokinetics of pemetrexed did not change over multiple treatment cycles.

### Distribution

Pemetrexed has a steady-state volume of distribution of 16.1 liters. In vitro studies indicated that pemetrexed is 81% bound to plasma proteins.

### Elimination

The total systemic clearance of pemetrexed is 91.8 mL/min and the elimination half-life of pemetrexed is 3.5 hours in patients with normal renal function (creatinine clearance of 90 mL/min). As renal function decreases, the clearance of pemetrexed decreases and exposure (AUC) of pemetrexed increases.

### *Metabolism*

Pemetrexed is not metabolized to an appreciable extent.

### *Excretion*

Pemetrexed is primarily eliminated in the urine, with 70% to 90% of the dose recovered unchanged within the first 24 hours following administration. In vitro studies indicated that pemetrexed is a substrate of OAT3 (organic anion transporter 3), a transporter that is involved in the active secretion of pemetrexed.

### Specific Populations

Age (26 to 80 years) and sex had no clinically meaningful effect on the systemic exposure of pemetrexed based on population pharmacokinetic analyses.

### *Racial Groups*

The pharmacokinetics of pemetrexed were similar in Whites and Blacks or African Americans. Insufficient data are available for other ethnic groups.

### *Patients with Hepatic Impairment*

Pemetrexed has not been formally studied in patients with hepatic impairment. No effect of elevated AST, ALT, or total bilirubin on the PK of pemetrexed was observed in clinical studies.

### *Patients with Renal Impairment*

Pharmacokinetic analyses of pemetrexed included 127 patients with impaired renal function. Plasma clearance of pemetrexed decreases as renal function decreases, with a resultant increase in systemic exposure. Patients with creatinine clearances of 45, 50, and 80 mL/min had 65%, 54%, and 13% increases, respectively in systemic exposure (AUC) compared to patients with creatinine clearance of 100 mL/min [see *Dosage and Administration (2.3)* and *Warnings and Precautions (5.2)*].

### *Third-Space Fluid*

The pemetrexed plasma concentrations in patients with various solid tumors with stable, mild to moderate third-space fluid were comparable to those observed in patients without third space fluid collections. The effect of severe third space fluid on pharmacokinetics is not known.

### Drug Interaction Studies

#### *Drugs Inhibiting OAT3 Transporter*

Ibuprofen, an OAT3 inhibitor, administered at 400 mg four times a day decreased the clearance of pemetrexed and increased its exposure (AUC) by approximately 20% in patients with normal renal function (creatinine clearance >80 mL/min).

#### *In Vitro Studies*

Pemetrexed is a substrate for OAT3. Ibuprofen, an OAT3 inhibitor inhibited the uptake of pemetrexed in OAT3-expressing cell cultures with an average  $[I_{50}]/IC_{50}$  ratio of 0.38. In vitro data predict that at clinically relevant concentrations, other NSAIDs (naproxen, diclofenac, celecoxib) would not inhibit the uptake of pemetrexed by OAT3 and would not increase the AUC of pemetrexed to a clinically significant extent. [see *Drug Interactions (7)*].

Pemetrexed is a substrate for OAT4. In vitro, ibuprofen and other NSAIDs (naproxen, diclofenac, celecoxib) are not inhibitors of OAT4 at clinically relevant concentrations.

#### *Aspirin*

Aspirin, administered in low to moderate doses (325 mg every 6 hours), does not affect the pharmacokinetics of pemetrexed.

#### *Cisplatin*

Cisplatin does not affect the pharmacokinetics of pemetrexed and the pharmacokinetics of total platinum are unaltered by pemetrexed.

#### *Vitamins*

Neither folic acid nor vitamin B<sub>12</sub> affect the pharmacokinetics of pemetrexed.

#### *Drugs Metabolized by Cytochrome P450 Enzymes*

In vitro studies suggest that pemetrexed does not inhibit the clearance of drugs metabolized by CYP3A, CYP2D6, CYP2C9, and CYP1A2.

## **13 NONCLINICAL TOXICOLOGY**

### **13.1 Carcinogenesis, Mutagenesis, Impairment of Fertility**

No carcinogenicity studies have been conducted with pemetrexed. Pemetrexed was clastogenic in an *in vivo* micronucleus assay in mouse bone marrow but was not mutagenic in multiple *in vitro* tests (Ames assay, Chinese Hamster Ovary cell assay).

Pemetrexed administered intraperitoneally at doses of  $\geq 0.1$  mg/kg/day to male mice (approximately 0.0006 times the recommended human dose based on BSA) resulted in reduced fertility, hypospermia, and testicular atrophy.

## 14 CLINICAL STUDIES

### 14.1 Non-Squamous NSCLC

#### Initial Treatment in Combination with Cisplatin

The efficacy of pemetrexed was evaluated in Study JMDB (NCT00087711), a multi-center, randomized (1:1), open-label study conducted in 1725 chemotherapy-naive patients with Stage IIIb/IV NSCLC. Patients were randomized to receive pemetrexed with cisplatin or gemcitabine with cisplatin. Randomization was stratified by Eastern Cooperative Oncology Group Performance Status (ECOG PS 0 versus 1), gender, disease stage, basis for pathological diagnosis (histopathological/cytopathological), history of brain metastases, and investigative center. Pemetrexed was administered intravenously over 10 minutes at a dose of 500 mg/m<sup>2</sup> on Day 1 of each 21-day cycle. Cisplatin was administered intravenously at a dose of 75 mg/m<sup>2</sup> approximately 30 minutes after pemetrexed administration on Day 1 of each cycle, gemcitabine was administered at a dose of 1250 mg/m<sup>2</sup> on Day 1 and Day 8, and cisplatin was administered intravenously at a dose of 75 mg/m<sup>2</sup> approximately 30 minutes after administration of gemcitabine, on Day 1 of each 21-day cycle. Treatment was administered up to a total of 6 cycles; patients in both arms received folic acid, vitamin B<sub>12</sub>, and dexamethasone [see *Dosage and Administration* (2.4)]. The primary efficacy outcome measure was overall survival.

A total of 1725 patients were enrolled with 862 patients randomized to pemetrexed in combination with cisplatin and 863 patients to gemcitabine in combination with cisplatin. The median age was 61 years (range 26-83 years), 70% were male, 78% were White, 17% were Asian, 2.9% were Hispanic or Latino, and 2.1% were Black or African American, and <1% were other ethnicities. Among patients for whom ECOG PS (n=1722) and smoking history (n=1516) were collected, 65% had an ECOG PS of 1, 36% had an ECOG PS of 0, and 84% were smokers. For tumor characteristics, 73% had non-squamous NSCLC and 27% had squamous NSCLC; 76% had Stage IV disease. Among 1252 patients with non-squamous NSCLC histology, 68% had a diagnosis of adenocarcinoma, 12% had large cell histology and 20% had other histologic subtypes.

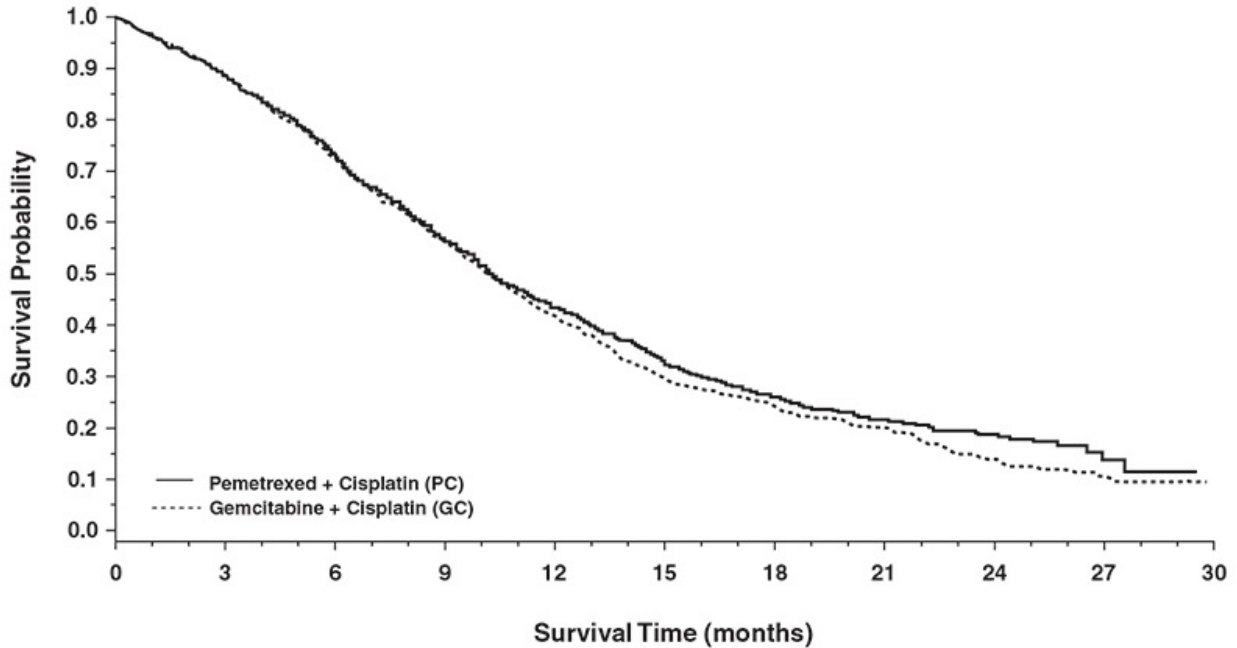
Efficacy results in Study JMDB are presented in Table 8 and Figure 1.

**Table 8: Efficacy Results in Study JMDB**

<b>Efficacy Parameter</b>	<b>Pemetrexed plus Cisplatin (N=862)</b>	<b>Gemcitabine plus Cisplatin (N=863)</b>
<b>Overall Survival</b>		
Median (months) (95% CI)	10.3 (9.8-11.2)	10.3 (9.6-10.9)
Hazard ratio (HR) <sup>a,b</sup> (95% CI)	0.94 (0.84-1.05)	
<b>Progression-Free Survival</b>		
Median (months) (95% CI)	4.8 (4.6-5.3)	5.1 (4.6-5.5)
Hazard ratio (HR) <sup>a,b</sup> (95% CI)	1.04 (0.94-1.15)	
<b>Overall Response Rate</b> (95% CI)	27.1% (24.2-30.1)	24.7% (21.8-27.6)

<sup>a</sup> Unadjusted for multiple comparisons.

<sup>b</sup> Adjusted for gender, stage, basis of diagnosis, and performance status.



Patients at Risk		Survival Time (months)									
	0	3	6	9	12	15	18	21	24	27	30
PC	862	737	598	458	341	235	146	88	45	10	0
GC	863	731	590	456	327	209	139	78	34	14	0

**Figure 1: Kaplan-Meier Curves for Overall Survival in Study JMDB**

In pre-specified analyses assessing the impact of NSCLC histology on overall survival, clinically relevant differences in survival according to histology were observed. These subgroup analyses are shown in Table 9 and Figures 2 and 3. This difference in treatment effect for pemetrexed based on histology demonstrating a lack of efficacy in squamous cell histology was also observed in Studies JMEN and JMEI.

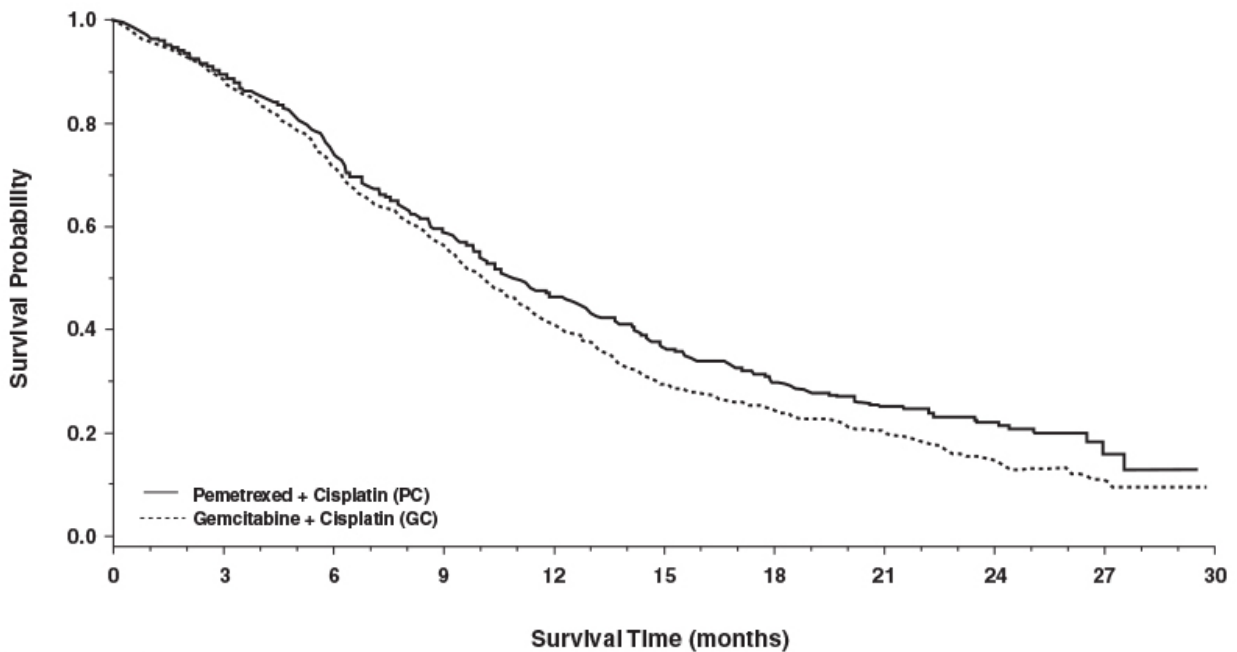
**Table 9: Overall Survival in NSCLC Histologic Subgroups in Study JMDB**

Histologic Subgroups	Pemetrexed plus Cisplatin (N=862)	Gemcitabine plus Cisplatin (N=863)
<b>Non-squamous NSCLC (N=1252)</b>		
Median (months) (95% CI)	11.0 (10.1-12.5)	10.1 (9.3-10.9)
HR <sup>a,b</sup> (95% CI)	0.84 (0.74-0.96)	
<b>Adenocarcinoma (N=847)</b>		
Median (months) (95% CI)	12.6 (10.7-13.6)	10.9 (10.2-11.9)
HR <sup>a,b</sup> (95% CI)	0.84 (0.71-0.99)	
<b>Large Cell (N=153)</b>		
Median (months) (95% CI)	10.4 (8.6-14.1)	6.7 (5.5-9.0)
HR <sup>a,b</sup> (95% CI)	0.67 (0.48-0.96)	
<b>Non-squamous, not otherwise specified (N=252)</b>		

Median (months) (95% CI)	8.6 (6.8-10.2)	9.2 (8.1-10.6)
HR <sup>a,b</sup> (95% CI)	1.08 (0.81-1.45)	
<b>Squamous Cell (N=473)</b>		
Median (months) (95% CI)	9.4 (8.4-10.2)	10.8 (9.5-12.1)
HR <sup>a,b</sup> (95% CI)	1.23 (1.00-1.51)	

<sup>a</sup> Unadjusted for multiple comparisons.

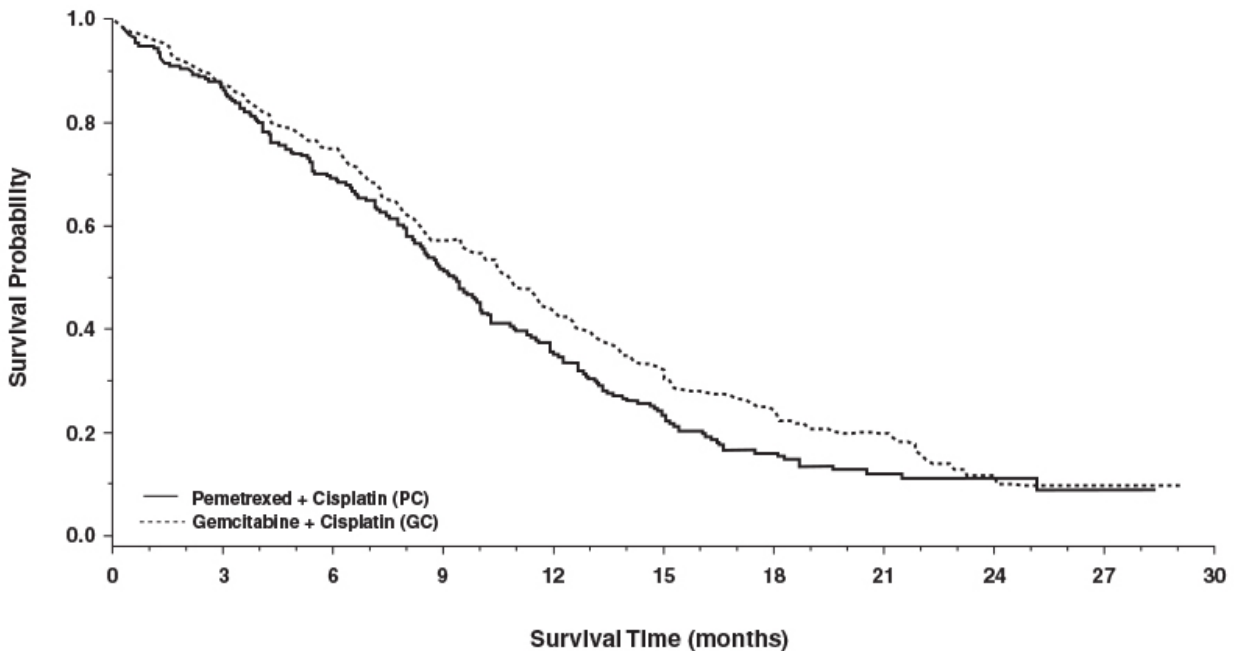
<sup>b</sup> Adjusted for ECOG PS, gender, disease stage, and basis for pathological diagnosis (histopathological/cytopathological).



Patients at Risk

PC	618	533	437	341	264	188	118	72	37	8	0
GC	634	542	435	339	240	151	101	55	26	10	0

**Figure 2: Kaplan-Meier Curves for Overall Survival in Non-squamous NSCLC in Study JMDB**



		Survival Time (months)										
Patients at Risk		0	3	6	9	12	15	18	21	24	27	30
PC	244	204	161	117	77	47	28	16	8	2	0	0
GC	229	189	155	117	87	58	38	23	8	4	0	0

**Figure 3: Kaplan-Meier Curves for Overall Survival in Squamous NSCLC in Study JMDB**

#### Maintenance Treatment Following First-line Non-Pemetrexed Containing Platinum-Based Chemotherapy

The efficacy of pemetrexed as maintenance therapy following first-line platinum-based chemotherapy was evaluated in Study JMEN (NCT00102804), a multicenter, randomized (2:1), double-blind, placebo-controlled study conducted in 663 patients with Stage IIIb/IV NSCLC who did not progress after four cycles of platinum-based chemotherapy. Patients were randomized to receive pemetrexed 500 mg/m<sup>2</sup> intravenously every 21 days or placebo until disease progression or intolerable toxicity. Patients in both study arms received folic acid, vitamin B<sub>12</sub>, and dexamethasone [see *Dosage and Administration (2.4)*]. Randomization was carried out using a minimization approach [Pocock and Simon (1975)] using the following factors: gender, ECOG PS (0 versus 1), response to prior chemotherapy (complete or partial response versus stable disease), history of brain metastases (yes versus no), non-platinum component of induction therapy (docetaxel versus gemcitabine versus paclitaxel), and disease stage (IIIb versus IV). The major efficacy outcome measures were progression-free survival based on assessment by independent review and overall survival; both were measured from the date of randomization in Study JMEN.

A total of 663 patients were enrolled with 441 patients randomized to pemetrexed and 222 patients randomized to placebo. The median age was 61 years (range 26-83 years); 73% were male; 65% were White, 32% were Asian, 2.9% were Hispanic or Latino, and <2% were other ethnicities; 60% had an ECOG PS of 1; and 73% were current or former smokers. Median time from initiation of platinum-based chemotherapy to randomization was 3.3 months (range 1.6 to 5.1 months) and 49% of the population achieved a partial or complete response to first-line, platinum-based chemotherapy. With regard to tumor characteristics, 81% had Stage IV disease, 73% had non-squamous NSCLC and 27% had squamous NSCLC. Among the 481 patients with

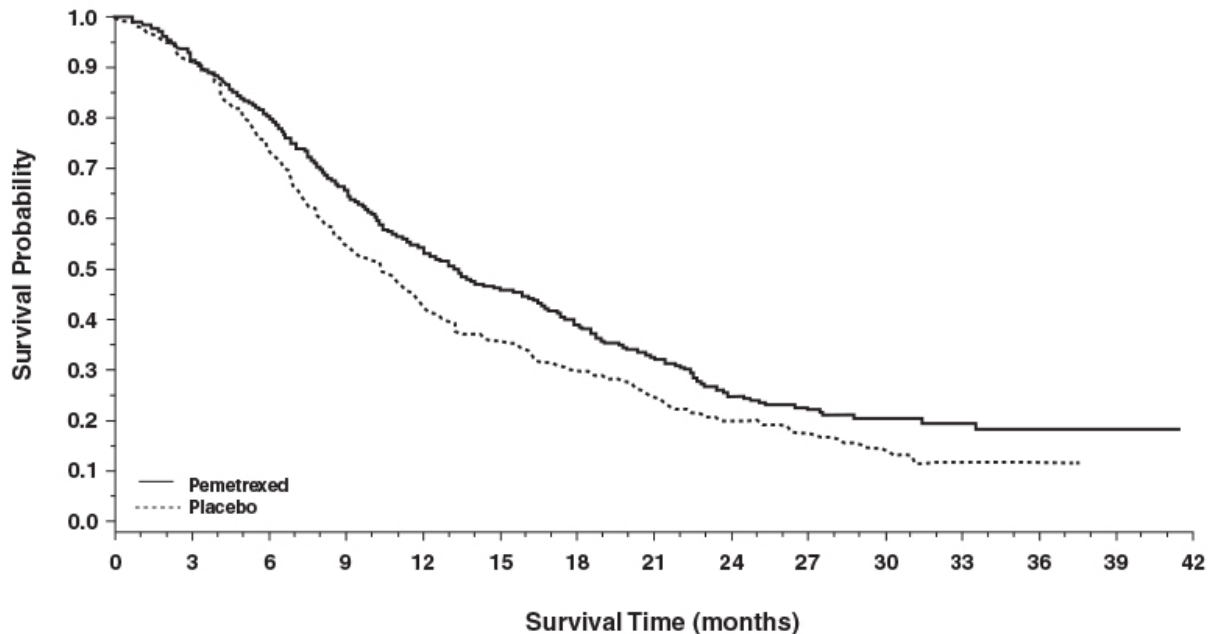
non-squamous NSCLC, 68% had adenocarcinoma, 4% had large cell, and 28% had other histologies.

Efficacy results are presented in Table 10 and Figure 4.

**Table 10: Efficacy Results in Study JMEN**

Efficacy Parameter	Pemetrexed	Placebo
<b>Overall survival</b>	N=441	N=222
Median (months) (95% CI)	13.4 (11.9-15.9)	10.6 (8.7-12.0)
Hazard ratio <sup>a</sup> (95% CI)	0.79 (0.65-0.95)	
p-value	p=0.012	
<b>Progression-free survival per independent review</b>	N=387	N=194
Median (months) (95% CI)	4.0 (3.1-4.4)	2.0 (1.5-2.8)
Hazard ratio <sup>a</sup> (95% CI)	0.60 (0.49-0.73)	
p-value	p<0.00001	

<sup>a</sup> Hazard ratios are adjusted for multiplicity but not for stratification variables.



**Patients at Risk**

Pemetrexed	441	396	340	274	221	179	141	97	63	45	29	19	11	2	0
Placebo	222	200	160	119	93	76	60	40	29	20	13	6	4	0	0

**Figure 4: Kaplan-Meier Curves for Overall Survival in Study JMEN**

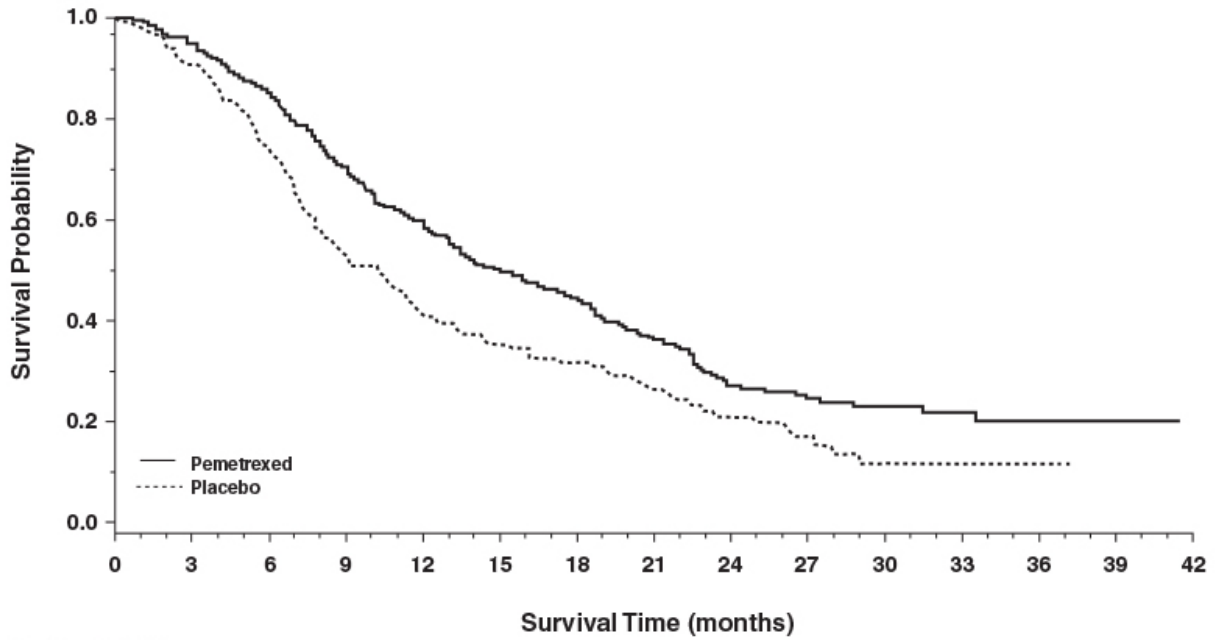
The results of pre-specified subgroup analyses by NSCLC histology are presented in Table 11 and Figures 5 and 6.

**Table 11: Efficacy Results in Study JMEN by Histologic Subgroup**

Efficacy Parameter	Overall Survival		Progression-Free Survival Per Independent Review	
	Pemetrexed (N=441)	Placebo (N=222)	Pemetrexed (N=387)	Placebo (N=194)
<b>Non-squamous NSCLC (n=481)</b>				
Median (months)	15.5	10.3	4.4	1.8
HR <sup>a</sup> (95% CI)	0.70 (0.56-0.88)		0.47 (0.37-0.60)	
<b>Adenocarcinoma (n=328)</b>				
Median (months)	16.8	11.5	4.6	2.7
HR <sup>a</sup> (95% CI)	0.73 (0.56-0.96)		0.51 (0.38-0.68)	
<b>Large cell carcinoma (n=20)</b>				
Median (months)	8.4	7.9	4.5	1.5
HR <sup>a</sup> (95% CI)	0.98 (0.36-2.65)		0.40 (0.12-1.29)	
<b>Other<sup>b</sup> (n=133)</b>				
Median (months)	11.3	7.7	4.1	1.6
HR <sup>a</sup> (95% CI)	0.61 (0.40-0.94)		0.44 (0.28-0.68)	
<b>Squamous cell NSCLC (n=182)</b>				
Median (months)	9.9	10.8	2.4	2.5
HR <sup>a</sup> (95% CI)	1.07 (0.77-1.50)		1.03 (0.71-1.49)	

<sup>a</sup> Hazard ratios are not adjusted for multiplicity

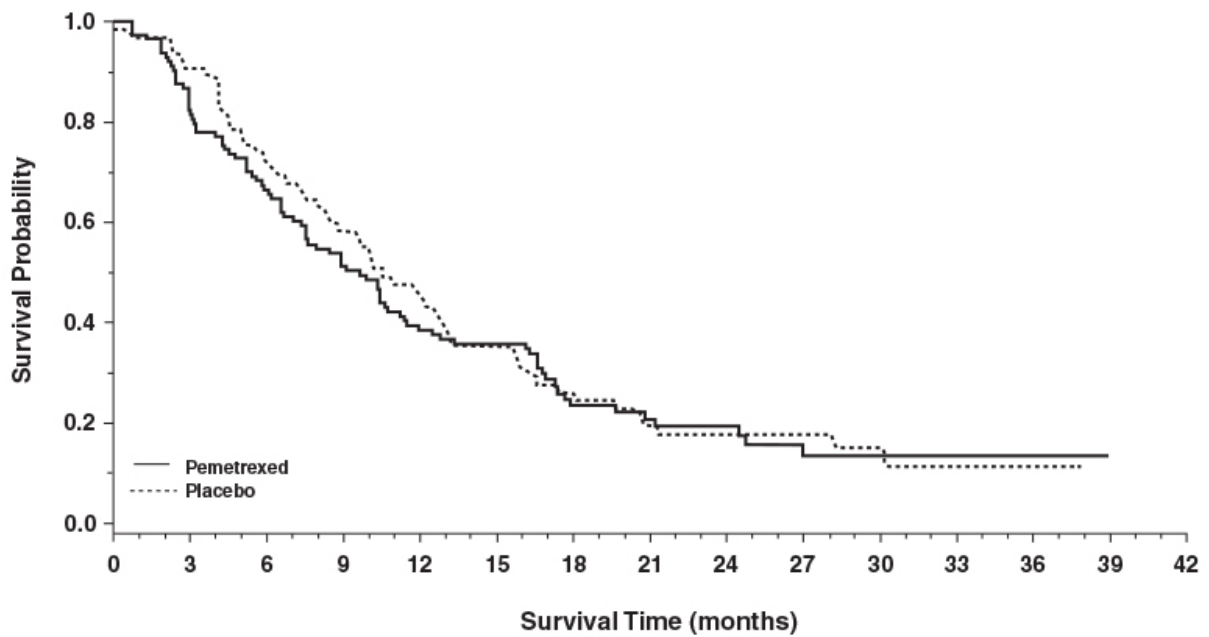
<sup>b</sup> Primary diagnosis of NSCLC not specified as adenocarcinoma, large cell carcinoma, or squamous cell carcinoma.



**Patients at Risk**

Pemetrexed	325	302	265	216	178	141	117	82	51	38	25	15	9	2	0
Placebo	156	140	112	80	63	52	42	28	20	11	7	4	3	0	0

**Figure 5: Kaplan-Meier Curves for Overall Survival in Non-squamous NSCLC in Study JMEN**



**Patients at Risk**

Pemetrexed	116	94	75	58	43	38	24	15	12	7	4	4	2	0	0
Placebo	66	60	48	39	30	24	18	12	9	9	6	2	1	0	0

**Figure 6: Kaplan-Meier Curves for Overall Survival in Squamous NSCLC in Study JMEN**

### Maintenance Treatment Following First-line Pemetrexed Plus Platinum Chemotherapy

The efficacy of pemetrexed as maintenance therapy following first-line platinum-based chemotherapy was also evaluated in PARAMOUNT (NCT00789373), a multi-center, randomized (2:1), double-blind, placebo-controlled study conducted in patients with Stage IIIb/IV non-squamous NSCLC who had completed four cycles of pemetrexed in combination with cisplatin and achieved a complete response (CR) or partial response (PR) or stable disease (SD). Patients were required to have an ECOG PS of 0 or 1. Patients were randomized to receive pemetrexed 500 mg/m<sup>2</sup> intravenously every 21 days or placebo until disease progression. Randomization was stratified by response to pemetrexed in combination with cisplatin induction therapy (CR or PR versus SD), disease stage (IIIb versus IV), and ECOG PS (0 versus 1). Patients in both arms received folic acid, vitamin B<sub>12</sub>, and dexamethasone. The main efficacy outcome measure was investigator-assessed progression-free survival (PFS) and an additional efficacy outcome measure was overall survival (OS); PFS and OS were measured from the time of randomization.

A total of 539 patients were enrolled with 359 patients randomized to pemetrexed and 180 patients randomized to placebo. The median age was 61 years (range 32 to 83 years); 58% were male; 95% were White, 4.5% were Asian, and <1% were Black or African American; 67% had an ECOG PS of 1; 78% were current or former smokers; and 43% of the population achieved a partial or complete response to first-line, platinum-based chemotherapy. With regard to tumor characteristics, 91% had Stage IV disease, 87% had adenocarcinoma, 7% had large cell, and 6% had other histologies.

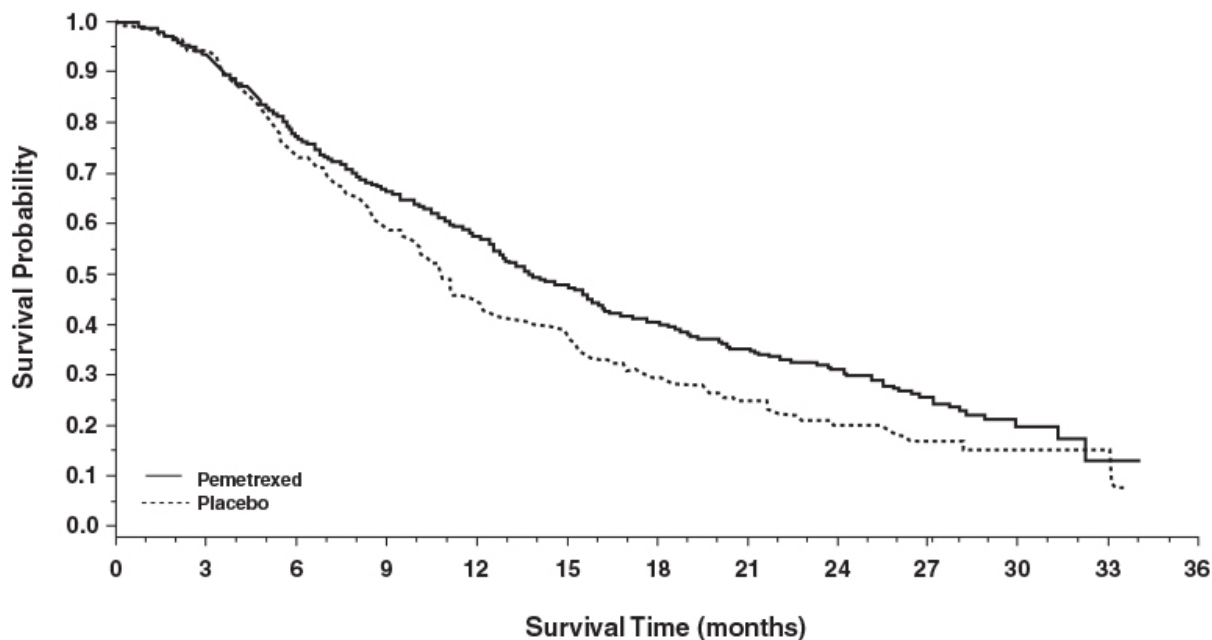
Efficacy results for PARAMOUNT are presented in Table 12 and Figure 7.

**Table 12: Efficacy Results in PARAMOUNT**

<b>Efficacy Parameter</b>	<b>Pemetrexed (N=359)</b>	<b>Placebo (N=180)</b>
<b>Overall survival</b>		
Median (months) (95% CI)	13.9 (12.8-16.0)	11.0 (10.0-12.5)
Hazard ratio (HR) <sup>a</sup> (95% CI)	0.78 (0.64-0.96)	
p-value	p=0.02	
<b>Progression-free survival<sup>b</sup></b>		
Median (months) (95% CI)	4.1 (3.2-4.6)	2.8 (2.6-3.1)
Hazard ratio (HR) <sup>a</sup> (95% CI)	0.62 (0.49-0.79)	
p-value	p<0.0001	

<sup>a</sup> Hazard ratios are adjusted for multiplicity but not for stratification variables.

<sup>b</sup> Based on investigator's assessment.



Patients at Risk		Survival Time (months)												
	0	3	6	9	12	15	18	21	24	27	30	33	36	
Pemetrexed	359	333	272	235	200	166	138	105	79	43	15	2	0	
Placebo	180	169	131	103	78	65	49	35	23	12	8	3	0	

**Figure 7: Kaplan-Meier Curves for Overall Survival in PARAMOUNT**

#### Treatment of Recurrent Disease After Prior Chemotherapy

The efficacy of pemetrexed was evaluated in Study JMEI (NCT00004881), a multicenter, randomized (1:1), open-label study conducted in patients with Stage III or IV NSCLC that had recurred or progressed following one prior chemotherapy regimen for advanced disease. Patients were randomized to receive pemetrexed 500 mg/m<sup>2</sup> intravenously or docetaxel 75 mg/m<sup>2</sup> as a 1-hour intravenous infusion once every 21 days. Patients randomized to pemetrexed also received folic acid and vitamin B<sub>12</sub>. The study was designed to show that overall survival with pemetrexed was non-inferior to docetaxel, as the major efficacy outcome measure, and that overall survival was superior for patients randomized to pemetrexed compared to docetaxel, as a secondary outcome measure.

A total of 571 patients were enrolled with 283 patients randomized to pemetrexed and 288 patients randomized to docetaxel. The median age was 58 years (range 22 to 87 years); 72% were male; 71% were White, 24% were Asian, 2.8% were Black or African American, 1.8% were Hispanic or Latino, and <2% were other ethnicities; 88% had an ECOG PS of 0 or 1. With regard to tumor characteristics, 75% had Stage IV disease; 53% had adenocarcinoma, 30% had squamous histology; 8% large cell; and 9% had other histologic subtypes of NSCLC.

The efficacy results in the overall population and in subgroup analyses based on histologic subtype are provided in Tables 13 and 14, respectively. Study JMEI did not show an improvement in overall survival in the intent-to-treat population. In subgroup analyses, there was no evidence of a treatment effect on survival in patients with squamous NSCLC; the absence of a treatment effect in patients with NSCLC of squamous histology was also observed Studies JMDB and JMEN [see *Clinical Studies (14.1)*].

**Table 13: Efficacy Results in Study JMEI**

Efficacy Parameter	Pemetrexed (N=283)	Docetaxel (N=288)
<b>Overall survival</b>		
Median (months) (95% CI)	8.3 (7.0-9.4)	7.9 (6.3-9.2)
Hazard ratio <sup>a</sup> (95% CI)	0.99 (0.82-1.20)	
<b>Progression-free survival</b>		
Median (months) (95% CI)	2.9 (2.4-3.1)	2.9 (2.7-3.4)
Hazard ratio <sup>a</sup> (95% CI)	0.97 (0.82-1.16)	
<b>Overall response rate</b> (95% CI)	8.5% (5.2-11.7)	8.3% (5.1-11.5)

<sup>a</sup> Hazard ratios are not adjusted for multiplicity or for stratification variables.

**Table 14: Exploratory Efficacy Analyses by Histologic Subgroup in Study JMEI**

Histologic Subgroups	Pemetrexed (N=283)	Docetaxel (N=288)
<b>Non-squamous NSCLC (N=399)</b>		
Median (months) (95% CI)	9.3 (7.8-9.7)	8.0 (6.3-9.3)
HR <sup>a</sup> (95% CI)	0.89 (0.71-1.13)	
<b>Adenocarcinoma (N=301)</b>		
Median (months) (95% CI)	9.0 (7.6-9.6)	9.2 (7.5-11.3)
HR <sup>a</sup> (95% CI)	1.09 (0.83-1.44)	
<b>Large Cell (N=47)</b>		
Median (months) (95% CI)	12.8 (5.8-14.0)	4.5 (2.3-9.1)
HR <sup>a</sup> (95% CI)	0.38 (0.18-0.78)	
<b>Other<sup>b</sup> (N=51)</b>		
Median (months) (95% CI)	9.4 (6.0-10.1)	7.9 (4.0-8.9)
HR <sup>a</sup> (95% CI)	0.62 (0.32-1.23)	
<b>Squamous NSCLC (N=172)</b>		
Median (months) (95% CI)	6.2 (4.9-8.0)	7.4 (5.6-9.5)
HR <sup>a</sup> (95% CI)	1.32 (0.93-1.86)	

<sup>a</sup> Hazard ratio unadjusted for multiple comparisons.

<sup>b</sup> Primary diagnosis of NSCLC not specified as adenocarcinoma, large cell carcinoma, or squamous cell carcinoma.

## 14.2 Mesothelioma

The efficacy of pemetrexed was evaluated in Study JMCH (NCT00005636), a multicenter, randomized (1:1), single-blind study conducted in patients with MPM who had received no prior chemotherapy. Patients were randomized (n=456) to receive pemetrexed 500 mg/m<sup>2</sup> intravenously over 10 minutes followed 30 minutes later by cisplatin 75 mg/m<sup>2</sup> intravenously over two hours on Day 1 of each 21-day cycle or to receive cisplatin 75 mg/m<sup>2</sup> intravenously over 2 hours on Day 1 of each 21-day cycle; treatment continued until disease progression or intolerable toxicity. The study was modified after randomization and treatment of 117 patients to require that all patients receive folic acid 350 mcg to 1000 mcg daily beginning 1 to 3 weeks prior to the first dose of pemetrexed and continuing until 1 to 3 weeks after the last dose, vitamin B<sub>12</sub> 1000 mcg intramuscularly 1 to 3 weeks prior to first dose of pemetrexed and every 9 weeks thereafter, and dexamethasone 4 mg orally, twice daily, for 3 days starting the day prior to each pemetrexed dose. Randomization was stratified by multiple baseline variables including KPS, histologic subtype (epithelial, mixed, sarcomatoid, other), and gender. The major efficacy outcome measure was overall survival and additional efficacy outcome measures were time to disease progression, overall response rate, and response duration.

A total of 448 patients received at least one dose of protocol-specified therapy; 226 patients were randomized to and received at least one dose of pemetrexed plus cisplatin, and 222 patients were randomized to and received cisplatin. Among the 226 patients who received cisplatin with pemetrexed, 74% received full supplementation with folic acid and vitamin B<sub>12</sub> during study therapy, 14% were never supplemented, and 12% were partially supplemented. Across the study population, the median age was 61 years (range: 20 to 86 years); 81% were male; 92% were White, 5% were Hispanic or Latino, 3.1% were Asian, and <1% were other ethnicities; and 54% had a baseline KPS score of 90-100% and 46% had a KPS score of 70-80%. With regard to tumor characteristics, 46% had Stage IV disease, 31% Stage III, 15% Stage II, and 7% Stage I disease at baseline; the histologic subtype of mesothelioma was epithelial in 68% of patients, mixed in 16%, sarcomatoid in 10% and other histologic subtypes in 6%. The baseline demographics and tumor characteristics of the subgroup of fully supplemented patients was similar to the overall study population.

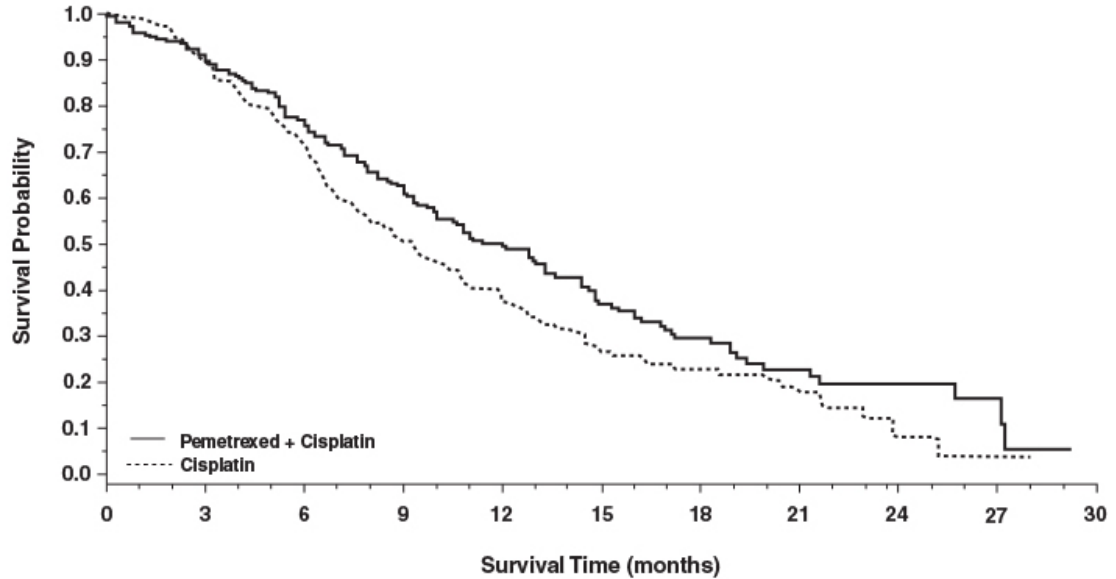
The efficacy results from Study JMCH are summarized in Table 15 and Figure 8.

**Table 15: Efficacy Results in Study JMCH**

Efficacy Parameter	All Randomized and Treated Patients (N=448)		Fully Supplemented Patients (N=331)	
	Pemetrexed /Cisplatin (N=226)	Cisplatin (N=222)	Pemetrexed /Cisplatin (N=168)	Cisplatin (N=163)
Median overall survival (months)	12.1	9.3	13.3	10.0
(95% CI)	(10.0-14.4)	(7.8-10.7)	(11.4-14.9)	(8.4-11.9)
Hazard ratio <sup>a</sup>	0.77		0.75	
Log rank p-value	0.020		NA <sup>b</sup>	

<sup>a</sup> Hazard ratios are not adjusted for stratification variables.

<sup>b</sup> Not a pre-specified analysis.



Patients at Risk		0	3	6	9	12	15	18	21	24	27	30
Pemetrexed + Cisplatin	226	201	166	128	84	50	32	17	8	4	0	0
Cisplatin	222	195	153	104	63	31	21	14	3	1	0	0

**Figure 8: Kaplan-Meier Curves for Overall Survival in Study JMCH**

Based upon prospectively defined criteria (modified Southwest Oncology Group methodology) the objective tumor response rate for pemetrexed plus cisplatin was greater than the objective tumor response rate for cisplatin alone. There was also improvement in lung function (forced vital capacity) in the pemetrexed plus cisplatin arm compared to the control arm.

## 15 REFERENCES

1. "OSHA Hazardous Drugs." OSHA. [<https://www.osha.gov/hazardous-drugs>]

## 16 HOW SUPPLIED/STORAGE AND HANDLING

### How Supplied

Pemetrexed for Injection, is a sterile preservative free white-to-light yellow or green-yellow lyophilized powder supplied in single-dose vials for reconstitution for intravenous infusion.

NDC 83831-111-01: 100 mg single-dose vial containing pemetrexed equivalent to 118.3 mg pemetrexed dipotassium with aluminum flip-off seals with grey color button individually packaged in a carton.

NDC 83831-112-01: 500 mg single-dose vial containing pemetrexed equivalent to 591.5 mg pemetrexed dipotassium with aluminum flip-off seals with red color button individually packaged in a carton.

### Storage and Handling

Store at controlled room temperature, 20°-25°C (68°-77°F); excursions permitted from 15° to 30°C (59° to 86°F) [see USP Controlled Room Temperature].

Pemetrexed for Injection is a hazardous drug. Follow applicable special handling and disposal procedures.<sup>1</sup>

## 17 PATIENT COUNSELING INFORMATION

Advise the patient to read the FDA-approved patient labeling (Patient Information).

**Premedication and Concomitant Medication:** Instruct patients to take folic acid as directed and to keep appointments for vitamin B<sub>12</sub> injections to reduce the risk of treatment-related toxicity. Instruct patients of the requirement to take corticosteroids to reduce the risks of treatment-related toxicity [see *Dosage and Administration (2.4)* and *Warnings and Precautions (5.1)*].

**Myelosuppression:** Inform patients of the risk of low blood cell counts and instruct them to immediately contact their physician for signs of infection, fever, bleeding, or symptoms of anemia [see *Warnings and Precautions (5.1)*].

**Renal Failure:** Inform patients of the risks of renal failure, which may be exacerbated in patients with dehydration arising from severe vomiting or diarrhea. Instruct patients to immediately contact their healthcare provider for a decrease in urine output [see *Warnings and Precautions (5.2)*].

**Bullous and Exfoliative Skin Disorders:** Inform patients of the risks of severe and exfoliative skin disorders. Instruct patients to immediately contact their healthcare provider for development of bullous lesions or exfoliation in the skin or mucous membranes [see *Warnings and Precautions (5.3)*].

**Interstitial Pneumonitis:** Inform patients of the risks of pneumonitis. Instruct patients to immediately contact their healthcare provider for development of dyspnea or persistent cough [see *Warnings and Precautions (5.4)*].

**Radiation Recall:** Inform patients who have received prior radiation of the risks of radiation recall. Instruct patients to immediately contact their healthcare provider for development of inflammation or blisters in an area that was previously irradiated [see *Warnings and Precautions (5.5)*].

**Increased Risk of Toxicity with Ibuprofen in Patients with Renal Impairment:** Advise patients with mild to moderate renal impairment of the risks associated with concomitant ibuprofen use and instruct them to avoid use of all ibuprofen containing products for 2 days before, the day of, and 2 days following administration of Pemetrexed for Injection [see *Dosage and Administration (2.5)*, *Warnings and Precautions (5.6)*, and *Drug Interactions (7)*].

**Embryo-Fetal Toxicity:** Advise females of reproductive potential and males with female partners of reproductive potential of the potential risk to a fetus [see *Warnings and Precautions (5.7)* and *Use in Specific Populations (8.1)*]. Advise females of reproductive potential to use effective contraception during treatment with Pemetrexed for Injection and for 6 months after the last dose. Advise females to inform their prescriber of a known or suspected pregnancy. Advise males with female partners of reproductive potential to use effective contraception during treatment with Pemetrexed for Injection and for 3 months after the last dose [see *Warnings and Precautions (5.7)* and *Use in Specific Populations (8.3)*].

Lactation: Advise women not to breastfeed during treatment with Pemetrexed for Injection and for 1 week after the last dose [see *Use in Specific Populations (8.2)*].

**Manufactured for:**  
Avyxa Pharma, LLC  
New Jersey 07054, USA  
Made in India



**PATIENT INFORMATION**  
**PEMETREXED FOR INJECTION**  
(pem e trex ed)  
**for intravenous use**

**What is Pemetrexed for Injection?**

Pemetrexed for Injection is a prescription medicine used to treat:

- **a kind of lung cancer called non-squamous non-small cell lung cancer (NSCLC).**

Pemetrexed for Injection is used:

- as the first treatment in combination with cisplatin when your lung cancer has spread (advanced NSCLC).
- alone as maintenance treatment after you have received 4 cycles of chemotherapy that contains platinum for first treatment of your advanced NSCLC and your cancer has not progressed.
- alone when your lung cancer has returned or spread after prior chemotherapy.

Pemetrexed for Injection is not for use for the treatment of people with squamous cell non-small cell lung cancer.

- **a kind of cancer called malignant pleural mesothelioma.** This cancer affects the lining of the lungs and chest wall. Pemetrexed for Injection is used in combination with cisplatin as the first treatment for malignant pleural mesothelioma that cannot be removed by surgery or you are not able to have surgery.

Pemetrexed for Injection has not been shown to be safe and effective in children.

**Do not take Pemetrexed for Injection: if you have had a severe allergic reaction to any medicine that contains pemetrexed.**

**Before taking Pemetrexed for Injection, tell your healthcare provider about all of your medical conditions, including if you:**

- have kidney problems.
- have had radiation therapy.
- are pregnant or plan to become pregnant. Pemetrexed for Injection can harm your unborn baby.

**Females who are able to become pregnant:**

Your healthcare provider will check to see if you are pregnant before you start treatment with Pemetrexed for Injection.

You should use effective birth control (contraception) during treatment with Pemetrexed for Injection and for 6 months after the last dose. Tell your healthcare provider right away if you become pregnant or think you are pregnant during treatment with Pemetrexed for Injection.

**Males** with female partners who are able to become pregnant should use effective birth control (contraception) during treatment with Pemetrexed for Injection and for 3 months after the last dose.

- are breastfeeding or plan to breastfeed. It is not known if Pemetrexed for Injection passes into breast milk. Do not breastfeed during treatment with Pemetrexed for Injection and for 1 week after the last dose.

**Tell your healthcare provider about all the medicines you take**, including prescription and over-the-counter medicines, vitamins, and herbal supplements.

**Tell your healthcare provider if you have kidney problems and take a medicine that contains ibuprofen.** You should avoid taking ibuprofen for 2 days before, the day of, and 2 days after receiving treatment with Pemetrexed for Injection.

### How is Pemetrexed for Injection given?

- **It is very important to take folic acid and vitamin B<sub>12</sub> during your treatment with Pemetrexed for Injection to lower your risk of harmful side effects.**
  - Take folic acid exactly as prescribed by your healthcare provider 1 time a day, beginning 7 days (1 week) before your first dose of Pemetrexed for Injection and continue taking folic acid until 21 days (3 weeks) after your last dose of Pemetrexed for Injection.
  - Your healthcare provider will give you vitamin B<sub>12</sub> injections during treatment with Pemetrexed for Injection. You will get your first vitamin B<sub>12</sub> injection 7 days (1 week) before your first dose of Pemetrexed for Injection, and then every 3 cycles.
- Your healthcare provider will prescribe a medicine called corticosteroid for you to take 2 times a day for 3 days, beginning the day before each treatment with Pemetrexed for Injection.
- Pemetrexed for Injection is given to you by intravenous (IV) infusion into your vein. The infusion is given over 10 minutes.
- Pemetrexed for Injection is usually given once every 21 days (3 weeks).

### What are the possible side effects of Pemetrexed for Injection?

#### Pemetrexed for Injection can cause serious side effects, including:

- **Low blood cell counts.** Low blood cell counts can be severe, including low white blood cell counts (neutropenia), low platelet counts (thrombocytopenia), and low red blood cell counts (anemia). Your healthcare provider will do blood tests to check your blood cell counts regularly during your treatment with Pemetrexed for Injection. **Tell your healthcare provider right away if you have any signs of infection, fever, bleeding, or severe tiredness during your treatment with Pemetrexed for Injection.**
- **Kidney problems, including kidney failure.** Pemetrexed for Injection can cause severe kidney problems that can lead to death. Severe vomiting or diarrhea can lead to loss of fluids (dehydration) which may cause kidney problems to become worse. Tell your healthcare provider right away if you have a decrease in amount of urine.
- **Severe skin reactions.** Severe skin reactions that may lead to death can happen with Pemetrexed for Injection. Tell your healthcare provider right away if you develop blisters, skin sores, skin peeling, or painful sores, or ulcers in your mouth, nose, throat or genital area.
- **Lung problems (pneumonitis).** Pemetrexed for Injection can cause serious lung problems that can lead to death. Tell your healthcare provider right away if you get any new or worsening symptoms of shortness of breath, cough, or fever.
- **Radiation recall.** Radiation recall is a skin reaction that can happen in people who have received radiation treatment in the past and are treated with Pemetrexed for Injection. Tell your healthcare provider if you get swelling, blistering, or a rash that looks like a sunburn in an area that was previously treated with radiation.

#### The most common side effects of Pemetrexed for Injection when given alone are:

- tiredness
- nausea
- loss of appetite

#### The most common side effects of Pemetrexed for Injection when given with cisplatin are:

- vomiting
- swelling or sores in your mouth or sore throat
- constipation
- low white blood cell counts (neutropenia)
- low platelet counts (thrombocytopenia)
- low red blood cell counts (anemia)

Pemetrexed for Injection may cause fertility problems in males. This may affect your ability to father a child. It is not known if these effects are reversible. Talk to your healthcare provider if this is a concern for you.

Your healthcare provider will do blood tests to check for side effects during treatment with

Pemetrexed for Injection. Your healthcare provider may change your dose of Pemetrexed for Injection, delay treatment, or stop treatment if you have certain side effects. Tell your healthcare provider if you have any side effect that bothers you or that does not go away. These are not all the side effects of Pemetrexed for Injection. For more information, ask your healthcare provider or pharmacist. Call your doctor for medical advice about side effects. You may report side effects to FDA at 1-800-FDA-1088.

**General information about the safe and effective use of Pemetrexed for Injection.** Medicines are sometimes prescribed for purposes other than those listed in a Patient Information leaflet. You can ask your pharmacist or healthcare provider for information about Pemetrexed for Injection that is written for health professionals.

**What are the ingredients in Pemetrexed for Injection?**

**Active ingredient:** pemetrexed

**Inactive ingredients:** mannitol. Hydrochloric acid may have been added to adjust pH.

**Manufactured for:**

Avyxa Pharma, LLC  
New Jersey 07054, USA  
Made in India



For more information, call 1-888-520-0954.

This Patient Information has been approved by the U.S. Food and Drug Administration.

Issued: June 2024