

# NEW ZEALAND DATA SHEET

## 1 SODIUM BICARBONATE INJECTION

Sodium bicarbonate 8.4 % w/v injection BP

## 2 QUALITATIVE AND QUANTITATIVE COMPOSITION

Each mL of solution contains 84.0 mg of sodium bicarbonate which gives 23.0 mg (or 1 mmol or 1 mEq) of sodium and 61.0 mg (or 1 mmol or 1 mEq) of bicarbonate.

The molecular weight of the compound is 84.01 and the CAS registry number is 144-55-8. The molecular formula is  $\text{NaHCO}_3$ .

## 3 PHARMACEUTICAL FORM

Sodium Bicarbonate Injection is a sterile solution containing 84 mg/mL sodium bicarbonate in water for injections. The pH is approximately 7.0-8.5

## 4 CLINICAL PARTICULARS

### 4.1 Therapeutic indications

Sodium bicarbonate is used as an alkalinising agent in the treatment of metabolic acidosis which may occur in many conditions including diabetes, starvation, hepatitis, cardiac arrest, shock, severe dehydration, renal insufficiency, severe diarrhoea, Addison's disease or administration of acidifying salts (e.g. excessive sodium chloride, calcium chloride, ammonium chloride).

Sodium bicarbonate is also used to increase urinary pH in order to increase the solubility of certain weak acids (e.g. cystine, sulphonamides, uric acid) and in the treatment of certain intoxications (e.g. methanol, phenobarbitone, salicylates) to decrease renal absorption of the drug or to correct acidosis.

### 4.2 Dose and method of administration

Dosage of Sodium Bicarbonate Injection is determined by the severity of the acidosis, appropriate laboratory determinations, and the patient's age, weight and clinical condition.

Sodium Bicarbonate Injection is administered by the intravenous route preferably via a central line. Extravasation must be avoided; the solution is hypertonic and irritant to veins resulting in extensive skin necrosis if the solution leaks from the vein in the tissues. Intramuscular injection is not recommended.

Contains no antimicrobial agent and is for single use in one patient on one occasion only.

### Cardiac Arrest or Severe Metabolic Acidosis

Administration is based on the results of arterial blood pH,  $\text{PaCO}_2$  and calculation of base deficit.

In cardiac arrest, an initial direct intravenous dose of 1 mmol/kg (1 mL/kg of an 8.4% sodium bicarbonate solution) may be given, followed by 0.5 mmol/kg (0.5 mL/kg of an 8.4% sodium bicarbonate solution) at ten minute intervals depending on arterial blood gases and according to the appropriate treatment protocol and guidelines.

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Adequate alveolar ventilation should be ensured during cardiac arrest and administration of sodium bicarbonate, since adequate ventilation contributes to the correction of acidosis and since administration of sodium bicarbonate is followed by release of carbon dioxide.

### Children

The usual dose is 1 mmol/kg (1mL/kg of an 8.4% sodium bicarbonate injection) given by slow intravenous injection.

### Infants (up to 2 years of age)

In infants (up to 2 years of age) the solution should be diluted with an equal amount (1:1 ratio) of 5% glucose or water for injections (to make 4.2% sodium bicarbonate solution) for slow intravenous administration and at a dose not to exceed 8mmol/kg/day, and according to the appropriate treatment protocol and guidelines. This diluted solution is hypertonic. Slow administration rates and a 4.2% solution are recommended in neonates to minimise the possibility of producing hypernatraemia, decreasing cerebrospinal fluid pressure and inducing intracranial haemorrhage (see sections 4.4 and 4.8).

Sodium bicarbonate should only be given if the child is being effectively ventilated as any carbon dioxide that is released by the process of acid neutralisation must be removed from the body via the lungs or paradoxical intracellular acidosis will result.

### Intravenous Infusion

In less urgent forms of metabolic acidosis, Sodium Bicarbonate Injection may be added to 5% glucose for intravenous infusion (see section 6.2).

Sodium Bicarbonate 8.4% Injection can be diluted with 5% glucose injection or 0.9% sodium chloride injection. To reduce microbiological hazard, use as soon as practicable after dilution. If storage is necessary, hold at 2°C-8°C for not more than 24 hours.

Sodium Bicarbonate Injection for intravenous infusion is preferably administered in a large vein, over 4 to 8 hours in mild conditions of metabolic acidosis.

The amount of bicarbonate to be given as intravenous infusion to older children and adults over a 4 to 8 hour period is approximately 2 to 5 mmol/kg of bodyweight, depending upon the severity of the acidosis as judged by the lowering of the total CO<sub>2</sub> content, blood pH and clinical condition of the patient. Standard texts and institutional protocols specific to the underlying disorder should be consulted for calculation of individual dosage.

Bicarbonate therapy should always be planned in a stepwise fashion since the degree of response from a given dose is not precisely predictable.

In general, it is unwise to attempt full correction of a low total CO<sub>2</sub> content during the first 24 hours of therapy, since this may be accompanied by an unrecognised alkalosis because of a delay in the readjustment of ventilation to normal.

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### 4.3 Contraindications

Sodium bicarbonate is contraindicated in patients with renal failure, respiratory or metabolic alkalosis, hypoventilation, hypernatraemia, hypertension, oedema, congestive heart failure, eclampsia, aldosteronism, a history of urinary calculi and consistent potassium depletion or hypocalcaemia.

It is also generally contraindicated in patients with excessive chloride loss from vomiting or continuous GI suctioning, and in patients at risk of developing diuretic induced hypochloraemic alkalosis.

### 4.4 Special warnings and precautions for use

Treatment strategies for metabolic acidosis are primarily directed towards the underlying cause. Bicarbonate therapy is a temporary measure used for severe acidosis.

Specialised texts and protocols should be consulted to guide use. Note that sodium bicarbonate 8.4% is a hypertonic solution.

Whenever respiratory acidosis is present with metabolic acidosis, both pulmonary ventilation and perfusion must be adequately supported to get rid of excess carbon dioxide.

Laboratory determination of the patient's acid-base status is recommended before and during treatment to minimise the possibility of overdose and resultant metabolic alkalosis. Frequent monitoring of serum electrolyte concentrations is essential.

To minimise the risks of pre-existing hypokalaemia and/or hypocalcaemia, these electrolyte disturbances should be corrected prior to initiation of, or concomitantly with, sodium bicarbonate therapy.

Solutions containing sodium may cause fluid overload when given in excess, resulting in dilution of serum electrolytes, overhydration, congestive conditions or pulmonary oedema.

Excessively elevated plasma sodium concentrations may cause dehydration of the brain, resulting in somnolence and confusion, which may progress to convulsions, coma, respiratory failure and ultimately death.

Bicarbonate should be given with caution to patients with 'type A' lactic acidosis (tissue hypoxia). Administration of bicarbonate will tend to limit the available oxygen, increase lactate production and thus worsen the acidosis.

Data from the literature are not in favour of the use of bicarbonate in the treatment of diabetic ketoacidosis with pH values between 6.90 and 7.10.

Sodium bicarbonate should be used with caution in patients with cirrhosis.

Accidental extravascular injection of hypertonic solutions may cause vascular irritation, chemical cellulitis (because of their alkalinity), subsequently resulting in tissue necrosis, ulceration and /or sloughing at the site of injection.

The use of scalp veins should be avoided.

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Do not use the injection if it contains precipitate. Do not use unless the solution is clear and the container and seal are intact. Discard any unused portion.

### Use in patients with congestive heart failure or renal insufficiency

Sodium retention and oedema may occur during sodium bicarbonate therapy, especially when the drug is given in large doses or to patients with renal insufficiency, congestive heart failure or those predisposed to sodium retention and oedema. Sodium and water overload may result in hypernatraemia and hyperosmolality. Severe hyperosmolal states may develop during cardiopulmonary resuscitation when excessive doses of sodium bicarbonate are administered. Serum potassium may decrease during sodium bicarbonate therapy leading to hypokalaemia.

Sodium bicarbonate should be used with extreme caution in patients with congestive heart failure or other oedematous or sodium-retaining conditions; in patients with renal insufficiency, especially those with severe insufficiency such as oliguria or anuria; and in patients receiving corticosteroids or corticotropin, since each gram of sodium bicarbonate contains 12mEq of sodium.

### Use in Children

Rapid injection (10 mL/min) of hypertonic Sodium Bicarbonate Injection solutions into neonates and children under 2 years of age may produce hypernatraemia, a decrease in cerebrospinal fluid pressure and possible intracranial haemorrhage. In emergency situations, such as cardiac arrest, the risk of rapid infusion of the drug must be weighed against the potential for death from acidosis. It should also be noted that administration of sodium bicarbonate to children undergoing cardiopulmonary resuscitation may worsen respiratory acidosis. Do not administer more than 8mmol/kg/day (see section 4.2).

### Use in Pregnancy and Lactation

Animal reproduction studies have not been conducted with sodium bicarbonate. Safety in pregnancy and lactation has not been established.

The use of Sodium Bicarbonate Injection, as with any drug, in pregnant or lactating women should only be undertaken if the expected benefit outweighs the possible risk to the mother and fetus or child.

### 4.5 Interaction with other medicines and other forms of interaction

Alkalinisation of the urine leads to increased renal clearance of acidic drugs such as salicylates, tetracyclines, (especially doxycycline), barbiturates and tricyclic antidepressants. Conversely, it prolongs the half-life and duration of basic drugs such as quinidine, amphetamines, ephedrine and pseudoephedrine and may result in toxicity.

Sodium bicarbonate enhances lithium excretion.

Solutions containing sodium ions should be used with great care, if at all, in patients receiving corticosteroids or corticotropin.

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Hypochloraemic alkalosis may occur if sodium bicarbonate is used in conjunction with potassium depleting diuretics such as bumetanide, ethacrynic acid, frusemide and thiazides. Concurrent use in patients taking potassium supplements may reduce serum potassium concentration by promoting an intracellular ion shift.

The following drug may have enhanced or prolonged effects due to concomitant administration with sodium bicarbonate: flecainide.

The following drugs may have decreased effectiveness due to concomitant administration with sodium bicarbonate: aspirin and other salicylates, barbiturates and lithium.

The following drugs have been reported to be susceptible to inactivation on mixing with sodium bicarbonate solution: adrenaline HCl, benzylpenicillin potassium, carmustine, glycopyrrolate, isoprenaline HCl and suxamethonium chloride.

### 4.6 Fertility, pregnancy and lactation

Animal reproduction studies have not been conducted with sodium bicarbonate. Safety in pregnancy and lactation has not been established.

The use of Sodium Bicarbonate Injection, as with any drug, in pregnant or lactating women should only be undertaken if the expected benefit outweighs the possible risk to the mother and fetus or child.

### 4.7 Effects on ability to drive and use machines

None known.

### 4.8 Undesirable effects

Metabolic alkalosis and/or hypokalaemia may ensue as a result of prolonged use or over correction of the bicarbonate deficit, especially in patients with impaired renal function (see section 4.9).

Metabolic alkalosis may be accompanied by compensatory hyperventilation, paradoxical acidosis of the cerebrospinal fluid, severe hypokalaemia, hyperirritability or tetany.

Hypernatraemia has been reported with sodium bicarbonate use, especially in patients with renal disease.

Hyperosmolality has also been associated with sodium bicarbonate use.

Accidental extravasation of intravenous hypertonic solutions of sodium bicarbonate has been reported to cause chemical cellulitis, with tissue necrosis, tissue calcification, ulceration or sloughing at the site of infiltration. Prompt elevation of the part, warmth and local injection of lignocaine or hyaluronidase are recommended to prevent sloughing of extravasated intravenous infusions. Hyperirritability or tetany may occur, caused by rapid shifts of free ionised calcium or due to serum protein alterations arising from the pH changes.

Cerebral oedema has occurred with sodium bicarbonate use and a possibility of intracranial haemorrhage exists.

Hypercapnia has occurred in patients receiving sodium bicarbonate and with fixed ventilation.

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### Reporting of suspected adverse reactions

Reporting suspected adverse reactions after authorisation of the medicine is important. It allows continued monitoring of the benefit/risk balance of the medicine. Healthcare professionals are asked to report any suspected adverse reactions <https://nzphvc.otago.ac.nz/reporting/>

### 4.9 Overdose

Alkalosis is a result of overdosage.

#### Symptoms of Overdosage

Symptoms include mood changes, tiredness, slow breathing, muscle weakness and irregular heartbeat. Muscle hypertonicity, twitching and tetany may develop, especially in hypocalcaemic patients.

Metabolic alkalosis, which may be accompanied by compensatory hyperventilation, paradoxical acidosis of the cerebrospinal fluid, severe hypokalaemia, hyperirritability or tetany.

#### Treatment of Overdosage

Treatment of metabolic alkalosis associated with bicarbonate overdose consists mainly of appropriate correction of fluid and electrolyte balance. Replacement of calcium, chloride and potassium ions may be of particular importance.

The bicarbonate should be stopped and the patient managed according to the degree of alkalosis present. To control the symptoms of alkalosis the patient should rebreathe expired air. Sodium chloride injection 0.9% may be given intravenously; potassium chloride also may be indicated if there is hypokalaemia.

Calcium gluconate may be used to control hyperirritability and tetany which can occur in severe alkalosis. Ammonium chloride may also be indicated as an acidifying agent in severe cases (except in patients with pre-existing hepatic disease).

Treatment of hypernatraemia usually requires water replacement; restricted sodium intake and oral water may be sufficient. If more severe, glucose 5% may be administered by slow intravenous infusion. If total body sodium is too high, loop diuretics combined with an infusion of glucose 5% and potassium supplementation may be necessary.

**For advice on the management of overdose please contact the National Poisons Centre on 0800 POISON (0800 764766).**

## 5 PHARMACOLOGICAL PROPERTIES

### 5.1 Pharmacodynamic properties

Sodium bicarbonate is a systemic alkalinizing agent which, when given intravenously, will increase plasma bicarbonate, buffer excess hydrogen ion concentration, raise blood pH and reverse the clinical manifestations of acidosis.

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Sodium bicarbonate dissociates in water to provide sodium and bicarbonate ions ( $\text{HCO}_3^-$ ). Sodium is the principal cation of the extracellular fluid and plays a large part in the therapy of fluid and electrolyte disturbances. Bicarbonate is a normal constituent of body fluids and the normal plasma level ranges from 24 to 31 mmol/L.

Acid-base homeostasis exerts a major influence on protein function, thereby critically affecting tissue and organ performance. Systemic arterial pH is maintained by extracellular and intracellular chemical buffering together with respiratory and renal regulatory mechanism. The control of arterial carbon dioxide ( $\text{CO}_2$ ) tension ( $\text{PaCO}_2$ ) by the central nervous system and respiratory systems and the control of the plasma bicarbonate by the kidneys stabilize the arterial pH by excretion or retention of acid or alkali. Under most circumstances,  $\text{CO}_2$  production and excretion are matched, and the usual steady-state  $\text{PaCO}_2$  is maintained at 40 mmHg. The kidneys regulate plasma  $\text{HCO}_3^-$  through three main processes: (1) "reabsorption" of filtered  $\text{HCO}_3^-$ , (2) formation of titratable acid, and (3) excretion of  $\text{NH}_4^+$  in the urine. The kidney filters approximately 4000 mmol of  $\text{HCO}_3^-$  per day. To reabsorb the filtered load of  $\text{HCO}_3^-$ , the renal tubules must therefore secrete 4000 mmol of hydrogen ions. Between 80 and 90% of  $\text{HCO}_3^-$  is reabsorbed in the proximal tubule. The distal nephron reabsorbs the remainder and secretes protons, as generated from metabolism, to defend systemic pH. While this quantity of protons, 40 to 60 mmol/d, is small, it must be secreted to prevent chronic positive  $\text{H}^+$  balance and metabolic acidosis. This quantity of secreted protons is represented in the urine as titratable acid and  $\text{NH}_4^+$ . Metabolic acidosis in the face of normal renal function increases  $\text{NH}_4^+$  production and excretion.  $\text{NH}_4^+$  production and excretion are impaired in chronic renal failure, hyperkalaemia, and renal tubular acidosis.

The management of serious acid-base disorders always demands precise diagnosis and treatment of the underlying disease, and in certain circumstances, it requires steps to combat the deviation in systemic acidity itself. Administration of sodium bicarbonate will increase the plasma  $\text{HCO}_3^-$  concentration and help restore the plasma pH within the normal range (pH 7.35-7.45). Changes in acid-base balance also stimulate compensatory ion-exchange mechanisms. When the extracellular hydrogen ion concentration increases, as in acidosis, there is a redistribution of potassium ions from intracellular to extracellular fluid. Administration of sodium bicarbonate can cause a redistribution of potassium ions into cells in patients with acidosis, by increasing the plasma pH.

The urinary pH will be increased by sodium bicarbonate in patients with normal renal function. Alkalinising the urine can increase the solubility of certain weak acids, and can increase the ionisation and urinary excretion of lipid-soluble organic acids (e.g. phenobarbitone, salicylates).

### Metabolic Acidosis

Metabolic acidosis is characterized by a primary decrease in serum bicarbonate ( $\text{HCO}_3^-$ ) concentration to below 24 mmol/L and a compensatory decrease in the  $\text{CO}_2$  concentration. It occurs from either loss of bicarbonate ( $\text{HCO}_3^-$ ) or addition of hydrogen ion ( $\text{H}^+$ ). Bicarbonate loss generally occurs through the kidneys or the bowel. Acidosis from decreased acid renal excretion generally is slow to develop. In contrast, acidosis from increased acid production,

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as in lactic acidosis or ketoacidosis, can exceed maximal renal excretion and cause a rapidly developing, severe acidosis.

Standard texts and institutional protocols should be consulted on the aetiology and management of metabolic acidosis.

### 5.2 Pharmacokinetic properties

Sodium bicarbonate is eliminated in the urine and it alkalis it.

### 5.3 Preclinical safety data

Not applicable.

## 6 PHARMACEUTICAL PARTICULARS

### 6.1 List of excipients

Disodium edetate

Sodium hydroxide

Water for injections.

### 6.2 Incompatibilities

Sodium Bicarbonate Injection 8.4% can be diluted with 5% glucose injection or 0.9% sodium chloride injection. To reduce microbiological hazard, use as soon as practicable after dilution. If storage is necessary, hold at 2°C-8°C for not more than 24 hours. (See DOSAGE AND ADMINISTRATION)

Sodium bicarbonate is incompatible with certain substances in solution and specialised literature should be consulted.

#### Incompatible Fluids / Medicines

Sodium bicarbonate is incompatible with acids, acidic salts and many alkaloidal salts. Sodium bicarbonate solutions should not be mixed with calcium or magnesium salts, cisplatin, dobutamine hydrochloride, labetalol hydrochloride or oxytetracycline hydrochloride as this may result in formation of insoluble precipitates. Sodium bicarbonate is also incompatible with corticotropin, hydromorphone hydrochloride, insulin, magnesium sulfate, methicillin sodium, narcotic salts, noradrenaline acid tartrate, pentobarbitone sodium, procaine hydrochloride, promazine hydrochloride (in glucose injection), streptomycin sulfate, tetracycline hydrochloride, thiopentone sodium, vancomycin hydrochloride, lactated Ringer's injection, sodium lactate injection or Ringer's injection.

The co-administration with other drugs is not recommended; medicines should not be added to, or run through the same giving set as sodium bicarbonate. Before the administration of other drugs, the cannula and intravenous tubing must be carefully irrigated with a 5 to 10 mL bolus of 0.9% sodium chloride injection following administration of sodium bicarbonate to avoid inactivation and precipitation.

The addition of sodium bicarbonate to solutions containing calcium should be avoided except where compatibility has been shown. Solutions turning hazy as a result of sodium bicarbonate/calcium admixtures should be discarded.

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## Effects on Laboratory Tests

False positive Labstix® for urine protein may result due to the high urinary alkalinity produced by sodium bicarbonate.

### 6.3 Shelf life

36 months

### 6.4 Special precautions for storage

Store at or below 30 °C. Do not freeze.

### 6.5 Nature and contents of container

Each pack contains 10 vials.

### 6.6 Special precautions for disposal

No special requirements.

## 7 MEDICINE SCHEDULE

General sale medicine

## 8 SPONSOR

AFT Pharmaceuticals Ltd

PO Box 33.203

Takapuna

Auckland

Email:customer.service@aftpharm.com

## 9 DATE OF FIRST APPROVAL

14 April 1983

## 10 DATE OF REVISION OF THE TEXT

October 2018

## SUMMARY TABLE OF CHANGES

Date	Section(s) Changed	Change (s)
October 2018	All	Reformat consistent with new Medsafe Data Sheet Template.