

HIGHLIGHTS OF PRESCRIBING INFORMATION

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

ARIKAYCE® (amikacin liposome inhalation suspension), for oral inhalation use

Initial U.S. Approval: 2018

LIMITED POPULATION

WARNING: RISK OF INCREASED RESPIRATORY ADVERSE REACTIONS

See full prescribing information for complete boxed warning.

ARIKAYCE has been associated with a risk of increased respiratory adverse reactions, including, hypersensitivity pneumonitis, hemoptysis, bronchospasm, and exacerbation of underlying pulmonary disease that have led to hospitalizations in some cases. (5.1, 5.2, 5.3, 5.4)

INDICATIONS AND USAGE

LIMITED POPULATION: ARIKAYCE is an aminoglycoside antibacterial indicated in adults who have limited or no alternative treatment options, for the treatment of *Mycobacterium avium* complex (MAC) lung disease as part of a combination antibacterial drug regimen in patients who do not achieve negative sputum cultures after a minimum of 6 consecutive months of a multidrug background regimen therapy. As only limited clinical safety and effectiveness data for ARIKAYCE are currently available, reserve ARIKAYCE for use in adults who have limited or no alternative treatment options. This drug is indicated for use in a limited and specific population of patients. (1)

This indication is approved under accelerated approval based on achieving sputum culture conversion (defined as 3 consecutive negative monthly sputum cultures) by Month 6. Clinical benefit has not yet been established. (1)

Limitation of Use:

ARIKAYCE has only been studied in patients with refractory MAC lung disease defined as patients who did not achieve negative sputum cultures after a minimum of 6 consecutive months of a multidrug background regimen therapy. The use of ARIKAYCE is not recommended for patients with non-refractory MAC lung disease.

DOSAGE AND ADMINISTRATION

- For oral inhalation use only. (2.1)
- Use ARIKAYCE vials only with the Lamira Nebulizer System. (2.1)
- The recommended dosage in adults is once daily oral inhalation of the contents of one 590 mg/8.4 mL ARIKAYCE vial. (2.2)
- Pre-treatment with inhaled bronchodilator should be considered in patients with a history of hyperreactive airway disease. (2.2)

FULL PRESCRIBING INFORMATION: CONTENTS*

WARNING: RISK OF INCREASED RESPIRATORY ADVERSE REACTIONS

1 INDICATIONS AND USAGE

2 DOSAGE AND ADMINISTRATION

2.1 Important Administration Instructions

2.2 Recommended Dosage

3 DOSAGE FORMS AND STRENGTHS

4 CONTRAINDICATIONS

5 WARNINGS AND PRECAUTIONS

5.1 Hypersensitivity Pneumonitis

5.2 Hemoptysis

5.3 Bronchospasm

5.4 Exacerbation of Underlying Pulmonary Disease

5.5 Ototoxicity

5.6 Nephrotoxicity

5.7 Neuromuscular Disorders

5.8 Embryofetal Toxicity

6 ADVERSE REACTIONS

6.1 Clinical Trials Experience

7 DRUG INTERACTIONS

7.1 Drugs with Neurotoxic, Nephrotoxic, or Ototoxic Potential

7.2 Ethacrynic Acid, Furosemide, Urea, or Mannitol

DOSAGE FORMS AND STRENGTHS

ARIKAYCE is supplied as a sterile, aqueous, liposome suspension for oral inhalation in a unit-dose glass vial containing amikacin 590 mg/8.4 mL. (3)

CONTRAINDICATIONS

ARIKAYCE is contraindicated in patients with a known hypersensitivity to any aminoglycoside. (4)

WARNINGS AND PRECAUTIONS

- **Hypersensitivity Pneumonitis:** Reported with ARIKAYCE treatment; if hypersensitivity pneumonitis occurs, discontinue ARIKAYCE and manage patients as medically appropriate. (5.1)
- **Hemoptysis:** Higher frequency of hemoptysis has been reported with ARIKAYCE treatment. If hemoptysis occurs, manage the patients as medically appropriate. (5.2)
- **Bronchospasm:** Higher frequency of bronchospasm has been reported with ARIKAYCE treatment. Treat patients as medically appropriate if this occurs during treatment with ARIKAYCE. (5.3)
- **Exacerbations of Underlying Pulmonary Disease:** Higher frequency of exacerbations of underlying pulmonary disease has been reported with ARIKAYCE treatment. Treat patients as medically appropriate if this occurs during treatment with ARIKAYCE. (5.4)
- **Ototoxicity:** Higher frequency of ototoxicity has been reported with ARIKAYCE treatment. Closely monitor patients with known or suspected auditory or vestibular dysfunction. If patients develop tinnitus this may be an early symptom of ototoxicity. (5.5)
- **Nephrotoxicity:** Aminoglycosides can cause nephrotoxicity. Close monitoring of patients with known or suspected renal dysfunction may be needed when prescribing ARIKAYCE. (5.6)
- **Neuromuscular Blockade:** Aminoglycosides may aggravate muscle weakness because of a potential curare-like effect on neuromuscular function. If neuromuscular blockade occurs, it may be reversed by the administration of calcium salts but mechanical assistance may be necessary. (5.7)
- **Embryo-Fetal Toxicity:** Aminoglycosides can cause total, irreversible, bilateral congenital deafness in pediatric patients exposed in utero. (5.8, 8.1)

ADVERSE REACTIONS

Most common adverse reactions (incidence $\geq 10\%$ and higher than control) in the patients with refractory MAC lung disease were: dysphonia, cough, bronchospasm, hemoptysis, ototoxicity, upper airway irritation, musculoskeletal pain, fatigue/asthenia and exacerbation of underlying pulmonary disease, diarrhea, and nausea. (6.1).

To report SUSPECTED ADVERSE REACTIONS, contact Inmed Incorporated at 1-844-4-INSMED or FDA at 1-800-FDA-1088 or www.fda.gov/medwatch.

See 17 for PATIENT COUNSELING INFORMATION and Medication Guide.

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8 USE IN SPECIFIC POPULATIONS

8.1 Pregnancy

8.2 Lactation

8.4 Pediatric Use

8.5 Geriatric Use

8.6 Hepatic Impairment

8.7 Renal Impairment

10 OVERDOSAGE

11 DESCRIPTION

12 CLINICAL PHARMACOLOGY

12.1 Mechanism of Action

12.2 Pharmacodynamics

12.3 Pharmacokinetics

12.4 Microbiology

13 NONCLINICAL TOXICOLOGY

13.1 Carcinogenesis, Mutagenesis, Impairment of Fertility

13.2 Animal Toxicology and/or Pharmacology

14 CLINICAL STUDIES

16 HOW SUPPLIED/STORAGE AND HANDLING

16.1 How Supplied

16.2 Storage and Handling

17 PATIENT COUNSELING INFORMATION

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

FULL PRESCRIBING INFORMATION

WARNING: RISK OF INCREASED RESPIRATORY ADVERSE REACTIONS

ARIKAYCE has been associated with an increased risk of respiratory adverse reactions including, hypersensitivity pneumonitis, hemoptysis, bronchospasm, exacerbation of underlying pulmonary disease that have led to hospitalizations in some cases [see Warnings and Precautions (5.1, 5.2, 5.3, 5.4)].

1 INDICATIONS AND USAGE

LIMITED POPULATION: ARIKAYCE® is indicated in adults, who have limited or no alternative treatment options, for the treatment of *Mycobacterium avium* complex (MAC) lung disease as part of a combination antibacterial drug regimen in patients who do not achieve negative sputum cultures after a minimum of 6 consecutive months of a multidrug background regimen therapy. As only limited clinical safety and effectiveness data for ARIKAYCE are currently available, reserve ARIKAYCE for use in adults who have limited or no alternative treatment options. This drug is indicated for use in a limited and specific population of patients.

This indication is approved under accelerated approval based on achieving sputum culture conversion (defined as 3 consecutive negative monthly sputum cultures) by Month 6. Clinical benefit has not yet been established [see *Clinical Studies (14)*]. Continued approval for this indication may be contingent upon verification and description of clinical benefit in confirmatory trials.

Limitation of Use:

ARIKAYCE has only been studied in patients with refractory MAC lung disease defined as patients who did not achieve negative sputum cultures after a minimum of 6 consecutive months of a multidrug background regimen therapy. The use of ARIKAYCE is not recommended for patients with non-refractory MAC lung disease.

2 DOSAGE AND ADMINISTRATION

2.1 Important Administration Instructions

ARIKAYCE is for oral inhalation use only. Administer by nebulization only with the Lamira™ Nebulizer System. Refer to the Instructions for Use for full administration information on use of ARIKAYCE with the Lamira Nebulizer System.

Instruct patients using a bronchodilator ('reliever') to first use the bronchodilator following the bronchodilator leaflet for use information before using ARIKAYCE.

Pre-treatment with short-acting selective beta-2 agonists should be considered for patients with known hyperreactive airway disease, chronic obstructive pulmonary disease, asthma, or bronchospasm [see *Warnings and Precautions (5.3)*].

2.2 Recommended Dosage

The recommended dosage of ARIKAYCE in adults is once daily inhalation of the contents of one 590 mg/8.4 mL ARIKAYCE vial (590 mg of amikacin) using the Lamira Nebulizer System.

Administer ARIKAYCE with the Lamira Nebulizer System only. ARIKAYCE should be at room temperature before use. Prior to opening, shake the ARIKAYCE vial well for at least 10 to 15 seconds until the contents appear uniform and well mixed. The ARIKAYCE vial is opened by flipping up the plastic top of the vial then pulling downward to loosen the metal ring. The metal ring and the rubber stopper should be removed carefully. The contents of the ARIKAYCE vial can then be poured into the medication reservoir of the nebulizer handset.

If a daily dose of ARIKAYCE is missed, administer the next dose the next day. Do **NOT** double the dose to make up for the missed dose.

3 DOSAGE FORMS AND STRENGTHS

ARIKAYCE is supplied as a sterile, white, milky, aqueous, liposome suspension for oral inhalation in a unit-dose glass vial containing amikacin 590 mg/8.4 mL (equivalent to amikacin sulfate 623 mg/8.4 mL).

4 CONTRAINDICATIONS

ARIKAYCE is contraindicated in patients with a known hypersensitivity to any aminoglycoside.

5 WARNINGS AND PRECAUTIONS

5.1 Hypersensitivity Pneumonitis

Hypersensitivity pneumonitis has been reported with the use of ARIKAYCE in the clinical trials. Hypersensitivity pneumonitis (reported as allergic alveolitis, pneumonitis, interstitial lung disease, allergic reaction to ARIKAYCE) was reported at a higher frequency in patients treated with ARIKAYCE plus a background regimen (3.1 %) compared to patients treated with a background regimen alone (0%). Most patients with hypersensitivity pneumonitis discontinued treatment with ARIKAYCE and received treatment with corticosteroids [see *Adverse Reactions (6.1)*]. If hypersensitivity pneumonitis occurs, discontinue ARIKAYCE and manage the patient as medically appropriate.

5.2 Hemoptysis

Hemoptysis has been reported with the use of ARIKAYCE in the clinical trials. Hemoptysis was reported at a higher frequency in patients treated with ARIKAYCE plus a background regimen (17.9 %) compared to patients treated with a background regimen alone (12.5 %) [see *Adverse Reactions (6.1)*]. If hemoptysis occurs, manage the patients as medically appropriate.

5.3 Bronchospasm

Bronchospasm has been reported with the use of ARIKAYCE in the clinical trials. Bronchospasm (reported as asthma, bronchial hyperreactivity, bronchospasm, dyspnea, dyspnea exertional, prolonged expiration, throat tightness, wheezing) was reported at a higher frequency in patients treated with ARIKAYCE plus a background regimen (28.7 %) compared to patients treated with a background regimen alone (10.7 %) [see *Adverse Reactions (6.1)*]. If bronchospasm occurs during the use of ARIKAYCE treat the patients as medically appropriate.

5.4 Exacerbation of Underlying Pulmonary Disease

Exacerbations of underlying pulmonary disease has been reported with the use of ARIKAYCE in the clinical trials. Exacerbations of underlying pulmonary disease (reported as chronic obstructive pulmonary disease, infective exacerbation of chronic obstructive pulmonary disease, infective exacerbation of bronchiectasis) have been reported at a higher frequency in patients treated with ARIKAYCE plus a background regimen (14.8 %) compared to patients treated with background regimen alone (9.8 %) [see *Adverse Reactions (6.1)*]. If exacerbations of underlying pulmonary disease occurs during the use of ARIKAYCE, treat the patients as medically appropriate.

5.5 Ototoxicity

Ototoxicity has been reported with the use of ARIKAYCE in the clinical trials. Ototoxicity (including deafness, dizziness, presyncope, tinnitus, and vertigo) were reported with a higher frequency in patients treated with ARIKAYCE plus a background regimen (17 %) compared to patients treated with background regimen alone (9.8 %). This was primarily driven by tinnitus (7.6% in ARIKAYCE plus background regimen vs. 0.9% in the background regimen alone arm) and dizziness (6.3% in ARIKAYCE plus background regimen vs. 2.7% in the background regimen alone arm). [see *Adverse Reactions (6.1)*].

Closely monitor patients with known or suspected auditory or vestibular dysfunction during treatment with ARIKAYCE. If ototoxicity occurs, manage the patient as medically appropriate, including potentially discontinuing ARIKAYCE.

5.6 Nephrotoxicity

Nephrotoxicity was observed during the clinical trials of ARIKAYCE in patients with MAC lung disease but not at a higher frequency than the background regimen alone [see *Adverse Reactions (6.1)*]. Nephrotoxicity has been associated with the aminoglycosides. Close monitoring of patients with known or suspected renal dysfunction may be needed when prescribing ARIKAYCE.

5.7 Neuromuscular Blockade

Patients with neuromuscular disorders were not enrolled in ARIKAYCE clinical trials. Patients with known or suspected neuromuscular disorders, such as myasthenia gravis, should be closely monitored since aminoglycosides may aggravate muscle weakness by blocking the release of acetylcholine at neuromuscular junctions.

5.8 Embryo-Fetal Toxicity

Aminoglycosides can cause fetal harm when administered to a pregnant woman. Aminoglycosides, including ARIKAYCE, may be associated with total, irreversible, bilateral congenital deafness in pediatric patients exposed *in utero*. Patients who use ARIKAYCE during pregnancy, or become pregnant while taking ARIKAYCE should be apprised of the potential hazard to the fetus [see *Use in Specific Populations (8.1)*].

6 ADVERSE REACTIONS

The following clinically significant adverse reactions are described in greater detail in other sections of labeling:

- Hypersensitivity pneumonitis [see *Boxed Warning and Warnings and Precautions (5.1)*]
- Hemoptysis [see *Boxed Warning and Warnings and Precautions (5.2)*]
- Bronchospasm [see *Boxed Warning and Warnings and Precautions (5.3)*]
- Exacerbation of Underlying Pulmonary Disease [see *Boxed Warning and Warnings and Precautions (5.4)*]
- Ototoxicity [see *Warnings and Precautions (5.5)*]
- Nephrotoxicity [see *Warnings and Precautions (5.6)*]
- Neuromuscular Blockade [see *Warnings and Precautions (5.7)*]

6.1 Clinical Trials Experience

Because clinical trials are conducted under widely varying conditions, adverse reaction rates observed in the clinical trials of a drug cannot be directly compared to rates in the clinical trials of another drug and may not reflect the rates observed in practice.

Overview of Clinical Trials for Safety Evaluation

Within the refractory NTM clinical program, 388 patients that participated in three clinical trials were treated with ARIKAYCE at the dose of 590 mg/day (median duration of exposure to ARIKAYCE was 169 days).

Trial 1 (NCT#02344004) was an open-label, randomized (2:1), multi-center Phase 3 trial in patients with refractory *Mycobacterium avium* complex (MAC) lung disease. Patients were randomized to either 8 months of ARIKAYCE plus a background regimen (n=223) or background regimen alone (n=112).

Trial 2 was a single-arm extension of Trial 1 for refractory MAC lung disease patients that failed to achieve negative sputum cultures after 6 months of treatment or had a relapse or recurrence by Month 6 from either study arm of Trial 1. A total of 133 patients (n=74 from the prior background regimen alone arm of Trial 1, and n=59 from the prior ARIKAYCE plus background regimen arm in Trial 1) participated in the trial.

Trial 3 (NCT#01315236) was a double-blind, randomized, placebo-controlled Phase 2 study in patients with refractory nontuberculous mycobacterial (NTM) lung disease caused by MAC and *Mycobacterium abscessus*. Patients were randomized to either ARIKAYCE plus background regimen or an inhaled diluted empty liposome placebo plus background regimen for 84 days.

Across all clinical trials of patients with and without refractory NTM lung infection, 802 patients were exposed to multiple doses of ARIKAYCE.

Adverse Reactions Leading to Treatment Discontinuation

In the three NTM studies, there was a higher incidence of premature discontinuation of ARIKAYCE. In Trial 1, 33.5% discontinued ARIKAYCE prematurely; most were due to adverse reactions (17.4%) and withdrawal by subject (9.4%). In the comparator arm 8% of subjects discontinued their background regimen, with 0.9% due to adverse reactions and 5.4% due to withdrawal by subject. In Trial 2 (the single-arm extension of Trial 1), 20.3% of patients starting on ARIKAYCE discontinued prematurely with 14.9% discontinuing due to adverse reactions. In Trial 3, all 9 (20.5%) premature discontinuations occurred in the ARIKAYCE plus background regimen -treated patients and there were no premature discontinuations in the placebo plus background regimen arm.

Serious Adverse Reactions in Trials 1 and 3

In the two randomized trials (Trial 1 and Trial 3), there were more serious adverse reactions (SARs) reported in the ARIKAYCE-treated arm as compared to the respective control arm. In Trial 1, 20.2% of patients treated with ARIKAYCE plus background regimen reported SAR as compared to 16.1% of

patients treated with background regimen alone. In addition, in Trial 1 [2 to 1 randomization, ARIKAYCE plus background regimen versus background regimen alone], there were 82 hospitalizations in 41 patients (18.4%) treated with ARIKAYCE plus background regimen compared to 23 hospitalizations in 15 patients (13.4%) treated with background regimen alone. The most common SARs and reasons for hospitalization in the ARIKAYCE plus background regimen arm were related to exacerbation of underlying pulmonary disease and lower respiratory tract infections, such as pneumonia.

In Trial 3, 18.2% of patients treated with ARIKAYCE plus background regimen reported SARs compared to 8.9% of patients treated with background regimen plus inhaled placebo.

Common Adverse Reactions

The incidence of adverse reactions in Trial 1 are displayed in Table 1. Only those adverse reactions with a rate of at least 5% in the ARIKAYCE plus background regimen group and greater than the background regimen alone group, are shown.

Table 1: Adverse Reactions in \geq 5% of ARIKAYCE-treated MAC Patients and More Frequent than Background Regimen Alone in Trial 1		
Adverse Reaction	ARIKAYCE plus Background Regimen (n=223) n (%)	Background Regimen Alone (n=112) n (%)
Dysphonia ^a	105 (47)	1 (1)
Cough ^b	87 (39)	19 (17)
Bronchospasm ^c	64 (29)	12 (11)
Hemoptysis	40 (18)	14 (13)
Ototoxicity ^d	38 (17)	11 (10)
Upper airway irritation ^e	37 (17)	2 (2)
Musculoskeletal pain ^f	37 (17)	9 (8)
Fatigue and asthenia	36 (16)	11 (10)
Exacerbation of underlying pulmonary disease ^g	33 (15)	11 (10)
Diarrhea	28 (13)	5 (5)
Nausea	26 (12)	4 (4)
Pneumonia ^h	22 (10)	9 (8)
Headache	22 (10)	5 (5)
Pyrexia	16 (7)	5 (5)
Vomiting ⁱ	15 (7)	4 (4)
Rash ^j	14 (6)	2 (2)
Weight decreased	14 (6)	1 (1)
Change in sputum ^k	12 (5)	1 (1)
Chest discomfort	12 (5)	3 (3)

^aIncludes aphonia and dysphonia

^bIncludes cough, productive cough and upper airway cough syndrome

^cIncludes asthma, bronchial hyperreactivity, bronchospasm, dyspnea, dyspnea exertional, prolonged expiration, throat tightness, wheezing

^dIncludes deafness, deafness neurosensory, deafness unilateral, dizziness, hypoacusis, presyncope, tinnitus, vertigo

^eIncludes oropharyngeal pain, oropharyngeal discomfort, throat irritation, pharyngeal erythema, upper airway inflammation, pharyngeal edema, vocal cord inflammation, laryngeal pain, laryngeal edema, laryngitis

^fIncludes back pain, arthralgia, myalgia, pain/body aches, muscle spasm and musculoskeletal ^gIncludes COPD, infective exacerbation of COPD, infective exacerbation of bronchiectasis

^hIncludes atypical pneumonia, empyema, infection pleural effusion, lower respiratory tract infection, lung infection, lung infection pseudomonas, pneumonia, pneumonia aspiration, pneumonia pseudomonas, pseudomonas infection and respiratory tract infection

ⁱIncludes vomiting and post-tussive vomiting

^jIncludes rash, rash maculo-papular, drug eruption and urticaria

^kIncludes increased sputum, sputum purulent and sputum discolored

Selected adverse drug reactions that occurred in <5% of patients and at higher frequency in ARIKAYCE-treated patients in Trial 1 are presented in Table 2.

Table 2: Selected Adverse Reactions in < 5% of ARIKAYCE-treated MAC Patients and More Frequent than Background Regimen Alone in Trial 1		
	ARIKAYCE plus Background Regimen N=223	Background Regimen Alone N=112
Anxiety	10 (4.5)	0 (0)
Oral fungal infection ^a	9 (4)	2 (1.8)
Bronchitis	8 (3.6)	3 (2.7)
Hypersensitivity pneumonitis ^b	8 (3.6)	0 (0)
Dysgeusia	7 (3.1)	0 (0)
Respiratory failure ^c	6 (2.7)	1 (0.9)
Epistaxis	6 (2.7)	1 (0.9)
Neuromuscular disorder ^d	5 (2.2)	0 (0)
Dry mouth	5 (2.2)	0 (0)
Pneumothorax ^e	5 (2.2)	1 (0.9)
Exercise tolerance decreased	3 (1.3)	0 (0)
Balance disorder	3 (1.3)	0 (0)

^aIncludes oral candidiasis and oral fungal infection

^bIncludes allergic alveolitis, interstitial lung disease, and pneumonitis

^cIncludes acuter respiratory failure and respiratory failure

^dIncludes muscle weakness, neuropathy peripheral, and balance disorder

^eIncludes pneumothorax, pneumothorax spontaneous and pneumomediastinum

Refer to Table 1 and Table 2 for the incidence rate of hypersensitivity pneumonitis, bronchospasm, cough, dysphonia, exacerbation of underlying disease, hemoptysis, ototoxicity, upper airway irritation, and neuromuscular disorders [see *Warnings and Precautions* (5.1, 5.2, 5.3, 5.4, 5.6)]

7 DRUG INTERACTIONS

7.1 Drugs with Neurotoxic, Nephrotoxic, or Ototoxic Potential

Avoid concomitant use of ARIKAYCE with medications associated with neurotoxicity, nephrotoxicity, and ototoxicity.

7.2 Ethacrynic Acid, Furosemide, Urea, or Mannitol

Some diuretics can enhance aminoglycoside toxicity by altering aminoglycoside concentrations in serum and tissue. Avoid concomitant use of ARIKAYCE with ethacrynic acid, furosemide, urea, or intravenous mannitol.

8 USE IN SPECIFIC POPULATIONS

8.1 Pregnancy

Risk Summary

There are no data on ARIKAYCE use in pregnant women to evaluate for any drug-associated risk of major birth defects, miscarriage or adverse maternal or fetal outcomes. Although systemic absorption of amikacin following oral inhalation is expected to be low [see *Clinical Pharmacology* (12.3)], systemic exposure to aminoglycoside antibacterial drugs, including ARIKAYCE, may be associated with total, irreversible, bilateral congenital deafness when administered to pregnant women [see *Warning and Precautions* (5.8)]. Advise pregnant women of the potential risk to a fetus.

Animal reproductive toxicology studies have not been conducted with inhaled amikacin. Subcutaneous administration of amikacin to pregnant rats (up to 100 mg/kg/day) and mice (up to 400 mg/kg/day) during organogenesis was not associated with fetal malformations. Ototoxicity was not adequately evaluated in offspring in animal studies.

The estimated background risk of major birth defects and miscarriage for the indicated populations is unknown. All pregnancies have a background risk of birth defect, loss, or other adverse outcomes. In the U.S. general population, the estimated background risk of major birth defects and miscarriage in clinically recognized pregnancies is 2-4% and 15-20%, respectively.

Data

Animal Data

No animal reproductive toxicology studies have been conducted with ARIKAYCE or non-liposomal amikacin administered by inhalation.

Amikacin was subcutaneously administered to pregnant rats (Gestation Days 8-14) and mice (Gestation Days 7-13) at doses of 25, 100, or 400 mg/kg to assess developmental toxicity. These doses did not cause fetal visceral or skeletal malformations in mice. The high dose was excessively maternally toxic in rats (nephrotoxicity and mortality were observed), precluding the evaluation of offspring at this dose. Fetal malformations were not observed at the low or mid dose in rats. Postnatal development of the rats and mice exposed to these doses of amikacin in utero did not differ significantly from control.

Ototoxicity was not adequately evaluated in offspring in animal developmental toxicology studies.

8.2 Lactation

Risk Summary

There is no information regarding the presence of ARIKAYCE in human milk, the effects on the breastfed infant, or the effects on milk production after administration of ARIKAYCE by inhalation. Although limited published data on other routes of administration of amikacin indicate that amikacin is present in human milk, systemic absorption of ARIKAYCE following inhaled administration is expected to be low [see *Clinical Pharmacology (12.3)*]. The developmental and health benefits of breastfeeding should be considered along with the mother's clinical need for ARIKAYCE and any potential adverse effects on the breastfed child from ARIKAYCE or from the underlying maternal condition.

8.4 Pediatric Use

Safety and effectiveness of ARIKAYCE in pediatric patients below 18 years of age have not been established.

8.5 Geriatric Use

In the NTM clinical trials, of the total number of patients receiving ARIKAYCE, 196 (50.5%) were ≥ 65 years and 55 (14.2%) were ≥ 75 years. No overall differences in safety and effectiveness were observed between elderly subjects and younger subjects. Because elderly patients are more likely to have decreased renal function, it may be useful to monitor renal function [see *Warnings and Precautions (5.6)*].

8.6 Hepatic Impairment

ARIKAYCE has not been studied in patients with hepatic impairment. No dose adjustments based on hepatic impairment are required since amikacin is not hepatically metabolized [see *Clinical Pharmacology (12.3)*].

8.7 Renal Impairment

ARIKAYCE has not been studied in patients with renal impairment. Given the low systemic exposure to amikacin following administration of ARIKAYCE, clinically relevant accumulation of amikacin is unlikely to occur in patients with renal impairment. However, renal function should be monitored in patients with known or suspected renal impairment, including elderly patients with potential age-related decreases in renal function [see *Warnings and Precautions (5.6)*, *Use in Specific Populations (8.5)*].

10 OVERDOSAGE

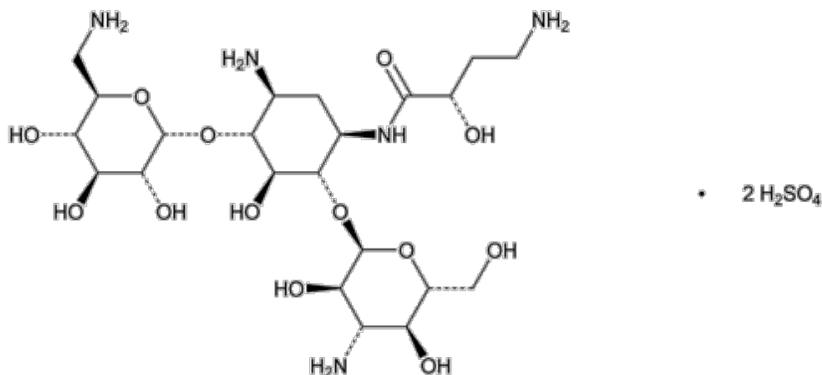
Adverse reactions specifically associated with overdose of ARIKAYCE have not been identified. Acute toxicity should be treated with immediate withdrawal of ARIKAYCE, and baseline tests of renal function should be undertaken.

Hemodialysis may be helpful in removing amikacin from the body.

In all cases of suspected overdose, physicians should contact the Regional Poison Control Center for information about effective treatment. In the case of any overdose, the possibility of drug interactions with alterations in drug disposition should be considered.

11 DESCRIPTION

The active ingredient in ARIKAYCE (amikacin liposome inhalation suspension) is amikacin sulfate USP, an aminoglycoside antibacterial. Its chemical name is D-Streptomine, *O*-3-amino-3-deoxy- α -D-glucopyranosyl-(1 \rightarrow 6)-*O*-[6-amino-6-deoxy- α -D-glucopyranosyl-(1 \rightarrow 4)]-*N*¹-(4-amino-2-hydroxy-1-oxobutyl)-2-deoxy-, (*S*)-, sulfate (1:2) salt with a chemical formula of C₂₂H₄₃N₅O₁₃•2H₂SO₄ with a molecular weight of 781.76. Its structural formula is:



ARIKAYCE is a white milky suspension consisting of amikacin sulfate encapsulated in liposomes and is supplied in a unit-dose 10 mL clear glass vial containing amikacin 590 mg/8.4 mL (equivalent to amikacin sulfate 623 mg/8.4 mL) as a sterile aqueous liposomal suspension for oral inhalation. ARIKAYCE consists of amikacin sulfate encapsulated in liposomes at a targeted concentration of 70 mg amikacin/mL with the pH range of 6.1 to 7.1 and lipid to amikacin weight ratio in the range of 0.60 to 0.79. The inactive ingredients are cholesterol, dipalmitoylphosphatidylcholine (DPPC), sodium chloride, sodium hydroxide (for pH adjustment), and water for injection.

ARIKAYCE is administered only using a Lamira Nebulizer System [see *Dosage and Administration (2.1)*]. Like all other nebulized treatments, the amount delivered to the lungs will depend upon patient factors. Under standardized *in vitro* testing per USP<1601> adult breathing pattern (500 mL tidal volume, 15 breaths per minute, and inhalation: exhalation ratio of 1:1), the mean delivered dose from the mouthpiece was approximately 312 mg of amikacin sulfate (53% of label claim). The mass median aerodynamic diameter (MMAD) of the nebulized aerosol droplets is about 4.7 μ m (4.1 – 5.3 μ m) as determined using the Next Generation Impactor (NGI) method. A percentage of the amikacin in the liposome is released by the nebulization process, thus nebulized ARIKAYCE delivers a combination of free and liposomal amikacin.

12 CLINICAL PHARMACOLOGY

12.1 Mechanism of Action

ARIKAYCE is an antibacterial drug [see *Microbiology (12.4)*].

12.2 Pharmacodynamics

ARIKAYCE exposure-response relationships and the time course of pharmacodynamic response are unknown.

12.3 Pharmacokinetics

Sputum Concentrations

Following once daily inhalation of 590 mg ARIKAYCE in *Mycobacterium avium* complex (MAC) patients, sputum concentrations at 1 to 4 hours post-inhalation were 1720, 884, and 1300 mcg/g at 1, 3, and 6 months, respectively. High variability in amikacin concentrations were observed (CV% >100%). After 48 to 72 hours post-inhalation, amikacin sputum concentrations decreased to approximately 5% of those at 1 to 4 hours post-inhalation.

Serum Concentrations

Following 3 months of once daily inhalation of 590 mg ARIKAYCE in MAC patients, the mean serum AUC₀₋₂₄ was 23.5 mcg*hr/mL (range: 8.0 to 46.5 mcg*hr/mL; n=12) and the mean serum C_{max} was 2.8 mcg/mL (range: 1.0 to 4.4 μ g/mL; n=12). The maximum C_{max} and AUC₀₋₂₄ were below the mean C_{max} of

approximately 76 mcg/mL and AUC₀₋₂₄ of 154 mcg*hr/mL observed for intravenous administration of amikacin sulfate for injection at the approved dosage of 15 mg/kg once daily in healthy adults.

Absorption

The bioavailability of ARIKAYCE is expected to vary primarily from individual differences in nebulizer efficiency and airway pathology.

Distribution

The protein binding of amikacin in serum is $\leq 10\%$.

Elimination

Following inhalation of ARIKAYCE in MAC patients, the apparent serum half-life of amikacin ranged from approximately 5.9 to 19.5 hrs.

Metabolism

Amikacin does not undergo appreciable metabolism.

Excretion

Systemically absorbed amikacin following ARIKAYCE administration is eliminated principally via glomerular filtration. On average, 7.42% (ranging from 0.72 to 22.60%; n=14) of the total ARIKAYCE dose was excreted in urine as unchanged drug compared to 94% following intravenous administration of amikacin sulfate for injection. Unabsorbed amikacin, following ARIKAYCE inhalation, is probably eliminated primarily by cellular turnover and expectoration.

Drug Interaction Studies

No clinical drug interaction studies have been conducted with ARIKAYCE [*see Drug Interactions (7)*].

12.4 Microbiology

Mechanism of Action

Amikacin is a polycationic, semisynthetic, bactericidal aminoglycoside. Amikacin enters the bacterial cell by binding to negatively charged components of the bacterial cell wall disrupting the overall architecture of the cell wall. The primary mechanism of action is the disruption and inhibition of protein synthesis in the target bacteria by binding to the 30S ribosomal subunit.

Resistance

The mechanism of resistance to amikacin in mycobacteria has been linked to mutations in the *rrs* gene of the 16S rRNA. In clinical trials, MAC isolates developing an amikacin MIC of > 64 mcg/mL after baseline were observed in a higher proportion of subjects treated with ARIKAYCE [*see Clinical Studies (14)*].

Interaction with Other Antimicrobials

There has been no *in vitro* signal for antagonism between amikacin and other antimicrobials against MAC based on fractional inhibitory concentration (FIC) and macrophage survival assays. In select instances, some degree of synergy between amikacin and other agents has been observed, as for example, synergy between aminoglycosides, including amikacin, and the beta-lactam class has been documented.

13. NONCLINICAL TOXICOLOGY

13.1 Carcinogenesis, Mutagenesis, Impairment of Fertility

In a 2-year inhalation carcinogenicity study, rats were exposed to ARIKAYCE for 15-25, 50-70, or 155-170 minutes per day for 96-104 weeks. These provided approximate inhaled doses of 5, 15, and 45 mg/kg/day. Squamous cell carcinoma was observed in the lungs of 2 of 120 rats administered the highest dose tested. Maximum serum AUC levels of amikacin in the rats at steady state were approximately 1.3, 2.8, and 7.6 mcg·hr/mL at the low, mid, and high doses, respectively, compared with 23.5 mcg·hr/mL (8.0 to 46.5 mcg·hr/mL) measured in humans. The squamous cell carcinomas may be the result of a high lung burden of particulates from ARIKAYCE in the rat lung. The relevance of the lung tumor findings with regards to humans receiving ARIKAYCE is unknown.

No evidence of mutagenicity or genotoxicity was observed in a battery of *in vitro* and *in vivo* genotoxicity studies with a liposome-encapsulated amikacin formulation similar to ARIKAYCE (*in vitro* microbial

mutagenesis test, *in vitro* mouse lymphoma mutation assay, *in vitro* chromosomal aberration study, and an *in vivo* micronucleus study in rats).

No fertility studies were conducted with ARIKAYCE. Intraperitoneal administration of amikacin to male and female rats at doses up to 200 mg/kg/day prior to mating through Day 7 of gestation were not associated with impairment of fertility or adverse effects on early embryonic development.

13.2 Animal Toxicology and/or Pharmacology

To provide information about chronic dosing of ARIKAYCE to another animal species, a 9-month inhalation toxicology study was conducted in dogs. Foamy alveolar macrophages associated with clearance of the inhaled product were present at dose-related incidence and severity, but they were not associated with inflammation, tissue hyperplasia, or the presence of preneoplastic or neoplastic changes. Dogs were exposed to ARIKAYCE for up to 90 minutes per day, providing inhaled amikacin doses of approximately 5, 10, and 30 mg/kg/day.

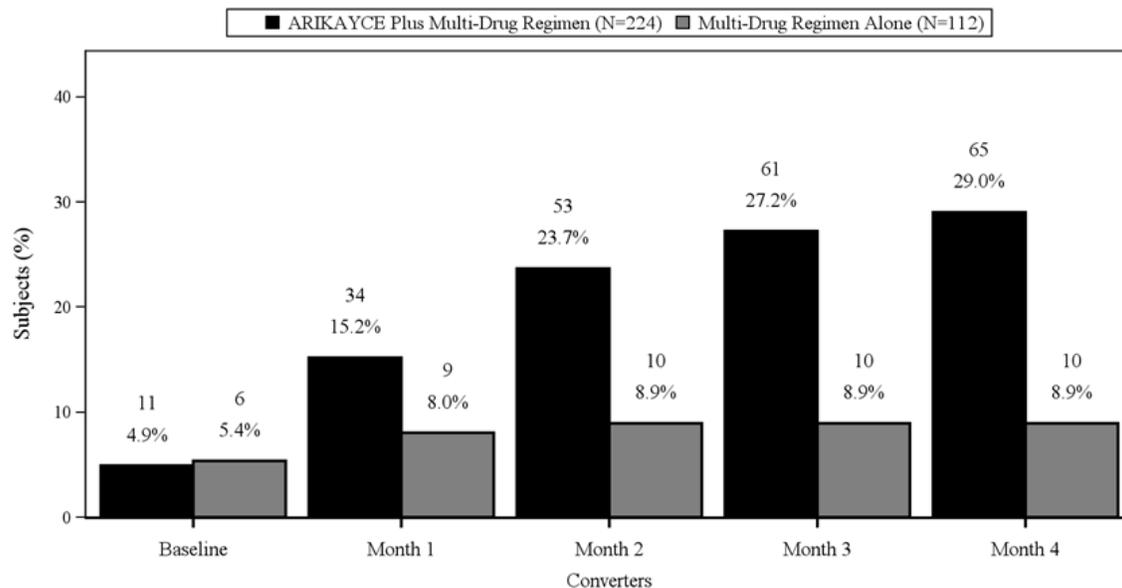
14. CLINICAL STUDIES

Trial 1 (NCT# 02344004) was an open-label, randomized (2:1), multi-center trial in patients with refractory *Mycobacterium avium* complex (MAC) lung disease as confirmed by at least 2 sputum culture results. Patients were considered to have refractory MAC lung disease if they did not achieve negative sputum cultures after a minimum duration of 6 consecutive months of background regimen therapy that was either ongoing or stopped no more than 12 months before the screening visit. Patients were randomized to either ARIKAYCE plus a background regimen or background regimen alone. The surrogate endpoint for assessing efficacy was based on achieving culture conversion (3 consecutive monthly negative sputum cultures) by Month 6. The date of conversion was defined as the date of the first of the 3 negative monthly cultures, which had to be achieved by Month 4 in order to meet the endpoint by Month 6.

A total of 336 patients were randomized (ARIKAYCE plus background regimen, n=224; background regimen alone, n=112) (ITT population), with a mean age of 64.7 years and there was a higher percentage of females (69.3%) than males (30.7%) in the study. At the time of enrollment, of the 336 subjects in the ITT population, 302 (89.9%) were either on a guideline-based regimen for MAC or off guideline-based therapy for MAC for less than 3 months while 34 (10.1%) were off treatment for 3 to 12 months prior to enrollment. At screening, patients were stratified by smoking status (current smoker or not) and by whether patients were on treatment or off treatment for at least 3 months. Most patients at screening were not current smokers (89.3%) and had underlying bronchiectasis (62.5%). At baseline, background regimens included a macrolide (91.9%), a rifamycin (85.7%), or ethambutol (80.3%). Overall, 54.9% of subjects were receiving a triple background regimen of a macrolide, a rifamycin and ethambutol.

The proportion of patients achieving culture conversion (3 consecutive monthly negative sputum cultures) by Month 6 was significantly ($p < 0.0001$) greater for ARIKAYCE plus background regimen (65/224, 29.0%) compared to background regimen alone (10/112, 8.9%). An analysis of sustained sputum culture conversion through Month 6 (defined as consecutive negative sputum cultures with no positive culture on solid media or no more than 2 consecutive positive cultures on liquid media following achieving initial culture conversion) showed that 3 subjects in each treatment arm who initially achieved culture conversion did not have sustained sputum culture conversion through Month 6. Thus, 27.7% (62/224) of ARIKAYCE plus background regimen patients and 6.3% (7/112) of background regimen alone patients had sustained sputum culture conversion through Month 6.

Cumulative Proportion of Subjects Achieving Culture Conversion Shown by the First Month of Conversion Intent to Treat (ITT) Population



In Trial 1, 23/224 (10.3%) of patients had MAC isolates that developed MIC of > 64 mcg/mL while receiving treatment with ARIKAYCE. In the background regimen alone arm, 4/112 (3.6%) of patients had MAC isolates that developed amikacin MIC of > 64 mcg/mL.

Additional endpoints to assess the clinical benefit of ARIKAYCE, for example, change from baseline in six-minute walk test distance and the Saint George's Respiratory Questionnaire, did not demonstrate clinical benefit by Month 6.

16 HOW SUPPLIED/STORAGE AND HANDLING

16.1 How Supplied

ARIKAYCE (amikacin liposome inhalation suspension), 590 mg/8.4 mL, is supplied in a sterile, unit-dose 10-mL glass vial. The product is dispensed as a 28-vial kit.

Each carton contains a 28-day supply of medication (28 vials). In addition to the ARIKAYCE vials in the carton, one Lamira Nebulizer Handset and four Lamira aerosol heads are provided.

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The Lamira Nebulizer System contains a controller, a spare aerosol head, a spare handset, power cord and accessories.

16.2 Storage and Handling

Store ARIKAYCE vials refrigerated at 2°C to 8°C (36°F to 46°F) until expiration date on vial. *Do not freeze.* Once expired, discard any unused drug.

ARIKAYCE can be stored at room temperature up to 25°C (77°F) for up to 4 weeks. Once at room temperature, any unused drug must be discarded at the end of 4 weeks.

17 PATIENT COUNSELING INFORMATION

Advise the patient to read the FDA-approved patient labeling (Medication Guide and Patient Instructions for Use).

Important Instructions for Administration of ARIKAYCE

Instruct patients to read the *Instructions for Use* before starting ARIKAYCE. Instruct patients to only use the Lamira™ Nebulizer System to administer ARIKAYCE. Advise the patient or caregiver not use the Lamira Nebulizer System with any other medicine.

Hypersensitivity Pneumonitis and Bronchospasm (Difficulty Breathing) Advise patients to inform their healthcare provider if they experience shortness of breath or wheezing after administration of ARIKAYCE.

Advise patients with a history of reactive airway disease, asthma, or bronchospasm, to administer ARIKAYCE after using a short-acting bronchodilator [see *Warnings and Precautions (5.1, 5.3)*].

Hemoptysis or Cough

Advise patients to inform their healthcare provider if they cough up blood or experience episodic cough either during or after ARIKAYCE administration particularly in the first month after starting ARIKAYCE [see *Warnings and Precautions (5.2) and Adverse Reactions (6.2)*].

Exacerbations of Underlying Pulmonary Disease Advise patients to inform their healthcare provider if they experience worsening of their lung disease after starting ARIKAYCE [see *Warnings and Precautions (5.4)*].

Dysphonia or Difficulty Speaking

Advise patients to inform their healthcare provider if they have difficulty speaking. Difficulty speaking or loss of ability to speak has been reported with ARIKAYCE [see *Adverse Reactions (6.2)*].

Ototoxicity (Ringing in the Ears)

Advise patients to inform their healthcare provider if they experience ringing in the ears, dizziness, or any changes in hearing because ARIKAYCE has been associated with hearing loss [see *Warnings and Precautions (5.6)*].

Advise the patient not to operate heavy machinery or do dangerous activities while inhaling ARIKAYCE through the Lamira Nebulizer System because ARIKAYCE can cause symptoms such as dizziness or respiratory symptoms

Nephrotoxicity or Kidney Damage

Advise patients to inform their health care provider if they have kidney problems because kidney damage has been reported with aminoglycosides. [see *Warnings and Precautions (5.7)*].

Neuromuscular Blockade: Advise patients to inform their healthcare provider of known neuromuscular disease (e.g., myasthenia gravis) [see *Warnings and Precautions (5.8)*].

Embryofetal Toxicity: Advise pregnant women that aminoglycosides, including ARIKAYCE, may cause irreversible congenital deafness when administered during pregnancy [see *Warnings and Precautions (5.9) and Use in Special Population (8.1)*].

Manufactured for:

Insmed[®], Bridgewater, NJ 08807

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