

NEW ZEALAND DATA SHEET

1. PRODUCT NAME

RETROVIR zidovudine (AZT) 100 mg capsules

RETROVIR zidovudine (AZT) 10 mg/mL oral solution

2. QUALITATIVE AND QUANTITATIVE COMPOSITION

RETROVIR 100 mg capsules contain 100 mg zidovudine.

RETROVIR oral solution/syrup contains 50 mg zidovudine per 5mL.

3. PHARMACEUTICAL FORM

RETROVIR 100 mg capsules have an opaque white cap and body and is coded GSYJU.

RETROVIR oral solution is a clear, pale yellow, strawberry-flavoured, sugar-free oral solution. The pack contains a 10 mL oral-dosing syringe.

4. CLINICAL PARTICULARS

4.1 Therapeutic indications

RETROVIR Oral Formulations are indicated in combination with other anti-retroviral agents for the treatment of Human Immunodeficiency Virus (HIV) infection in adults and children.

RETROVIR is indicated for use in HIV-positive pregnant women and their newborn infants as it has been shown to reduce the rate of maternal-foetal transmission of HIV (see section 4.6 Fertility, Pregnancy and Lactation).

4.2 Dose and method of administration

RETROVIR therapy should be initiated by a physician experienced in the management of HIV infection.

Dose

Dosage in adults and adolescents weighing at least 30kg

The recommended dose of RETROVIR in combination with other anti-retroviral agents is 250 or 300 mg twice daily.

Dosage in children

Children weighing at least 9 kg and less than 30 kg:

The recommended dose of RETROVIR is 0.9 mL/kg (9 mg/kg) twice daily in combination with other anti-retroviral agents (e.g. a 15 kg child would require a 13.5 mL dose of oral solution twice daily). The maximum dosage should not exceed 300 mg (30 mL) twice daily.

Children weighing at least 4 kg and less than 9 kg:

The recommended dose of zidovudine is 1.2 mL/kg (12 mg/kg) twice daily in combination with other antiretroviral agents (e.g. a 5 kg neonate would require a 6 mL dose of oral solution twice daily).

Available data are insufficient to propose specific dosage recommendations for children weighing less than 4 kg (see section 4.2 Dose and method of administration, Dose, Dosage in the prevention of maternal-foetal transmission and section 5.2 Pharmacokinetic properties).

Dosage in the prevention of maternal-foetal transmission

The following RETROVIR dosage regimens have been shown to be effective (see section 4.6 Fertility, Pregnancy and Lactation):

ACTG 076 study: The recommended dose of RETROVIR for pregnant women (over 14 weeks of gestation) is 500 mg/day orally (100 mg five times daily) until the beginning of labour. During labour and delivery RETROVIR should be administered intravenously at 2 mg/kg bodyweight given over 1 hour, followed by a continuous intravenous infusion at 1mg/kg/h until the umbilical cord is clamped.

Neonates should be given RETROVIR 0.2 mL/kg (2 mg/kg) bodyweight of oral solution every 6 hours starting within 12 hours after birth, and continuing until 6 weeks old.

An appropriate sized syringe with 0.1 mL graduations should be used to ensure accurate dosing of infants.

Table 1: Examples of neonatal dosing recommendations for RETROVIR oral solution for the prevention of mother to child transmission (PMTCT) of HIV in Neonates.

Neonates bodyweight in kilograms (kg)	Total volume of dose in millilitres (mL)	How often should each dose be taken (in 24 hours)	Dose of RETROVIR in milligrams (mg)
	0.2 mL/kg		
2.0 kg	0.4 mL	4 times	4 mg
5.0 kg	1.0 mL	4 times	10 mg

Infants unable to receive oral dosing should be given RETROVIR infusion intravenously at 1.5 mg/kg bodyweight infused over 30 minutes every 6 hours

Thailand-Centres for Disease Control (CDC) study: The recommended dose of RETROVIR for pregnant women from week 36 of gestation is 300 mg RETROVIR twice daily orally until onset of labour, and 300 mg RETROVIR orally every three hours from onset of labour until delivery.

Special populations

Dosage in renal impairment

In patients with severe renal impairment daily dosages of 300-400mg should be appropriate. Haematological parameters and clinical response may influence the need for subsequent dosage adjustment.

Haemodialysis and peritoneal dialysis have no significant effect on zidovudine elimination whereas elimination of the glucuronide metabolite is increased. For patients with end-stage renal disease maintained on haemodialysis or peritoneal dialysis, the recommended dose is 100 mg every 6 to 8 hours (see section 5.2 Pharmacokinetic properties).

Dosage in hepatic impairment

Data in patients with cirrhosis suggest that accumulation of zidovudine may occur in patients with hepatic impairment because of decreased glucuronidation. Dosage adjustments may be necessary, but as there is only limited data available precise recommendations cannot be made. If monitoring of plasma zidovudine levels is not feasible, physicians will need to monitor for signs of intolerance and adjust the dose and/or increase the interval between doses as appropriate.

Dosage adjustments in patients with haematological adverse reactions

Dosage reduction or interruption of RETROVIR therapy may be necessary in patients whose haemoglobin level falls to between 7.5 g/dL (4.65 mmol/L) and 9 g/dL (5.59 mmol/L) or whose neutrophil count falls to between $0.75 \times 10^9/L$ and $1.0 \times 10^9/L$ (see section 4.3 Contraindications and section 4.4 Special warnings and precautions for use).

Dosage in the elderly

Zidovudine pharmacokinetics have not been studied in patients over 65 years of age and no specific data are available. However, since special care is advised in this age group due to age-associated changes such as the decrease in renal function and alterations in haematological parameters, appropriate monitoring of patients before and during use of RETROVIR is advised.

4.3 Contraindications

RETROVIR Oral Formulations are contra-indicated in patients known to be hypersensitive to zidovudine, or to any of the components of the formulations.

RETROVIR Oral Formulations should not be given to patients with abnormally low neutrophil counts (less than $0.75 \times 10^9/L$) or abnormally low haemoglobin levels (less than 7.5 g/dL or 4.65 mmol/L) (see section 4.4 Special warnings and precautions for use).

4.4 Special warnings and precautions for use

Patients should be cautioned about the concomitant use of self-administered medications (see section 4.5 Interactions with other medicines and other forms of interaction).

While effective viral suppression with antiretroviral therapy has been proven to substantially reduce the risk of sexual transmission, a residual risk cannot be excluded. Precautions to prevent transmission should be taken in accordance with national guidelines.

RETROVIR is not a cure for HIV infection and patients remain at risk of developing illnesses which are associated with immune suppression, including opportunistic infections and neoplasms. Whilst it has been shown to reduce the risks of opportunistic infections, data on the development of neoplasms, including lymphomas, are limited. The available data on patients treated for advanced HIV disease indicate that the risk of lymphoma development is consistent with that observed in untreated patients. In patients with early HIV disease on long-term treatment the risk of lymphoma development is unknown.

Pregnant women considering the use of RETROVIR during pregnancy for prevention of HIV transmission to their infants should be advised that transmission may still occur in some cases despite therapy.

Haematological adverse reactions

Anaemia (usually not observed before 6 weeks of RETROVIR therapy but occasionally occurring earlier), neutropenia (usually not observed before 4 weeks' therapy but sometimes occurring earlier) and leucopenia (usually secondary to neutropenia) can be expected to occur in patients with advanced symptomatic HIV disease receiving RETROVIR. These occurred more frequently at higher dosages (1200-1500 mg/day) and in patients with poor bone marrow reserve prior to treatment, particularly with advanced HIV disease.

Haematological parameters should be carefully monitored. For patients with advanced symptomatic HIV disease it is generally recommended that blood tests are performed at least every 2 weeks for the first 3 months of therapy and at least monthly thereafter. In patients with early HIV disease (where bone marrow reserve is generally good), haematological adverse reactions

are infrequent. Depending on the overall condition of the patient, blood tests may be performed less often, for example every 1-3 months.

If the haemoglobin level falls to between 7.5 g/dL (4.65 mmol/L) and 9 g/dL (5.59 mmol/L) or the neutrophil count falls to between $0.75 \times 10^9/L$ and $1.0 \times 10^9/L$, the daily dosage may be reduced until there is evidence of marrow recovery; alternatively, recovery may be enhanced by brief (2-4 weeks) interruption of RETROVIR therapy. Marrow recovery is usually observed within 2 weeks after which time RETROVIR therapy at a reduced dosage may be reinstated. In patients with significant anaemia, dosage adjustments do not necessarily eliminate the need for transfusions (see section 4.3 Contraindications).

Lactic acidosis/severe hepatomegaly with steatosis

Lactic acidosis and severe hepatomegaly with steatosis, including fatal cases, have been reported with the use of antiretroviral nucleoside analogues either alone or in combination, including zidovudine. A majority of these cases have been in women. Clinical features which may be indicative of the development of lactic acidosis include generalised weakness, anorexia and sudden unexplained weight loss, gastrointestinal symptoms and respiratory symptoms (dyspnoea and tachypnoea). Caution should be exercised when administering RETROVIR, particularly to those with known risk factors for liver disease. Treatment with RETROVIR should be suspended in any patient who develops clinical or laboratory findings suggestive of lactic acidosis or hepatotoxicity (which may include hepatomegaly and steatosis even in the absence of marked transaminase elevations).

Lipoatrophy

Treatment with zidovudine has been associated with loss of subcutaneous fat. The incidence and severity of lipoatrophy are related to cumulative exposure. This fat loss, which is most evident in the face, limbs and buttocks, may be only partially reversible and improvement may take several months when switching to a zidovudine-free regimen. Patients should be regularly assessed for signs of lipoatrophy during therapy with zidovudine and other zidovudine containing products (COMBIVIR and TRIZIVIR), and if feasible therapy should be switched to an alternative regimen if there is suspicion of lipoatrophy development.

Serum lipids and blood glucose

Serum lipid and blood glucose levels may increase during antiretroviral therapy. Disease control and life style changes may also be contributing factors. Consideration should be given to the measurement of serum lipids and blood glucose. Lipid disorders should be managed as clinically appropriate.

Immune Reconstitution Syndrome (IRIS)

In HIV-infected patients with severe immune deficiency at the time of initiation of anti-retroviral therapy (ART), an inflammatory reaction to asymptomatic or residual opportunistic infections may arise and cause serious clinical conditions, or aggravation of symptoms. Typically, such reactions have been observed within the first few weeks or months of initiation of ART. Relevant examples are cytomegalovirus retinitis, generalised and/or focal mycobacterial infections and *Pneumocystis jirovecii* (*P. carinii*) pneumonia. Any inflammatory symptoms must be evaluated without delay and treatment initiated when necessary. Autoimmune disorders (such as Graves' disease, polymyositis and Guillain-Barre syndrome) have also been reported to occur in the setting of immune reconstitution, however the time to onset is more variable, and can occur many months after initiation of treatment and sometimes can be an atypical presentation.

Patients co-infected with hepatitis C virus

Exacerbation of anaemia due to ribavirin has been reported when zidovudine is part of the regimen used to treat HIV although the exact mechanism remains to be elucidated. Therefore, the co-administration of ribavirin and zidovudine is not advised and consideration should be given to replacing zidovudine in a combination ART regimen if this is already established. This is particularly important in patients with a known history of zidovudine induced anaemia.

4.5 Interaction with other medicines and other forms of interaction

Zidovudine is primarily eliminated by hepatic conjugation to an inactive glucuronidated metabolite. Active substances which are primarily eliminated by hepatic metabolism especially via glucuronidation may have the potential to inhibit metabolism of zidovudine. The interactions listed below should not be considered exhaustive but are representative of the classes of medicinal products where caution should be exercised.

Atovaquone

Zidovudine does not appear to affect the pharmacokinetics of atovaquone. However, pharmacokinetic data have shown that atovaquone appears to decrease the rate of metabolism of zidovudine to its glucuronide metabolite (steady state AUC of zidovudine was increased by 33% and peak plasma concentration of the glucuronide was decreased by 19%). At zidovudine dosages of 500 or 600 mg/day it would seem unlikely that a three week, concomitant course of atovaquone for the treatment of acute PCP would result in an increased incidence of adverse reactions attributable to higher plasma concentrations of zidovudine. Extra care should be taken in monitoring patients receiving prolonged atovaquone therapy.

Clarithromycin

Clarithromycin tablets reduce the absorption of zidovudine. This can be avoided by separating the administration of zidovudine and clarithromycin by at least two hours.

Lamivudine

A modest increase in C_{max} (28%) was observed for zidovudine when administered with lamivudine, however overall exposure (AUC) was not significantly altered. Zidovudine has no effect on the pharmacokinetics of lamivudine.

Phenytoin

Phenytoin blood levels have been reported to be low in some patients receiving RETROVIR, while in one patient a high level was noted. These observations suggest that phenytoin levels should be carefully monitored in patients receiving both medicinal products.

Probenecid

Limited data suggest that probenecid increases the mean half-life and area under the plasma concentration-time curve of zidovudine by decreasing glucuronidation. Renal excretion of the glucuronide (and possibly zidovudine itself) is reduced in the presence of probenecid.

Ribavarin

The nucleoside analogue ribavirin antagonises the *in vitro* antiviral activity of zidovudine and so concomitant use of this active substance should be avoided.

Rifampicin

Limited data suggests that co-administration of zidovudine and rifampicin decreases AUC of zidovudine by $48\% \pm 34\%$. However, the clinical significance of this is unknown.

Stavudine

Zidovudine may inhibit the intracellular phosphorylation of stavudine when the two medicinal products are used concurrently. Stavudine is therefore not recommended to be used in combination with zidovudine.

Miscellaneous

Other active substances including but not limited to, aspirin, codeine, morphine, methadone, indomethacin, ketoprofen, naproxen, oxazepam, lorazepam, cimetidine, clofibrate, dapsone and isoprinosine may alter the metabolism of zidovudine by competitively inhibiting glucuronidation or directly inhibiting hepatic microsomal metabolism. Careful thought should be given to

the possibilities of interactions before using such medicinal products, particularly for chronic therapy, in combination with RETROVIR.

Concomitant treatment, especially acute therapy, with potentially nephrotoxic or myelosuppressive medicinal products (e.g. systemic pentamidine, dapsone, pyrimethamine, co-trimoxazole, amphotericin, flucytosine, ganciclovir, interferon, vincristine, vinblastine and doxorubicin) may also increase the risk of adverse reactions to RETROVIR. If concomitant therapy with any of these medicinal products is necessary then extra care should be taken in monitoring renal function and haematological parameters and, if required, the dosage of one or more agents should be reduced.

Since some patients receiving RETROVIR may continue to experience opportunistic infections, concomitant use of prophylactic antimicrobial therapy may have to be considered. Such prophylaxis has included co-trimoxazole, aerosolised pentamidine, pyrimethamine and aciclovir. Limited data from clinical trials do not indicate a significantly increased risk of adverse reactions to RETROVIR with these medicinal products.

4.6 Fertility, pregnancy and lactation

Pregnancy

Zidovudine has been evaluated in the Antiretroviral Pregnancy Registry (APR) in over 13,000 women during pregnancy and postpartum. Available human data from the APR do not show an increased risk of major birth defects for zidovudine compared to the background rate (see section 5.1 Pharmacodynamic properties, Clinical efficacy and safety).

The safe use of zidovudine in human pregnancy has not been established in adequate and well-controlled trials investigating congenital abnormalities. Therefore, administration of zidovudine in pregnancy should be considered only if the expected benefit outweighs the possible risk to the foetus.

Zidovudine has been shown to cross the placenta in humans (see section 5.2 Pharmacokinetic properties). Zidovudine has been associated with findings in animal reproductive studies (see section 5.3 Preclinical safety data). Pregnant women considering using zidovudine during pregnancy should be made aware of these findings.

There have been reports of mild, transient elevations in serum lactate levels, which may be due to mitochondrial dysfunction, in neonates and infants exposed in utero or peri-partum to nucleoside reverse transcriptase inhibitors (NRTIs). The clinical relevance of transient elevations in serum lactate is unknown. There have also been very rare reports of developmental delay, seizures and other neurological disease. However, a causal relationship between these events and NRTI exposure in utero or peri-partum has not been established. These findings do not affect current recommendations to use antiretroviral therapy in pregnant women to prevent vertical transmission of HIV.

Maternal-foetal transmission

In ACTG 076 the use of RETROVIR in pregnant women over 14 weeks of gestation, with subsequent treatment of their newborn infants, has been shown to significantly reduce the rate of maternal-foetal transmission of HIV (23% infection rate for placebo versus 8% for zidovudine). Oral RETROVIR therapy began between weeks 14 and 34 of gestation and continued until onset of labour. During labour and delivery RETROVIR was administered intravenously. The newborn infants received RETROVIR orally until 6 weeks old. Infants unable to receive oral dosing were given the intravenous formulation.

In the 1998 Thailand CDC study, use of oral RETROVIR therapy only, from week 36 of gestation until delivery, significantly reduced the rate of maternal-foetal transmission of HIV (19% infection rate for placebo versus 9% for zidovudine). No mothers in this study breast fed their infants.

It is unknown whether there are any long-term consequences of in utero and infant exposure to RETROVIR. Based on the animal carcinogenicity/mutagenicity findings a carcinogenic risk to humans cannot be excluded (see section 5.3 Preclinical safety data). The relevance of these findings to both infected and uninfected infants exposed to RETROVIR is unknown. However, pregnant women considering using RETROVIR during pregnancy should be made aware of these findings.

Breast-feeding

Health experts recommend that where possible women infected with HIV do not breast feed their infants in order to avoid the transmission of HIV. In settings where formula feeding is not feasible, local official lactation and treatment guidelines should be followed when considering breast feeding during antiretroviral therapy.

After administration of a single dose of 200 mg zidovudine to HIV-infected women, the mean concentration of zidovudine was similar in human milk and serum. In other studies following repeat oral dose of 300 mg zidovudine twice daily (given either as a single entity or as COMBIVIR or TRIZIVIR) the maternal plasma:breast milk ratio ranged between 0.4 and 3.2. Zidovudine median infant serum concentration was 24 ng/mL in one study and was below assay limit of quantification (30 ng/mL) in another study. Intracellular zidovudine triphosphate (active metabolite of zidovudine) levels in breastfed infants were not measured therefore the clinical relevance of the serum concentrations of the parent compound measured is unknown.

Fertility

There are no data on the effect of RETROVIR on human female fertility. In men, RETROVIR has been shown to have no effect on sperm count, morphology or motility.

4.7 Effects on ability to drive and use machines

There have been no studies to investigate the effect of RETROVIR on driving performance or the ability to operate machinery. Further, a detrimental effect on such activities cannot be predicted from the pharmacology of the active substance. Nevertheless, the clinical status of the patient and the adverse event profile of RETROVIR should be borne in mind when considering the patient's ability to drive or operate machinery.

4.8 Undesirable effects

Summary of safety profile

The adverse event profile appears similar for adults and children. The following events have been reported in patients treated with RETROVIR. They may also occur as part of the underlying disease process in association with other medicinal products used in the management of HIV disease. The relationship between these events and use of RETROVIR is therefore difficult to evaluate, particularly in the medically complicated situations which characterise advanced HIV disease. A reduction in dose or suspension of RETROVIR therapy may be warranted in the management of these conditions.

Tabulated list of adverse reactions

The following convention has been utilised for the classification of undesirable effects:

Very common	(>1/10)
Common	(>1/100, <1/10)
Uncommon	(>1/1,000, <1/100),
Rare	(>1/10,000, <1/1,000),
Very rare	(<1/10,000).

Blood and lymphatic system disorders

Common: Anaemia (which may require transfusions), neutropenia and leucopenia

These occur more frequently at higher dosages (1200-1500 mg/day) and in patients with advanced HIV disease (especially when there is poor bone marrow reserve prior to treatment), and particularly in patients with CD₄ cell counts less than 100/mm³. Dosage reduction or cessation of therapy may become necessary (see section 4.4 Special warnings and precautions for use). The incidence of neutropenia was also increased in those patients whose neutrophil counts, haemoglobin levels and serum vitamin B₁₂ levels were low at the start of RETROVIR therapy.

Uncommon: Thrombocytopenia and pancytopenia (with marrow hypoplasia).

Rare: Pure red cell aplasia.

Very rare: Aplastic anaemia

Metabolism and nutrition disorders

Common: Hyperlactataemia

Rare: Lactic acidosis (see section 4.4 Special warnings and precautions for use), anorexia.

Treatment with zidovudine has been associated with loss of subcutaneous fat (see section 4.4 Special warnings and precautions for use).

Psychiatric disorders

Rare: Anxiety and depression

Nervous system disorders

Very common: Headache

Common: Dizziness

Rare: Insomnia, paraesthesia, somnolence, loss of mental acuity, convulsions.

Cardiac disorders

Rare: Cardiomyopathy

Respiratory, thoracic and mediastinal disorders

Uncommon: Dyspnoea

Rare: Cough

Gastrointestinal disorders

Very common: Nausea

Common: Vomiting, abdominal pain, and diarrhoea

Uncommon: Flatulence

Rare: Oral mucosa pigmentation, taste disturbance and dyspepsia. Pancreatitis.

Hepatobiliary disorders

Common: Raised blood levels of liver enzymes and bilirubin

Rare: Liver disorders such as severe hepatomegaly with steatosis

Skin and subcutaneous tissue disorders

Uncommon: Rash and pruritus

Rare: Nail and skin pigmentation, urticaria and sweating

Musculoskeletal and connective tissue disorders

Common: Myalgia

Uncommon: Myopathy

Renal and urinary disorders

Rare: Urinary frequency

Reproductive system and breast disorders

Rare: Gynaecomastia

General disorders and administration site conditions:

Common: Malaise

Uncommon: Fever, generalised pain and asthenia
Rare: Chills, chest pain and influenza-like syndrome

The available data from both placebo-controlled and open-labelled studies indicate that the incidence of nausea and other frequently reported clinical adverse events consistently decreases over time during the first few weeks of therapy with RETROVIR.

Adverse reactions with RETROVIR for the prevention of maternal-foetal transmission:

In a placebo-controlled trial (ACTG 076), RETROVIR was well tolerated in pregnant women at the doses recommended for this indication. Clinical adverse events and laboratory test abnormalities were similar in the RETROVIR and placebo groups.

In the same trial, haemoglobin concentrations in infants exposed to RETROVIR for this indication were marginally lower than in infants in the placebo group, but transfusion was not required. Anaemia resolved within 6 weeks after completion of RETROVIR therapy. Other clinical adverse events and laboratory test abnormalities were similar in the RETROVIR and placebo groups. The long-term consequences of in utero and infant exposure to RETROVIR are unknown.

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 via: <https://nzphvc.otago.ac.nz/reporting/>

4.9 Overdose

Symptoms and signs

No specific symptoms or signs have been identified following acute overdose with zidovudine, apart from those listed as undesirable effects.

Treatment

Patients should be observed closely for evidence of toxicity (see section 4.8 Undesirable effects) and given the necessary supportive therapy.

Haemodialysis and peritoneal dialysis appear to have a limited effect on elimination of zidovudine but enhance the elimination of the glucuronide metabolite.

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

Pharmacotherapeutic group - nucleoside analogue.

Mechanism of action

Zidovudine is an antiviral agent which is highly active *in vitro* against retroviruses including the Human Immunodeficiency Virus (HIV).

Zidovudine is phosphorylated in both infected and uninfected cells to the monophosphate (MP) derivative by cellular thymidine kinase. Subsequent phosphorylation of zidovudine-MP to the diphosphate (DP), and then the triphosphate (TP) derivative is catalysed by cellular thymidylate kinase and non-specific kinases respectively. Zidovudine-TP acts as an inhibitor of and substrate for the viral reverse transcriptase. The formation of further proviral DNA is blocked by incorporation of zidovudine-TP into the chain and subsequent chain termination. Competition by zidovudine-TP for HIV reverse transcriptase is approximately 100-fold greater than for cellular DNA polymerase alpha. No antagonistic effects *in vitro* were seen with zidovudine and other antiretrovirals (tested agents: abacavir, didanosine, lamivudine and interferon-alpha).

Pharmacodynamic effects

Resistance to thymidine analogues (of which zidovudine is one) is well characterised and is conferred by the stepwise accumulation of up to six specific mutations in the HIV reverse transcriptase at codons 41, 67, 70, 210, 215 and 219. Viruses acquire phenotypic resistance to thymidine analogues through the combination of mutations at codons 41 and 215 or by the accumulation of at least four of the six mutations. These thymidine analogue mutations alone do not cause high-level cross-resistance to any of the other nucleosides, allowing for the subsequent use of any of the other approved reverse transcriptase inhibitors.

Two patterns of multi-drug resistance mutations, the first characterised by mutations in the HIV reverse transcriptase at codons 62, 75, 77, 116 and 151 and the second typically involving a T69S mutation plus a 6-base pair insert at the same position, result in phenotypic resistance to zidovudine as well as to the other approved nucleoside reverse transcriptase inhibitors. Either of these two patterns of multinucleoside resistance mutations severely limits future therapeutic options.

Reduced *in vitro* sensitivity to zidovudine has been reported for HIV isolates from patients who have received prolonged courses of RETROVIR therapy. The available information indicates that for early HIV disease, the frequency and degree of reduction of *in vitro* sensitivity is notably less than for advanced disease.

The relationships between *in vitro* susceptibility of HIV to zidovudine and clinical response to therapy remain under investigation. *In vitro* susceptibility testing has not been standardised and results may therefore vary according to methodological factors.

Studies *in vitro* of zidovudine in combination with lamivudine indicate that zidovudine-resistant virus isolates can become zidovudine sensitive when they simultaneously acquire resistance to lamivudine. Evidence from clinical studies show that lamivudine plus zidovudine delays the emergence of zidovudine-resistant isolates in individuals with no prior anti-retroviral therapy.

Zidovudine has been widely used as a component of antiretroviral combination therapy with other antiretroviral agents of the same class (nucleoside reverse transcriptase inhibitors) or different classes (protease inhibitors, non-nucleoside reverse transcriptase inhibitors).

Clinical efficacy and safety

The Antiretroviral Pregnancy Registry (APR) has received reports of over 13,000 exposures to zidovudine during pregnancy resulting in live birth. These consist of over 4,100 exposures during the first trimester, over 9,300 exposures during the second/third trimester and included 133 and 264 birth defects respectively. The prevalence (95% CI) of defects in the first trimester was 3.2% (2.7, 3.8%) and in the second/third trimester, 2.8% (2.5, 3.2%). This proportion is not significantly higher than those reported in the two population based surveillance systems (2.72 per 100 live births and 4.17 per 100 live births respectively). The APR does not show an increased risk of major birth defects zidovudine compared to the background rate.

Post-exposure prophylaxis (PEP)

Internationally recognised guidelines (Centre for Disease Control and Prevention - June 1998), recommend that in the event of accidental exposure to HIV infected blood e.g. from a needlestick injury, a combination of RETROVIR and 3TC should be administered promptly (within one to two hours). In cases of higher risk of infection a protease inhibitor should be included in the regimen. It is recommended that antiretroviral prophylaxis be continued for four weeks. No controlled clinical studies have been carried out in post-exposure prophylaxis and supporting data is limited. Seroconversion may still occur despite prompt treatment with antiretroviral agents.

5.2 Pharmacokinetic properties

Absorption

Zidovudine is well absorbed from the gut and, at all dose levels studied, the bioavailability was 60-70%. From a Phase I study, mean steady state peak ($C_{[ss]max}$) and trough ($C_{[ss]min}$) plasma concentrations following oral administration of RETROVIR (in solution) at doses of 5 mg/kg every 4 hours were 7.1 and 0.4 microM (or 1.9 and 0.1 mcg/mL) respectively.

From a bioequivalence study, mean $C_{[ss]max}$ and $C_{[ss]min}$ levels following oral administration of RETROVIR Capsules every 4 hours and dose normalised to 200 mg were 4.5 microM (or 1.2 mcg/mL) and 0.4 microM (or 0.1 mcg/mL) respectively.

Distribution

From studies with intravenous RETROVIR, the mean terminal plasma half-life was 1.1 hours, the mean total body clearance was 27.1 mL/min/kg and the apparent volume of distribution was 1.6 L/kg. Renal clearance of zidovudine greatly exceeds creatinine clearance, indicating that significant tubular secretion takes place.

In adults, the average cerebrospinal fluid/plasma zidovudine concentration ratio 2-4 hours after dosing was found to be approximately 0.5. Data indicate that zidovudine crosses the placenta and is found in amniotic fluid and foetal blood. Zidovudine has also been detected in semen and milk.

Plasma protein binding is relatively low (34-38%) and interactions with other active substances involving binding site displacement are not anticipated.

Metabolism

The 5'-glucuronide of zidovudine is the major metabolite in both plasma and urine, accounting for approximately 50-80% of the administered dose eliminated by renal excretion. 3'-amino- 3'- deoxythymidine (AMT) has been identified as a metabolite of zidovudine following intravenous dosing.

Elimination

Renal clearance of zidovudine greatly exceeds creatinine clearance indicating that significant tubular secretion takes place.

Special Populations

Children

In children over the age of 5-6 months, the pharmacokinetic profile of zidovudine is similar to that in adults. Zidovudine is well absorbed from the gut and, at all dose levels studied, its bioavailability was 60-74% with a mean of 65%. $C_{[ss]max}$ levels were 4.45 microM (1.19 mcg/mL) following a dose of 120

mg zidovudine (in solution)/m² body surface area and 7.7 microM (2.06 mcg/mL) at 180 mg/m² body surface area.

With intravenous dosing, the mean terminal plasma half-life and total body clearance were 1.5 hours and 30.9 mL/min/kg respectively. The major metabolite is the 5'-glucuronide. After intravenous dosing, 29% of the dose was recovered unchanged in the urine and 45% excreted as the glucuronide.

The data available on the pharmacokinetics in neonates and young infants indicate that glucuronidation of zidovudine is reduced with a consequent increase in bioavailability, reduction in clearance and longer half-life in infants less than 14 days old but thereafter the pharmacokinetics appear similar to those reported in adults.

In children, the mean cerebrospinal fluid/plasma zidovudine concentration ratio ranged from 0.52-0.85, as determined during oral therapy 0.5-4 hours after dosing and was 0.87 as determined during intravenous therapy 1-5 hours after a 1 hour infusion. During continuous intravenous infusion, the mean steady-state cerebrospinal fluid/plasma concentration ratio was 0.24.

Renal impairment

Compared to healthy subjects, patients with advanced renal failure have a 50% higher peak plasma concentration of zidovudine. Systemic exposure (measured as area under the zidovudine concentration-time curve) is increased 100%; the half-life is not significantly altered. In renal failure there is substantial accumulation of the major, glucuronide metabolite but this does not appear to cause toxicity. Haemodialysis and peritoneal dialysis have no significant effect on zidovudine elimination whereas elimination of the glucuronide metabolite is increased (see section 4.2 Dose and method of administration).

Hepatic impairment:

Data in patients with cirrhosis suggest that accumulation of zidovudine may occur in patients with hepatic impairment because of decreased glucuronidation. Dosage adjustments may be necessary, but as there is only limited data available precise recommendations cannot be made (see section 4.2 Dose and method of administration).

Elderly

The pharmacokinetics of zidovudine have not been studied in patients over 65 years of age.

Pregnancy

The pharmacokinetics of zidovudine has been investigated in a study of eight women during the last trimester of pregnancy. As pregnancy progressed, there was no evidence of accumulation of zidovudine. The pharmacokinetics of zidovudine was similar to that of non-pregnant adults. Consistent with

passive transmission of zidovudine across the placenta, zidovudine concentrations in infant plasma at birth were essentially equal to those in maternal plasma at delivery.

Bioequivalence

RETROVIR Oral Solution was shown, in patients, to be bioequivalent to RETROVIR Capsules in respect to the area under the zidovudine plasma concentration-time curve (AUC). The absorption of zidovudine following the administration of the oral solution was marginally faster than that following the administration of capsules, with mean times to peak concentrations of 0.5 and 0.8 hours respectively. Mean values for $C_{[ss]max}$, dose-normalised to 200 mg were 5.8 microM (or 1.55 mcg/mL) and 4.5 microM (1.2 mcg/mL) for oral solution and capsules respectively. These data were generated using the US oral RETROVIR Syrup but can be considered to apply equally to RETROVIR Oral Solution.

5.3 Preclinical safety data

Mutagenicity

No evidence of mutagenicity was observed in the Ames test. However, zidovudine was weakly mutagenic in a mouse lymphoma cell assay and was positive in an *in vitro* cell transformation assay. Clastogenic effects were observed in an *in vitro* study in human lymphocytes and *in vivo* oral repeat dose micronucleus studies in rats and mice. An *in vivo* cytogenetic study in rats did not show chromosomal damage. A study of the peripheral blood lymphocytes of eleven AIDS patients showed a higher chromosome breakage frequency in those who had received RETROVIR than in those who had not. A pilot study has demonstrated that zidovudine is incorporated into leukocyte nuclear DNA of adults, including pregnant women, taking zidovudine as treatment for HIV-1 infection, or for the prevention of mother to child viral transmission. Zidovudine was also incorporated into DNA from cord blood leukocytes of infants from zidovudine-treated mothers. The clinical significance of these findings is unknown.

Carcinogenicity

In oral carcinogenicity studies with zidovudine in mice and rats, late appearing -vaginal epithelial tumours were observed. There were no other zidovudine-related tumours observed in either sex of either species. A subsequent intravaginal carcinogenicity study confirmed the hypothesis that the vaginal tumours were the result of long term local exposure of the rodent vaginal epithelium to high concentrations of unmetabolised zidovudine in urine. The predictive value of rodent carcinogenicity studies for humans is uncertain and thus the clinical significance of these findings is unclear.

In addition, two transplacental carcinogenicity studies have been conducted in mice. One study, by the US National Cancer Institute, administered zidovudine at maximum tolerated doses to pregnant mice from day 12 to 18 of gestation. One year post-natally, there was an increase in the incidence of

tumours in the lung, liver and female reproductive tract of offspring exposed to the highest dose level (420 mg/kg/term body weight).

In a second study, mice were administered zidovudine at doses up to 40 mg/kg for 24 months, with exposure beginning prenatally on gestation day 10. Treatment related findings were limited to late-occurring vaginal epithelial tumours, which were seen with a similar incidence and time of onset as in the standard oral carcinogenicity study. The second study thus provided no evidence that zidovudine acts as a transplacental carcinogen.

It is concluded that the transplacental carcinogenicity data from the first study represents a hypothetical risk, whereas the reduction in risk of maternal transfection of HIV to the uninfected child by the use of zidovudine in pregnancy has been well proven.

Reproductive toxicology

Studies in pregnant rats and rabbits with zidovudine have shown increased incidences of early embryo deaths. A separate study in rats found that dosages very near the oral median lethal dose caused an increase in the incidence of foetal malformations. No evidence of teratogenicity has been observed at lower dosages tested.

Fertility

Zidovudine did not impair male or female fertility in studies in rats.

6. PHARMACEUTICAL PARTICULARS

6.1 List of excipients

RETROVIR capsules

Capsule contents:

- Maize starch,
- Microcrystalline Cellulose,
- Sodium Starch Glycollate,
- Magnesium Stearate

Capsule shell:

- Titanium dioxide,
- Gelatin
- Opacode S-1-277002 Black or TekPrint SW-9008 Black Ink (both inks contain black iron oxide).

RETROVIR oral solution/syrup:

Hydrogenated Glucose Syrup
Glycerol
Citric Acid monohydrate
Sodium Benzoate
Saccharin Sodium
Strawberry Flavour
White Sugar Flavour
Purified Water

6.2 Incompatibilities

None known.

6.3 Shelf life

RETROVIR Capsules 100mg: 5 years.
RETROVIR Oral Solution/Syrup: 2 years.

6.4 Special precautions for storage

RETROVIR Capsules 100 mg: Store below 30°C. Keep dry. Protect from light.
RETROVIR Oral Solution/Syrup: Store below 30°C. Discard one month after first opening.

6.5 Nature and contents of container

RETROVIR Capsules 100 mg: Bottle or blister containing 100 capsules.

RETROVIR Oral Solution/Syrup: 200 mL amber glass bottle with either metal or plastic cap and polyethylene wad, with a 10 mL oral-dosing syringe in the pack.

6.6 Special precautions for disposal

No special instructions are required.

7. MEDICINE SCHEDULE

Prescription Only Medicine

8. SPONSOR

GlaxoSmithKline NZ Ltd
Private Bag 106600
Downtown Auckland
NEW ZEALAND

Phone: (09) 367 2900
Facsimile: (09) 367 2910

9. DATE OF FIRST APPROVAL

Date of publication in the New Zealand Gazette of consent to distribute the medicine:

RETROVIR 100 mg capsule: 24 June 1993

RETROVIR oral solution/syrup: 17 December 1992

10. DATE OF REVISION OF THE TEXT

4 May 2021

Summary table of changes:

Section changed	Summary of new information
6.4	Update to include in-use shelf life information

Version: 10.0

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