

ALBUTEROL SULFATE INHALATION SOLUTION, 0.5%- albuterol sulfate solution
Ritedose Pharmaceuticals, LLC

Albuterol Sulfate Inhalation Solution, EQ 0.5% Base (2.5 mg/0.5 mL)

Albuterol Sulfate Inhalation Solution

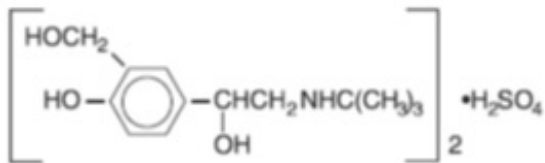
0.5%2.5 mg* / 0.5 mL

(*Equivalent to 3 mg of albuterol sulfate)

*Potency expressed as albuterol

DESCRIPTION

Albuterol Sulfate Inhalation Solution, 0.5% contains albuterol sulfate, USP, the racemic form of albuterol and a relatively selective beta₂-adrenergic bronchodilator. Albuterol sulfate has the chemical name α₁[(tert-Butylamino) methyl]-4-hydroxy-m-xylene-α, α'-diol sulfate (2:1) (salt), and the following chemical structure:



The molecular weight of albuterol sulfate is 576.7, and the empirical formula is (C₁₃H₂₁NO₃)₂•H₂SO₄. Albuterol sulfate is a white crystalline powder, soluble in water and slightly soluble in ethanol. The World Health Organization's recommended name for albuterol base is salbutamol.

Albuterol sulfate inhalation solution, 0.5%, is in concentrated form. Dilute 0.5 mL of the solution to 3 mL with sterile normal saline solution prior to administration by nebulization.

Each 0.5 mL Unit-Dose Vial Contains: 2.5 mg of albuterol (equivalent to 3 mg of albuterol sulfate, USP) in a sterile, aqueous solution; sulfuric acid is used to adjust the pH to between 3 and 5. Albuterol Sulfate Inhalation solution contains no sulfiting agents or preservatives. It is supplied in 0.5 mL sterile Unit-Dose Vials.

Albuterol sulfate inhalation solution is a clear, colorless to light yellow solution.

CLINICAL PHARMACOLOGY

The primary action of beta-adrenergic drugs, is to stimulate adenylyl cyclase, the enzyme that catalyzes the formation of cyclic-3',5'-adenosine monophosphate (cyclic AMP) from adenosine triphosphate (ATP) in beta-adrenergic cells. The cyclic AMP thus formed mediates the cellular responses. Increased cyclic AMP levels are associated with relaxation of bronchial smooth muscle and inhibition of release of mediators of immediate hypersensitivity from cells, especially from mast cells.

In vitro studies and *in vivo* pharmacologic studies have demonstrated that albuterol has a preferential effect on beta₂-adrenergic receptors compared with isoproterenol. While it is recognized that beta₂-adrenergic receptors are the predominant receptors in bronchial smooth muscle, data indicate that there is a population of beta₂-receptors in the human heart existing in a concentration between 10% and 50%. The precise function of these receptors has not been established.

In controlled clinical trials, albuterol has been shown in most controlled clinical trials to have more effect on the respiratory tract, in the form of bronchial smooth muscle relaxation, than isoproterenol at comparable doses while producing fewer cardiovascular effects.

Controlled clinical studies and other clinical experience have shown that inhaled albuterol, like other beta-adrenergic agonist drugs, can produce a significant cardiovascular effect in some patients, as measured by pulse rate, blood pressure, symptoms, and/or ECG changes.

Albuterol is longer acting than isoproterenol in most patients by any route of administration because it is not a substrate for the cellular uptake processes for catecholamines nor for catechol-O-methyl transferase.

The effects of rising doses of albuterol and isoproterenol aerosols were studied in volunteers and asthmatic patients. Results in normal volunteers indicated that the propensity for increase in heart rate for albuterol is 1/2 to 1/4 that of isoproterenol. In asthmatic patients similar cardiovascular differentiation between the MO drugs was also seen.

Pharmacokinetics

Preclinical: Intravenous studies in rats with albuterol sulfate have demonstrated that albuterol crosses the blood-brain barrier and reaches brain concentrations that are amounting to approximately 5.0% of the plasma concentrations. In structures outside the brain barrier (pineal and pituitary glands), albuterol concentrations were found to be 100 times those in the whole brain.

Studies in laboratory animals (minipigs, rodents, and dogs) have demonstrated the occurrence of cardiac arrhythmias and sudden death (with histologic evidence of myocardial necrosis) when beta-agonists and methylxanthines were administered concurrently. The significance of these findings is unknown.

Pharmacokinetics

After either IPPB or nebulizer administration in asthmatic patients, less than 20% of a single albuterol dose was absorbed; the remaining amount was recovered from the nebulizer and apparatus and expired air. Most of the absorbed dose was recovered in the urine 24 hours after drug administration. Following a 3.0 mg dose of nebulized albuterol, the maximum albuterol plasma level at 0.5 hour was 2.1 ng/mL (range 1.4 to 3.2 ng/mL). It has been demonstrated that following oral administration of 4 mg of albuterol, the elimination half-life was 5 to 6 hours.

Clinical Trials:

In controlled clinical trials, most patients exhibited an onset of improvement in

pulmonary function within 5 minutes as determined by FEV₁. FEV₁ measurements also showed that the maximum average improvement in pulmonary function usually occurred at approximately 1 hour following inhalation of 2.5 mg of albuterol by compressor-nebulizer and remained close to peak for 2 hours. Clinically significant improvement in pulmonary function (defined as maintenance of a 15% or more increase in FEV₁ over baseline values) continued for 3 to 4 hours in most patients and in some patients continued up to 6 hours.

INDICATIONS AND USAGE

Albuterol sulfate inhalation solution is indicated for the relief of bronchospasm in patients 12 years of age and older with reversible obstructive airway disease and acute attacks of bronchospasm.

CONTRAINDICATIONS

Albuterol sulfate inhalation solution is contraindicated in patients with a history of hypersensitivity to albuterol or any of its components.

WARNINGS

DETERIORATION OF ASTHMA

Asthma may deteriorate acutely over a period of hours or chronically over several days or longer. If the patient needs more doses of albuterol sulfate inhalation solution than usual, this may be a marker of destabilization of asthma and requires re-evaluation of the patient and treatment regimen, giving special consideration to the possible need for anti-inflammatory treatment, e.g., corticosteroids.

USE OF ANTI-INFLAMMATORY AGENTS

The use of beta-adrenergic agonist bronchodilators alone may not be adequate to control asthma in many patients. Early consideration should be given to adding anti-inflammatory agents, e.g., corticosteroids.

PARADOXICAL BRONCHOSPASM

Albuterol sulfate inhalation solution can produce paradoxical bronchospasm, which may be life threatening. If paradoxical bronchospasm occurs, albuterol sulfate inhalation solution should be discontinued immediately and alternative therapy instituted. It should be recognized that paradoxical bronchospasm, when associated with inhaled formulations, frequently occurs with the first use of a new vial.

CARDIOVASCULAR EFFECTS

Albuterol sulfate inhalation solution, like all other beta-adrenergic agonists, can produce a clinically significant cardiovascular effect in some patients as measured by pulse rate, blood pressure, and/or symptoms. Although such effects are uncommon after administration of albuterol sulfate inhalation solution at recommended doses, if they occur, the drug may need to be discontinued. In addition, beta-agonists have been reported to produce electrocardiogram (ECG) changes, such as flattening of the T wave, prolongation of the QTc interval, and ST segment depression. The clinical significance of

these findings is unknown. Therefore, albuterol sulfate inhalation solution, like all sympathomimetic amines, should be used with caution in patients with cardiovascular disorders, especially coronary insufficiency, cardiac arrhythmias, and hypertension.

IMMEDIATE HYPERSENSITIVITY REACTIONS

Immediate hypersensitivity reactions may occur after administration of albuterol, as demonstrated by rare cases of urticaria, angioedema, rash, bronchospasm, anaphylaxis, and oropharyngeal edema.

PRECAUTIONS

General

Albuterol, as with all sympathomimetic amines, should be used with caution in patients with cardiovascular disorders, especially coronary insufficiency, cardiac arrhythmias, and hypertension; in patients with convulsive disorders, hyperthyroidism, or diabetes mellitus; and in patients who are unusually responsive to sympathomimetic amines. Clinically significant changes in systolic and diastolic blood pressure have been seen in individual patients and could be expected to occur in some patients after use of any beta-adrenergic bronchodilator.

Large doses of intravenous albuterol have been reported to aggravate pre-existing diabetes mellitus and ketoacidosis. As with other beta-agonist medications, albuterol may produce significant hypokalemia in some patients, possibly through intracellular shunting, which has the potential to produce adverse cardiovascular effects. The decrease is usually transient, not requiring potassium supplementation.

Informations for Patients

The action of albuterol sulfate inhalation solution may last up to 6 hours or longer. Albuterol sulfate inhalation solution should not be used more frequently than recommended. Do not increase the dose or frequency of albuterol sulfate inhalation solution without consulting your physician. If you find that treatment with albuterol sulfate inhalation solution becomes less effective for symptomatic relief, your symptoms become worse, and/or you need to use the product more frequently than usual, you should seek medical attention immediately. While you are using albuterol sulfate inhalation solution, other inhaled drugs and asthma medications should be taken only as directed by your physician. Common adverse effects include palpitations, chest pain, rapid heart rate, tremor or nervousness. If you are pregnant or nursing, contact your physician about use of albuterol sulfate inhalation solution. Effective use of albuterol sulfate inhalation solution includes an understanding of the way it should be administered. See illustrated Instructions for Use.

Mixing Different Inhalation Solutions

Drug compatibility (physical and chemical), efficacy, and safety of Albuterol Sulfate Inhalation Solution when mixed with other drugs in a nebulizer have not been established.

Drug Interactions

Other short-acting sympathomimetic aerosol bronchodilators or epinephrine should not be used concomitantly with albuterol sulfate inhalation solution.

Beta-Blockers

Beta-adrenergic receptor blocking agents not only block the pulmonary effect of beta-agonists, such as albuterol sulfate inhalation solution, but may produce severe bronchospasm in asthmatic patients. Therefore, patients with asthma should not normally be treated with beta-blockers. However, under certain circumstances (e.g., as prophylaxis after myocardial infarction), there may be no acceptable alternatives to the use of beta-adrenergic blocking agents in patients with asthma. In this setting, cardioselective beta-blockers could be considered, although they should be administered with caution.

Diuretics

The ECG changes and/or hypokalemia that may result from the administration of non-potassium sparing diuretics (such as loop or thiazide diuretics) can be acutely worsened by beta-agonists, especially when the recommended dose of the beta-agonist is exceeded. Although the clinical significance of these effects is not known, caution is advised in the co-administration of beta-agonists with non-potassium sparing diuretics.

Digoxin

Mean decreases of 16% to 22% in serum digoxin levels were demonstrated after single dose intravenous and oral administration of albuterol, respectively, to normal volunteers who had received digoxin for 10 days. The clinical significance of these findings for patients with obstructive airway disease who are receiving albuterol and digoxin on a chronic basis is unclear. Nevertheless, it would be prudent to carefully evaluate the serum digoxin levels in patients who are currently receiving digoxin and albuterol.

Monoamine Oxidase Inhibitors or Tricyclic Antidepressants:

Albuterol sulfate inhalation solution should be administered with extreme caution to patients being treated with monoamine oxidase inhibitors or tricyclic antidepressants or within 2 weeks of discontinuation of such agents, because the action of albuterol on the vascular system may be potentiated.

Carcinogenesis, Mutagenesis, and Impairment of Fertility

In a 2-year study in Sprague-Dawley rats, albuterol sulfate caused a significant dose-related increase in the incidence of benign leiomyomas of the mesovarium at and above dietary doses of 2 mg/kg (approximately 2 times the maximum recommended daily inhalation dose for adults on a mg/m² basis). In another study, this effect was blocked by the co-administration of propranolol, a non-selective beta-adrenergic antagonist.

In an 18-month study in CD-1 mice, albuterol sulfate showed no evidence of tumorigenicity at dietary doses up to 500 mg/kg (approximately 200 times the maximum recommended daily inhalation dose for adults on a mg/m² basis). In a 22-month study in the Golden hamster, albuterol sulfate showed no evidence of tumorigenicity at dietary doses up to 50 mg/kg (approximately 25 times the maximum recommended daily inhalation dose for adults on a mg/m² basis).

Albuterol sulfate was not mutagenic in the Ames test with or without metabolic activation using tester strains *S. typhimurium*TA1537, TA1538, and TA98 or *E. coli*WP2, WP2uvrA, and WP67. No forward mutation was seen in yeast strain *S. cerevisiae*S9 nor any mitotic gene conversion in yeast strain *S. cerevisiae*JD1 with or without metabolic activation. Fluctuation assays in *S. typhimurium*TA98 and *E. coli*WP2, both with metabolic activation, were negative. Albuterol sulfate was not clastogenic in a human peripheral lymphocyte assay or in an AH1 strain mouse micronucleus assay.

Reproduction studies in rats demonstrated no evidence of impaired fertility at oral doses of albuterol sulfate up to 50 mg/kg (approximately 40 times the maximum recommended daily inhalation dose for adults on a mg/m²basis).

Pregnancy

Teratogenic Effects

Albuterol has been shown to be teratogenic in mice. A study in CD-1 mice at subcutaneous doses at and above 0.25 mg/kg (corresponding to less than the maximum recommended daily inhalation dose for adults on a mg/m²basis), induced cleft palate formation in 5 of 111 (4.5%) fetuses. At an subcutaneous dose of 2.5 mg/kg (approximately equal to the maximum recommended daily inhalation dose for adults on mg/m²basis), albuterol sulfate induced cleft palate formation in 10 of 108 (9.3%) fetuses. The drug did not induce cleft palate formation when administered at an subcutaneous dose of 0.025 mg/kg (corresponding to less than the maximum recommended daily inhalation dose for adults on mg/m²basis). Cleft palate also occurred in 22 of 72 (30.5%) fetuses from females treated with 2.5 mg/kg isoproterenol (positive control) administered subcutaneously.

A reproduction study in Stride Dutch rabbits revealed cranioschisis in 7 of 19 (37%) fetuses when albuterol was administered orally at a dose of 50 mg/kg dose (approximately 80 times the maximum recommended daily inhalation dose for adults on a mg/m²basis).

Studies in pregnant rats with titrated Albuterol demonstrated that approximately 10% of the circulating maternal drug is transferred to the fetus. Disposition in the fetal lungs is comparable to maternal lungs; but fetal liver disposition is 1% of the maternal liver levels.

There are no adequate and well-controlled studies in pregnant women. Because animal reproduction studies are not always predictive of human response. Albuterol should be used during pregnancy only if the potential benefit justifies the potential risk to the fetus.

During worldwide marketing experience, various congenital anomalies, including cleft palate and limb defects, have been reported in the offspring of patients being treated with albuterol. Some of the mothers were taking multiple medications during their pregnancies. No consistent pattern of defects can be discerned, and a relationship between albuterol use and congenital anomalies has not been established.

Labor and Delivery

Tocolysis:

Because of the potential for beta-agonist interference with uterine contractility, use of albuterol sulfate inhalation solution for relief of bronchospasm during labor should be restricted to those patients in whom the benefits clearly outweigh the risk.

Albuterol has not been approved for the management of preterm labor. The benefit:risk ratio when albuterol is administered for tocolysis has not been established. Serious adverse reactions, including maternal pulmonary edema, have been reported during or following treatment of premature labor with beta 2-agonists, including albuterol.

Nursing Mothers

It is not known whether this drug is excreted in human milk. Because of the potential for tumorigenicity shown for albuterol in some animal studies, a decision should be made whether to discontinue nursing or to discontinue the drug, taking into account the importance of the drug to the mother.

Pediatric Use

Safety and effectiveness of albuterol inhalation solution and solution for inhalation in children below the age of 12 years have not been established.

ADVERSE REACTIONS

The results of clinical trials with albuterol sulfate inhalation solution in 135 patients showed the following side effects which were considered probably or possibly drug related:

Percent Incidence of Adverse Reactions

Reaction	Percent Incidence (N=135)
<i>Central Nervous System</i>	
Tremors	20
Dizziness	7
Nervousness	4
Headache	3
Insomnia	1
<i>Gastrointestinal</i>	
Nausea	4
Dyspepsia	1
Ear, nose and throat Nasal congestion	1
Pharyngitis	<1
<i>Cardiovascular</i>	
Tachycardia	1
Hypertensions	1
<i>Respiratory</i>	
Bronchospasm	8
Cough	4
Bronchitis	4
Wheezing	1

No clinically relevant laboratory abnormalities related to albuterol sulfate inhalation solution were determined in these studies.

Cases of urticaria, angioedema, rash, bronchospasm, hoarseness, oropharyngeal edema, and arrhythmias (including atrial fibrillation, supraventricular tachycardia, and extrasystoles) have also been reported after the use of inhaled albuterol.

To report SUSPECTED ADVERSE REACTIONS, contact Ritedose Pharmaceuticals, LLC at 1-855-806-3300 or FDA at 1-800-FDA-1088 or www.fda.gov/medwatch.

OVERDOSAGE

The expected symptoms with overdosage are those of excessive beta-adrenergic stimulation and/or occurrence or exaggeration of any of the symptoms listed under ADVERSE REACTIONS, e.g., angina, hypertension, tachycardia with rates up to 200 beats per minute, arrhythmias, nervousness, headache, tremor, dry mouth, palpitation, nausea, dizziness, malaise, and insomnia. In addition, seizures, hypotension, fatigue, and hypokalemia may also occur. As with all sympathomimetic aerosol medications, cardiac arrest and even death may be associated with abuse of albuterol sulfate inhalation solution. Treatment consists of discontinuation of albuterol sulfate inhalation solution together with appropriate symptomatic therapy. The judicious use of a cardioselective beta-receptor blocker may be considered bearing in mind that such medication can produce bronchospasm. There is insufficient evidence to determine if dialysis is beneficial for overdosage of albuterol sulfate inhalation solution.

The oral median lethal dose of albuterol sulfate in mice is greater than 2000 mg/kg (approximately 810 times the maximum recommended daily inhalation dose for adults on a mg/m² basis). In mature rats, the subcutaneous median lethal dose of albuterol sulfate is approximately 450 mg/kg (approximately 360 times the maximum recommended daily inhalation dose for adults on a mg/m² basis). In small young rats, the subcutaneous median lethal dose of albuterol sulfate is approximately 2000 mg/kg (approximately 1600 times the maximum recommended daily inhalation dose for adults on a mg/m² basis). The inhalation median lethal dose has not been determined in animals.

DOSAGE AND ADMINISTRATION

The usual dosage for adults and pediatric patients 12 years of age and older is 2.5 mg of albuterol (one unit-of-use vial) administered 3 to 4 times daily by nebulization. More frequent administration or higher doses are not recommended. To administer 2.5 mg of albuterol, dilute 0.5 mL of the 0.5% solution for inhalation to a total volume of 3 mL with sterile normal saline solution and administer by nebulization. The flow rate is regulated to suit the particular nebulizer so that albuterol sulfate inhalation solution will be delivered over approximately 5 to 15 minutes.

Drug compatibility (physical and chemical), efficacy, and safety of albuterol sulfate inhalation solution when mixed with other drugs in a nebulizer have not been established.

The use of albuterol sulfate inhalation solution can be continued as medically indicated to control recurring bouts of bronchospasm. During treatment, most patients gain

optimum benefit from regular use of the nebulizer solution.

If a previously effective dosage regimen fails to provide the usual relief, medical advice should be sought immediately, as this is often a sign of seriously worsening asthma which would require reassessment of therapy.

The nebulizer should be cleaned in accordance with the manufacturer's instructions. Failure to do so could lead to bacterial contamination of the nebulizer and possible infection.

HOW SUPPLIED

Albuterol Sulfate Inhalation Solution, 2.5 mg/0.5 mL (equivalent to 3 mg albuterol sulfate), is a clear, colorless to light yellow solution, and is supplied in plastic sterile unit-dose vials of 0.5 mL each, supplied in individual foil pouches:

NDC 76204-027-01: 30 unit-dose vials, each in an individual pouch.

Storage and Handling

Store between 2°C and 25°C (36°F – 77°F). Protect from light. Store in a pouch until time of use.

Rx Only

Manufactured for:

Ritedose Pharmaceuticals, LLC

Columbia, SC 29203

Manufactured by:

The Ritedose Corporation

Columbia, SC 29203

March 2024

INSTRUCTIONS FOR USE

Albuterol Sulfate Inhalation Solution

2.5 mg/0.5 mL (equivalent to 3 mg albuterol sulfate)

Note: The Albuterol Sulfate Inhalation Solution is concentrated and must be diluted.

Read complete instructions carefully before using.

1. Twist open the top of one Albuterol Sulfate Inhalation Solution unit-of-use container (Figure 1).

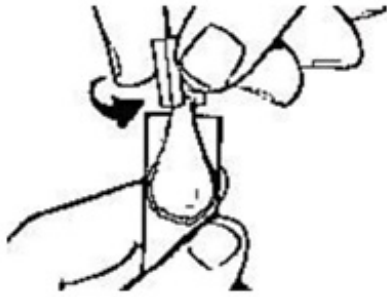


FIGURE 1

2. Squeeze the solution into the nebulizer reservoir through the appropriate opening (Figure 2).

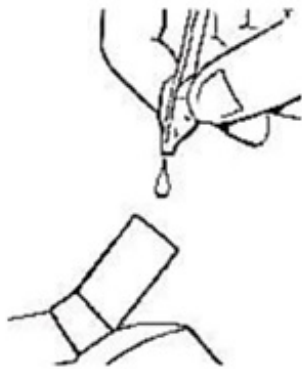


FIGURE 2

3. Add 2.5 mL of diluting fluid – sterile normal saline solution (as your doctor has directed).4. Gently swirl the nebulizer to mix the contents and connect it with the mouthpiece or face mask (Figure 3).

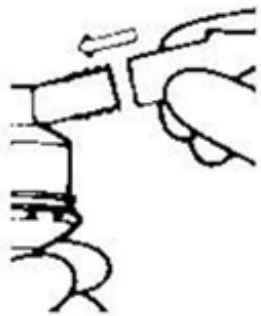


FIGURE 3

5. Connect the nebulizer to the compressor.

6. Sit in a comfortable, upright position; place the mouthpiece in your mouth (Figure 4) (or put on the face mask); and turn the compressor on.

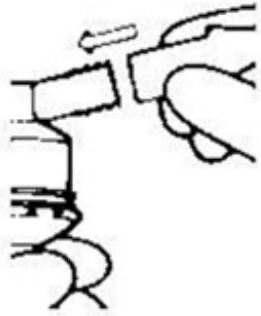


FIGURE 4

7. Breathe as calmly, deeply, and evenly as possible until no more mist is formed in the nebulizer chamber (about 5 to 15 minutes). At this point, the treatment is finished.

8. Clean the nebulizer (see manufacturer's instructions). Failure to clean the nebulizer in accordance with the manufacturer's instructions could lead to bacterial contamination of the nebulizer, and possible infection.

Note: Use only as directed by your physician. More frequent administration or higher doses are not recommended.

Mixing Compatibility: The safety and effectiveness of Albuterol sulfate solution for inhalation have not been determined when one or more drugs are mixed with it in a nebulizer.

Store Albuterol Sulfate Inhalation Solution, 0.5%, between 2° and 25° C (36° and 77° F).

ADDITIONAL INSTRUCTIONS _____

This Instructions for Use has been approved by the U.S. Food and Drug Administration.

Manufactured for:

Ritedose Pharmaceuticals, LLC

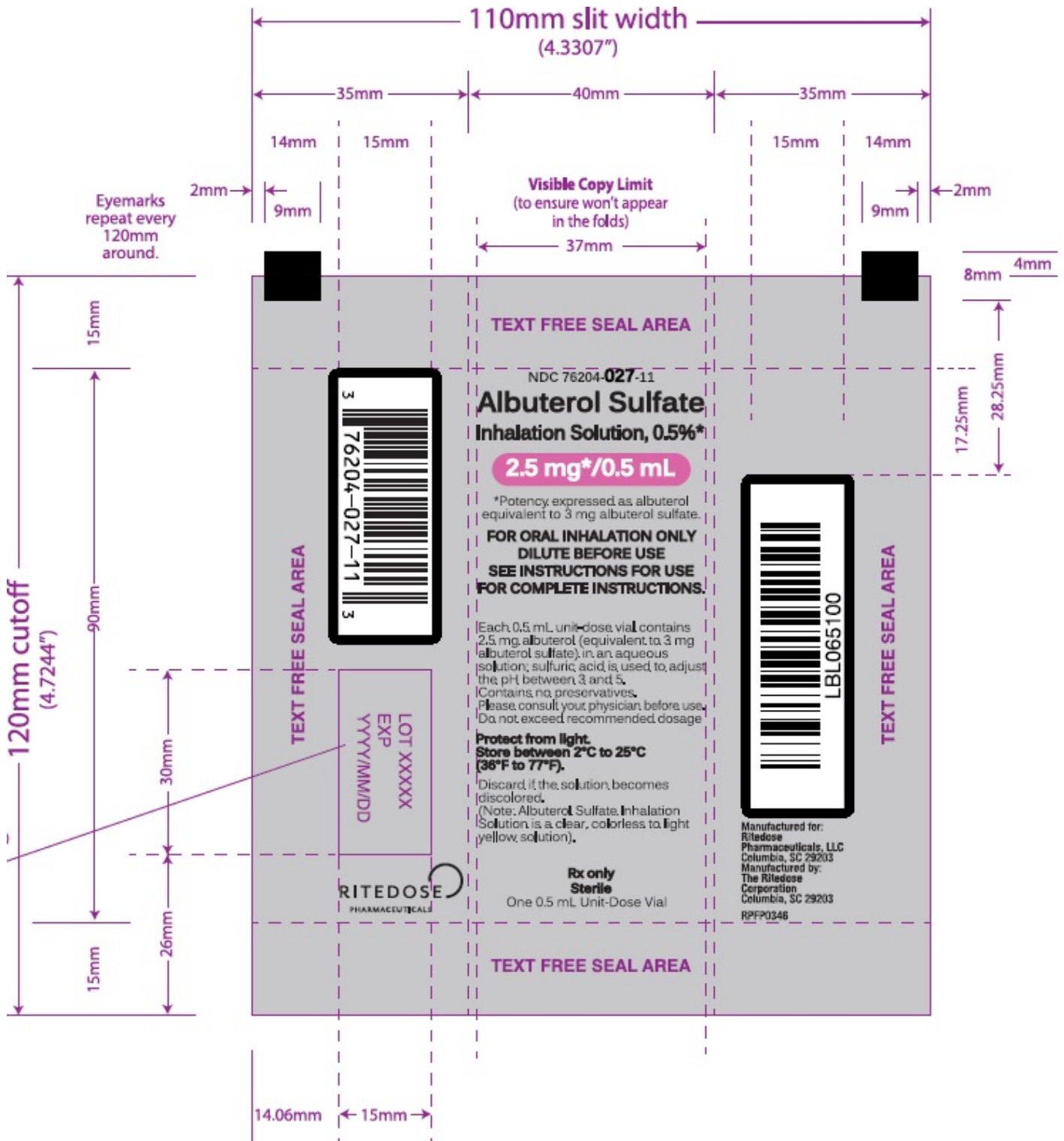
Columbia, SC 29203

Manufactured by:

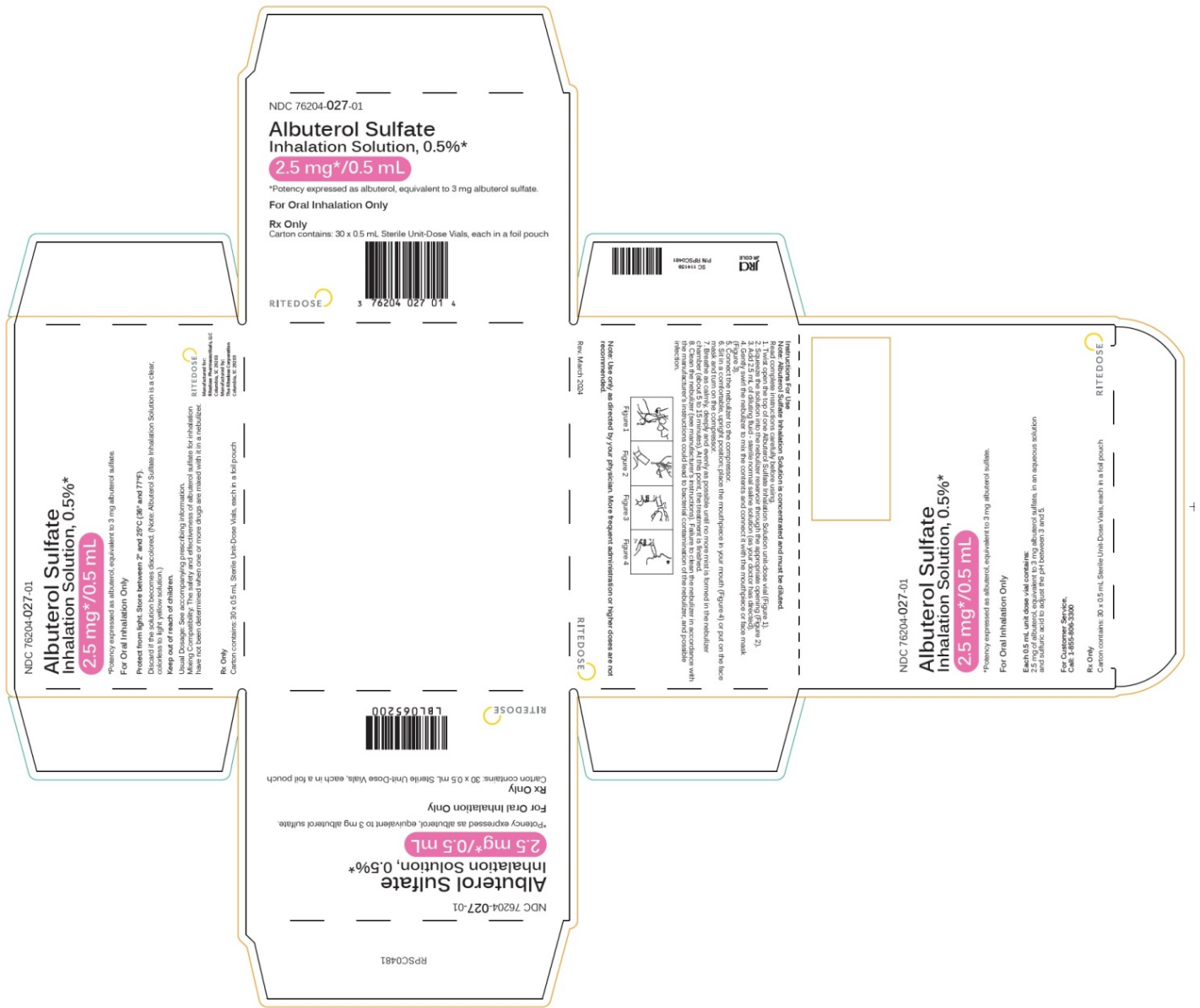
The Ritedose Corporation

Columbia, SC 29203

Albuterol Sulfate Inhalation Solution, 0.5% Foil Pouch (1 Count)



Albuterol Sulfate Inhalation Solution, 0.5% Carton (30 Count)



ALBUTEROL SULFATE INHALATION SOLUTION, 0.5%

albuterol sulfate solution

Product Information

Product Type	HUMAN PRESCRIPTION DRUG	Item Code (Source)	NDC:76204-027
Route of Administration	RESPIRATORY (INHALATION)		

Active Ingredient/Active Moiety

Ingredient Name	Basis of Strength	Strength
ALBUTEROL SULFATE (UNII: 021SEF3731) (ALBUTEROL - UNII:QF8SVZ843E)	ALBUTEROL	2.5 mg in 0.5 mL

Inactive Ingredients

Ingredient Name	Strength

SULFURIC ACID (UNII: O40UQP6WCF)	
WATER (UNII: 059QF0KO0R)	

Packaging				
#	Item Code	Package Description	Marketing Start Date	Marketing End Date
1	NDC:76204-027-01	30 in 1 CARTON	03/24/2025	
1	NDC:76204-027-11	1 in 1 POUCH		
1		0.5 mL in 1 VIAL; Type 0: Not a Combination Product		

Marketing Information			
Marketing Category	Application Number or Monograph Citation	Marketing Start Date	Marketing End Date
ANDA	ANDA218386	03/24/2025	

Labeler - Ritedose Pharmaceuticals, LLC (968062294)

Establishment			
Name	Address	ID/FEI	Business Operations
The Ritedose Corporation		837769546	analysis(76204-027) , manufacture(76204-027) , pack(76204-027) , label(76204-027)

Establishment			
Name	Address	ID/FEI	Business Operations
SICOR S.r.L.		435496145	api manufacture(76204-027)

Establishment			
Name	Address	ID/FEI	Business Operations
Quality Chemical Laboratories		071344167	analysis(76204-027)

Revised: 3/2025

Ritedose Pharmaceuticals, LLC